z/OS
Cryptographic Services
Integrated Cryptographic Service Facility

Administrator's Guide

SA22-7521-16

Note!

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 417.

This edition applies to Version 1 Release 13 of z/OS (5694–A01) and to all subsequent releases and modifications until otherwise indicated in new editions. This edition applies to ICSF FMID HCR7790.

This edition replaces SA22-7521-15.

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About this information

This information describes how to manage cryptographic keys by using the z/OS Integrated Cryptographic Service Facility (ICSF), which is part of z/OS Cryptographic Services. The z/OS Cryptographic Services include these components:

- z/OS Integrated Cryptographic Service Facility (ICSF)
- z/OS Open Cryptographic Services Facility (OCSF)
- z/OS System Secure Socket Level Programming (SSL)
- z/OS Public Key Infrastructure Services (PKI)

ICSF is a software product that works with the hardware cryptographic feature and the z/OS Security Server (RACF element) to provide secure, high-speed cryptographic services in the z/OS environment. ICSF provides the application programming interfaces by which applications request the cryptographic services. The cryptographic coprocessor is secure, high-speed hardware that performs the actual cryptographic functions. The cryptographic feature available to your applications depends on the server or processor hardware.

References to the IBM @server zSeries 800 (z800) do not appear in this information. Be aware that the documented notes and restrictions for the IBM @server zSeries 900 (z900) also apply to the z800. References to the IBM zEnterprise 114 (z114) do not appear in this information. Be aware that the documented notes and restrictions for the IBM zEnterprise 196 (z196) also apply to the z114.

ICSF Features

ICSF enhances z/OS security as follows:

- It ensures data privacy by encrypting and decrypting the data.
- It manages personal identification numbers (PINs).
- It ensures the integrity of data through the use of modification detection codes (MDCs), hash functions, or digital signatures.
- It ensures the privacy of cryptographic keys themselves by encrypting them under a master key or another key-encrypting key.
- It enforces DES key separation, which ensures that cryptographic keys are used only for their intended purposes.
- It enhances system availability by providing continuous operation.
- It enables the use of Rivest-Shamir-Adelman (RSA), Digital Signature Standard (DSS), and Elliptic Curve Cryptography (ECC) public and private keys on a multi-user, multi-application platform.
- It provides the ability to generate RSA key pairs within the secure hardware boundary of the PCI Cryptographic Coprocessor, PCI X Cryptographic Coprocessor, Crypto Express2 Coprocessor, or Crypto Express3 Coprocessor. It provides the ability to generate ECC key pairs within the secure boundary of the Crypto Express3 Coprocessor.

Resource Access Control Facility (RACF), an element of z/OS can be used to control access to cryptographic keys and functions.

This information explains the basic concepts of protecting and managing the keys used in cryptographic functions. It provides step-by-step guidance for the ICSF administration tasks.

Who should use this information

This information is intended for anyone who manages cryptographic keys. Usually, this person is the ICSF administrator.

The ICSF administrator performs these major tasks:

- Entering and changing master keys
- Generating, entering, and updating cryptographic keys
- Viewing system status, which includes hardware status, installation options, installation exits, and installation services

How to use this information

The first three topics give you background information you need to manage cryptographic keys on ICSF.

- Chapter 1, “Introduction,” on page 1, gives a brief introduction to the role of cryptography in data security. It describes the cryptographic algorithms that ICSF supports and discusses the importance of key secrecy.
- Chapter 2, “Understanding Cryptographic Keys,” on page 9, describes how ICSF protects keys and controls their use. It also describes the types of keys and how ICSF protects data and keys within a system and outside a system.
- Chapter 3, “Managing Cryptographic Keys,” on page 25, describes how to manage keys with ICSF. It introduces how to generate or enter, maintain, and distribute keys using ICSF. It also describes how to use keys to distribute keys and PINs between systems.
- Chapter 4, “Using RACF to Protect Keys and Services,” on page 43, describes how you can use z/OS Security Server RACF to control access to, and use of, cryptographic keys and services.

The remaining topics describe how to use the ICSF panels to manage cryptographic keys and also to view system status. Each topic gives background information about a major task and leads you through the panels, step-by-step, for the task.

- Chapter 5, “Using the Pass Phrase Initialization Utility,” on page 77 discusses pass phrase initialization and gives step-by-step instructions on how to get your cryptographic system up and running quickly. The pass phrase initialization utility allows you to install the necessary master keys on cryptographic coprocessors, and initialize the CKDS and PKDS with a minimal effort.
- Chapter 6, “Managing Master Keys - CCF and PCICC,” on page 99 describes how to enter, activate, and manage master keys with both the Cryptographic Coprocessor Feature and the PCI Cryptographic Coprocessor.
- Chapter 7, “Managing Master Keys - PCIXCC, CEX2C, or CEX3C,” on page 143 describes how to enter, activate, and manage master keys with the PCI X Cryptographic Coprocessor, Crypto Express2 Coprocessor, or Crypto Express3 Coprocessor.
- Chapter 8, “Key Management on Systems without Coprocessors,” on page 187, describes how to manage clear AES and DES DATA keys on a system that does not have any cryptographic coprocessors or accelerators.

- Chapter 9, “Running in a Sysplex Environment,” on page 191, describes various considerations for the PKDS and CKDS when running in a sysplex.
- Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215, describes how to use the *key generator utility program* (KGUP). The program generates keys and stores them in the *cryptographic key data set* (CKDS).
- Chapter 11, “Viewing and Changing System Status,” on page 281, describes how to display information about parts of ICSF that your installation can specify and change. It describes how to use the panels to display installation options, hardware status, PCI management status, installation exits, and installation-defined services.
- Chapter 12, “Managing User Defined Extensions,” on page 327, describes how to use panels to manage your own cryptographic callable service.
- Chapter 13, “Using the Utility Panels to Encode and Decode Data,” on page 331, describes how to use utility panels to encipher and decipher data with a key that is not enciphered.
- Chapter 14, “Using the Utility Panels to Manage Keys in the PKDS,” on page 335, describes how to use the new PKDSKEYS option on the ICSF utilities panel to provide PKDS key management capability.
- Chapter 15, “Using PKCS11 Token Browser Utility Panels,” on page 341, describes how to use the new PKCS11 TOKEN option on the ICSF utilities panel to provide TKDS key management capability.
- Chapter 16, “Using the ICSF Utility Program CSFEUTIL,” on page 359, describes how to use the CSFEUTIL utility program to change master keys and refresh or reencipher the CKDS.
- Chapter 17, “Using the ICSF Utility Program CSFPUTIL,” on page 371, describes how to use the CSFPUTIL utility program to reencipher, activate and refresh a PKDS.
- Chapter 19, “Rewrapping DES key token values in the CKDS using the utility program CSFCNV2,” on page 383, describes how to use the CSFCNV2 utility to rewrap encrypted tokens in the CKDS.
- Chapter 20, “Using ICSF Health Checks,” on page 387, describes a set of health checks that inform you of potential ICSF problems.
- Appendix A, “CCC Bit Assignments,” on page 393, contains selected CCC (crypto configuration control) definitions.
- Appendix B, “Control Vector Table,” on page 395, contains a table of the control vector values that are associated with each key type.
- Appendix C, “Supporting Algorithms and Calculations,” on page 397, shows algorithms that are used to calculate checksums, verification patterns, and other values.
- Appendix D, “PR/SM Considerations during Key Entry,” on page 403, discusses additional considerations when running in PR/SM logical partition mode.
- Appendix F, “Questionable (Weak) Keys,” on page 413, gives examples of questionable keys.
- “Notices” on page 417, discusses notices, programming interface information and trademarks.

Where to find more information

The publications in the z/OS ICSF library include:

- *z/OS Cryptographic Services ICSF Overview*
- *z/OS Cryptographic Services ICSF Administrator's Guide*
- *z/OS Cryptographic Services ICSF System Programmer's Guide*
- *z/OS Cryptographic Services ICSF Application Programmer's Guide*
- *z/OS Cryptographic Services ICSF Messages*
- *z/OS Cryptographic Services ICSF Writing PKCS #11 Applications*
- *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*

These publications contain additional ICSF information:

- *z/OS MVS System Codes*, SA22-7626

  This publication describes the 18F abend code ICSF issues.
- *z/OS MVS System Management Facilities (SMF)*, SA22-7630

  This publication describes SMF record type 82, where ICSF records events.
- *z/OS MVS Initialization and Tuning Guide*, SA22-7591
- *z/OS MVS Initialization and Tuning Reference*, SA22-7592
- *z/OS MVS Programming: Callable Services for High-Level Languages*, SA22-7613
- *z/OS MVS Programming: Authorized Assembler Services Guide*, SA22-7608
- *z/OS MVS Programming: Extended Addressability Guide*, SA22-7614
- *z/OS MVS Programming: Authorized Assembler Services Reference ALE-DYN*, SA22-7609
- *z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG*, SA22-7610
- *z/OS MVS Programming: Authorized Assembler Services Reference LLA-SDU*, SA22-7611
- *z/OS MVS Programming: Authorized Assembler Services Reference SET-WTO*, SA22-7612
- *MVS Batch Local Shared Resources*, GC28-1469
- *z/OS DFSMSdfp Storage Administration*, SC26-7402
- *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394

Related Publications

- *Support Element Operations Guide*
- *zSeries PR/SM Planning Guide*
- *zSeries Hardware Configuration Manager User's Guide*
- *zSeries Hardware Management Console Operations*
- *IBM Security Architecture: Securing the Open Client/Server Distributed Enterprise*
- *VTAM in a Parallel Sysplex Environment*
- *RSA's Frequently Asked Questions About Today's Cryptography* , available on the World Wide Web. See RSA's home page at http://www.rsa.com.
- *Applied Cryptography, Second Edition*, by Bruce Schneier, John Wiley & Sons, Inc.

Information for the PCI Cryptographic Coprocessor is found on the web at **http://www.ibm.com/security/cryptocards/html/library.shtml**.

- *IBM 4758 PCI Cryptographic Coprocessor CCA Support Program Installation Manual for IBM 4758 Models 002 and 023*
- *IBM 4758 PCI Cryptographic Coprocessor CCA Basic Services Reference and Guide for the IBM 4758 Models 002 and 023*
- *IBM 4758 PCI Cryptographic Coprocessor General Information*
- *IBM 4758 PCI Cryptographic Coprocessor Installation*

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- Contact your IBM service representative
- Call IBM technical support
- Visit the IBM zSeries support web page at http://www.ibm.com/systems/z/support/

Summary of Changes

This document contains terminology, maintenance, and editorial changes to improve consistency and retrievability. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Changes made in z/OS Version 1 Release 13

This document contains information previously presented in *z/OS ICSF Administrator's Guide*, SA22-7521-15, which supports z/OS Version 1 Release 12.

This document is for ICSF FMID HCR7790. This release of ICSF runs on z/OS V1R11, z/OS V1R12, and z/OS V1R13, and only on zSeries hardware.

New information:

- Added support for AES CIPHER keys, AES EXPORTER and AES IMPORTER keys. These are variable-length AES keys up to 725 bytes in length, and require a CEX3C and the Sep. 2011 or later licensed internal code (LIC). To store these keys in the CKDS, the CKDS must first have been converted to the variable-length record format. ICSF provides a CKDS conversion program, CSFCNV2, that converts a fixed-length record format CKDS to a variable-length record format. For more information in this utility, refer to *z/OS Cryptographic Services ICSF System Programmer's Guide*.
- Added support for dynamic change of the RSA master key on z196 systems with CEX3C coprocessors and the Sep. 2011 licensed internal code (LIC). Refer to "Changes concerning the RSA master key (RSA-MK)" on page 143.
- Added new panels to simplify CKDS administration. The coordinated CKDS administration panels simplify the process for changing the CKDS master keys and performing CKDS refreshes. Tasks that had once been distinct and spread over multiple panels and manual steps are combined into a single panel. In a sysplex environment, these new panels enable you to drive a CKDS change master key operation or a CKDS refresh operation from a single instance of ICSF across all sysplex members sharing the same active CKDS. For more information, refer to "Symmetric Master Keys and the CKDS" on page 174 and "Changing symmetric master keys and refreshing the CKDS when the CKDS is shared in a sysplex environment" on page 193.
- A new message, CSFC0316, is generated for a CKDS reencipher fail. The message specifies the CKDS entry being processed at the time of the fail.
- New health checks for informing the user of potential ICSF problems have been added. See Chapter 20, "Using ICSF Health Checks," on page 387 for more information.

Changed information:

- New profiles in the CSFSERV general resource class for covering the resources associated with new callable services. Refer to "Setting up profiles in the CSFSERV general resource class" on page 46.
- References to the IBM @server zSeries 800 (z800) do not appear in this information. Be aware that the documented notes and restrictions for the IBM @server zSeries 900 (z900) also apply to the z800.

Changes made in z/OS Version 1 Release 12

This document contains information previously presented in *z/OS ICSF Administrator's Guide*, SA22-7521-14, which supports z/OS Version 1 Release 12.

This document is for ICSF FMID HCR7780. This release of ICSF runs on z/OS V1R10, z/OS V1R11, and z/OS V1R12, and only on zSeries hardware.

New information:

- Added support for IBM zEnterprise 196 (z196) Servers.
- Added information on HMAC key support. HMAC key support is to be enabled with the PTF for APAR OA33260.

  The HMAC keys are variable-length (80-2024 bit) symmetric keys protected by the AES master key and used to generate and verify MACs using the FIPS-198 algorithm. To support these variable-length keys, a new variable-length record format is available for CKDS records. To store HMAC keys in the CKDS, the CKDS must first have been converted to the variable-length record format. ICSF provides a CKDS conversion program, CSFCNV2, that converts a fixed-length record format CKDS to a variable-length record format. For more information in this utility, refer to *z/OS Cryptographic Services ICSF System Programmer's Guide*.
- Added support for an enhanced method of symmetric key wrapping that is designed to be ANSI X9.24 compliant. Using the enhanced method, the key value for keys is bundled with other token data and encrypted using triple DES encryption and cipher block chaining mode. See “DES key wrapping” on page 25 for more information.

  A CKDS conversion utility is provided to convert all tokens in the CKDS to use either the original or the enhanced wrapping method. Refer to Chapter 19, “Rewrapping DES key token values in the CKDS using the utility program CSFCNV2,” on page 383 for more information.
- Added support for ECC master keys.

Changed information:

- Modified the description of the ICSF Utility Program CSFPUTIL This utility can no longer be used to initialize a PKDS. It can still be used to reencipher a PKDS and to refresh the in-storage copy of the PKDS.

Changes made in z/OS Version 1 Release 11

This document contains information previously presented in *z/OS ICSF Administrator's Guide*, SA22-7521-13, which supports z/OS Version 1 Release 11.

This document is for ICSF FMID HCR7770. This release of ICSF runs on z/OS V1R9, z/OS V1R10, and z/OS V1R11 and only on zSeries hardware.

New information:

- Added information on the Crypto Express3 feature
- Added information on PKA Key Management Extensions control
- Added information on Symmetric Key Encipher and Symmetric Key Decipher support of encrypted data-encrypting keys in the CKDS.

Changed information:

- Updated information on key store policy

- Updated PKCS11 token browser utility panels

Chapter 1. Introduction

In today's business environment, data is one of the most valuable resources that is required for maintaining a competitive edge. As a result, businesses must often be able to maintain data secrecy, readily determine the authenticity of data, and closely control access to data.

Data systems commonly consist of many types and sizes of computer systems that are interconnected through many different electronic data networks. It is now common for an organization to interconnect its data systems with systems that belong to customers, vendors, and competitors. Larger organizations might include international operations, or they might provide continual services. As the Internet becomes the basis for electronic commerce and as more businesses automate their data processing operations, the potential for disclosing sensitive data to unauthorized persons increases. As a result, approaches to data security must provide:

- Common services for each computing environment
- Support for national and international standards
- Graduated degrees of support
- Flexibility to work with existing and emerging systems
- Management of the increased risks to data assets

A combination of elements must work together to achieve a more secure environment. To provide a foundation for a secure environment, a security policy should be based on the following:

- An appraisal of the value of data
- An analysis of the potential threats to that data

The Tasks of a Data Security System

To help you select the products and services that you need to put a data security policy into effect, IBM has categorized these security functions. These functions are based on the International Organization for Standardization (ISO) standard 7498-2:

- **Identification and authentication**—identifies users to the system and provides proof that they are who they claim to be.
- **Access control**—determines which users can access which resources.
- **Data confidentiality**—protects an organization's sensitive data from being disclosed to unauthorized individuals.
- **Data integrity**—ensures that data is in its original and unaltered form.
- **Security management**—administers, controls, and reviews a business security policy.
- **Nonrepudiation**—assures that a message sender cannot deny later that he or she sent the message.

The z/OS Integrated Cryptographic Service Facility (ICSF) provides a cryptographic application programming interface that you can use along with your system's cryptographic feature to put these functions into effect in your data security policy.

The Role of Cryptography in Data Security

Cryptography includes a set of techniques for scrambling or disguising data so that it is available only to someone who can restore the data to its original form. In current computer systems, cryptography provides a strong, economical basis for keeping data secret and for verifying data integrity.

ICSF supports these two main types of cryptographic processes:

- Symmetric algorithms, in which the same key value is used in both the encryption and decryption calculations
- Asymmetric algorithms, in which a different key is used in the decryption calculation than was used in the encryption calculation

Symmetric Cryptography

ICSF supports several symmetric cryptography algorithms: The Data Encryption Algorithm, the Advanced Encryption Standard, and the Commercial Data Masking Facility.

The Data Encryption Algorithm and the Data Encryption Standard

For commercial business applications, the cryptographic process that is known as the Data Encryption Algorithm (DEA)[1] has been widely adopted. The Data Encryption Standard (DES), as well as other documents, defines how to use the DES algorithm to encipher data. The Data Encryption Standard is the basis for many other processes for concealing data, such as protection of passwords and personal identification numbers (PINs). DES uses a key to vary the way that the algorithm processes the data. DES data-encrypting keys can be single-, double-, or triple-length. A single-length DES key is a 56-bit piece of data that is normally retained in 8 bytes of data. Each eighth bit of the key data is designated as a parity bit. A symmetric cryptographic system uses the same key both to transform the original data (plaintext) to its disguised, enciphered form (ciphertext) and to return it to its plaintext form.

The DES algorithm, which has been proven to be efficient and strong, is widely known. For this reason, data security is dependent on maintaining the secrecy of the cryptographic keys. Because the DES algorithm is common knowledge, you must keep the key secret to ensure that the data remains secret. Otherwise, someone who has the key that you used to encipher the data would be able to decipher the data. Key management refers to the procedures that are used to keep keys secret.

When you want someone to be able to confirm the integrity of your data, you can use the DES algorithm to compute a message authentication code (MAC). When used in this way, the DES algorithm is a powerful tool. It is almost impossible to meaningfully change the data and still have it produce the same MAC for a given key. The standardized approaches authenticate data such as financial transactions, passwords, and computer programs.

The originator of the data sends the computed MAC with the data. To authenticate the data, the receiver uses the DES algorithm to recompute the MAC. The receiver's application then compares this result with the MAC that was sent with the

1. The Data Encryption Algorithm is often referred to as the DEA, the DES algorithm or just as DES. This information uses the term DES to refer to this algorithm.

data. Someone could, of course, change both the data and the MAC. Therefore, the key that is used to compute the MAC must be kept a secret between the MAC's originator and the MAC's authenticator.

An alternative approach to data-integrity checking uses a standard key value and multiple iterations of the DES algorithm to generate a modification detection code (MDC). In this approach to data-integrity checking, the MDC must be received from a trusted source. The person who wants to authenticate the data recomputes the MDC and compares the result with the MDC that was sent with the data.

Advanced Encryption Standard

ICSF supports the Advanced Encryption Standard algorithm for data privacy. This provides strong encryption. Key lengths of 128-bits, 192-bits and 256-bits are supported. Secure key AES is available if running on an IBM System z9 EC, z9 BC, z10 EC, or z10 BC with the Nov. 2008 or later licensed internal code (LIC).

The Commercial Data Masking Facility

The Commercial Data Masking Facility (CDMF) defines a scrambling technique for data confidentiality. CDMF is a substitute for DES for those customers who have been previously prohibited from receiving IBM products that support DES data confidentiality services.

Restriction: CDMF is only supported on the IBM @server zSeries 900.

The CDMF data confidentiality algorithm is a cryptographic system that provides data masking and unmasking. The algorithm includes both a key-shortening process and a standard DES encryption and decryption process. The first process shortens the key to an effective length of 40 bits prior to its use in the data masking process. CDMF uses the DES algortihm with the shortened key to ensure confidence in the CDMF algorithm.

Asymmetric Algorithm or Public Key Cryptography

In an asymmetric cryptographic process one key is used to encipher the data, and a different but corresponding key is used to decipher the data. A system that uses this type of process is known as a public key system. The key that is used to encipher the data is widely known, but the corresponding key for deciphering the data is a secret. For example, many people can use your public key to send enciphered data to you with confidence, knowing that only you should possess the secret key for deciphering the data.

Public key cryptographic algorithms are used in processes that simplify the distribution of secret keys, assuring data integrity and provide nonrepudiation through the use of digital signatures.

The widely known and tested public key algorithms use a relatively large key. The resulting computer processing time makes them less than ideal for data encryption that requires a high transaction rate. Public key systems, therefore, are often restricted to situations in which the characteristics of the public key algorithms have special value, such as digital signatures or key distribution. PKA calculation rates are fast enough to enable the common use of digital signatures.

ICSF supports these public key algorithms:

- Rivest-Shamir-Adelman (RSA)
- Digital Signature Standard (DSS)
- Elliptic Curve Digital Signature Algorithm (ECDSA)

Note: DSS is only supported on the IBM @server zSeries 900.

The RSA Public Key Algorithm

The Rivest-Shamir-Adelman (RSA)[2] public key algorithm is based on the difficulty of the factorization problem. The factorization problem is to find all prime numbers of a given number, n. When n is sufficiently large and is the product of a few large prime numbers, this problem is believed to be difficult to solve. For RSA, n is typically at least 512 bits, and n is the product of two large prime numbers. The ISO 9796 standard and *RSA's Frequently Asked Questions About Today's Cryptography* provide more information about the RSA public key algorithm.

The DSS Public Key Algorithm

The U.S. National Institute of Science and Technology (NIST) Digital Signature Standard (DSS) public key algorithm is based on the difficulty of the discrete logarithm problem. The discrete logarithm problem is to find x given a large prime p, a generator g and a value y = (g**x) mod p. In this equation, ** represents exponentiation. This problem is believed to be very hard when p is sufficiently large and x is a sufficiently large random number. For DSS, p is at least 512 bits, and x is 160 bits. DSS is defined in the NIST Federal Information Processing Standard (FIPS) 186 Digital Signature Standard.

A DSS key pair includes a private and a public key. The DSS private key is used to generate a digital signature, and the DSS public key is used to verify a digital signature.

DSS is only supported on the IBM @server zSeries 900.

Elliptic Curve Digital Signature Algorithm (ECDSA)

The ECDSA algorithm uses elliptic curve cryptography (an encryption system based on the properties of elliptic curves) to provide a variant of the Digital Signature Algorithm.

Cryptographic Hardware Features supported by z/OS ICSF

The cryptographic hardware available to your applications depends on your processor or server model. z/OS ICSF supports this hardware:

Crypto Express3 Feature (CEX3C or CEX3A)

- available on IBM System z10 Enterprise Class, IBM System z10 Business Class, and IBM zEnterprise 196.
- contains two cryptographic engines that can be independently configured as a coprocessor (CEX3C) or as an accelerator (CEX3A)

Crypto Express2 Feature (CEX2C or CEX2A)

- available on IBM System z9 Enterprise Class, IBM System z9 Business Class, IBM System z10 Enterprise Class and IBM System z10 Business Class
- contains two cryptographic engines that can be independently configured as a coprocessor (CEX2C) or as an accelerator (CEX2A)
- provides support for clear keys in the CSNDDSV, CSNDPKD, and CSNDPKE callable services for better performance
- enables maximum SSL performance

2. Invented in 1977 by Ron Rivest, Adi Shamir, and Leonard Adelman

Crypto Express2-1P Feature

- available on IBM System z9 Enterprise Class, IBM System z9 Business Class, IBM System z10 Enterprise Class and IBM System z10 Business Class
- contains one cryptographic engine that can be independently configured as a coprocessor or accelerator
- provides support for clear keys in the CSNDDSV, CSNDPKD, and CSNDPKE callable services for better performance
- enables maximum SSL performance

PCI X Cryptographic Coprocessor (PCIXCC)

The PCI X Cryptographic Coprocessor (PCIXCC) is available on IBM @server zSeries 990 and IBM @server zSeries 890.

CP Assist for Cryptographic Functions (CPACF)

CPACF is a set of cryptographic instructions providing improved performance. The servers support different algorithms:

- on the IBM @server zSeries 990 and IBM @server zSeries 890
  - SHA-1 algorithm is available
- on the IBM System z9 Enterprise Class and IBM System z9 Business Class
  - SHA-1 algorithm is available
  - SHA-224 and SHA-256 algorithms are available
  - AES algorithm using 128-bit length keys is available
- on IBM System z10 Enterprise Class, IBM System z10 Business Class, and IBM zEnterprise 196
  - SHA-1 algorithm is available
  - SHA-224, SHA-256, SHA-384 and SHA-512 algorithms are available
  - AES algorithm using 128-, 192-, and 256-bit keys is available

CP Assist for Cryptographic Functions (CPACF) DES/TDES Enablement

CP Assist for Cryptographic Functions (CPACF) DES/TDES Enablement, feature 3863, provides for clear key DES and TDES instructions.

If you want to include cryptographic hardware (CEX2C, CEX2A, CEX3C, CEX3A, PCIXCC, PCICA), then feature 3863 is required.

If the CPACF feature is installed without the cryptographic hardware, you will not be able to:

1. Set master keys (SYM-MK and ASYM-MK)
2. Initialize the PKDS or CKDS.
3. Store keys in the PKDS or CKDS.

PCI Cryptographic Accelerator (PCICA)

The PCI Cryptographic Accelerator:

- available on IBM @server zSeries 900, IBM @server zSeries 990 and IBM @server zSeries 890
- provides support for clear keys in the CSNDPKD callable services for better performance. On z990 and z890, it also supports CSNDDSV and CSNDPKE.

- enables maximum SSL performance

Cryptographic Coprocessor Feature (CCF)

The Cryptographic Coprocessor Feature (CCF) is available on the IBM @server zSeries 900.

PCI Cryptographic Coprocessor

The PCI Cryptographic Coprocessor is available on the IBM @server zSeries 900.

Managing Crypto Express2 Features on an IBM System z9 EC, z9 BC, z10 EC, and z10 BC

The Crypto Express2 feature can be configured as a coprocessor for secure key operation or as an accelerator for clear key RSA operations. The ability to change the configuration of the Crypto Express2 feature allows the administrator to change the Crypto Express2 to meet the site's processing needs. If master keys have been loaded into the registers on the Crypo Express3 feature, the master keys will be not be zeroized when the configuration is changed.

The Crypto Express2 is configured from the support element. See *Support Element Operations Guide*, SC28-6820, for details.

When changing the configuration:

- The coprocessor/accelerator must be deactivated on all partitions using that coprocessor/accelerator. From a z/OS System, you can do this using the ICSF coprocessor management panel. This allows any existing work queued to the coprocessor/accelerator to complete and prevents new work from being enqueued.
- When the configuration change is complete (please allow sufficient time for the support element to complete the change), the coprocessor/accelerator can be activated on the ICSF coprocessor management panel. If the support element hasn't completed the change when a coprocessor/accelerator is activated, the status will be 'busy'.
- Coprocessors with valid master keys will become active and will be used to process work. Coprocessors without valid master keys will need to have a master key loaded. Accelerators will become active and will be used to process work.

Managing Crypto Express3 Features on an IBM System z10 EC, z10 BC, and z196

The Crypto Express3 feature can be configured as a coprocessor for secure key operation or as an accelerator for clear key RSA operations. The ability to change the configuration of the Crypto Express3 feature allows the administrator to change the Crypto Express3 to meet the site's processing needs. If master keys have been loaded into the registers on the Crypo Express3 feature, the master keys will be not be zeroized when the configuration is changed.

The Crypto Express3 is configured from the support element. See *Support Element Operations Guide*, SC28-6820, for details.

When changing the configuration:

- The coprocessor/accelerator must be deactivated on all partitions using that coprocessor/accelerator. From a z/OS System, you can do this using the ICSF

coprocessor management panel. This allows any existing work queued to the coprocessor/accelerator to complete and prevents new work from being enqueued.

- When the configuration change is complete (please allow sufficient time for the support element to complete the change), the coprocessor/accelerator can be activated on the ICSF coprocessor management panel. If the support element hasn't completed the change when a coprocessor/accelerator is activated, the status will be 'busy'.
- Coprocessors with valid master keys will become active and will be used to process work. Coprocessors without valid master keys will need to have a master key loaded. Accelerators will become active and will be used to process work.

Strength of Hardware Cryptography

Cryptographic algorithms can be implemented in both software and specialized hardware. A hardware solution is often desirable because it provides these advantages:

- More secure protection to maintain the secrecy of keys
- Greater transaction rates

If a data security threat comes from an external source, a software implementation of the cryptographic algorithm might be sufficient. Unfortunately, however, much fraud originates with individuals within the organization (insiders). As a result, specialized cryptographic hardware can be required to protect against both insider and outsider data security threats. Well-designed hardware can:

- Ensure the security of cryptographic keys
- Ensure the integrity of the cryptographic processes
- Limit the key-management activities to a well-defined and carefully controllable set of services

The Role of Key Secrecy in Data Security

In both the symmetric key and asymmetric key algorithms, no practical means exists to identically cipher data without knowing the cryptographic key. Therefore, it is essential to keep a key secret at a cryptographic node. In real systems, however, this often does not provide sufficient protection. If adversaries have access to the cryptographic process and to certain protected keys, they could possibly misuse the keys and eventually compromise your system. A carefully devised set of processes must be in place to protect and distribute cryptographic keys in a secure manner.

ICSF, and other products that comply with the IBM Common Cryptographic Architecture (CCA), provide a means of controlling the use of cryptographic keys. This protects against the misuse of the cryptographic system.

This publication explains the concepts of key management and gives step-by-step instructions for using ICSF to generate, enter, and manage cryptographic keys.

Chapter 2. Understanding Cryptographic Keys

To understand cryptographic keys, you need to know the types of keys that exist and how ICSF protects them and controls their use. The Integrated Cryptographic Service Facility uses a hierarchical key management approach. A master key protects all the keys that are active on your system. Other types of keys protect keys that are transported out of the system. This topic gives you an understanding of how ICSF organizes and protects keys.

Values of Keys

Keys can either be clear or encrypted. A clear key is the base value of a key. A clear key is not encrypted under another key. To create an encrypted key, either a master key or a transport key is used to encrypt the base value of the key.

Clear keys, if used carelessly, can compromise security. In symmetric cryptographic processes, such as DES or AES, anyone can use the clear key and the publicly known algorithm to decipher data, key values, or PINs. In asymmetric cryptographic processes it is important to protect the clear value of the private key. It would cause a serious security exposure if the wrong person obtained the value of the private key. It could be used to forge electronic signatures on documents, or decipher key values encrypted under the corresponding public key.

ICSF uses clear key values to *encode* and *decode* data. You can use the encode and decode callable services (CSNBECO and CSNBDCO) or the ICSF utility panels to encode and decode data. For a description of the callable services, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*. For a description of how to use the utility panels, see Chapter 13, “Using the Utility Panels to Encode and Decode Data.”

ICSF may have to input and output clear keys. For example, it might receive and send clear keys when it communicates with other cryptographic systems that use clear keys in their functions. When you give ICSF a clear key value, ICSF can encrypt the key before using it on the system. ICSF has specific callable services that perform this function. These callable services are clear key import and secure key import, which are described in *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Types of Keys

ICSF groups the cryptographic keys into these categories, which correspond to the functions they perform:

- DES master key
- AES master key
- PKA master keys
- Asymmetric master key on the PCICC, PCIXCC, CEX2C, or CEX3C.
- Data-encrypting keys
- Data-translation keys - not supported on the PCIXCC, CEX2C, or CEX3C
- MAC keys
- PIN keys
- Cryptographic Variable keys
- Transport keys
- Key Generating keys
- HMAC keys

- PKA keys

Master Keys

ICSF uses master keys to protect other keys. Keys are active on a system only when they are encrypted under a master key variant, so the master key protects all keys that are used on the system. A key is in operational form when it has been encrypted under a master key variant.

The ICSF administrator initializes and changes master keys using the ICSF panels or TKE. Master keys always remain in a secure area in the cryptographic hardware.

ICSF uses master keys to protect keys that are used with the PCICC, PCIXCC, CEX2C, or CEX3C:

DES Master Key
The DES (DES-MK) master key is a 16-byte (128-bit) key that is used to protect symmetric DES/TDES keys used on the PCICC, PCIXCC, CEX2C or CEX3C. On a PCICC, this key must have the same value as the DES master key on the zSeries.

AES Master Key
The AES (AES-MK) master key is a 32-byte (256 bit) key that is used to protect AES keys used on the CEX2C or CEX3C, and HMAC keys used on a CEX3C. It is only available on the z9 EC, z9 BC, z10 EC, z10 BC, and z196 with the Nov. 2008 or later licensed internal code (LIC).

RSA Master Key
The RSA (RSA-MK) master key is a 24-byte (192-bit) key. The RSA-MK master key protects RSA private keys that are used on the PCICC, PCIXCC, CEX2C, or CEX3C.

ECC Master Key
The ECC (ECC-MK) master key is a 32-byte (256 bit) key that is used to protect ECC keys used on the CEX3C. It is only available on the z196 with the Sept. 2010 or later licensed internal code (LIC).

Restriction: Master keys on a z990 or z890 require a PCIXCC or CEX2C. Master Keys on a z9 EC and z9 BC require a CEX2C. Master keys on a z10 EC and z10 BC require a CEX2C or CEX3C. Master keys on a z196 require a CEX3C.

ICSF uses three types of master keys to protect keys that are used with the Cryptographic Coprocessor Feature:

DES Master Key
The DES master key is a double-length (128-bit) key that is used to protect DES and CDMF keys.

PKA Key Management Master Key
The PKA key management master key (KMMK) is a triple-length (192-bit) key. The KMMK protects PKA private keys that are used in both the digital signature services and in the CDMF and DES data key distribution functions. Support for the PKA KMMK is available only on the Cryptographic Coprocessor Feature on the IBM @server zSeries 900 processors.

PKA Signature Master Key
The PKA signature master key (SMK) is a triple-length (192-bit) key. The SMK protects PKA private keys that are used only in digital signature services. Support for the PKA SMK is available only on the Cryptographic Coprocessor Feature on the IBM @server zSeries 900 processors.

Note: On CCF systems, it is strongly recommended that the KMMK have the same value as the SMK.

Data-Encrypting Keys

Data-encrypting keys, also referred to as data keys, are used to encrypt and decrypt data. AES and DES data-encrypting keys are supported. DES keys can be single-length, double-length, or triple-length. AES keys can be 128-bits, 192-bits, or 256-bits in length. Data keys can be either encrypted under the master key or in the clear.

Single-length DES data-encryption keys can also be used in place of the MAC keys to generate or verify a message authentication code.

CIPHER keys are DES or AES data-encrypting keys (CIPHER, ENCIPHER, and DECIPER).

- DES CIPHER keys are single- or double-length keys.
- AES CIPHER keys are 128-, 192-, or 256-bits in length. AES CIPHER keys require a CEX3C and the Sep. 2011 or later licensed internal code (LIC).

CIPHER can be used only for encrypting or decrypting data.

Data-Translation Keys

Data-translation keys are single-length (64-bit) keys that protect data that is transmitted through intermediate systems when the originator and receiver do not share a common key. Data that is enciphered under one data-translation key is reenciphered under another data-translation key on the intermediate node. During this process, the data never appears in the clear.

A data-translation key cannot be used in the decipher callable service to decipher data directly. It can translate the data from encipherment under one data-translation key to encipherment under another data-translation key. See “Protection of Data” on page 22 for a description of how data-translation keys protect data that is sent through intermediate systems.

Restriction: Data-translation keys are not supported on the PCIXCC, CEX2C, or CEX3C.

MAC Keys

Message authentication is the process of verifying the integrity of transmitted messages. Message authentication code (MAC) processing enables you to verify that a message has not been altered. You can use a MAC to check that a message you receive is the same one the message originator sent. The message itself may be in clear or encrypted form. MAC keys are either single-length (64-bit) or double-length (128-bit) keys.

A DES MAC key or DATA key checks that a message you receive is the same one the message originator sent.

Note: **For CCF/PCICC systems only.** In order to generate and use double-length MAC keys in importable or exportable form, the CKDS must contain NOCV-enablement keys and ANSI system keys. When creating a new CKDS, add the NOCV-enablement keys and ANSI system keys during the initialization process. For information on initializing a CKDS, refer to “Initializing the CKDS and PKDS at First-Time Startup” on page 117.

ICSF uses these MAC keys in message authentication:

MAC Generation Keys
Before sending a message, an application program can generate an authentication code for the message, using the MAC generate callable service. The callable service computes the message authentication code by using a MAC generation key to process the message text. The originator of the message sends the message authentication code with the message text.

Single-length MAC generation keys (MAC keys) are used in the ANSI X9.9-1 MAC procedure. They support EMV algorithms. Double-length MAC generation keys (DATAM keys) are used in the ANSI X9.19 optional double key MAC procedure. For compatibility with ICSF Version 2 Release 1, ICSF continues to support the MACD key type, which uses the single-length control vector for both the left and right half of the key to create an external token (MAC || MAC).

On the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196, ICSF supports double-length MAC keys with the MAC key type.

MAC Verification Key
The message receiver uses a single-length (MACVER) or double-length (DATAMV) MAC verification key to verify the message authentication code that the message originator sends.

Note: On the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196, ICSF supports double-length MACVER keys with the MACVER key type.

When the receiver gets the message, an application program calls the MAC verify callable service. The callable service verifies a message authentication code by using the MAC verification key to process the message text. It compares the MAC it generates internally with the MAC that was sent with the message. If the two MACs are the same, the message that was sent is identical to the message that was received.

The MAC generation key the sender uses and the MAC verification key the receiver uses have the same clear value. However, each is protected under the master key variant for its key type.

PIN Keys

Personal authentication is the process of validating personal identities in a financial transaction system. The personal identification number (PIN) is the basis for verifying the identity of a customer across the financial industry networks. A PIN is a number that the bank customer enters into an automatic teller machine (ATM) to identify and validate a request for an ATM service.

You can use ICSF to generate PINs and PIN offsets. A PIN offset is a value that is the difference between two PINs. For example, a PIN offset may be the difference between a PIN that is chosen by the customer and one that is assigned by an institution. You can use ICSF to verify the PIN that was generated by ICSF. You can also use ICSF to protect PIN blocks that are sent between systems and to translate PIN blocks from one format to another. A PIN block contains a PIN and non-PIN data. You use PIN keys to generate and verify PINs and PIN offsets, and to protect and translate PIN blocks. All PIN keys are double-length (128-bit) DES keys.

PIN keys for generating and verifying PINs and PIN offsets

These PIN keys generate and verify PINs and PIN offsets:

PIN Generation Key
A PIN generation key is used in an algorithm to generate PINs or PIN offsets.

To generate PINs, use an application program to call the PIN generate callable service. The PIN generation algorithm uses the PIN generation key and some relevant data to generate a clear PIN, a PIN verification value, or an offset.

PIN Verification Key
A PIN verification key is used in an algorithm to verify PINs and PIN offsets.

To verify a supplied PIN, use an application program to call the PIN verification callable service. You need to specify the supplied enciphered PIN block and PIN-encrypting key that enciphers it. You must also specify the PIN verification key, the PIN verification algorithm, and other relevant data. The callable service generates a verification PIN. It compares the supplied PIN and the verification PIN, and if they are the same, it verifies the supplied PIN.

For a specific PIN generation key and PIN verification key pair, the PIN generation key and the PIN verification key have the same clear value. However, each key is protected by the master key variant for its key type.

PIN keys to protect and translate PIN blocks

These PIN keys protect and translate PIN blocks:

Output PIN-Encrypting Key
Two systems must share a common key for securely transmitting PIN blocks. The output PIN-encrypting key protects PIN blocks that are sent from your system to another system.

PIN-encrypting keys are used in the PIN translate service. Use the PIN translate service to translate PIN blocks from protection under one PIN-encrypting key to protection under another PIN-encrypting key. You can also use the PIN translate service to translate a PIN block from one PIN block format to another PIN block format. For more information about the PIN translate service, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Input PIN-Encrypting Key
Two systems must share a common key for securely transmitting PIN blocks. The input PIN-encrypting key protects PIN blocks that are sent from another system to your system.

PIN-encrypting keys are used in the PIN translate service. You also use the input PIN-encrypting key in the PIN verify service. For more information about the PIN translate service and PIN verify service, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

For a specific pair of PIN-encrypting keys, the input PIN-encrypting key and the output PIN-encrypting key have the same clear value. However, each key is protected by the master key variant for its key type.

Cryptographic Variable Keys

These single or double-length DES keys are used to encrypt special control values in CCA DES key management. The Control Vector Translate and Cryptographic Variable Encipher callable services use cryptographic variable encrypting keys.

Transport Keys

Transport keys protect a key that is sent to another system, received from another system, or stored with data in a file. Transport keys can be either AES or DES keys.

These transport keys support the Common Cryptographic Architecture:

Exporter Key-encrypting Key
An exporter key-encrypting key protects keys that are sent from your system to another system. The exporter key at the originator has the same clear value as the importer key at the receiver. An exporter key is paired with an importer key-encrypting key. OKEYXLAT keys are a particular form of DES exporter key-encrypting keys.

Importer Key-encrypting Key
An importer key-encrypting key protects keys that are sent from another system to your system. It also protects keys that you store externally in a file that you can import to your system later. The importer key at the receiver has the same clear value as the exporter key at the originator. An importer key is paired with an exporter key-encrypting key. IKEYXLAT keys are a particular form of DES importer key-encrypting keys.

For a specific pair of transport keys, the importer key-encrypting key and the exporter key-encrypting key have the same clear value. However, each key is protected by the master key variant for its key type.

ICSF provides this transport key type to support the ANSI X9.17 standard.

ANSI Key-encrypting Key
An importer and exporter key-encrypting key that is used in the ANSI key management callable services. ANSI key-encrypting keys (AKEKs) are bidirectional and are either single- or double-length keys.

Restriction: ANSI keys are only supported on the IBM @server zSeries 900.

Key Generating Keys

Key-generating keys are double-length keys used to derive unique-key-per-transaction DES keys.

HMAC Keys

HMAC keys are symmetric keys. They are variable-length keys (80-2024 bits). They can only be used to generate and verify MACs using the FIPS-198 algorithm.

- Operational keys will be encrypted under the AES master key.
- HMAC keys may be imported and exported under an RSA key.
- HMAC keys will be stored in the CKDS. The AES master key must be active.

PKA Keys

ICSF supports the use of public key cryptography. This requires the generation of a pair of PKA keys. One key is made public, and the other key is kept private. The private key is protected through encryption under the appropriate PKA master key. The public key is used to encrypt DES or AES data-encrypting keys in a key distribution system. The private key is then used to decrypt the DES or AES data-encrypting key. The private key is also used for generating digital signatures which are verified using the corresponding public key.

ICSF supports the use of these PKA keys.

RSA
An RSA key pair includes a private key and a public key. RSA keys can be used for key distribution and authentication. When used for key distribution, a DES key is encrypted under an RSA public key by the sender. The key can only

be decrypted with the receiver's private key. When used for authentication, the RSA private key is used for digital signature generation and the RSA public key is used for digital signature verification.

The optional PCICC, PCIXCC, CEX2C, or CEX3C provide the ability to generate RSA public and private key pairs within their secure hardware boundary.

The Cryptographic Coprocessor Feature (CCF) does not provide the ability to generate RSA public and private keys within its secure hardware boundary. If you have CCF without a PCI Cryptographic Coprocessor, you can generate RSA key pairs in the encrypted form on a TKE Workstation with APAR OW32982 or a workstation with a 4764 or 4758 cryptographic adapter installed. RSA keys generated on the TKE workstation can be loaded directly to the PKDS from the TKE workstation. RSA keys generated on a non-TKE workstation can use the PKA key import callable service to import the RSA key pair to the Cryptographic Coprocessor Feature.

DSS

A DSS key pair includes a private and a public key. The DSS private key is used for digital signature generation, and the DSS public key is used for digital signature verification.

ICSF provides a callable service to generate PKA internal key tokens for use with the DSS algorithm in digital signature services.

Restriction: DSS keys are not supported on the PCIXCC, CEX2C, or CEX3C.

ECC

An ECC key pair includes a private and public key. The ECC private key is used to generate digital signatures, and the ECC public key is used to verify digital signatures.

ICSF generates ECC key pairs using the Elliptic Curve Digital Signature Algorithm (ECDSA). This algorithm uses elliptic curve cryptography (an encryption system based on the properties of elliptic curves) to provide a variant of the Digital Signature Algorithm.

ECC keys are supported on the z196 with a CEX3C. With a CEX3C that is ECC capable, you can use the PKA key generate callable service to generate ECC keys.

RSA, DSS, and ECC public and private keys can be stored in the PKA key data set (PKDS), a VSAM data set. For retained private keys, only the public key is stored in the PKDS. For more information about the PKDS, refer to “Setting up and maintaining the PKDS” on page 37.

Protection and control of cryptographic keys

Because the cryptographic algorithms are all key-controlled algorithms, the security of protected data depends on the security of the cryptographic key. With the exception of master keys, which are physically secured, keys that require a high level of protection are enciphered under another key to provide this necessary security.

A key can be protected under either a master key, a transport key, or a PKA key. The master key protects a key you use on the system. When you send a key to another system, you protect it under a transport key rather than under the master key. You can use RSA public keys to protect DES and AES data-encrypting keys that are transported between systems.

ICSF controls the use of DES keys by separating them into types that can be used to do only specific functions. AES keys are not separated into types.

Master Key Concept

ICSF uses the master key concept to protect cryptographic keys. Master keys, which are stored in secure hardware in the cryptographic feature, are used to encrypt all other keys on the system. All other keys that are encrypted under these master keys are stored outside the protected area of the cryptographic feature. This is an effective way to protect a large number of keys while needing to provide physical security for only a few master keys.

The master keys are used only to encipher and decipher keys. Other key-encrypting keys that are called *transport keys* also encipher and decipher keys and are used to protect cryptographic keys you transmit to other systems. These transport keys, while on the system, are also encrypted under a master key.

Key Separation

The cryptographic hardware, or cryptographic feature, controls the use of DES keys by separating them into unique types. How a key is used distinguishes it from other keys. The cryptographic feature allows you to use only a specific type of key for its intended purpose. For example, a key that is used to protect data cannot be used to protect a key.

Depending on the cryptographic feature, an ICSF system may have multiple master keys:

- A DES master key protecting keys that are used in DES or CDMF operations on the Cryptographic Coprocessor Feature.
- A DES master key protecting keys that are used in operations on the PCICC, PCIXCC, CEX2C, or CEX3C
- An AES master key protecting AES keys that are used in operations on the CEX2C or CEX3C, and HMAC keys that are used in operations on the CEX3C.
- A PKA key management master key (KMMK) protecting keys that are used in PKA key distribution operations on the Cryptographic Coprocessor Feature.
- A PKA signature master key (SMK) protecting keys that are used in digital signature operations on the Cryptographic Coprocessor Feature.
- An asymmetric-keys (ASYM-MK) master key protecting RSA keys used in key distribution and authentication operations on the PCICC, PCIXCC, CEX2C, or CEX3C.
- An ECC master key (ECC-MK) protecting ECC keys on the CEX3C.

DES master key variants protect DES and CDMF keys

To provide for key separation, the cryptographic feature automatically encrypts each type of key that is used in either DES or CDMF services under a unique variation of the DES master key. Each variation encrypts a different type of key. Although you define only one master key, in effect you have a unique master key to encrypt each type of key that is used in DES or CDMF services.

Restriction: CDMF services are only supported on the IBM @server zSeries 900.

A key that is protected under the master key is in *operational form*, which means that ICSF can use it in cryptographic functions on the system. As is shown in Figure 1 on page 17, all secure keys that you want ICSF to use in cryptographic functions are enciphered under the master key.

Whenever the master key is used to encipher a key, the cryptographic feature produces a variation of the master key according to the type of key that is being enciphered. These variations are called *master key variants*. The cryptographic feature creates a master key variant by exclusive ORing a fixed pattern, called a *control vector*, with the master key. Each type of key that is used in DES or CDMF services has a unique control vector associated with it. For example, the cryptographic feature uses one control vector when the master key enciphers a PIN generation key, and a different control vector when the master key enciphers a PIN verification key.

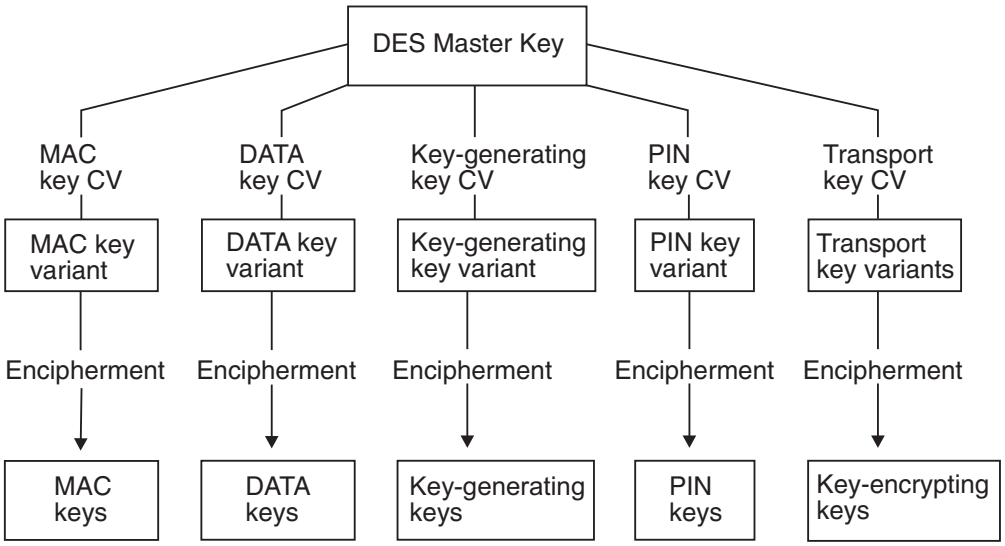

Figure 1. Keys Protected in a System

When systems want to share keys, transport keys can be used to protect keys sent outside of systems. A key that is enciphered under a transport key cannot be used in a cryptographic function. The key must first be brought into a system, deciphered from under the transport key, and enciphered under the system's master key.

ICSF creates variations of a transport key to encrypt a key according to its type. Whenever a transport key is used to encipher a key, the cryptographic feature produces the variation of the transport key according to the type of key that is being enciphered. This allows for key separation when a key is transported off the system.

A transport key variant, also called a *key-encrypting key variant*, is created in the same way as a master key variant. The transport key is exclusive ORed with a control vector that is associated with the key type of the key it protects. See Appendix B, “Control Vector Table” for a listing of the control vector that is used for each key type.

DES cryptographic keys can be single- or double-length keys, depending on their key type. A single-length key is 64 bits, and a double-length key is 128 bits. For double-length keys, one control vector exists for the left half of the key and another control vector for the right half. Therefore, ICSF creates a master key variant or transport key variant for each half of the key the master key or transport key will protect.

Multiple Encipherment

The cryptographic feature uses multiple encipherment when it enciphers a key under a key-encrypting key such as the master key or a transport key. Multiple

encipherment is used whenever the key-encrypting key is double-length. The cryptographic feature enciphers each half of the key that it is encrypting.

To multiple-encipher the left half of a key, the cryptographic feature performs these steps:

1. Exclusive ORs the left half of the key-encrypting key with the control vector for the left half of the key to create the variant. The cryptographic feature then enciphers the left half of the key under this variant.
2. Exclusive ORs the right half of the key-encrypting key with the control vector for the left half of the key to create the variant. The cryptographic feature then deciphers the value that results from step 1 under this variant.
3. Exclusive ORs the left half of the key-encrypting key with the control vector for the left half of the key. The cryptographic feature then enciphers the value that results from step 2 under this variant.

To multiple-encipher the right half of the key, the cryptographic feature performs these steps:

1. Exclusive ORs the left half of the key-encrypting key with the control vector for the right half of the key to create the variant. The cryptographic feature then enciphers the right half of the key under this variant.
2. Exclusive ORs the right half of the key-encrypting key with the control vector for the right half of the key to create the variant. The cryptographic feature then deciphers the value that results from step 1 under this variant.
3. Exclusive ORs the left half of the key-encrypting key with the control vector for the right half of the key. The cryptographic feature then enciphers the value that results from step 2 under this variant.

On ICSF, an effective single-length key can exist as a double-length key; each key half has an identical value. The result of the multiple encipherment process on an effective single-length key is the key value that is encrypted once under the variant.

Migrating from PCF Key Types

Your installation may use Programmed Cryptographic Facility (PCF). ICSF provides key types that are similar to the PCF key types and provides other key types for enhanced key separation and more functions. You cannot use a PCF key on ICSF, but you can convert a PCF key into an ICSF key. Table 1 lists which ICSF key types correspond to the PCF key types.

Table 1. PCF and Corresponding ICSF Key Types

PCF Key Type	**ICSF Key Type**
Local key	Exporter key-encrypting key or Output PIN-encrypting key
Remote key	Importer key-encrypting key or Input PIN-encrypting key
Cross key	Importer key-encrypting key and exporter key-encrypting key or Input PIN-encrypting key and output PIN-encrypting key

ICSF provides compatibility modes and a conversion program to help you run PCF with ICSF and to migrate from PCF to ICSF. The conversion program converts PCF keys to ICSF keys. For information about migration from PCF to z/OS ICSF, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Protection of Distributed Keys

When you store a key with a file or send it to another system, you can protect the key in either of these ways:

- DES keys enciphered under a DES transport key.
- DES and AES keys enciphered under the receiver's RSA public key.

When ICSF enciphers a key under a DES transport key, the key is not in operational form and cannot be used to perform cryptographic functions. When you receive a key from a system, the key is enciphered under a transport key. You can reencipher the key from under the transport key to under your master key. You can then use the key on your system. When a key is enciphered under a transport key, the sending system considers it in exportable form, and the receiving system considers it in importable form. When a key is reenciphered from under a transport key to under a system's master key, it is in operational form again.

In an RSA public key cryptographic system, the sending system and receiving system do not need to share complementary importer and exporter key pairs to exchange data-encrypting keys. The sender uses the receiver's public key to encipher the data-encrypting key. The receiver uses his or her own private key to decipher the data-encrypting key. You can use RACF to control which applications can use specific keys and services. For more information, see Chapter 4, “Using RACF to Protect Keys and Services,” on page 43.

Protecting Keys Stored with a File

You may want to store encrypted data in a file that is stored on DASD or on magnetic tape. For example, if you use a data-encrypting key to encrypt data in a file, you can store the data-encrypting key with the encrypted data. As is shown in Figure 2, you use an importer key-encrypting key to encrypt the data-encrypting key.

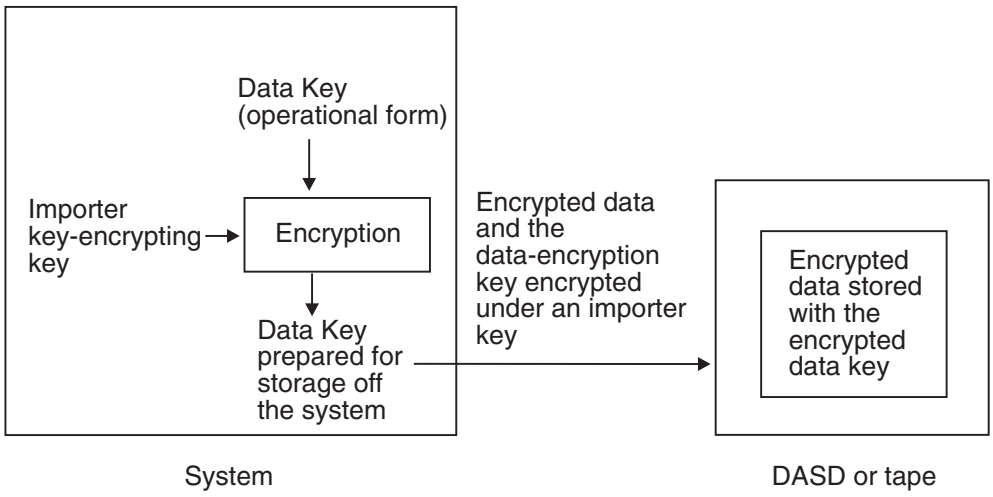

Figure 2. Keys Protected in a File Outside the System

When you encipher a key under an importer key, the key is no longer enciphered under the master key and is no longer operational. You can store the key off the system because the key will not become obsolete if you change the master key. The importer key that protects the data-encrypting key is reenciphered under the correct master key during a master key change. Therefore, when enciphered under the importer key, the data-encrypting key is not directly affected by a master key change.

When you are ready to use the data-encrypting key, use ICSF to reencipher it from under the transport key to under the master key. This makes the data-encrypting key operational. You can then use the data-encrypting key to decrypt the data.

Remote key loading

The process of remote key loading is loading DES keys to automated teller machines (ATMs) from a central administrative site. Because a new ATM has none of the bank's keys installed, getting the first key securely loaded is currently done manually by loading the first key-encrypting key (KEK) in multiple cleartext key parts. A new standard ANSI X9.24-2 defines the acceptable methods of doing this using public key cryptographic techniques, which will allow banks to load the initial KEKs without having to send anything to the ATMs. This method is quicker, more reliable and much less expensive.

Once an ATM is in operation, the bank can install new keys as needed by sending them enciphered under a KEK it installs at an earlier time. Cryptographic architecture in the ATMs is not Common Cryptographic Architecture (CCA) and it is difficult to export CCA keys in a form understood by the ATM. Remote key loading will make it easier to export keys to non-CCA systems without compromising security.

In order to use ATM Remote Key Loading, TKE users will have to enable the access control points for these functions:

- Trusted Block Create - API Keyword = Inactive
- Trusted Block Create - API Keyword = Active
- Public Key Import - Source Key Token = Trusted Block
- Public Key Import - Source Key Token = PKA96 Key Token
- Remote Key Export

Using DES Transport Keys to Protect Keys Sent between Systems

You can send and receive keys and PINs between your system and another system. For example, if you send encrypted data to another system, you also send the data-encrypting key that enciphered the data. The other system can then use the data-encrypting key to decipher the data. In a financial system, you might need to send a PIN from the system that received the PIN from a customer to a system that uses it to verify a customer's identity. As shown in Figure 3 on page 21, when you send the PIN between systems, you encipher the PIN under a PIN-encrypting key.

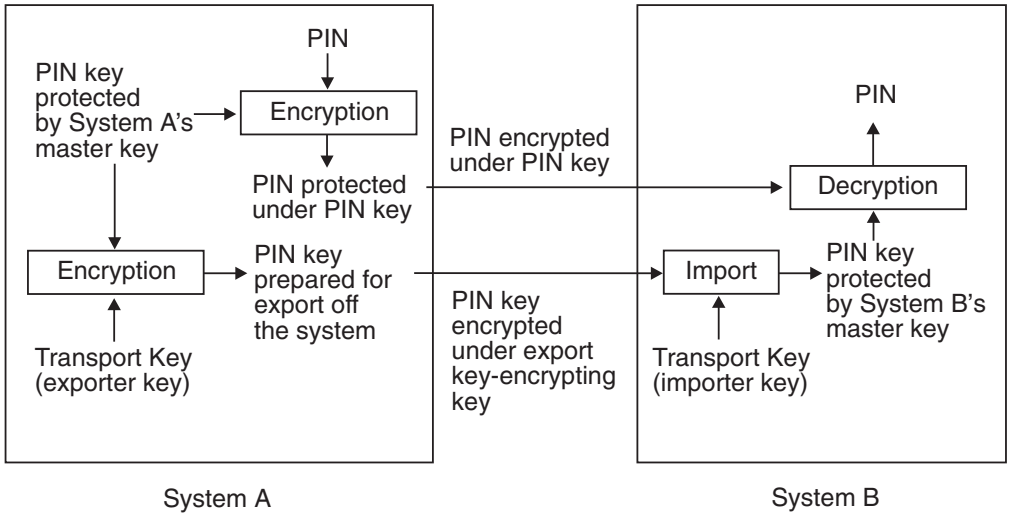

Figure 3. Keys and PINs Protected When Sent between Two Systems

Two systems do not share a master key. When you send a key to another system, you do not encrypt it under a master key. You encrypt it under a transport key.

Two systems that exchange keys share transport keys that have the same clear value. At the sending system, the transport key is an exporter key-encrypting key. At the receiving system, the transport key is an importer key-encrypting key. When the sending system wants to send a key, the sending system encrypts the key under an exporter key-encrypting key. The key is in exportable form on the system that sends the key.

The key is in importable form on the system that receives the key. The receiving system reencrypts the key from under the importer key-encrypting key to under its own master key. The key is then in operational form and can be used on the system.

Using RSA Public Keys to Protect Keys Sent between Systems

The ability to create more-secure key-exchange systems is one of the advantages of combining DES or AES and PKA support in the same cryptographic system. Because PKA cryptography is more computationally intensive than DES or AES cryptography, it is not the method of choice for all cryptographic functions. It can be used, however, in combination with DES and AES cryptography to enhance the security of key exchange. DES data-encrypting keys and AES data-encrypting keys can be exchanged safely between two systems when encrypted using an RSA public key. Sending system and receiving system do not need to share a secret key to be able to exchange RSA-encrypted data-encrypting keys. An example of this is shown in Figure 4. The sending system enciphers the data-encrypting key under the receiver's RSA public key and sends the enciphered data-encrypting key to the receiver. The receiver uses his or her RSA private key to decipher the data-encrypting key.

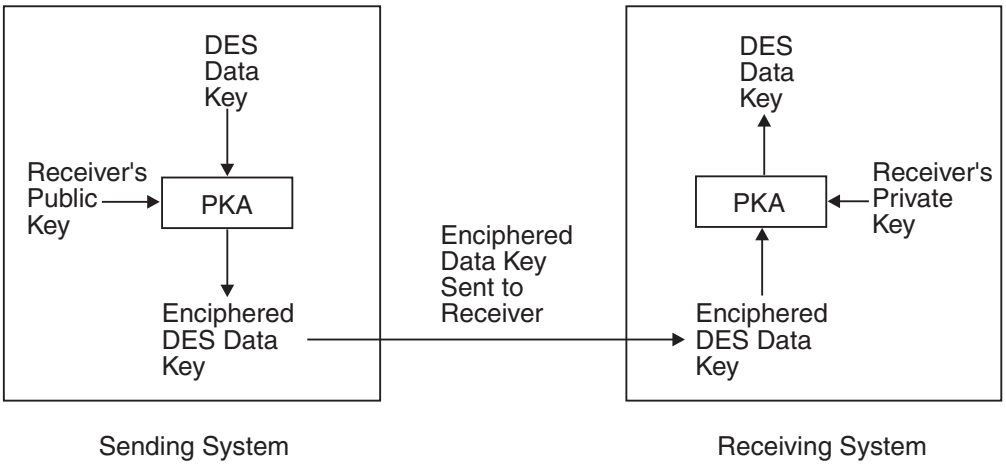

Figure 4. Distributing a DES Data-Encrypting Key Using an RSA Cryptographic Scheme

Note: Only data-encrypting keys can be encrypted under RSA public keys.

Protection of Data

You use data-encrypting keys to encrypt data. On a system, a data-encrypting key is often encrypted under the master key.

A data-encrypting key can encrypt data that is stored in a file outside the system. The data-encrypting key itself is encrypted under a transport key.

You may also need to protect data that you send from one system to another system. The data-encrypting key that protects this data must be sent with the data so that the receiving system can decrypt the data. In this case, the data-encrypting key is encrypted under a transport key.

Sometimes two systems that want to exchange data are not directly connected. There may be intermediate systems between the systems that the data must travel through, as in Figure 5 on page 23.

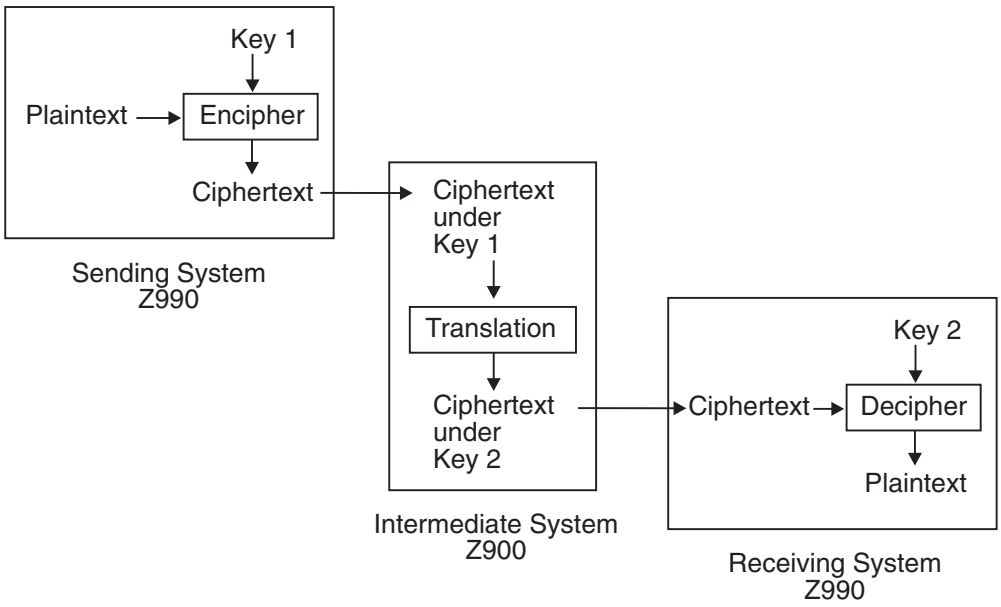

Figure 5. Data Protected When Sent between Intermediate Systems

In this situation, when you pass enciphered data to a system, you do not send a data-encrypting key to decipher the data at the receiving system. Instead, the systems establish pairs of data-encrypting and data-translation keys that exist on the systems. These keys encipher and reencipher the data. The data ends up enciphered under a data-encrypting key that exists on the receiving system. Transport keys may be needed to establish the data-encrypting keys and the data-translation keys on the systems.

Both the sending and receiving systems give data-translation keys to the intermediate system. On the intermediate system, a data-translation key from the sending system matches a data-encrypting key on the sending system. In Figure 5, this key is called *Key 1*. Also on the intermediate system, a data-translation key from the receiving system matches the data-encrypting key on the receiving system. In Figure 5, this key is called *Key 2*. Note that *Key 1* and *Key 2* do not have the same clear key value.

The data-translation keys cannot decipher data. They are used in the ciphertext translate callable service, which reenciphers data from protection under one key to protection under another key.

On the sending system, the plaintext is enciphered under *Key 1*, so it is ciphertext. Then the ciphertext is sent to the intermediate system. At the intermediate system, the data is reenciphered from under *Key 1* to under *Key 2* without appearing as plaintext. When the receiving system receives the ciphertext, the system can decipher the ciphertext from under *Key 2*, so it is plaintext.

Data-translation keys are also used when there is more than one intermediate system between the sending system and receiving system. The sending system and the first intermediate system share a data-encrypting/data-translation key pair. Each pair of neighboring intermediate systems shares a data-translation key pair. The final intermediate system and the receiving system share a data-translation/data-encrypting key pair.

Triple DES for Privacy

ICSF supports triple DES encryption for data privacy. This provides stronger encryption than the current DES algorithm and single-length DES data-encryption keys. Triple DES uses three, single-length keys to encipher and decipher the data which results in a stronger form of cryptography.

Data that has been encrypted under a double-length or triple-length DATA key cannot be reenciphered using data-translation keys as described in “Protection of Data” on page 22.

Advanced Encryption Standard (AES)

ICSF supports the Advanced Encryption Standard (AES) algorithm for data privacy. This provides strong encryption. Data can be encrypted and decrypted using 128-bit, 192-bit, and 256-bit keys. The algorithm has the same availability as triple DES.

AES on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196 requires feature 3863, CP Assist for Cryptographic Functions (CPACF) DES/TDES Enablement.

Chapter 3. Managing Cryptographic Keys

To perform cryptographic services, you need to know how to create, maintain, and use cryptographic keys. This topic gives an overview on entering master keys, generating keys, creating and maintaining the cryptographic key data sets (CKDS, PKDS and TKDS), and entering keys into the CKDS. This topic also discusses distributing keys and controlling access to keys.

Generating Cryptographic Keys

Using ICSF, you can generate keys by using either the key generator utility program (KGUP) or the key generate callable service. Both KGUP and the key generate callable service create all types of keys except PKA keys and ANSI X9.17 keys. KGUP stores the key that it generates in the CKDS. The key generate callable service returns the key to the application program that called it, instead of storing it in the CKDS. The application program can then call the dynamic CKDS update service to store the key in the CKDS.

Enhanced key management for crypto assist instructions

To exploit clear key DES and AES instructions on the CPACF, ICSF can generate and format clear DES and AES tokens to be used in callable services and stored in the cryptographic key data set (CKDS). With clear key support on the CKDS, clear keys do not have to appear in application storage during use. Clear key tokens on the CKDS can be referenced by label name in these callable services:

- Symmetric Key Encipher (CSNBSYE and CSNBSYE1)
- Symmetric Key Decipher (CSNBSYD and CSNBSYD1)
- Symmetric MAC generate (CSNBSMG and CSNBSMG1)
- Symmetric MAC verify (CSNBSMV and CSNBSMV1)

On systems sharing the CKDS without this support, it is highly recommended that you RACF-protect the label name of the clear key tokens on the other systems. This will provide additional security for your installation. Refer to Chapter 4, “Using RACF to Protect Keys and Services,” on page 43 for more information.

Encrypted key support for Crypto Assist instructions

ICSF will exploit the performance of the CP Assist for Cryptographic Functions using encrypted AES and DES keys stored in the CKDS. Symmetric Key Encipher (CSNBSYE, CSNBSYE1, CSNESYE and CSNESYE1) and Symmetric Key Decipher (CSNBSYD, CSNBSYD1, CSNESYD and CSNESYD1) callable services will accept the label of a encrypted key as the key identifier.

DES key wrapping

ICSF wraps the key value in a DES key token using one of two possible methods.

- The original method of DES key wrapping has been used by ICSF since its initial release, and is the only key wrapping method that was available prior to FMID HCR7780. Using this original key wrapping method, the key value in DES tokens are encrypted using triple DES encryption, and key parts are encrypted separately.
- The enhanced method of symmetric key wrapping, introduced in FMID HCR7780, is designed to be ANSI X9.24 compliant. Using the enhanced method, the key value for keys is bundled with other token data and encrypted using triple DES

encryption and cipher block chaining mode. The enhanced method is only available on the z196 with a CEX3C and applies only to DES key tokens.

Using the DEFAULTWRAP keyword in the installation options data set, you can specify the default wrapping method that ICSF will use for internal key tokens and external key tokens. The default wrapping method for internal key tokens and the default wrapping method for external key tokens are independent to each other and are specified separately. If the installation options data set does not contain the DEFAULTWRAP keyword, the original method of symmetric key wrapping will be the default key wrapping method for both internal and external key tokens. Refer to *z/OS Cryptographic Services ICSF System Programmer's Guide* for information on the installation options data set and the DEFAULTWRAP keyword.

If you are sharing a CKDS with a release of ICSF that does not support the enhanced wrapping method (which is available only on systems running ICSF FMID HCR7780 or later), you should use the original wrapping method until all systems sharing the CKDS support the enhanced wrapping method.

A CKDS conversion utility, CSFCNV2, enables you to convert all tokens in the CKDS to use either the original or the enhanced wrapping method. Refer to Chapter 19, “Rewrapping DES key token values in the CKDS using the utility program CSFCNV2,” on page 383 for more information.

TKDS key protection

The keys stored in the TKDS are not encrypted. Therefore, it is recommended that you RACF-protect data set access to the TKDS. (This is in addition to the RACF protection of the individual tokens via the CRYPTOZ class.) This will provide additional security for your installation.

Generating PKA Keys

If a PCICC, PCIXCC, CEX2C, or CEX3C is installed, ICSF is able to generate RSA keys using the PKA Key Generate service. On the z196 with the CEX3C, ICSF is able to generate ECC keys using the PKA Key Generate service.

The RSA key format can be the Modulus Exponent form or the Chinese Remainder form. Retained keys are RSA keys generated within the secure boundary of the card and never leave the secure boundary. Only the domain that created the retained key can access it. Retained key format can be the Modulus Exponent form or the Chinese Remainder form. For more information on how to retain a generated key, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Normally the output key is randomly generated. You may find it useful in testing situations to recreate the same key values. By providing regeneration data, a seed can be supplied so that the same value of the generated key can be obtained in multiple instances. To generate the keys based on the value supplied in the regeneration_data parameter, you must enable one of these access control points:

- When using the RETAIN keyword, enable the Permit Regeneration Data for Retain Keys access control point.
- When not using the RETAIN keyword, enable the Permit Regeneration Data access control point.

For more information on enabling access control points, refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

RSA keys in the PKDS can be managed using the PKDS key management panel utilities.

- You can generate an RSA key which is stored in the PKDS
- You can delete any key from the PKDS
- You can create an X.509 certificate to export an RSA public key in the PKDS
- You can import an RSA public key from an X.509 certificate and store it in the PKDS.

For more information see Chapter 14, “Using the Utility Panels to Manage Keys in the PKDS,” on page 335.

Key Generator Utility Program (KGUP)

You can use KGUP to generate keys in either an operational form or an exportable form. When KGUP generates a key in the operational form, it stores it in the cryptographic key data set (CKDS). When KGUP generates a key in exportable form, you can send it to another system.

To specify the function that you want KGUP to perform, you use KGUP control statements. For a detailed description of how to use the program to generate keys, see Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215.

Key Generate Callable Service

The key generate callable service generates a single key or a pair of keys. Unlike KGUP, the key generate callable service does not store the keys in the CKDS but returns them to the application program that called the service. The application program can then call the dynamic CKDS update service to store the keys in the CKDS.

When you call the key generate callable service, you pass parameters that specify information about the key you want generated. The key generate callable service generates keys in these possible forms:

- Operational, if the master key protects it
- Importable, if an importer key-encrypting key protects it
- Exportable, if an exporter key-encrypting key protects it

Use of this callable service is optional and should be enabled as required for authorized usage. Enabling this callable service is not recommended for production and usage requires special consideration.

For more information about the key generate callable service, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Entering Keys

This topic gives you an overview of key entry and the methods of key entry.

Master keys are used to protect sensitive cryptographic keys that are active on your system. The number and types of master keys you need to enter depends on your hardware configuration and application requirements.

- A DES master key on the Cryptographic Coprocessor Feature protects DES keys and PKA master keys protect DSS and RSA keys.
- On the PCICC, PCIXCC, CEX2C, or CEX3C, the DES master key (DES-MK) protects DES keys and the RSA master key (RSA-MK) protects RSA keys.

- The AES master key (AES-MK) protects AES keys on the CEX2C and CEX3C, and HMAC keys on the CEX3C.
- The ECC master key (ECC-MK) protects ECC keys on the CEX3C.

The first time you start ICSF on your system, you may enter master keys and initialize the cryptographic key data set (CKDS) and PKA cryptographic key data set (PKDS). You can then generate and enter the keys you use to perform cryptographic functions. The master keys you enter protect sensitive keys stored in the CKDS and the PKDS.

If you have no coprocessor, you can initialize the CKDS for use with clear AES and DES data keys. This CKDS can not be used on a system with cryptographic coprocessors.

Because master key protection is essential to the security of the other keys, ICSF stores the master keys within the secure hardware of the cryptographic feature. This nonvolatile key storage area is unaffected by system power outages, because it is protected by a battery power unit. The values of the master keys never appear in the clear outside the cryptographic feature.

Managing master keys involves these tasks:
- Entering the master keys the first time you start ICSF
- Reentering the master keys if they are cleared
- Changing the DES or AES master key periodically
- Changing the PKA master keys periodically

Entering master keys

The types of master keys you can enter and the steps you take to enter master keys depend on your system processor and hardware features.

You can use any of these methods to enter the master keys:

- Pass Phrase Initialization

  The pass phrase initialization utility allows the user of ICSF to:
  - set both the DES and PKA master keys on the Cryptographic Coprocessor Feature, PCICC and PCIXCC.
  - set the DES-MK, AES-MK, and ASYM-MK on the CEX2C or CEX3C.
  - set the DES-MK, AES-MK, RSA-MK, and ECC-MK on the CEX3C.
  - initialize the CKDS and PKDS

  For steps in using the pass phrase initialization utility, refer to Chapter 5, “Using the Pass Phrase Initialization Utility,” on page 77.
- Master Key Entry panels

  The Master Key Entry panels are enhanced ISPF panels enabling you to enter master key parts in the clear. Use these panels to enter master key parts into cryptographic coprocessor hardware. The master key parts appear briefly in the clear in MVS host storage within the address space of the TSO user before being transferred to the secure hardware. Within the boundaries of the secure hardware, the key parts are combined to produce the master key. The master key part entry panels provide a level of security for master key entry that is superior to that provided with PCF. Master key part entry is provided for installations where the security requirements do not warrant the additional expense and complexity of the optional TKE workstation. For master key entry

steps on the coprocessors, see Chapter 6, “Managing Master Keys - CCF and PCICC,” on page 99 and Chapter 7, “Managing Master Keys - PCIXCC, CEX2C, or CEX3C,” on page 143.

- Trusted Key Entry (TKE) workstation

  The TKE workstation is an optional hardware feature. The TKE workstation uses a variety of public key cryptographic techniques to ensure both the integrity and privacy of the logically secure master key transfer channel. You can use a single TKE workstation to set up master keys in all Cryptographic Coprocessor Features and Cryptographic Coprocessors within a server complex.

  You must use TKE V4.0 or higher to set up DES master keys on a PCIXCC/CEX2C. You must use TKE V5.3 or higher to set up AES master keys on a CEX2C. You must use TKE V6.0 or higher to set up AES master keys on a CEX3C.

  For information on using the TKE workstation, see *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

When you have entered the master keys, choose option 1 on the ICSF Master Key Management panel to:

- Create the CKDS header record.
- Activate the DES master key and/or AES master key and read the CKDS into storage.
- Create keys that ICSF uses for internal processing, and read the CKDS into storage again.

If you wish to add ANSI, NOCV, or Enhanced System Keys to your CKDS, choose the appropriate option. Refresh the CKDS. Note that these keys are not present in a CKDS initialized on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196. A CKDS initialized on the newer systems (listed above) cannot be shared with legacy systems.

Servers or processor models may have multiple cryptographic coprocessor features. The master keys must be the same for all coprocessors accessed by the same operating system.

When you have entered the PKA master keys, enter the name of the PKDS to be initialized on the panel. To initialize the PKDS, choose option 5 on the ICSF Master Key Management panel to:

- Create the PKDS header record.
- Activate the RSA master key and/or the ECC master key and read that PKDS into storage.

Entering system keys into the cryptographic key data set (CKDS)

The ICSF CKDS has several sets of system keys. These are the keys with labelname of X'00' and are installed during CKDS initialization. The system keys are required in the CKDS. Other keys are optional; however, their absence will affect functions in many services.

Notes:

1. FMID HCR7780 introduced a new variable-length record format for CKDS records. When a variable-length CKDS is initialized on a non-CCF system, no system keys are written to the CKDS. A variable-length CKDS that was converted from a fixed-length CKDS will have any system keys of the original CKDS.

2. The NOCV, ANSI and Extended Systems keys are not required on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system with a PCIXCC, CEX2C, or CEX3C.

Note:

If the system keys are not in the CKDS, an 18F abnormal end with reason code X'A1' can occur. If the ANSI, NOCV enablement, or the ESYS keys are not in the CKDS, an 18F abnormal end with reason code X'A3' can occur.

This is a summarization of where the keys are used:

- Required System Keys

  These keys are used to validate CKDS entries and used in many services. These keys are required.
- NOCV-enablement Keys
  - These keys are needed for all services where NOCV key-encrypting keys are required. See *z/OS Cryptographic Services ICSF Application Programmer's Guide* for more information.
  - These keys are needed in CSNBKGN and KGUP where replicated keys are generated, that is, where key length of SINGLE is specified for double-length keys.
  - These keys are used during verification pattern generation on a CDMF-only system.
  - These keys are used by CSNBSBC on a CDMF-only system.
  - These keys are used during CKDS conversion.
  - These keys are required to export and import double-length DATAM and DATAMV keys.
- ANSI System Keys
  - These keys are used by CSNBSBD on a CDMF-only system.
  - These keys are used when installing the extended system keys (ESYS) on the CKDS initialization panel.
  - These keys are needed for key part import services.
  - These keys are required for key test service CSNBKYT if there are no PCICCs active.
  - These keys are required to generate double-length DATAM and DATAMV keys in the importable form.
- Extended System Keys

  These keys are required for symmetric key export if there are no PCICCs active.

Entering keys into the cryptographic key data set (CKDS)

All DES, AES, and HMAC keys (except for master keys) can be stored in the CKDS.

Note: FMID HCR7780 introduced a new variable-length record format for CKDS records. HMAC keys, also introduced in FMID HCR7780, are variable-length keys. Variable-length AES keys are introduced in FMID HCR7790. To store variable-length keys in the CKDS, the CKDS must first have been converted to the variable-length record format. ICSF provides a CKDS conversion program, CSFCNV2, that converts a fixed-length record format CKDS to a variable-length record format. For more information in this utility, refer to *z/OS Cryptographic Services ICSF System Programmer's Guide*.

There are several methods you can use to enter keys into the CKDS.

- Key generator utility program (KGUP)

  Regardless of your processor or server model, you can use KGUP to enter keys into the CKDS.
- Dynamic CKDS update callable services

  Regardless of your processor or server model, you can program applications to use the dynamic CKDS update callable services to enter keys into the CKDS.
- Trusted Key Entry (TKE) workstation

  With the TKE workstation you can load key parts for operational (PIN and transport) keys into a key queue on the CCF. To load these key parts into the CKDS, you must also use the ICSF Operational Key panel and perform a CKDS refresh. For more information, refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

  DES operational key support for PCIXCC/CEX2C is available in TKE V4.1 and higher. AES operational key support for CEX2C is available in TKE V5.3. You can load key parts for all operational keys into key part registers on the card. To load the accumulated key into the CKDS, you must use the ICSF DES Operational Key Load panel or KGUP. For more information, refer to the *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

The table in Table 2 shows which keys can be entered by each of these methods.

Table 2. Methods for Entering Each Key Type into the CKDS

Key Type	KGUP	Dynamic Update	TKE with CCF	TKE with PCIXCC, CEX2C, or CEX3C
PIN	X	X	X	X
Importer and Exporter key-encrypting keys	X	X	X	X
Data-encrypting	X	X		
Data-translation*	X	X		
MAC and MACVER	X	X		X
HMAC and HMACVER		X		
DATAM and DATAMV	X	X		X
ANSI key-encrypting keys*		X		
IMP-PKA keys	X**	X	X	X
Non-standard CV keys	X**	X		X

Notes:

1. * ANSI and data-translation keys are only supported on the IBM @server zSeries 900.
2. ** The key can only be loaded using the KGUP OPKYLOAD option, requiring a TKE workstation to accumulate the key in the key part register.

Entering keys by using the key generator utility program

One function that KGUP performs is to enter key values that you supply into the CKDS. You can enter a clear or encrypted key value by using KGUP.

You submit KGUP control statements to specify to KGUP the function that you want KGUP to perform. To enter a key, you specify the key value in a KGUP control statement. You can either specify an encrypted or clear key value.

When you enter an encrypted key value, the key value must be encrypted under an importer key-encrypting key that exists in the CKDS. You use the KGUP control statement to specify which importer key-encrypting key encrypts the key. KGUP reenciphers the key from under the importer key-encrypting key to under the master key and places the key in the CKDS.

When you enter a clear key value, KGUP enciphers the clear key value under the master key and places the key in the CKDS. Because entering clear keys may endanger security, ICSF must be in special secure mode before you can enter a clear key by using KGUP. Special secure mode lowers the security of your system to allow you to use KGUP to enter clear keys, and to produce clear PINs.

Special Secure Mode: To use special secure mode, several conditions must be met.

- The installation options data set must specify YES for the SSM installation option.

  For information about specifying installation options, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.
- The environmental control mask (ECM) must be configured to permit special secure mode.

  The ECM is a 32-bit mask that is defined for each crypto domain during hardware installation. The second bit in this mask must have been turned on to enable special secure mode.

  This is required for systems with the Cryptographic Coprocessor Feature.
- If you are running in LPAR mode, special secure mode must be enabled

  You enable special secure mode during activation using the Crypto page of the Customize Activation Profiles task. After activation, you can enable or disable special secure mode on the Change LPAR Crypto task. Both of these tasks can be accessed from the Hardware Master Console.

  This is required for systems with the Cryptographic Coprocessor Feature.

If these conditions permit the use of special secure mode, it is enabled automatically when you specify that you are entering clear key values in a KGUP statement.

For a detailed description of how to use KGUP to enter keys, see Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215.

Entering keys by using the dynamic CKDS update services

ICSF provides a set of callable services that allow applications to dynamically update the CKDS. Applications can use these services to create, write, and delete records from the CKDS. These dynamic updates affect both the DASD copy of the CKDS currently in use and the in-storage copy. Another service allows an application to retrieve the key token from a record in the in-storage CKDS. That token can be used directly in subsequent CALLs to cryptographic services. The key part import callable service combines the clear key parts and returns the key value either in an internal key token or as a dynamic update to the CKDS. For more

information on using the dynamic CKDS update services or the key part import service, refer to *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Entering keys into the PKDS

You can store DSS, ECC, and RSA public and private keys in the PKA key data set (PKDS). Trusted block tokens can also be stored in the PKA key data set through the use of the same ICSF callable services. ICSF provides a set of callable services that allow applications to update the PKDS. Applications can use some of these services to create, write, and delete records from the PKDS. ICSF maintains an in-storage copy of the PKDS similar to the in-storage copy of the CKDS. It's purpose is to improve performance and eliminate I/O.

Restriction: DSS keys are only supported on the IBM @server zSeries 900.

For more information on using the PKDS update services, refer to the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

When you initialize ICSF, the system obtains space in storage for the PKDS. For more information about initializing space for the PKDS, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Besides the in-storage PKDS, there is a copy of the PKDS on disk. Your installation can have many disk copies of PKDSs, backup copies, and different disk copies. For example, an installation may have a separate PKDS with different keys for each shift. When a certain shift is working, you can load the PKDS for that shift into storage. Then only the keys in the PKDS loaded for that shift can be accessed for ICSF functions. However, only one disk copy is read into storage at a time.

RSA and ECC private keys can also be stored in the PKDS from TKE. For more information, see *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Entering cryptographic objects into the TKDS

PKCS #11 is a standard set of programming interfaces for cryptographic functions developed by RSA Laboratories of RSA Security Inc. A subset of these functions is supported by ICSF. ICSF stores the PKCS #11 tokens and token objects in a specialized data set called the token data set (TKDS). In the context of PKCS #11, a token is a representation of a cryptographic device, such as a smart card reader. You can store public key objects, private key objects, secret key objects, certificate objects, data objects, and domain parameter objects in the TKDS through the use of ICSF callable services. ICSF provides a set of callable services that allow applications to update the TKDS. Applications can use these services to create, delete, list, set and get attribute values from the TKDS.

For more information on using the TKDS services refer to the *z/OS Cryptographic Services ICSF Writing PKCS #11 Applications* and *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

PKCS #11 and FIPS 140-2

The National Institute of Standards and Technology (NIST), the US federal technology agency that works with industry to develop and apply technology, has published the Federal Information Processing Standard Security Requirements for Cryptographic Modules standard (FIPS 140-2), that can be required by organizations who specify that cryptographic-based security systems are to be used to provide protection for sensitive or valuable data.

The z/OS PKCS #11 services are designed to meet FIPS 140-2 Level 1 criteria, and can be configured to operate in compliance with FIPS 140-2 specifications. Applications that need to comply with the FIPS 140-2 standard can therefore use the z/OS PKCS #11 services in a way that allows only the cryptographic algorithms (including key sizes) approved by the standard and restricts access to the algorithms that are not approved.

For more information on using the TKDS services, refer to the *z/OS Cryptographic Services ICSF Writing PKCS #11 Applications* and the *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Maintaining cryptographic keys

You can use either KGUP or the dynamic CKDS update services to generate and enter keys into the cryptographic key data set (CKDS), or to maintain keys already existing in the CKDS. The keys are stored in records. A record exists for each key that is stored in the CKDS.

A record in the CKDS is called a *key entry* and has a label associated with it. When you call some ICSF callable services, you specify a key label as a parameter to identify the key for the callable service to use.

Use KGUP to change the key value of an entry, rename entry labels, and delete entries in the CKDS. For more information about how to use KGUP to update key entries in the CKDS, see Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215.

Use the dynamic CKDS update services in applications to create entries, change the key value of an entry, and delete entries in the CKDS.

You can use RACF to control which applications can use specific keys and services. For more information, see Chapter 4, “Using RACF to Protect Keys and Services,” on page 43.

Setting up and maintaining the cryptographic key data set (CKDS)

The cryptographic key data set (CKDS) stores operational DES, AES, and HMAC keys of all types. It contains an entry for each key.

Note: FMID HCR7780 introduced a variable-length record format for CKDS records. HMAC keys, also introduced in FMID HCR7780, are variable-length keys. Variable-length AES keys are introduced in FMID HCR7790. To store variable-length keys in the CKDS, the CKDS must first have been converted to the variable-length record format. ICSF provides a CKDS conversion program, CSFCNV2, that converts a fixed-length record format CKDS to a variable-length record format. For more information in this utility, refer to *z/OS Cryptographic Services ICSF System Programmer's Guide*.

If you have no coprocessor, you can initialize the CKDS for use with clear AES and DES data keys. This CKDS can not be used on a system with cryptographic coprocessors.

DES keys that are stored in the CKDS are encrypted under the appropriate variants of the DES master key, except for clear key value data-encrypting keys. AES keys that are stored in the CKDS are encrypted under the AES master key. HMAC keys are encrypted under the AES master key. Encrypted keys in the CKDS cannot be

overwritten with a key encrypted under a different master key. (DES replaces DES, AES replaces AES, HMAC replaces HMAC). For clear keys, the same is true, DES can overwrite DES, AES can overwrite AES, and HMAC can overwrite HMAC.

Before you generate keys that you store in the CKDS, you must define a DES or AES master key to your system. You define a master key by entering its value and setting it so it is active on the system. When you enter the master key, you must make it active on the system by setting it when you initialize the CKDS. For information about entering and setting the master key and initializing CKDS , see Chapter 6, “Managing Master Keys - CCF and PCICC,” on page 99 or Chapter 7, “Managing Master Keys - PCIXCC, CEX2C, or CEX3C,” on page 143.

Once you define a master key, you generate keys and store them in the CKDS. You use KGUP to generate keys and change key values and other information for a key entry in the CKDS. For more information about running KGUP, see Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215. You can also program applications to use callable services to generate keys and change key information in the CKDS. For more information about how to use callable services to update key entries in the CKDS, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*. You can use the optional TKE workstation to load key parts for operational (PIN and transport) keys into a key part queue on the CCF. To load these key parts into the CKDS, you must also use the ICSF Operational Key panel and perform a CKDS refresh. For more information on using the TKE workstation, see *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Support for operational keys is available beginning with TKE V4.1. You can load key parts for all operational keys into key part registers on the PCIXCC, CEX2C, or CEX3C. To load the accumulated key into the CKDS, you must use the ICSF Operational Key Load panel. For more information, refer to the *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

When you initialize ICSF, the system obtains space in storage for the CKDS. For more information about initializing space for the CKDS, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Besides the in-storage CKDS, there is a copy of the CKDS on disk. Your installation can have many disk copies of CKDSs, backup copies, and different disk copies. For example, an installation may have a separate CKDS with different keys for each shift. When a certain shift is working, you can load the CKDS for that shift into storage. Then only the keys in the CKDS loaded for that shift can be accessed for ICSF functions. However, only one disk copy is read into storage at a time.

A CKDS with encrypted AES or HMAC keys must be managed from a system that has an AES master key.

You use KGUP to make changes to any disk copy of the CKDS. When you use KGUP to generate and maintain keys, or enter keys directly, you change only the disk copy of a CKDS. Therefore, you can change keys in the disk copy of the data set without disturbing ICSF functions that are using the keys in the in-storage copy of the data set. To make the changes to the disk copy of the CKDS active, you need to replace the in-storage CKDS using the refresh utility. When you use the dynamic CKDS update callable services to change entries in the CKDS, you change both the in-storage copy of the CKDS and the disk copy. This allows for the immediate use of the new keys without an intervening refresh of the entire CKDS. Figure 6 on page 36 shows that ICSF callable services use keys in the in-storage

copy of the CKDS.

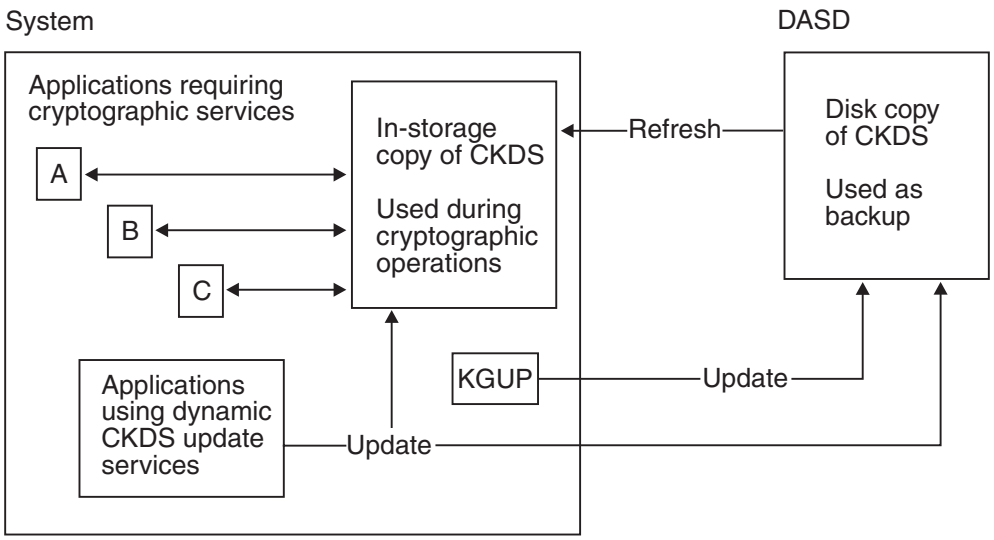

Figure 6. Updating the In-Storage Copy and the Disk Copy of the CKDS

You just specify the name of the disk copy of the CKDS when you run KGUP. You can also read any disk copy of the CKDS into storage, by specifying the name of the disk copy of the CKDS on a Refresh In-Storage CKDS panel. You can also run a utility program to read a disk copy of the CKDS into storage. However, the disk copy must be enciphered under the correct master key. All the copies of your disk copies of the CKDS should be enciphered under the same master key.

Your installation should periodically change the master key. To change the master key, you enter a new master key value and make that value active. The keys in a CKDS must then be enciphered under the new master key. Therefore, to make the new master key active, the CKDS must be reenciphered from under the current master key to under the new master key.

First, you reencipher the disk copy of the CKDS under the new master key. Then you activate the new master key using the change master key option. This option automatically replaces the old in-storage CKDS with the disk copy that is reenciphered under the new master key. If you have multiple disk copies of CKDSs, reencipher all of them under the new master key before changing the master key.

You can reencipher a CKDS under a new master key by using the master key panels or a utility program. For more information about reenciphering a CKDS, see “Steps for changing the DES master key and reenciphering the CKDS” on page 128.

Note: When you perform any functions that affect the in-storage copy of the CKDS, you should consider temporarily disallowing the dynamic CKDS update services. Functions that affect the in-storage copy of the CKDS include changing the master key, reenciphering, or refreshing. For more information, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration updates” on page 216.

If running in a sysplex, see Chapter 9, “Running in a Sysplex Environment,” on page 191.

Setting up and maintaining the PKDS

Public Key Algorithm (DSS, ECC, and RSA) public and private keys and trusted block can be stored in the PKA key data set (PKDS), a VSAM data set. Applications can use the dynamic PKDS callable services to create, write, read and delete PKDS records.

The PKDS may be initialized at ICSF setup. There are internal and external tokens in the PKDS. External tokens may be used irrespective of the PKA master keys. Internal tokens, however, can only be used if they are encrypted under the appropriate PKA master key.

Your installation should periodically change the PKA/asymmetric master key. To change the master key, you enter a new master key value and make that value active. After the master key has been set, the PKDS must be reenciphered under the new master key. You can reencipher a PKDS under a new master key by using the master key panels or a utility program. For more information about reenciphering a PKDS, see “Steps for reenciphering and refreshing the PKDS” on page 136. If you have multiple disk copies of PKDSs, reencipher all of them under the new master key after changing the master key.

You can program applications to use the PKDS callable services to create entries, change entries and delete entries in the PKDS. For more information about how to use callable services to update key entries in the PKDS, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

PKDS Key management panels support:

- Generating an RSA key pair PKDS record
- Deleting an existing PKDS record
- Exporting an existing public key to an X.509 certificate stored in an MVS physically sequential data set
- Importing a public key from an X.509 certificate stored in an MVS physically sequential data set.

If running in a sysplex, see Chapter 9, “Running in a Sysplex Environment,” on page 191.

Distributing Cryptographic Keys

With ICSF you can develop key distribution systems as defined in any of these:

- The IBM Common Cryptographic Architecture
- The ANSI X9.17 Standard
- The Public Key Cryptographic Standard (PKCS)

These key distribution systems are explained in these topics:

Common Cryptographic Architecture Key Distribution

ICSF provides protection for keys when the keys are sent outside your system. You must generate complementary keys for key distribution. A complementary pair of keys has these characteristics:

- The keys have the same clear key value.
- The key types are different but complementary.
- Each key usually exists on a different system.

Complementary keys apply only to DES keys. AES keys can be distributed to other systems using RSA key pairs.

Complementary keys are these types:
- Importer key-encrypting key and exporter key-encrypting key (transport keys)
- PIN generation key and PIN verification key
- Input PIN-encrypting key and output PIN-encrypting key
- MAC generation key and MAC verification key
- Data-encrypting key and data-translation key (**Restriction**: Data-translation keys are only supported on the IBM @server zSeries 900).
- Input key translate and output key translate keys

When protected data is sent between intermediate systems, these keys exist as complementary keys:
- Data-encrypting key and data-translation key (**Restriction**: Data-translation keys are only supported on the IBM @server zSeries 900).
- Data-translation key and data-translation key (**Restriction**: Data-translation keys are only supported on the IBM @server zSeries 900).

For more information about this situation, see “Protection of Data” on page 22.

The same data-encrypting key can also exist on two different systems so that both systems can encipher and decipher the data.

You can use ICSF to protect keys that are distributed across networks. You distribute keys across a network for some of these reasons:
- When you send encrypted data to another system, you send the data-encrypting key with the data or before it.
- When you share complementary keys with another system.

Transport keys protect keys being sent to another system. When a key leaves your system, an exporter key-encrypting key encrypts the key. When another system receives the key, the key is still encrypted under the same key-encrypting key, but the key-encrypting key is now considered an importer key-encrypting key. The exporter key-encrypting key at the sending system and the importer key-encrypting key at the receiving system must have the same clear value. For two systems to exchange keys, they must establish pairs of transport keys.

In Figure 7 on page 39 System A wants to send an output PIN-encrypting key to System B.

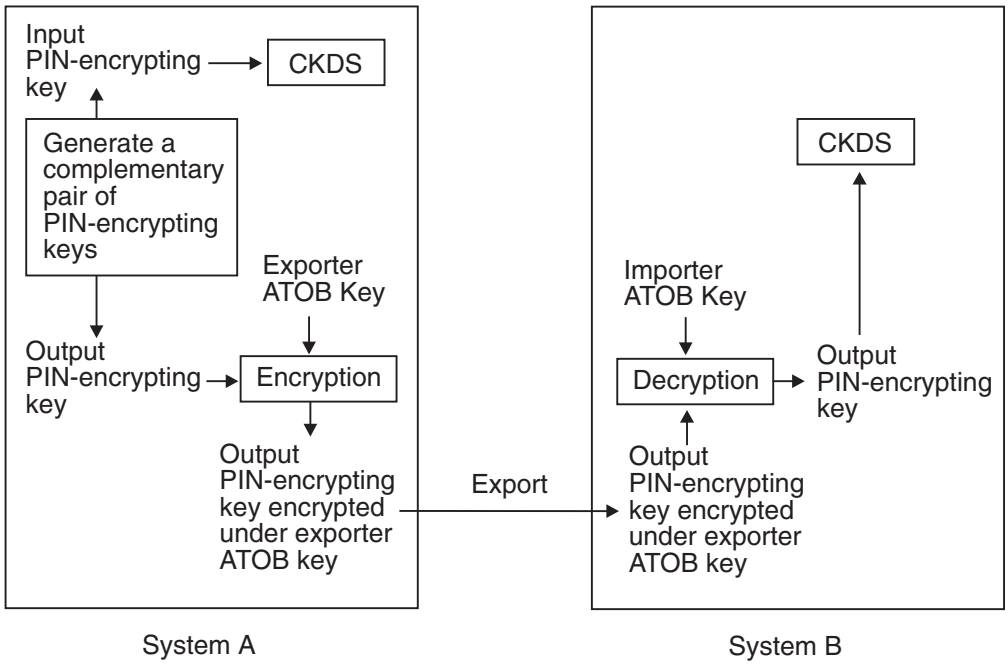

Figure 7. Key Sent from System A to System B

To send the key, System A and System B must establish a pair of transport keys between them. System A has an exporter key-encrypting key called Exporter ATOB, which has the same key value as the importer key-encrypting key called Importer ATOB at System B. This pair of transport keys is unidirectional, because they are used only for distributing keys from System A to System B.

When System A generates the input PIN-encrypting key, the system also creates a complementary output PIN-encrypting key. System A enciphers the input PIN-encrypting key under System A's master key and stores the input PIN-encrypting key in the CKDS. It encrypts the complementary output PIN-encrypting key under the Exporter ATOB key so it can send the output PIN-encrypting key to System B. System B decrypts the output PIN-encrypting key using the Importer ATOB key, and encrypts the output PIN-encrypting key under System B's master key.

For the systems to send keys in both directions, they must establish two pairs of transport keys at each site, as in Figure 8 on page 40.

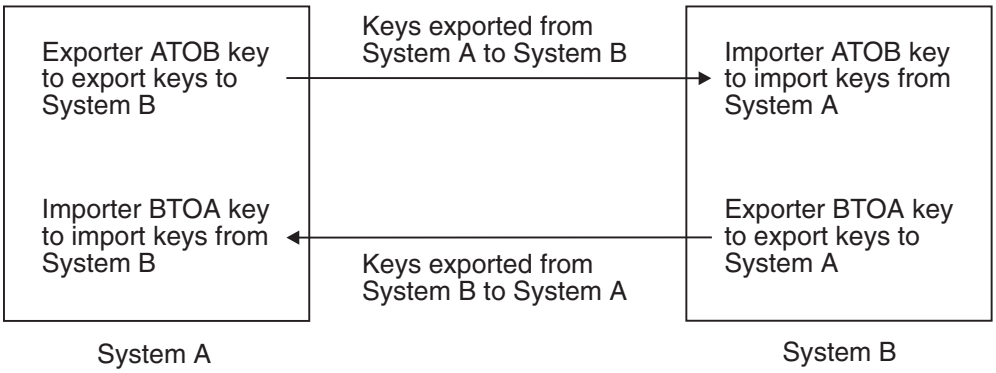

Figure 8. Keys Sent between System A and System B

To send keys from System A to System B, use the key generator utility program (KGUP) to establish an importer and exporter complementary key pair. You establish an exporter key, Exporter ATOB key, on System A and establish the complementary importer key, Importer ATOB key, on System B. Then when System A sends a key to System B, System A sends the key in exportable form encrypted under Exporter ATOB key. When System B receives the key, System B considers the key in importable form encrypted under Importer ATOB key.

To send keys from System B to System A, use KGUP to establish an importer and exporter complementary key pair. You establish an exporter key, Exporter BTOA key, on System B and the complementary importer key, Importer BTOA key, on System A. When System B sends a key to System A, System B sends the key in exportable form encrypted under Exporter BTOA key. When System A receives the key, System A considers the key in importable form encrypted under Importer BTOA key.

KGUP can create a pair of complementary keys, one key in operational form, and its complement in exportable form. You can also use KGUP to receive keys that are in importable form. When you want KGUP to create a key value in exportable form or import a key value in importable form, you specify the transport key that encrypts the key value. For more information about using KGUP for key distribution, see Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215.

You can also use one of two callable services to reencipher a key from operational form into exportable form. Both the key export callable service and the data key export callable service reencipher a key from encryption under the master key to encryption under an exporter key-encrypting key.

You can call the key import callable service to convert a key from importable form to operational form. The key import callable service reenciphers a key from encryption under an importer key-encrypting key to encryption under the system's master key.

With interlinked computer networks, sensitive data passes through multiple nodes before reaching its final destination. The originator and the receiver do not share a common key. Data-translation keys are shared between the originator and an intermediate system, between two intermediate systems, and between an intermediate system and the receiver system. As the data is passed along between these systems, they must reencipher it under the different data-translation keys without it ever appearing in the clear. Each system can call the ciphertext translate

callable service to do this function. For a description of sending data between intermediate systems, see “Protection of Data” on page 22.

ANSI X9.17 Key Distribution

ICSF provides callable services that allow you to develop key distribution systems that adhere to the ANSI X9.17 standard.

Restriction: These services are not supported on a PCIXCC/CEX2C.

When protected data is sent between two systems, it is protected by data-encrypting keys. The same data-encrypting key exists on two different systems so that both systems can encipher and decipher the data.

For two systems to exchange keys, they must establish a shared transport key, the ANSI key-encrypting key (AKEK), which is distributed manually. This transport key is bidirectional, and can be used for distributing keys in both directions between System A and System B, as shown in Figure 9.

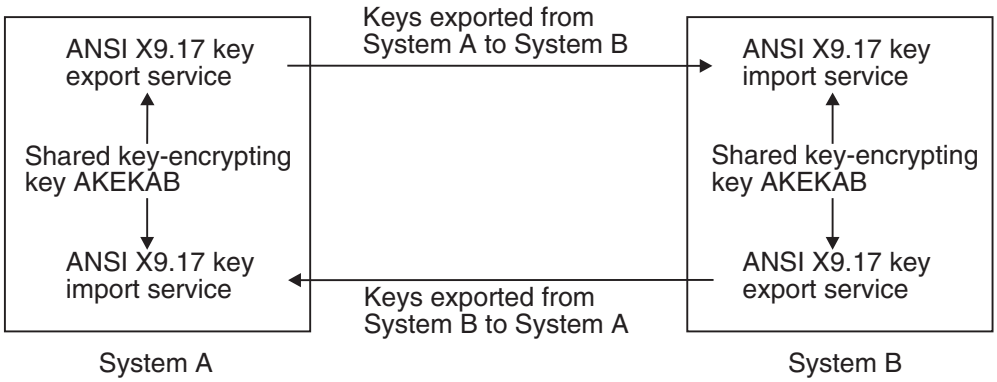

Figure 9. ANSI X9.17 Keys Sent between System A and System B

System A generates the data-encrypting key, enciphers it under System A's master key, and stores it in the CKDS. System A uses the ANSI X9.17 key export callable service to encrypt the data-encrypting key under the shared transport key, AKEKAB, and export it to System B. System B then uses the ANSI X9.17 key import callable service to decrypt the data-encrypting key using the shared transport key, AKEKAB, and then encrypts it under System B's master key. The shared transport key is coupled with source and destination identifiers for System A and System B, and a message counter as defined in the ANSI offset and notarization processes.

The shared ANSI key-encrypting key is bidirectional. System B can also send keys to System A. The systems can also exchange data keys along with the AKEK used to encrypt them. The AKEKs are themselves encrypted under the transport AKEK.

ANSI X9.17 key distribution can take place in several types of environments:
- Point-to-point environment
- Key distribution center environment
- Key translation center environment

For more information on ANSI X9.17 key distribution, refer to the ANSI X9.17 Standard.

Public Key Cryptographic Standard Key Distribution

ICSF provides support for the Public Key Cryptographic Standard (PKCS). PKCS is a set of standards for public-key cryptography developed by RSA Data Security, Inc. An example of using RSA public-key cryptography to distribute DES, AES and CDMF data-encrypting keys is presented in “Using RSA Public Keys to Protect Keys Sent between Systems” on page 21.

Controlling PCICC, PCIXCC, CEX2C, and CEX3C services

This topic only applies if you have a TKE workstation. For non-TKE users, all access control points are enabled with the exception of the access control points listed below. These are disabled for all users and require a TKE workstation to enable.

- ANSI X9.8 PIN - Enforce PIN block restrictions
- ANSI X9.8 PIN - Allow modification of PAN
- ANSI X9.8 PIN - Allow only ANSI PIN blocks
- ANSI X9.8 PIN - Use stored decimalization tables only
- DKYGENKY-DALL
- DSG ZERO-PAD unrestricted hash length
- PTR enhanced PIN security

Access control points for ISPF, API, and UDX services on the coprocessor can be enabled/disabled using the TKE workstation. All access control points will be enabled when the TKE workstation is installed. If you don't enable or disable any access control points, all new access control points will be enabled when a new release of ICSF is installed and the services will be available. However, if any access control points have been enabled or disabled, all new access control points will be disabled when a new release of ICSF is installed. These new access control points must be enabled to before the services are available. UDX support is dependent on access control points. If your installation wants to use UDX callable services, the corresponding access control point must be enabled.

To enable/disable access control points on a PCICC/PCIXCC/CEX2C, TKE V5.0 or higher is required.

To enable/disable access control points on a CEX2C/CEX3C on z10, TKE V6.0 or higher is required.

To enable/disable access control points on a CEX3C on z196, TKE V7.0 or higher is required.

To list the access control points that are enabled, see “Displaying PCICC coprocessor roles” on page 311 and “Displaying PCIXCC, CEX2C, and CEX3C coprocessor roles” on page 314.

For more information, see *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Chapter 4. Using RACF to Protect Keys and Services

You can use z/OS Security Server RACF to control which applications can use specific keys and services. This can help you ensure that keys and services are used only by authorized users and jobs. You can also use RACF to audit the use of keys and services. In addition, you can establish a Key Store Policy that defines rules for the use of encrypted key tokens that are stored in a CKDS or PKDS. To use RACF to control access to keys and services, you create and maintain general resource profiles in the CSFKEYS class, the CSFSERV class, and the XFACILIT class.

- The CSFKEYS class controls access to cryptographic keys. You create profiles in this class (based on the label by which the key is defined in the CKDS or PKDS) to set access authority for the keys. For the exclusive purpose of requiring UPDATE instead of READ authority when transferring a secure AES or DES key from encryption under the master key to encryption under an RSA key, you can define profiles in the XCSFKEY class. Profiles in the XCSFKEY class are used in authorization checks only when the Symmetric Key Export service (CSNDSYX or CSNFSYX) is called. For all other callable services, the CSFKEYS class is used.
- The CSFSERV class controls access to ICSF services and ICSF TSO panel utilities.
- One or more resource profiles in the XFACILIT class define your Key Store Policy. A Key Store Policy consists of a number of controls that collectively determine how encrypted key tokens defined in a CKDS or PKDS can be accessed and used.

If you are not the RACF security administrator, you may need to ask assistance from that person. To use the auditing capabilities of RACF, you may need to ask for reports from a RACF auditor. Your installation's security plan should show who is responsible for maintaining these RACF profiles and auditing their use.

Steps for RACF-protecting keys and services

This procedure describes one approach for RACF-protecting keys and services:

1. Decide whether you will protect keys, services, or both. You can select which keys and services to protect.
2. You may want to organize the users who need access to ICSF keys and services into groups. To do this, obtain a list of the user IDs of users who need to use ICSF keys and services. If batch jobs or started tasks need to use ICSF, obtain the user IDs under which they will run.

   Group any of the user IDs together if they require access to the same keys and services. For example, you might want to set up groups as follows:
   - Users who work with MAC-related callable services
   - Users who work with PIN-related callable services
   - Users who work with a particular MAC, or a particular PIN
   - Users who call applications to dynamically update the CKDS
   - Users who perform functions available on the User Control Functions panel

   Usually, all users of ICSF should have access to keys and services by virtue of their membership in one of these RACF groups, rather than specific users. This is because RACF maintains the access lists in in-storage profiles. When the in-storage profiles are created or changed, the in-storage profiles must be refreshed. (Merely changing them in the RACF data base is not sufficient. This

is analogous to the in-storage CKDS maintained by ICSF.) To refresh the in-storage RACF profiles, the RACF security administrator must use the SETROPTS command:

```
SETROPTS RACLIST(CSFKEYS) REFRESH

SETROPTS RACLIST(CSFSERV) REFRESH
```

If you place *RACF groups* in the access lists of the RACF profiles, you can change a user's access to the protected services and keys by adding or removing the user from the groups. Ask your RACF security administrator to create the RACF groups.

You should also ask your RACF security administrator to connect you to these groups with CONNECT group authority. This permits you to connect and remove users from the groups.

For example, the security administrator could issue these commands:

```
ADDGROUP groupid

CONNECT  your-userid  GROUP(groupid)  AUTHORITY(CONNECT)
```

With CONNECT group authority, you are able to connect other users to the groups:

```
CONNECT  other-userid  GROUP(groupid)
```

With CONNECT group authority, you are also able to remove users from the groups:

```
REMOVE  other-userid  GROUP(groupid)
```

3. Ask your RACF security administrator for the authority to create and maintain profiles in the CSFKEYS and CSFSERV general resource classes. Usually, this is done by assigning a user the CLAUTH (class authority) attribute in the specified classes. For example, the security administrator can issue this command:

   ```
   ALTUSER  your-userid  CLAUTH(CSFKEYS CSFSERV)
   ```

4. If you want to use generic profiles that contain characters such as * and %, ask your RACF security administrator to activate generic profile checking in the CSFKEYS and CSFSERV classes:

   ```
   SETROPTS  GENERIC(CSFKEYS CSFSERV)
   ```

   Note: Using generic profiles has several advantages. Using generic profiles you can reduce the number of profiles that you need to maintain. You can also create a “top” generic profile that can be used to protect all keys and services that are not protected by a more specific profile.

5. Define profiles in the CSFKEYS and CSFSERV classes. For further instructions, see “Setting up profiles in the CSFKEYS general resource class” on page 45 and “Setting up profiles in the CSFSERV general resource class” on page 46.
6. Activate logging for CSFSERV using these commands:
   - ALTUSER userid UAUDIT - audits a userid
   - RALTER class-name profile-name AUDIT(*audit-attempt*[(*audit-access-level*)]) - used by the profile owner

     RALTER class-name profile-name GLOBALAUDIT(*access-attempt*[(*audit-access-level*)]) - used by a user with AUDITOR authority to set up profiles
   - SETROPTS CLASSACT(CSFSERV) RACLIST(CSFSERV)
     SETR LOGOPTIONS(CSFSERV(....))

   For more information on RDEFINE, RALTER, and SETR, see the *z/OS Security Server RACF Command Language Reference*.

7. Determine if you need to establish a Key Store Policy for a CKDS and/or a PKDS. A Key Store Policy is made up of a number of controls. Each Key Store Policy control is a resource in the XFACILIT class. The existence of a profile for a particular resource in the XFACILIT class enables that control. A Key Store Policy applies only to encrypted keys in a CKDS or PKDS. No key store policy controls are available or needed for a TKDS, because none of the keys in a TKDS are enciphered under a key-encrypting key. By enabling Key Store Policy controls, you can:
   - verify, when an application passes a callable service a key token instead of a key label, that the user has authority to the secure token. Profiles in the CSFKEYS class are named based on key labels (a discrete profile will exactly match the key label, while a generic profile will contain generic characters to match a number of key labels). Because the profiles are based on the key label, a SAF authorization check needs to know the key label of a CKDS or PKDS key record in order to perform the authorization check. A Key Store Policy control is available that will, if an application passes a callable service a key token instead of a key label, locate the associated key label(s) for the token so that a SAF authorization check can be carried out. By default, if ICSF cannot find an associated key label for the key token, the callable service will fail. However, another Key Store Policy control lets you use a default profile to specify access authority to tokens that are not stored in the CKDS or PKDS.
   - prevent applications from storing duplicate tokens in a CKDS or PKDS.
   - raise the level of access authority required to create, write to, or delete a key label.
   - raise the level of access authority required to export a token using the Symmetric Key Export callable service (CSNDSYX or CSNFSYX).
   - set additional restrictions on how keys covered by the profile can be used.

   You should familiarize yourself with the controls you can enable and decide on the Key Store Policy that is best for your installation. Refer to “Defining a key store policy” on page 53 for more information.

Setting up profiles in the CSFKEYS general resource class

To set up profiles in the CSFKEYS general resource class, take these steps:

1. Define appropriate profiles in the CSFKEYS class:

```
RDEFINE  CSFKEYS label  UACC(NONE)
         other-optional-operands
```

   where *label* is the label by which the key is defined in the CKDS or PKDS. Note that if an application uses a token instead of a key label, no authorization checking is done on the use of the key.

   Notes:

   a. If you have ICSF/MVS Version 1 Release 1 profiles that specify *key-type.label*, you need to change them to specify only *label*.

   b. As with any RACF profile, if you want to change the profile later, use the RALTER command. To change the access list, use the PERMIT command as described in the next step.

   c. If you have already started ICSF, you need to refresh the in-storage profiles. See Step 3.

   d. You can specify other operands, such as auditing (AUDIT operand), on the RDEFINE or RALTER commands.

e. If the RACF security administrator has activated generic profile checking for the CSFKEYS class, you can create generic profiles using the generic characters * and %. This is the same as any RACF general resource class.

2. Give appropriate users (preferably groups) access to the profiles:

```
PERMIT  profile-name  CLASS(CSFKEYS)
        ID(groupid)  ACCESS(READ)
```

3. When the profiles are ready to be used, ask the RACF security administrator to activate the CSFKEYS class and refresh the in-storage RACF profiles:

```
SETROPTS  CLASSACT(CSFKEYS)

SETROPTS RACLIST(CSFKEYS) REFRESH
```

Setting up profiles in the CSFSERV general resource class

To set up profiles in the CSFSERV general resource class, take these steps:

1. Define appropriate profiles in the CSFSERV class:

```
RDEFINE  CSFSERV profile-name  UACC(NONE)
         other-optional-operands
```

Where *profile-name* is the profile used to protect the resource. Table 3 lists the resources used by ICSF callable services. Table 4 on page 52 shows the resource names used by ICSF TSO panels, utilities, and compatibility services for PCF macros.

Table 3. Resource names for ICSF Callable Services

Resource Name	Callable Service Name(s)	Callable Service Description
CSFAEGN	CSNAEGN CSNGEGN	ANSI X9.17 EDC Generate
CSFAKEX	CSNAKEX CSNGKEX	ANSI X9.17 Key Export
CSFAKIM	CSNAKIM CSNGKIM	ANSI X9.17 Key Import
CSFAKTR	CSNAKTR CSNGKTR	ANSI X9.17 Key Translate
CSFATKN	CSNATKN CSNGTKN	ANSI X9.17 Transport Key Partial Notarize
CSFCKC	CSNBCKC CSNECKC	CVV Key Combine
CSFCKI	CSNBCKI CSNECKI	Clear Key Import
CSFCKM	CSNBCKM CSNECKM	Multiple Clear Key Import
CSFCPA	CSNBCPA CSNECPA	Clear PIN Generate Alternate
CSFCPE	CSNBCPE CSNECPE	Clear PIN Encrypt
CSFCRC	CSFCRC CSFCRC6	Coordinated KDS Administration
CSFCSG	CSNBCSG CSNECSG	VISA CVV Service Generate
CSFCSV	CSNBCSV CSNECSV	VISA CVV Service Verify

Table 3. Resource names for ICSF Callable Services (continued)

Resource Name	Callable Service Name(s)	Callable Service Description
CSFCTT	CSNBCTT CSNECTT	Ciphertext Translate
CSFCTT1	CSNBCTT1 CSNECTT1	Ciphertext Translate (with ALET)
CSFCVE	CSNBCVE CSNECVE	Cryptographic Variable Encipher
CSFCVT	CSNBCVT CSNECVT	Control Vector Translate
CSFDCO	CSNBDCO CSNEDCO	Decode
CSFDEC	CSNBDEC CSNEDEC	Decipher
CSFDEC1	CSNBDEC1 CSNEDEC1	Decipher (with ALET)
CSFDKG	CSNBDKG CSNEDKG	Diversified Key Generate
CSFDKM	CSNBDKM CSNEDKM	Data Key Import
CSFDKX	CSNBDKX CSNEDKX	Data Key Export
CSFDSG	CSNDDSG CSNFDSG	Digital Signature Generate
CSFDSV	CSNDDSV CSNFDSV	Digital Signature Verify
CSFECO	CSNBECO CSNEECO	Encode
CSFEDH	CSNDEDH CSNFEDH	ECC Diffie-Hellman
CSFENC	CSNBENC CSNEENC	Encipher
CSFENC1	CSNBENC1 CSNEENC1	Encipher (with ALET)
CSFEPG	CSNBEPG CSNEEPG	Encrypted PIN Generate
CSFHMG	CSNBHMG CSNEHMG	HMAC Generate
CSFHMG1	CSNBHMG1 CSNEHMG1	HMAC Generate (with ALET)
CSFHMV	CSNBHMV CSNEHMV	HMAC Verify
CSFHMV1	CSNBHMV1 CSNEHMV1	HMAC Verify (with ALET)
CSFIQA	CSFIQA CSFIQA6	ICSF Query Algorithm
CSFIQF	CSFIQF CSFIQF6	ICSF Query Facility

Table 3. Resource names for ICSF Callable Services (continued)

Resource Name	Callable Service Name(s)	Callable Service Description
CSFKEX	CSNBKEX CSNEKEX	Key Export
CSFKGN	CSNBKGN CSNEKGN	Key Generate
CSFKGN2	CSNBKGN2 CSNEKGN2	Key Generate2
CSFKIM	CSNBKIM CSNEKIM	Key Import
CSFKPI	CSNBKPI CSNEKPI	Key Part Import
CSFKPI2	CSNBKPI2 CSNEKPI2	Key Part Import2
CSFKRC	CSNBKRC CSNEKRC	Key Record Create
CSFKRC2	CSNBKRC2 CSNEKRC2	Key Record Create2
CSFKRD	CSNBKRD CSNEKRD	Key Record Delete
CSFKRR	CSNBKRR CSNEKRR	Key Record Read
CSFKRR2	CSNBKRR2 CSNEKRR2	Key Record Read2
CSFKRW	CSNBKRW CSNEKRW	Key Record Write
CSFKRW2	CSNBKRW2 CSNEKRW2	Key Record Write2
CSFKTR	CSNBKTR CSNEKTR	Key Translate
CSFKTR2	CSNBKTR2 CSNEKTR2	Key Translate2
CSFKYT	CSNBKYT CSNEKYT	Key Test
CSFKYT2	CSNBKYT2 CSNEKYT2	Key Test2
CSFKYTX	CSNBKYTX CSNEKYTX	Key Test Extended
CSFMDG	CSNBMDG CSNEMDG	MDC Generate
CSFMDG1	CSNBMDG1 CSNEMDG1	MDC Generate (with ALET)
CSFMGN	CSNBMGN CSNEMGN	MAC Generate
CSFMGN1	CSNBMGN1 CSNEMGN1	MAC Generate (with ALET)
CSFMVR	CSNBMVR CSNEMVR	MAC Verify

Table 3. Resource names for ICSF Callable Services (continued)

Resource Name	Callable Service Name(s)	Callable Service Description
CSFMVR1	CSNBMVR1 CSNEMVR1	MAC Verify (with ALET)
CSFOWH	CSNBOWH CSNEOWH CSFPOWH CSFPOWH6	One-Way Hash Generate and PKCS #11 One-way hash, sign, or verify
CSFOWH1	CSNBOWH1 CSNEOWH1	One-Way Hash Generate (with ALET)
CSFPCI	CSFPCI CSFPCI6	PCI Interface Callable Service
CSFPCU	CSNBPCU CSNEPCU	PIN Change/Unblock
CSFPEX	CSNBPEX CSNEPEX	Prohibit Export
CSFPEXX	CSNBPEXX CSNEPEXX	Prohibit Export Extended
CSFPGN	CSNBPGN CSNEPGN	Clear PIN Generate
CSFPKD	CSNDPKD CSNFPKD	PKA Decrypt
CSFPKE	CSNDPKE CSNFPKE	PKA Encrypt
CSFPKG	CSNDPKG CSNFPKG	PKA Key Generate
CSFPKI	CSNDPKI CSNFPKI	PKA Key Import
CSFPKRC	CSNDKRC CSNFKRC	PKDS Record Create
CSFPKRD	CSNDKRD CSNFKRD	PKDS Record Delete
CSFPKRR	CSNDKRR CSNFKRR	PKDS Record Read
CSFPKRW	CSNDKRW CSNFKRW	PKDS Record Write
CSFPKSC	CSFPKSC	PKSC Interface Callable Service
CSFPKT	CSNDPKT CSNFPKT	PKA Key Translate
CSFPKTC	CSNDKTC CSNFKTC	PKA Key Token Change
CSFPKX	CSNDPKX CSNFPKX	PKA Public Key Extract
CSFPTR	CSNBPTR CSNEPTR	Encrypted PIN Translate
CSFPVR	CSNBPVR CSNEPVR	Encrypted PIN Verify

Table 3. Resource names for ICSF Callable Services (continued)

Resource Name	Callable Service Name(s)	Callable Service Description
CSFRKA	CSNBRKA CSNERKA	Restrict Key Attribute
CSFRKD	CSNDRKD CSNFRKD	Retained Key Delete
CSFRKL	CSNDRKL CSNFRKL	Retained Key List
CSFRKX	CSNDRKX CSNFRKX	Remote Key Export
CSFRNG	CSNBRNG CSNERNG CSFPPRF CSFPPRF6	Random Number Generate (returning an 8-byte random number) and PKCS #11 Pseudo-random function
CSFRNGL	CSNBRNGL CSNERNGL	Random Number Generate (returning a random number of a length specified by the caller)
CSFSAD	CSNBSAD CSNESAD	Symmetric Algorithm Decipher
CSFSAD1	CSNBSAD1 CSNESAD1	Symmetric Algorithm Decipher (with ALET)
CSFSAE	CSNBSAE CSNESAE	Symmetric Algorithm Encipher
CSFSAE1	CSNBSAE1 CSNESAE1	Symmetric Algorithm Encipher (with ALET)
CSFSBC	CSNDSBC CSNFSBC	SET Block Compose
CSFSBD	CSNDSBD CSNFSBD	SET Block Decompose
CSFSKI	CSNBSKI CSNESKI	Secure Key Import
CSFSKI2	CSNBSKI2 CSNESKI2	Secure Key Import2
CSFSKM	CSNBSKM CSNESKM	Multiple Secure Key Import
CSFSKY	CSNBSKY CSNESKY	Secure Messaging for Keys
CSFSPN	CSNBSPN CSNESPN	Secure Messaging for PINs
CSFSYG	CSNDSYG CSNFSYG	Symmetric Key Generate
CSFSYI	CSNDSYI CSNFSYI	Symmetric Key Import
CSFSYI2	CSNDSYI2 CSNFSYI2	Symmetric Key Import2
CSFSYX	CSNDSYX CSNFSYX	Symmetric Key Export

Table 3. Resource names for ICSF Callable Services (continued)

Resource Name	Callable Service Name(s)	Callable Service Description
CSFTBC	CSNDTBC CSNFTBC	Trusted Block Create
CSFTCK	CSNBTCK CSNETCK	Transform CDMF Key
CSFTRV	CSNBTRV CSNETRV	Transaction Validation
CSFT31I	CSNBT31I CSNET31I	TR-31 Import
CSFT31X	CSNBT31X CSNET31X	TR-31 Export
CSFUDK	CSFUDK CSFUDK6	User Derived Key
CSF1DVK	CSFPDVK CSFPDVK6	PKCS #11 Derive key
CSF1DMK	CSFPDMK CSFPDMK6	PKCS #11 Derive multiple keys
CSF1HMG	CSFPHMG CSFPHMG6	PKCS #11 Generate HMAC
CSF1GKP	CSFPGKP CSFPGKP6	PKCS #11 Generate key pair
CSF1GSK	CSFPGSK CSFPGSK6	PKCS #11 Generate secret key
CSF1GAV	CSFPGAV CSFPGAV6	PKCS #11 Get attribute value
CSF1PKS	CSFPPKS CSFPPKS6	PKCS #11 Private key sign
CSF1PKV	CSFPPKV CSFPPKV6	PKCS #11 Public key verify
CSF1SKD	CSFPSKD CSFPSKD6	PKCS #11 Secret key decrypt
CSF1SKE	CSFPSKE CSFPSKE6	PKCS #11 Secret key encrypt
CSF1SAV	CSFPSAV CSFPSAV6	PKCS #11 Set attribute value
CSF1TRC	CSFPTRC CSFPTRC6	PKCS #11 Token record create
CSF1TRD	CSFPTRD CSFPTRD6	PKCS #11 Token record delete
CSF1TRL	CSFPTRL CSFPTRL6	PKCS #11 Token record list
CSF1UWK	CSFPUWK CSFPUWK6	PKCS #11 Unwrap key
CSF1HMV	CSFPHMV CSFPHMV6	PKCS #11 Verify HMAC
CSF1WPK	CSFPWPK CSFPWPK6	PKCS #11 Wrap key

Table 4. Resource names for ICSF TSO panels, utilities, and compatibility services for PCF macros

Resource Name	Utility and Callable Service Description
CSFCMK	Change master key utility
CSFCONV	PCF CKDS to ICSF CKDS conversion utility
CSFDKCS	Clear master key entry utility (PCICC, PCIXCC,CEX2C, or CEX3C)
CSFDKEF	Clear master key entry utility (CCF)
CSFEDC	Compatibility service for the PCF CIPHER macro
CSFEMK	Compatibility service for the PCF EMK macro
CSFGKC	Compatibility service for the PCF GENKEY macro
CSFINIT	CKDS initialization utility (CCF)
CSFKGUP	Key generation utility program
CSFOPKL	Operational key load
CSFPCAD	PCICC, PCIXCC, CEX2C, and CEX3C management utility (activate/deactivate)
CSFPKDR	PKDS reencipher and PKDS refresh utilities
CSFPMCI	Pass phrase master key/KDS initialization utility
CSFREFR	Refresh CKDS utility
CSFRENC	Reencipher CKDS utility
CSFRSWS	Administrative control functions utility (ENABLE)
CSFRWP	CKDS Conversion2 - rewrap option.
CSFRTC	Compatibility service for the CUSP or PCF RETKEY macro
CSFSMK	Set master key utility
CSFSSWS	Administrative control functions utility (DISABLE)
CSFUDM	User Defined Extensions (UDX) management functions

Notes:

a. As with any RACF general resource profile, if you want to change the profile later, use the RALTER command. To change the access list, use the PERMIT command as described in the next step.

b. If you have already started ICSF, you need to refresh the in-storage profiles. See Step 3 on page 53.

c. You can specify other operands, such as auditing (AUDIT operand), on the RDEFINE or RALTER commands.

d. If the RACF security administrator has activated generic profile checking for the CSFSERV class, you can create generic profiles using the generic characters * and %. This is the same as with any RACF general resource class.

For example, if generic profile checking is in effect, these profiles enable you to specify which users and jobs can use the ciphertext translate callable services. No other services can be used by any job on the system.

```
RDEFINE  CSFSERV  CSFCTT   UACC(NONE)

RDEFINE  CSFSERV  CSFCTT1  UACC(NONE)

RDEFINE  CSFSERV  *        UACC(NONE)
```

2. Give appropriate users (preferably groups) access to the profiles:

```
PERMIT  profile-name  CLASS(CSFSERV)
        ID(groupid)  ACCESS(READ)
```

3. When the profiles are ready to be used, ask the RACF security administrator to activate the CSFSERV class and refresh the in-storage RACF profiles:

```
SETROPTS  CLASSACT(CSFSERV)

SETROPTS RACLIST(CSFSERV) REFRESH
```

Defining a key store policy

A Key Store Policy defines rules for how encrypted key tokens stored in a CKDS or PKDS can be accessed and used. A Key Store Policy is collectively defined by a number of separate controls that each specify a particular rule. Most of the Key Store Policy controls work in conjunction with profiles in the CSFKEYS class, and enable you to:

- Specify how ICSF should respond when a key token is passed to a callable service instead of a key label (which is needed to perform a SAF authorization check).
- Determine if applications should be prevented from creating a new key record (with a new key label) for a token that is already stored in the CKDS or PKDS (in a key record with a different key label).
- Specify if READ access authority is sufficient to create, write to, or delete a key label, or if a higher level of access authority should be required for these actions.
- Specify if READ access authority to an AES or DES key is sufficient to export the key (move it from encryption under a master key to encryption under an RSA key), or if UPDATE authority should be required for this action.
- Place restrictions on how keys can be used. You can:
  - restrict a particular AES or DES key from being exported, or allow it to be exported only by certain RSA keys (or only by RSA keys bound to identities in certain key certificates).
  - restrict certain RSA keys from being used in secure export and import operations, or from being used in handshake operations.

Each Key Store Policy control is a resource in the XFACILIT class, and can be enabled by creating a profile for the resource using the RDEFINE command. Similarly, you can disable a control by deleting its profile using the RDELETE command.

Certain controls, when enabled, will *activate* Key Store Policy for either the CKDS or PKDS. When Key Store Policy is *activated*, ICSF will identify the key label(s) associated with each key token in the key store. This information is needed, for example, in order to carry out SAF authorization checks against RACF profiles (which are based on key labels) when a key token is passed to a callable service, or to ensure an application doesn't store a duplicate token (a token that is already stored, but associated with a different key label) in the key store. In addition to the controls that activate Key Store Policy, other controls that do not themselves

activate Key Store Policy may still require, or to a lesser degree rely upon, an active Key Store Policy and its key token/label associations. The following table outlines the Key Store Policy controls that are available. This table also highlights the controls that activate Key Store Policy for a CKDS or PKDS, as well as the dependencies the other controls have on Key Store Policy being active. Be aware that Key Store Policy is activated separately for a CKDS and a PKDS.

Table 5. Key Store Policy controls

The following Key Store Policy controls:	**Consist of the following XFACILIT class resources:**	**Description:**
Key Token Authorization Checking controls Verifies, when an application passes a callable service a key token instead of a key label, that the user has authority to the key token in the CKDS or PKDS. It does this by identifying the key label associated with the passed token.	CSF.CKDS.TOKEN.CHECK.LABEL.WARN	**Activates Key Store Policy for CKDS.** Enables Key Token Authorization Checking for the CKDS in warning mode. In this mode, a failing authorization check will result in a warning, but the operation will be allowed to continue.
	CSF.CKDS.TOKEN.CHECK.LABEL.FAIL	**Activates Key Store Policy for CKDS.** Enables Key Token Authorization Checking for the CKDS in fail mode. In this mode, ICSF does not allow the operation to continue when the authorization check fails. The service returns with an error.
	CSF.PKDS.TOKEN.CHECK.LABEL.WARN	**Activates Key Store Policy for PKDS.** Enables Key Token Authorization Checking for the PKDS in warning mode. In this mode, a failing authorization check will result in a warning, but the operation will be allowed to continue.
	CSF.PKDS.TOKEN.CHECK.LABEL.FAIL	**Activates Key Store Policy for PKDS.** Enables Key Token Authorization Checking for the PKDS in fail mode. In this mode, ICSF does not allow the operation to continue when the authorization check fails. The service returns with an error.
Default Key Label Checking controls Specifies that ICSF should use a default profile to determine application access to tokens that are not stored in the CKDS or PKDS. Can be enabled only if the Key Token Authorization Checking control for the appropriate key store is also enabled.	CSF.CKDS.TOKEN.CHECK.DEFAULT.LABEL	**Requires an active Key Store Policy for CKDS.** Specifically, this control can be enabled only if the CSF.CKDS.TOKEN.CHECK.LABEL.WARN or CSF.CKDS.TOKEN.CHECK.LABEL.FAIL control is also enabled. Specifies that ICSF should use the default profile CSF-CKDS-DEFAULT in the CSFKEYS class to determine user access to tokens that are not stored in the CKDS.
	CSF.PKDS.TOKEN.CHECK.DEFAULT.LABEL	**Requires an active Key Store Policy for PKDS.** Specifically, this control can be enabled only if the CSF.PKDS.TOKEN.CHECK.LABEL.WARN or CSF.PKDS.TOKEN.CHECK.LABEL.FAIL control is also enabled. Specifies that ICSF should use the default profile CSF-PKDS-DEFAULT in the CSFKEYS class to determine user access to tokens that are not stored in the PKDS.
Duplicate Key Token Checking controls Prevents applications from storing duplicate tokens in the CKDS or PKDS.	CSF.CKDS.TOKEN.NODUPLICATES	**Activates Key Store Policy for CKDS.** Enables Duplicate Key Token Checking for the CKDS. ICSF will prevent an application from creating a new key record (with a new key label) for a token that is already stored in the CKDS.
	CSF.PKDS.TOKEN.NODUPLICATES	**Activates Key Store Policy for PKDS.** Enables Duplicate Key Token Checking for the PKDS. ICSF will prevent an application from creating a new key record (with a new key label) for a token that is already stored in the PKDS.

Table 5. Key Store Policy controls (continued)

The following Key Store Policy controls:	Consist of the following XFACILIT class resources:	Description:
Granular Key Label Access controls Increases the level of access authority required to create, write to, or delete a key label.	CSF.CSFKEYS.AUTHORITY.LEVELS.WARN	Enables Granular Key Label Access in warning mode. In this mode, a warning will be issued if the user does not have UPDATE authority (if creating a label), or CONTROL authority (if writing to or deleting a label). As long as the user has READ authority, however, ICSF will allow the operation to continue. **Does not require an active Key Store Policy for CKDS or PKDS. However, if a key token is passed to a callable service instead of a key label, ICSF will, in order to initiate a SAF authorization check, rely on an active Key Store Policy for the appropriate key store.**
	CSF.CSFKEYS.AUTHORITY.LEVELS.FAIL	Enables Granular Key Label Access in fail mode. In this mode, ICSF will not allow a key label to be modified if the user does not have UPDATE authority (if creating a label), or CONTROL authority (if writing to or deleting a label). The service returns with an error. **Does not require an active Key Store Policy for CKDS or PKDS. However, if a key token is passed to a callable service instead of a key label, ICSF will, in order to initiate a SAF authorization check, rely on an active Key Store Policy for the appropriate key store.**
Symmetric Key Label Export controls Specifies that profiles in the XCSFKEY class (instead of profiles in the CSFKEYS class) should be used to determine access to AES or DES keys that an application is attempting to export using the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service. This allows you to control access to AES and DES keys for the purpose of key export separately from the access allowed to the keys for other purposes.	CSF.XCSFKEY.ENABLE.AES	Enables Symmetric Key Label Export for AES keys. Specifies that profiles in the XCSFKEY class should determine access to an AES key when an application is attempting to export it using the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service. **Does not require an active Key Store Policy for CKDS or PKDS. However, if a key token is passed to the callable service instead of a key label, ICSF will, in order to initiate the SAF authorization check, rely on an active Key Store Policy for CKDS.**
	CSF.XCSFKEY.ENABLE.DES	Enables Symmetric Key Label Export for DES keys. Specifies that profiles in the XCSFKEY class should determine access to a DES key when an application is attempting to export it using the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service. **Does not require an active Key Store Policy for CKDS or PKDS. However, if a key token is passed to the callable service instead of a key label, ICSF will, in order to initiate the SAF authorization check, rely on an active Key Store Policy for CKDS.**

Table 5. Key Store Policy controls (continued)

The following Key Store Policy controls:	Consist of the following XFACILIT class resources:	Description:
PKA Key Management Extensions control Specifies that the ICSF segment of profiles in the CSFKEYS class (and the XCSFKEY class when a Symmetric Key Label Export control is enabled) will be checked to determine additional restrictions on how keys covered by the profile can be used.	CSF.PKAEXTNS.ENABLE.WARNONLY	**Requires an active Key Store Policy for CKDS and PKDS.** Enables PKA Key Management Extensions in warning mode. The ICSF segment of CSFKEYS or XCSFKEY profiles will be checked to: • determine if a symmetric key can be exported, and, if so, which asymmetric keys can be used in the operation to re-encrypt the symmetric key. • determine if an asymmetric key can be used in secure export and import operations, or in handshake operations. However, because this is warning mode, ICSF will allow the operation to continue even if the ICSF segment indicates that the operation is not allowed.
	CSF.PKAEXTNS.ENABLE	**Requires an active Key Store Policy for CKDS and PKDS.** Enables PKA Key Management Extensions in fail mode. The ICSF segment of CSFKEYS or XCSFKEY profiles will be checked to: • determine if a symmetric key can be exported, and, if so, which asymmetric keys can be used in the operation to re-encrypt the symmetric key. • determine if an asymmetric key can be used in secure export and import operations, or in handshake operations. If the ICSF segment indicates that the operation is not allowed, the service returns with an error.

For more information on the:

- Key Token Authorization Checking controls, refer to “Enabling access authority checking for key tokens”
- Default Key Label Checking controls, refer to “Determining access to tokens not stored in the CKDS or PKDS” on page 58
- Duplicate Key Token Checking controls, refer to “Enabling duplicate key label checking” on page 59
- Granular Key Label Access controls, refer to “Increasing the level of authority needed to modify key labels” on page 60
- Symmetric Key Label Export controls, refer to “Increasing the level of authority required to export symmetric keys” on page 62
- PKA Key Management Extension control, refer to “Controlling how cryptographic keys can be used” on page 64

Enabling access authority checking for key tokens

Profiles in the CSFKEYS class determine access authority to cryptographic keys. However, CSFKEYS profiles protect keys by their key label (discrete or generic CSFKEYS profiles are named to match one or more key labels), and ICSF callable services accept either a key label or key token. By default, if an application passes a callable service a key token instead of a key label, no authorization checking is done on the use of the key. By enabling Key Token Authorization Checking controls, you can have ICSF identify a key token's associated key label so that a SAF authorization check can be performed. This lets you implement a consistent security policy for keys regardless of how they are identified (by key label or key token) to callable services.

Separate Key Token Authorization Checking controls are provided for activating the checking for either a CKDS or a PKDS in either warning or fail mode. In warning mode, authorization checking is performed, but an application will not be prevented from using a token even when the user lacks the necessary authority. Instead, ICSF will merely log an SMF type 82 subtype 25 record in the SMF data set. Warning mode allows you to identify users who will need access permission to a key prior to moving to a stricter implementation of the Key Token Authorization Checking policy.

This stricter implementation of the policy is called fail mode. In fail mode, an application will be denied access to a token when the user does not have authority to access it. The operation will be unsuccessful, and a return code 8, reason code BF7 (3063) will be returned to the calling application. As with warning mode, ICSF will log an SMF type 82 subtype 25 record in the SMF data set. In addition, RACF will log an SMF type 80 record (with event code qualifier of ACCESS). The resource name in the SMF type 80 record will be the first label associated with the key token that failed the check.

Because the same token could be associated with multiple key records in the key store, when an application passes an encrypted key token to an ICSF callable service, ICSF locates all the labels associated with the passed token. If the user has permission to any of the key labels, then the application is granted authority to use the token. Because access authority to any label associated with a token will give a user access to the token, you may want to ensure that the key store does not contain multiple key records for the same key token. ICSF provides a utility program, CSFDUTIL, that generates a report of all duplicate keys for either a CKDS or PKDS. To prevent duplicate keys from being added to a key store, you can enable the Default Key Label Checking control for either the CKDS or PKDS as described in “Enabling duplicate key label checking” on page 59.

If ICSF can not find an associated key label for the passed token in the key store, no authorization checking will be performed on the use of the key unless the Default Key Label Checking control is enabled for the key store. If the Default Key Label Checking control is enabled (as described in “Determining access to tokens not stored in the CKDS or PKDS” on page 58), a default profile will determine user access when ICSF cannot identify an associated label for the passed token.

The following table shows the controls for enabling Key Token Authorization Checking for the CKDS and PKDS in either warning or fail mode. To enable one of the Key Token Authorization Checking controls, create the appropriate profile in the XFACILIT class.

Table 6. Key Store Policy controls: The Key Token Authorization Checking controls

The existence of this resource profile in the XFACILIT class:	**Does this:**
CSF.CKDS.TOKEN.CHECK.LABEL.WARN	**Activates Key Store Policy for CKDS.** Enables Key Token Authorization Checking for the CKDS in warning mode. In this mode, a failing authorization check will result in a warning, but the operation will be allowed to continue.
CSF.CKDS.TOKEN.CHECK.LABEL.FAIL	**Activates Key Store Policy for CKDS.** Enables Key Token Authorization Checking for the CKDS in fail mode. In this mode, ICSF does not allow the operation to continue when the authorization check fails. The service returns with an error.
CSF.PKDS.TOKEN.CHECK.LABEL.WARN	**Activates Key Store Policy for PKDS.** Enables Key Token Authorization Checking for the PKDS in warning mode. In this mode, a failing authorization check will result in a warning, but the operation will be allowed to continue.

Table 6. Key Store Policy controls: The Key Token Authorization Checking controls (continued)

The existence of this resource profile in the XFACILIT class:	Does this:
CSF.PKDS.TOKEN.CHECK.LABEL.FAIL	**Activates Key Store Policy for PKDS.** Enables Key Token Authorization Checking for the PKDS in fail mode. In this mode, ICSF does not allow the operation to continue when the authorization check fails. The service returns with an error.

For example, say you want to enable Key Token Authorization Checking for both a CKDS and a PKDS. You're not certain all the users currently accessing key tokens in these key stores will have the necessary access authority, and do not want to disrupt current work patterns at your installation. For this reason, you decide to allow a warning period during which you can identify users who will need permission to access certain key tokens. The following commands will enable Key Token Authorization Checking for the CKDS and the PKDS in warning mode.

```
RDEFINE XFACILIT CSF.CKDS.TOKEN.CHECK.LABEL.WARN
RDEFINE XFACILIT CSF.PKDS.TOKEN.CHECK.LABEL.WARN
SETROPTS RACLIST(XFACILIT) REFRESH
```

During the warning period, you can, by examining the SMF type 82 subtype 25 records logged in the SMF data set, identify the users who need permission to access keys. You can then create or modify the necessary profiles in the CSFKEYS class. When you are ready to move to a stricter implementation of this policy, you enable the controls for fail mode and disable the ones for warning mode.

```
RDEFINE XFACILIT CSF.CKDS.TOKEN.CHECK.LABEL.FAIL
RDEFINE XFACILIT CSF.PKDS.TOKEN.CHECK.LABEL.FAIL
RDELETE XFACILIT CSF.CKDS.TOKEN.CHECK.LABEL.WARN
RDELETE XFACILIT CSF.PKDS.TOKEN.CHECK.LABEL.WARN
SETROPTS RACLIST(XFACILIT) REFRESH
```

If you accidentally enable the Key Token Authorization Checking controls for both warning and fail mode, the control for fail mode will take precedence.

Determining access to tokens not stored in the CKDS or PKDS

When the Key Token Authorization Checking control for a key store has been enabled, and a token is passed to a callable service, ICSF will find the key label(s) associated with the passed token so that a SAF authority check can be performed. If, however, the token passed to the callable service is not in the key store, there will be no associated key label to find. By default, no authorization checking is performed on the use of the key, and the operation is allowed. If you enable the Default Key Label Checking control for the CKDS or PKDS, however, ICSF will use a default profile to determine user access to tokens that are not in the key store.

Separate controls are provided for enabling Default Key Label Checking for a CKDS or a PKDS, The Default Key Label Checking control will be enabled only if the Key Token Authorization Checking control for the appropriate key store is also enabled. Refer to “Enabling access authority checking for key tokens” on page 56 for more information. To enable one the Default Key Label Checking controls, create the appropriate profile in the XFACILIT class.

Table 7. Key Store Policy controls: The Default Key Label Checking controls

The existence of this resource profile in the XFACILIT class:	Does this:
CSF.CKDS.TOKEN.CHECK.DEFAULT.LABEL	Specifies that ICSF should use the default profile CSF-CKDS-DEFAULT in the CSFKEYS class to determine user access to tokens that are not stored in the CKDS. This control is enabled only if the CSF.CKDS.TOKEN.CHECK.LABEL.WARN or CSF.CKDS.TOKEN.CHECK.LABEL.FAIL control is also enabled.
CSF.PKDS.TOKEN.CHECK.DEFAULT.LABEL	Specifies that ICSF should use the default profile CSF-PKDS-DEFAULT in the CSFKEYS class to determine user access to tokens that are not stored in the PKDS. This control is enabled only if the CSF.PKDS.TOKEN.CHECK.LABEL.WARN or CSF.PKDS.TOKEN.CHECK.LABEL.FAIL control is also enabled.

For example, to enable the Default Key Label Checking control for a CKDS, you would:

1. Create the default profile CSF-CKDS-DEFAULT in the CSFKEYS class.

   ```
   RDEFINE CSFKEYS CSF-CKDS-DEFAULT UACC(NONE)
   ```

2. By defining the universal access authority (UACC) as NONE in the preceding step, the use of key tokens that do not reside in the key store has been prohibited. If necessary, however, you can give appropriate users (preferably groups) access in the CSF-CKDS-DEFAULT profile and refresh the CSFKEYS class in storage:

   ```
   PERMIT CSF-CKDS-DEFAULT CLASS(CSFKEYS) ID(group-id) ACCESS(READ)
   SETROPTS RACLIST(CSFKEYS) REFRESH
   ```

3. Create a profile for the CSF.CKDS.TOKEN.CHECK.DEFAULT.LABEL resource in the XFACILIT class, and refresh the XFACILIT class in storage.

   ```
   RDEFINE XFACILIT CSF.CKDS.TOKEN.CHECK.DEFAULT.LABEL
   SETROPTS RACLIST(XFACILIT) REFRESH
   ```

Enabling duplicate key label checking

A key token could be stored in a key store within multiple key records, and so could be associated with multiple key labels. When the Key Token Authorization Checking control is enabled for the key store, duplicate tokens can cause problems because all labels that are associated with a key token passed to an ICSF callable service will be used to determine user access to that token. Although you may deliberately restrict access to a token by one of the labels associated with it, a user might still have access to the token through another label. You can enable the Duplicate Key Token Checking control for the CKDS or PKDS to prevent applications from storing duplicate tokens in the key store. When enabled, ICSF services that update the key store will check for duplicate tokens. ICSF will not allow a key token to be written to the key store if it matches a token that is already stored. The Duplicate Key Token Checking controls do not rely on SAF authorization checks against CSFKEYS class profiles. Instead, the callable services that update the key store will verify that a duplicate token does not already exist within the key store.

Note: Enabling the Duplicate Key Token Checking control for the CKDS or PKDS ensures only that no duplicate keys are added to the key store. To identify any duplicate key tokens that may already exist in a CKDS or PKDS, use the CSFDUTIL utility program. The CSFDUTIL utility program generates a report of all duplicate keys in either a CKDS or a PKDS.

Separate controls are provided for enabling Duplicate Key Token Checking for a CKDS or a PKDS. To enable either of the Duplicate Key Token Checking controls, create the appropriate profile in the XFACILIT class.

Table 8. Key Store Policy controls: The Duplicate Key Token Checking controls

The existence of this resource profile in the XFACILIT class:	Does this:
CSF.CKDS.TOKEN.NODUPLICATES	**Activates Key Store Policy for CKDS.** Enables Duplicate Key Token Checking for the CKDS. ICSF will prevent an application from creating a new key record (with a new key label) for a token that is already stored in the CKDS.
CSF.PKDS.TOKEN.NODUPLICATES	**Activates Key Store Policy for PKDS.** Enables Duplicate Key Token Checking for the PKDS. ICSF will prevent an application from creating a new key record (with a new key label) for a token that is already stored in the PKDS.

For example, to ensure that duplicate tokens are not stored in either the CKDS or PKDS, you would enter the following commands:

```
RDEFINE XFACILIT CSF.CKDS.TOKEN.NODUPLICATES
RDEFINE XFACILIT CSF.PKDS.TOKEN.NODUPLICATES
SETROPTS RACLIST(XFACILIT) REFRESH
```

Increasing the level of authority needed to modify key labels

A number of ICSF callable services enable an application to create, write to, or delete a key label. By default, the user needs only READ authority to read from, create, write to, or delete a label. In some cases, however, you might want to require a higher level of authority for modifying a label than is required to merely read a label. By enabling the Granular Key Label Access control, you increase the level of access authority required to create, write to, or delete a label, while still requiring only READ authority for cryptographic functions. This way, you can give a user permission to access a key for encryption or decryption operations, while preventing that same user from changing or deleting the key record.

The following table outlines the increased access authority required when the Granular Key Label Access control is enabled.

Table 9. Increased access authority required to modify key labels when Granular Key Label Access control is enabled

To do this:	The level of access authority required is increased from READ to:	This impacts the following callable services:
Create a label	UPDATE	Key Record Create / Key Record Create2 PKDS Record Create
Write to a label	CONTROL	Key Part Import / Key Part Import2 Key Record Create2 Key Record Write / Key Record Write2 PKDS Record Create PKDS Record Write PKA Key Generate PKA Key Import Trusted Block Create
Delete a label	CONTROL	Key Record Delete PKDS Record Delete Retained Key Delete

You can enable the Granular Key Label Access control in warning or fail mode. In warning mode, the user's access authority will be checked, but only READ authority will be required. However, if a user does not have UPDATE authority when creating a label, or CONTROL authority when writing to or deleting a label, a warning will be issued and the access will be logged. Warning mode allows you to identify any users who will need to be granted increased access authority prior to moving to a stricter implementation of the policy. The stricter implementation of the policy is called fail mode. In fail mode, users who lack the increased access authority required will not be able to modify key labels. The operation will be unsuccessful, and a return code of 8 (reason code 16004) will be returned to the calling application.

It is recommended that you activate Key Store Policy for both the CKDS and the PKDS before enabling the Granular Key Label Access control. If Key Store Policy is not activated and the Granular Key Label Access control is enabled, the increased access authority checks will work only when the application passes a callable service a key label. However, if the application were to pass the callable service a key token instead of a key label, then no authorization checking will be performed. When a token is passed, ICSF will, in order to initiate a SAF authorization check, rely on an active Key Store Policy for the appropriate key store.

Enabling any one of the following controls will activate Key Store Policy for a CKDS:

- CSF.CKDS.TOKEN.CHECK.LABEL.WARN
- CSF.CKDS.TOKEN.CHECK.LABEL.FAIL
- CSF.CKDS.TOKEN.NODUPLICATES

Enabling any one of the following controls will activate Key Store Policy for a PKDS:

- CSF.PKDS.TOKEN.CHECK.LABEL.WARN
- CSF.PKDS.TOKEN.CHECK.LABEL.FAIL
- CSF.PKDS.TOKEN.NODUPLICATES

The following table shows the controls for enabling Granular Key Label Access in warning or fail mode. To enable one of the controls, create the appropriate profile in the XFACILIT class.

Table 10. Key Store Policy controls: The Granular Key Label Access controls

The existence of this resource profile in the XFACILIT class:	**Does this:**
CSF.CSFKEYS.AUTHORITY.LEVELS.WARN	Enables Granular Key Label Access in warning mode. In this mode, a warning will be issued if the user does not have UPDATE authority if creating a label, or CONTROL authority if writing to or deleting a label. As long as the user has READ authority, however, ICSF will allow the operation to continue.
CSF.CSFKEYS.AUTHORITY.LEVELS.FAIL	Enables Granular Key Label Access in fail mode. In this mode, ICSF will not allow a key label to be modified if the user does not have UPDATE authority if creating a label, or CONTROL authority if writing to or deleting a label. The service returns with an error.

For example, you want to require UPDATE authority to create a label, and CONTROL authority to write to or delete a label. You're not certain all the users currently modifying key labels will have the necessary access authority, and do not want to disrupt current work patterns at your installation. For this reason, you decide to allow a warning period during which you can identify which users will need to be granted increased authority. To do this, you would:

1. Enable the Granular Key Label Access control in warning mode.

   ```
   RDEFINE XFACILIT CSF.CSFKEYS.AUTHORITY.LEVELS.WARN
   SETROPTS RACLIST(XFACILIT) REFRESH
   ```

2. Because you have enabled the control in warning mode, a failing access check will still allow a user to modify the key record (as long as the user has READ authority), but will issue a warning and log the access. Using this information, you can update the appropriate profiles in the CSFKEYS class to grant increased access authority to the appropriate users. For example, if user RITA needs to be able to generate RSA key tokens (by way of the CSNDKRC and CSNDPKG callable services), she will need CONTROL access to the label:

   ```
   PERMIT RITA.RSA.TEST.* CLASS(CSFKEYS) ID(RITA) ACCESS(CONTROL)
   ```

3. When you are ready to move to a stricter implementation of the policy, you would enable the control for fail mode and disable the one for warning mode.

   ```
   RDEFINE XFACILIT CSF.CKDS.TOKEN.CHECK.LABEL.FAIL
   RDELETE XFACILIT CSF.CKDS.TOKEN.CHECK.LABEL.WARN
   SETROPTS RACLIST(XFACILIT) REFRESH
   ```

If you accidentally enable the Granular Key Label Access controls for both warning and fail mode, the control for fail mode will take precedence.

Increasing the level of authority required to export symmetric keys

Using the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service, an application can transfer a symmetric (AES or DES) key from encryption under a master key to encryption under an application-supplied RSA public key. This callable service is used because a secure key (which is encrypted under a master key in the ICSF environment) might need to be shared with a partner, and to transfer it to that partner securely, it will need to be encrypted under an RSA key provided by the partner. The partner will then be able to decrypt it using a corresponding private key.

The export operation performed by the Symmetric Key Export callable service does not fit into a traditional access control hierarchy. Due to the nature of the export operation, you might want to restrict users from accessing a symmetric key for the purpose of exporting it, while still allowing users to access the key for other purposes. By enabling the Symmetric Key Label Export control for AES or DES keys, and creating profiles in the XCSFKEY resource class, you can increase the level of access authority needed to export AES or DES keys without increasing the level of authority needed to access the keys for other operations.

By default, the CSFKEYS class determines access authority to cryptographic keys passed to callable services (including the CSNDSYX/CSNFSYX callable service). When the Symmetric Key Label Export control for AES or DES keys is **not** enabled and the CSNDSYX or CSNFSYX service is called, a user needs only READ authority for the key (as specified in a CSFKEYS class profile). If, however, the Symmetric Key Label Export control for AES or DES keys **is** enabled and the CSNDSYX or CSNFSYX service is called, then a user needs UPDATE authority for the key (as specified in an XCSFKEY class profile). The Symmetric Key Label Export controls affect only the CSNDSYX/CSNFSYX callable service; for all other callable services, access to cryptographic keys is checked against profiles in the CSFKEYS class. What's more, the Symmetric Key Label Export controls affect access only to the symmetric key the application is attempting to export, and do not affect access to the RSA key that is being used to re-encrypt the symmetric key. Access authority to the AES or DES key will be checked against XCSFKEY class profiles, while access to the RSA key will still be checked against CSFKEYS class profiles.

It is recommended that you activate Key Store Policy for the CKDS before enabling the Symmetric Key Label Export control for AES or DES keys. If Key Store Policy is not activated for the CKDS and the Symmetric Key Label Export control for AES or DES keys is enabled, the access authority check for the symmetric key will be performed only when it is identified to the CSNDSYX or CSNFSYX callable service by its key label. If the application were to pass the callable service a key token instead of a key label, then no authorization checking will be performed. When a token is passed, ICSF will, in order to initiate a SAF authorization check, rely on an active Key Store Policy for CKDS. Enabling any one of the following controls will activate Key Store Policy for a CKDS:

- CSF.CKDS.TOKEN.CHECK.LABEL.WARN
- CSF.CKDS.TOKEN.CHECK.LABEL.FAIL
- CSF.CKDS.TOKEN.NODUPLICATES

The following table shows the controls for enabling Symmetric Key Label Export for AES or DES keys. To enable the controls, create the appropriate profile in the XFACILIT class. There are separate Symmetric Key Label Export controls for AES and DES keys, so you can require UPDATE authority (which will be checked against XCSFKEY profiles) for export of one type of key, while still requiring only READ authority (which will still be checked against CSFKEY profiles) for export of the other type of key. There are no Symmetric Key Label Export controls that enable the policy in a warning mode. However, you can use the WARNING operand on XCSFKEY profiles to achieve the same results.

Table 11. Key Store Policy controls: The Symmetric Key Label Export controls

The existence of this resource profile in the XFACILIT class:	**Does this:**
CSF.XCSFKEY.ENABLE.AES	Enables Symmetric Key Label Export for AES keys. Specifies that profiles in the XCSFKEY class should determine access to an AES key when an application is attempting to export it using the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service.
CSF.XCSFKEY.ENABLE.DES	Enables Symmetric Key Label Export for DES keys. Specifies that profiles in the XCSFKEY class should determine access to a DES key when an application is attempting to export it using the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service.

For example, you want to require UPDATE authority to export any symmetric key (AES or DES) using the Symmetric Key Export callable service. You're not certain all the users currently exporting symmetric keys will have the necessary access authority, and do not want to disrupt current work patterns at your installation. For this reason, you decide to allow a warning period during which you can identify which users will need to be granted increased authority. To do this, you would:

1. Create profiles in the XCSFKEY class to cover the symmetric keys. In this example, your installation has a consistent naming policy for AES and DES key labels, so the following two generic profiles will cover all symmetric keys. The WARNING operand is specified to initiate the warning period.

   ```
   RDEFINE XCSFKEY AES* UACC(NONE) WARNING
   RDEFINE XCSFKEY DES* UACC(NONE) WARNING
   ```

   The XCSFKEY class will need to be activated and placed in common storage:

   ```
   SETROPTS CLASSACT(XCSFKEY)
   SETROPTS RACLIST(XCSFKEY)
   ```

2. Enable the Symmetric Key Label Export control for AES and DES. In this example, we enable both controls so that UPDATE authority is required when exporting any symmetric key.

   ```
   RDEFINE CSF.XCSFKEY.ENABLE.AES
   RDEFINE CSF.XCSFKEY.ENABLE.DES
   ```

3. Because the WARNING operand was specified on the generic profiles AES* and DES*, any failing access check will still allow access to the symmetric key, but will issue a warning message and log the access. Using this information, you can grant UPDATE access to users or groups as needed. Since the generic profiles in our example cover all AES and all DES keys, you may need to create other generic profiles or discrete profiles to limit access for certain users. Here, user BOBADMIN is given UPDATE access to all symmetric keys, while user GWEN is given UPDATE access to the key labeled DES.BURDA.MEDINC.

   ```
   PERMIT AES* CLASS(XCSFKEY) ID(BOBADMIN) ACCESS(UPDATE)
   PERMIT DES* CLASS(XCSFKEY) ID(BOBADMIN) ACCESS(UPDATE)
   RDEFINE XCSFKEY DES.BURDA.MEDINC UACC(NONE)
   PERMIT DES.BURDA.MEDINC CLASS(XCSFKEY) ID(GWEN) ACCESS(UPDATE)
   ```

   The XCSFKEY class will need to be refreshed in common storage:

   ```
   SETROPTS RACLIST(XCSFKEY) REFRESH
   ```

4. When you are ready to move to a stricter implementation of the policy, you can end the warning period. To do this, update the necessary profiles in the XCSFKEY class using the RALTER command with its NOWARNING operand.

   ```
   RALTER XCSFKEY AES* UACC(NONE) NOWARNING
   RALTER XCSFKEY DES* UACC(NONE) NOWARNING
   ```

   The XCSFKEY class will need to be refreshed in common storage:

   ```
   SETROPTS RACLIST(XCSFKEY) REFRESH
   ```

Controlling how cryptographic keys can be used

In addition to using profiles in the CSFKEYS class (and, when Symmetric Key Label Export is enabled, the XCSFKEY class) to identify which users have permission to certain cryptographic keys, you can also enable the PKA Key Management Extensions control so that CSFKEYS and XCSFKEY profiles can place restrictions on how keys are used. For example, you can:

- restrict an asymmetric key from being used in secure export and import operations.
- restrict an asymmetric key from being used in handshake operations.
- Restrict a symmetric key from being exported (transferred from encryption under a master key to encryption under an application-supplied RSA public key). Alternatively, you can allow the symmetric key to be exported, but only by certain public keys (as indicated by a list of key labels), or only by public keys bound to certain identities (as indicated by a list of certificates in either a PKCS #11 token, or a SAF key ring).

Setting restrictions such as these can help ensure that keys are used only for intended purposes, regardless of who has access to the keys. For example, if you have an RSA key pair intended only for generating and verifying digital signatures, you can set a restriction to ensure that the public key of this key pair is never used to export a symmetric key.

You place restrictions on cryptographic keys using the ICSF segment of the CSFKEYS or XCSFKEY class profiles that cover the keys. After you have modified the profiles with the restrictions you want to place on the keys, you can enable the PKA Key Management Extensions control by creating a CSF.PKAEXTNS.ENABLE

profile in class XFACILIT. You can also enable PKA Key Management Extensions in warning mode by creating a CSF.PKAEXTNS.ENABLE.WARNONLY profile in class XFACILIT. In order to enable PKA Key Management Extensions, Key Store Policy must be active for both the CKDS and the PKDS. For more information, refer to "Enabling PKA Key Management Extensions" on page 72.

Restricting asymmetric keys from being used in secure import and export operations

Using the ASYMUSAGE field in the ICSF segment of CSFKEYS profiles enables you to restrict asymmetric keys covered by the profile from being used in secure import and export operations. In secure export operations, a symmetric key (AES or DES) is moved from encryption under a master key to encryption under an asymmetric key (RSA public key). In a secure import operation, the private key of an RSA key pair is used to move a symmetric key from encryption under the RSA public key to encryption under a master key. The following callable services all identify an asymmetric key (either the public or private key of an RSA key pair) to encrypt or decrypt a symmetric key. The callable services that perform secure import and export operations are:

- Symmetric Key Generate (CSNDSYG and CSNFSYG)
- Symmetric Key Export (CSNDSYX and CSNFSYX)
- Symmetric Key Import (CSNDSYI and CSNFSYI) and Symmetric Key Import2 (CSNDSYI2 and CSNFSYI2)

For each of these services, a profile in the CSFKEYS class will control access to the asymmetric key. In addition to specifying user access to the key, the CSFKEYS profile can also specify information (in the ICSF segment of the profile) on how the key can be used. The ASYMUSAGE field of the ICSF segment enables you to specify whether an asymmetric key covered by the profile can participate in secure import or export operations. By specifying the NOSECUREEXPORT keyword in the ASYMUSAGE field, you restrict any asymmetric key covered by the profile from being used to encrypt or decrypt the symmetric key in these operations.

For example, the profile RSA.SAMMY.DIGSIG in class CSFKEYS covers an RSA key pair that should be used only for generating and verifying digital signatures and performing TLS/SSL handshakes. The following RALTER command modifies the profile to ensure that the public key of the RSA key pair is never used to export keys. The SETROPTS RACLIST command is used to refresh the profile in common storage.

```
RALTER CSFKEYS RSA.SAMMY.DIGSIG ICSF(ASYMUSAGE(NOSECUREEXPORT))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

In order for the secure import/export restriction to take effect, you will need to enable the PKA Key Management Extensions control by creating a CSF.PKAEXTNS.ENABLE profile in class XFACILIT. In order to enable the PKA Key Management Extensions control, the Key Store Policy for both the CKDS and the PKDS must also be active. Refer to "Enabling PKA Key Management Extensions" on page 72 for more information.

When the PKA Key Management Extensions control is enabled, the default is to allow keys to participate in secure import and export operations. You can also explicitly specify this using the SECUREEXPORT keyword in the ASYMUSAGE field of a CSFKEYS profile. For example:

```
RALTER CSFKEYS RSA.SAMMY.EXPORT ICSF(ASYMUSAGE(SECUREEXPORT))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

The ASYMUSAGE field can also contain the NOHANDSHAKE or HANDSHAKE keywords to specify whether keys covered by the profile can participate in handshake operations (as described in "Restricting asymmetric keys from being used in handshake operations"). These keywords can be specified along with the NOSECUREEXPORT or SECUREEXPORT keywords when entering the RDEFINE or RALTER command.

```
RALTER CSFKEYS RSA.SAMMY.EXPORT ICSF(ASYMUSAGE(SECUREEXPORT NOHANDSHAKE))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

Restricting asymmetric keys from being used in handshake operations

Using the ASYMUSAGE field in the ICSF segment of CSFKEYS profiles enables you to restrict asymmetric keys covered by the profile from being used in handshake operations. The following callable services all identify an asymmetric key to be used in a handshake operation. The callable services that perform handshake operations are:

- Digital Signature Generate (CSNDDSG and CSNFDSG)
- Digital Signature Verify (CSNDDSV and CSNFDSV)
- PKA Encrypt (CSNDPKE and CSNFPKE)
- PKA Decrypt (CSNDPKD and CSNFPKD)

For each of these services, a profile in the CSFKEYS class will control access to the asymmetric key used to generate/verify a digital signature, or encrypt/decrypt a clear key value. In addition to specifying user access to the key, the CSFKEYS profile can also specify information (in the ICSF segment of the profile) on how the key can be used. The ASYMUSAGE field of the ICSF segment enables you to specify whether an asymmetric key covered by the profile can participate in handshake operations. By specifying the NOHANDSHAKE keyword in the ASYMUSAGE field, you restrict any key covered by the profile from being used in handshake operations. For example, the profile RSA.SAMMY.EXPORT in class CSFKEYS covers an RSA key pair intended for exporting and importing symmetric keys. The following RALTER command modifies the profile to ensure that the RSA keys are not used in handshake operations. The SETROPTS RACLIST command is used to refresh the profile in common storage.

```
RALTER CSFKEYS RSA.SAMMY.EXPORT ICSF(ASYMUSAGE(NOHANDSHAKE))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

In order for the restriction on handshake operations to take effect, you will need to enable the PKA Key Management Extensions control by creating a CSF.PKAEXTNS.ENABLE profile in class XFACILIT. In order to enable the PKA Key Management Extensions control, the Key Store Policy for both the CKDS and the PKDS must also be active. Refer to "Enabling PKA Key Management Extensions" on page 72 for more information.

When the PKA Key Management Extensions control is enabled, the default is to allow keys to participate in handshake operations. You can also explicitly specify this using the HANDSHAKE keyword in the ASYMUSAGE field of profiles in the CSFKEYS class. For example:

```
RALTER CSFKEYS RSA.SAMMY.EXPORT ICSF(ASYMUSAGE(HANDSHAKE))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

The ASYMUSAGE field can also contain the NOSECUREEXPORT or SECUREEXPORT keywords to specify whether keys covered by the profile can participate in secure import and export operations (as described in "Restricting asymmetric keys from being used in secure import and export operations" on page 65

65). These keywords can be specified along with the NOHANDSHAKE or HANDSHAKE keywords when entering the RDEFINE or RALTER command.

```
RALTER CSFKEYS RSA.SAMMY.EXPORT ICSF(ASYMUSAGE(NOSECUREEXPORT HANDSHAKE))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

Placing restrictions on exporting symmetric keys

The Symmetric Key Export (CSNDSYX or CSNFSYX) callable service lets a calling application transfer a symmetric (AES or DES) key from encryption under a master key to encryption under an application-supplied RSA public key. This callable service is needed because a secure key (which is encrypted under a master key in the ICSF environment) might need to be shared with a partner, and to transfer it to that partner securely, it will need to be encrypted under an RSA key provided by the partner. The partner will then be able to decrypt it using a corresponding private key. Due to the nature of the operation performed by the Symmetric Key Export callable service, you may want to place additional restrictions on its use. “Increasing the level of authority required to export symmetric keys” on page 62 describes how you can enable the Symmetric Key Label Export controls to specify that a user needs UPDATE authority in the XCSFKEY class (instead of the default READ authority in the CSFKEYS class) to export a symmetric key. By enabling the PKA Key Management Extensions control, can also specify that a symmetric key covered by a CSFKEYS or XCSFKEY profile:

- cannot be exported.
- can be exported by any asymmetric key in the PKDS
- can be exported only by certain asymmetric keys in the PKDS (as specified by a supplied list).
- can be exported by any asymmetric key, provided it is bound to an identity in a key certificate in a trusted certificate repository (either a PKCS #11 token or a SAF key ring).
- can be exported only by an asymmetric key that is bound to certain identities (as specified by a supplied list of key certificates in a trusted certificate repository).

When an application calls the CSNDSYX or CSNFSYX service, access to the symmetric key (the AES or DES key to be re-encrypted) is determined by a profile in the CSFKEYS class or, if the Symmetric Key Label Export control has been enabled, the XCSFKEY class. In addition to specifying user access to the key, the CSFKEYS or XCSFKEY profile can also place restrictions (in the ICSF segment of the profile) on export of the symmetric key. In the ICSF segment of a CSFKEYS or XCSFKEY profile, the SYMEXPORTABLE field contains a keyword that determines if the key can be exported, and, if so, how ICSF will determine the asymmetric keys (the RSA public keys) that can export (re-encrypt) the key.

Table 12. Keyword settings for symmetric key export using the ICSF segment's SYMEXPORTABLE field

This field/keyword	Specifies:
SYMEXPORTABLE(BYNONE)	The symmetric key can not be exported.
SYMEXPORTABLE(BYLIST)	The symmetric key can be exported, but only by certain RSA public keys in the PKDS (as specified by a supplied list), or only by RSA public keys bound to certain identities (as specified by a supplied list of key certificates). • To supply a list of RSA public keys in the PKDS that can export the symmetric key, you use the SYMEXPORTKEYS field on the ICSF segment. You can list the RSA public keys by label, or you can use a special character setting in this field to specify that any RSA public key in the PKDS can export the symmetric key. • To supply a list a key certificates, you use the SYMEXPORTCERTS field of the ICSF segment. You can list the certificates by label, or you can use a special character setting in this field to specify that any RSA public key bound to an identity in any certificate in the repository can export the symmetric key.

Table 12. Keyword settings for symmetric key export using the ICSF segment's SYMEXPORTABLE field (continued)

This field/keyword	Specifies:
SYMEXPORTABLE(BYANY)	There are no additional restrictions placed on export of the key. Provided no other access requirement or control prevents it, the symmetric key can be exported by any asymmetric key. This is the default.

- For more information on the BYNONE keyword, refer to "Restricting the symmetric key from being exported."
- For more information on using the BYLIST keyword and the SYMEXPORTKEYS field, refer to "Identifying RSA public keys that can export the symmetric key."
- For more information on using the BYLIST keyword and the SYMEXPORTCERTS field, refer to "Identifying key certificates for symmetric key export" on page 69.
- For more information on the BYANY keyword, refer to "Placing no additional restrictions on symmetric key export" on page 71.

Restricting the symmetric key from being exported: CSFKEYS and XCSFKEY profiles can contain an ICSF segment. Fields of the ICSF segment specify rules for key use. In the SYMEXPORTABLE field of the ICSF segment, the BYNONE keyword specifies that the symmetric key(s) covered by the profile can not be exported, regardless of a user's access authority to the key. If an application attempts to use the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service to transfer a symmetric (AES or DES) key covered by the profile, the operation will fail and the service will return an error.

For example, the CKDS contains a DES key labeled DES.BRADY.CASTLE that should never be exported. The Symmetric Key Label Export control for DES keys has not been enabled, so the key is covered by a profile in the CSFKEYS class. The following RALTER command modifies the discrete profile DES.BRADY.CASTLE to indicate that the key should never be exported. The SETROPTS RACLIST command is used to refresh the profile in common storage.

```
RALTER CSFKEYS DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYNONE))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

Identifying RSA public keys that can export the symmetric key: CSFKEYS and XCSFKEY profiles can contain an ICSF segment. Fields of the ICSF segment specify rules for key use. In the SYMEXPORTABLE field of the ICSF segment, the BYLIST keyword specifies that the symmetric key(s) covered by the profile can be exported by keys identified using the SYMEXPORTKEYS or SYMEXPORTCERTS fields.

Using the SYMEXPORTKEYS field, you can list the RSA public keys in the PKDS that are allowed to export the symmetric key. The SYMEXPORTKEYS list consists of one or more PKDS key labels identifying the RSA public keys under which the symmetric key can be re-encrypted. These labels follow the normal ICSF label conventions; they can be space separated, and quotes are optional.

Note: Key Store Policy must be active in order for the PKA Key Management Extensions to be enabled. Because Key Store Policy for the PKDS is active, ICSF knows the key label(s) associated with each key token. Tokens associated with multiple labels are considered equivalent. Be aware that as long as one of the labels associated with the token appears in the SYMEXPORTKEYS list, the RSA public key can export symmetric key.

A special key label is the asterisk character (*). If the SYMEXPORTKEYS field contains this special key label, any RSA public key in the PKDS can export the symmetric key (provided no other access requirement or control prevents it).

If an application attempts to use the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service to transfer a symmetric (AES or DES) key covered by the profile, ICSF will compare the RSA public key identified by the application with those identified in the SYMEXPORTKEYS list. If the key is in the list, the operation is allowed to continue. If it is not in the list, and is also not bound to an identity in a certificate listed in the SYMEXPORTCERTS field (as described in "Identifying key certificates for symmetric key export"), the operation will fail and the service will return an error.

For example, the following RALTER command modifies the discrete profile DES.BRADY.CASTLE so that the DES key it covers can be exported only by the RSA public key RSA.BRADY.CASTLE. In this example, the Symmetric Key Label Export control has been enabled for DES keys, so the DES.BRADY.CASTLE profile is defined in the XCSFKEY class. The SETROPTS RACLIST command is used to refresh the profile in common storage.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYLIST) SYMEXPORTKEYS(RSA.BRADY.CASTLE))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

To instead allow any RSA public key in the PKDS to export the symmetric key covered by the DES.BRADY.CASTLE profile, you would specify the asterisk character (*) in the SYMEXPORTKEYS field.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYLIST) SYMEXPORTKEYS(*))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

The ADDSYMEXPORTKEYS keyword of the ICSF segment enables you to add labels to a SYMEXPORTKEYS list without having to recreate the entire list. For example, to add the label RSA.BKNIGHT.CASTLE to the list, you would enter:

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(ADDSYMEXPORTKEYS(RSA.BKNIGHT.CASTLE))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Similarly, you can delete labels from a SYMEXPORTKEYS list using the DELSYMEXPORTKEYS keyword:

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(DELSYMEXPORTKEYS(RSA.BKNIGHT.CASTLE))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

You can also delete the entire SYMEXPORTKEYS field using the NOSYMEXPORTKEYS keyword.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(NOSYMEXPORTKEYS)
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Identifying key certificates for symmetric key export: CSFKEYS and XCSFKEY profiles can contain an ICSF segment. Fields of the ICSF segment specify rules for key use. In the SYMEXPORTABLE field of the ICSF segment, the BYLIST keyword specifies that the symmetric key(s) covered by the CSFKEYS or the XCSFKEY profile can be exported by keys identified using the SYMEXPORTKEYS or SYMEXPORTCERTS fields.

Using the SYMEXPORTCERTS field, you can supply a list of certificate labels in a trusted certificate repository (either a PKCS #11 token or a SAF key ring). As described in "Enabling PKA Key Management Extensions" on page 72, you enable the PKA Key Management Extensions control by creating a CSF.PKAEXTNS.ENABLE profile in class XFACILIT. You can use the APPLDATA

field in that profile to identify the type and name of the trusted certificate repository. If the APPLDATA field is not used to provide this information, the default certificate repository is a PKCS #11 token named CSF.TRUSTED.KEYRING. The format of the SYMEXPORTCERTS field depends on whether the trusted certificate repository is a PKCS #11 token or a SAF key ring.

- If the trusted certificate repository is a PKCS #11 token, the certificate labels are listed in the format '*cka-id*/*cert-label*', where:

  cka-id is the CKA_ID attribute of the certificate object. This portion of the specification is optional, and only necessary if multiple certificate objects have the same CKA_LABEL. If provided, RACF will convert this portion of the specification into uppercase before storing it in the profile.

  /*cert-label*
  is the CKA_LABEL attribute of the certificate object. Note that the forward slash character (/) is required even if the optional *cka-id* portion of the specification is omitted. If this portion of the specification contains blank characters, the entire specification must be enclosed in single quotes.

- If the trusted certificate repository is a SAF key ring, the certificate labels are listed in the format '*userID*/*cert-label*', where:

  userID is the owner of the certificate. This portion of the specification is optional, and only necessary if multiple certificates have the same label. If provided, RACF will convert this portion of the specification into uppercase before storing it in the profile.

  /*cert-label*
  is the label of the digital certificate that was assigned when the certificate was created. Note that the forward slash character (/) is required even if the optional *userID* portion of the specification is omitted. If this portion of the specification contains blank characters, the entire specification must be enclosed in single quotes.

Regardless of whether you are using a PKCS #11 token or a SAF key ring, you can also use the asterisk character (*) in the SYMEXPORTCERTS field to match any certificate in the trusted certificate repository. Using the asterisk character in the SYMEXPORTCERTS field is the same as listing all the certificates in the trusted certificate repository.

If an application attempts to use the Symmetric Key Export (CSNDSYX or CSNFSYX) callable service to transfer a symmetric (AES or DES) key covered by the profile, ICSF will compare the RSA public key identified by the application with those bound to identities in certificates in the SYMEXPORTCERTS list. If any of the listed certificates contains the RSA public key, the operation is allowed to continue. If none of the listed certificates contain the public key, and the key is also not listed in the SYMEXPORTKEYS field (as described in “Identifying RSA public keys that can export the symmetric key” on page 68), the operation will fail and the service will return an error.

For example, say you want to allow export of a the symmetric key DES.BRADY.CASTLE only by the user and public key bound by a certificate in a SAF key ring. The SAF key ring was identified to ICSF when the PKA Key Management Extensions control was enabled (using the APPLDATA field of the CSF.PKAEXTNS.ENABLE profile). The label of the digital certificate in the SAF key ring is "Mister Ink", and the discrete profile covering the key has already been defined in the XCSFKEY class. The following RALTER command specifies that the

only RSA public key that can export the symmetric key is the one bound to the identity in the "Mister Ink" certificate. The SETROPTS RACLIST command is used to refresh the profile in common storage.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYLIST) SYMEXPORTCERTS('/Mister Ink'))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

The preceding example assumes that no other certificates have the same label. If other certificates do have the same label, you would want to include the user ID of the certificate owner in the SYMEXPORTCERTS list specification. For example, if the user BKNIGHT is the certificate owner, you would enter:

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYLIST) SYMEXPORTCERTS('BKNIGHT/Mister Ink'))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

You can also use the asterisk character (*) in the SYMEXPORTCERT field to match any certificate in the certificate repository.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYLIST) SYMEXPORTCERTS(*))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

The ADDSYMEXPORTCERTS keyword of the ICSF segment enables you to add certificate labels to a SYMEXPORTCERTS list without having to recreate the entire list. For example, to add the certificate 'SERRIN/Mister Ink' to the list of certificate labels, you would enter:

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(ADDSYMEXPORTCERTS('SERRIN/Mister Ink'))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Similarly, you can delete certificate labels from a SYMEXPORTCERTS list using the DELSYMEXPORTCERTS keyword:

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(DELSYMEXPORTCERTS('BKNIGHT/Mister Ink'))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

You can also delete the entire SYMEXPORTCERTS field using the NOSYMEXPORTCERTS keyword.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(NOSYMEXPORTCERTS)
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Placing no additional restrictions on symmetric key export: If no keyword value is specified in the ICSF segment's SYMEXPORTABLE field, then, by default, no additional restrictions are placed on the export of symmetric keys covered by the profile. Provided no other access requirement or control prevents it, the symmetric key can be exported by any RSA public key. Although this is the default behavior, you can also explicitly specify it using the BYANY keyword. You might want to do this, for example, if you had previously specified the BYNONE or BYLIST keyword in the SYMEXPORTABLE field, and now want to return to the default behavior.

For example, to specify that there are no restrictions on the export of the symmetric key covered by the profile DES.BRADY.CASTLE in the XCSFKEY class, and that any RSA key can be used in the export operation (provided the user has access permission to the key), you could enter the following RALTER command. The SETROPTS RACLIST command is used to refresh the profile in common storage.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYANY))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

You can also return to the default behavior by deleting the entire SYMEXPORTABLE field using the NOSYMEXPORTABLE keyword.

```
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(NOSYMEXPORTABLE)
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Enabling PKA Key Management Extensions

The rules for cryptographic key usage defined in the ICSF segment of CSFKEYS and XCSFKEY profiles (described in “Restricting asymmetric keys from being used in secure import and export operations” on page 65, “Restricting asymmetric keys from being used in handshake operations” on page 66, and “Placing restrictions on exporting symmetric keys” on page 67) will not be in effect unless PKA Key Management Extensions are enabled. PKA Key Management Extensions cannot be enabled unless Key Store Policy is active for both the CKDS and PKDS.

Enabling any one of the following controls will activate Key Store Policy for a CKDS:

- CSF.CKDS.TOKEN.CHECK.LABEL.WARN
- CSF.CKDS.TOKEN.CHECK.LABEL.FAIL
- CSF.CKDS.TOKEN.NODUPLICATES

Enabling any one of the following controls will activate Key Store Policy for a PKDS:

- CSF.PKDS.TOKEN.CHECK.LABEL.WARN
- CSF.PKDS.TOKEN.CHECK.LABEL.FAIL
- CSF.PKDS.TOKEN.NODUPLICATES

The following table shows the controls for enabling PKA Key Management Extensions in either warning or fail mode. To enable one of the controls, create the appropriate profile in the XFACILIT class.

Table 13. Key Store Policy controls: The PKA Key Management Extensions controls

The existence of this resource profile in the XFACILIT class:	**Does this:**
CSF.PKAEXTNS.ENABLE.WARNONLY	Enables PKA Key Management Extensions in warning mode. The ICSF segment of CSFKEYS or XCSFKEY profiles will be checked to: • determine if a symmetric key can be exported, and, if so, which asymmetric keys can be used in the operation to re-encrypt the symmetric key. • determine if an asymmetric key can be used in secure export and import operations, or in handshake operations. However, because this is warning mode, ICSF will allow the operation to continue even if the ICSF segment indicates that the operation is not allowed.
CSF.PKAEXTNS.ENABLE	Enables PKA Key Management Extensions in fail mode. The ICSF segment of CSFKEYS or XCSFKEY profiles will be checked to: • determine if a symmetric key can be exported, and, if so, which asymmetric keys can be used in the operation to re-encrypt the symmetric key. • determine if an asymmetric key can be used in secure export and import operations, or in handshake operations. If the ICSF segment indicates that the operation is not allowed, the service returns with an error.

For example, you've already used the ICSF segment of profiles in the CSFKEYS or XCSFKEY class to define various restrictions on how keys covered by the profiles can be used. You're not certain that all applications at your installation are using the keys according to the new restrictions, and do not want to disrupt current work patterns at your installation. For this reason, you decide to allow a warning period during which you can identify noncompliant applications without causing application failure. To do this, you would:

1. Enable PKA Key Management Extensions in warning mode:

```
RDEFINE XFACILIT CSF.PKAEXTNS.ENABLE.WARNONLY
SETROPTS RACLIST(XFACILIT) REFRESH
```

2. Because you have enabled PKA Key Management Extensions in warning mode, ICSF will allow applications to use keys in ways that violate ICSF segment specifications. However, ICSF will generate SMF type 82 subtype 27 records for any violation. Using the information in these records, you can modify your installation's applications as needed.
3. When you are ready to move to a stricter implementation of the policy, you enable the PKA Key Management Extensions control for fail mode, and disable the one for warning mode.

   ```
   RDEFINE XFACILIT CSF.PKAEXTNS.ENABLE
   RDELETE XFACILIT CSF.PKAEXTNS.ENABLE.WARNONLY
   SETROPTS RACLIST(XFACILIT) REFRESH
   ```

   If you accidentally enable PKA Key Management Extensions in both warning and fail mode, the control for fail mode will take precedence.

As described in “Identifying key certificates for symmetric key export” on page 69, you can use the ICSF segment's SYMEXPORTCERTS field to provide a list of certificate labels in a trusted certificate repository (either a PKCS #11 token or a SAF key ring). This enables you to specify that symmetric keys covered by a CSFKEYS or XCSFKEY profile can be exported only by RSA public keys that are bound to identities in the listed certificates. If using the SYMEXPORTCERTS field to provide a list of certificate labels in a trusted certificate repository, you will need to identify that trusted certificate repository to ICSF. You do this using the APPLDATA field of the CSF.PKAEXTNS.ENABLE profile. If the trusted key repository is a PKCS #11 token, it should be identified in the APPLDATA field in the format *TOKEN*/*PKCS-token-name*. If the trusted key repository is a SAF key ring, it should be identified in the APPLDATA field in the format *userID*/*key-ring-name*. For example, if the trusted key repository was a SAF key ring named TRUSTED.KEY.EXPORTERS created by BOBADMIN, you would enter:

```
RDEFINE XFACILIT CSF.PKAEXTNS.ENABLE APPLDATA(BOBADMIN/TRUSTD.KEY.EXPORTERS)
SETROPTS RACLIST(XFACILIT) REFRESH
```

If an APPLDATA field is not provided on the CSF.PKAEXTNS.ENABLE, the default certificate repository is a PKCS #11 token named CSF.TRUSTED.KEYRING.

PKA key management extensions example

The following example provides additional illustration of the ICSF segment fields and keywords that you can use to place restrictions on how cryptographic keys can be used.

A DES key has been created for encrypting transactions between a Company and its Business Partner. The Business Partner's public key has previously been added to the PKDS for the purpose of exporting the DES key. The Company's security administrator wants to be sure that only the Business Partner's public key can be used to export the DES key that the Company and its Business Partner are sharing. There is already a profile covering the label of the RSA public key in the PKDS, but no profile covering the label of the new DES key. The security administrator needs to alter the profile for the RSA public key label, and define a new profile for the DES key label. The security administrator has also enabled the Symmetric Key Label Export Control to increase the level of authority needed to export symmetric keys, and so the profile covering the DES key is defined in the XCSFKEY class.

```
RALTER CSFKEYS RSA.BRADY.CASTLE ICSF(ASYMUSAGE(SECUREEXPORT NOHANDSHAKE))
RDEFINE XCSFKEY DES.BRADY.CASTLE ICSF(SYMEXPORTABLE(BYLIST) SYMEXPORTKEYS(RSA.BRADY.CASTLE)) UACC(NONE)
PERMIT DES.BRADY.CASTLE CL(XCSFKEY) ID(SAMPRTNR) UPDATE
SETROPTS RACLIST(CSFKEYS) REFRESH
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Key Store Policy is active for both the CKDS and PKDS, so the security administrator only needs to enable the PKA Key Management Extensions control, and refresh the XFACILIT class in storage.

```
RDEFINE XFACILIT CSF.PKAEXTNS.ENABLE
SETROPTS RACLIST(XFACILIT) REFRESH
```

Later, the security administrator wants further restrictions on exporting the DES key that the Company and its Business Partner are sharing. The security administrator wants to bind an existing RSA public key to an identity, and allow export of the DES key only by the user and public key bound by a particular certificate. The security administrator creates the certificate for the RSA key, creates a SAF key ring, and adds the certificate to the key ring.

```
RACDCERT ID(BOBADMIN) GENCERT                                          +
         SUBJECTSDN(CN('Mister Ink Inc')O('Business Partner')C('uk'))  +
         WITHLABEL('Mister Ink')SIGNWITH(CERTAUTH LABEL(LocalCertauth'))  +
         KEYUSAGE(DOCSIGN)                                             +
         NOTAFTER(DATE(2020-12-31))                                    +
         FROMICSF(RSA.BRADY.CASTLE)                                    +
RACDCERT ID(BOBADMIN) ADDRING(TRUSTD.KEY.EXPORTERS)
RACDCERT ID(BOBADMIN) CONNECT(LABEL('Mister Ink' RING(TRUSTD.KEY.EXPORTERS)  +
         USAGE(PERSONAL))
RALTER XCSFKEY DES.BRADY.CASTLE ICSF(NOSYMEXPORTKEYS                   +
         SYMEXPORTCERTS('/Mister Ink'))
SETROPTS RACLIST(XCSFKEY) REFRESH
```

Because the security administrator knows that only one certificate with the label "Mister Ink" will be present in the key ring, he does not specify the user ID portion of the string in the SYMEXPORTCERTS list. Note, however, that the security administrator still needs to include the forward slash (/) delimiter even though a user ID was not provided. Also note that the NOSYMEXPORTKEYS keyword is used to remove the SYMEXPORTKEYS list that had been previously defined.

The security administrator modifies the CSF.PKAEXTNS.ENABLE profile in the XFACILIT class to identify the SAF key ring as the certificate repository.

```
RDEFINE XFACILIT CSF.PKAEXTNS.ENABLE APPLDATA(TRUSTD.KEY.EXPORTERS)
SETROPTS RACLIST(XFACILIT) REFRESH
```

For more information on the ICSF fields and keywords, refer to “Restricting asymmetric keys from being used in secure import and export operations” on page 65, “Restricting asymmetric keys from being used in handshake operations” on page 66, and “Placing restrictions on exporting symmetric keys” on page 67.

Enabling use of encrypted keys in Symmetric Key Encipher and Symmetric Key Decipher callable services

The Symmetric Key Encipher (CSNBSYE, CSNBSYE1, CSNESYE and CSNESYE1) and Symmetric Key Decipher (CSNBSYD, CSNBSYD1, CSNESYD and CSNESYD1) callable services exploit CP Assist for Cryptographic Functions (CPACF) for improved performance. These services accept AES and DES clear key values and clear key tokens for the key identifier. These services have been enhanced to support encrypted AES and DES key tokens. This support requires the Crypto Express3 Feature. The encrypted keys tokens must be stored in the CKDS and have a CSFKEYS profile with the ICSF segment.

A CSFKEYS profile can contain an ICSF segment, which specifies rules for key use. The SYMCPACFWRAP field of the ICSF segment enables you to specify whether ICSF can rewrap the encrypted key using the CPACF wrapping key. The specification:

- SYMCPACFWRAP(YES) indicates that encrypted keys covered by the profile can be rewrapped.
- SYMCPACFWRAP(NO), which is the default, indicates that encrypted keys covered by the profile cannot be rewrapped.

Rewrapping the encrypted key using the CPACF wrapping key is necessary in order to use an encrypted key as input to the Symmetric Key Encipher or Symmetric Key Decipher callable services. You should be aware, however, that although the rewrapping operation ensures that no key is visible in application or system storage, the operation also requires the key to exist in the clear outside of the tamper-resistant hardware boundary. If your installation requires that a particular encrypted key must never exist outside of the tamper-resistant hardware boundary, do not use the SYMCPACFWRAP(YES) specification in a CSFKEYS profile that covers the key.

For example, say the CSFKEYs general resource profile DES.CHAOS.CAT covers an encrypted key stored in the CKDS that you would like to use as input to the Symmetric Key Encipher and Symmetric Key Decipher callable services. The following command modifies the SYMCPACFWRAP field of the profile's ICSF segment to allow this. The SETROPTS RACLIST command is used to refresh the CSFKEYS class in common storage.

```
RALTER CSFKEYS DES.CHAOS.CAT ICSF(SYMCPACFWRAP(YES))
SETROPTS RACLIST(CSFKEYS) REFRESH
```

Chapter 5. Using the Pass Phrase Initialization Utility

The pass phrase initialization utility allows the casual user of ICSF to install the necessary master keys on the cryptographic coprocessors, and initialize the CKDS and PKDS with a minimal effort. This topic describes how to use this utility to get up and running quickly.

The pass phrase is case sensitive and should be chosen according to these rules:
- It can contain a minimum of 16 and a maximum of 64 characters.
- It can include any characters in the EBCDIC character set.
- It can contain imbedded blanks, but leading and trailing blanks are truncated.

Important: The same pass phrase will always produce the same master key values, and is therefore as critical and sensitive as the master key values themselves. Make sure you save the pass phrase so that you can later reenter it if needed (for example, if you need to restore master key values that have been cleared). Because of the sensitive nature of the pass phrase, make sure you secure it in a safe place.

The pass phrase initialization utility can initialize a new system or initialize PCICCs, PCIXCCs, CEX2Cs, or CEX3Cs that are brought online after system initialization. You cannot use this utility to change master keys. To change master keys you need to use either the master key entry panels or the TKE workstation.

Restriction: If you are running on a system with the Cryptographic Coprocessor Feature, special secure mode must be enabled.

If you plan on sharing your CKDS within your sysplex, refer to Chapter 9, “Running in a Sysplex Environment,” on page 191 for important information. If you have a z9 EC, z9 BC, z10 EC, z10 BC, or z196 installed, there is an important restriction to consider.

Starting with release HCR7780, there are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). The pass phrase initialization utility can be used with either format of CKDS.

Steps required when running the Pass Phrase Initialization Utility

When you run the pass phrase initialization utility for the first time, you must perform these steps:

1. Install the ICSF program product according to the instructions in *z/OS Planning for Installation* and *z/OS Program Directory*.
2. Create an empty CKDS.
3. Create an empty PKDS.
4. Create an installation options data set.
5. Create an ICSF startup procedure.
6. Ensure ICSF is running in COMPAT(NO) mode
7. Start ICSF.
8. Access the ICSF panels.

These steps are described in *z/OS Cryptographic Services ICSF System Programmer's Guide*

SAF Protection

The pass phrase initialization utility is primarily protected by the CSFPMCI service name. Only the users authorized to the CSFPMCI service can use the utility. In addition, the user must be authorized to all or some of these services which are used by the utility. The services used are dependent on the crypto processor type and the function(s) of PPINIT that are being utilized.

- CSFOWH
- CSFDKEF (CCF systems only)
- CSFDKCS
- CSFCMK
- CSFECO
- CSFMDG
- CSFSMK
- CSFINIT (CCF system only)
- CSFREFR
- CSFPKDR
- CSFRSWS

Running the Pass Phrase Initialization Utility

When you start ICSF, you can use the ICSF panels to run the pass phrase initialization utility. When you access the ICSF panels, the primary menu panel appears. Note that the ICSF FMID appears in the upper left hand corner (it will toggle to the panel identification ID). See Figure 10.

```
HCR7780 ------------- Integrated Cryptographic Service Facility ---------
OPTION ===> 6

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 10. Selecting the Pass Phrase Initialization Option on the ICSF Primary Menu Panel

Select option 6, PPINIT, and press ENTER to begin the pass phrase initialization utility. The pass phrase panel appropriate for your hardware configuration will appear.

Steps for running PPINIT on a CCF system

The Pass Phrase MK/KDS Initialization panel appears. See Figure 11.

```
CSFPMC00 ------- ICSF - Pass Phrase MK/KDS Initialization ---
Command ===>
Enter your pass phrase and the names of the CKDS and PKDS:

Pass Phrase (16 to 64 characters)
===>

CKDS
===>

PKDS
===>

Initialize the CKDS and PKDS? (Y/N) ===> Y
Signature MK = Key Management MK? (Y/N) ===> Y
Initialize new PCICCs only? (Y/N) ===> N



Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 11. ICSF Pass Phrase MK/CKDS/PKDS Initialization Panel

1. Type the pass phrase and the data set name in the spaces that are provided. **Make sure you save the pass phrase and store it in a secure place.**

   The CKDS and PKDS names must be valid VSAM data sets.

   Notes:

   a. The same pass phrase will always produce the same master key values, and is therefore as critical and sensitive as the master key values themselves. Make sure you save the pass phrase so that you can later reenter it if needed (for example, if you need to restore master key values that have been cleared). Because of the sensitive nature of the pass phrase, make sure you secure it in a safe place.

   b. If you are reentering master keys when they have been cleared, use the same pass phrase as when you originally entered the keys.

2. Answer the "Initialize the CKDS and PKDS?" question by typing your response in the space following the question.

   a. If the CKDS and PKDS have not been initialized, type Y.

      If you select Y, the CKDS and PKDS names must refer to a valid, uninitialized CKDS and PKDS.

   b. If this is an existing CKDS and PKDS, type N.

      If you select N, the CKDS and PKDS must have already been initialized with the pass phrase initialization utility and the identical pass phrase.

      ICSF checks and refreshes the existing CKDS.

3. Answer the "Signature MK = Key Management MK?" question by typing your response in the space following the question.

   a. If you have a new system with PCI Cryptographic Coprocessors installed, type Y.

The signature master key and the key management master key will have the same value as the ASYM master key on the PCI Cryptographic Coprocessors. This increases the flexibility in routing services among the cryptographic coprocessors.

b. If you have previously used pass phrase initialization and you have PKA key tokens that are encrypted under a key management master key that cannot be recreated, type N.

c. If none of these two scenarios apply to you, type Y.

4. Answer the "Initialize new PCICCs only?" question by typing your response in the space following the question.

   a. If you have already initialized your system with the Pass Phrase Initialization utility and now want to initialize new PCI cards, type Y.

   b. If this is the first time you are running the Pass Phrase Initialization Utility, type N.

```
CSFPMC00 --------- ICSF - Pass Phrase MK/KDS Initialization ---------------

Enter your pass phrase and the names of the CKDS and PKDS:

Pass Phrase (16 to 64 characters)
===> winnie the pooh and tigger too

CKDS
===> 'CRYPTO.HCRICSF.CKDS'

PKDS
===> 'CRYPTO.HCRICSF.PKDS'

Initialize the CKDS and PKDS? (Y/N) ===> Y
Signature MK = Key Management MK? (Y/N) ===> Y
Initialize new PCICCs only? ===> N
```

Figure 12. Entering Options on the Pass Phrase MK/KDS Initialization Panel

5. Press ENTER to run the utility.

   This utility uses the pass phrase, a series of constants, and the MD5 hash algorithm to:

   - Calculate the DES master key and load the new master key registers on the Cryptographic Coprocessor Features with the value.
   - Use the value of the DES master key as the value of the DES-MK key and load the new master key registers on the PCI Cryptographic Coprocessors with the value.
   - Calculate the PKA master keys and set the PKA signature master key register and the PKA key management master key register with these values. If you specified "Y" for the question about making the signature master key equal to the key management master key, then the value calculated for the key management master key will be used for both PKA master keys.
   - Use the value of the PKA signature master key as the value of the ASYM-MK and set the new asymmetric-keys master key registers on the PCI Cryptographic Coprocessors with the value.
   - Set the master key register.
   - Initialize the CKDS or refresh an existing CKDS.
   - Initialize the PKDS.

For details of these calculations, refer to “Pass Phrase Initialization master key calculations” on page 400.

Messages on the bottom half of the panel display the progress of the utility.

6. When the utility has completed successfully, press END to return to the primary menu.

Steps for running PPINIT on a PCIXCC, CEX2C, or CEX3C system

When initializing only new PCIXCCs, CEX2Cs, or CEX3C, at least one card must be active and PKA callable services must be enabled.

If you are running on a:

- z196 server with a CEX3C, you have ECC master key support. See “Steps for running PPINIT with ECC master key support” on page 84.
- z9, z10, or z196 server with the Nov. 2008 or later licensed internal code (LIC), you have AES master key support. See “Steps for running PPINIT with AES master key support” on page 86 unless you also have ECC master key support.

The Pass Phrase MK/CKDS/PKDS Initialization panel appears. See Figure 13.

```
CSFPMC10 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
Command ===>
Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

_ Initialize system - Load the DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===>
    PKDS ===>

_ Reinitialize system - Load the DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


_ Add coprocessors - Initialize additional online coprocessors with the
  same DES and asymmetric master keys.


Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 13. ICSF Pass Phrase MK/CKDS/PKDS Initialization Panel

1. Type the pass phrase and the data set names in the spaces that are provided. **Make sure you save the pass phrase and store it in a secure place.**

   Notes:

   a. The same pass phrase will always produce the same master key values, and is therefore as critical and sensitive as the master key values themselves. Make sure you save the pass phrase so that you can later reenter it if needed (for example, if you need to restore master key values

that have been cleared). Because of the sensitive nature of the pass phrase, make sure you secure it in a safe place.

b. If you are reentering master keys when they have been cleared, use the same pass phrase as when you originally entered the keys. If you are adding coprocessors or missing master keys, use the same pass phrase you used when you initialized the system.

2. Select one of the following initialization actions:
   - Select 'Initialize system' if this is the first time you are running the pass phrase initialization utility.

     Fill in the CKDS and PKDS fields with the names of two valid VSAM data sets that have not been initialized
   - Select 'Reinitialize system' if there is an existing CKDS and PKDS,

     The CKDS and PKDS must have already been initialized with the pass phrase initialization utility and the identical pass phrase.

     ICSF checks and refreshes the existing CKDS and PKDS.

     When using PPINIT with a system where coprocessors have been initialized with PPINIT (the CKDS/PKDS are initialized), keep in mind:
     - If the CKDS and PKDS were initialized with the same pass phrase, the 'Reinitialize system' option will process active coprocessors, and online processors will become active. However, if the coprocessor supports any additional master key type and there is no MKVP in the KDS for the key type, the master key will not become active during reinitialization. To initialize online coprocessors in this scenario, use the 'Add coprocessors' option.
     - When the CKDS and PKDS were initialized with a different pass phrase, 'Reinitialize system' will fail.
   - Select 'Add coprocessors' if you have already initialized your system with the Pass Phrase Initialization utility and now want to initialize new PCI cards.

```
CSFPMC10 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
Command ===>
Enter your pass phrase (16 to 64 characters)
  ===> winnie the pooh and tigger too

Select one of the initialization actions then press ENTER to process.

S Initialize system - Load the DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===> CRYPTO.HCRICSF.CKDS
    PKDS ===> CRYPTO.HCRICSF.PKDS

_ Reinitialize system - Load the DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


 _ Add coprocessors - Initialize additional online coprocessors with the
   same DES and asymmetric master keys.


Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 14. Entering Options on the Pass Phrase MK/CKDS/PKDS Initialization Panel

3. Press ENTER to run the utility.

   This utility uses the pass phrase, a series of constants, and the MD5 hash algorithm to:

   - Calculate the DES master key and load the new master key register on the card with the value.
   - Calculate the ASYM-MK value and load the new asymmetric-keys master key register on the card with the value.
   - Set the master key registers.
   - Initialize the CKDS or refresh an existing CKDS.
   - Initialize the PKDS.

   For details of these calculations, refer to “Pass Phrase Initialization master key calculations” on page 400.

   Messages on the bottom half of the panel display the progress of the utility.
4. When the utility has completed successfully, press END to return to the primary menu.
5. If either KDS has already been initialized, and if the DES-MK or RSA-MK is valid, this panel appears:

```
CSFPMC20 --------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ----------

ARE YOU SURE YOU WISH TO PROCEED WITH PASS PHRASE INITIALIZATION?

There are currently coprocessors with valid valid_master_key_types master
key(s). If you proceed with pass phrase initialization, the master key value(s)
May change.

If you wish to initialize new coprocessors only, return to the previous panel
and select the Add coprocessors action.

To proceed with pass phrase initialization, PKA callable services must be
disabled. Use the Administrative Control Functions utility to disable PKA
callable services.


Press ENTER to proceed with pass phrase initialization.
Press END to exit to the previous menu.
```

Figure 15. Pass Phrase MK/CKDS/PKDS Initialization Panel

This prevents you from making a mistake and changing a system that is already operational.

Steps for running PPINIT with ECC master key support

If you are running on a z196 server with a CEX3C, the Pass Phrase MK/KDS Initialization panel appears as shown in the following figure.

```
CSFPMC40 ------- ICSF – Pass Phrase MK/CKDS/PKDS Initialization ---------------
COMMAND ===>

Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

 _ Initialize system - Load the AES, DES, ECC, and RSA master keys to all
   coprocessors and initialize the CKDS and PKDS, making then the active key
   data sets.
   CKDS ===>
   PKDS ===>

 _ Reinitialize system - Load the AES, DES, ECC, and RSA master keys to all
   coprocessors and make the specified CKDS and PKDS the active key data sets.
   CKDS ===>
   PKDS ===>

 _ Add coprocessors - Initialize additional online coprocessors with the
   same currently active master keys.

 _ Add missing MKs – Load missing AES and/or ECC master keys on each active
   coprocessor. Update the CKDS and/or PKDS to include the MKVP of the loaded MK(s).

Press ENTER to process.
Press END to exit to the previous menu.
```

Figure 16. ICSF Pass Phrase MK/CKDS/PKDS Initialization Panel

1. Type the pass phrase and the data set names in the spaces that are provided. **Make sure you save the pass phrase and store it in a secure location.**

   Notes:

   a. The same pass phrase will always produce the same master key values, and is therefore as critical and sensitive as the master key values

themselves. Make sure you save the pass phrase so that you can later reenter it if needed (for example, if you need to restore master key values that have been cleared). Because of the sensitive nature of the pass phrase, make sure you secure it in a safe place.

b. If you are reentering master keys when they have been cleared, use the same pass phrase as when you originally entered the keys.

2. Select one of the following initialization actions:
   - Select 'Initialize system' if this is the first time you are running the pass phrase initialization utility.

     Save the pass phrase in a secure place.

     The CKDS and PKDS names must refer to a valid CKDS and PKDS in your system that have not been initialized.
   - Select 'Reinitialize system' if there is an existing CKDS and PKDS,

     The CKDS and PKDS must have already been initialized with the pass phrase initialization utility and the identical pass phrase.

     ICSF checks and refreshes the existing CKDS and PKDS.
   - Select 'Add coprocessors' if you have previously initialized your system with the Pass Phrase Initialization utility and now want to initialize additional online coprocessors.
   - Select 'Add missing MKs' if you want to load missing AES and ECC master keys on each active coprocessor that supports AES and/or ECC keys.

```
CSFPMC40 ------- ICSF – Pass Phrase MK/CKDS/PKDS Initialization ---------------
COMMAND ===>

Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

 _ Initialize system - Load the AES, DES, ECC, and RSA master keys to all
   coprocessors and initialize the CKDS and PKDS, making then the active key
   data sets.
   CKDS ===> CRYPTO.HCRICSF.CKDS
   PKDS ===> CRYPTO.HCRICSF.PKDS

 _ Reinitialize system - Load the AES, DES, ECC, and RSA master keys to all
   coprocessors and make the specified CKDS and PKDS the active key data sets.
   CKDS ===>
   PKDS ===>

 _ Add coprocessors - Initialize additional online coprocessors with the
   same currently active master keys.

 _ Add missing MKs – Load missing AES and/or ECC master keys on each active
   coprocessor. Update the CKDS and/or PKDS to include the MKVP of the loaded MK(s).

Press ENTER to process.
Press END to exit to the previous menu.
```

Figure 17. Entering Options on the Pass Phrase MK/CKDS/PKDS Initialization Panel

3. Press ENTER to run the utility.

   This utility uses the pass phrase, a series of constants, and the MD5 and SHA-256 hash functions to load AES, DES, ECC, and RSA master keys, and initialize the CKDS and PKDS.

   For details on how the values of master keys are calculated, refer to “Pass Phrase Initialization master key calculations” on page 400.

   Messages on the bottom half of the panel display the progress of the utility.

4. When the utility has completed successfully, press END to return to the primary menu.
5. If there is currently any coprocessor with a valid master key, the following panel appears. The *valid_master_key_types* could be DES, AES, ECC, and/or RSA.

```
CSFPMC20 --------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ----------

ARE YOU SURE YOU WISH TO PROCEED WITH PASS PHRASE INITIALIZATION?

There are currently coprocessors with valid valid_master_key_types master
key(s). If you proceed with pass phrase initialization, the master key value(s)
May change.

If you wish to initialize new coprocessors only, return to the previous panel
and select the Add coprocessors action.

To proceed with pass phrase initialization, PKA callable services must be
disabled. Use the Administrative Control Functions utility to disable PKA
callable services.


Press ENTER to proceed with pass phrase initialization.
Press END to exit to the previous menu.
```

Figure 18. Pass Phrase MK/CKDS/PKDS Initialization Panel

This prevents you from making a mistake and changing a system that is already operational.

Steps for running PPINIT with AES master key support

When initializing only new CEX2Cs or CEX3Cs, at least one card must be active and PKA callable services must be enabled.

If you are running on z9, z10, or z196 servers with the Nov. 2008 or later licensed internal code (LIC), the Pass Phrase MK/KDS Initialization panel appears. See Figure 19 on page 87.

```
CSFPMC30 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
Command ===>
Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

_ Initialize system - Load the AES, DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===>
    PKDS ===>

_ Reinitialize system - Load the AES, DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


 _ Add coprocessors - Initialize additional online coprocessors with the
   same DES and asymmetric master keys.

_ Add AES-MK - Add the AES master key to all active coprocessors and the
   current CKDS.


Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 19. ICSF Pass Phrase MK/CKDS/PKDS Initialization Panel

1. Type the pass phrase and the data set names in the spaces that are provided. **Make sure you save the pass phrase and store it in a secure location.**

   Notes:

   a. The same pass phrase will always produce the same master key values, and is therefore as critical and sensitive as the master key values themselves. Make sure you save the pass phrase so that you can later reenter it if needed (for example, if you need to restore master key values that have been cleared). Because of the sensitive nature of the pass phrase, make sure you secure it in a safe place.

   b. If you are reentering master keys when they have been cleared, use the same pass phrase as when you originally entered the keys.

2. Select one of the following initialization actions:

   - Select 'Initialize system' if this is the first time you are running the pass phrase initialization utility.

     Save the pass phrase in a secure place.

     The CKDS and PKDS names must refer to a valid CKDS and PKDS in your system that have not been initialized.

   - Select 'Reinitialize system' if there is an existing CKDS and PKDS,

     The CKDS and PKDS must have already been initialized with the pass phrase initialization utility and the identical pass phrase.

     ICSF checks and refreshes the existing CKDS and PKDS.

   - Select 'Add coprocessors' if you have previously initialized your system with the Pass Phrase Initialization utility and now want to initialize new PCI cards.

- Select 'Add AES-MK' if you want to add secure key AES support to a system previously initialized with the utility. This selection updates the active CKDS.

```
 CSFPMC30 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
 Command ===>
 Enter your pass phrase (16 to 64 characters)
   ===> winnie the pooh and tigger too

 Select one of the initialization actions then press ENTER to process.

S Initialize system - Load the AES, DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===> CRYPTO.HCRICSF.CKDS
    PKDS ===> CRYPTO.HCRICSF.CKDS

_ Reinitialize system - Load the AES, DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


  _ Add coprocessors - Initialize additional online coprocessors with the
    same DES and asymmetric master keys.

_ Add AES-MK - Add the AES master key to all active coprocessors and the
    current CKDS.


 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 20. Entering Options on the Pass Phrase MK/CKDS/PKDS Initialization Panel

3. Press ENTER to run the utility.

   This utility uses the pass phrase, a series of constants, and the MD5 hash algorithm to:

   - Calculates the DES and AES master key values and loads the new master key register on the CEX2C or CEX3C with the value.
   - Calculate the ASYM-MK value and load the new asymmetric-keys master key register on the CEX2C or CEX3C with the value.
   - Set the master key registers.
   - Initialize the CKDS or refresh an existing CKDS.
   - Initialize the PKDS.

   For details of these calculations, refer to “Pass Phrase Initialization master key calculations” on page 400.

   Messages on the bottom half of the panel display the progress of the utility.
4. When the utility has completed successfully, press END to return to the primary menu.
5. If the KDS has been initialized and if either the DES or AES master key is valid, the following panel appears. The *valid_master_key_types* could be DES, AES, and/or RSA.

```
CSFPMC20 --------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ----------

ARE YOU SURE YOU WISH TO PROCEED WITH PASS PHRASE INITIALIZATION?

There are currently coprocessors with valid valid_master_key_types master
key(s). If you proceed with pass phrase initialization, the master key value(s)
May change.

If you wish to initialize new coprocessors only, return to the previous panel
and select the Add coprocessors action.

To proceed with pass phrase initialization, PKA callable services must be
disabled. Use the Administrative Control Functions utility to disable PKA
callable services.


Press ENTER to proceed with pass phrase initialization.
Press END to exit to the previous menu.
```

Figure 21. Pass Phrase MK/CKDS/PKDS Initialization Panel

This prevents you from making a mistake and changing a system that is already operational.

Steps for adding a PCICC after first time Pass Phrase Initialization

The pass phrase initialization utility can be used to initialize PCI Cryptographic Coprocessors after system initialization. The procedure is to re-run the Pass Phrase Initialization Utility.

Note: Special Secure Mode is not required when adding PCICCs after first time pass phrase initialization.

The step-by-step procedure is:

1. Run the Pass Phrase Initialization Utility.

   Access the primary menu panel.

```
CSF@PRIM ------------- Integrated Cryptographic Service Facility ---------
OPTION ===> 6

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 22. Selecting the Pass Phrase Initialization Option on the ICSF Primary Menu Panel

2. Select option 6, PPINIT, and press ENTER to begin the pass phrase initialization utility.

   The Pass Phrase MK/KDS Initialization panel appears. See Figure 23.

```
CSFPMC00 ------- ICSF - Pass Phrase MK/KDS Initialization ---
Command ===>
Enter your pass phrase and the names of the CKDS and PKDS:

Pass Phrase (16 to 64 characters)
===>

CKDS
===>

PKDS
===>

Initialize the CKDS and PKDS? (Y/N) ===>
Signature MK = Key Management MK? (Y/N) ===>
Initialize new PCICCs only? (Y/N) ===>




Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 23. ICSF Pass Phrase MK/KDS Initialization Panel

3. Type the pass phrase and the data set name in the spaces that are provided. The CKDS and PKDS names must be the current, active CKDS and PKDS.

   Note: The same pass phrase will always produce the same master key values. Because you are reentering master keys, you must use the same pass

phrase as when you originally entered the keys. You should have saved the pass phrase in a secure place when you entered the master keys previously.

4. The "Initialize the CKDS and PKDS?" and "Signature MK = Key Management MK?" questions are ignored.
5. Answer the "Initialize new PCICCs only" question by typing your response in the space following the question. Your response should be Y.

```
CSFPMC00 --------- ICSF - Pass Phrase MK/KDS Initialization ----------

Enter your pass phrase and the names of the CKDS and PKDS:

Pass Phrase (16 to 64 characters)
===> winnie the pooh and tigger too

CKDS
===> 'CRYPTO.HCRICSF.CKDS'

PKDS
===> CRYPTO.HCRICSF.PKDS

Initialize the CKDS and PKDS? (Y/N) ===> N
Signature MK = Key Management MK? (Y/N) ===> Y
Initialize new PCICCs only? ===> Y
```

Figure 24. Entering Options on the Pass Phrase MK/KDS Initialization Panel

6. Press ENTER to run the utility.

   For details of these calculations, refer to “Pass Phrase Initialization master key calculations” on page 400.

   Messages on the bottom half of the panel display the progress of the utility.
7. When the utility has completed successfully, press END to return to the primary menu.

Steps for adding a PCIXCC, CEX2C, or CEX3C after first time Pass Phrase Initialization

The pass phrase initialization utility can be used to initialize PCIXCCs, CEX2Cs, or CEX3Cs after system initialization. The procedure is to rerun the Pass Phrase Initialization Utility.

The step-by-step procedure is:

1. Run the Pass Phrase Initialization Utility.

   Access the primary menu panel.

```
CSF@PRIM ------------- Integrated Cryptographic Service Facility ---------
OPTION ===> 6

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY          -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 25. Selecting the Pass Phrase Initialization Option on the ICSF Primary Menu Panel

2. Select option 6, PPINIT, and press ENTER to begin the pass phrase initialization utility.

   The Pass Phrase MK/CKDS/PKDS Initialization panel appears. See Figure 26 on page 93.

   Notes:

   a. Panel CSFPMC30 appears if you are running on a z9, z10, or z196 server with the Nov. 2008 or later licensed internal code (LIC).

   b. Panel CSFPMC40 appears if you are running on a z196 server with the Sept. 2010 or later LIC.

```
CSFPMC10 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
Command ===>
Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

_ Initialize system - Load the DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===>
    PKDS ===>

_ Reinitialize system - Load the DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


 _ Add coprocessors - Initialize additional online coprocessors with the
   same DES and asymmetric master keys.


Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 26. ICSF Pass Phrase MK/CKDS/PKDS Initialization Panel

3. Type the pass phrase and the data set name in the spaces that are provided. Refer to the example in Figure 27 on page 94.

   The CKDS and PKDS names must be the current, active CKDS and PKDS.

   Note: The same pass phrase will always produce the same master key values. Because you are reentering master keys, you must use the same pass phrase as when you originally entered the keys. You should have saved the pass phrase in a secure place when you entered the master keys previously.

4. Select the 'Add coprocessors' action.

```
CSFPMC10 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
Command ===>
Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

_ Initialize system - Load the DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===>
    PKDS ===>

_ Reinitialize system - Load the DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


s Add coprocessors - Initialize additional online coprocessors with the
  same DES and asymmetric master keys.


Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 27. Entering Options on the Pass Phrase MK/CKDS/PKDS Initialization Panel

5. Press ENTER to run the utility.

   For details of these calculations, refer to “Pass Phrase Initialization master key calculations” on page 400.

   Messages on the bottom half of the panel display the progress of the utility.
6. When the utility has completed successfully, press END to return to the primary menu.

Migrating to a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 server

If you are migrating to a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 server from a CCF system, follow this procedure.

Assumptions are:

1. You used PPINIT to initialize your CKDS and PKDS.
2. You have not changed your master key since running PPINIT.
3. You are migrating to a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 from a CCF system and using the same CKDS and PKDS from assumption number 1.

Note: If you are planning to use a PKDS and CKDS, you must set the master keys; a CEX2C or CEX3C is is required for this task. The CEX2C is supported on the z9 EC, z9 BC, z10 EC, and z10 BC. The CEX3C is supported on the z10 EC, z10 BC, and z196. Ensure that you have at least one CEX2C or CEX3C configured on your server.

The procedure is as follows:

- Access the primary menu panel and select option 6, PPINIT. The Pass Phrase MK/KDS Initialization panel appears.

Notes:

1. Panel CSFPMC30 appears if you are running on a z9, z10, or z196 server with the Nov. 2008 or later licensed internal code (LIC).
2. Panel CSFPMC40 appears if you are running on a z196 server with the Sept. 2010 or later LIC.

- Select the 'Reinitialize system' action and enter the same pass phrase from assumption number 1 on page 94 and the same CKDS and PKDS.

```
CSFPMC10 ------- ICSF - Pass Phrase MK/CKDS/PKDS Initialization ---
Command ===>
Enter your pass phrase (16 to 64 characters)
  ===>

Select one of the initialization actions then press ENTER to process.

_ Initialize system - Load the DES and asymmetric master keys to all
    coprocesors and initialize the CKDS and the PKDS.
    CKDS ===>
    PKDS ===>

s Reinitialize system - Load the DES and asymmetric master keys to all
    coprocesors and make the specified CKDS and the PKDS the current key data
    sets.
    CKDS ===>
    PKDS ===>


  _ Add coprocessors - Initialize additional online coprocessors with the
    same DES and asymmetric master keys.


Press ENTER to process.
Press END   to exit to the previous menu.
```

Figure 28. ICSF Pass Phrase MK/CKDS/PKDS Initialization Panel

- Press ENTER to run the utility
- When the utility has completed successfully, press END to return to the primary menu.

PPINIT Recovery

If you are unsuccessful using the pass phrase initialization, you should follow one of these procedures. Your recovery steps will vary as they are dependent on your hardware configuration.

Steps recovering with a CCF (with or without a PCICC)

If your panel message returns `NOT SUCCESSFUL` or PPINIT fails to complete, try to:

1. Delete and reallocate the CKDS
2. Delete and reallocate the PKDS
3. Go to the ICSF Coprocessor Management Panel to list the coprocessors and their status:

```
CSFCMP00 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                 STATUS
-----------  ------------------------------          -------

_ A06                                                 ACTIVE
_ A07                                                 ACTIVE
s C0         E589C396944007A6 5D40369997A386F4        ONLINE
s C1         79BF0AA3D2387960 0367DC04533125FF        ACTIVE_
_ P00        41-00YE1                                 ONLINE
_ P01        41-00K11                                 ONLINE
_ P02        41-0A355                                 ONLINE
_ P03        41-0BA3F                                 ONLINE
_ P04        41-0RT2T                                 DEACTIVATED
_ P05        41-00342                                 DISABLED
_
```

4. Make sure that these registers are EMPTY (for C0 and C1): DES new master key register, the current signature master key register (SMK) and the PKA key management master key register (KMMK). On a z900, you should see this:

```
CSFCMP10 ----------- ICSF - Coprocessor Hardware Status  ----------------
OPTION ===>

                                                      CRYPTO DOMAIN: 0

REGISTER STATUS                COPROCESSOR C0          COPROCESSOR C1
                                                       More:    +
Crypto Serial Number or         : E589C396944007A6     79BF0AA3D2387960
     Module Id                  : 5D40C39997A396F0     0367DC04533125FF
Status                          : ONLINE               ACTIVE
DES/Symmetric-Keys Master Key
  New master key register       : EMPTY                EMPTY
    Verification pattern        :
    Hash pattern                :
                                :
  Old master key register       : EMPTY                EMPTY
    Verification pattern        :
    Hash pattern                :
                                :
  Current master key register   : VALID                VALID
    Verification pattern        : CA6B408A02371B1D     261AAB8A02371705
    Hash pattern                : 41DF774FF81547D0     562A5202F8154331
                                : 090ABC4539727511     4093990AB1202451
PKA Signature/Asymmetric-Keys Master Key
  New master key register       : N/A                  N/A
    Hash pattern                :
                                :
  Old master key register       : N/A                  N/A
    Hash pattern                :
                                :
  Current master key register   : EMPTY                EMPTY
    Hash pattern                :
                                :
PKA Key Management Master Key register
    Hash pattern                : EMPTY                EMPTY
                                :
Special Secure Mode             : Enabled              Enabled
Environment Control Mask        : FBFEFCF0             FBFEFCF0
Crypto Configuration Control    : EF569412CD91AB78     EF569412CD91AB78
                                : 1F25A78BC88ED77A     1F25A78BC88ED77A


 Press ENTER to refresh the hardware status display.
 Press END   to exit to the previous menu.
```

Figure 29. Coprocessor Hardware Status Panel

5. If the registers are not EMPTY, go to “Entering master key parts” on page 99. Reset the registers that are not EMPTY. Be sure to check both C0 and C1.
6. If you have one or more PCICCs, there is no checking to be done.
7. Rerun PPINIT.

Steps recovering with a PCIXCC, CEX2C, or CEX3C

If your panel message returns NOT SUCCESSFUL or PPINIT fails to complete, try this:

1. Delete and reallocate the CKDS
2. Delete and reallocate the PKDS
3. Rerun PPINIT.

Initializing multiple systems with pass phrase initialization utility

Use this scenario when using the pass phrase initialization utility to initialize more than one system where the CKDS and PKDS will be shared by all systems:

1. Select a system, A. This system will be used to initialize the CKDS and PKDS.
2. On system A, enter your pass phrase, the names of the empty CKDS and PKDS and select 'Initialize system' and press ENTER to run the utility.
3. When system A has been successfully initialized, the rest of the systems to share the CKDS and PKDS can be initialized.
4. For the rest of the systems, enter your pass phrase, the names of the initialized CKDS and PKDS and select 'Reinitialize system' and press ENTER to run the utility.

Chapter 6. Managing Master Keys - CCF and PCICC

This topic describes how to use the master key entry panels to enter master keys in the Cryptographic Coprocessor Feature and PCI Cryptographic Coprocessor.

You can have up to two Cryptographic Coprocessor Features on each IBM @server zSeries 900. Each Cryptographic Coprocessor Feature is capable of performing cryptographic functions and holding the master keys within a secure boundary.

You can have multiple PCI Cryptographic Coprocessors and PCI Cryptographic Accelerators on these servers. There can be a total of 16.

Each PCI Cryptographic Coprocessor is capable of performing cryptographic functions and holding the master keys within a secure boundary. The PCI Cryptographic Coprocessors work in conjunction with the Cryptographic Coprocessor Features on your server.

Restriction: The CCF and PCICC are only available on the IBM @server zSeries 900 processors.

Requests for cryptographic services are routed to either the PCICC or CCF, depending on key types specified in the request. In order for these two types of cryptographic coprocessors to work together, you need to install the same master key values for each coprocessor.

Note: The PCI Cryptographic Accelerators improve private key decryption performance. They do not require setting of master keys.

Entering master key parts

You can use the Master Key Entry panels to enter master key parts in the clear. The way you obtain master key parts depends on the security guidelines in your enterprise. You may receive master key parts from a key distribution center or you may generate your own key parts using the ICSF random number utility.

Important: Regardless of how you get the master key parts, **make sure the key parts are recorded and saved in a secure location**. When you are entering the key parts for the first time, be aware that **you may need to reenter these same key values at a later date** to restore master key values that have been cleared.

When you enter the PKA master keys and the asymmetric-keys master key (ASYM-MK) the first time, the PKA callable services are initially disabled. Once you have entered the PKA master keys and the ASYM-MK, you must enable the PKA callable services for these services to work. When you change the PKA master keys and the ASYM-MK, you need to disable the PKA callable services. To enable and disable the PKA callable services refer to “Steps for enabling and disabling PKA services” on page 131.

To enter master key parts that you do not generate using the random number utility, continue with “Steps for entering the first master key part” on page 107.

To begin master key entry by generating random numbers for the key parts, continue with “Generating master key data for master key entry” on page 100.

Generating master key data for master key entry

If you intend to use the key entry panels to enter master keys, you need to generate and record these values when you begin:

- Key parts
- Checksums
- Verification patterns (optional)
- Hash patterns (optional)

Note: If you are reentering master keys when they have been cleared, use the same master key part values as when you originally entered the keys. You should have saved the key part values in a secure place when you entered the master keys previously.

A DES master key is 16 bytes long. A symmetric-keys master key (SYM-MK) is 24 bytes long. ICSF enforces the SYM-MK to be 16 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts. Each of the master key parts is also 16 bytes long. To enter either a DES master key or a SYM-MK, you must enter a first key part and a final key part. If you choose to, you can also enter one or more intermediate key parts when entering the first key part and when entering the final key part.

Note: The combined DES master key is forced to have odd parity, but the parity of the individual key parts can be odd, even or mixed. We refer to even or mixed parity keys as non-odd parity keys.

Attention: The PCICC will not allow certain 'weak' keys as master keys. The list of weak keys are documented in Appendix F, “Questionable (Weak) Keys,” on page 413. If you have an existing CCF installed with a weak master key, you can not install that master key in the PCICC. You must change the CCF master keys and load those same master keys in the PCICCs.

PKA master keys and the ASYM-MKs are each 24 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts. Each of the PKA master key parts is also 24 bytes long.

If you are using ICSF to generate random numbers, generate a random number for each key part that you need to enter to create the master key.

Note: It is recommended that you enter the same key value for the SMK and KMMK of the Cryptographic Coprocessor Feature and the ASYM-MK of the PCI Cryptographic Coprocessor Feature. This will allow ICSF flexibility in workload balancing.

A 16-byte key part consists of 32 hexadecimal digits. A 24-byte key part consists of 48 hexadecimal digits. To make this process easier, each part is broken into segments of 16 digits each.

When you are manually entering the master key parts, you also enter a checksum that verifies whether you entered the key part correctly. A checksum is a two-digit result of putting a key part value through a series of calculations. The coprocessors calculate the checksum with the key part you enter and compare the one they calculated with the one you entered. The checksum verifies that you did not transpose any digits when entering the key part. If the checksums are equal, you have successfully entered the key.

When you enter a key part and its checksum for a DES master key or SYM-MK, the coprocessor calculates an eight-byte verification pattern and sixteen byte hash pattern. When you enter a key part and its checksum for a PKA master key (SMK, KMMK or ASYM-MK), the coprocessor calculates a sixteen-byte hash pattern.

When the verification and hash patterns can be calculated, the DES master key must have been set.

The ICSF Master Key Entry panel displays the verification pattern or hash pattern. Check the displayed verification pattern against the optional verification pattern you may have generated at the time you generated the DES or SYM-MK master key parts and the checksum. Check the displayed hash pattern against the optional hash pattern that you may have generated at the same time you generated the PKA master key part and the checksum. The verification pattern or hash pattern checks whether you entered the key part correctly, and whether you entered the correct key type.

ICSF displays a verification and hash pattern for each DES master key part. It also displays a verification and hash pattern for the DES master key when you enter all the key parts. If the verification and hash patterns are the same, you have entered the key part correctly. Likewise, in addition to displaying a hash pattern for each PKA master key part, ICSF also displays a hash pattern for the PKA master key when you enter all the key parts. If the hash patterns are the same, you have entered the key part correctly.

Note: Keys stored in the CKDS are enciphered under the DES master key. The master key verification pattern is stored in the CKDS header record. Checking the verification pattern is optional; it is not required for key entry.

To generate the value for a key part, you can use one of these methods:

- Choose a random number yourself.
- Access the ICSF utility panels to generate a random number.
- Call the random number generate callable service. For more information, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

  Note: ICSF must be initialized with a DES master key to use the random number generate callable service or the Random Number Generator panel.

These topics describe using the ICSF utilities to generate key parts, checksums, verification patterns, and hash patterns.

Steps for generating key parts using ICSF utilities

1. Access ICSF utilities by choosing option 5, UTILITY, on the Primary Menu panel, as shown in Figure 30 on page 102.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 5

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions


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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 30. Selecting the Utility Option on the ICSF Primary Menu Panel

The Utilities panel appears. See Figure 31. You use the RANDOM and CHECKSUM options to generate random numbers, checksums, and verification patterns for master key management.

```
CSFUTL00 ---------------- ICSF - Utilities -------------------------
OPTION ===> 3


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 31. ICSF Utilities Panel

2. Choose option 3, RANDOM, to access the Random Number Generator panel, shown in Figure 32 on page 103.

```
CSFRNG00 ---------------- ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 0000000000000000  Random Number 1
  Random Number2    : 0000000000000000  Random Number 2
  Random Number3    : 0000000000000000  Random Number 3
  Random Number4    : 0000000000000000  Random Number 4
```

Figure 32. ICSF Random Number Generator Panel

3. To select the parity of the random numbers, enter ODD, EVEN, or RANDOM next to Parity Option and press ENTER.

   The DES master key is forced to have odd parity, regardless of the parity option you select for each key part. Parity is not checked for PKA master keys.

   A random 16-digit number appears in each of the Random Number fields. You can use each of these random numbers for a segment of a key part.

   Note: The third random number is only for PKA master keys. It is not used for DES master keys or operational keys.

```
CSFRNG00 ---------------- ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 51ED9CFA90716CFB  Random Number 1
  Random Number2    : 58403BFA02BD13E8  Random Number 2
  Random Number3    : 9B28AEFA8C47760F  Random Number 3
  Random Number4    : 0000000000000000  Random Number 4
```

Figure 33. ICSF Random Number Generator Panel with Generated Numbers

4. When you end the utility panels and access the Master Key Part Entry panel, the key parts you generated are transferred automatically to the Master Key Part Entry panels. For this reason, you will not need to enter the key parts on the Master Key Part Entry panels.

   Important: Although the key parts are automatically transferred to the Master Key Entry panels, make sure you **record the random numbers and store them in a safe place**. You must have these numbers in case you ever need to reenter the master key values. If you ever need to restore a master key that has been cleared for any reason, you will need the key part values.
5. Press END to return to the Utilities panel.
6. Continue with Steps for generating a checksum, verification pattern, or hash pattern for a key part.

Steps for generating a checksum, verification pattern, or hash pattern for a key part

You can use the ICSF utilities panel to generate a checksum and either an optional verification pattern or an optional hash pattern for a key part. You can use this

panel to generate a checksum for a key part even if ICSF has not been initialized. The random number generator and the hash and verification pattern, however, do not work until ICSF has been initialized with a valid master key.

Note: The use of these utility panels to generate the key part, the checksum, and the verification pattern exposes the key part in storage for the duration of the dialogs. For this reason, you can choose to calculate both the checksum, the verification pattern or the hash pattern values manually or by using a PC program. See “Checksum Algorithm” on page 397 for a description of the checksum algorithm. See “Algorithm for calculating a verification pattern” on page 399 for a description of the algorithm for the verification pattern. See “The MDC–4 Algorithm for Generating Hash Patterns” on page 400 for a description of the MDC-4 algorithm that is used to calculate a hash pattern for a key part. The use of the verification pattern or hash pattern is optional.

Follow these steps to generate a checksum and the optional verification pattern or hash pattern for a key part.

1. Select option 4, CHECKSUM, on the ICSF Utilities panel as shown in Figure 34.

```
CSFUTL00 ---------------- ICSF - Utilities ------------------------
OPTION ===> 4


Enter the number of the desired option above.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash patterns
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 34. Selecting the Checksum Option on the ICSF Utilities Panel

The Checksum and Verification and Hash Pattern panel appears. See Figure 35 on page 105.

```
CSFMKV00 ------------ ICSF - Checksum and Verification and Hash Pattern -----
COMMAND ===>


Enter data below:

 Key Type      ===>                   (Selection panel displayed if blank)

 Key Value     ===> 51ED9CFA90716CFB  Input key value 1
               ===> 58403BFA02BD13E8  Input key value 2
               ===> 9B28AEFA8C47760F  Input key value 3 (AES & ECC & RSA Keys)
               ===> 0000000000000000  Input key value 4 (AES & ECC Keys only)

 Checksum         : 00                Check digit for key value
 Key Part VP      : 0000000000000000  Verification Pattern
 Key Part HP      : 0000000000000000  Hash Pattern
                  : 0000000000000000
```

Figure 35. ICSF Checksum and Verification and Hash Pattern Panel

If you accessed the Random Number Generator panel before this panel, the random numbers that are generated appear automatically in the Key Value fields.

2. If you did not use the Random Number Generator panel to generate random numbers, enter the numbers for which you want to create checksum, verification pattern, or hash patterns into the key value fields. Because these will be the key part values you will later specify in the Master Key Entry panels, make sure you record the numbers.
3. In the Key Type field, specify either:
   - MASTER to generate a checksum and hash and verification pattern for a DES master key part.
   - PKAMSTR to generate a checksum and hash pattern for a PKA master key part.

   If you leave the Key Type field blank and press ENTER, the Key Type Selection panel appears. See Figure 36 on page 106.

```
CSFMKV10 ------------- ICSF - Key Type Selection Panel ---- ROW 1 to 12 OF 12
COMMAND ===>                                                SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   AES-MK     AES Master Key
   ASYM-MK    Asymmetric Master key
   DES-MK     DES Master key
   ECC-MK     ECC Master key
   EXPORTER   Export key encrypting key
   IMP-PKA    Limited authority importer key
   IMPORTER   Import key encrypting key
   IPINENC    Input PIN encrypting key
s  MASTER     DES master key
   OPINENC    Output PIN encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
   PKAMSTR    PKA/Asymmetric Master key
   RSA-MK     RSA Master key
***************************** BOTTOM OF DATA ******************************
```

Figure 36. Key Type Selection Panel Displayed During Hardware Key Entry

4. Type 'S' to the left of the MASTER key type, and press ENTER to return to the Checksum and Verification Pattern panel as shown in Figure 37.

   In this example, we have selected the DES master key.

```
CSFMKV00 ------ ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


Enter data below:

 Key Type      ===> MASTER            (Selection panel displayed if blank)

 Key Value     ===> 51ED9CFA90716CFB  Input key value 1
               ===> 58403BFA02BD13E8  Input key value 2
               ===> 9B28AEFA8C47760F  Input key value 3 (AES & ECC & RSA Keys)
               ===> 0000000000000000  Input key value 4 (AES & ECC Keys only)

 Checksum        : 00                Check digit for key part
 Key Part VP     : 0000000000000000  Verification Pattern
 Key Part HP     : 0000000000000000  Hash Pattern
                 : 0000000000000000
```

Figure 37. ICSF Checksum and Verification Pattern Panel

5. On the Checksum and Verification Pattern panel, press ENTER.

   ICSF calculates the checksum, verification pattern, and hash pattern for the key part segments and displays them on the panel as shown in Figure 38 on page 107. Since a DES master key was selected for this example, the key part last segment was not used in the calculations. The key part last field is zeroed out on the panel. For a PKA master key, ICSF uses all three key part segments to calculate the checksum and hash pattern.

```
CSFMKV00 ------ ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


Enter data below:

  Key Type      ===> MASTER            (Selection panel displayed if blank)

  Key Value    ===> 51ED9CFA90716CFB  Input key value 1
               ===> 58403BFA02BD13E8  Input key value 2
               ===> 0000000000000000  Input key value 3 (AES & ECC & RSA Keys)
               ===> 0000000000000000  Input key value 4 (AES & ECC Keys only)

  Checksum         : 40                Check digit for key part
  Key Part VP      : 0CCE190A635A6C89  Verification Pattern
  Key Part HP      : EA58E51179754FB7  Hash Pattern
                   : C102957465CE479E
```

Figure 38. Checksum, Verification Pattern, and Hash Pattern Calculated for a DES Master Key Part

6. *Record the checksum, verification pattern, and hash pattern.*

   Save these values in a secure place along with the key part values in case of a tamper. If the Cryptographic Coprocessor Feature detects tampering, it clears the master key, and you have to reenter the same master key again.
7. Press END to return to the Utilities panel.
8. Press END again to return to the ICSF Primary menu.

Continue with the appropriate topic for steps to enter the master key part you have just generated.

- If you have generated the first master key part, continue with “Steps for entering the first master key part.”
- If you have generated an intermediate master key part, continue with “Steps for entering intermediate key parts” on page 110.
- If you have generated a final master key part, continue with “Steps for entering the final key part” on page 112.

Steps for entering the first master key part

Use the Master Key Entry panels to enter each key part. You can enter as many key parts as you like. When the new master key register is empty, the first key part must be identified as FIRST. Subsequent intermediate key parts must be identified as MIDDLE. To close the new master key register to prevent additional key parts from being loaded, the final key part must be identified as FINAL.

Important: When entering key part values, be aware that **you may need to reenter these same key values at a later date** to restore master key values that have been cleared. **Make sure the key parts are recorded and saved in a secure location**.

If you use the random number generator utility to generate key parts, enter each key part directly after you generate the key part data and when generating another key part.

To enter master key parts:

1. Select option 1, COPROCESSOR MGMT, on the ICSF Primary menu, as shown in Figure 39, and press ENTER.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions


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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 39. Selecting the Coprocessor Management option on the primary menu panel

The ICSF Coprocessor Management panel appears (Figure 40).

2. Select the coprocessor(s) to be processed by entering an 'E' and then pressing ENTER. Select as many coprocessors as required. This loads the same master key for all coprocessors selected.

   Note: During first time initialization, the coprocessor status will be `ONLINE`. When the master keys are set, status will be `ACTIVE`.

```
CSFCMP00 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                 STATUS
-----------  ------------------------------          -------

_ A06                                                 ACTIVE
_ A07                                                 ACTIVE
E C0         E589C396944007A6 5D40369997A386F4        ONLINE
E C1         0AA379BFD2387960 0367DC04533125FF        ONLINE
E P00        41-00YE1                                 ONLINE
E P01        41-00K11                                 ONLINE
E P02        41-0A355                                 ONLINE
E P03        41-0BA3F                                 ONLINE
_ P04        41-0RT2T                                 DEACTIVATED
_ P05        41-00342                                 DISABLED
_
```

Figure 40. Selecting the coprocessor on the Coprocessor Management Panel

3. The ICSF Master Key Entry panel appears. See Figure 41.

```
CSFDKE10------------- ICSF - Master Key Entry -----------------
COMMAND ===>

              CCF DES/PCICC SYM-MK new master key register     : EMPTY
              CCF Signature/PCICC ASYM-MK master key register  : EMPTY
              CCF Key management master key register           : EMPTY


  Specify information below
    Key Type  ===> ___                (DES, SMK, KMMK, ALL-PKA)

    Part      ===> ______             (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 40

    Key Value ===> 51ED9CFA90716CFB
              ===> 58403BFA02BD13E8
              ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)


  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 41. Master Key Entry Panel

4. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are entering the DES master key.
   b. Enter FIRST in the Part field.
   c. Enter the two-digit checksum and the two 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the two 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**
   e. When all the fields are complete, press ENTER.

      If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 42 on page 110. The new master key register status changes to `PART FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel. Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.
   f. Record the verification pattern and hash pattern.

```
CSFDKE10 -------------- ICSF - Master Key Entry --- KEY PART LOADED
COMMAND ===>

           CCF DES/PCICC SYM-MK new master key register     : PART FULL
           CCF Signature/PCICC ASYM-MK master key register  : EMPTY
           CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===> DES         (DES, SMK, KMMK, ALL-PKA)

   Part      ===> FIRST       (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)


Entered key part VP: 0CCE190A63546489  HP: 9C92A343479D33F2 66229FCD55B49C26

                    (Record and secure these patterns)

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 42. The Master Key Entry Panel Following Key Part Entry

5. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

When you have entered the first key part successfully, continue with:

- “Steps for generating key parts using ICSF utilities” on page 101 if you are using the ICSF utilities to generate random numbers for key values.
- “Steps for entering intermediate key parts” if you are entering key parts manually.

Steps for entering intermediate key parts

If you want to enter more than two key parts, you must enter one or more intermediate key parts. Enter intermediate key parts after you enter the first key part and prior to entering the final one.

To enter intermediate master key parts:

1. Select option 1, COPROCESSOR MGMT, on the ICSF Primary menu and press ENTER.

   The Coprocessor Management panel appears.
2. Select the coprocessor(s) to be processed by entering an 'E' on the Coprocessor Management panel. Select the same coprocessors that were selected when entering the first key value.

3. When pressing ENTER, the Master Key Entry panel appears (Figure 43).

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : PART FULL
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===> ___           (DES, SMK, KMMK, ALL-PKA)

   Part      ===> ______        (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 42

   Key Value ===> 4C2269A1008A754D
             ===> B7642C135F68329A
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)
```

Figure 43. The Master Key Entry Panel for Intermediate Key Values

4. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are continuing to enter the DES master key.
   b. Enter MIDDLE in the Part field.
   c. Enter the two-digit checksum and the two 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the two 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**
   e. When all the fields are complete, press ENTER.

      If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 44 on page 112. The new master key register status changes to `PART FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

      Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.
   f. Record the verification pattern and hash pattern.

```
CSFDKE10 -------------- ICSF - Master Key Entry -----KEY PART LOADED
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : PART FULL
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===> DES      (DES, SMK, KMMK, ALL-PKA)

   Part      ===> MIDDLE   (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)

 Entered key part VP:  8D8A000BE067EBF7  HP: 9D92F343479D77F2  229FD4CDB49C2679

                    (Record and secure these patterns)
```

Figure 44. The Master Key Entry Panel with Intermediate Key Values

5. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

When you have entered the middle key part successfully, continue with:

- “Steps for generating key parts using ICSF utilities” on page 101 if you are using the ICSF utilities to generate random numbers for key values.
- “Steps for entering the final key part” if you are entering key parts manually.

Steps for entering the final key part

When you enter the first key part, and any intermediate key parts, you then enter the final master key part.

1. Select option 1, COPROCESSOR MGMT, on the ICSF Primary menu and press ENTER.

   The Coprocessor Management panel appears.
2. Select the coprocessor(s) to be processed by entering an 'E' on the Coprocessor Management panel.
3. When pressing ENTER, the Master Key Entry panel appears.

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : PART FULL
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===>  ___          (DES, SMK, KMMK, ALL-PKA)

   Part      ===>  ________     (RESET, FIRST, MIDDLE, FINAL)


   Checksum  ===> 4A

   Key Value ===> 8697ACDC2431BABA
             ===> CE369D24680E9753
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)



 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 45. The Master Key Entry Panel when entering Final Key Values

4. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are continuing to enter the DES master key.
   b. Enter FINAL in the Part field.
   c. Enter the two-digit checksum and the two 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the two 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**
   e. When all the fields are complete, press ENTER.

      If the checksum entered in the checksum field matches the checksum that the Cryptographic Coprocessor Feature calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 46 on page 114. The new master key register status changes to `FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel. Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.
   f. Record the verification pattern and hash pattern.

```
CSFDKE10 -------------- ICSF - Master Key Entry ------  KEY PART LOADED
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : FULL
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===>  DES          (DES, SMK, KMMK, ALL-PKA)

   Part      ===>  FINAL        (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===>  00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)

 Entered key part VP: 8D8A000BE067EBF7 HP: 9D92F343479D77F2 229FD4CDB49C2679
 Master Key       VP: 8F887096A8D4922C HP: 4C887096A8D4922B 33387096A8D4922B
                    (Record and secure these patterns)
```

Figure 46. The Master Key Entry Panel with Final Key Values

5. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.
6. When you have entered the final key part successfully, it is combined with the first key part and any intermediate key parts in the new master key register.

   The new master key register status is now FULL, and the panel displays two verification patterns and two hash patterns. It gives you verification patterns and hash patterns for both the final key part and the new master key, since it is now complete.
7. Check that the key part verification pattern or hash pattern you may have previously calculated matches the verification pattern or hash pattern that is shown on the panel. If they do not, you may want to restart the key entry process. For information on how to restart the key entry process, see “Steps for restarting the key entry process” on page 115.
8. *Record the verification pattern and hash pattern* for the new master key, because you may want to verify it at another time.

   Note: When you initialize or reencipher a CKDS, ICSF places the verification pattern for the DES master key into the CKDS header record.

When you have entered the master key parts correctly, they are in the new master key registers and are not active on the system.

Note: Ensure that the new master key is installed on all cryptographic coprocessors.

When you enter the master keys, you should do *one* of these:

- If you are defining the DES master key and SYM-MK for the first time, initialize the CKDS with the DES master key. For a description of the process of initializing the CKDS with the DES master key on your system, see “Initializing the CKDS and PKDS at First-Time Startup” on page 117.
- If you are defining a DES master key after it was cleared, set the DES master key to make it active. For a description of the process of recovering from tampering, see “Reentering master keys when they have been cleared” on page 124.
- If you are changing a DES master key, reencipher the CKDS under the new DES master key and make it active. For a description of the process of changing a DES master key, see “Steps for changing master keys” on page 126.
- If you are changing the PKA Master Key, see “Steps for changing PKA master keys” on page 132.

Steps for restarting the key entry process

If you realize that you made an error when entering a key part, you can restart the process of entering the new master key. For example, if the verification pattern or the hash pattern that was calculated does not match the one that you calculated, you may want to restart the process. Restarting the key entry process clears the new master key register, which erases all the new master key parts you entered previously.

Note: If you are working on a CCF, when you enter the first key part, your old master key is lost, even if you restart the process.

To restart the key entry process, follow these steps:

1. On the Master Key Entry panel, enter the master key type in the Key Type field.

   In this example, we are resetting a new DES master key.
2. Enter RESET in the Part field.

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : PART FULL
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===>  DES              (DES, SMK, KMMK, ALL-PKA)

   Part      ===>  RESET_           (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===>  00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)
```

Figure 47. Selecting Reset on the Master Key Entry Panel

3. Press ENTER.

   The Restart Key Entry Process panel appears. See Figure 48 on page 116. This panel confirms your request to restart the key entry process.

```
CSFDKE40 -------------- ICSF - Restart Key Entry Process -------------
COMMAND ===>

ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


  Restarting the process will clear the DES master key register.


  WARNING: Resetting the KMMK or SMK will invalidate any private
           internal key tokens in the PKDS.


Press ENTER to confirm restart request
Press END   to cancel restart request
```

Figure 48. Confirm Restart Request Panel

Note: If you are restarting the key entry process for one or all of the PKA master keys, the panel message will differ. ICSF substitutes either 'KMMK register', 'SMK register' or 'ALL-PKA register' for ' *the DES master key register*' phrase in the panel message.

4. If you want to restart the key entry process, press ENTER.

   The restart request automatically empties the master key register.

5. If you do not want to restart, press END.

   When you make a choice, you return to the Master Key Entry panel. If you selected to continue with the restart process, the new master key register status field is reset to EMPTY, as shown in Figure 49. This indicates that the register has been cleared.

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : EMPTY
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===> ___          (DES, SMK, KMMK, ALL-PKA)

   Part      ===> ________     (RESET, FIRST, MIDDLE, FINAL)


   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)
```

Figure 49. The Master Key Entry Panel Following Reset Request

6. Either begin the key entry process again or press END to return to the ICSF primary menu panel.

Initializing the CKDS and PKDS at First-Time Startup

The first time you start ICSF, you must:

- Create a cryptographic key data set (CKDS)
- Create a PKA key data set (PKDS)
- Enter a DES new master key into the Cryptographic Coprocessor Feature
- Enter a new SYM-MK into each PCI Cryptographic Coprocessor, if you have PCICCs in your environment
- Initialize the CKDS
- Enter PKA Key Management and Signature master keys into the Cryptographic Coprocessor Feature
- Enter a new ASYM-MK into each PCI Cryptographic Coprocessor, if you have PCICCs in your environment
- Initialize the PKDS

Note: Once these tasks are completed, you should enable PKA callable services and PKDS read and write access.

When you initialize the CKDS, ICSF creates a header record for the CKDS, and sets the DES master key. Keys stored in the CKDS are enciphered under the DES master key.

CKDS

When you define the DES master key and initialize a CKDS, you can generate or enter any additional system keys you need to perform cryptographic functions.

If you are running on a IBM @server zSeries 990, and wish to share your CKDS and PKDS with an IBM @server zSeries 900 (which might be your disaster recovery site), the CKDS and PKDS should be initialized on the IBM @server zSeries 900.

There are four different types of system keys you can install in the CKDS:

- Required SYSTEM keys are automatically generated when you first initialize the CKDS. These include the MAC and MACVER keys that ICSF uses to generate and validate the MAC code in each CKDS record.
- NOCV-enablement keys are required for NOCV IMPORTERs and EXPORTERs. The NOCV-enablement system keys are used to twist on and twist off the CVs on external tokens during key import and key export. This allows ICSF to communicate with systems that do not use control vectors.
- ANSI system keys are required for almost all ANSI services to perform the notarization and offset that are required by ANSI X9.17.
- ESYS, or enhanced system keys, are used only in Symmetric Key Export service.

For information on system keys, see “Entering system keys into the cryptographic key data set (CKDS)” on page 29.

If running in a sysplex, see Chapter 9, “Running in a Sysplex Environment,” on page 191.

Steps for initializing a CKDS

You have to initialize a CKDS only the first time you start ICSF on a system. When you initialize a CKDS, you can copy the disk copy of the CKDS to create other CKDSs for use on the system. You can also use a CKDS on another ICSF system if the system has the same master key value. At any time, you can read a different disk copy into storage. For information about how to read a disk copy into storage, see “Refreshing the CKDS at any time” on page 122. For information about initializing a CKDS in a sysplex environment, see Chapter 9, “Running in a Sysplex Environment,” on page 191.

For a description of how to use the Master Key Entry panels to enter the master key, see “Steps for entering the first master key part” on page 107. For a description of how to use the TKE workstation to enter the master key, refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Starting with release HCR7780, there are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). You can use the following steps to initialize either format of CKDS.

To initialize the CKDS:

1. Return to the Primary Menu panel by pressing END from the Master Key Entry panel.
2. Select Option 2, MASTER KEY, on the Primary Menu panel as shown in Figure 50.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 2

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 50. Selecting the Master Key option on the primary menu panel

The Master Key Management panel appears. See Figure 51 on page 119.

```
CSFMKM00 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1


Enter the number of the desired option above.

  1 INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                       activate an updated Cryptographic Key Data Set
  2 SET MK            - Set a symmetric (DES or AES) master key
  3 REENCIPHER CKDS   - Reencipher the CKDS prior to changing a symmetric
                        master key
  4 CHANGE MK         - Change a symmetric master key and
                        activate the reenciphered CKDS
  5 INITIALIZE PKDS   - Initialize or update a PKA Cryptographic
                        Key Data Set header record
  6 REENCIPHER PKDS   - Reencipher the PKA Cryptographic Key Data Set
  7 REFRESH PKDS      - Activate an updated PKA Cryptographic Key Data Set
```

Figure 51. ICSF Master Key Management Panel

3. Select option 1, INIT/REFRESH CKDS and the Initialize a CKDS panel appears. See Figure 52.

```
CSFCKD00 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===> 1


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 52. ICSF Initialize a CKDS Panel

4. In the CKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the CKDS.

   The name you enter should be the same name that is specified in the CKDSN installation option in the installation options data set. For information about creating a CKDS and specifying the CKDS name in the installation options data set, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

5. Choose option 1, Initialize an empty CKDS, and press ENTER.

   ICSF creates the header record in the disk copy of the CKDS. Next, ICSF sets the DES master key. ICSF then adds the required system keys to the CKDS and refreshes the CKDS. When ICSF completes all these steps, the message `INITIALIZATION COMPLETE` appears. If you did not enter a master key into the new master key register previously, the message `NMK REGISTER NOT FULL` appears and the initialization process ends. You must enter a master key into the new master key register to initialize the CKDS.

Note: If any part of the option 1 fails, you must delete the CKDS and start over. If the failure occurs when the master key has been set and before the system keys have been created, you will need to reset the master keys.

6. If you want ICSF to create NOCV-enablement keys when the initialization process has been completed, select option 2, NOCVKEYS, and press ENTER.

   The creation of NOCV-enablement keys is optional. It allows you to use either the key generator utility program or the Key Token Build callable service to create NOCV keys. NOCV keys allow you to send and receive keys from systems that do not use control vectors. For a description of NOCV keys, see the description of the NOCV keyword for the key generator utility program on 225.

   Note: If you want to run the ICSF conversion program to convert a PCF CKDS into ICSF format, the CKDS you start ICSF with must contain NOCV-enablement keys. For more information about the conversion program, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

7. To create ANSI system keys that are used for the ANSI X9.17 services, choose option 3, ANSI.

   The creation of ANSI system keys is optional. ANSI system keys are required if you intend to also create enhanced system keys.

   The message `ANSI KEYS ADDED` appears on the top right of the panel, if the process succeeds.

8. To create enhanced system keys, choose option 4, ESYS.

   The creation of enhanced system keys is optional. To create enhanced system keys, you must have previously installed the ANSI system keys in the CKDS.

   The message `ESYS KEYS ADDED` appears on the top right of the panel, if the process succeeds.

When you complete the entire process, a master key and CKDS exist on your system. You can now generate keys using the key generate callable service and key generator utility program, or convert PCF keys to ICSF keys using the conversion program. ICSF services use the keys to perform the cryptographic functions you request.

Note: You enable special secure mode to initialize ICSF for the first time. When you perform the initialization process, you may choose to disable special secure mode.

PKDS

You normally have to initialize a PKDS only the first time you start ICSF on a system. However, depending on your system configuration, on a legacy machine that has a PKDS that doesn't have any keys, the PKDS will need to be initialized. Until this is done, PKA Callable Services cannot be enabled.

When you initialize a PKDS, you can copy the disk copy of the PKDS to create other PKDSs for use on the system. You can also use a PKDS on another ICSF system if the system has the same master key value.

For a description of how to use the Master Key Entry panels to enter the master key, see “Steps for entering the first master key part” on page 151. For a description of how to use the TKE workstation to enter the master key, refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Steps for initializing the PKDS

To initialize the PKDS:

1. Return to the Primary Menu panel by pressing END from the Master Key Entry panel.
2. Select Option 2, MASTER KEY, on the Primary Menu panel as shown in Figure 53.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 2

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 53. Selecting the Master Key option on the primary menu panel

The Master Key Management panel appears. See Figure 54.

```
CSFMKM00 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1


Enter the number of the desired option above.

  1 INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                       activate an updated Cryptographic Key Data Set
  2 SET MK            - Set a symmetric (DES or AES) master key
  3 REENCIPHER CKDS   - Reencipher the CKDS prior to changing a symmetric
                       master key
  4 CHANGE MK         - Change a symmetric master key and
                       activate the reenciphered CKDS
  5 INITIALIZE PKDS   - Initialize or update a PKA Cryptographic
                       Key Data Set header record
  6 REENCIPHER PKDS   - Reencipher the PKA Cryptographic Key Data Set
  7 REFRESH PKDS      - Activate an updated PKA Cryptographic Key Data Set
```

Figure 54. ICSF Master Key Management Panel

3. Select option 5, INITIALIZE PKDS and the Initialize a PKDS panel appears. See Figure 55 on page 122.

```
CSFCMK30 ---------------- ICSF - Initialize a PKDS  ----------------
COMMAND ===>


Enter the name of the PKDS to be initialized below.

  PKDS ===> 'FIRST.EMPTY.PKDS'
```

Figure 55. ICSF Initialize a PKDS Panel

4. In the PKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the PKDS.
5. The PKDS must now be refreshed to become active. Return to the previous panel and select option 7.

```
CSFCMK21 ---------- ICSF - Refresh PKA Cryptographic Key Data Set -------
COMMAND ===>


Enter the name of the new PKDS below.

   New PKDS ===> 'PKDS.NEW.MASTER'

Press ENTER to refresh the PKDS.
Press END   to exit to the previous menu
```

Figure 56. Refresh PKDS

   When you press ENTER, the PKDS is refreshed and becomes the in-storage copy.
6. In the New PKDS field, enter the name the initialized PKDS to make it the active PKDS.

Refreshing the CKDS at any time

When you initialize a CKDS for the first time, you can copy the disk copy of the CKDS to create other CKDSs for the system. You can use KGUP to add and update any of the disk copies on your system. You can use the dynamic CKDS update callable services to add or update the disk copy of the current in-storage CKDS. For information about using KGUP, see Chapter 10, “Managing Cryptographic Keys Using the Key Generator Utility Program,” on page 215. For information on using the dynamic CKDS callable services, refer to the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Steps for refreshing the CKDS

You can refresh the in-storage CKDS with an updated or different disk copy of the CKDS by using these steps. You can refresh the CKDS at any time without disrupting cryptographic functions.

Note: When you refresh a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration updates” on page 216.

1. Enter option 2, MASTER KEY, on the ICSF Primary Menu panel to access the Master Key Management Panel.
2. Enter option 1, INIT/REFRESH CKDS to access the Initialize a CKDS panel, which is shown in Figure 57 on page 123.

```
CSFCKD00 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>  5


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)

  2  NOCVKEYS  -  Create NOCV-Enablement keys (for keys without CVs)
  3  ANSI      -  Create ANSI system keys (for ANSI X9.17 services)
  4  ESYS      -  Create enhanced system keys (for Symmetric services)

  5  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'PIN1.CKDS'
```

Figure 57. Selecting the Refresh Option on the ICSF Initialize a CKDS Panel

3. In the CKDS field, specify the name of the disk copy of the CKDS that you want ICSF to read into storage.
4. Choose option 5, REFRESH, and press ENTER.

   ICSF places the disk copy of the specified CKDS into storage. During a REFRESH, ICSF does not load into storage any partial keys that may exist when you enter keys manually. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the CKDS was refreshed appears on the right of the top line on the panel.

   When ICSF reads the CKDS into storage, it performs a MAC verification on each record in the CKDS. If a record fails the MAC verification, ICSF sends a message that gives the key label and type to the z/OS system security console. You can then use either KGUP or the dynamic CKDS update services to delete the record from the CKDS. Any other attempts to access a record that has failed MAC verification results in a return code and reason code that indicate that the MAC is not valid.
5. Press END to return to the Primary Menu panel.

Note: You can use either a KGUP panel or a utility program, instead of the CKDS panel, to refresh the CKDS. For information about these other methods, see “Refreshing the In-Storage CKDS” on page 250.

Refreshing the PKDS at any time

When you initialize a PKDS for the first time, you can copy the disk copy of the PKDS to create other PKDSs for the system. You can use the dynamic PKDS update callable services to add or update the disk copy of the current in-storage PKDS. For information on using the dynamic PKDS callable services, refer to the *z/OS Cryptographic Services ICSF Application Programmer's Guide*. You can refresh the in-storage PKDS with an updated or different disk copy of the PKDS by using these steps. You can refresh the PKDS at any time without disrupting cryptographic functions.

Note: Prior to refreshing a PKDS, consider temporarily disallowing PKDS write, create and delete services using the ICSF Administrative Control Functions panel.

1. Enter option 2, MASTER KEY MGMT, on the ICSF Primary Menu panel to access the Master Key Management Panel.

2. Enter option 7, REFRESH PKDS to access the Refresh PKA Cryptographic Key Data Set panel, which is shown in Figure 56 on page 122
3. In the New PKDS field, specify the name of the disk copy of the PKDS that you want ICSF to read into storage. ICSF places the disk copy of the specified PKDS into storage. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the PKDS was refreshed appears on the right of the top line on the panel.
4. Press END to return to the Primary Menu panel.

Reentering master keys when they have been cleared

In these situations, the Cryptographic Coprocessor Feature clears the master key registers so that the master key values are not disclosed.

- If the Cryptographic Coprocessor Feature detects tampering
- If you issue a command from the TKE workstation to zeroize a domain
- If you issue a command from the Support Element to zeroize all domains

In these situations, the PCI Cryptographic Coprocessor Feature (PCICC) clears the master key registers so that the master key values are not disclosed.

- If the PCI Cryptographic Coprocessor Feature detects tampering (the intrusion latch is tripped), ALL installation data is cleared: master keys, retained keys for all domains, as well as roles and profiles.
- If the PCI Cryptographic Coprocessor Feature detects tampering (the secure boundary of the card is compromised), it self-destructs and can no longer be used.
- If you issue a command from the TKE workstation to zeroize a domain

  This command zeroizes the master key data specific to the domain.
- If you issue a command from the Support Element panels to zeroize all domains.

  This command zeroizes ALL installation data: master keys, retained keys and access control roles and profiles.

Although the values of the master keys are cleared, the keys in the CKDS are still enciphered under the cleared DES master key. The RSA and DSS private keys are also each enciphered under one of the cleared PKA master keys. Therefore, to recover the keys in the CKDS, and the PKA private keys, you must reenter the same master keys and set the DES master key. For security reasons, you may then want to change all the master keys.

PR/SM Considerations: If you are running in PR/SM logical partition (LPAR) mode, there are several situations (listed previously) that can cause loss of master keys and other data. In these cases, you must first ensure that key entry is enabled for each LP on the Change LPAR Crypto page on the support element Hardware Master Console. You must then reenter the master keys in each LP. If you zeroize a domain using the TKE workstation, however, the master keys are cleared only in that domain. Master keys in other domains are not affected and do not need to be reentered. For more information about reentering master keys in LPAR mode, see Appendix D, “PR/SM Considerations during Key Entry,” on page 403.

Steps to reenter cleared master keys

Note: If PPINIT was used initially, you must rerun the utility with the same pass phrase to reenter the cleared master keys.

When the Cryptographic Coprocessor Feature clears the master keys, reenter the same master keys using these steps:

1. Check the status of the PKA callable services. If they are enabled, use the Administrative Control Functions to disable them. See “Steps for enabling and disabling PKA services” on page 131 for details.
2. Retrieve the key parts, checksums, verification patterns, and hash patterns you used when you entered the master keys originally.

   These values should be stored in a secure place as specified in your enterprises security process.
3. Access the Master Key Entry panels and enter the master keys as described in “Steps for entering the first master key part” on page 107.
4. When you enter the new DES master key, select option 2, MASTER KEY, from the primary menu. The Master Key Management panel appears. See Figure 58.

   To activate the DES master key you just entered, you need to set it.
5. To set the DES master key, choose option 2 on the panel and press ENTER.

```
CSFMKM00 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1


Enter the number of the desired option above.

  1 INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                       activate an updated Cryptographic Key Data Set
  2 SET MK            - Set a symmetric (DES or AES) master key
  3 REENCIPHER CKDS   - Reencipher the CKDS prior to changing a symmetric
                       master key
  4 CHANGE MK         - Change a symmetric master key and
                       activate the reenciphered CKDS
  5 INITIALIZE PKDS   - Initialize or update a PKA Cryptographic
                       Key Data Set header record
  6 REENCIPHER PKDS   - Reencipher the PKA Cryptographic Key Data Set
  7 REFRESH PKDS      - Activate an updated PKA Cryptographic Key Data Set
```

Figure 58. Selecting the Set Host Master Key Option on the ICSF Master Key Management Panel

When you select option 2, ICSF checks that the states of the registers are correct. ICSF then transfers the DES master key from the new master key register to the master key register. This process sets the DES master key.

When ICSF attempts to set the DES master key, it displays a message on the top right of the Master Key Management panel. The message indicates either that the master key was successfully set, or that an error prevented the completion of the set process.

Notes:

a. If your system is using both crypto modules provided by a Cryptographic Coprocessor Feature, ICSF sets the DES master key for each crypto module whose new DES master key enciphers the in-storage CKDS. You should reenter the DES master key into the new master key register for each of the crypto modules.

b. The operator console receives messages that state that the crypto module is offline and then online for each crypto module. These actions should not affect cryptographic operations. However, if a crypto module does not have

either a current DES master key or a new DES master key that enciphers the current in-storage CKDS, the crypto module is left offline.

When you set the reentered DES master key, the DES master key that enciphers the existing CKDS now exists.

6. You can now change the DES master key, if you choose to, for security reasons. Continue with “Steps for changing master keys.”

Steps for changing master keys

For security reasons your installation should change the master keys periodically. In addition, if the master keys have been cleared, you may also want to change the master keys when you reenter the cleared master keys.

There are three main steps involved in changing the DES master key:
1. Enter the DES and SYM-MK master key parts.
2. Reencipher the CKDS under the new DES master key.
3. Change the new DES master key and activate the reenciphered CKDS.

Note: When changing the master key, remember to change the name of the CKDS in the Installation Options Data Set.

There are six main steps involved in changing the PKA master keys:
1. Disable PKA Services
2. Enter the PKA master keys (SMK and KMMK, if equal to the SMK) and ASYM-MK.
3. Reencipher the PKDS under the new PKA master keys.
4. Refresh the PKDS.
5. Enable PKA Services
6. Enable PKDS read and write access.

Notes:

1. PKA master keys should only be changed if there is a PCICC available on the system.
2. When changing the master key, remember to change the name of the PKDS in the Installation Options Data Set.

DES master keys and the CKDS

The step-by-step procedure for changing the DES master key, reenciphering the CKDS, and activating the new DES master key are presented in “Steps for changing the DES master key and reenciphering the CKDS” on page 128. This topic provides some background on the contents of the master key registers during the key change process, and some compatibility mode considerations.

A DES master key and a CKDS that contains keys that are enciphered under that DES master key already exist. When you replace this existing DES master key with the new DES master key, you must reencipher the CKDS under the new DES master key.

Note: When you reencipher a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration updates” on page 216.

For the CCF, if you changed the DES master key previously, the previous DES master key was stored in the auxiliary (or new/old) master key register. The currently active DES master key exists in the master key register. When you enter

the key parts of a new DES master key, they displace the previous DES master key in the auxiliary master key register. Therefore, the previous DES master key is lost. This is not true for the PCICC, which has separate registers for the old, new and current master key.

If you are using the Cryptographic Coprocessor Feature (CCF), to make the new DES master key the current active DES master key, you have ICSF swap the contents of the master key register and the auxiliary master key register. If you also have the PCICC, ICSF will change the PCI SYM-MKs. In this way, the new DES master key you have just entered becomes the current DES master key, and the previous DES master key is stored in the auxiliary master key register.

When the new DES master key is placed into the master key register, you must reencipher all disk copies of the CKDS under the new DES master key. Then you are ready to activate the master key. When you change the master key, you have ICSF replace the in-storage copy of the CKDS with the reenciphered disk copy. This also makes the new master key active on the system.

The procedures you use to activate the new master key depend on your system's compatibility mode. ICSF runs in noncompatibility, compatibility, or co-existence mode with the IBM cryptographic products and Programmed Cryptographic Facility (PCF). You specify which mode ICSF runs in by using an installation option. For a description of the modes and how to specify an installation option, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

In noncompatibility mode, ICSF allows you to change the master key with continuous operations. Therefore applications can continue to run without disruption. However, when ICSF is in compatibility mode or co-existence mode, you should use a different procedure to activate the changed master key. This is to ensure that no application is holding an internal token with the wrong master key.

In all three modes, you enter the new master key and reencipher the disk copy of the CKDS under the new master key using the master key panels. In noncompatibility mode, you then activate the new master key and refresh the in-storage copy of the CKDS with the disk copy using the master key panels or a utility program.

In compatibility mode and coexistence mode, however, activating the new master key and refreshing the in-storage copy of the CKDS does not reencipher internal key tokens under the new master key. ICSF applications that are holding internal key tokens which have been enciphered under the wrong master key will fail with a warning message. Applications that use the PCF macros, run with no warning message and produce erroneous results.

If you are using the CCF, the safest method to use when changing the master key in either compatibility or coexistence mode is as follows:
1. Ensure that the name of the new CKDS is in the installation data set.
2. Re-IPL MVS.
3. Start CSF.

If you also have PCICC installed, when you start CSF, you must go to the Master Key Management panel (Figure 58 on page 125) and do a set (option 2). This will change the master keys of all the PCICC that match the CCF.

A re-IPL ensures that a program does not access a cryptographic service that uses a key that is encrypted under a different master key. If a program is using an operational key, the program should either re-create or reimport the key, or generate a new key.

If a re-IPL is not practical in your installation, you can use this alternative method. Stop all cryptographic applications, especially those using PCF macros, when activating the new master key and refreshing the in-storage copy of the CKDS. This eliminates all operational keys that are encrypted under the current master key. When you start CSF again, applications using an operational key can either re-create or reimport the key.

Steps for changing the DES master key and reenciphering the CKDS

For information about reenciphering a CKDS in a sysplex environment, see Chapter 9, “Running in a Sysplex Environment,” on page 191.

1. Enter the key parts of the new master key that you want to replace the current master key. For information about how to do this procedure, see “Entering master key parts” on page 99.

   The new master key register must be full when you change the master key.
2. Select option 3, REENCIPHER CKDS, on the Master Key Management panel, as shown in Figure 59, and press ENTER.

   When you change the master key, you must first reencipher the disk copy of the CKDS under the new master key.

   Notes:

   a. If your system is using multiple coprocessors, they must have the same master key. When you change the master key in one coprocessor, you should change the master key in the other coprocessors. Therefore, when you reencipher a CKDS under a new master key, the new master key registers in all coprocessors must contain the same value.

   b. If the CKDS contains HMAC keys, it must be reenciphered on a system with a CEX3C and the Sept. 2010 or later licensed internal code.

```
CSFMKM00 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1


Enter the number of the desired option above.

  1 INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                       activate an updated Cryptographic Key Data Set
  2 SET MK            - Set a symmetric (DES or AES) master key
  3 REENCIPHER CKDS   - Reencipher the CKDS prior to changing a symmetric
                       master key
  4 CHANGE MK         - Change a symmetric master key and
                       activate the reenciphered CKDS
  5 INITIALIZE PKDS   - Initialize or update a PKA Cryptographic
                       Key Data Set header record
  6 REENCIPHER PKDS   - Reencipher the PKA Cryptographic Key Data Set
  7 REFRESH PKDS      - Activate an updated PKA Cryptographic Key Data Set
```

Figure 59. Selecting the Reencipher CKDS option on the ICSF Master Key Management Panel

3. The Reencipher CKDS panel appears. See Figure 60 on page 129.

```
CSFCMK10 ----------------- ICSF - Reencipher CKDS ------------------
COMMAND ===>


To reencipher all CKDS entries from encryption under the current master key
to encryption under the new master key enter the CKDS names below.



   Input CKDS ===> 'CKDS.CURRENT.MASTER'

   Output CKDS ===> 'CKDS.NEW.MASTER'
```

Figure 60. Reencipher CKDS

4. In the Input CKDS field, enter the name of the CKDS that you want to reencipher. In the Output CKDS field, enter the name of the data set in which you want to place the reenciphered keys.

   Notes:

   a. The output data set should already exist although it must be empty. For more information about defining a CKDS, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

   b. The input CKDS and the output CKDS must have the same VSAM attributes.

   Reenciphering the disk copy of the CKDS does not affect the in-storage copy of the CKDS. On this panel, you are working with only a disk copy of the CKDS.

5. Press ENTER to reencipher the input CKDS entries and place them into the output CKDS.

   The message REENCIPHER SUCCESSFUL appears on the top right of the panel if the reencipher succeeds.

6. If you have more than one CKDS on disk, specify the information and press ENTER as many times as you need to reencipher all of them. Reencipher all your disk copies at this time. When you have reenciphered all the disk copies of the CKDS, you are ready to change the master key.

7. Press END to return to the Master Key Management panel.

   Changing the master key involves refreshing the in-storage copy of the CKDS with a disk copy and activating the new master key.

8. If you are running in compatibility or co-existence mode, *do not* select option 4, the Change option. To activate the changed master key when running in compatibility or co-existence mode, you need to re-IPL MVS and start ICSF. When you re-IPL MVS and start ICSF, you activate the changed master key and refresh the in-storage CKDS. To do this, you must exit the panels at this time.

9. If you are running in noncompatibility mode, to change the master key select option 4, CHANGE MK, on the Master Key Management panel.

   When you press the ENTER key, the Change Master Key panel appears. See Figure 61.

```
CSFCMK20 ---------------------- ICSF Change Master Key --------------
COMMAND ===>


Enter the name of the new CKDS below:

  New CKDS ===> 'CKDS.NEW.MASTER'

When the master key is changed, the new CKDS will become active.
```

Figure 61. Change Master Key Panel

10. In the New CKDS field, enter the name of the disk copy of the CKDS that you want ICSF to place in storage.

    You should have already reenciphered the disk copy of the CKDS under the new master key. The last CKDS name that you specified in the Output CKDS field on the Reencipher CKDS panel, which is shown in Figure 60 on page 129, automatically appears in this field.

11. Press ENTER.

    ICSF loads the data set into storage where it becomes operational on the system. ICSF also places the new master key into the master key register so it becomes active.

    When you press ENTER, ICSF attempts to change the master key. It displays a message on the top right of the panel. The message indicates either that the master key was changed successfully or that an error occurred that prevented the successful completion of the change process. For example, if you indicate a data set that is not reenciphered under the new master key, an error message displays, and the master key is not changed.

    Note: Each Cryptographic Coprocessor Feature includes two crypto modules, which ICSF recognizes as C0 and C1. You must enter the new master key into each of the coprocessors, when you perform the change. ICSF activates the new master key of both coprocessors that contain a new master key value that will encipher the CKDS. If you also have PCICCs on your system, load the new master key into all of the coprocessors.

    If only one coprocessor new master key value matches the new CKDS, then that coprocessor will be used. The other coprocessor will remain offline until the new master key is changed to match the other coprocessor.

    When the change occurs, the operator console receives messages that state that the Cryptographic Coprocessor Feature is offline and then online for each coprocessor. These actions should not affect cryptographic operations.

    If there is a problem reenciphering a CKDS entry, then the CSFC0316 message is generated specifying the label for the CKDS problem entry.

12. When changing the master key, remember to change the name of the CKDS in the Installation Options Data Set.

You can use a utility program to reencipher the CKDSs and change the master key instead of using the panels. “Reenciphering a disk copy of a CKDS and changing the master key” on page 359 describes how to use the utility program for these procedures.

PKA master keys and the PKDS

The step-by-step procedure for changing the PKA master keys is documented in this topic. The procedure assumes that SMK=KMMK. It is recommended that the KMMK=SMK to maximize the routing capability to the PCICC and to enable PKDS reencipher. Once that is completed, it is necessary to reencipher and activate the PKDS.

If the SMK does not equal KMMK, see “Steps for setting the SMK equal to the KMMK” on page 138.

Attention: If you do not have a PCICC, you should not change the PKA Master Keys. Changing the PKA master keys will make all internal tokens in the current PKDS unusable. You will need to reencipher and activate the PKDS in order to use them with the changed master key. This requires a PCICC on your system. See “Steps for reenciphering and refreshing the PKDS” on page 136 for more information.

When the PKDS is shared by multiple images in a sysplex environment, the PKA master key must also be changed on all the sharing systems. See Chapter 9, “Running in a Sysplex Environment,” on page 191.

Steps for enabling and disabling PKA services

When you enter or change the PKA master keys or the ASYM-MK, you must first disable the PKA services. To enable or disable PKA services:

1. Access the administrative control functions by choosing option 4, ADMINCNTL, on the Primary Menu panel, as shown in Figure 62 on page 132.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility -------
OPTION ===> 4

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions


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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 62. Selecting Administrative Control on the ICSF Primary Menu Panel

The Administrative Control Function panel appears. See Figure 63.

```
CSFACF00 ------------- ICSF Administrative Control Functions
COMMAND ===>
          Active CKDS: CRYPTO25.HCR7704.CKDS
          Active PKDS: CRYPTO25.HCR7704.PKDS
          Active TKDS: CRYPTO25.HCR7704.TKDS

To change the status of a control, enter the appropriate character
(E - ENABLE, D - DISABLE) and press ENTER.

         Function                                  STATUS
         --------                                  ------
.  Dynamic CKDS Access                           ENABLED
.  PKA Callable Services                         ENABLED
.  Dynamic PKDS Access                           ENABLED
```

Figure 63. Enabling and Disabling the PKA Callable Services

2. Enter the appropriate character and press ENTER.
   - To enable the PKA callable services, enter an 'E' before the PKA Callable Services function.

     Note: If using a PKDS, you must also enable Dynamic PKDS Access.
   - To disable the PKA callable services, enter a 'D' before the PKA Callable Services function.

     Note: Disabling PKA callable services also disables Dynamic PKDS Access.

Steps for changing PKA master keys

To change the PKA master keys:

1. Disable the PKA callable services as described previously.

2. Return to the primary menu and select option 1, COPROCESSOR MGMT, and press enter.

   The Coprocessor Management panel appears.

```
CSFCMP00 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                  STATUS
-----------  -------------------------------          -------

_ A06                                                  ACTIVE
_ A07                                                  ACTIVE
E C0         E589C396944007A6 5D40369997A386F4         ACTIVE
E C1         0AA379BFD2387960 0367DC04533125FF         ACTIVE
E P00        41-00YE1                                  ACTIVE
E P01        41-00K11                                  ACTIVE
E P02        41-0A355                                  ACTIVE
_ P03        41-0BA3F                                  ONLINE
_ P04        41-0RT2T                                  DEACTIVATED
_ P05        41-00342                                  DISABLED
```

Figure 64. Selecting the coprocessor on the Coprocessor Management Panel

3. Select the coprocessor(s) for PKA master key entry by entering 'E' before the coprocessor and pressing enter.

   The Master Key Entry panel appears. See Figure 65. You need to RESET to clear the contents of the registers so you can set a new key value.

   In this example, ALL-PKA has been entered, as SMK=KMMK. If this was not the case, SMK would have been used.

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : EMPTY
             CCF Signature/PCICC ASYM-MK master key register  : NOT THE SAME
             CCF Key management master key register           : FULL


 Specify information below
   Key Type  ===> ALL-PKA      (DES, SMK, KMMK, ALL-PKA)

   Part      ===> RESET        (RESET, FIRST, MIDDLE, FINAL)


   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)
```

Figure 65. The Master Key Entry Panel to Reset Registers

4. When you select RESET, the Restart Key Entry Process panel is displayed. See Figure 66 on page 134.

This panel confirms your request to restart the key entry process. Press ENTER.

```
CSFDKE40 -------------- ICSF - Restart Key Entry Process -------------


ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


  Restarting the process will clear the ALL-PKA master key register.


 WARNING:  Resetting the KMMK or SMK will invalidate any private
           internal key tokens in the PKDS


Press ENTER to confirm restart request
Press END   to  cancel restart request
```

Figure 66. Confirm Restart Request Panel

5. The Master Key Entry panel again appears. See Figure 67. Enter the type of PKA master key you are changing and enter the key part.

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : EMPTY
             CCF Signature/PCICC ASYM-MK master key register  : EMPTY
             CCF Key management master key register           : EMPTY


 Specify information below
   Key Type  ===> ALL-PKA      (DES, SMK, KMMK, ALL-PKA)

   Part      ===> FIRST        (RESET, FIRST, MIDDLE, FINAL)


   Checksum  ===> 59

   Key Value ===> 8F887096A8D4922B
             ===> 75D1189666F4DAA7
             ===> 9B28AEFA8C47760F  (SMK, KMMK and ALL-PKA only)
```

Figure 67. The Master Key Entry Panel with First Key Values

6. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are entering ALL-PKA. A PKA master key requires at least two key parts. You may enter additional key parts if necessary. ALL-PKA includes the SMK, KMMK and ASYM-MK.
   b. Enter FIRST in the Part field.
   c. Enter the two-digit checksum and the three 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the three 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**

e. When all the fields are complete, press ENTER.

   If the checksum entered in the checksum field matches the checksum that the cryptographic coprocessor calculated, the key part is accepted. The message at the top of the panel will now state `KEY PART LOADED`.

   The Signature/PCICC ASYM-MK register status and KMMK status change to `PART FULL`. The hash pattern that is calculated for the key part appears near the bottom of the panel. Compare it with the pattern generated by the checksum, VP, HP utility or provided by the person who gave you the key part value to enter.

f. Record the hash pattern.

7. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.
8. Now enter the FINAL key part.

```
CSFDKE10 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : EMPTY
             CCF Signature/PCICC ASYM-MK master key register  : NOT THE SAME
             CCF Key management master key register           : FULL


 Specify information below
   Key Type  ===> ALL-PKA      (DES, SMK, KMMK, ALL-PKA)

   Part      ===> FINAL        (RESET, FIRST, MIDDLE, FINAL)


   Checksum  ===> 53

   Key Value ===> 8FDAD096A8D4922B
             ===> 75D1189ADAF4DAA7
             ===> 9B28333A8C47760F  (SMK, KMMK and ALL-PKA only)
```

Figure 68. The Master Key Entry Panel with Final Key Values

9. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are entering ALL-PKA. ALL-PKA includes the SMK, KMMK and ASYM-MK.

   b. Enter FINAL in the Part field.
   c. Enter the two-digit checksum and the three 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the three 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**

e. When all the fields are complete, press ENTER.

   If the checksum entered in the checksum field matches the checksum that the cryptographic coprocessor calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 68 on page 135.

   The Signature/PCICC ASYM-MK master key register status changes to `NOT THE SAME`. This is because the PCICC current ASYM-MK register is loaded with the value in the new master key register and the new ASYM-MK register is empty. The KMMK status changes to `FULL`.

   The hash pattern that is calculated for the key part appears near the bottom of the panel. Compare it with the pattern generated by the checksum, VP, HP utility or provided by the person who gave you the key part value to enter.

f. Record the hash pattern.

10. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
    a. Reenter the checksum.
    b. If you still get a checksum error, recalculate the checksum.
    c. If your calculations result in a different value for the checksum, enter the new value.
    d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.
11. When you have entered the PKA master keys correctly, the PKA master key registers are active when the final key part is loaded. You must then reencipher and activate the PKDS (“Steps for reenciphering and refreshing the PKDS”) and enable PKA callable services “Steps for enabling and disabling PKA services” on page 131. Also enable PKDS Read and PKDS Write, Create and Delete.
12. When changing the master key, remember to change the name of the PKDS in the Installation Options Data Set.

Steps for reenciphering and refreshing the PKDS

When changing the PKA master keys, you must reencipher the private keys.

Note: Beginning with HCR7750, LRECL length in the PKDS has increased. You can share the larger PKDS with down-level systems by installing the toleration APAR OA21807. Even with toleration APAR OA21807 installed, however, be aware that reencipherment of a larger PKDS must always be performed on an HCR7750 or later system.

1. To reencipher the PKDS when the PKA SMK and ASYM-MK have been changed, go to the Master Key Management panel and select option 6.

   Note: Only keys enciphered under the SMK and the ASYM-MK are reenciphered. PKDS reencipher will not be able to reencipher private keys encrypted under the CCF key management key (KMMK) if the KMMK does not equal the SMK. If this is the case, see “Steps for setting the SMK equal to the KMMK” on page 138 when you reencipher.

```
CSFMKM00 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  6


Enter the number of the desired option above.

  1 INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                       activate an updated Cryptographic Key Data Set
  2 SET MK            - Set a symmetric (DES or AES) master key
  3 REENCIPHER CKDS   - Reencipher the CKDS prior to changing a symmetric
                        master key
  4 CHANGE MK         - Change a symmetric master key and
                        activate the reenciphered CKDS
  5 INITIALIZE PKDS   - Initialize or update a PKA Cryptographic
                        Key Data Set header record
  6 REENCIPHER PKDS   - Reencipher the PKA Cryptographic Key Data Set
  7 REFRESH PKDS      - Activate an updated PKA Cryptographic Key Data Set
```

Figure 69. Selecting the Reencipher PKDS Option on the Master Key Management Panel

2. The Reencipher PKDS panel appears. In the Input PKDS field, specify the name of the PKDS that you want ICSF to reencipher under the current SMK and ASYM-MK.

   In the Ouput PKDS field, specify the name of an empty VSAM data set. ICSF places the reenciphered keys in this data set.

```
CSFCMK11 ---------------- ICSF - Reencipher PKDS -------------
COMMAND ===>


 To reencipher all PKDS entries from encryption under the old RSA master
 key and/or current ECC master keys to encryption under the current RSA
 master key and/or new ECC master key, enter the PKDS names below.


   Input PKDS   ===> 'PKDS.CURRENT.MASTER'

   Output PKDS ===> 'PKDS.NEW.MASTER'

Press ENTER to reencipher the PKDS.
Press END   to exit to the previous menu
```

Figure 70. Reencipher PKDS

   Press enter to reencipher the PKDS. Once successful, you have to refresh the PKDS. Return to the Master Key Management panel and select option 7.

```
CSFMKM00 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  7


Enter the number of the desired option above.

  1 INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                       activate an updated Cryptographic Key Data Set
  2 SET MK            - Set a symmetric (DES or AES) master key
  3 REENCIPHER CKDS   - Reencipher the CKDS prior to changing a symmetric
                       master key
  4 CHANGE MK         - Change a symmetric master key and
                       activate the reenciphered CKDS
  5 INITIALIZE PKDS   - Initialize or update a PKA Cryptographic
                       Key Data Set header record
  6 REENCIPHER PKDS   - Reencipher the PKA Cryptographic Key Data Set
  7 REFRESH PKDS      - Activate an updated PKA Cryptographic Key Data Set
```

Figure 71. Selecting the Activate PKDS Option on the Master Key Management Panel

The Refresh PKDS panel appears. Enter the name of the PKDS that you want ICSF to use. The PKDS must have already been reenciphered under the current Signature/Asymmetric-keys master key.

```
CSFCMK21 ---------- ICSF - Refresh PKA Cryptographic Key Data Set -------
COMMAND ===>


Enter the name of the new PKDS below.

   New PKDS ===> 'PKDS.NEW.MASTER'

Press ENTER to refresh the PKDS.
Press END   to exit to the previous menu
```

Figure 72. Refresh PKDS

When you press ENTER, the PKDS becomes active.

Steps for setting the SMK equal to the KMMK

It is highly recommended that the KMMK, SMK and ASYM-MK be equal. This will facilitate migration to new features on crypto hardware.

If you are a new user and using Pass Phrase Initialization, ensure that you answer Y for `Signature MK = Key Management MK?` on Figure 11 on page 79. If using Clear Key Entry, make sure that you enter the same value for your SMK and KMMK.

If you are an existing user and for some reason your KMMK does not equal the SMK and ASYM-MK, you should follow this procedure. You must have a PCICC on your system.

1. Disable PKA services (see “Steps for enabling and disabling PKA services” on page 131).
2. Determine the value of the SMK
   a. If you used Pass Phrase Initialization, go to the main menu and and choose option 5, UTILITY. Select option 5, PPKEYS.

```
CSFUTL00 ---------------- ICSF - Utilities --------------------------
OPTION ===> 5


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 73. ICSF Utilities Panel

The Master Key Values from Pass Phrase panel appears (Figure 74).

```
 CSFPPM00 ------------ ICSF - Master Key Values from Pass Phrase -----

Pass Phrase ( 16 to 64 characters)
 ==>_____________________________________________________________

Signature/Asymmetric-keys master key  : 0000000000000000
                                      : 0000000000000000
                                      : 0000000000000000

Key Management master key             : 0000000000000000
                                      : 0000000000000000
                                      : 0000000000000000
```

Figure 74. ICSF Master Key Values from Pass Phrase Panel

Enter the previously used pass phrase and your SMK and KMMK values will be displayed.

b. If you used Master Key entry, you must retrieve the value from your written files.

3. Use the value of the SMK as the new KMMK and ASYM-MK values (see “PKA master keys and the PKDS” on page 131).
4. Reencipher and Activate the PKDS (see “Steps for reenciphering and refreshing the PKDS” on page 136).

Steps for clearing master keys

For security reasons, your installation may need to clear the master keys. This may be required, for example, when turning the processor hardware over for maintenance.

If you have a TKE workstation, you can use it to zeroize all domains that have keys loaded. Refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide* for more information.

If you do not have a TKE workstation, you might want to consider nullifying the master keys. To do this you would need to enter a new DES master key, reencipher a dummy CKDS, and change the master key. You would need to perform this

operation twice to ensure that the master key is cleared from the auxiliary (old) master key register. You would also need to reset both of the PKA master keys and process the PCICC master keys.

You can also use the zeroize function on the Support Element panel. Besides clearing the master keys, this also clears all domains and installation data.

Steps for adding a PCICC after CCF initialization

You may need to initialize PCI Cryptographic Coprocessors after system initialization.

Note: Use this procedure if you did not run the Pass Phrase Initialization utility. If you used the utility, see Chapter 5, “Using the Pass Phrase Initialization Utility,” on page 77.

Follow this procedure.

1. Select option 1, COPROCESSOR MGMT, on the Primary Menu panel.
2. The Coprocessor Management panel, as shown in Figure 75, appears.

```
 CSFCMP00 ---------------- ICSF Coprocessor Management -------------
 COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                  STATUS
-----------  -------------------------------          -------

_ A06                                                  ACTIVE
_ A07                                                  ACTIVE
_ C0         E589C396944007A6 5D40369997A386F4         ACTIVE
_ C1         0AA379BFD2387960 0367DC04533125FF         ACTIVE
_ P00        41-00YE1                                  ACTIVE
_ P01        41-00K11                                  ACTIVE
_ P02        41-0A355                                  ACTIVE
E P03        41-0BA3F                                  ONLINE
_ P04        41-0RT2T                                  DEACTIVATED
_ P05        41-00342                                  DISABLED
_
```

Figure 75. Selecting a coprocessor on the Coprocessor Management Panel

3. Select the Coprocessor to be processed by entering 'E' next to the Coprocessor.
4. The Master Key Entry panel appears. See Figure 76 on page 141.

```
CSFDKE10------------- ICSF - Master Key Entry -----------------
COMMAND ===>

              CCF DES/PCICC SYM-MK new master key register     : EMPTY
              CCF Signature/PCICC ASYM-MK master key register  : EMPTY
              CCF Key management master key register           : EMPTY


  Specify information below
    Key Type  ===> ___              (DES, SMK, KMMK, ALL-PKA)

    Part      ===> ______           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)



  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 76. The Master Key Entry Panel to Reset Registers

Ensure that the CCF Signature/PCICC ASYM-MK master key register field indicates EMPTY. If it does not, you will need to RESET to clear the contents of the registers to set a new key value.

5. You must now load the SYM-MK and ASYM-MK keys into your system.

   If you are going to reload your current master keys, you need to know the current master key value and checksum. If you want the PCICC to become ACTIVE after CCF initialization, you MUST enter the same master key values.

   Follow the instructions on “Steps for entering the first master key part” on page 107.

6. When all key parts have been loaded, SET the master key. From the Primary Menu panel choose option 2 - Master Key. From the Master Key Management panel, choose option 2 - SET MK.

Chapter 7. Managing Master Keys - PCIXCC, CEX2C, or CEX3C

This topic describes how to use the Master Key Entry panels to enter master keys in a PCIXCC, CEX2C, or CEX3C. Each PCIXCC, CEX2C, or CEX3C is capable of performing cryptographic functions and holding master keys within a secure boundary.

You can have multiple PCIXCCs/CEX2Cs on the z990 and z890. Multiple CEX2Cs are available on z9 EC, z9 BC, z10 EC and z10 BC systems. Muliple CEX3Cs are available on z10 EC, z10 BC, and z196 systems. Requests for cryptographic services are routed to the PCIXCC, CEX2C, or CEX3C.

Note: The PCI Cryptographic Accelerators improve private key decryption performance. They do not require setting of master keys.

Changes concerning the RSA master key (RSA-MK)

The procedures presented in this chapter involving the RSA master key will depend on whether your system has any CEX3C coprocessors with the Sep. 2011 or later LIC installed and online. If your system has any CEX3C coprocessors with the Sep. 2011 or later LIC online, the RSA-MK will be processed in the same manner as the DES, AES, and ECC master keys.

If your system has any CEX3C coprocessors with the Sep. 2011 or later LIC online:

- The PKA callable services control will not be used on your system. It will not appear on the Administrative Control Functions panel.
- The RSA-MK will not be set when the final key part is loaded on the Master Key Entry panel. The master key will be in the new master key register.
- The TKE Workstation cannot be used to set the RSA-MK.
- PKDS initialization will use the new master key register to get the verification pattern of the RSA-MK to be stored in the PKDS header record. The RSA-MK will be activated as part of PKDS initialization.
- The RSA-MK can be loaded to a coprocessor (new or after the master keys are cleared) and set by using the Set MK utility on the Master Key Management panel.
- The steps to change the RSA-MK are:
  1. Load the new master key value into the new RSA-MK register.
  2. Reencipher the PKDS from the current to the new master key.
  3. Change the RSA-MK using the Change ASYM MK utility on the Master Key Management panel.

If your system doesn't have any CEX3C coprocessors with the Sep. 2011 or later LIC:

- The PKA callable services control will be used as it has in past releases of ICSF.
- The RSA-MK will be set when the final key part is loaded on the Master Key Entry panel. The PKA callable services control must be disabled to load the RSA-MK
- The RSA-MK can be set using the TKE Workstation.
- PKDS initialization will use the current master key register to get the verification pattern of the RSA-MK to be stored in the PKDS header record.

- The steps to change the RSA-MK are:
  1. Disable the PKA callable services control.
  2. Load the new master key value into the new RSA-MK register. The master key will be set when the final key part is entered.
  3. Reencipher the PKDS from the old to the current master key.
  4. Refresh the PKDS with the reenciphered PKDS.
  5. Enable the PKA callable services control.

Note: The PCI Cryptographic Accelerators improve private key decryption performance. They do not require setting of master keys.

Coprocessor Activation

Prior to the HCR7780 release of ICSF, a DES master key was required on all systems. Starting with FMID HCR7780, this requirement is removed for non-CCF systems (CCF systems, however, still require a DES master key). The new master key activation procedure now permits any combination of master keys to be loaded.

The activation procedure for non-CCF systems selects the combination of master keys that will maximize the number of active coprocessors. ICSF checks the master keys available on the system (AES, DES, ECC and RSA) and determines validity based on the master keys used for the CKDS and PKDS. The master key verification patterns (MKVPs) contained in the header of the CKDS and PKDS are compared to the MKVPs of the master keys on the coprocessors. If they match, then the master key is valid. After determining the valid master keys for the system, it then selects the set of available master keys that will maximize the number of active coprocessors.

ECC master key support is based on the existence of CEX3C coprocessors with the Sept. 2010 or later licensed internal code (LIC). If a mixture of CEX3C coprocessors and older coprocessors exist on a system, then ECC support will be based solely on the state of the CEX3C coprocessors.

As coprocessor master keys are set or changed, additional function may become available.

Entering master key parts

You can use the Master Key Entry panels to enter clear master key parts. The way you obtain master key parts depends on the security guidelines in your enterprise. You may receive master key parts from a key distribution center or you may generate your own key parts using the ICSF random number utility.

Important: Regardless of how you get the master key parts, **make sure the key parts are recorded and saved in a secure location**. When you are entering the key parts for the first time, be aware that **you may need to reenter these same key values at a later date** to restore master key values that have been cleared.

When you enter the RSA master key (RSA-MK) the first time, the PKA callable services control is initially disabled. Once you have entered the RSA-MK and initialized the PKDS, the PKA callable services control will be enabled automatically. When you change the RSA-MK, you need to disable the PKA callable services control. To enable and disable the PKA callable services control refer to “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179.

Note: If your system has any CEX3C coprocessors with the Sep. 2011 or later LIC, the PKA callable services control will not be active.

To enter master key parts that you do not generate using the random number utility, continue with “Steps for entering the first master key part” on page 151.

To begin master key entry by generating random numbers for the key parts, continue with “Generating master key data for master key entry.”

Generating master key data for master key entry

If you intend to use the key entry panels to enter master keys, you need to generate and record these values when you begin:

- Key parts
- Checksums
- Verification patterns (optional)
- Hash patterns (optional)

Note: If you are reentering master keys when they have been cleared, use the same master key part values as when you originally entered the keys. You should have saved the key part values in a secure place when you entered the master keys previously.

The DES master key (DES-MK) is 16 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts. Each of the master key parts is also 16 bytes long. To enter a DES-MK, you must enter a first key part and a final key part. If you choose to, you can also enter one or more intermediate key parts when entering the first key part and the final key part.

Note: The combined DES-MK master key is forced to have odd parity, but the parity of the individual key parts can be odd, even or mixed. We refer to even or mixed parity keys as non-odd parity keys.

Attention: The PCIXCC, CEX2C, or CEX3C will not allow certain 'weak' keys as DES and asymmetric master keys. The list of weak keys are documented in Appendix F, “Questionable (Weak) Keys,” on page 413.

The AES master key (AES-MK) is 32 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts.

The RSA master key (RSA-MK) is 24 bytes long. ICSF defines these master keys by exclusive ORing two or more key parts.

The ECC master key (ECC-MK) is 32-bytes long. ICSF defines these master keys by exclusive ORing two or more key parts. ECC master key support is available on the CEX3C.

If you are using ICSF to generate random numbers, generate a random number for each key part that you need to enter to create the master key.

A 16-byte key part consists of 32 hexadecimal digits. A 24-byte key part consists of 48 hexadecimal digits. To make this process easier, each part is broken into segments of 16 digits each. A 32-byte key part consists of 64 hexadecimal digits.

When you are manually entering the master key parts, you also enter a checksum that verifies whether you entered the key part correctly. A checksum is a two-digit

result of putting a key part value through a series of calculations. The coprocessors calculate the checksum with the key part you enter and compare the one they calculated with the one you entered. The checksum verifies that you did not transpose any digits when entering the key part. If the checksums are equal, you have successfully entered the key.

When you enter a key part and its checksum for a DES-MK, the coprocessor calculates an eight-byte verification pattern and sixteen byte hash pattern. When you enter a key part and its checksum for a AES-MK, the coprocessor calculates an eight-byte verification pattern. When you enter a key part and its checksum for the RSA-MK, the coprocessor calculates a sixteen-byte verification pattern. When you enter a key part and its checksum for an ECC-MK, the coprocessor calculates an eight-byte verification pattern.

Before the verification and hash patterns can be calculated, the DES-MK master key must have been set.

The ICSF Master Key Entry panel displays the verification pattern. Check that the displayed verification pattern against the option verification pattern you may have generated at the time you generated the AES, DES, ECC, or RSA master key parts. The verification pattern checks whether you entered the key part correctly, and whether you entered the correct key type.

ICSF displays a verification and/or hash pattern for each master key part. It also displays a verification and/or hash pattern for the master key when you enter all the key parts. If the verification and hash patterns are the same, you have entered the key parts correctly.

To generate the value for a key part, you can use one of these methods:

- Choose a random number yourself.
- Access the ICSF utility panels to generate a random number.
- Call the random number generate callable service. For more information, see *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Note: ICSF must be initialized with a DES-MK or AES-MK master key to use the random number generate callable service or the Random Number Generator panel.

Steps for generating key parts using ICSF utilities

1. Access ICSF utilities by choosing option 5, UTILITY, on the Primary Menu panel, as shown in Figure 77 on page 147.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 5

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions


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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 77. Selecting the Utility Option on the ICSF Primary Menu Panel

The Utilities panel appears. See Figure 78. You use the RANDOM and CHECKSUM options to generate random numbers, checksums, and verification patterns for master key management.

```
CSFUTL00 ---------------- ICSF - Utilities --------------------------
OPTION ===> 3


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                       hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 78. ICSF Utilities Panel

2. Choose option 3, RANDOM, to access the Random Number Generator panel, shown in Figure 79 on page 148.

```
CSFRNG00 ---------------- ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 0000000000000000  Random Number 1
  Random Number2    : 0000000000000000  Random Number 2
  Random Number3    : 0000000000000000  Random Number 3
  Random Number4    : 0000000000000000  Random Number 4
```

Figure 79. ICSF Random Number Generator Panel

3. To select the parity of the random numbers, enter ODD, EVEN, or RANDOM next to Parity Option and press ENTER.

   The DES-MK master key is forced to have odd parity, regardless of the parity option you select for each key part. Parity is not checked for AES, ECC, or PKA master keys.

   A random 16-digit number appears in each of the Random Number fields. You can use each of these random numbers for a segment of a key part.

   The DES master key uses random numbers 1 and 2. The PKA master key uses random numbers 1 through 3. The AES and ECC master keys use random numbers 1 through 4.

```
CSFRNG00 ---------------- ICSF - Random Number Generator -------------
COMMAND ===>


Enter data below:

  Parity Option  ===> RANDOM            ODD, EVEN, RANDOM
  Random Number1    : 51ED9CFA90716CFB  Random Number 1
  Random Number2    : 58403BFA02BD13E8  Random Number 2
  Random Number3    : 9B28AEFA8C47760F  Random Number 3
  Random Number4    : 8453313235ABF69C  Random Number 4
```

Figure 80. ICSF Random Number Generator Panel with Generated Numbers

4. When you end the utility panels and access the Master Key Part Entry panel, the key parts you generated are transferred automatically to the Master Key Part Entry panels. For this reason, you will not need to enter the key parts on the Master Key Part Entry panels.

   Although the key parts are automatically transferred to the Master Key Entry panels, make sure you **record the random numbers and store them in a safe place**. You must have these numbers in case you ever need to reenter the master key values. If you ever need to restore a master key that has been cleared for any reason, you will need the key part values.
5. Press END to return to the Utilities panel.
6. Continue with Steps for generating a checksum, verification pattern, or hash pattern for a key part.

Steps for generating a checksum, verification pattern, or hash pattern for a key part

You can use the Utilities panel to generate a checksum and either an optional verification pattern or an optional hash pattern for a key part. You can use this panel to generate a checksum for a key part even if ICSF has not been initialized.

Note: The use of the Utilities panel to generate the key part, the checksum, and the verification pattern exposes the key part in storage for the duration of the dialogs. For this reason, you can choose to calculate both the checksum, the verification pattern or the hash pattern values manually or by using a PC program. See “Checksum Algorithm” on page 397 for a description of the checksum algorithm. See “Algorithm for calculating a verification pattern” on page 399 for a description of the algorithm for the verification pattern. See “The MDC–4 Algorithm for Generating Hash Patterns” on page 400 for a description of the MDC-4 algorithm that is used to calculate a hash pattern for a key part. The use of the verification pattern or hash pattern is optional.

Follow these steps to generate the checksum and the optional verification pattern or hash pattern for a key part.

1. Select option 4, CHECKSUM, on the ICSF Utilities panel as shown in Figure 81.

```
CSFUTL00 ---------------- ICSF - Utilities ------------------------
OPTION ===> 4


Enter the number of the desired option above.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash patterns
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 81. Selecting the Checksum Option on the ICSF Utilities Panel

The Checksum and Verification and Hash Pattern panel appears. See Figure 82.

```
CSFMKV00 ------------ ICSF - Checksum and Verification and Hash Pattern -----
COMMAND ===>


Enter data below:

 Key Type      ===>                   (Selection panel displayed if blank)

 Key Value     ===> 51ED9CFA90716CFB  Input key value 1
               ===> 58403BFA02BD13E8  Input key value 2
               ===> 9B28AEFA8C47760F  Input key value 3 (AES & ECC & RSA Keys)
               ===> 8453313235ABF69C  Input key value 4 (AES & ECC Keys only)


 Checksum         : 00                Check digit for key value
 Key Part VP      : 0000000000000000  Verification Pattern
 Key Part HP      : 0000000000000000  Hash Pattern
                  : 0000000000000000
```

Figure 82. ICSF Checksum and Verification and Hash Pattern Panel

If you accessed the Random Number Generator panel prior to this panel, the random numbers that are generated appear automatically in the Key Value fields.

2. If you did not use the Random Number Generator panel to generate random numbers, enter the numbers for which you want to create checksum, verification pattern, or hash patterns into the key value fields. Because these will be the key part values you will specify in the Master Key Entry panels, make sure you record the numbers.
3. In the Key Type field, specify either:
   - MASTER or DES-MK to generate a checksum and hash and verification pattern for a DES master key part
   - AES-MK to generate a checksum and verification pattern for an AES master key part
   - RSA-MK or PKAMSTR to generate a checksum and verification pattern for an RSA master key part
   - ECC-MK to generate a checksum and verification pattern for an ECC master key part.

   If you leave the Key Type field blank and press ENTER, the Key Type Selection panel appears. See Figure 83.

```
CSFMKV10 ------------- ICSF - Key Type Selection Panel ---- ROW 1 to 9 OF 9
COMMAND ===>                                               SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION
   AES-MK     AES Master key
   DES-MK     DES Master key
   ECC-MK     ECC Master key
   EXPORTER   Export key encrypting key
   IMP-PKA    Limited authority importer key
   IMPORTER   Import key encrypting key
   IPINENC    Input PIN encrypting key
s  MASTER     DES Master key
   OPINENC    Output PIN encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
   PKAMSTR    PKA/Asymmetric Master key
   RSA-MK     RSA Master key
***************************** BOTTOM OF DATA ******************************
```

Figure 83. Key Type Selection Panel Displayed During Hardware Key Entry

4. Type 'S' to the left of the MASTER key type, and press ENTER to return to the Checksum and Verification Pattern panel as shown in Figure 84 on page 151.

   In this example, we have selected the DES-MK master key.

```
CSFMKV00 ------ ICSF - Checksum and Verification and Hash Pattern ---
COMMAND ===>


 Enter data below:

Key Type      ===> MASTER            (Selection panel displayed if blank)

   Key Value     ===> 51ED9CFA90716CFB  Input key value 1
                 ===> 58403BFA02BD13E8  Input key value 2
                 ===> 0000000000000000  Input key value 3 (AES & ECC & RSA Keys)
                 ===> 0000000000000000  Input key value 4 (AES & ECC Keys only)

   Checksum         : 40                   Check digit for key part
   Key Part VP      : 0CCE190A635A6C89  Verification Pattern
   Key Part HP      : EA58E51179754FB7  Hash Pattern
                    : C102957465CE479E
```

Figure 84. ICSF Checksum and Verification Pattern Panel

5. *Record the checksum, verification pattern, and hash pattern.*

   Save these values in a secure place along with the key part values in case of a tamper. If the PCIXCC, CEX2C, or CEX3C detects tampering, it clears the master key, and you have to reenter the same master key again.
6. Press END to return to the Utilities panel.
7. Press END again to return to the ICSF Primary menu.

Continue with the appropriate topic for steps to enter the master key part you have just generated.

- If you have generated the first master key part, continue with “Steps for entering the first master key part.”
- If you have generated an intermediate master key part, continue with “Steps for entering intermediate key parts” on page 155.
- If you have generated a final master key part, continue with “Steps for entering the final key part” on page 157.

Steps for entering the first master key part

Use the Master Key Entry panels to enter each key part. You can enter as many key parts as you like. When the new master key register is empty, the first key part must be identified as FIRST. Subsequent intermediate key parts must be identified as MIDDLE. To close the new master key register to prevent additional key parts from being loaded, the final key part must be identified as FINAL.

Important: When entering the key part values, be aware that **you may need to reenter these same key values at a later date** to restore master key values that have been cleared. Make sure the key part values are recorded and saved in a secure location.

If you use the random number generator utility to generate key parts, enter each key part directly after you generate the key part data and prior to generating another key part.

To enter master key parts:

1. Select option 1, COPROCESSOR MGMT, on the ICSF Primary menu, as shown in Figure 85 on page 152, and press ENTER.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 1

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions


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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 85. Selecting the Coprocessor Management option on the primary menu panel

The ICSF Coprocessor Management panel appears (Figure 86).

2. Select the coprocessor(s) to be processed by entering an 'E' and then pressing ENTER. Select as many coprocessors as required. This loads the same master key for all coprocessors selected.

   Note: During first time initialization, the coprocessor status will be `ONLINE`. When master key (AES, DES, ECC, or RSA) has been set, the status will be `ACTIVE`.

```
CSFGCMP0 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

                Serial
 CoProcessor    Number         Status   AES   DES   ECC   RSA
 -----------   ---------       ------   ---   ---   ---   ----
__ H00                         ACTIVE
__ G01          00000001       ONLINE    U     U     U     U
__ G02          00000002       ACTIVE    C     U     U     C
__ G03          00000003       ACTIVE    C     U     A     C
E  G04          00000004       ACTIVE    C     C     A     C
__ G05          00000005       ONLINE    U     C     E     U
__ E06          00000006       ACTIVE    C     C     -     C
__ G07          00000007       OFFLINE
```

Figure 86. Selecting the coprocessor on the Coprocessor Management Panel

The coprocessor management panels shows all accelerators and coprocessors, their status, and the state of the master keys for coprocessors. The panel shows an accelerator (H00), a CEX2C coprocessor (E06), and a set of CEX3C processors. Accelerators don't have master keys and the states are blank.

When a coprocessor doesn't s support a master key, a hyphen (-) is used for its state. The master key state for coprocessors shows U (uninitialized), C (correct), A (active), and E (error).

The activation procedure for non-CCF systems selects the combination of master keys that will maximize the number of active coprocessors. ICSF checks the master keys available on the system (AES, DES, ECC and RSA) and determines validity based on the master keys used for the CKDS and PKDS. The master key verification patterns (MKVPs) contained in the header of the CKDS and PKDS are compared to the MKVPs of the master keys on the coprocessors. If they match, then the master key is valid. After determining the valid master keys for the system, it then selects the set of available master keys that will maximize the number of active coprocessors.

For example, consider the master key states for the preceding coprocessor management panel. There are 4 coprocessors with a valid AES master key. There are 3 coprocessors with a valid DES master key. There are 2 coprocessors with a valid ECC master key. There are 4 coprocessors with a valid RSA master key. If AES and RSA support is made available, then 4 coprocessors (G02, G03, G04 and E06) can be activated. This is the largest subset of the coprocessors that can be activated based on the state of the master keys. For this reason, AES and RSA support will be made available and cards G02, G03, G04 and E06 will be activated. Cards G01 and G05 will be ONLINE but not ACTIVE until their MKs are put in the proper state. DES and ECC support is not available.

ECC master key support is based on the existence of CEX3C coprocessors. If a mixture of CEX3C coprocessors and older coprocessors exist on a system, then ECC support will be based solely on the state of the CEX3C coprocessors. In our example, if the ECC MK for coprocessor G02 is loaded with a valid value, then ECC support will be available despite the fact that E06 is a CEX2C coprocessor and does not support an ECC MK.

As coprocessor master keys are set or changed, additional function may become available. If a valid DES master key is loaded on G02 and G03 then DES functionality will become available.

3. The ICSF Master Key Entry panel appears. See Figure 87 on page 154.

```
CSFDKE50------------- ICSF - Master Key Entry -----------------
COMMAND ===>

             AES new master key register               : EMPTY
             DES new master key register               : EMPTY
             ECC new master key register               : EMPTY
             RSA new master key register               : EMPTY

  Specify information below
    Key Type  ===> ___              (AES-MK, DES-MK, ECC-MK, RSA-MK)

    Part      ===> ______           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 40

    Key Value ===> 51ED9CFA90716CFB
              ===> 58403BFA02BD13E8
              ===> 0000000000000000   (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000   (AES-MK, ECC-MK only)




  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 87. Master Key Entry Panel

If you are not running on z10 EC, z10 BC, or z196 with the Nov. 2008 or later licensed internal code (LIC), AES keys are not supported. If you are running without a CEX3C coprocessor with the Sept. 2010 or later LIC, ECC keys are not supported.

4. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are entering the DES-MK master key.
   b. Enter FIRST in the Part field.
   c. Enter the two-digit checksum and the two 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the two 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**
   e. When all the fields are complete, press ENTER.

      If the checksum entered in the checksum field matches the checksum that the master key entry utility calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 88 on page 155. The new master key register status changes to `PART FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel. Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.
   f. Record the verification pattern and hash pattern.

```
CSFDKE60 -------------- ICSF - Master Key Entry --- KEY PART LOADED
COMMAND ===>

           AES new master key register                     : EMPTY
           DES new master key register                     : PART FULL
           ECC new master key register                     : EMPTY
           RSA new master key register                     : EMPTY


 Specify information below
   Key Type  ===> DES-MK      (AES-MK, DES-MK, ECC-MK, RSA-MK)

   Part      ===> FIRST       (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (AES-MK, ECC-MK, and RSA-MK only)
             ===> 0000000000000000   (AES-MK, ECC-MK only)



Entered key part VP: 0CCE190A63546489  HP: 9C92A343479D33F2 66229FCD55B49C26

                    (Record and secure these patterns)

 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 88. The Master Key Entry Panel Following Key Part Entry

5. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

When you have entered the first key part successfully, continue with:

- “Steps for generating key parts using ICSF utilities” on page 146 if you are using the ICSF utilities to generate random numbers for key values.
- “Steps for entering intermediate key parts” if you are entering key parts manually.

Steps for entering intermediate key parts

If you want to enter more than two key parts, you must enter one or more intermediate key parts. Enter intermediate key parts after you enter the first key part and prior to entering the final one.

To enter intermediate master key parts:

1. Select option 1, COPROCESSOR MGMT, on the ICSF Primary menu and press ENTER.

   The Coprocessor Management panel appears.

2. Select the coprocessor(s) to be processed by entering an 'E' on the Coprocessor Management panel. Select the same coprocessors that were selected when entering the first key value.
3. When pressing ENTER, the Master Key Entry panel appears (Figure 89).

```
CSFDKE50 -------------- ICSF - Master Key Entry ---------
COMMAND ===>

             AES new master key register                     : EMPTY
             DES new master key register                     : PART FULL
             ECC new master key register                     : EMPTY
             RSA new master key register                     : EMPTY


 Specify information below
   Key Type  ===> DES-MK        (AES-MK, DES-MK, ECC-MK, RSA-MK)

   Part      ===> MIDDLE        (RESET, FIRST, MIDDLE, FINAL)

   Checksum  ===> 58

   Key Value ===> 12021945CADE8431
             ===> 04091939BABE9632
             ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
             ===> 0000000000000000  (AES-MK, ECC-MK only)


 Press ENTER to process.
 Press END   to exit to the previous menu.
```

Figure 89. The Master Key Entry Panel for Intermediate Key Values

4. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are continuing to enter the DES-MK master key.
   b. Enter MIDDLE in the Part field.
   c. Enter the two-digit checksum and the two 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the two 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**
   e. When all the fields are complete, press ENTER.

      If the checksum entered in the checksum field matches the checksum that the master key entry utility calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 90 on page 157. The new master key register status changes to `PART FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel.

      Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.
   f. Record the verification pattern and hash pattern.

```
CSFDKE50 -------------- ICSF - Master Key Entry --------KEY PART LOADED-
 COMMAND ===>

              AES new master key register                      : EMPTY
              DES new master key register                      : PART FULL
              ECC new master key register                      : EMPTY
              RSA new master key register                      : EMPTY


  Specify information below
    Key Type  ===> ___          (AES-MK, DES-MK, ECC-MK, RSA-MK)

    Part      ===> ______       (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000  (AES-MK, ECC-MK only)

  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 90. The Master Key Entry Panel with Intermediate Key Values

5. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.

When you have entered the middle key part successfully, continue with:

- “Steps for generating key parts using ICSF utilities” on page 146 if you are using the ICSF utilities to generate random numbers for key values.
- “Steps for entering the final key part” if you are entering key parts manually.

Steps for entering the final key part

When you enter the first key part, and any intermediate key parts, you then enter the final master key part.

1. Select option 1, COPROCESSOR MGMT, on the ICSF Primary menu and press ENTER.

   The Coprocessor Management panel appears.
2. Select the coprocessor(s) to be processed by entering an 'E' on the Coprocessor Management panel.
3. When pressing ENTER, the Master Key Entry panel appears.

```
CSFDKE50 -------------- ICSF - Master Key Entry ---------
 COMMAND ===>

             AES new master key register                      : EMPTY
             DES new master key register                      : PART FULL
             ECC new master key register                      : EMPTY
             RSA new master key register                      : EMPTY


  Specify information below
    Key Type  ===> ___          (AES-MK, ASYM-MK, DES-MK)

    Part      ===> ______       (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 65

    Key Value ===> 1939040919720419
              ===> EA10111975BB5312
              ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000  (AES-MK, ECC-MK only)

              Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 91. The Master Key Entry Panel when entering Final Key Values

4. Fill in the panel
   a. Enter the master key type in the Key Type field.

      In this example we are continuing to enter the DES-MK master key.
   b. Enter FINAL in the Part field.
   c. Enter the two-digit checksum and the two 16-digit key values (if you did not use random number generate).
   d. Make sure you have recorded the two 16-digit key values. You may need to reenter these same values at a later date to restore master key values that have been cleared. **Make sure all master key parts you enter are recorded and saved in a secure location.**
   e. When all the fields are complete, press ENTER.

      If the checksum entered in the checksum field matches the checksum that the master key entry utility calculated, the key part is accepted. The message at the top of the panel states `KEY PART LOADED`, as shown in Figure 92 on page 159. The new master key register status changes to `FULL`. The verification pattern and hash pattern that are calculated for the key part appear near the bottom of the panel. Compare them with the patterns generated by the random number generator or provided by the person who gave you the key part value to enter.
   f. Record the verification pattern and hash pattern.

```
CSFDKE60 -------------- ICSF - Master Key Entry ---------KEY PART LOADED
 COMMAND ===>

              AES new master key register                      : EMPTY
              DES new master key register                      : FULL
              ECC new master key register                      : EMPTY
              RSA new master key register                      : EMPTY


  Specify information below
    Key Type  ===> DES-MK        (AES-MK, DES-MK, ECC-MK, RSA-MK)

    Part      ===>  FINAL        (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===>  00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000  (AES-MK, ECC-MK only)


  Entered key part VP: 8D8A000BE067EBF7 HP: 9D92F343479D77F2 229FD4CDB49C2679
  Master Key       VP: 8F887096A8D4922C HP: 4C887096A8D4922B 33387096A8D4922B
                     (Record and secure these patterns)

  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 92. The Master Key Entry Panel with Final Key Values

5. If the checksums do not match, the message `Invalid Checksum` appears. If this occurs, follow this sequence to resolve the problem:
   a. Reenter the checksum.
   b. If you still get a checksum error, recalculate the checksum.
   c. If your calculations result in a different value for the checksum, enter the new value.
   d. If your calculations result in the same value for the checksum, or if a new checksum value does not resolve the error, reenter the key part halves and checksum.
6. When you have entered the final key part successfully, it is combined with the first key part and any intermediate key parts in the new master key register.

   The new master key register status is now FULL, and the panel displays two verification patterns and two hash patterns. It gives you verification patterns and hash patterns for both the final key part and the new master key, since it is now complete.
7. Check that the key part verification pattern or hash pattern you may have previously calculated matches the verification pattern or hash pattern that is shown on the panel. If they do not, you may want to restart the key entry process. For information on how to restart the key entry process, see “Steps for restarting the key entry process” on page 160.
8. *Record the verification pattern and hash pattern* for the new master key, because you may want to verify it at another time.

   Note: When you initialize or reencipher a CKDS, ICSF places the verification pattern for the DES-MK and AES-MK master key into the CKDS header record.

When you have entered the master keys correctly, they are in the new master key registers and are not active on the system.

Note: Ensure that the new master key is installed on all cryptographic coprocessors.

When you enter the master keys, you should do *one* of these:

- If you are defining the DES or AES master keys for the first time, initialize the CKDS with the DES and AES master keys. For a description of the process of initializing a DES-MK or AES-MK master key on your system, see “Initializing the CKDS and PKDS at First-Time Startup” on page 162.
- If you are defining an AES, DES, ECC or RSA master key when it was cleared, set the master keys to make them active. For a description of the process of recovering from tampering, see “Reentering master keys when they have been cleared” on page 172.
- If you are changing a DES-MK master key, reencipher the CKDS under the new DES-MK or AES-MK master key and make it active. For a description of the process of changing a DES-MK or AES-MK master key, see “Steps for changing master keys” on page 173.
- If you are defining the ECC or RSA master keys for the first time, initialize the PKDS with the master keys. For a description of the process of initializing an ECC or RSA master key on your system, see “Initializing the CKDS and PKDS at First-Time Startup” on page 162.
- If you are changing an ECC or RSA master keys, reencipher the PKDS under the new ECC or RSA master key and make it active. For a description of the process of changing a ECC or RSA master key, see “Steps for changing master keys” on page 173.

Steps for restarting the key entry process

If you realize that you made an error when entering a key part, you can restart the process of entering the new master key. For example, if the verification pattern or the hash pattern that was calculated does not match the one that you calculated, you may want to restart the process. Restarting the key entry process clears the new master key register, which erases all the new master key parts you entered previously.

To restart the key entry process, follow these steps:

1. On the Master Key Entry panel, enter the master key type in the Key Type field.
   In this example, we are resetting a new DES-MK master key.
2. Enter RESET in the Part field.

```
CSFDKE50 -------------- ICSF - Master Key Entry ---------
 COMMAND ===>

              AES new master key register                     : EMPTY
              DES new master key register                     : PART FULL
              ECC new master key register                     : EMPTY
              RSA new master key register                     : EMPTY


  Specify information below
    Key Type  ===> DES-MK        (AES-MK, DES-MK, ECC-MK, RSA-MK)


    Part      ===>  RESET_            (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===>  40

    Key Value ===> 51ED9CFA90716CFB
              ===> 58403BFA02BD13E8
              ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000  (AES-MK, ECC-MK only)

  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 93. Selecting Reset on the Master Key Entry Panel

3. Press ENTER.

   The Restart Key Entry Process panel appears. See Figure 94. This panel confirms your request to restart the key entry process.

```
CSFDKE80 -------------- ICSF - Restart Key Entry Process -------------
COMMAND ===>

ARE YOU SURE YOU WISH TO RESTART THE KEY ENTRY PROCESS?


  Restarting the process will clear the DES-MK master key register.







Press ENTER to confirm restart request
Press END   to cancel restart request
```

Figure 94. Confirm Restart Request Panel

4. If you want to restart the key entry process, press ENTER.

   The restart request automatically empties the master key register.

5. If you do not want to restart, press END.

   When you make a choice, you return to the Master Key Entry panel. If you selected to continue with the restart process, the new master key register status field is reset to EMPTY, as shown in Figure 95 on page 162. This indicates that the register has been cleared.

```
CSFDKE50 -------------- ICSF - Master Key Entry ---------
 COMMAND ===>

              AES new master key register                      : EMPTY
              DES new master key register                      : EMPTY
              ECC new master key register                      : EMPTY
              RSA new master key register                      : EMPTY


  Specify information below
    Key Type  ===> _____        (AES-MK, DES-MK, ECC-MK, RSA-MK)


    Part      ===> ______       (RESET, FIRST, MIDDLE, FINAL)


    Checksum  ===> 00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000  (AES-MK, ECC-MK only)
```

Figure 95. The Master Key Entry Panel Following Reset Request

6. Either begin the key entry process again or press END to return to the ICSF primary menu panel.

Initializing the CKDS and PKDS at First-Time Startup

If running in a sysplex, see Chapter 9, “Running in a Sysplex Environment,” on page 191.

If you are running on a IBM @server zSeries 990, IBM @server zSeries 890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 and wish to share your CKDS and PKDS with a CCF system on an IBM @server zSeries 900, you should initialize the CKDS and PKDS on the IBM @server zSeries 900.

The first time you start ICSF, you must:

- Create a cryptographic key data set (CKDS)
- Create a PKA key data set (PKDS)
- Enter a new DES-MK into each PCIXCC, CEX2C, or CEX3C (optional)
- Enter a new RSA-MK into each PCIXCC, CEX2C, or CEX3C (optional)
- Enter a new AES-MK into each CEX2C, or CEX3C (optional)
- Enter a new ECC-MK into each CEX3C (optional)
- Initialize the CKDS
- Initialize the PKDS

When you initialize the CKDS, ICSF creates a header record for the CKDS and sets any DES or AES master keys in the new master key registers. When you initialize the PKDS, ICSF creates a header record for the PKDS and sets any ECC or RSA master keys in the new master key registers.

CKDS

You only have to initialize a CKDS the first time you start ICSF on a system. When you initialize a CKDS, you can copy the disk copy of the CKDS to create other

CKDSs for use on the system. You can also use a CKDS on another ICSF system if the system has the same master key value.

Note: Use of a CKDS on another system depends both upon where the CKDS was initialized and the cryptographic hardware type of the other system.

At any time, you can read a different disk copy into storage. For information about how to read a disk copy into storage, see "Performing a single system CKDS refresh" on page 170.

For a description of how to use the Master Key Entry panels to enter the master key, see "Steps for entering the first master key part" on page 151. For a description of how to use the TKE workstation to enter the master key, refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Steps for initializing a CKDS

For information about initializing a CKDS in a sysplex environment, see Chapter 9, "Running in a Sysplex Environment," on page 191.

There are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). You can use the following steps to initialize either format of CKDS.

To initialize the CKDS:

1. Return to the Primary Menu panel by pressing END from the Master Key Entry panel.
2. Select Option 2, MASTER KEY MGMT, on the Primary Menu panel as shown in Figure 96.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 2

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 96. Selecting the Master Key option on the primary menu panel

The Master Key Management panel appears. See Figure 97 on page 164.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                        activate an updated Cryptographic Key Data Set
  2  SET MK            -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS   -  Reencipher the CKDS prior to changing a symmetric
                        master key
  4  CHANGE SYM MK     -  Change a symmetric master key and activate the
                        reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                        activate an updated Public Key Data Set or
                        update the Public Key Data Set header
  6  REENCIPHER PKDS   -  Reencipher the PKDS
  7  CHANGE ASYM MK    -  Change an asymmetric master key and activate the
                        reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 97. ICSF Master Key Management Panel

3. Select option 1, INIT/REFRESH/UPDATE CKDS and the Initialize a CKDS panel appears. See Figure 98. If AES master keys are supported, a different panel appears (Figure 99).

```
CSFCKD10 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)
       Record authentication required (Y/N)
  2  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 98. ICSF Initialize a CKDS Panel

```
CSFCKD20 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS
       Record authentication required? (Y/N) ===>
  2  REFRESH   -  Activate an updated CKDS
  3  Update an existing CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 99. ICSF Initialize a CKDS Panel if AES master keys are supported

4. In the CKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the CKDS.

   The name you enter can be the same name that is specified in the CKDSN keyword option in the installation options data set. You can also initialize a data set that might serve as a backup. For information about creating a CKDS and specifying the CKDS name in the installation options data set, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.
5. Choose option 1, Initialize an empty CKDS, and press ENTER.

   To improve performance, answer **N** to Record authentication required.

   ICSF creates the header record in the disk copy of the CKDS. Next, ICSF sets the DES or AES master key, if any. ICSF then adds the required system key to the CKDS and refreshes the CKDS. When ICSF completes all these steps, the message `INITIALIZATION COMPLETE` appears. If you did not enter a master key into the new master key register previously, the message `NMK REGISTER NOT FULL` appears and the initialization process ends. You must enter a master key into the new master key register to initialize the CKDS.

   Note: If any part of the option 1 fails, you must delete the CKDS and start over. If the failure occurs when one of the master keys has been set and prior to the system key being created, you will need to reset the master key.

When you complete the entire process, a CKDS and zero or more master keys exist on your system. You can now generate keys using functions like the key generate callable service and the key generator utility program (KGUP) or convert PCF keys to ICSF keys using the conversion program. ICSF services use the keys to perform the cryptographic functions you request.

Updating the CKDS with the AES master key

On systems that support the AES master key, you can add the AES master key to any existing CKDS. It is also possible to add the DES master key to a CKDS that was initialized with only the AES master key.

These are the steps to update the CKDS:

1. Load the new AES master key by using the master key entry panels or by using TKE. The AES master key must be loaded on all active coprocessors.
2. From the Primary Menu, select option 2, MASTER KEY MGMT:

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 2

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 100. Selecting the Master Key option on the primary menu panel

3. Select option 1, INIT/REFRESH/UPDATE CKDS.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                          activate an updated Cryptographic Key Data Set
  2  SET MK             -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS    -  Reencipher the CKDS prior to changing a symmetric
                          master key
  4  CHANGE SYM MK      -  Change a symmetric master key and activate the
                          reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                          activate an updated Public Key Data Set or
                          update the Public Key Data Set header
  6  REENCIPHER PKDS    -  Reencipher the PKDS
  7  CHANGE ASYM MK     -  Change an asymmetric master key and activate the
                          reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 101. ICSF Master Key Management Panel

4. The Initialize a CKDS panel appears. In the CKDS field, enter the name of an existing, initialized CKDS.

```
CSFCKD20 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS
        Record authentication required? (Y/N) ===>
  2  REFRESH   -  Activate an updated CKDS
  3  Update an existing CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 102. ICSF Initialize a CKDS Panel if AES master keys are supported

5. Choose option 3, Update an existing CKDS and press **ENTER**. ICSF will check the status of the new master key registers and the master key verification pattern of the master key is written to the CKDS header record. Note that all the CKDS' that you wish to update should be processed prior to going to step 6.
6. In the CKDS field, enter the name of the updated CKDS that will be the active CKDS.
7. Select option 2, REFRESH and press **ENTER**. The in-storage copy of the CKDS will be updated with your updated CKDS.

```
CSFCKD20 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS
        Record authentication required? (Y/N) ===>
  2  REFRESH   -  Activate an updated CKDS
  3  Update an existing CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 103. ICSF Initialize a CKDS Panel

8. Return to the Master Key Management panel by pressing **END**. Choose option 2, SET MK and press **ENTER**. ICSF sets the AES master key and your system can be used to encrypt AES key operations.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  2

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                          activate an updated Cryptographic Key Data Set
  2  SET MK             -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS    -  Reencipher the CKDS prior to changing a symmetric
                          master key
  4  CHANGE SYM MK      -  Change a symmetric master key and activate the
                          reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                          activate an updated Public Key Data Set or
                          update the Public Key Data Set header
  6  REENCIPHER PKDS    -  Reencipher the PKDS
  7  CHANGE ASYM MK     -  Change an asymmetric master key and activate the
                          reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 104. ICSF Master Key Management Panel

PKDS

You only have to initialize a PKDS the first time you start ICSF on a system.

Note: You must have a valid RSA-MK or ECC-MK loaded to initialize the PKDS. When you initialize a PKDS, you can copy the disk copy of the PKDS to create other PKDSs for use on the system. You can also use a PKDS on another ICSF system if the system has the same master key value.

For a description of how to use the Master Key Entry panels to enter the master key, see “Steps for entering the first master key part” on page 151. For a description of how to use the TKE workstation to enter the master key, refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

Steps for initializing a PKDS

To initialize the PKDS:

1. Return to the Primary Menu panel by pressing END from the Master Key Entry panel.
2. Select Option 2, MASTER KEY MGMT, on the Primary Menu panel as shown in Figure 105 on page 169.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility ---------
OPTION ===> 2

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 105. Selecting the Master Key option on the primary menu panel

The Master Key Management panel appears. See Figure 106.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  5

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                                activate an updated Cryptographic Key Data Set
  2  SET MK             -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS    -  Reencipher the CKDS prior to changing a symmetric
                           master key
  4  CHANGE SYM MK      -  Change a symmetric master key and activate the
                           reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                                 activate an updated Public Key Data Set or
                                 update the Public Key Data Set header
  6  REENCIPHER PKDS    -  Reencipher the PKDS
  7  CHANGE ASYM MK     -  Change an asymmetric master key and activate the
                           reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 106. ICSF Master Key Management Panel

3. Select option 5, INIT/REFRESH/UPDATE PKDS and the Initialize a PKDS panel appears. See Figure 107 on page 170.

```
CSFCKD30 ---------------- ICSF - PKDS Initialize/Refresh ----------------
COMMAND ===>

Enter the number of the desired option.

  1  Initialize an empty PKDS
  2  Refresh - Activate an updated PKDS
  3  Update an existing PKDS



Enter the name of the PKDS below.

  PKDS ===>
```

Figure 107. ICSF Initialize/Refresh a PKDS Panel

4. In the PKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the PKDS.
5. Select option 1, Initialize an empty PKDS.

Performing a single system CKDS refresh

When you initialize a CKDS for the first time, you can copy the disk copy of the CKDS to create other CKDSs for the system. You can use KGUP to add and update any of the disk copies on your system. You can use the dynamic CKDS update callable services to add or update the disk copy of the current in-storage CKDS. For information about using KGUP, see Chapter 10, "Managing Cryptographic Keys Using the Key Generator Utility Program," on page 215. For information on using the dynamic CKDS callable services, refer to the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Note: If you are running in a sysplex environment with multiple ICSF instances sharing the same active CKDS, you may be able to perform a coordinated CKDS refresh. The coordinated CKDS refresh operation simplifies CKDS administration by allowing a refresh to be initiated from a single ICSF instance. The refresh is then carried out for all ICSF instances in the sysplex sharing the same active CKDS. To perform a coordinated CKDS refresh, all members of the sysplex (regardless of their active CKDS) must be at ICSF FMID HCR7790 or later. If your sysplex meets this requirement, refer to "Performing a coordinated CKDS refresh" on page 198 for more information.

You can refresh the in-storage CKDS with an updated or different disk copy of the CKDS by using these steps. You can refresh the CKDS at any time without disrupting cryptographic functions.

Note: Prior to refreshing a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to "Steps for disallowing dynamic CKDS updates during CKDS administration updates" on page 216.

1. Enter option 2, MASTER KEY, on the ICSF Primary Menu panel to access the Master Key Management Panel.
2. Enter option 1, INIT/REFRESH/UPDATE CKDS to access the Initialize a CKDS panel, which is shown in Figure 108 on page 171.

```
CSFCKD10 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)
        Record authentication required (Y/N)
  2  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'PIN1.CKDS'
```

Figure 108. Selecting the Refresh Option on the ICSF Initialize a CKDS Panel

3. In the CKDS field, specify the name of the disk copy of the CKDS that you want ICSF to read into storage.
4. Choose option 2, REFRESH, and press ENTER.

   ICSF places the disk copy of the specified CKDS into storage. During a REFRESH, ICSF does not load into storage any partial keys that may exist when you enter keys manually. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the CKDS was refreshed appears on the right of the top line on the panel.

   When ICSF reads the CKDS into storage, it performs a MAC verification on each record in the CKDS. If a record fails the MAC verification, ICSF sends a message that gives the key label and type to the z/OS system security console. You can then use either KGUP or the dynamic CKDS update services to delete the record from the CKDS. Any other attempts to access a record that has failed MAC verification results in a return code and reason code that indicate that the MAC is not valid.
5. Press END to return to the Primary Menu panel.

Note: You can use either a KGUP panel or a utility program, instead of the CKDS panel, to refresh the CKDS. For information about these other methods, see “Refreshing the In-Storage CKDS” on page 250.

Refreshing the PKDS at any time

When you initialize a PKDS for the first time, you can copy the disk copy of the PKDS to create other PKDSs for the system. You can use the dynamic PKDS update callable services to add or update the disk copy of the current in-storage PKDS. For information on using the dynamic PKDS callable services, refer to the *z/OS Cryptographic Services ICSF Application Programmer's Guide*. You can refresh the in-storage PKDS with an updated or different disk copy of the PKDS by using these steps. You can refresh the PKDS at any time without disrupting cryptographic functions.

Note: Prior to refreshing a PKDS, consider temporarily disallowing PKDS write, create and delete services using the ICSF Administrative Control Functions panel.

1. Enter option 2, MASTER KEY MGMT, on the ICSF Primary Menu panel to access the Master Key Management Panel.
2. Enter option 5, INIT/REFRESH/UPDATE PKDS to access the PKDS Initialize/Refresh panel.

3. In the New PKDS field, specify the name of the disk copy of the PKDS that you want ICSF to read into storage. ICSF places the disk copy of the specified PKDS into storage. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the PKDS was refreshed appears on the right of the top line on the panel.
4. Press END to return to the Primary Menu panel.

Reentering master keys when they have been cleared

In these situations, the PCIXCC, CEX2C, or CEX3C clears the master key registers so that the master key values are not disclosed.

- If the PCIXCC, CEX2C, or CEX3C detects tampering (the intrusion latch is tripped), ALL installation data is cleared: master keys, retained keys for all domains, as well as roles and profiles.
- If the PCIXCC, CEX2C, or CEX3C detects tampering (the secure boundary of the card is compromised), the card is rendered inoperable.
- If you issue a command from the TKE workstation to zeroize a domain

  This command zeroizes the master key data specific to the domain.
- If you issue a command from the Support Element panels to zeroize all domains.

  This command zeroizes ALL installation data: master keys, retained keys and access control roles and profiles.

Although the values of the master keys are cleared, the secure keys in the CKDS are still enciphered under the cleared DES or AES master keys. The PKA private keys are also each enciphered under the cleared asymmetric master key. Therefore, to recover the keys in the CKDS, and the PKA private keys, you must reenter the same master keys and set the master key. For security reasons, you may then want to change all the master keys.

PR/SM Considerations: If you are running in PR/SM logical partition (LPAR) mode, there are several situations (listed previously) that can cause loss of master keys and other data. You must then reenter the master keys in each LPAR. If you zeroize a domain using the TKE workstation, however, the master keys are cleared only in that domain. Master keys in other domains are not affected and do not need to be reentered. For more information about reentering master keys in LPAR mode, see Appendix D, “PR/SM Considerations during Key Entry,” on page 403.

Note: If PPINIT was used initially, you must rerun the utility with the same pass phrase.

When the PCIXCC, CEX2C, or CEX3C clears the master keys, reenter the same master keys by using these steps:

1. Check the status of the PKA callable services. If they are enabled, use the Administrative Control Functions to disable them. See “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179 for details.
2. Retrieve the key parts, checksums, verification patterns, and hash patterns you used when you entered the master keys originally.

   These values should be stored in a secure place as specified in your enterprises security process.
3. Access the Master Key Entry panels and enter the master keys as described in “Steps for entering the first master key part” on page 151.

4. After you have entered the master keys, select option 2, MASTER KEY MGMT, from the primary menu. The Master Key Management panel appears. See Figure 109.

   To activate the master keys you just entered, you need to set them.

5. To set any master key, choose option 2 on the panel and press ENTER.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  2

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                                activate an updated Cryptographic Key Data Set
  2  SET MK             -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS    -  Reencipher the CKDS prior to changing a symmetric
                           master key
  4  CHANGE SYM MK      -  Change a symmetric master key and activate the
                           reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                           activate an updated Public Key Data Set or
                           update the Public Key Data Set header
  6  REENCIPHER PKDS    -  Reencipher the PKDS
  7  CHANGE ASYM MK     -  Change an asymmetric master key and activate the
                           reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 109. Selecting the Set Host Master Key Option on the ICSF Master Key Management Panel

When you select option 2, ICSF checks that the states of the registers are correct. ICSF then transfers the DES-MK master key from the new master key register to the master key register. This process sets the DES-MK master key.

When ICSF attempts to set the DES-MK master key, it displays a message on the top right of the Master Key Management panel. The message indicates either that the master key was successfully set, or that an error prevented the completion of the set process.

When you set the reentered DES-MK master key, the DES-MK master key that enciphers the existing CKDS now exists.

6. You can now change the DES-MK master key, if you choose to, for security reasons. Continue with “Steps for changing master keys.”

Steps for changing master keys

For security reasons your installation should change the master keys periodically. In addition, if the master keys have been cleared, you may also want to change the master keys when you reenter the cleared master keys.

There are three main steps involved in changing the DES-MK master key or AES-MK master key:

1. Enter the DES-MK or AES-MK master key parts.
2. Reencipher the CKDS under the new DES-MK or AES-MK master key.
3. Change the new DES-MK or AES-MK master key and activate the reenciphered CKDS.

The procedure for the changing the RSA-MK depends on the cryptographic coprocessors on your system.

- If your system has one or more CEX3C coprocessors (with the Sep. 2011 or later LIC) online with the RSA-MK loaded, these are the main steps involved in changing the RSA-MK:
  1. Enter the RSA-MK master key parts.
  2. Reencipher the PKDS under the new RSA-MK.
  3. Change the new RSA-MK.
- If your system doesn't have any CEX3C coprocessors (with the Sep. 2011 or later LIC) online, these are the main steps involved in changing the RSA-MK:
  1. Disable PKA callable services control.
  2. Enter the RSA-MK master key parts.
  3. Reencipher the PKDS under the new RSA-MK.
  4. Change the new RSA-MK.
  5. Enable PKA callable services control.
- These are the main steps involved in changing the ECC-MK:
  1. Enter the ECC-MK master key parts.
  2. Reencipher the PKDS under the new ECC-MK.
  3. Change the new ECC-MK.

Notes:

1. When changing a master key, remember to change the name of the CKDS and PKDS in the Installation Options Data Set.
2. DES and AES master keys can be changed separately or together.
3. RSA and ECC master keys can be changed separately or together.

Symmetric Master Keys and the CKDS

The procedure you need to follow for changing the DES or AES master key, reenciphering the CKDS, and activating the new DES or AES master key will differ depending on factors such as the version of ICSF you are running and your system's compatibility mode. Although the details of the various procedures do differ, they are all guiding you through performing the same significant actions. Essentially, to change the symmetric keys, you need to:

1. Enter the master key parts into the new master key registers (as described in "Entering master key parts" on page 144).
2. Reencipher the CKDS under the new master key. This fills an empty VSAM data set you created earlier with the reenciphered keys, making the data set the new CKDS. This new reenciphered CKDS is a disk copy.
3. Change the symmetric master keys and make the reenciphered CKDS the active CKDS.

Starting with ICSF FMID HCR7790, a new option is available to provide a simplified procedure for changing the symmetric master keys. Tasks that had once been distinct and spread over multiple panels and manual steps are now combined in a single panel. Other steps, due to changes in how ICSF reenciphers the CKDS, are no longer necessary.

This new procedure is called a coordinated CKDS change master key. This procedure will combine the CKDS reencipher and set master key steps for both single system environments and sysplex environments. When in a sysplex environment, the coordinated CKDS change master key procedure additionally coordinates across all sysplex members sharing the same active CKDS. This

removes the need to perform manual steps on each system sharing the same CKDS, including bringing the disk copy of the reenciphered CKDS into storage.

For the additional advantages realized by a coordinated CKDS change master key, refer to “Changing symmetric master keys and refreshing the CKDS when the CKDS is shared in a sysplex environment” on page 193.

Use the coordinated CKDS change master key procedure only if your system (and, if applicable, your sysplex) meets the following requirements.

- Your system must be running ICSF FMID HCR7790 or later. In a sysplex environment, all members of the sysplex (including any sysplex members that are not using the same active CKDS) must be at ICSF FMID HCR7790 or later. The sysplex communication protocol used by the coordinated change master key procedure is only understood by ICSF FMID HCR7790 and later. For this reason, the coordinated change master key procedure can only be performed when all systems in the sysplex are at ICSF FMID HCR7790 and later. Be aware that this procedure will change the symmetric master keys for all systems in the sysplex that share the same active CKDS as the member who initiates the procedure.
- None of the systems in the sysplex can be a IBM zSeries 900.
- ICSF on all systems in the sysplex must be running in noncompatibility mode.
- Do not use the coordinated CKDS procedure to reencipher archived or backup copies of the CKDS that are not currently active. Only use it to reencipher the active CKDS.

If your system (and, if applicable, your sysplex) meets the requirements in the preceding list, you can use the procedure described in “Performing a coordinated CKDS master key change” on page 195 to change your master key.

If your system or sysplex does not meet the requirements in the preceding list, follow the procedure described in “Steps for reenciphering the CKDS and performing a single-system CKDS master key change” on page 176. Because this procedure branches into different instructions based on whether ICSF is running in noncompatibility, compatibility, or co-existence mode, you should first understand the following background information on these modes before referring to and performing the procedure.

ICSF runs in noncompatibility, compatibility, or co-existence mode with the IBM cryptographic products, and Programmed Cryptographic Facility (PCF). You specify which mode ICSF runs in by using an installation option. For a description of the modes and how to specify an installation option, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

In noncompatibility mode, ICSF allows you to change the master key with continuous operations. Therefore applications can continue to run without disruption. However, when ICSF is in compatibility mode or co-existence mode, you should use a different procedure to activate the changed master key. This is to ensure that no application is holding an internal token with the wrong master key.

In all three modes, you enter the new master key and reencipher the disk copy of the CKDS under the new master key using the master key panels. In noncompatibility mode, you then activate the new master key and refresh the in-storage copy of the CKDS with the disk copy using the master key panels or a utility program.

In compatibility mode and coexistence mode, however, activating the new master key and refreshing the in-storage copy of the CKDS does not reencipher internal key tokens under the new master key. ICSF applications that are holding internal key tokens which have been enciphered under the wrong master key will fail with a warning message. Applications that use the PCF macros, run with no warning message and produce erroneous results.

If you have a PCIXCC, CEX2C, and CEX3C installed, when you start ICSF, you must go to the Master Key Management panel (Figure 109 on page 173) and do a set (option 2). This will change the master keys of all the PCIXCCs, CEX2Cs, and CEX3Cs.

A re-IPL ensures that a program does not access a cryptographic service that uses a key that is encrypted under a different master key. If a program is using an operational key, the program should either re-create or reimport the key, or generate a new key.

If a re-IPL is not practical in your installation, you can use this alternative method. Stop all cryptographic applications, especially those using PCF macros, when activating the new master key and refreshing the in-storage copy of the CKDS. This eliminates all operational keys that are encrypted under the current master key. When you start ICSF again, applications using an operational key can either re-create or reimport the key.

Steps for reenciphering the CKDS and performing a single-system CKDS master key change

Notes:

1. If running in a sysplex, see Chapter 9, “Running in a Sysplex Environment,” on page 191.
2. Prior to reenciphering a CKDS, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration updates” on page 216.
3. A simplified procedure for changing the symmetric master key and reenciphering the CKDS is described in “Performing a coordinated CKDS master key change” on page 195. However, only systems that are running ICSF FMID HCR7790 or later and that meet other requirements can use this other procedure. If you are interested in using this simplified procedure, refer to the requirements outlined in “Symmetric Master Keys and the CKDS” on page 174.

Before beginning this procedure, you must:

Notes:

1. Enter the key parts of the new master key that you want to replace the current master key. For information about how to do this procedure, see “Entering master key parts” on page 144. The new master key register must be full when you change the master key.
2. Create a new VSAM data set in which the reenciphered keys will be placed to create the new reenciphered CKDS. This data set must be allocated and empty, and must contain the same data set attributes as the active CKDS. For more information about defining a CKDS, refer to *z/OS Cryptographic Services ICSF System Programmer's Guide*.

To reencipher the CKDS and change the master key:

1. Select option 3, REENCIPHER CKDS, on the Master Key Management panel, as shown in Figure 110 on page 177, and press ENTER.

When you change the master key, you must first reencipher the disk copy of the CKDS under the new master key.

Notes:

a. If your system is using multiple coprocessors, they must have the same master key. When you change the master key in one coprocessor, you should change the master key in the other coprocessors. Therefore, to reencipher a CKDS under a new master key, the new master key registers in all coprocessors must contain the same value.

b. If the CKDS contains HMAC keys, it must be reenciphered on a system with a CEX3C and the Sept. 2010 or later licensed internal code.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  3

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                                activate an updated Cryptographic Key Data Set
  2  SET MK            -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS   -  Reencipher the CKDS prior to changing a symmetric
                          master key
  4  CHANGE SYM MK     -  Change a symmetric master key and activate the
                          reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                          activate an updated Public Key Data Set or
                          update the Public Key Data Set header
  6  REENCIPHER PKDS   -  Reencipher the PKDS
  7  CHANGE ASYM MK    -  Change an asymmetric master key and activate the
                          reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 110. Selecting the Reencipher CKDS option on the ICSF Master Key Management Panel

2. The Reencipher CKDS panel appears. See Figure 111.

```
CSFCMK10 ----------------- ICSF - Reencipher CKDS ------------------
COMMAND ===>


To reencipher all CKDS entries from encryption under the current DES/
Symmetric-keys master key to encryption under the new master key enter
the CKDS names below.



    Input CKDS ===> 'CKDS.CURRENT.MASTER'

    Output CKDS ===> 'CKDS.NEW.MASTER'
```

Figure 111. Reencipher CKDS

3. In the Input CKDS field, enter the name of the CKDS that you want to reencipher. In the Output CKDS field, enter the name of the data set in which you want to place the reenciphered keys.

Notes:

a. The output data set should already exist although it must be empty. For more information about defining a CKDS, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

b. The input CKDS and the output CKDS must have the same VSAM attibutes.

Reenciphering the disk copy of the CKDS does not affect the in-storage copy of the CKDS. On this panel, you are working with only a disk copy of the CKDS.

4. Press ENTER to reencipher the input CKDS entries and place them into the output CKDS.

   The message REENCIPHER SUCCESSFUL appears on the top right of the panel if the reencipher succeeds.

5. If you have more than one CKDS on disk, specify the information and press ENTER as many times as you need to reencipher all of them. Reencipher all your disk copies at this time. When you have reenciphered all the disk copies of the CKDS, you are ready to change the master key.

6. Press END to return to the Master Key Management panel.

   Changing the master key involves refreshing the in-storage copy of the CKDS with a disk copy and activating the new master key.

7. If you are running in compatibility or co-existence mode, *do not* select option 4, the Change option. To activate the changed master key when running in compatibility or co-existence mode, you need to re-IPL MVS and start ICSF. When you re-IPL MVS and start ICSF, you activate the changed master key and refresh the in-storage CKDS.

8. If you are running in noncompatibility mode, to change the master key select option 4, CHANGE MK, on the Master Key Management panel.

   When you press the ENTER key, the Change Master Key panel appears. See Figure 112.

```
CSFCMK20 ---------------------- ICSF Change Master Key --------------
COMMAND ===>


Enter the name of the new CKDS below:

  New CKDS ===> 'CKDS.NEW.MASTER'

When the master key is changed, the new CKDS will become active.
```

Figure 112. Change Master Key Panel

9. In the New CKDS field, enter the name of the disk copy of the CKDS that you want ICSF to place in storage.

   You should have already reenciphered the disk copy of the CKDS under the new master key. The last CKDS name that you specified in the Output CKDS field on the Reencipher CKDS panel, which is shown in Figure 60 on page 129, automatically appears in this field.

10. Press ENTER.

    ICSF loads the data set into storage where it becomes operational on the system. ICSF also places the new master key into the master key register so it becomes active.

When you press ENTER, ICSF attempts to change the master key. It displays a message on the top right of the panel. The message indicates either that the master key was changed successfully or that an error occurred that prevented the successful completion of the change process. For example, if you indicate a data set that is not reenciphered under the new master key, an error message displays, and the master key is not changed.

11. When changing the master key, remember to change the name of the CKDS in the Installation Options Data Set.

You can use a utility program to reencipher the CKDSs and change the master key instead of using the panels. "Reenciphering a disk copy of a CKDS and changing the master key" on page 359 describes how to use the utility program for these procedures.

Asymmetric master keys and the PKDS

The step-by-step procedure for changing the RSA-MK or ECC-MK is documented in this topic.

Notes:

1. Prior to reenciphering a PKDS, consider temporarily disallowing dynamic PKDS update services. For more information, refer to "Steps for enabling and disabling PKA callable services and PKDS updates."
2. The procedure for changing the RSA-MK depends on the cryptographic coprocessors online on your system. When your system has CEX3C coprocessors that are online and have the RSA-MK loaded, the steps involving the PKA callable services control should be ignored. The control will not be active.
3. When the PKDS is shared by multiple images in a sysplex environment, the asymmetric key master keys must also be changed on all the sharing systems. See Chapter 9, "Running in a Sysplex Environment," on page 191.

Steps for enabling and disabling PKA callable services and PKDS updates

Note: The PKA callable services control may not be active on your system. When the control isn't active, all steps referring to the control can be ignored.

When you enter or change the RSA-MK, you must first disable the PKA callable services control. This requirement applies only to the RSA-MK. You do not need to disable PKA callable services control in order to enter or change the ECC-MK.

1. Access the administrative control functions by choosing option 4, ADMINCNTL, on the Primary Menu panel, as shown in Figure 113 on page 180.

```
CSF@PRIM --------- Integrated Cryptographic Service Facility -------
OPTION ===> 4

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions


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     disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 113. Selecting Administrative Control on the ICSF Primary Menu Panel

The Administrative Control Function panel appears. See Figure 114.

```
CSFACF00 ------------- ICSF Administrative Control Functions
COMMAND ===>
          Active CKDS: CRYPTO25.HCRICSF.CKDS
          Active PKDS: CRYPTO25.HCRICSF.PKDS
          Active TKDS: CRYPTO25.HCRICSF.TKDS

To change the status of a control, enter the appropriate character
(E - ENABLE, D - DISABLE) and press ENTER.

         Function                                  STATUS
         --------                                  ------
.  Dynamic CKDS Access                           ENABLED
.  PKA Callable Services                         ENABLED
.  Dynamic PKDS Access                           ENABLED
```

Figure 114. Enabling and Disabling the PKA Callable Services

2. Enter the appropriate character and press ENTER.
   - To enable the PKA callable services control, enter an 'E' before the PKA Callable Services function.
   - To disable the PKA callable services control, enter a 'D' before the PKA Callable Services function.
   - To enable the dynamic PKCS update services control, enter an ‘E’ before the Dynamic PKDS Access function.
   - To disable the dynamic PKCS update services control, enter a ‘D’ before the Dynamic PKDS Access function.

Steps for changing the RSA-MK or ECC-MK master key and reenciphering the PKDS

To change the RSA-MK or ECC-MK master key and reencipher the PKDS:

1. Enter the key parts of the new master key that you want to replace the current master key. For information about how to do this procedure, see “Entering master key parts” on page 144. The new master key register must be full when you change the master key.

   Note: When the PKA callable services control is active, the RSA-MK will be set when the final key part is loaded.

2. Select option 6, REENCIPHER PKDS, on the Master Key Management panel and press ENTER. When you change the master key, you must first reencipher the disk copy of the PKDS under the new master key.

   Note: If your system is using multiple coprocessors, they must have the same master key. When you change the master key in one coprocessor, you should change the master key in the other coprocessors. Therefore, to reencipher a PKDS under a new master key, the new master key registers in all coprocessors must contain the same value.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  6


Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                                activate an updated Cryptographic Key Data Set
  2  SET MK             -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS    -  Reencipher the CKDS prior to changing a symmetric
                           master key
  4  CHANGE SYM MK      -  Change a symmetric master key and activate the
                           reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                                 activate an updated Public Key Data Set or
                                 update the Public Key Data Set header
  6  REENCIPHER PKDS    -  Reencipher the PKDS
  7  CHANGE ASYM MK     -  Change an asymmetric master key and activate the
                           reenciphered PKDS
```

Figure 115. Selecting the Reencipher PKDS Option on the ICSF Master Key Management Panel

3. The Reencipher PKDS panel appears.

```
CSFCMK11 ---------------- ICSF - Reencipher PKDS -------------
COMMAND ===>


To reencipher all PKDS entries from encryption under the old RSA master
key and/or current ECC master keys to encryption under the current RSA
master key and/or new ECC master key, enter the PKDS names below.

    Input PKDS   ===> 'PKDS.CURRENT.MASTER'

   Output PKDS ===> 'PKDS.NEW.MASTER'

Press ENTER to reencipher the PKDS.
Press END   to exit to the previous menu
```

Figure 116. Reencipher PKDS

3. In the Input PKDS field, enter the name of the PKDS that you want to reencipher. In the Output PKDS field, enter the name of the data set in which you want to place the reenciphered keys.

   Reenciphering the disk copy of the PKDS does not affect the in-storage copy of the PKDS. On this panel, you are working with only a disk copy of the PKDS.

   Note: The output data set should already exist although it must be empty. For more information about defining a PKDS, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.
4. Press ENTER to reencipher the input PKDS entries and place them into the output PKDS.

   The message REENCIPHER SUCCESSFUL appears on the top right of the panel if the reencipher succeeds.
5. If you have more than one PKDS on disk, specify the information and press ENTER as many times as you need to reencipher all of them. Reencipher all your disk copies at this time. When you have reenciphered all the disk copies of the PKDS, you are ready to change the master key.
6. Press END to return to the Master Key Management panel.

   Changing the master key involves refreshing the in-storage copy of the PKDS with a disk copy and activating the new master key.
7. To change the master key select option 7, CHANGE ASYM MK, on the Master Key Management panel.

   When you press the ENTER key, the Change Master Key panel appears.

```
CSFCMK22 --------------- ICSF - Change Asymmetric Master Key ---------------------

Enter the name of the new PKDS below.

New PKDS ===>

When the master key is changed, the new PKDS will become active.
```

Figure 117. Change Master Key Panel

8. In the New PKDS field, enter the name of the disk copy of the PKDS that you want ICSF to place in storage.

   You should have already reenciphered the disk copy of the PKDS under the new master key. The last PKDS name that you specified in the Output PKDS field on the Reencipher PKDS panel, which is shown in Figure 60 on page 129, automatically appears in this field.
9. Press ENTER

   ICSF loads the data set into storage where it becomes operational on the system. ICSF also places the new master key into the master key register so it becomes active.

   When you press ENTER, ICSF attempts to change the master key. It displays a message on the top right of the panel. The message indicates either that the master key was changed successfully or that an error occurred that prevented the successful completion of the change process. For example, if you indicate a data set that is not reenciphered under the new master key, an error message displays, and the master key is not changed.
10. When changing the master key, remember to change the name of the PKDS in the Installation Options Data Set.

You can use a utility program to reencipher the PKDSs instead of using the panels. “Reenciphering a PKDS” on page 371 describes how to use the utility program for these procedures.

Steps for clearing master keys

For security reasons, your installation may need to clear the master keys. This may be required, for example, prior to turning the processor hardware over for maintenance.

If you have a TKE workstation, you can use it to zeroize all domains that have keys loaded. Refer to *z/OS Cryptographic Services ICSF TKE Workstation User's Guide* for more information.

If you do not have a TKE workstation, you might want to consider nullifying the master keys. To do this you would need to enter a new DES-MK or AES-MK master key, reencipher a dummy CKDS, and change the master key. You would need to perform this operation twice to ensure that the master key is cleared from the auxiliary (old) master key register. You would also need to reset the asymmetric-keys master keys and process the PCIXCC, CEX2C, and CEX3C master keys.

You can also use the zeroize function on the Support Element panel. Besides clearing the master keys, this also clears all domains and installation data.

Steps for adding PCIXCC, CEX2C, or CEX3C coprocessors after initialization

You may need to initialize PCIXCCs, CEX2Cs, and CEX3Cs after system initialization.

Note: Use this procedure if you did not run the Pass Phrase Initialization utility. If you used the utility, see “Steps for adding a PCIXCC, CEX2C, or CEX3C after first time Pass Phrase Initialization” on page 91.

Follow this procedure.

1. Select option 1, COPROCESSOR MGMT, on the Primary Menu panel.
2. The Coprocessor Management panel, as shown in Figure 118 on page 184, appears.

```
CSFGCMP0 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

                Serial
 CoProcessor    Number         Status   AES   DES   ECC   RSA
 -----------   ---------       ------   ---   ---   ---   ----
__ H00                         ACTIVE
__ G01          00000001       ONLINE    U     U     U     U
__ G02          00000002       ACTIVE    C     U     U     C
__ G03          00000003       ACTIVE    C     U     A     C
E  G04          00000004       ACTIVE    C     C     A     C
__ G05          00000005       ONLINE    U     C     E     U
__ E06          00000006       ACTIVE    C     C     -     C
__ G07          00000007       OFFLINE
```

Figure 118. Selecting a coprocessor on the Coprocessor Management Panel

3. Select the Coprocessor to be processed by entering 'E' next to the Coprocessor.
4. The Master Key Entry panel appears. See Figure 119.

```
CSFDKE50------------- ICSF - Master Key Entry -----------------
COMMAND ===>

              AES new master key register               : EMPTY
              DES new master key register               : EMPTY
              ECC new master key register               : EMPTY
              RSA new master key register               : EMPTY

  Specify information below
    Key Type  ===> ___              (AES-MK, DES-MK, ECC-MK, RSA-MK)

    Part      ===> ______           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000  (AES-MK, ECC-MK and RSA-MK only)
              ===> 0000000000000000  (AES-MK, ECC-MK only)



  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 119. The Master Key Entry Panel to Reset Registers

Ensure that the new master key registers are EMPTY. If they are not, you will need to RESET to clear the contents of the registers to set a new key value.

5. You must now load the master keys into your system.

   If you are going to reload your current master keys, you need to know the current master key value and checksum. If you want the PCIXCC, CEX2C, or CEX3C to become ACTIVE after initialization, you MUST enter the same master key values.

   Follow the instructions on “Steps for entering the first master key part” on page 151.

6. When all key parts have been loaded, SET the master key. From the Primary Menu panel choose option 2 - Master Key. From the Master Key Management panel, choose option 2 - SET MK.

Chapter 8. Key Management on Systems without Coprocessors

The CKDS can be used to manage clear AES and DES DATA keys on a system that does not have any cryptographic coprocessors or accelerators on z890, z990, z9, z10, and z196 systems.

Note: z900 systems require the CCF be available for ICSF and do not support this usage.

A CKDS initialized on a system without coprocessors can not be used with a system with coprocessors. ICSF will terminate during initialization and issue the CSFM128E message if you attempt to start ICSF with a CKDS that was initialized on a system without coprocessors. The CKDS can not be updated to support systems with coprocessors.

Starting with release HCR7780, there are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). Both formats are supported for systems without coprocessors.

Initializing the CKDS at First-Time Startup

The first time you start ICSF, you must:

- Create a cryptographic key data set (CKDS)
- Create a PKA key data set (PKDS)
- The PKDS is required but can not be used for asymmetric key management
- Initialize the CKDS

You only have to initialize a CKDS the first time you start ICSF on a system. When you initialize a CKDS, you can copy the disk copy of the CKDS to create other CKDSs for use on the system. You can also use a CKDS from another ICSF system.

At any time, you can read a different disk copy into storage. For information about how to read a disk copy into storage, see “Refreshing the CKDS at Any Time” on page 188.

Steps for initializing a CKDS

1. Select Option 2, MASTER KEY MGMT, on the ICSF Primary Menu panel
2. Select option 1, INIT/REFRESH/UPDATE CKDS and the Initialize a CKDS panel appears.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                        activate an updated Cryptographic Key Data Set
  2  SET MK            -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS   -  Reencipher the CKDS prior to changing a symmetric
                        master key
  4  CHANGE SYM MK     -  Change a symmetric master key and activate the
                        reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                        activate an updated Public Key Data Set or
                        update the Public Key Data Set header
  6  REENCIPHER PKDS   -  Reencipher the PKDS
  7  CHANGE ASYM MK    -  Change an asymmetric master key and activate the
                        reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 120. ICSF Master Key Management Panel

3. In the CKDS field, enter the name of the empty VSAM data set that was created to use as the disk copy of the CKDS.

```
CSFCKD10 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)
       Record authentication required (Y/N)
  2  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 121. ICSF Initialize a CKDS Panel

   The name you enter can be the same name that is specified in the CKDSN keyword option in the installation options data set. You can also initialize a data set that might serve as a backup. For information about creating a CKDS and specifying the CKDS name in the installation options data set, see *z/OS Cryptographic Services ICSF System Programmer's Guide*, SA22-7520.

4. Choose option 1, Initialize an empty CKDS, and press ENTER.

   To improve performance, answer **N** to Record authentication required.

   ICSF creates the header record in the disk copy of the CKDS and refreshes the CKDS.

   When ICSF completes all these steps, the message INITIALIZATION COMPLETE appears.

Refreshing the CKDS at Any Time

When you initialize a CKDS for the first time, you can copy the disk copy of the CKDS to create other CKDSs for the system. You can use the dynamic CKDS update callable services to add or update the disk copy of the current in-storage

CKDS. For information on using the dynamic CKDS callable services, refer to the z/OS Cryptographic Services ICSF Application Programmer's Guide.

Notes:

1. Prior to refreshing a CKDS, consider temporarily disallowing dynamic CKDS update services.
2. You may refresh any CKDS with the REFRESH CKDS option. This includes CKDS that were initialized on systems with master keys. This is the only way to share a CKDS with a system that has cryptographic coprocessors. If you are sharing a CKDS with encrypted keys, the system with no coprocessors can not manage the encrypted keys.

You can refresh the in-storage CKDS with an updated or different disk copy of the CKDS by using these steps. You can refresh the CKDS at any time without disrupting cryptographic functions.

1. Enter option 2, MASTER KEY, on the ICSF Primary Menu panel to access the Master Key Management Panel.
2. Select option 1, INIT/REFRESH/UPDATE CKDS and the Initialize a CKDS panel appears.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  1

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                                activate an updated Cryptographic Key Data Set
  2  SET MK             -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS    -  Reencipher the CKDS prior to changing a symmetric
                           master key
  4  CHANGE SYM MK      -  Change a symmetric master key and activate the
                           reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                           activate an updated Public Key Data Set or
                           update the Public Key Data Set header
  6  REENCIPHER PKDS    -  Reencipher the PKDS
  7  CHANGE ASYM MK     -  Change an asymmetric master key and activate the
                           reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

Figure 122. ICSF Master Key Management Panel

3. In the CKDS field, specify the name of the disk copy of the CKDS that you want ICSF to read into storage.

```
CSFCKD10 ---------------- ICSF - Initialize a CKDS  ----------------
COMMAND ===>


Enter the number of the desired option.

  1  Initialize an empty CKDS (creates the header and system keys)
        Record authentication required (Y/N)
  2  REFRESH   -  Activate an updated CKDS

Enter the name of the CKDS below.

  CKDS ===> 'FIRST.EMPTY.CKDS'
```

Figure 123. ICSF Initialize a CKDS Panel

4. Choose option 2, REFRESH, and press ENTER. ICSF places the disk copy of the specified CKDS into storage. A REFRESH does not disrupt any applications that are running on ICSF. A message that states that the CKDS was refreshed appears on the right of the top line on the panel.
5. Press **END** to return to the Primary Menu panel.

Callable services

These callable services can be used on a system without coprocessors with an initialized CKDS. The key management services can only be used to manage clear keys, encrypted keys can not be managed in this configuration.

- Key record create (CSNBKRC) and key record create2 (CSNBKRC2)
- Key record write (CSNBKRW) and key record write2 (CSNBKRW2)
- Key record delete (CSNBKRD)
- Key record read (CSNBKRR) and key record read2 (CSNBKRR2)

  Key record read will not return a clear key token to the caller unless the caller is in supervisor state or system key.

These services support labels for the key identifier:

- Symmetric key decipher (CSNBSYD)
- Symmetric key encipher (CSNBSYE)
- Symmetric MAC generate (CSNBSMG)
- Symmetric MAC verify (CSNBSMV)

These services do not require a coprocessor:

- Key token build (CSNBKTB)
- One way hash (CSNBOWH)
- MDC generate (CSNBMDG)

Chapter 9. Running in a Sysplex Environment

ICSF is supported in a SYSPLEX environment. The CKDS, PKDS and TKDS can be shared across systems in a sysplex.

Attention: If you are running on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 and wish to share your CKDS and PKDS with another system, such as a CCF system on a z900, you should initialize the CKDS and PKDS on the CCF system.

CKDS management in a sysplex

ICSF instances may share the same active CKDS across multiple LPARs on the same system, or across LPARs on different zSeries Processors. All ICSF instances sharing the same active CKDS must have the same DES and, if applicable, AES master key installed.

It is not required that all ICSF instances share their active CKDS across a sysplex. It is also not required that all ICSF instances in a sysplex be configured with the same active CKDS. Each system may have its own Master Key(s) and its own active CKDS. A sysplex may have a combination of ICSF instances that share their active CKDS and ICSF instances that do not share their active CKDS.

In a sysplex environment, a set of ICSF instances all sharing the same active CKDS can be described as a CKDS sysplex cluster. Other ICSF instances configured with different active CKDSs can join the same sysplex group to create multiple CKDS sysplex clusters.

It is not required for each ICSF instances sharing the same active CKDS to be configured with the same DOMAIN. Cryptographic Coprocessor DOMAINs may be split up across LPARs all sharing the same active CKDS.

When sharing the CKDS, a few precautions should be observed:

- Dynamic CKDS services update the DASD copy of the active CKDS and the in-storage copy on the system where it is run. The SYSPLEXCKDS option in the ICSF installation options data set provides consistent sysplex-wide update of the DASD copy of the active CKDS and the in-storage copies of the active CKDS for all members of the sysplex sharing the same active CKDS. If SYSPLEXCKDS(YES,FAIL(xxx)) is specified in the installation options data set, sysplex messages will be issued to sysplex members configured with the same active CKDS. The messages will inform them of the CKDS update and request them to update their in-storage CKDS copy. If SYSPLEXCKDS(NO,FAIL(xxx)) is specified in the installation options data set, sysplex messages will not be sent to sysplex members for CKDS updates. When configured this way, either a coordinated refresh or a single-system refresh must be performed to load the updates into ICSFs in-storage copy of the CKDS. To perform a coordinated CKDS refresh, refer to “Performing a coordinated CKDS refresh” on page 198. To perform a single-system CKDS refresh on each ICSF instance configured with the affected CKDS, refer to “Performing a single system CKDS refresh” on page 170 or Chapter 16, “Using the ICSF Utility Program CSFEUTIL,” on page 359.
- If multiple sysplexes share a CKDS, or if a sysplex and other non-sysplex systems share a CKDS, there is no provision for automatic update of the in-storage copies of the CKDS on the systems that are not in the same sysplex as the system initiating the CKDS update. When configured this way, either a coordinated CKDS refresh or a single-system CKDS refresh will be required on

the systems that are sharing the same active CKDS but are not in the same sysplex as the initiating system in order to update the in-storage copy on each system. To perform a coordinated CKDS refresh, refer to “Performing a coordinated CKDS refresh” on page 198. To perform a single-system CKDS refresh on each ICSF instance configured with the affected CKDS, refer to “Performing a coordinated CKDS refresh” on page 198 or Chapter 16, “Using the ICSF Utility Program CSFEUTIL,” on page 359.

- If KGUP is used to update the active CKDS, the update is only made to the DASD copy of the CKDS. Either a coordinated CKDS refresh or a single-system CKDS refresh must be performed to load the updates into ICSFs in-storage copy of the CKDS. To perform a coordinated CKDS refresh, refer to “Performing a coordinated CKDS refresh” on page 198. To perform a single-system CKDS refresh on each ICSF instance configured with the effected CKDS, refer to the “Performing a single system CKDS refresh” on page 170 or Chapter 16, “Using the ICSF Utility Program CSFEUTIL,” on page 359.
- Starting with release HCR7780, there are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). The variable-length record format can be shared only by systems running ICSF HCR7780 or later.

Restriction: If you initialized your CKDS on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 the CKDS cannot be shared with other CCF systems.

Setting DES and AES master keys for the first time when sharing a CKDS in a sysplex environment

Setting symmetric master keys for the first time in a sysplex environment can be accomplished using:

- the optional TKE Workstation (Group of coprocessors and/or group of domains function). See the *z/OS Cryptographic Services ICSF TKE Workstation User's Guide* for more information.
- Master Key Entry
- PPINIT

Before setting symmetric master keys for the first time in a sysplex environment, you will need to allocate an empty CKDS. For information about defining a CKDS, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Once you have allocated an empty CKDS, all LPARs that will share this CKDS must update their ICSF options data set to use this CKDS as their active CKDS. On the first LPAR that starts ICSF, you will load the symmetric master keys, initialize the CKDS, and set the symmetric master keys. On all other LPARs that will share the same active CKDS, you will only load the same master keys, and then set the master key. You should only initialize the CKDS once from the first LPAR that started ICSF.

Note: AES master keys are only supported with FMID HCR7751 running on z9 and z10 servers with a CEX2C and the Nov. 2008 or later licensed internal code (LIC), and on later releases with a CEX2C or CEX3C. ICSF releases before HCR7751 do not support secure AES keys and require APAR OA26579 for toleration.

Using master key entry

Master key entry may be used to set master keys in a sysplex environment. First, load your master keys in the first LPAR as described in “Entering master key parts” on page 99

on page 99 (CCF and PCICC) or "Entering master key parts" on page 144 (PCIXCC, CEX2C, or CEX3C). Next, you will initialize the CKDS from the first LPAR as described in "Steps for initializing a CKDS" on page 118 (CCF and PCICC) or "Steps for initializing a CKDS" on page 163 (PCIXCC, CEX2C, or CEX3C). Finally, for all subsequent LPARs, enter the master keys as described in "Reentering master keys when they have been cleared" on page 124 (CCF and PCICC) or "Reentering master keys when they have been cleared" on page 172 (PCIXCC, CEX2C, or CEX3C).

Using Pass Phrase Initialization

The Pass Phrase Initialization utility can be used to set master keys an initialize the CKDS and PKDS in a sysplex environment.

1. Start ICSF in the first LPAR and follow the instructions in Chapter 5, "Using the Pass Phrase Initialization Utility," on page 77.
2. Once the first LPAR has been successfully initialized, start ICSF in the other LPARs that are sharing the same active CKDS.
3. From each LPAR that is sharing the same active CKDS, go to the Pass Phrase Initialization panel, and:
   a. Enter the same pass phrase as entered on the first LPAR
   b. If running on a non-CCF system:
      1) Select 'Reinitialize System'
      2) Enter the same CKDS name and PKDS name as entered on the first LPAR

      If running on a CCF system:
      1) Respond N to 'Initialize the CKDS and PKDS'
      2) Respond to the remaining questions as for the first LPAR
      3) Enter the same CKDS name and PKDS name as entered on the first LPAR

These steps will load and set the same master keys as in the first LPAR and activate the same CKDS.

Changing symmetric master keys and refreshing the CKDS when the CKDS is shared in a sysplex environment

In ICSF FMID HCR7790, two functions have been added that coordinate CKDS refreshes and CKDS master key changes across sysplex members sharing the same active CKDS. The coordinated CKDS administration functions simplify CKDS management by automating the manual process for performing single-system CKDS refreshes and single-system CKDS master key changes. Although a sysplex environment is not required to use these functions, sysplex environments gain the maximum benefit from them when the changes are coordinated across all LPARs sharing the same active CKDS.

Both functions are initiated from a single ICSF instance. This instance will drive the operation across the sysplex using sysplex messaging to other members sharing the same active CKDS.

For coordinated CKDS refresh, the initiating system sends sysplex messages to all sysplex members sharing the same active CKDS, instructing them to either refresh their in-store CKDS copy of the active CKDS, or refresh their in-store CKDS copy to

a new CKDS. Performing a coordinated CKDS refresh to a new CKDS will result in the new CKDS becoming the active CKDS for all sysplex members in this CKDS sysplex cluster.

Coordinated CKDS change master key will reencipher the active CKDS disk-copy to a new CKDS using the master key values that have been pre-loaded into the new master key registers. Before performing the coordinated CKDS change master key function, you must use either Master Key Entry or TKE to load the new master key registers. The coordinated CKDS change master key function may be used to change both the DES and AES master keys, or just one or the other.

For more information on Master Key Entry refer to “Entering master key parts” on page 144 (PCIXCC, CEX2C, or CEX3C). For more information on loading the new master key registers from TKE, refer to the *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

After reenciphering the active CKDS disk-copy, the initiating system will send sysplex messages to the other members sharing the same active CKDS, informing them to re-load their in-store CKDS from the new reenciphered CKDS.

Next, the initiating system will set the symmetric master keys for the new master key registers (DES and/or AES) that have been pre-loaded, and make the new CKDS the active CKDS.

Finally, the initiating system will send sysplex messages to the other members of their CKDS sysplex cluster, informing them to set their symmetric master keys for the new master key registers (DES and/or AES) that have been pre-loaded, and to make the new CKDS their active CKDS.

It is not required to disable dynamic CKDS updates within the sysplex while performing a coordinated CKDS master key change. This is an enhancement over the single-system CKDS master key change function, for which disallowing dynamic CKDS update services is recommended.

During a coordinated CKDS master key change, dynamic CKDS update requests will be routed to, and processed by, the ICSF instance that initiated the coordinated CKDS master key change. The initiator will process dynamic CKDS updates against the active CKDS during the coordinated CKDS change master key. When the initiating system has reenciphered the CKDS, and before it coordinates the CKDS master key change across the sysplex, there is a brief suspension to dynamic CKDS update processing. During this brief suspension, dynamic CKDS updates that were processed by the initiator are applied to the new reenciphered CKDS. If you cannot tolerate a temporary suspensions of dynamic CKDS update services in your workload, and would prefer that update requests are failed instead, you should disallow dynamic CKDS access prior to performing a coordinated CKDS change master key.

For a coordinated CKDS refresh, dynamic CKDS update processing is internally suspended by the initiator until the coordinated CKDS refresh completes. However, IBM still recommends that you disallow dynamic CKDS access prior to performing a coordinated CKDS refresh.

For more information on disabling dynamic CKDS updates, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration updates” on page 216.

If a Key Store Policy is defined on the active CKDS, it will continue to be used on the new CKDS after a coordinated CKDS change master key or coordinated CKDS refresh completes.

In order to perform one of the coordinated CKDS administration functions, all ICSF instances in the sysplex, regardless of their active CKDS, must be at the HCR7790 level or later. Coordinated CKDS administration functions will be unavailable if an instance of ICSF joins the sysplex that is running at a level lower then HCR7790. When an ICSF instance running at a level lower than HCR7790 joins the sysplex group, the manual single-system process must be used to perform CKDS refreshes and CKDS master key changes on each LPAR in the CKDS sysplex cluster.

To perform a coordinated CKDS refresh, use the procedure describe in “Performing a coordinated CKDS refresh” on page 198. To perform a single-system CKDS refresh, use the procedure described in “Performing a single system CKDS refresh” on page 170 on each member of the CKDS sysplex cluster. When performing a single-system CKDS refresh or a coordinated CKDS refresh, you should disable dynamic CKDS updates on all sysplex members.

To change symmetric master keys, use the coordinated CKDS master key change function described in “Performing a coordinated CKDS master key change.” This capability is only available if your system and/or sysplex meets the necessary requirements outlined in “Symmetric Master Keys and the CKDS” on page 174.

If your environment does not meet the necessary requirements for performing a coordinated CKDS master key change, use the single-system CKDS change master key process. The single-system process should be performed on an instance running the latest level of ICSF. On the other CKDS sysplex cluster members, enter the master keys as described in “Reentering master keys when they have been cleared” on page 124 (CCF and PCICC) or “Reentering master keys when they have been cleared” on page 172 (PCIXCC, CEX2C, or CEX3C). Reenciphering the CKDS is not necessary on the other CKDS sysplex cluster members.

When using the manual single system process, it is recommended to disable dynamic CKDS updates on all sysplex members.

Performing a coordinated CKDS master key change

The coordinated KDS change master key option simplifies the procedure for changing symmetric master keys. All systems must be running ICSF FMID HCR7790 or later. Before using this procedure, make sure that your system meets all the requirements outlined in “Symmetric Master Keys and the CKDS” on page 174. If your system does not meet these requirements, do not use this procedure. Instead, use the procedure described in “Steps for reenciphering the CKDS and performing a single-system CKDS master key change” on page 176.

Notes:

1. Coordinated CKDS change master key is not supported on the IBM zSeries 900. In a sysplex environment, the master key will be changed for all systems in the sysplex that share the active CKDS. None of these systems can be an IBM zSeries 900.
2. The coordinated KDS reencipher procedure offers further advantages in a sysplex environment. Specifically, a master key change initiated from one ICSF instance in the sysplex will change the master key(s) for all ICSF instances in the sysplex that share the same active CKDS. The instructions that follow assume you are running on a single system. If you are running in sysplex

environment, make sure you also understand the information in "Changing symmetric master keys and refreshing the CKDS when the CKDS is shared in a sysplex environment" on page 193 before proceeding.

3. Reenciphering a large CKDS (millions of records) may cause a temporary internal suspension of CKDS update requests running in parallel. If you cannot tolerate a temporary suspension in your workload, and would prefer that update requests are failed instead of suspended, you should disallow dynamic CKDS access prior to performing the coordinated CKDS reencipher. For more information, refer to "Steps for disallowing dynamic CKDS updates during CKDS administration updates" on page 216.
4. This procedure is only for reenciphering the active CKDS. It is not for reencipherring archived or backup copies of the CKDS that are not currently active.
5. If you have a combination of PCIXCCs, CEX2Cs, and/or CEX3Cs installed in a sysplex environment, the ICSF instance configured with the cryptographic coprocessor containing the highest level of licensed internal code must initiate the coordinated CKDS change master key. If the coordinated CKDS change master key is not initiated by the ICSF instance containing the highest level of licensed internal code, the operation will fail.
6. If your system is using multiple coprocessors, they must have the same master key(s). When you change the master key(s) in one coprocessor, you should change the master key(s) in the other coprocessors. Therefore, to reencipher a CKDS under a new master key, the new master key registers in all coprocessors must contain the same value.
7. If the CKDS contains HMAC keys, it must be reenciphered on a system with a CEX3C and the Sept. 2010 or later licensed internal code.
8. If the CKDS contains variable-length AES keys, it must be reenciphered on a system with a CEX3C and the Sep. 2011 or later licensed internal code.
9. If there is a problem reenciphering a CKDS entry, the CSFC0316 message is generated specifying the label for the CKDS problem entry.

Before beginning this procedure, you must:

- Enter the key parts of the new master key(s) (AES master key, DES master key, or both) that you want to replace the current master key(s). For information about how to do this procedure, see "Entering master key parts" on page 144. The new master key register must be full when you change the master key.
- Create a new VSAM data set in which the reenciphered keys will be placed to create the new reenciphered CKDS. This data set must be allocated and empty, and must contain the same data set attributes as the active CKDS. For more information about defining a CKDS, see the *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Before beginning this procedure, you may optionally:

- Create an additional VSAM data set to serve as a backup of the new, reenciphered, CKDS. This data set must be allocated and empty, and must contain the same data set attributes as the active CKDS.
- If you are planning to use the archive option, which is described below, determine a VSAM data set name to use for the archived CKDS data set. This data set must not be allocated and must not exist on the system.

For more information about defining a CKDS, see the *z/OS Cryptographic Services ICSF System Programmer's Guide*.

To reencipher the CKDS and change the master key:

1. Enter option 2, MASTER KEY MGMT, on the ICSF Primary Menu panel to access the Master Key Management panel.
2. On the Master Key Management panel, select option 9, COORDINATED KDS CHANGE MK.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  9

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                        activate an updated Cryptographic Key Data Set
  2  SET MK           -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS  -  Reencipher the CKDS prior to changing a symmetric
                        master key
  4  CHANGE SYM MK    -  Change a symmetric master key and activate the
                        reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                        activate an updated Public Key Data Set or
                        update the Public Key Data Set header
  6  REENCIPHER PKDS  -  Reencipher the PKDS
  7  CHANGE ASYM MK   -  Change an asymmetric master key and activate the
                        reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

3. The Coordinated Change Master Key KDS Selection panel is displayed. You are prompted for the KDS type for the coordinated change master key action. The coordinated change master key action is supported only for a CKDS.

```
CSFCRC4P ----------- ICSF - Coordinated Change Master Key KDS Selection -------

  Select one Key Data Set type and press ENTER to continue.

  ==> / CKDS - Cryptographic Key Data Set
```

4. The Coordinated KDS change master key panel is displayed.

```
------------------- ICSF - Coordinated KDS change master key ------------------

To perform a coordinated KDS change master key, enter the KDS names below
and optionally select the rename option.

    KDS Type ===> CKDS

  Active KDS ===> 'PLEX.TEST.CKDS'

     New KDS ===>

          Rename Active to Archived and New to Active (Y/N) ===> N

          Archived KDS ===>

          Create a backup of the reenciphered KDS (Y/N) ===> N

          Backup KDS ===>

Press ENTER to perform a coordinated KDS change master key.
Press END to exit to the previous menu.
```

The KDS type is displayed in the **KDS Type** field. The active CKDS is displayed in the **Active KDS** field.

a. Enter the name of the new CKDS in the **New KDS** field. This must be an empty and allocated VSAM data set containing the same data set attributes as the active CKDS. The reenciphered keys will be placed into this new data set to create the new CKDS.

b. Decide if you want to have the new CKDS renamed to the match the name of the current active CKDS. Having the new CKDS renamed to match the name of the current active CKDS simplifies CKDS administration, because you will not need to update the ICSF Options Data Set with the name of the new data set after the CKDS is reenciphered.

   - If you would like the have the new CKDS renamed to match the name of the current active CKDS:
     1) Type Y in the **Rename Active to Archived and the New to Active (Y / N)** field.
     2) Enter the name under which the currently active CKDS will be archived in the **Archived KDS** field. This must be a VSAM data set name that is not allocated and does not exist on the system.
   - If you do not want to have the new CKDS renamed to match the name of the current active CKDS, type N in the **Rename Active to Archived and the New to Active (Y / N)** field. Remember to change the name of the CKDS in the Installation Options Data Set as described in the *z/OS Cryptographic Services ICSF System Programmer's Guide*. The CKDS name must be changed in each cluster member's Installation Options Data Set after the coordinated KDS change master key function completes successfully. If the Installation Options Data Set is updated with a new CKDS name and the coordinated KDS change master key function fails, ICSF might be configured with an invalid CKDS the next time it is restarted.

c. Decide if you want to also create a backup copy of the newly enciphered CKDS. This is an empty and allocated VSAM data set containing the same data set attributes as the active CKDS. The reenciphered keys will be placed into this data set to create the backup CKDS.

5. Press ENTER to begin the coordinated change master key. This will reencipher the disk copy of the active CKDS under the new master keys to create the new CKDS on disk, and will create an in-storage copy of that new CKDS.

   Note: In a sysplex environment, the in-storage copy of the new CKDS will be created for all ICSF instances that share the CKDS. See "Changing symmetric master keys and refreshing the CKDS when the CKDS is shared in a sysplex environment" on page 193 for more information.

6. A confirmation panel will be displayed, prompting you to verify that you want to continue with the coordinated change master key. Verify that the information on this confirmation panel is correct. If it is, type Y in the confirmation field provided and press ENTER.

   The coordinated change master key function will be executed. This function will verify that all ICSF instances sharing the same active CKDS are configured with the same New Master Key registers values. Additionally it will verify that the CKDS names specified for input are valid and are compatible with each other.

7. Verify the dialog results, and address any indicated failures or unexpected results.

Performing a coordinated CKDS refresh

Coordinated CKDS refresh may be performed on a single instance of ICSF, on a single-system sysplex, or on a multi-system sysplex. The coordinated CKDS refresh

operation is initiated from a single ICSF instance and then carried out across all other sysplex members sharing the same active CKDS. This results in the in-storage copy of the CKDS being updated for all ICSF instances in the sysplex that share the same active CKDS as the initiator.

To perform a coordinated CKDS refresh, all members of the sysplex (including sysplex members that are not configured with the same active CKDS) must be at the ICSF FMID HCR7790 level or later. In addition, no system sharing the CKDS can be a CCF system (such as a z900 system).

Before performing a coordinated CKDS refresh, you should disable dynamic CKDS updates on all sysplex members. For more information, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration updates” on page 216.

If you are performing a coordinated CKDS refresh to a new CKDS, you must ensure that the new target CKDS of the refresh contains data set attributes that are consistent with the currently active CKDS. This data set must be allocated, must not be empty, and must be enciphered with the current master key(s). You will optionally be able to use the archive option for renaming the current CKDS to an archive name and the new CKDS to the active CKDS name. The archive data set name must not be allocated or exist on the system prior to performing the coordinated CKDS refresh.

To perform a coordinated CKDS refresh:

1. Enter option 2, MASTER KEY MGMT, on the ICSF Primary Menu panel to access the Master Key Management panel.
2. The Master Key Management panel is displayed. To perform a coordinated refresh of the CKDS, specify option 8 and press enter.

```
CSFMKM10 ---------------- ICSF - Master Key Management  ----------------
OPTION ===>  8

Enter the number of the desired option.

  1  INIT/REFRESH/UPDATE CKDS - Initialize a Cryptographic Key Data Set or
                          activate an updated Cryptographic Key Data Set
  2  SET MK            -  Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS   -  Reencipher the CKDS prior to changing a symmetric
                          master key
  4  CHANGE SYM MK     -  Change a symmetric master key and activate the
                          reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS -  Initialize a Public Key Data Set or
                          activate an updated Public Key Data Set or
                          update the Public Key Data Set header
  6  REENCIPHER PKDS   -  Reencipher the PKDS
  7  CHANGE ASYM MK    -  Change an asymmetric master key and activate the
                          reenciphered PKDS
  8  COORDINATED KDS REFRESH - Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK - Perform a coordinated KDS change master key
```

3. The Coordinated Refresh KDS Selection panel is displayed. You are prompted for the KDS type for the coordinated refresh. The coordinated refresh function is only supported for the CKDS.

```
CSFCRC4P ----------- ICSF - Coordinated Refresh KDS Selection -------

  Select one Key Data Set type and press ENTER to continue.

  ==> / CKDS - Cryptographic Key Data Set
```

4. The Coordinated KDS Refresh panel is displayed.

```
 --------------------  ICSF – Coordinated KDS Refresh --------------------
COMMAND ===>
To perform a coordinated KDS refresh to a new KDS, enter the KDS names below
and optionally select the rename option. To perform a coordinated KDS refresh
of the active KDS, simply press enter without entering anything on this panel.

    KDS Type ===> CKDS
  Active KDS ===> 'PLEX.TEST.CKDS'

     New KDS ===>

           Rename Active to Archived and New to Active (Y/N) ===> N

           Archived KDS ===>

Press ENTER to perform a coordinated KDS refresh.
Press END to exit to the previous menu.
```

The active KDS name is displayed in the **Active KDS** field for the selected KDS type. You can use this panel to refresh to a new CKDS or to refresh the active CKDS.

- To refresh to a new CKDS:
  a. Enter the name of the new CKDS in the **New KDS** field. This data set must be allocated, not empty, and enciphered under the current master key(s).
  b. Optionally the rename option may be used to have the current CKDS renamed to an archive name and the new CKDS renamed to the active CKDS name. The rename option simplifies KDS administration by removing the need to update the ICSF Options Data Set with the name of the new data set after the coordinated CKDS refresh to a new data set completes.
     – If you would like the have the new CKDS renamed to match the name of the current active CKDS:
       1) Type Y in the **Rename Active to Archived and the New to Active (Y / N)** field.
       2) Enter the name under which the currently active CKDS will be archived in the **Archived KDS** field. The archive KDS name must not be allocated and must not exist on the system prior to performing the coordinated refresh to a new data set.
     – If you do not want to have the new CKDS renamed to match the name of the current active CKDS, type N in the **Rename Active to Archived and the New to Active (Y / N)** field. Remember to change the name of the CKDS in the Installation Options Data Set as described in the *z/OS Cryptographic Services ICSF System Programmer's Guide*. The CKDS name must be changed in each cluster member's Installation Options Data Set after the coordinated KDS refresh function completes successfully. If the Installation Options Data Set is updated with a new CKDS name and the coordinated KDS refresh function fails, ICSF might be configured with an invalid CKDS the next time it is restarted.

c. Press ENTER to begin the coordinated refresh.

- To refresh the active CKDS, no input is required on the panel and will be ignored if entered.
  a. Verify that the **Active KDS** field shows the name of the active CKDS. ICSF should have filled in this field automatically.
  b. Press ENTER to begin the coordinated refresh.

5. A confirmation panel will be displayed, prompting you to verify that you want to continue with the coordinated refresh. Verify that the information on this confirmation panel is correct. If it is, type Y in the confirmation field provided and press ENTER. The Coordinated KDS Refresh will then start processing.
6. Verify the dialog results, and address any indicated failures or unexpected results.

Recovering from a Coordinated CKDS administration failure

This information describes how to use ICSF diagnostic information to recover from a coordinated CKDS administration failure.

The coordinated CKDS administration functions performs multiple steps to validate the environment, including verifying master key registers across the CKDS sysplex cluster and validating CKDSs involved in the operation. If the environment is verified and meets criteria for the operation, then the initiating system of the coordinated CKDS administration function will attempt to coordinate the function across all members of the CKDS sysplex cluster (all ICSF instances sharing the same active CKDS).

Coordinated CKDS change master key or coordinated CKDS refresh messages

The coordinated CKDS refresh and coordinated CKDS change master key dialogs result in one or more dialog messages indicating the success or failure of the operation. In the case of a failure, there should be enough information in the dialog message to identify the problem. If there is not enough information in the dialog, you must use the ICSF job log to further identify the problem.

During coordinated CKDS change master key and coordinated CKDS refresh, a sequence of messages are written to the ICSF job log. CSFM622I messages are written to provide status for internal steps taken by the function. For example, one of the very first steps for a coordinated CKDS change master key operation is to make a copy of the in-storage KDS that will be used for the subsequent reencipher step. When this copy is made, the following CSFM622I message is written to the ICSF joblog.

```
CSFM622I COORDINATED CHANGE-MK PROGRESS: NEW IN-STORAGE KDS CONSTRUCTED.
```

If a failure occurs during a coordinated CKDS change master key or coordinate CKDS refresh operation, failure messages are written to the ICSF job log that provide diagnostic information for determining the cause of the problem. Depending on how far the function is into processing, steps may be required to back out from the overall operation. CSFM622I messages are also used to provide status for back out steps. Additionally, all failure cases will end with the following CSFM616I message to provide further diagnostic information.

```
CSFM616I COORDINATED operation FAILED, RC=return-code RS=reason-code
         SUPRC=supplemental-return-code SUPRS=supplemental-reason-code
         FLAGS= flags.
```

An explanation of the return code and reason code provided in the CSFM616I message can be found in the "Return and Reason Codes" section of the *z/OS Cryptographic Services ICSF Application Programmer's Guide*. The rest of the information in this message is IBM internal diagnostic information.

The sequence of messages written to the ICSF job log during a coordinated CKDS change master key and coordinated CKDS refresh should indicate how far along the function progressed, and, if a failure occurred, should include enough diagnostic information to determine the cause of the problem. Use the CSFM622I messages to determine how far along the function progressed before the failure. Then use the failure messages to determine why the problem occurred.

New master key register mismatch: For a coordinated CKDS change master key, all CKDS sysplex cluster members must have their symmetric (DES and/or AES) new master key registers pre-loaded with the same master key values. Either the DES or AES new master key registers may be pre-loaded, or both may be pre-loaded on all CKDS sysplex cluster members.

If a CKDS sysplex cluster member's symmetric new master key registers do not match the initiator's new master key registers, the following error message will be displayed on the dialog. In this example, it is the AES new master key register that does not match.

```
THE AES NEW MASTER KEY REGISTERS ARE NOT CONSISTENT ACROSS ALL COPROCESSORS FOR
THE SYSPLEX SYSTEMS PARTICIPATING IN THIS OPERATION. THEY MUST BE THE SAME. THIS
ERROR WAS DETECTED ON A SYSTEM OTHER THAN THIS ONE.
```

In addition, the following message will be written to the ICSF job log.

```
CSFM615I COORDINATED CHANGE-MK FAILED. NEW MASTER KEYS INCORRECT ON sysname.
         RC = return-code, RSN = reason-code.
```

To resolve this problem, the security administrator should compare all CKDS sysplex cluster members' symmetric new master key registers to ensure they match the initiators exactly. If a CKDS sysplex cluster member's symmetric new master key registers do not match, the security administrator should re-load them or clear them to match the values on the initiating system.

Additional information about the failure can be determined by looking up the return and reason codes in the Return and Reason Codes section of the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Cataloged failures: If any of these data sets are not cataloged, one of the following dialog messages will be displayed:

```
ICSF COULD NOT SUFFICIENTLY RESOLVE SYSTEM CATALOG INFORMATION FOR ONE OF THE
CURRENTLY ACTIVE OR NEW DATA SETS. REFER TO THE ICSF JOBLOG(S) FOR ADDITIONAL
INFO. IBM DIAGNOSTIC INFORMATION: RROPRC=0000000C RROPRSN=00000C2C SUPPRC=00000000
SUPPRSN=00000000 FLAGS=02800000
```

```
ICSF SUFFERED AN UNEXPECTED I/O ERROR REFERENCING OR UPDATING ONE OF THE ACTIVE,
NEW OR BACKUP DATA SETS. REFER TO THE ICSF JOBLOG(S) FOR ADDITIONAL INFO. IBM
DIAGNOSTIC INFORMATION: RROPRC=0000000C RROPRSN=00002740 SUPPRC=0000000C
SUPPRSN=00001790 FLAGS=41800000
```

In addition, a CSFM619I and/or a CSFM623I message will be written to the ICSF job log.

To correct this problem, make sure the necessary data sets are cataloged and retry the function.

Mainline processing failure: If a coordinated CKDS change master key or coordinated CKDS refresh operation fails during one of its internal mainline processing steps, a dialog message will be displayed indicating the problem and a CSFM620I message will be written to the ICSF job log.

For example, when using the rename option, if the active CKDS cannot be renamed to the archive data set name, the following dialog message will be displayed:

```
ICSF WAS UNABLE TO SUCCESSFULLY RENAME ONE OF THE ACTIVE DATA SET TO THE
ARCHIVE NAME, OR THE NEW DATA SET TO THE ACTIVE NAME. REFER TO THE ICSF
JOBLOG(S) FOR ADDITIONAL INFO. IBM DIAGNOSTIC INFORMATION: RROPRC=0000000C
RROPRSN=00000C3E SUPPRC=0000000C SUPPRSN=00000C3E FLAGS=41800000
```

In addition, the following message will be written to the ICSF job log:

```
CSFM620I COORDINATED CHANGE-MK MAINLINE PROCESSING FAILED BECAUSE THE ACTIVE DATA
         SET CANNOT BE RENAMED TO THE ARCHIVE NAME.
```

To correct this problem the security administrator and/or system programmer should determine if there is a conflict with the archive data set name that caused the failure. The CSFM620I is also used for other internal mainline processing failures, such as if a problem occurs trying to load or process the target or backup data sets. For either case, the CSFM620I message should provide enough information for the security administrator and/or system programmer to further investigate the problem.

Backout processing failure: If a failure occurs during mainline processing of a coordinated KDS change master key or coordinated KDS refresh, backout processing will attempt to undo any steps that have already completed in the operation.

A CSFM620I message will be written to the ICSF job log to indicate the mainline processing failure. Additionally backout processing messages will be written to the ICSF job log indicating the status of the backout.

If backout processing fails, a dialog message will indicate the problem. For example:

```
ICSF PROCESSING SUFFERED AN UNRECOVERABLE ERROR AND WAS FORCED TO SHUT
DOWN ACROSS PARTICIPATING SYSPLEX SYSTEMS TO AVOID A POTENTIAL INCONSISTENT
ENVIRONMENT. REFER TO THE ICSF JOBLOG(S) FOR ADDITIONAL INFO. IBM DIAGNOSTIC
INFORMATION: RROPRC=0000000C RROPRSN=0000C3E SUPPRC=0000000C SUPPRSN=00000C42
FLAGS=C5800000
```

A series of CSFM622I messages will be written to the ICSF joblog to track the status of the back out steps. If there is a failure during backout processing, a CSFM621I message will be written to the ICSF job log indicating the failure during backout processing.

When a failure in backout processing occurs, use the overall sequence of CSFM620I, CSFM621I, and CSFM622I messages to determine which step the function failed on, and which step failed during backout processing. For this situation, it is likely other messages listed in this section are also written to the ICSF job log to help determine the root cause of the problem.

Set master key failure: If there was a problem setting the master key on either the initiating system or a target system of a coordinated CKDS change master key, a dialog message will indicate the failure and a CSFM625I message will be written to that system's ICSF job log.

For example, if the step for setting the AES master key fails, the following dialog message will be displayed:

```
THE OPERATION TO CHANGE BOTH DES AND AES MASTER KEYS HAS COMPLETED SUCCESSFULLY.
A SET-MASTER-KEY ACTION FAILED ON THIS SYSTEM. REFER TO THE ICSF JOBLOG(S) FOR
ADDITIONAL INFO.
```

The following message will be written to the ICSF job log for this failure.

```
CSFM625I SET AES MASTER KEY FAILED FOR COPROCESSOR SERIAL NUMBER 93X06032.
```

If this failure occurs on the initiating system, the entire change master key processes will be cancelled and the target systems will not be affected by the operation. Check the status of the coprocessor with serial number identified in the message to determine if it requires maintenance.

If this failure occurs on a target system, the initiating system and other target systems may have successfully changed their master key. If the initiating system has set the master key and completed the coordinated CKDS change master key function, the active CKDS is now reenciphered under the new master key. Check the status of the coprocessor with serial number identified in the message to determine if it requires maintenance. After the coprocessors status is resolved, the target system must perform a single-system change master key in order to remain in synch with the active CKDS. Follow the steps in “Reentering master keys when they have been cleared” on page 172 (PCIXCC, CEX2C, or CEX3C).

Back-level ICSF releases in the sysplex: The coordinated CKDS change master key and coordinated CKDS refresh functions are only available if all ICSF instances in the CKDS sysplex group are running FMID HCR7790 or later. If an ICSF instance at a level lower than HCR7790 joins the sysplex group, a CSFM631I message (indicating all downlevel systems) will be written to the ICSF job log and the operation will fail.

To resolve this problem, all downlevel systems must either be removed from the CKDS sysplex group or upgraded to HCR7790 or higher. If this is not possible, the coordinated CKDS change master key and coordinated CKDS refresh functions cannot be used. The single-system CKDS change master key and single-system CKDS refresh can be used with ICSF instances running at supported FMID levels.

Rename failures: If there is a failure during the optional rename step of coordinated CKDS change master key or coordinated CKDS refresh, CSFM629I and CSFM630I messages will be written to the ICSF job log to indicate the reason for the failure.

The rename function uses the IDCAMS processor to perform the actual VSAM data set rename. CSFM629I messages are used to route IDCAMS processor messages to the ICSF job log when the IDCAMS processor fails to perform the rename. The CSFM629I messages contain the reason from the IDCAMS failure. These messages are followed by a CSFM630I message that indicates which data set name failed to be renamed to which new name.

CKDS data sets are KDS VSAM data sets. They consist of 3 parts: a cluster name, an index name, and a data name. For example, if you use the sample JCL provided in the "Steps to create the CKDS" section of the *z/OS Cryptographic Services ICSF System Programmer's Guide*, the cluster name, data name, and index name will be the following in order.

CSF.CSFCKDS
CSF.CSFCKDS.DATA
CSF.CSFCKDS.INDEX

When the rename option is selected, all 3 parts of the active CKDS will be renamed to the archive name, and all 3 parts of the target CKDS will be renamed to the active name. When renaming the data and index portions of a CKDS VSAM data set, the suffix format of the original data set is maintained. For example, if the preceding data set names are used for the active CKDS, and the archive data set name is specified as CSF.CSFCKDS.ARC, the 3 portions of the active CKDS will be renamed to:

CSF.CSFCKDS.ARC
CSF.CSFCKDS.ARC.DATA
CSF.CSFCKDS.ARC.INDEX

In the case of a failure during rename processing, the coordinated function will attempt to back out and rename the data sets back to their original names. If the back out fails, you may end up with a partially renamed data set. This can be easily corrected by performing an IDCAMS ALTER from JCL.

Whenever a rename failure occurs, scan the ICSF job log of the initiating system for CSFM629I and CSFM630I messages. These messages will indicate which data set part failed during rename and if backout processing was able to rename the data set back to its original name. If backout processing was able to rename back to the original name, check the catalog for the data set name that failed to be used for rename. Most likely you have a conflict with the archive data set name and need to either rename existing data sets in your catalog or choose a different archive name.

If backout processing failed to rename your data set back to the original name, use ISPF to confirm that the data set parts match up with what is reported in the CSFM629I and CSFM630I messages.

For example, if during a coordinated CKDS change master key operation, the active CKDS cluster name is successfully renamed to the archive name, but the data portion fails to be renamed, backout processing begins. If backout processing fails to rename the data set back to the original active CKDS name, ICSF will shut down all instances in the sysplex CKDS cluster because the active CKDS name is only half renamed. In this scenario, the following set of messages may be reported in the ICSF job log.

```
CSFM618I CKDS DATA SET CSF.CSFCKDS RENAMED TO CSF.CSFCKDS.ARC
CSFM629I IDCAMS  SYSTEM SERVICES                                    TIME: 13:35:12        06/07/11
CSFM629I
CSFM629I  ALTER CSF.CSFCKDS.DATA                  -
CSFM629I  NEWNAME(CSF.CSFCKDS.ARC.DATA             )
CSFM629I IDC3013I DUPLICATE DATA SET NAME
CSFM629I IDC3009I ** VSAM CATALOG RETURN CODE IS 8 - REASON CODE IS IGG0CLE6-8
CSFM629I IDC0532I **ENTRY CSF.CSFCKDS.DATA NOT ALTERED
CSFM629I IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 8
CSFM629I
CSFM629I IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 8
CSFM630I CKDS RENAME FAILED: CSF.CSFCKDS.DATA TO CSF.CSFCKDS.ARC.DATA
CSFM629I IDCAMS  SYSTEM SERVICES                                    TIME: 13:35:18        06/07/11
CSFM629I
CSFM629I  ALTER CSF.CSFCKDS.ARC                   -
CSFM629I  NEWNAME(CSF.CSFCKDS                      )
CSFM629I IDC3013I DUPLICATE DATA SET NAME
CSFM629I IDC3009I ** VSAM CATALOG RETURN CODE IS 8 - REASON CODE IS IGG0CLE6-8
CSFM629I IDC0532I **ENTRY CSF.CSFCKDS.ARC NOT ALTERED
```

```
CSFM629I IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 8
CSFM629I
CSFM629I IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 8
CSFM630I CKDS RENAME FAILED: CSF.CSFCKDS.ARC TO CSF.CSFCKDS
CSFM620I COORDINATED CHANGE-MK MAINLINE PROCESSING FAILED BECAUSE THE ACTIVE DATA SET
         CANNOT BE RENAMED TO THE ARCHIVE NAME.
CSFM622I COORDINATED CHANGE-MK PROGRESS: BACKOUT IS BEING DRIVEN BY MAINLINE.
CSFM629I IDCAMS  SYSTEM SERVICES                                  TIME: 13:35:24        06/07/11
CSFM629I
CSFM629I  ALTER CSF.CSFCKDS.ARC                    -
CSFM629I  NEWNAME(CSF.CSFCKDS                       )
CSFM629I IDC3013I DUPLICATE DATA SET NAME
CSFM629I IDC3009I ** VSAM CATALOG RETURN CODE IS 8 - REASON CODE IS IGG0CLE6-8
CSFM629I IDC0532I **ENTRY CSF.CSFCKDS.ARC NOT ALTERED
CSFM629I IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 8
CSFM629I
CSFM629I IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 8
CSFM630I CKDS RENAME FAILED: CSF.CSFCKDS.ARC TO CSF.CSFCKDS
CSFM621I COORDINATED CHANGE-MK BACK OUT PROCESSING FAILED BECAUSE THE ARCHIVE DATA SET
         CANNOT BE RENAMED TO THE ACTIVE NAME.
CSFM621I COORDINATED CHANGE-MK BACK OUT PROCESSING FAILED BECAUSE ICSF IS UNABLE TO
         RELIABLY RESTORE THE ORIGINAL ACTIVE KDS.
CSFM622I COORDINATED CHANGE-MK PROGRESS: CANCELING CORE WORK.
CSFM616I COORDINATED CHANGE-MK FAILED, RC=0000000C RS= 00000C3E SUPRC= 0000000C SUPRS=
         00000C42 FLAGS= C5800000.
CSFU006I CHANGE-MK FEEDBACK: CC=0000000C RSN=00000C3E SUPPRC=0000000C SUPPRSN=00000C42
         FLAGS=C5800000.
CSFM308I MEMBER XXX REPORTED REMOVED FROM SYSPLEX GROUP SYSICSF.
CSFM308I MEMBER XXX REPORTED REMOVED FROM SYSPLEX GROUP SYSICSF.
CSFM401I CRYPTOGRAPHY - SERVICES ARE NO LONGER AVAILABLE.
```

This sequence of messages indicates that the active CKDS name of CSF.CSFCKDS was renamed to CSF.CSFCKDS.ARC. Then, the CSF.CSFCKDS.DATA data portion of the active CKDS failed to be renamed to CSF.CSFCKDS.DATA.ARC because another data set in the catalog was already using this name. At this point, the coordinated CKDS change master key function tried to back out and rename the cluster portion of the CKDS from CSF.CSFCKDS.ARC back to its original name of CSF.CSFCKDS. However the renaming failed because another data set with name CSF.CSFCKDS now exists in the catalog. The result is a half renamed active CKDS which causes ICSF to shut down across the CKDS sysplex cluster.

The first step to resolving this problem is to confirm in ISPF that the following data set names reported in the messages above do exist:

CSF.CSFCKDS.ARC
CSF.CSFCKDS.DATA
CSF.CSFCKDS.INDEX

Once this is confirmed, the next step is to rename the cluster name back to the original name manually by calling IDCAMS ALTER from JCL. Before doing that, the messages above indicate that back out processing already failed to rename the cluster name back because another data set is now using that name. The data set that has taken that name should be renamed to a different name as this name is needed to restore the active CKDS.

Once the cluster name conflict has been resolved, issue IDCAMS ALTER from JCL to rename the CSF.CSFCKDS.ARC cluster name back to the original active CKDS name of CSF.CSFCKDS.

For example:

```
//DEFINE   EXEC  PGM=IDCAMS,REGION=4M
//SYSPRINT  DD   SYSOUT=*
//SYSIN  DD  *
      ALTER  CSF.CSFCKDS.ARC   -
             NEWNAME(CSF.CSFCKDS)
/*
```

ICSF may be restarted on all instances that were previously taken down. Processing should resume as normal and the coordinated CKDS change master key with rename option may be issued again with an archive data set name that does not have a conflict in the catalog.

PKDS management in a sysplex

The systems sharing a PKDS may be different LPARs on the same system or different systems across multiple zSeries Processors. The only requirement for sharing the PKDS is that the same PKA Master Keys be installed on all systems sharing that PKDS. It is not required to share the PKDS across a sysplex. Each system may have its own PKA Master Keys and its own PKDS. A sysplex may have a combination of systems that share a PKDS and individual systems with separate PKDSs.

When sharing the PKDS, a few precautions should be observed:

- Dynamic PKDS services update the DASD copy of the PKDS and the in-storage copy on the system where it is run. The SYSPLEXPKDS option in the ICSF installation options data set provides for sysplex-wide consistent updates of the DASD copy of the PKDS and the in-storage copies of the PKDS on all members of the sysplex sharing the same PKDS. (Note that all members of the sysplex sharing the PKDS must be running ICSF HCR7751 or higher in order to participate in the sysplex-wide consistency of PKDS data.) If SYSPLEXPKDS(YES,FAIL(xxx)) is coded in the installation options data set, a sysplex broadcast message will be issued informing sysplex members of the PKDS update and requesting them to update their in-storage PKDS copy. If SYSPLEXPKDS(NO,FAIL(xxx)) is coded in the installation options data set, there is no sysplex broadcast of the update. In order to update the in-storage copy of all images that share the PKDS, you must perform a PKDS REFRESH on each image. This can be done by using either the TSO panels or the CSFPUTIL utility.
- The PKDS must be initialized for PKA callable services to be enabled. Use the TSO panels to initialize a new PKDS.

There is no longer a PKDS cache. ICSF maintains an in-storage copy of the PKDS.

On CCF systems, it is highly recommended that the SMK and KMMK be the same on all systems sharing the PKDS in order to reencipher the PKDS when a PKA master key changes. PKDS reencipher requires a PCICC on your system. PKDS reencipher is not supported on CCF-only systems. For instructions on creating this environment, see “Steps for setting the SMK equal to the KMMK” on page 138.

Restriction: The PKDS can be shared between a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196 system and CCF systems (z900). However, DSA tokens and RSA tokens encrypted under the KMMK (if KMMK is not equal to the SMK) are not usable on the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196 system.

Steps for changing asymmetric master keys when sharing a PKDS

If you have multiple systems sharing a PKDS and make changes to the PKA master keys, you must reencipher and activate the PKDS. A PCICC, PCIXCC, CEX2C, or CEX3C is required on your system for this process.

Note: If a system has a CEX3C coprocessor with the Sep. 2011 or later LIC, the PKA callable services control will not be activated and the steps to disable/enable the PKA callable service control are not applicable in the following procedure.

Assume you have two systems, A and B sharing a PKDS data set, OLDPKDS. The steps to reencipher and activate are:

1. From SYSTEM A, disable PKA callable services if active. To do this, enter a 'D' prior to the function (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).
2. On SYSTEM B, disable Dynamic PKDS Access. To do this, enter a 'D' prior to the function (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).
3. On system A, load the new master keys (see “PKA master keys and the PKDS” on page 131).
4. On system A, reencipher OLDPKDS, creating NEWPKDS (see “Steps for changing the RSA-MK or ECC-MK master key and reenciphering the PKDS” on page 180).
5. On system A, change master keys (see “Steps for changing the RSA-MK or ECC-MK master key and reenciphering the PKDS” on page 180).
6. On system A, enable PKA callable services if active (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).
7. On system A, enable Dynamic PKDS Access (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).
8. On system B, disable PKA callable services if active (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).
9. On system B, load the new master keys (see “Steps for changing the RSA-MK or ECC-MK master key and reenciphering the PKDS” on page 180).
10. On system B, change master keys (see “Steps for changing the RSA-MK or ECC-MK master key and reenciphering the PKDS” on page 180).
11. On system B, enable PKA callable services if active (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).
12. On system B, enable Dynamic PKDS Access (see “Steps for enabling and disabling PKA callable services and PKDS updates” on page 179).

Steps for refreshing the PKDS

If multiple sysplexes share a PKDS, or if a sysplex and other non-sysplex systems share a PKDS, there is no provision for automatic update of the in-storage copies of the PKDS on the systems which are not in the same sysplex as the system initiating the PKDS update.

When you are sharing the PKDS in a sysplex, there will be occasions when you change or delete PKDS records, causing changes to the PKDS. In order to reflect the change on other systems in your sysplex, you must refresh the PKDS on each sharing system.

Sharing and migrating a CKDS/PKDS between a CCF system and a PCIXCC, CEX2C, or CEX3C system

The z890 and z990 support the PCI X Cryptographic Coprocessor (PCIXCC) and Crypto Express2 Coprocessor (CEX2C).

z9 EC and z9 BC support the Crypto Express2 Coprocessor (CEX2C).

z10 EC and z10 BC support the Crypto Express2 Coprocessor (CEX2C) and the Crypto Express3 Coprocessor (CEX3C).

z196 supports the Crypto Express3 Coprocessor (CEX3C).

The z900 support the Cryptographic Coprocessor Feature (CCF). The PCI Cryptographic Coprocessor (PCICC) is an optional feature.

When sharing a CKDS/PKDS between multiple LPARs, these need to be considered:

1. If mixing z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 and legacy systems, the CKDS must have been initialized on the legacy (CCF) system. A CKDS initialized on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system cannot be shared with a CCF system; ICSF will not start.
2. The DES-MK on your PCIXCC, CEX2C, or CEX3C must match the DES master key on the CCF.
3. The ASYM-MK on your PCIXCC, CEX2C, or CEX3C system must match the SMK master key on the CCF system. If mixing different releases of ICSF, make sure service is up to date with regard to CKDS/PKDS toleration.

   If sharing a PKDS between z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 and a legacy system, and the legacy system does NOT have the SMK=KMMK, then the PKDS needs to be initialized on the legacy system. If not, the KMMK hash will not be in the PKDS header and PKA Callable Services cannot be enabled.
4. Retained keys on the PCICC, PCIXCC, CEX2C, or CEX3C cannot be shared across LPARs. Retained keys are domain specific; they can only be used on the domain where they were generated.

Note: ICSF needs to be started to perform the PKDS Initialization.

CCF only system

SMK equal to KMMK

- Using Master Key Entry
  1. Start ICSF on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to the initialized CKDS/PKDS. You will see the message: `CSFM419E INCORRECT MASTER KEY (BOTH) ON PCI X CRYPTOGRAPHIC COPROCESSOR Xnn, SERIAL NUMBER nnnnnnnn.`
  2. Using Master Key Entry, load the value of the CCF DES master key into the new DES-MK register. Load the value of the CCF SMK/KMMK master key into the new ASYM-MK register. You will need the checksums for each of these values.
  3. Set the DES master key.
  4. Enable PKA Callable Services/Dynamic PKDS Access.
- Using Pass Phrase Initialization

1. Start ICSF on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to the initialized CKDS/PKDS.
2. Using PPINIT, type in the same pass phrase used to initialize CCF system. Respond N to `Initialize the CKDS/PKDS? (Y/N)` question.

SMK not equal to KMMK

Without a PCICC, the PKDS reencipher must run on the PCIXCC, CEX2C, or CEX3C. If it is not, the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system will not be able to use the tokens encrypted under the KMMK. This procedure requires that you switch between your legacy and z990/z890 TSO sessions.

- Using Master Key Entry

  It does not matter whether you reencipher to the KMMK or the SMK. This checklist reenciphers to the SMK.

  1. Start ICSF on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to the initialized CKDS/PKDS.
  2. Define an empty PKDS.
  3. Load the value of the CCF DES master key into the new DES-MK register. You will need the checksum.
  4. Load the value of the CCF KMMK master key into the new ASYM-MK register. You will need the checksum. The ASYM-MK is automatically set when the final key part is loaded.
  5. Load the value of the CCF SMK master key into the new ASYM-MK register. You will need the checksum. The ASYM-MK is automatically set when the final key part is loaded. The old ASYM-MK register now contains the KMMK value and the current ASYM-MK register contains the SMK value.
  6. Set the DES-MK.
  7. Reencipher the active PKDS to the empty PKDS.
  8. Refresh the new PKDS. Enable PKA Callable Services/Dynamic PKDS Access.
  9. Update options data set to point to the new PKDS.
  10. On CCF system, disable PKA Callable Services.
  11. Reset the KMMK register.
  12. Load the value of the CCF SMK master key into the KMMK register.
  13. Activate the new PKDS.
  14. Enable PKA Callable Services/Dynamic PKDS Access.
  15. Update options data set to point to the new PKDS.

- Using Pass Phrase Initialization

  1. On a CCF system, use PPKEYS to get the clear key values of the SMK and KMMK from a pass phrase. You will need the checksum for each of these values.
  2. On z990/z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, start ICSF pointing to initialized CKDS/PKDS.
  3. Define an empty PKDS.
  4. Using Master Key Entry, load the value of the CCF KMMK master key into the new ASYM-MK register. You will need the checksum. Load a final key part of zeroes. The ASYM-MK is automatically set when the final key part is loaded.
  5. Using PPINIT, type in the pass phrase used to initialize the CCF system, enter the names of the initialized CKDS/PKDS, respond N to `Initialize the CKDS/PKDS? (Y/N)`.

6. Reencipher the PKDS to the empty PKDS.
7. Refresh the new PKDS.
8. Update options data set to point to new PKDS.
9. On a CCF system, disable PKA Callable Services.
10. Using Master Key Entry, reset the KMMK register.
11. Load the value of the SMK into the KMMK register. You can get the clear key value of the SMK using the PPKEYS utility. You will need the SMK checksum.
12. Activate the new PKDS.
13. Enable PKA Callable Services/Dynamic PKDS Access.
14. Update options data set to point to new PKDS.

CCF with PCICCs

SMK equal to KMMK

- Using Master Key Entry
  1. Start ICSF on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to the initialized CKDS/PKDS. You will see message: `CSFM419E INCORRECT MASTER KEY (BOTH) ON PCI X CRYPTOGRAPHIC COPROCESSOR Xnn, SERIAL NUMBER nnnnnnnn.`
  2. Using Master Key Entry, load the value of the CCF DES master key into the new DES-MK register. Load the value of the CCF SMK/KMMK master key into the new ASYM-MK register. You will need the checksums for each of the master key values.
  3. Set the DES master key.
  4. Enable PKA Callable Services/Dynamic PKDS Access.
- Using Pass Phrase Initialization
  1. Start ICSF on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to the initialized CKDS/PKDS.
  2. Using PPINIT, type in the same pass phrase used to initialize CCF system. Respond N to `Initialize the CKDS/PKDS? (Y/N).`

SMK not equal to KMMK

Make the SMK=KMMK prior to sharing the CKDS/PKDS with the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system.

- Using Master Key Entry
  1. Define an empty PKDS.
  2. On the CCF system, disable PKA Callable Services.
  3. Using Master Key Entry, reset ALL-PKA registers. Load the value of the CCF KMMK master key into the SMK/KMMK/ASYM-MK registers on all CCF/PCICC coprocessors. You will need the checksum. The ASYM-MK is automatically set when the final key part is loaded.
  4. Reencipher the PKDS to the empty PKDS.
  5. Activate the new PKDS.
  6. Enable PKA Callable Services/Dynamic PKDS Access.
  7. Update options data set to point to new PKDS.
  8. Start ICSF on the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to initialized CKDS/PKDS.
  9. Load the value of the CCF DES master key into the new DES-MK register.

10. Load the value of the CCF KMMK master key into the new ASYM-MK register. You will need the checksum. The ASYM-MK is automatically set when the final key part is loaded. The current ASYM-MK now has the same value as the SMK/KMMK/ASYM-MK on the CCF/PCICC(s).
11. Set the DES-MK.
12. Enable PKA Callable Services/Dynamic PKDS Access.

- Using Pass Phrase Initialization
  1. On the CCF system, use PPKEYS to get the clear key values of the SMK and KMMK from a pass phrase. You will also need the checksum for each of these values.
  2. Define an empty PKDS. Disable PKA Callable Services.
  3. Using Master Key Entry, load the value of the CCF KMMK master key into the new ASYM-MK register on the PCICC(s). You will need the checksum. Load a final key part of zeroes. The ASYM-MK is automatically set when the final key part is loaded. The current ASYM-MK is now the same as the KMMK value.
  4. Load the value of the CCF SMK into the new ASYM-MK register on the PCICC(s). You will need the checksum. Load a final key part of zeroes. The ASYM-MK is automatically set when the final key part is loaded. The current ASYM-MK is now the same as the SMK value. The KMMK value is now in the old ASYM-MK register.
  5. Reset the KMMK register on the CCFs. Load the SMK value into the KMMK register. Now the KMMK = SMK.
  6. Reencipher the PKDS to the empty PKDS.
  7. Activate the new PKDS.
  8. Enable PKA Callable Services/Dynamic PKDS Access.
  9. Update options data set to point to the new PKDS.
  10. Start ICSF on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196 system, pointing to the initialized CKDS/PKDS (the one just reenciphered previously).
  11. Using PPINIT, type in the same pass phrase used to initialize CCF system. Respond N to `Initialize the CKDS/PKDS? (Y/N)`.

TKDS management in a sysplex

The systems sharing a TKDS may be different LPARs on the same system or different systems across multiple zSeries processors. It is not required to share the TKDS across a sysplex. Each system may have its own TKDS. A sysplex may have a combination of systems that share a TKDS and individual systems with separate TKDSs. There is no requirement that the DOMAINs must be the same to share a TKDS. When sharing the TKDS, a few precautions should be observed:

- Dynamic TKDS services update the DASD copy of the TKDS and the in-storage copy on the system where it runs. The SYSPLEXTKDS option in the ICSF installation options data set provides for sysplex-wide consistent updates of the DASD copy of the TKDS and the in-storage copies of the TKDS on all members of the sysplex sharing the same TKDS.

  If SYSPLEXTKDS(YES,FAIL(xxx)) is coded in the installation options data set, a sysplex broadcast message will be issued informing sysplex members of the TKDS update and requesting them to update their in-storage TKDS copy. If SYSPLEXTKDS(NO,FAIL(xxx)) is coded in the installation options data set, there is no sysplex broadcast of the update.

- If multiple sysplexes share a TKDS, or if a sysplex and other non-sysplex systems share a TKDS, there is no provision for automatic update of the in-storage copies of the TKDS on the systems which are not in the same sysplex as the system initiating the TKDS update.

Chapter 10. Managing Cryptographic Keys Using the Key Generator Utility Program

The key generator utility program (KGUP) generates and maintains keys in the cryptographic key data set (CKDS). The CKDS stores DATA keys, MAC keys, PIN keys, and transport keys. If you are running a z890, z990, z9 EC, z9 BC, z10 EC, z10 BC, or z196 KGUP supports double length MAC and MACVER keys. Although ANSI transport keys are stored in the CKDS, KGUP does not support the generation or import of ANSI transport keys. KGUP does not support non-standard CV keys.

Starting with release HCR7780, there are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). Both formats are supported by KGUP.

Restriction: KGUP does not support DATAXLAT keys on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, or z196.

To run KGUP, ICSF must be active, master keys must be loaded on the cryptographic coprocessors, the user must have access, and the CKDS must be initialized.

Use the CSFKGUP profile in the CSFSERV class to permit or deny users access to the utility.

You use KGUP to perform these tasks:
- Generate or enter keys
- Maintain CKDS entries by deleting or renaming the entries
- Load completed operational keys into the CKDS that were entered from a TKE workstation.

When KGUP generates or receives a key value, the program either adds a new entry or updates an existing entry in the CKDS. For information about how KGUP generates and receives keys to establish key exchange with other systems, see “Using KGUP for key exchange” on page 218.

Each key that KGUP generates (except clear key value data-encrypting keys and clear AES keys) exists in the CKDS enciphered under your system's master key. When the master key enciphers a key, the cryptographic facility exclusive ORs the master key with a pattern of characters called a control vector. A master key exclusive ORed with a control vector is called a master key variant.

A unique control vector exists for each type of key the master key enciphers. The cryptographic facility exclusive ORs the master key with the control vector associated with the type of key the master key will encipher. The control vector ensures that a key is only used in the cryptographic functions for which the key is intended. For example, the control vector for an input PIN encryption key ensures that such a key can be used only in PIN translate and PIN verification functions.

When you specify to KGUP to generate an input PIN-encrypting key, the cryptographic facility creates a master key variant for the key. The master key variant is a product of exclusive ORing the master key with the control vector associated with an input PIN-encrypting key. This master key variant enciphers the input PIN-encrypting key so the input PIN-encrypting key is in operational form. KGUP places the input PIN-encrypting key in a CKDS entry.

You use control statements to specify the functions for KGUP to perform. The control statement specifies the task you want KGUP to perform and information about the CKDS entry that is affected. For example, to have KGUP generate an importer key-encrypting key, you use a control statement like:

```
ADD  LABEL(KEY1)  TYPE(IMPORTER)
```

When KGUP processes the control statement, the program generates a key value and encrypts the value under a master key variant for an importer key-encrypting key. KGUP places the key in a CKDS entry labelled KEY1. The key type field of the entry specifies IMPORTER. For a description of the fields in a CKDS entry, see "Specifying KGUP data sets" on page 242.

You store the control statements in a data set. You must also specify other data sets that KGUP uses when the program processes control statements. You submit a batch job stream to run KGUP. In the job control statements, you specify the names of the data sets that KGUP uses.

KGUP changes a disk copy of the CKDS according to the functions you specify with the control statements. When KGUP changes the disk copy of the CKDS, you may replace the in-storage copy of the CKDS with the disk copy using the ICSF panels. This operation should be performed on all systems sharing the updated CKDS.

To use KGUP, you must perform these tasks:
- Create control statements
- Specify data sets
- Submit a job stream

You may also want to refresh the CKDS with the disk copy of the CKDS that KGUP updated. You can use the KGUP panels to help you perform these tasks. However you can also use KGUP without accessing the panels. This topic first describes each of the tasks to run KGUP, and then describes how to use the panels to perform the tasks.

Steps for disallowing dynamic CKDS updates during CKDS administration updates

ICSF prioritizes changes to the CKDS sequentially, regardless of the source. A KGUP job does not have priority over application calls to the dynamic CKDS update services. Exclusive use of the CKDS by any one application call is minimal, however. For this reason, ICSF allows for a maximum concurrent usage of the CKDS by both KGUP and the dynamic update services.

When you perform any function that affects the current CKDS (such as reenciphering, refreshing, or changing the master key), you should consider temporarily disallowing the dynamic CKDS update services.

If you are planning to use KGUP to make significant changes to the CKDS, you should disallow dynamic CKDS update on every system which shares the CKDS. If you are planning to perform a coordinated CKDS change master key or coordinated CKDS refresh operation on a large CKDS (millions of records), you may experience a temporary suspension of CKDS update requests running in parallel. If you cannot tolerate a temporary suspension in your workload, and would prefer that update requests are failed instead of suspended, you should disallow dynamic CKDS updates on every system which shares the same active CKDS prior to performing the coordinated CKDS administration operation. If an application tries to use the

dynamic CKDS update services when they are disallowed, the return code indicates that the CKDS management service has been disabled by the system administrator.

To disallow dynamic CKDS access, perform these tasks:

1. Choose option 4, Administrative Control Functions, on the Primary Menu Panel, as shown in Figure 124.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility ---------
OPTION ===> 4

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 124. Selecting the Adminstrative Control Option on the Primary Menu Panel

   The Administrative Control Functions panel appears. See Figure 125.

2. Enter a 'D' to disallow dynamic CKDS access.

```
CSFACF00 ------------- ICSF Administrative Control Functions
COMMAND ===>
          Active CKDS: CRYPTO25.HCRICSF.CKDS
          Active PKDS: CRYPTO25.HCRICSF.PKDS
          Active TKDS: CRYPTO25.HCRICSF.TKDS

To change the status of a control, enter the appropriate character
(E - ENABLE, D - DISABLE) and press ENTER.

         Function                                  STATUS
         --------                                  ------

 D  Dynamic CKDS Access                             ENABLED
 .  PKA Callable Services                           ENABLED
 .  Dynamic PKDS Access                             DISABLED

 Press ENTER to go to the selected option.
 Press END   to exit to the previous menu.
```

Figure 125. Selecting to Disallow Dynamic CKDS Access on User Control Functions Panel

3. Press ENTER.

The message CKDS UPDATES DISABLED appears in the upper right-hand corner of the panel.

4. Press END to return to the Primary Menu panel.

Using KGUP for key exchange

KGUP generates keys that are complementary keys. Complementary keys have the same clear key value for corresponding key types. KGUP generates and maintains these types of complementary keys:

- Data-encrypting (DATA) and data-translation (DATAXLAT) keys
- Importer key-encrypting key and exporter key-encrypting key
- Input PIN-encrypting key and output PIN-encrypting key
- MAC generation key and MAC verification key
- PIN generation key and PIN verification key

Restriction: DATAXLAT keys are only supported on the IBM @server zSeries 900.

When you distribute keys or PINs, your system has one key, and the other system has the complementary key. For example, when your system sends a DATA key to another system, the importer and exporter key-encrypting keys at the systems complement each other. The DATA key is encrypted under an exporter key-encrypting key at your system. The DATA key is decrypted by the complementary importer key-encrypting key at the receiving system.

When KGUP generates a key, the other system involved in the key or PIN exchange needs the complement of the key. When KGUP generates a key, the program also generates a control statement to create the complement of the key. You send the control statement to the other system which uses the statement to create the complementary key.

For example, when you use KGUP to create an input PIN-encrypting key, KGUP also creates a control statement for the complementary output PIN-encrypting key. You send the control statement to another system. The other system uses the control statement to create the output PIN-encrypting key. Then your system can send PIN blocks to the other system.

For some key types you can choose the output key type by specifying the OUTTYPE parameter on a KGUP ADD statement. For example, you can generate a DATA key for inclusion into the CKDS and export a copy of the key as either a DATA key or a DATAXLAT key. If you export the copy of the DATA key as a DATA key, the receiver of the key can use it to decipher data. If you export the copy of the DATA key as a DATAXLAT key, the receiver can use the key only to translate cipher text from one DATAXLAT key to another. The receiver of the DATAXLAT key cannot use the key to actually decipher the data.

KGUP stores the complementary key control statement in a data set. Because some cryptographic systems may not use KGUP control statements, KGUP also stores complementary key information as a record in a different data set. The information is not in the form of a control statement. You process and send the information to a system which creates the complementary key.

When KGUP generates a key, the program also generates information to create the complementary key. This information includes the complementary key value. The value is either a clear key value or encrypted key value. For an encrypted key value, the program encrypts the value under an exporter key. The importer key that complements this exporter key already exists at the other system. The importer key

is one key in a complementary transport key pair that your system already established with the other system. The pair would be an importer key on the other system and an exporter key on your system. The other system reenciphers the value from under the importer key to under its master key to generate the complementary key.

Besides generating keys and complementary key information, KGUP imports key values that are sent from other systems. The program can receive a control statement to create a key that is the complement of a key on another system. The key value your KGUP receives may be encrypted under a transport key. The transport key would be one key of a complementary transport key pair that you already established with the other system. The pair would be an exporter key on the other system and an importer key on your system. KGUP reenciphers the complementary key from under the importer key to under the master key and places the key in the CKDS.

For KGUP to send or receive keys in a key exchange with another system, the systems must previously establish a pair of complementary transport keys. For example, KGUP on one system defines the pair and generates the importer key in the clear. KGUP on the other system uses this value to define a pair of keys that are complements of the keys at the original site. For an example of how two ICSF systems establish pairs of complementary transport keys for key exchange, see “Scenario of Two ICSF Systems Establishing Initial Transport Keys” on page 275.

The cryptographic facility exclusive ORs a transport key with a control vector when using the transport key to encipher a key. A transport key exclusive ORed with a control vector is called a transport key variant. ICSF uses the control vector associated with the key type that the transport key will encipher. The control vector ensures that when another site imports the key, the resulting operational key can only be the type that the control vector indicates. For example, the control vector for a PIN verification key ensures that the system that receives the key can import the key only as a PIN verification key.

When KGUP generates a PIN generation key, the program generates a key value to create a PIN verification key. You can specify that the key value be an encrypted key value. When you do this, ICSF exclusive ORs the transport key with the control vector for a PIN verification key to create the transport key variant. Then the cryptographic facility enciphers the PIN verification key under the transport key variant.

To view the specific control vector value that is associated with each type of key to create master key variants and transport key variants, see Appendix B, “Control Vector Table.”

Transport key variants ensure that the receiving system uses the key as the type of key that the sending system intended. However transport key variants can only be used if both systems recognize transport key variants. You should use transport key variants when exchanging keys with the 4758 PCI Cryptographic Coprocessor. However, systems with some cryptographic products, such as PCF, do not recognize control vectors. When you exchange keys with such a system, a key that you send or receive is enciphered under a transport key rather than a transport key variant. You just specify to KGUP that the transport key should not be exclusive ORed with a control vector.

You can define a pair of complementary transport keys with another system so your system and the other system can exchange keys without control vectors. You use a

control statement to indicate to KGUP to produce these keys. Then send the clear value that KGUP produced to the PCF system so the system can generate the corresponding complementary pair of keys. Then you use the transport keys to exchange other keys. Refer to “Scenario of an ICSF System and a PCF System Establishing Initial Transport Keys” on page 277 for an example of how to establish pairs of complementary transport keys for key exchange between an ICSF system and a PCF system.

You can also use KGUP to create complementary keys that are used by two different systems. Neither key would be operational on your system so KGUP would not update your CKDS. When KGUP generates the complementary key information, you send it to the two systems that need to share complementary keys.

Using KGUP control statements

You use control statements to specify the function you want the key generator utility program (KGUP) to perform. You use job control language (JCL) to submit the control statements to KGUP. You can create and submit KGUP control statements either on your own or using the KGUP panels. OPKYLOAD control statements can not be created using the KGUP panels.

You specify information to KGUP using an ADD, UPDATE, DELETE, RENAME, SET or OPKYLOAD control statement. You use keywords on the control statement to specify:

- The function KGUP performs
- Information about the key that KGUP processes

For example, if you specify the KEY keyword on an ADD control statement, you supply a key which KGUP adds to the CKDS in an entry.

This topic describes the syntax of the control statements with their keywords. Use these rules when interpreting the syntax of the control statements:

- Specify uppercase letters and special characters as shown in the examples.
- Lowercase letters represent keyword values that you must specify.
- A bar (|) indicates a choice (OR).
- Ellipses (...) indicates that multiple entries are possible.
- Braces ({ }) denote choices, one of which you must specify.
- Brackets ([ ]) denote choices, one of which you may specify.

General Rules for CKDS Records

There are some general rules for creating labels for CKDS key records.

- Each label can consist of up to 64 characters. The first character must be alphabetic or a national character (#, $, @). The remaining characters can be alphanumeric, a national character (#, $, @), or a period (.).
- Labels must be unique for DATA, DATAXLAT, MAC, MACVER, DATAM, DATAMV, and NULL keys.
- For compatibility with Version 1 Release 1 function, transport and PIN keys can have duplicate labels for different key types. Keys that use the dynamic CKDS update services to create or update, however, must have unique key labels.
- Labels must be unique for any key record, including transport and PIN keys, created or updated using the dynamic CKDS update services.

KGUP and the dynamic CKDS update services, unless they are modified by user-written exits, check for uniqueness according to these rules prior to making any change to the CKDS.

CKDS record level authentication

ICSF may have an optional record level authentication code that is part of each record in the CKDS. The record level authentication code is used to identify when a record in the CKDS is modified by a program other than ICSF. The record level authentication is enabled when the CKDS is initialized and can not be changed after the CKDS is initialized. If the CKDS is properly protected using RACF profiles, then unauthorized modification of the CKDS can be prevented.

KGUP detects when ICSF and the CKDS are enabled for record level authentication and performs the necessary processing. When record level authentication is not enabled, KGUP does not perform record level authentication processing.

KGUP Uniqueness Checking

KGUP first checks to see if the label in the control statement matches a label that already exists in the CKDS.

If KGUP is processing an ADD control statement and there is no matching record, KGUP continues processing. Also, if KGUP is processing a RENAME control statement and there is no match for the *new-label* parameter, KGUP continues processing the control statement. If KGUP finds a matching label, KGUP then checks whether the key requires a unique label. If the key does not require a unique label, KGUP continues processing the ADD or RENAME control statement. If the key does require a unique label, KGUP stops processing the control statement and issues a message.

If KGUP is processing an UPDATE or DELETE control statement and there is no matching record, KGUP ends processing and issues an error message. Also, if KGUP is processing a RENAME control statement and there is no match for the *old-label* parameter, KGUP ends processing and issues an error message. If KGUP finds a matching label, KGUP continues processing the UPDATE, DELETE, or RENAME control statement.

Dynamic CKDS Update Services Uniqueness Checking

The dynamic CKDS update services require unique record labels in the CKDS. Each service checks to see if the label in the application call matches a label that already exists in the CKDS. For the Key Record Create service, if there is no matching record in the CKDS, ICSF continues processing the application call. If there is a match, ICSF stops processing and returns a return code and reason code to the application. For the Key Record Write and Key Record Delete services, if there is only one record in the CKDS that matches the label in the application call, ICSF continues processing the application call. If there is more than one matching record in the CKDS, ICSF stops processing and returns a return code and reason code to the application.

Syntax of the ADD and UPDATE Control Statements

The ADD and UPDATE control statements use the same keywords. The ADD control statement adds new keys to the CKDS. UPDATE changes existing key entries. Use the ADD or UPDATE control statement to specify that KGUP generate a key value or import a key value that you provide.

Refer to Figure 126 for the syntax of the ADD and UPDATE control statements.

```
{ADD | UPDATE}

  {LABEL(label1[,...,label64]) | RANGE(start-label,end-label)}

  TYPE(key-type)

  ALGORITHM(DES|AES)

  [OUTTYPE(key-type)]

  [TRANSKEY(key-label1[,key-label2]) | CLEAR]

  [NOCV]

  [LENGTH(n) | SINGLE]

  [KEY(key-value[,ikey-value])]
```

Figure 126. ADD and UPDATE Control Statement Syntax

LABEL (label1[,...,label64])
This keyword defines the names of the key entries for KGUP to process within the CKDS. KGUP processes a separate entry for each label. If you specify more than one label on an ADD or UPDATE control statement, the program uses identical key values in each entry.

You must specify at least one key label, and you can specify up to 64 labels with the LABEL keyword. For the general rules about key label conventions and uniqueness, see “General Rules for CKDS Records” on page 220.

On a KGUP control statement, you must specify either the LABEL or RANGE keyword. When you supply a key value on the control statement with the KEY keyword, you must specify the LABEL keyword.

RANGE (start-label, end-label)
This keyword defines the range of the multiple labels that you want KGUP to create or maintain within the CKDS.

The label consists of between 2 and 64 characters that are divided as follows:

- The first 1 to 63 characters are the label base. These characters must be identical on both the start-label and end-label and are repeated for each label in the range. For the general rules about key label conventions and uniqueness, see “General Rules for CKDS Records” on page 220.
- The last 1 to 4 characters form the suffix. The number of digits in the start-label and end-label must be the same, and the characters must all be numeric. These numeric characters establish the range of labels KGUP creates. The start-label numeric value must be less than the end-label numeric value.

KGUP creates a separate CKDS entry for each label including the start and end labels. The program generates a different key value for each entry it creates.

You cannot use the RANGE keyword when you supply a key value to KGUP. Only use RANGE to generate a key value. The RANGE and KEY keywords are mutually exclusive.

On a KGUP control statement, you must specify either the LABEL or RANGE keyword.

TYPE (key-type)

This keyword specifies the type of key you want KGUP to process. You can specify only one key type for each control statement. For CLRAES, CLRDES, DATA, DATAXLAT, MAC, MACVER, DATAM, DATAMV, and NULL key types, KGUP allows only one key per label. For all other key types, you can have keys with the same labels but different key types.

You can specify any of these key types:

CLRAES
: Clear Encryption/decryption key for AES

CLRDES
: Clear Encryption/decryption key

DATA Encryption/decryption key

DATAXLAT
: Cipher text translate key – DATAXLAT is only supported on the IBM @server zSeries 900.

DATAM
: Double-length MAC generation key

DATAMV
: Double-length MAC verification key

EXPORTER
: Exporter key-encrypting key

IMPORTER
: Importer key-encrypting key

IPINENC
: Input PIN encryption key

MAC Single-length MAC generation key

Note: On a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196, MAC is a single or double-length key.

MACVER
: Single-length MAC verification key

Note: On a z990, z890, 9 EC, z9 BC, z10 EC, and z196, MACVER is a single or double-length key.

NULL Used to create a null CKDS entry

OPINENC
: Output PIN encryption key

PINGEN
: PIN generation key

PINVER
: PIN verification key

All these types of keys are stored in the CKDS.

Note: For compatibility with previous releases of OS/390 ICSF, KGUP stores internal versions of DATAM and DATAMV keys in the CKDS under the key types of MACD and MACVER, respectively.

ALGORITHM (DES|AES)

This keyword defines the algorithm of the key you are generating. DES is the default value. All key types except CLRAES and CLRDES are valid with the DES value. Only the DATA and NULL key types are valid with AES. Generated operational keys will be encrypted under the respective master key.

Note: To use AES, you need to have an AES-MK

OUTTYPE (key-type)

This keyword specifies the type of complementary key you want KGUP to generate for export. This keyword is valid only when you are requesting KGUP to generate keys and you also specify the CLEAR or TRANSKEY keywords. OUTTYPE is mutually exclusive with the KEY keyword. You cannot specify an OUTTYPE when you have chosen either CLRAES, CLRDES, DATAMV, PINVER, MACVER, or NULL for the key TYPE.

Refer to Table 14 for a list of the default and optional complementary key types for each of the 11 different key types. If OUTTYPE is not specified, KGUP generates the default complementary key that is shown in this table.

Table 14. Default and Optional OUTTYPES Allowed for Each Key TYPE

TYPE	OUTTYPE (Default)	OUTTYPE (Allowed)
CLRAES	Not Allowed	Not Allowed
CLRDES	Not Allowed	Not Allowed
DATA	DATA	DATA, DATAXLAT*
DATAXLAT	DATAXLAT	DATAXLAT*
DATAM	DATAMV	DATAM, DATAMV
DATAMV	Not Allowed	Not Allowed
EXPORTER	IMPORTER	IMPORTER
IMPORTER	EXPORTER	EXPORTER
IPINENC	OPINENC	OPINENC
MAC	MACVER	MAC, MACVER
MACVER	Not Allowed	Not Allowed
NULL	Not Allowed	Not Allowed
OPINENC	IPINENC	IPINENC
PINGEN	PINVER	PINVER
PINVER	Not Allowed	Not Allowed

Notes:

1. * DATAXLAT is only supported on the IBM @server zSeries 900
2. There is no defined OUTTYPE for the AES algorithm and the keyword may not be used with ALGORITHM(AES).

TRANSKEY (key-label1[,key-label2])

This keyword identifies the label of a transport key that already exists in the CKDS. KGUP uses the transport key either to decrypt an imported key value or to encrypt a key value to send to another system.

When KGUP generates a key, the program enciphers the key under a master key variant. KGUP may also generate a key value that can be used to create the key's complement. You can have KGUP encrypt the key value under a transport key or transport key variant. On the control statement, use the TRANSKEY keyword to specify the transport key that KGUP should use to encipher the complementary key. You can send the encrypted key value to another system to create the complementary key.

When you generate an importer key-encrypting key to encipher a key stored with data in a file, you can request that KGUP not generate the complementary export key-encrypting key. You do this by not specifying the TRANSKEY or CLEAR keyword. This is also true for DATA and MAC keys.

When you input a key value that is in importable form, the key that is specified by the KEY keyword is enciphered under a transport key. KGUP reenciphers the key value from under the transport key to under a master key variant. On the control statement, you use the TRANSKEY keyword to specify the transport key that enciphers the key.

You can import or export a new version of a key that is encrypted under the current version of the same key. You can do this by specifying the same key label in the TRANSKEY keyword as in the LABEL or RANGE keyword on an UPDATE control statement.

Your site can generate keys for key exchange between two other sites. These sites do not need to know the clear value of the keys used for this communication. KGUP generates control statements that you send to the sites. Then the sites' KGUPs establish the keys they need for key exchange.

To do this procedure, submit an ADD or UPDATE control statement with two TRANSKEY key labels. The first TRANSKEY label identifies the transport key that is valid between your site and the first recipient site. The second TRANSKEY label identifies the transport key that is valid between your site and the second recipient site. KGUP generates of a pair of control statements to create the complementary pair of keys that are needed at the two sites.

Note: You cannot specify two transport keys that were installed without control vectors. For more information about control vectors, see the description of the NOCV keyword.

The TRANSKEY keyword and the CLEAR keyword are mutually exclusive.

If you have specified a key type of NULL, CLRDES or CLRAES for the TYPE keyword, you cannot use the TRANSKEY keyword.

Note: TRANSKEY is not valid with ALGORITHM(AES).

CLEAR

This keyword indicates that either:

- You are supplying an unencrypted key value with the KEY keyword.
- KGUP should create a control statement that generates an unencrypted complementary key value.

You can supply either encrypted or unencrypted key values to KGUP with the KEY keyword. On the control statement to supply the unencrypted key, you specify the CLEAR keyword.

When KGUP generates a key, KGUP enciphers the key under a master key variant. KGUP may also generate a key value to be used to create the key's complement. KGUP can create the complementary key value in unencrypted form. To generate an unencrypted complementary key value, you specify the CLEAR keyword. Your ICSF system must be in special secure mode to use this keyword.

The CLEAR keyword and the TRANSKEY keyword are mutually exclusive. You cannot use the CLEAR keyword on a control statement when you use the TRANSKEY keyword. You cannot use the CLEAR keyword if you specify a NULL, CLRDES or CLRAES key for the TYPE keyword.

NOCV

To exchange keys with systems that do not recognize transport key variants, ICSF provides a way to by-pass transport key variant processing. KGUP or an

application program encrypts a key under the transport key itself not under the transport key variant. This is called NOCV processing.

The NOCV keyword indicates that the key that is generated or imported is a transport key to use in NOCV processing. The transport key has the NOCV flag set in the key control information when stored in the CKDS.

Note: To create keys for NOCV processing, NOCV-Enablement keys must exist. For a description of how to create NOCV-Enablement keys, see "Initializing the CKDS and PKDS at First-Time Startup" on page 117.

The NOCV keyword is only valid for generating transport keys. The keyword is not valid if you specify the TRANSKEY keyword with two transport key labels.

LENGTH or SINGLE

LENGTH indicates the length of the key to generate. LENGTH(8) generates a single-length key. LENGTH(16) generates a double-length DES key or 128-bit AES key, LENGTH(24) generates a triple-length DES key (DATA only) or a 192-bit AES key. LENGTH(32) generates a 256-bit AES key. If a LENGTH is specified when generating DATAM or DATAMV keys, it must be LENGTH(16). For CLRDES, valid values for the LENGTH keyword are 8, 16, and 24. For CLRAES, valid values for the LENGTH keyword are 16, 24 and 32.

For double-length key types, LENGTH(8) or SINGLE in an ADD or UPDATE statement causes KGUP to generate a double-length key with both halves the same. On the KGUP panel, you can achieve this by specifying 8 in the LENGTH field for a double-length key type.

In either case, LENGTH is used only for generating keys. If you are specifying clear or encrypted key parts, do not use the LENGTH keyword (and do not fill in a value for LENGTH on the KGUP panel).

The LENGTH keyword and the KEY keyword are mutually exclusive. Although the LENGTH keyword is valid when you create control statements to generate DATA keys, KGUP ignores it for DATAXLAT keys. KGUP automatically generates them as single-length keys.

DES

This keyword is no longer supported but is tolerated.

KEY (key-value[,key-value[,key_value[,key_value]]])

This keyword allows you to supply KGUP with a key value. KGUP can use this key value to add a key or update a key entry.

If you do not specify this keyword, KGUP generates the key value for you. You cannot use the RANGE keyword or the LENGTH keyword with this keyword. Each key part consists of exactly 16 characters that represent 8 hexadecimal values.

This keyword is required when you specify either DATAMV, MACVER, or PINVER for the TYPE keyword. Because KGUP cannot generate PIN verification or MAC verification keys in operational form, you must always supply values for these types of keys.

For DATAXLAT, supply one key value. DATAXLAT is a single-length key, if you supply a second key value, KGUP discontinues processing the control statement and issues an error message.

For a double-length key (EXPORTER, IMPORTER, IPINENC, OPINEC, PINGEN, PINVER), supply two key values. If you supply only one key value,

KGUP will duplicate the key value as the secode key value. KGUP concatenates these two identical values, and then stores and uses the key as if the key was double-length.

For double-length keys, when you use the TRANSKEY keyword with the KEY keyword, the transport key you specify is the importer key that encrypts the key value. If you supply only one key value for a double-length key and also specify TRANSKEY, the TRANSKEY must be an NOCV importer.

For MAC and MACVER types, you can supply one or two key values.

For a DES DATA or CLRDES key, you can supply the key in one, two, or three parts.

For an AES DATA or CLRAES key, you must supply two, three or four parts.

Attention: NOCV processing takes place automatically when KGUP or an application specifies the use of a transport key that was generated by KGUP with a NOCV keyword specified.

The use of NOCV processing eliminates the ability of the system that generates the key to determine the use of the key on a receiving system. Therefore, access to these keys should be strictly controlled. For a description of security considerations, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

Using the ADD and UPDATE control statements for key management and distribution functions

You use the ADD and UPDATE control statements to run KGUP for functions that involve key generation, maintenance, and distribution. For ADD and UPDATE control statements, KGUP either imports a key value that you supply or generates a key value. KGUP allows the creation and maintenance of clear key tokens in the CKDS. This topic describes the combinations of control statement keywords you use to perform these functions. Table 15 shows the keyword combinations permitted on ADD and UPDATE control statements.

Table 15. Keyword Combinations Permitted in ADD and UPDATE Control Statements

Control Statement	LABEL or RANGE	TYPE	OUTTYPE	TRANSKEY or CLEAR	NOCV	ALGORITHM	LENGTH or KEY
ADD	Yes	Yes	Yes[1]	Yes[2]	Yes[3]	Yes[4]	Yes[1]
UPDATE	Yes	Yes	Yes[1]	Yes[2]	Yes[3]	Yes[4]	Yes[1]

Notes:

1. OUTTYPE can be used with either TRANSKEY or CLEAR but is mutually exclusive with KEY.
2. TRANSKEY is not valid when TYPE is NULL, CLRDES or CLRAES.
3. NOCV is not valid when TRANSKEY is specified with two key labels. It is not valid when TYPE is CLRDES or CLRAES.
4. OUTTYPE, TRANSKEY and NOCV are not valid with ALGORITHM(AES). There are no restrictions with ALGORITHM(DES).

To Import Keys

You use an ADD or UPDATE control statement to supply a value to KGUP. The program receives the value, enciphers the value under a master key variant, and places the value in a CKDS entry. The value that you supply may be in clear form or it may be encrypted under a transport key. The statement that contains the value

may be sent from another system. The other system sends the value to create a key on your system. This key is the complement of a key that was generated on the other system.

You can supply a transport key value to KGUP from a system that does not use control vectors. You use the key for key exchange with that system. KGUP places the key into the CKDS with an indication that the key is to be used without control vectors.

Import a Clear Key Value: You can supply a clear key value on a control statement for KGUP to import.

These statements show the syntax when you supply a clear key value to KGUP.

Note: For these control statements, your system should be in special secure mode.

When you supply a single-length, clear key value:

```
ADD or UPDATE  LABEL(label)    TYPE(data,exporter,importer,
mac,macver, or any PIN key)  CLEAR  KEY(key-value)
```

When you supply a double-length, clear key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data,datam,datamv,exporter,importer,
or any PIN key)  CLEAR  KEY(key-value, key-value)
```

When you supply a triple-length, clear key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data),
CLEAR  KEY(key-value, key-value, key-value)
```

When you supply a single-length clear key value and you use the key to exchange keys with a cryptographic product that does not use control vectors or double-length keys:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer),
CLEAR  KEY(key-value)  NOCV
```

When you supply a double-length, clear key value, and you use the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer),
CLEAR  KEY(key-value,ikey-value)  NOCV
```

When you supply a 128-bit, clear key value for an AES DATA key:

```
ADD or UPDATE  LABEL(label)  TYPE(data) ALGORITHM(AES),
CLEAR KEY(key-value,key-value)
```

For the CLRDES and CLRAES key types, the CLEAR keyword is not allowed because the key type indicates that the KEY is a clear key value. Also, special secure mode is not required for these key types.

```
ADD or UPDATE LABEL(label) TYPE(clraes),
KEY(key-value, key-value)
```

```
ADD or UPDATE LABEL(label) TYPE(clrdes),
KEY(key-value, key-value)
```

Import an Encrypted Key Value: When you supply KGUP with an encrypted key value, the value is encrypted under a transport key. The transport key is one key in a complementary key pair that you share with another system. When the other system's KGUP generated a key, the program also stored a control statement to

use to create the complementary key. The other system sends the control statement to your system. You can use the statement to supply an encrypted key value to KGUP to create the key.

These statements show the syntax when you supply an encrypted key value to KGUP.

When you supply a single-length, encrypted key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data,exporter,importer,
mac,macver, or any PIN key) TRANSKEY(key-label 1)  KEY(key-value)
```

When you supply a double-length, encrypted key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data,datam,datamv,exporter,importer,
or any PIN key) TRANSKEY(key-label 1)  KEY(key-value,ikey-value)
```

When you supply a triple-length, encrypted key value:

```
ADD or UPDATE  LABEL(label)  TYPE(data),
TRANSKEY(key-label 1)  KEY(key-value, key-value, key-value)
```

When you supply a single-length, encrypted key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors or double-length keys:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer),
TRANSKEY(key-label 1)  KEY(key-value)  NOCV
```

Note: Single-length keys with replicated key parts can be brought in under a TRANSKEY only if the TRANSKEY is an NOCV IMPORTER.

When you supply a double-length encrypted key value and you will use the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label)  TYPE(exporter or importer),
TRANSKEY(key-label 1)  KEY(key-value,ikey-value)  NOCV
```

To Generate Keys

You use an ADD or UPDATE control statement to have KGUP generate a key value to place in the CKDS. The program generates the value, enciphers the value under a master key variant, and places the value in the CKDS. When KGUP generates a key, the program may also store information to create the key's complement in a data set.

You can have KGUP generate a transport key that you use to send or receive keys from a system that does not use control vectors. KGUP places the key into the CKDS with an indication that the key is to be used without control vectors.

Generate an Importer Key For File Encryption: You can have KGUP create an importer key without having KGUP store information about the complement of the key. You do not use the importer key in key exchange with another system. You use the importer key to encrypt a data-encrypting key that you use to encrypt data in a file on your system. You can store the data-encrypting key with the file, because the data-encrypting key is encrypted under the importer key.

These statements show the syntax when you generate an importer key to use in file encryption on a system:

When you generate a single-length key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(importer)  SINGLE
```

When you generate a double-length key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(importer)
```

Generate an AES data key: You can have KGUP create an AES data key. The keys may be 128-, 192- or 256-bits in length.

These statements show the syntax when you generate an AES data key on a system.

When you generate a 128-bit key value:

```
ADD or UPDATE  ALGORITHM(AES) LABEL(label) or RANGE(start-label,end-label),
TYPE(data)
```

When you generate a 192-bit key value:

```
ADD or UPDATE  ALGORITHM(AES) LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(24)
```

Generate a Complementary, Clear Key Value: You can have KGUP store complementary key information when KGUP generates a key. This information includes the key value. You send the information to another system which uses the information to generate the complementary key. KGUP stores the key value to create the complementary key in either clear or encrypted form. KGUP stores information both in and not in the form of a control statement.

These statements show the syntax when you have KGUP store the complementary key value in clear form.

Note: For these control statements, your system should be in special secure mode.

When you generate a single-length, transport or PIN clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter,importer,ipinenc,opinenc, or pingen) CLEAR  SINGLE
```

When you generate a single-length, DATA clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(8) CLEAR
```

When you generate a double-length, DATA clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(16) CLEAR
```

When you generate a triple-length, DATA clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(24) CLEAR
```

When you generate a single-length, MAC clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(mac) OUTTYPE(mac or macver) CLEAR
```

When you generate a double-length, DATAM clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(datam) LENGTH(16) OUTTYPE(datam or datamv) CLEAR
```

When you generate a single-length, PINGEN clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(pingen) LENGTH(8) CLEAR
```

When you generate a double-length, clear key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter,importer,ipinenc,opinenc, or pingen) CLEAR
```

When you generate a single-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter or importer)  CLEAR  NOCV  SINGLE
```

When you generate a double-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(16) CLEAR NOCV
```

When you generate a triple-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(24)  CLEAR  NOCV
```

When you generate a double-length, clear key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter or importer)  CLEAR  NOCV
```

When you generate a clear key value to transport data-encrypting keys for use in the DES algorithm:

```
ADD or UPDATE LABEL(label) TYPE(exporter or importer) CLEAR
```

Generate a Complementary, Encrypted Key Value: KGUP encrypts the complementary key value under the exporter key that you specify.

These statements show the syntax when you have KGUP generate the complementary key value in encrypted form.

When you generate a single-length, transport or PIN encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter,importer,ipinenc,opinenc, or pingen),
TRANSKEY(key-label 1)  SINGLE
```

When you generate a single-length, DATA encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) OUTTYPE(data) TRANSKEY(key-label 1)
```

When you generate a single-length, MAC encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(mac) OUTTYPE(mac or macver) TRANSKEY(key-label 1)
```

When you generate a double-length, encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter,importer,ipinenc,opinenc, or pingen)  TRANSKEY(key-label 1)
```

When you generate a double-length DATA encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data or datam)  LENGTH(16) TRANSKEY(key-label 1)
```

When you generate a double-length DATAM encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(datam)  TRANSKEY(key-label 1)
```

When you generate a triple-length DATA encrypted key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data)  LENGTH(24) TRANSKEY(key-label 1)
```

When you generate a single-length, encrypted key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter or importer)  TRANSKEY(key-label 1)  SINGLE  NOCV
```

When you generate a double-length, encrypted key value, and you are using the key to exchange keys with a cryptographic product that does not use control vectors.

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter or importer)  TRANSKEY(key-label 1)  NOCV
```

Generate a Complementary Key Pair For Other Systems: You can also use KGUP as a key distribution center. KGUP generates a pair of complementary key values that are both used on other systems. KGUP encrypts the values under appropriate variants of two different exporter key-encrypting keys. KGUP does not alter your system's CKDS. The program stores two control statements each containing one of the keys that are encrypted under a transport key. You send the statements to two other sites which can create the keys and use the keys to exchange keys.

These statements show the syntax when you have KGUP generate a pair of complementary key values to send to other systems.

When you generate single-length transport or PIN key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter,importer,ipinenc,opinenc, or pingen),
TRANSKEY(key-label 1,key-label 2)  SINGLE
```

When you generate single-length DATA key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) OUTTYPE(data) TRANSKEY(key-label 1,key-label 2)
```

When you generate double-length DATA key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(16) TRANSKEY(key-label 1,key-label 2)
```

When you generate triple-length DATA key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(data) LENGTH(24) TRANSKEY(key-label 1,key-label 2)
```

When you generate single-length MAC key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(mac) OUTTYPE(mac or macver) TRANSKEY(key-label 1,key-label 2)
```

When you generate double-length DATAM key values:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label)
TYPE(datam) OUTTYPE(datam or datamv),
TRANSKEY(key-label 1,key-label 2)
```

When you generate a double-length key value:

```
ADD or UPDATE  LABEL(label) or RANGE(start-label,end-label),
TYPE(exporter,importer,ipinenc,opinenc, or pingen),
TRANSKEY(key-label 1,key-label2)
```

To Create NULL Keys

You can use KGUP to create an initial record in the CKDS. To do this, you create an ADD control statement with a key TYPE of NULL. Once you have created this key record, you can use the Key Record Write callable service to place a key value in the record.

If you are generating a large number of keys, you will get better performance if you create the NULL key records with KGUP. This is preferrable to using the Key_Record_Create callable service.

Create NULL Key Records: You can use KGUP to create a single NULL key record or a range of NULL key records. This statement shows the syntax you use:

```
ADD  LABEL(label) or RANGE(start-label,end-label)  TYPE(null)
```

Syntax of the RENAME Control Statement

The RENAME control statement changes the label of a key entry in the CKDS. KGUP does not change any other information in the entry.

The RENAME control statement has this syntax:

RENAME

LABEL(*old-label*,*new-label***)**

TYPE(*key-type***)**

Figure 127. RENAME Control Statement Syntax

LABEL(old-label,new-label)
This keyword specifies the labels of the CKDS entries that you want KGUP to process. For the general rules about key label conventions and uniqueness, see “General Rules for CKDS Records” on page 220.

First you specify the old label which is the current label in the CKDS that KGUP changes. Then you specify the new label to replace the old label.

TYPE(key-type)
Because you can use the same label in entries with different key types, this keyword specifies the type of key for the old entry and the new entry.

Syntax of the DELETE Control Statement

DELETE control statements instruct KGUP to remove key entries from the CKDS.

The DELETE control statement has this syntax:

```
DELETE

   {LABEL(label1[,...,label64]) | RANGE(start-label,end-label)}

   TYPE(key-type)
```

Figure 128. DELETE Control Statement Syntax

LABEL (label1[,...,label64])
This keyword defines the names of the key entries for KGUP to delete from the CKDS. KGUP deletes a separate entry for each label.

You must specify at least one key label, and you can specify up to 64 labels with the LABEL keyword. For the general rules about key label conventions and uniqueness, see "General Rules for CKDS Records" on page 220.

On a KGUP control statement, you must specify either the LABEL or RANGE keyword.

RANGE (start-label, end-label)
This keyword defines the range of the multiple labels that you want KGUP to delete from the CKDS.

The label consists of between 2 and 64 characters that are divided as follows:

- The first 1 to 63 characters are the label base. These characters must be identical on both the start-label and end-label and are repeated for each label in the range. For the general rules about key label conventions and uniqueness, see "General Rules for CKDS Records" on page 220.
- The last 1 to 4 characters form the suffix. The number of digits in the start-label and end-label must be the same, and the characters must all be numeric. These numeric characters establish the range of labels KGUP creates. The start-label numeric value must be less than the end-label numeric value.

TYPE(key-type)
Because you can use the same label in entries with different key types, this keyword specifies the type of key that is being deleted.

To Delete Keys

You can use a KGUP control statement to remove a key or a range of keys from the CKDS. This statement shows the syntax when you delete keys from the CKDS:

```
DELETE  LABEL(label) or RANGE(start-label,end-label)
TYPE(data,dataxlat,exporter,importer,ipinenc,mac,macver,
null,opinenc,pingen, or pinver)
```

Syntax of the SET Control Statement

The SET control statement specifies data you want KGUP to pass to the installation-defined exit routine for processing.

The SET control statement has this syntax:

```
SET

   INSTDATA(data-value)
```

Figure 129. SET Control Statement Syntax

INSTDATA(data-value)
This keyword specifies the data KGUP sends to the KGUP exit routine while processing control statements.

During a KGUP job, the data you specify with the INSTDATA keyword is held and sent to the exit routine each time the exit is entered for control statement processing. The same information is sent until KGUP encounters another SET control statement. The data you specified in this SET control statement replaces the data you specified in the previous SET control statement.

A KGUP exit routine performs different operations that depend on the data that is sent and the time of the call. A KGUP exit routine can change the data you send the exit and send the changed data to the user area of a key entry in the CKDS. The user area of a key entry can contain any information that you choose to store in the area.

For more information about the KGUP exit routine, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

The maximum length of the character string that you can specify to an exit routine is 52 bytes. If you use blanks or special characters within the string, then you must delimit the entire string with single quotes ('). These quotes are not included as part of the 52-byte string.

Syntax of the OPKYLOAD Control Statement

The OPKYLOAD control statement specifies the operational key created by the TKE workstation on a PCIXCC, CEX2C, or CEX3C that you want KGUP to load to the CKDS. An SMF record type 82 subtype 7 will be generated when the key is written to the CKDS. This keyword in only supported on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196.

The OPKYLOAD control statement has this syntax:

```
OPKYLOAD

   LABEL (key-label)
   SERNBR (coprocessor-serial-number)
   [NOCV]
```

Figure 130. OPKYLOAD Control Statement Syntax

LABEL (*key-label***)**
This label must match the label used to create the key by the TKE workstation on the PCIXCC.

SERNBR (*coprocessor-serial-number***)**
The serial number is available on the Service Element panels and the ICSF coprocessor management panel. The coprocessor-serial-number is the serial number of the coprocessor where the key identified by the key-label has been loaded from the TKE workstation.

NOCV
NOCV specifies that the IMPORTER/EXPORTER key being written to the CKDS should be NOCV IMPORTER/EXPORTER. The key must have a default control vector.

Examples of Control Statements

Example 1: ADD Control Statement

This example shows a control statement that specifies that KGUP add an entry to the CKDS.

```
ADD  TYPE(IMPORTER) LABEL(DASDOCT93401E)
```

KGUP checks that an entry labeled DASDOCT93401E with a keytype of importer does not already exist in the CKDS. It also checks that there are no DATA, DATAXLAT, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label. Each of these keys requires a unique label. If the key entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of DASDOCT93401E and type of IMPORTER. KGUP generates a double-length key and encrypts the key under the master key variant for an importer key. KGUP places the key in the entry.

Note: Because neither the TRANSKEY nor CLEAR keyword is specified, KGUP does not create a complementary key. You cannot use this key to communicate with another system. You can, however, use the key to encipher a key stored with data in a file. IMPORTER, DATA, DATAM, and MAC are the only key types that do not require either the TRANSKEY or CLEAR keyword specified.

Example 2: ADD Control Statement with CLEAR Keyword

This example shows a control statement that specifies that KGUP add an entry to the CKDS. Because the CLEAR keyword is specified, KGUP processes only this control statement if ICSF is in special secure mode.

```
ADD  TYPE(EXPORTER)  LABEL(ATMBRANCH5MO001)  CLEAR
```

KGUP checks that an entry with the label ATMBRANCH5MO001 with the type EXPORTER does not already exist in the CKDS. It also checks that there are no DATA, DATAXLAT, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label. Each of these keys requires a unique label. If the entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry for the label specified and the type exporter. KGUP generates a double-length key, encrypts the key under the master key variant for an exporter key, and places the key in the entry.

KGUP stores information to the key output data set. You can send the information to another system that does not use KGUP. The other system uses the information to create the complements of the keys you created. The information contains the clear key value and specifies the key type as importer.

For example, the control statement would be in this format:

```
ADD  TYPE(IMPORTER)  LABEL(ATMBRANCH5MO001)  CLEAR,
KEY(6709E5593933DA00,9099937DDE93A944)
```

The key value is the clear key value of the key created. The type of key is the complement of the type of key created.

Note: The key in the previous example is a mixed parity key. KGUP imports mixed parity keys, but issues a warning message.

Example 3: ADD Control Statement with one TRANSKEY Keyword

This example shows a control statement that specifies that KGUP add an entry to the CKDS. Because the TRANSKEY keyword is specified, KGUP also creates a control statement that another installation uses to create the complement of the key for PIN exchange.

```
ADD  TYPE(IPINENC)  LABEL(LOCTOJWL.JULY03)  TRANSKEY(SENDJWL.JULY03)
```

KGUP checks that an entry with the label LOCTOJWL.JULY03 for an input PIN-encrypting key does not already exist in the CKDS. It also checks that there are no DATA, DATAM, DATAMV, MAC, MACVER, or NULL key entries with that label. Each of these keys requires a unique label. If the entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of LOCTOJWL.JULY03 and type of IPINENC. KGUP generates a double-length key. KGUP encrypts the key under the master key variant for an input PIN-encrypting key and places the key in the entry.

KGUP stores information to the key output data set. You can send the information to another system that does not use KGUP. The other system uses the information to create the complement of the key you created. The information contains the key in exportable form. The key is encrypted under the exporter key, labelled SENDJWL.JULY03, that was specified by the TRANSKEY keyword. The information specifies the key type as output PIN-encrypting key (OPINENC).

Note: If SENDJWL.JULY03 is an NOCV exporter, the exportable OPINENC key is encrypted without a control vector.

KGUP stores a control statement to the control statement output data set. You can send the control statement to another system. The other system's KGUP uses the statement to create a key that complements the key that you created.

For example, the control statement would be in this format:

```
ADD  TYPE(OPINENC)  LABEL(LOCTOJWL.JULY03)  TRANSKEY(SENDJWL.JULY03),
KEY(6709E5593933DA00,9099937DDE93A944)
```

The key value is the encrypted value of the key that KGUP created. The key is encrypted under the exporter key, labeled SENDJWL.JULY03, which was the transport key label that was specified on the original control statement. The type of key is the complement of the type of key it created.

Example 4: ADD Control Statement with two TRANSKEY Keywords

This example shows a control statement specifying that KGUP create keys for key exchange between two other sites.

```
ADD  TYPE(EXPORTER)  LABEL(JWL@SSIJULY03),
TRANSKEY(SENDTOJWLJULY03,SENDTOSIIJULY03)
```

KGUP generates a key value and encrypts the value under the variants of the exporter key-encrypting keys that are specified by the TRANSKEY keyword. KGUP does not alter the CKDS in any way.

KGUP stores these two control statements to the control statement output data set:

```
ADD  TYPE(EXPORTER)  LABEL(JWL@SSIJULY03)  TRANSKEY(SENDTOJWLJULY03),
KEY(4542E37B570033AD,3C00F6850A99E11B)

ADD  TYPE(IMPORTER)  LABEL(JWL@SSIJULY03)  TRANSKEY(SENDTOSIIJULY03),
KEY(6709E5993933DA00,1449A3D9ED0A1586)
```

The control statements create keys that complement each other. You send the statements to two sites that want to exchange keys. The receiving sites process the statements to create a complementary pair of transport keys.

KGUP also stores information to create the keys in the key output data set.

Example 5: ADD Control Statement with a Range of NULL Keys

This example shows a control statement that creates a range of empty key records in a CKDS. Once the key labels exist, you can enter key types and key values for these records in several ways. One method is to use KGUP to create UPDATE control statements. Another method is to write application programs that use the Key_Record_Write callable service to add key types and key values to the existing empty key records.

```
ADD  TYPE(NULL)  RANGE(BRANCH5M0001,BRANCH5M0025)
```

KGUP checks for any entries with labels between BRANCH5M001 and BRANCH5M0025 in the CKDS. If any entries in this range already exist, KGUP processes the control statement up to the point where a duplicate label is found. It then stops processing the control statement and issues error messages.

If no entries exist, KGUP creates a range of 25 sequentially-numbered key records and adds them to the CKDS.

Example 6: ADD Control Statement with OUTTYPE and TRANSKEY Keywords

This example shows a control statement that specifies that KGUP add an entry with the key type of DATAM to the CKDS. The TRANSKEY keyword instructs KGUP to create a control statement for an intermediate node to use to create the complement DATAMV key for intermediate node data translation.

```
ADD  LABEL(DATAKEY.TO.TRANSLATION)  TYPE(DATAM)  OUTTYPE(DATAMV),
TRANSKEY(TKBRANCH2.INTER)
```

KGUP checks that an entry with the label DATAKEY.TO.TRANSLATION does not already exist in the CKDS, because DATAM keys require unique labels. If the entry already exists, KGUP stops processing the control statement.

If the entry does not exist, KGUP creates the entry with a label of DATAKEY.TO.TRANSLATION and a type of DATAM. KGUP then generates a single-length key, encrypts the key under the master key variant for a DATAM key, and places the key in the CKDS entry.

KGUP stores information to the key output data set. You can send the information to another system that does not use KGUP. The other system uses the information to create the complement of the key you created. The information contains the key value of the key in exportable form. The key is encrypted under the exporter key, labeled TKBRANCH2.INTER, that was specified by the TRANSKEY keyword. The information specifies the key type as data-translation key (DATAMV).

KGUP stores a control statement to the control statement output data set. You can send the control statement to another system. The other system's KGUP uses the statement to create a key that complements the key you created.

For example, the control statement would be in this format:

```
ADD  TYPE(DATAMV)  LABEL(DATAKEY.TO.TRANSLATION),
TRANSKEY(TKBRANCH2.INTER), KEY(2509F2869257BD00)
```

The key value is the encrypted value of the key that KGUP created. The key is encrypted under the exporter key, labelled TKBRANCH2.INTER, which was the transport key label that was specified on the original control statement. The type of key is the complement of the type of key it created.

Example 7: UPDATE Control Statement with Key Value and Transkey Keywords

This example shows a control statement that specifies that KGUP import a key value. KGUP places the key value into an entry in the CKDS that already exists.

```
UPDATE  LABEL(PINVBRANCH5M0002)  TYPE(PINVER)  TRANSKEY(TKBRANCH5JUNE99),
KEY(7165865940460A48,2237451B4545718B)
```

The key value on the control statement is encrypted under a transport key that is shared with another system. The label for the transport key is TKBRANCH5JUNE99. KGUP uses the importer key labelled TKBRANCH5JUNE99 to decrypt the key value.

KGUP encrypts the key value under the master key variant for a PIN verification key. KGUP then places the key in a key entry labelled PINVBRANCH5M0002 with the type PINVER in the CKDS.

Example 8: DELETE Control Statement

This example shows a control statement that specifies that KGUP delete an entry from the CKDS.

```
DELETE  LABEL(GENBRANCH2M0003)  TYPE(PINGEN)
```

KGUP deletes the entry with a label of GENBRANCH2M0003 and type of PIN generation key from the CKDS. If KGUP cannot find the entry, KGUP gives you an error message.

Example 9: RENAME Control Statement

This example shows a control statement that specifies that KGUP rename an entry in the CKDS.

```
RENAME  LABEL(JWL@SSIDEC97,JWL@SSIJUNE99)  TYPE(EXPORTER)
```

KGUP checks if an entry with a label of JWL@SSIJUNE99 and a key type of EXPORTER already exists in the CKDS. If the entry does exist, KGUP does not process the control statement. KGUP checks if an entry with the label JWL@SSIDEC97 contains a key type of EXPORTER exists. If the entry exists, KGUP renames the entry JWL@SSIJUNE99.

Example 10: SET Control Statement

This example shows a control statement that specifies that KGUP send certain installation data every time an exit is called during KGUP processing. KGUP sends the data every time an exit is called until KGUP encounters another SET statement or the job stream completes.

```
SET  INSTDATA('This key is valid effective 9/9/99')
```

KGUP sends the installation data each time an installation exit is called during KGUP processing.

Example 11: OPKYLOAD Control Statement

This example shows a control statement to load a key into the CKDS from a PCIXCC, CEX2C, or CEX3C. The serial number of the card is 94000011. A key has been loaded on the card with the label ERC033.DEC50.

```
OPKYLOAD LABEL(ERC033.DEC50) SERNBR(94000011)
```

KGUP checks the CKDS for the label and will fail if the label exists. KGUP then queries the PCIXCC, CEX2C or CEX3C to see if the key exists on the card. If the key exists, the key token is retrieved from the card and loaded into the CKDS.

Example 12: OPKYLOAD Control Statement for NOCV Key-encrypting Keys

This example shows a control statement to load a key into the CKDS from a PCIXCC, CEX2C, or CEX3C where the key is a key-encrypting key to be used as a NOCV KEK. The serial number of the card is 94000064. A key has been loaded on the card with the label ERC033.NOCV.IMPORTER.

```
OPKYLOAD LABEL(ERC033.NOCV.IMPORTER) SERNBR(94000064) NOCV
```

KGUP checks the CKDS for the label and will fail if the label exists. KGUP then queries the PCIXCC, CEX2C, or CEX3C to see if the key exists on the card. If the key exists, the key token is retrieved from the card. If the key is a key-encrypting key with the default control vector, the NOCV token flag is set. The token is then loaded into the CKDS.

Example 13 – ADD control statement with CLRDES keyword

This example shows a control statement that adds a CLRDES key to the CKDS with a random 8 byte key.

```
ADD TYPE(CLRDES) LENGTH(8) LAB(CLRDES.KEYLN8)
```

Example 14 – ADD control statement to add a group of CLRDES keys

This example shows a control statement that adds a group of CLRDES keys to the CKDS. Key value is generated.

```
ADD TYPE(CLRDES) LENGTH(8) LAB(A.CLRDES.KEYLN8,B.CLRDES.KEYLN8,C.CLRDES.KEYLN8)
```

Example 15 – ADD control statement to add a group of CLRDES keys

This example shows a control statement that adds a group of CLRDES keys. The clear key value is specified.

```
ADD TYPE(CLRDES) KEY(2C2C2C2C2C2C2C2C,1616161616161616),
LAB(X.CLRDES.KEYLN16,Y.CLRDES.KEYLN16,Z.CLRDES.KEYLN16)
```

Example 16 – ADD control statement to add a range of CLRDES keys

This example shows a control statement that adds a range of CLRDES keys. A different key value is generated for each key label.

```
ADD TYPE(CLRDES) LENGTH(24) RAN(CLRDES.KEYLN24.KEY1,CLRDES.KEYLN24.KEY3)
```

Example 17 – UPDATE control statement with CLRDES keyword

This example shows a control statement that changes a CLRDES key.

```
UPDATE TYPE(CLRDES) KEY(4343434343434343) LAB(CLRDES.KEYLN8)
```

Example 18 – UPDATE control statement with CLRDES keyword

This example shows a control statement that changes a range of CLRDES keys.

```
UPDATE TYPE(CLRDES) LENGTH(16) RAN(CLRDES.KEY1,CLRDES.KEY3)
```

Example 19 – DELETE control statement with CLRDES keyword

This example shows a control statement that deletes a CLRDES key.

```
DELETE TYPE(CLRDES) LAB(CLRDES.KEYLN24)
```

Example 20 – DELETE control statement to delete a group of CLRDES key labels

This example shows a control statement that deletes a group of CLRDES keys.

```
DELETE TYPE(CLRDES) LAB(A.KEYLN16,B.KEYLN16,C.KEYLN16)
```

Example 21 – RENAME Control Statement with CLRDES Keyword

This example shows a control statement that renames a CLRDES key.

```
RENAME TYPE(CLRDES) LAB(CLRDES.KEYLN16,CLRDES.DOUBLE.LENGTH.KEY)
```

Example 22 – ADD Control Statement with CLRAES Keyword

This example shows a control statement that adds a CLRAES key to the CKDS with a random 16 byte key.

```
ADD TYPE(CLRDES) LENGTH(16) LAB(AES.BIT128)
```

Example 23 – ADD Control Statement to Add a Group of CLRAES Keys

This example shows a control statement that adds a group of CLRAES keys to the CKDS. Key value is generated.

```
ADD TYPE(CLRAES) LENGTH(16) LAB(A.AES.L128,B.AES.L128,C.AES.L128)
```

Example 24 – ADD Control Statement to Add a Group of CLRAES Keys

This example shows a control statement that adds a group of CLRAES keys. The clear key value is specified.

```
ADD TYPE(CLRAES) KEY(2C2C2C2C2C2C2C2C,1616161616161616,A9A9A9A9A9A9A9A9),
LAB(X.AES.BIT192,Y.AES.BIT192,Z.AES.BIT192)
```

Example 25 – ADD Control Statement to Add a Range of CLRAES Keys

This example shows a control statement that adds a range of CLRAES keys. A different key value is generated for each key label.

```
473 ADD TYPE(CLRAES) LENGTH(32) RAN(AES.LN32.KEY1,AES.LN32.KEY3)
```

Example 26 – UPDATE Control Statement with CLRAES Keyword

This example shows a control statement that changes a CLRAES key.

```
UPDATE TYPE(CLRAES) KEY(4343434343434343) LAB(AES.BIT128)
```

Example 27 – UPDATE Control Statement with CLRAES Keyword

This example shows a control statement that changes a range of CLRAES keys.

```
UPDATE TYPE(CLRAES) LENGTH(16) RAN(AES.KEY1,AES.KEY3)
```

Example 28 – DELETE Control Statement with CLRAES Keyword

This example shows a control statement that deletes a CLRAES key.

```
DELETE TYPE(CLRAES) LAB(AES.LN24)
```

Example 29 – DELETE Control Statement to Delete a Group of CLRAES Key Labels

This example shows a control statement that deletes a group of CLRAES keys.

```
DELETE TYPE(CLRAES) LAB(A.AES.LN16,B.AES.LN16,C.AES.LN16)
```

Example 30 – RENAME Control Statement with CLRAES Keyword

This example shows a control statement that renames a CLRAES key.

```
RENAME TYPE(CLRAES) LAB(AES.ESC001,AES.EXC001)
```

Example 31 – ADD Control Statement for ALGORITHM keyword

This example shows a control statement that adds an AES DATA key to the CKDS with a random 128-bit key value.

```
ADD TYPE(DATA) ALGORITHM(AES) LENGTH(16) LAB(AES.BIT128)
```

This example shows a control statement that adds a DES DATA key to the CKDS with a random 16-byte key value.

```
ADD TYPE(DATA) ALGORITHM(DES) LENGTH(16) LAB(DES.KEYLN16)
```

This example shows a control statement that adds a group of AES DATA keys to the CKDS. A different key value will generated for each label.

```
 ADD TYPE(DATA) LENGTH(16) LAB(A.AES.L128,B.AES.L128,C.AES.L128) ALGORITHM(AES)
```

This example shows a control statement that adds a group of DES DATA keys to the CKDS. A different key value will generated for each label.

```
ADD TYPE(DATA) LENGTH(16) LAB(A.DES.L16,B.DES.L16,C.DES.L16) ALGORITHM(DES)
```

This example shows a control statement that adds a group of AES DATA keys. The clear key value is specified.

```
ADD TYPE(DATA) ALGORITHM(AES) KEY(2C2C2C2C2C2C2C2C,1616161616161616,A9A9A9A9A9A9A9A9),
LAB(X.AES.BIT192,Y.AES.BIT192,Z.AES.BIT192)
```

This example shows a control statement that adds a group of DES DATA keys to the CKDS. A different key value will generated for each label.

```
ADD TYPE(DATA) ALGORITHM(DES) LENGTH(24) RAN(DES.LN24.KEY1,DES.LN24.KEY3)
```

Example 32 – UPDATE Control Statement with the ALGORITHM keyword

This example shows a control statement that changes an AES DATA key.

```
UPDATE TYPE(DATA) KEY(4343434343434343,5656565656565656) LAB(AES.BIT128) ALGORITHM(AES)
```

This example shows a control statement that changes a range of DES keys.

```
UPDATE TYPE(DATA) LENGTH(16) RAN(DES.KEY1,DES.KEY3) ALGORITHM(DES)
```

Specifying KGUP data sets

During key generator utility program (KGUP) processing, you store the information you supply and receive in these data sets:

- The cryptographic key data set (CKDS) contains key entries that you have KGUP add, update, rename, or delete.
- The control statement input data set contains the control statements that specify the functions you want KGUP to perform.
- The diagnostics data set contains information you can use to check that the control statement succeeded.
- The key output data set contains information that another system uses to create keys that are complements of keys on your system.
- The control statement data set contains control statements that another system uses to create keys that are complements of keys on your system.

You specify the names of the data sets in the job control language to submit the job.

These topics describe the data sets that KGUP accesses or generates in detail.

Cryptographic Key Data Set (CKDS)
This VSAM key sequenced data set contains the cryptographic keys for a

particular KGUP job. It has a fixed logical record length (LRECL) of 252 bytes.

Programming Interface information

The records in the CKDS are in this format:

Key label
(Character length 64 bytes) The key label specified on the control statement.

Key type
(Character length 8 bytes) The key type specified on the control statement.

Creation date
(Character length 8 bytes) The initial date the record was created, in the format `YYYYMMDD`.

Creation time
(Character length 8 bytes) The initial time the record was created, in the format `HHMMSSTH`.

Last update date
(Character length 8 bytes) The most recent date the record was updated, in the format `YYYYMMDD`.

Last update time
(Character length 8 bytes) The most recent time the record was updated, in the format `HHMMSSTH`.

Key token
(Character length 64 bytes) A key token is composed of the key value and control information. The master key encrypts the key value in this field. For a description of format of a key token, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

CKDS flag bytes
(Bit length 2 bytes) If bit zero is set to one, the key within the token is a partial key. All the other bits are reserved.

Reserved
(Character length 26 bytes) Reserved. This field contains binary zeros.

Installation Data
(Character length 52 bytes) Using the KGUP exit, conversion program exit, or single-record, single-record, read-write exit, you can place information associated with the key entry into this field.

Authentication code
(Character length 4 bytes) The message authentication code computed on the previous fields of the record using a system key that is a MAC generation key. ICSF uses the code to verify the record when the record is updated.

The first record in the CKDS is a header record. The header record in the CKDS is in this format:

Key label
(Character length 64 bytes) Binary zeros. This field is not to be used.

Key type
(Character length 8 bytes) Binary zeros. This field is not to be used.

Creation date
(Character length 8 bytes) The initial date the record was created, in the format YYYYMMDD.

Creation time
(Character length 8 bytes) The initial time the record was created, in the format HHMMSSTH.

Last update date
(Character length 8 bytes) The most recent date the record was updated, in the format YYYYMMDD.

Last update time
(Character length 8 bytes) The most recent time the record was updated, in the format HHMMSSTH.

Sequence number
(Character length 2 bytes) Initially binary zero, incremented each time the data set is processed.

CKDS header flag bytes
(Bit length 2 bytes) If bit zero is set to one, the DES master key verification pattern is valid. If bit one is set to one, the DES master key authentication pattern is valid. If bit two is set to one, the AES master key verification pattern is valid. If bit 8 is set to one, record authentication has been disabled. All the other bits are reserved.

DES master key verification pattern
(Character length 8 bytes) The DES master key verification pattern.

When you initialize the CKDS and master key or change the master key, ICSF calculates a verification pattern and places it into this field. ICSF calculates the verification pattern by using the current master key and the verification algorithm that is described in “Algorithm for calculating a verification pattern” on page 399.

DES master key authentication pattern
(Character length 8 bytes) The DES master key authentication pattern.

When you initialize the CKDS and master key or change the master key, ICSF calculates an authentication pattern and places it into this field. ICSF calculates the authentication pattern by using the current master key and the authentication pattern algorithm that is described in “Algorithm for calculating an authentication pattern” on page 399.

Whenever you start ICSF, ICSF uses the authentication pattern to verify that the current master key is the master key that enciphers the current CKDS. ICSF fails if the authentication pattern that is stored in the CKDS and the authentication pattern that ICSF calculates at startup do not match.

AES master key verification pattern
(Character length 8 bytes) The AES master key verification pattern.

When you initialize the CKDS and AES master key or change the AES master key, ICSF calculates a verification pattern and places it into this field. ICSF calculates the verification pattern by using the current master key and the verification algorithm that is described in “Algorithm for calculating an authentication pattern” on page 399.

Reserved
(Character length 64 bytes) Reserved. This field contains binary zeros.

Installation Data
(Character length 52 bytes) Using the KGUP installation exit, you can place information associated with the key entry into this field.

Authentication code
(Character length 4 bytes) The message authentication code computed on the previous fields of the record using a system key that is a MAC generation key. ICSF creates the code when ICSF creates the system keys at CKDS initialization. ICSF uses the code to verify the CKDS when the CKDS is read.

End of Programming Interface information

In the KGUP job stream, it is defined by the CSFCKDS data definition statement.

Control Statement Input Data Set
This data set contains the control statements that the particular KGUP job processes. For a description of the syntax of these control statements, see "Using KGUP control statements" on page 220.

This data set is a physical sequential data set with a fixed logical record length (LRECL) of 80 bytes.

Note: If a control statement adds or updates a key, later control statements in the control statement input data set for that KGUP job use the new or updated key.

In the KGUP job stream, the control statement input data set is defined by the CSFIN data definition statement.

Diagnostics Data Set
This data set contains a copy of each input control statement that is followed by one or more diagnostic messages that were generated for that control statement. It is a physical sequential data set with a fixed logical record length (LRECL) of 133 bytes. It should be fixed with ASA codes. Figure 131 shows an example of a diagnostics data set.

```
KEY GENERATION DIAGNOSTIC REPORT  DATE:1997/9/14 (YYYY/MM/DD) TIME:12:10:15 PAGE 1


 /* THIS IS A KEY USED TO EXPORT KEYS FROM A TO B */
 ADD TYPE(EXPORTER) TRANSKEY(TK1),
  LABEL(ATOB)
 > > > CSFG0321 STATEMENT SUCCESSFULLY PROCESSED.




 /* THIS IS A KEY USED TO IMPORT KEYS FROM B TO A */
 ADD TYPE(IMPORTER) TRANSKEY(TK1),
  LABEL(BTOA)
 > > > CSFG0321 STATEMENT SUCCESSFULLY PROCESSED.
 > > > CSFG0780 A REFRESH OF THE IN-STORAGE CKDS IS NECESSARY TO ACTIVATE CHANGES MADE BY KGUP.
 > > > CSFG0002 CRYPTOGRAPHIC KEY GENERATION - END OF JOB. RETURN CODE = 0.
```

Figure 131. Diagnostics Data Set Example

In the KGUP job stream, the data set is defined by the CSFDIAG data definition statement.

Key Output Data Set

This data set contains information about each key KGUP generates, except an importer key used to protect a key that is stored with a file. Each entry contains the key value and the complement key type of the key created. Another system can use this information to create a key that is the complement of the key your system created.

This data set is a physical sequential data set with a fixed logical record length (LRECL) of 208 bytes.

To establish key exchange with a system that does not use KGUP control statements, you can send that system information from this data set. The receiving system can then use this information to create the complement of the key you created. You can print or process this data set when KGUP ends.

KGUP only lists a record for the key if the TRANSKEY or CLEAR keyword was in the control statement. If the TRANSKEY keyword was specified in the output key data set, KGUP lists, for the key type, the complement of the control statement key type. KGUP lists, for the key value, the key encrypted under the transport key as specified by the TRANSKEY keyword.

The encrypted key is in the form of an external key token. An external key token contains the encrypted key value and control information about the key. For example, the token contains the control vector for the key type.

If the CLEAR keyword was specified, in the output key data set KGUP lists, for the key type, the complement of the control statement key type. KGUP lists, for the key value, the clear key value of the key. With this information another system could generate keys that are complements of the keys your system generated. This would permit your system and the other system to exchange keys.

When KGUP generates two complementary keys, each encrypted by a different transport key, KGUP lists a record for each key. The first record contains a key that is encrypted under the first transport key variant and the type that is specified on the control statement. The second record contains a key that is encrypted under the second transport key variant and a type that is the complement of the first key.

The records in the key output data set are in this format:

Key label
(Character length 64 bytes) The key label specified on the control statement.

Key type
(Character length 8 bytes) The key type specified on the control statement or the complement of that key type if the TRANSKEY keyword was specified.

TRANSKEY label or `CLEAR`
(Character length 64 bytes) Either the key label of a transport key which encrypts the key entry or the character string `CLEAR` (left justified) if the key is unencrypted.

TRANSKEY type
(Character length 8 bytes) The key type of the TRANSKEY, which is always exporter.

Key Token
(Character length 64 bytes) A key token is composed of the key value and control information. The key value in this field is either unencrypted or encrypted under a transport key. For a description of format of a key token, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

In the KGUP job stream, the data set is defined by the CSFKEYS data definition statement.

Control Statement Output Data Set
KGUP produces an output control statement for every key that is generated as a result of an input control statement with the TRANSKEY keyword specified. The output control statement contains the complement key type of the key type that is specified on the input control statement. The value that is output for the KEY keyword is encrypted under the transport key that is specified on the input control statement.

You can edit the output control statements and distribute them to the appropriate sites for input to KGUP at those locations.

The data set is a physical sequential data set with a fixed logical record length (LRECL) of 80 bytes.

One output control statement appears when you have KGUP generate a key value and create an operational and exportable key pair using a transport key.

Two output control statements appear when you have KGUP generate two exportable keys by using two different transport keys. These statements generate complementary keys types. You can send each statement to a different site to establish communication between the two sites.

In the KGUP job stream, the data set is defined by the CSFSTMNT data definition statement. The data set will contain information only when the input control statement contains the TRANSKEY keyword. The TRANSKEY keyword indicates that you will be transporting the key to another system.

The specific name of these types of data sets must appear in the job stream that runs KGUP.

Submitting a job stream for KGUP

The key generator utility program (KGUP) is an APF-authorized program that runs as a batch job. It requires certain JCL statements to run. Submit the JCL to run KGUP when you create the KGUP control statements and data sets.

The JCL to run KGUP should be in this format:

```
//KGUPPROC EXEC PGM=CSFKGUP,PARM=('SSM')
//CSFCKDS  DD   DSN=PROD.CKDS,DISP=OLD
//CSFIN    DD   DSN=PROD.KGUPIN.GLOBAL,DISP=OLD
//CSFDIAG  DD   DSN=PROD.DIAG.GLOBAL,DISP=OLD
//CSFKEYS  DD   DSN=PROD.KEYS.GLOBAL,DISP=OLD
//CSFSTMNT DD   DSN=PROD.STMT.GLOBAL,DISP=OLD
//
```

Figure 132. KGUP Job Stream

The EXEC statement specifies the load module name for KGUP. The PARM keyword on the EXEC statement passes information to KGUP. The keyword specifies either:

- NOSSM to indicate that special secure mode must be disabled
- SSM to indicate that special secure mode must be enabled

You must pass the SSM parameter if any KGUP control statements for the KGUP run contain the CLEAR keyword. NOSSM is the default.

If special secure mode is not enabled and you pass the SSM parameter to KGUP, the program ends immediately without processing any KGUP control statements. If you pass the NOSSM parameter and KGUP encounters a control statement with the CLEAR keyword, the job ends immediately.

In the JCL example, the PARM keyword specifies SSM to indicate that special secure mode should be enabled. You specify SSM if any control statement in the control statement input data set, PROD.KGUPIN.GLOBAL, contains the CLEAR keyword.

In the JCL, the data definition (DD) statements name the data sets necessary to input information to KGUP and output information from the program. See “Specifying KGUP data sets” on page 242 for a detailed description of these data sets.

Attention: If a KGUP job ends prematurely, results of the job are unpredictable. You should not read that cryptographic key data set into storage for use.

For a description of the KGUP return codes, see the explanation of message CSFG0002, which is in *z/OS Cryptographic Services ICSF Messages*.

Enabling Special Secure Mode

When you pass the SSM parameter to KGUP in a JCL statement, you need to enable special secure mode processing. You must specify SSM(YES) in the installation options data set.

For CCF Systems, if you use logical partition (LPAR) mode, you also need to enable special secure mode on the Change LPAR Crypto panel from the Hardware Master Console of the server support element. If you have the optional TKE workstation, you can use it to enable and disable special secure mode.

Running KGUP Using the MVS/ESA Batch Local Shared Resource (LSR) Facility

The MVS/ESA batch LSR subsystem improves performance for random access file processing by reducing the number of inputs and outputs to VSAM data sets. Batch LSR allows a program to use local shared resources rather than non-shared resources. For information about the batch LSR subsystem, see *MVS Batch Local Shared Resources* .

VSAM provides a deferred write option on VSAM ACB processing when a program uses shared resources. For more information about VSAM processing, see *MVS/DFP Managing VSAM Data Sets* and the *MVS/ESA Data Administration: Macro Instruction Reference* .

By using the batch LSR subsystem and the VSAM deferred write option together, you may improve KGUP performance when adding many keys, for example 10,000 keys, to the CKDS. If your installation has batch LSR and VSAM deferred write, you may improve performance when adding a large number of keys by using different JCL in the KGUP job stream.

Instead of using this CSFCKDS DD statement:

```
//CSFCKDS DD DSN=cryptographic-key-data-set-name,DISP=OLD
```

Use these statements:

```
//CSFALT  DD DSN=cryptographic-key-data-set-name,DISP=OLD
//CSFCKDS DD SUBSYS=(BLSR,'DDNAME=CSFALT',
//           'DEFERW=YES')
```

You should specify a large amount of storage for the REGION parameter (for example, REGION=32M) on the JOB or EXEC JCL statement. The rest of the JCL statements to run the KGUP job should be in the format that is shown in Figure 132 on page 247.

Reducing Control Area Splits and Control Interval Splits from a KGUP Run

KGUP processes keys on a disk copy of a CKDS which is a VSAM data set. KGUP uses key-direct update processing to process the keys. To access keys, VSAM uses the key's label as the VSAM key. This means that keys are added to the data set in collating sequence. That is, if two keys named A and B are in the data set, A appears earlier in the data set than B. As a result, adding keys to the data set can cause multiple VSAM control interval splits and control area splits. For example, a split might occur if the data set contains keys A, B, E and you add C (C must be placed between B and E). These splits can leave considerable free space in the data set.

The amount of control area splits and control interval splits in the CKDS affects performance. You may want to periodically use the TSO LISTCAT command to list information about the number of control area splits and control interval splits in a CKDS.

You can help reduce the frequency of control interval and control area splits by ensuring that key generator utility control statements are always in the correct collating sequence, A-Z, 0-9, if possible. When adding keys to a new CKDS, add the key entries in sequential order. Also, when adding new entries to the CKDS, you can reorganize the data set to reduce control area splits and control interval splits. To do this, copy the disk copy of the CKDS into another disk copy using the AMS REPRO command or AMS EXPORT/IMPORT commands. You may want to reorganize the data set after every KGUP run.

Note: If it is practical, you may want to perform this procedure to reduce control area splits. If you are inserting a large number of keys in the middle of a CKDS, you may want to remove and save all the keys after the place in the data set where you are inserting the keys. In this way, you are adding the keys to the end rather than the middle of the data set. When you finish adding the keys, place the keys that you removed back in the data set.

For a detailed explanation of keyed-direct update processing and a description of what happens when control area and control interval splits occur, refer to *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394.

Refreshing the In-Storage CKDS

ICSF functions access an in-storage copy of the CKDS when the functions reference keys by label. However when you use KGUP, the program makes changes to a disk copy of the CKDS. This situation allows you to maintain the keys in the data set without disturbing current cryptographic operations.

When you update the disk copy, you can use the Refresh option on the Key Administration panel to replace the in-storage copy with the disk copy. For a description of this panel path, see “Steps for refreshing the active CKDS using the ICSF panels” on page 274. Besides using the panels to refresh the in-storage CKDS, you can invoke a utility program to perform the task. Refer to “Refreshing the in-storage CKDS using a utility program” on page 361 for details.

If you are running in a sysplex environment and ICSF instances are sharing a CKDS, you should perform a coordinated CKDS refresh operation . Refer to “Performing a coordinated CKDS refresh” on page 198.

Using KGUP Panels

The key generator utility program (KGUP) panels help you run KGUP by providing panels to do these tasks:

- Create KGUP control statements (except OPKYLOAD).
- Specify the data sets for KGUP processing.
- Invoke KGUP by submitting job control language (JCL) statements.
- Replace the in-storage copy of the cryptographic key data set (CKDS) with the disk copy that KGUP processing changed.

Using the panels, you can perform the tasks to use KGUP to generate or receive keys for PIN and key distribution and to maintain the CKDS.

To access the KGUP panels, select option 8, KGUP, on the Primary Menu panel as shown in Figure 133.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 8

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions
```

Figure 133. Selecting the KGUP Option on the Primary Menu Panel

The Key Administration panel appears. See Figure 134 on page 251.

```
CSFSAM00 ----------------- ICSF - Key Administration ---------------
OPTION ===>


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Dataset        - Specify datasets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key dataset


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 134. Key Administration Panel

This panel allows you to access panels to perform the tasks to run KGUP. These topics describe the KGUP tasks.

Steps for creating KGUP control statements using the ICSF panels

You create the control statements to specify the functions you want KGUP to perform. When you create the control statements, ICSF stores the statements in the control statement input data set.

When you create the control statements, do one of these procedures:

- Process the control statements by running KGUP.
- Do not process the control statements and just save the statements in the data set. Then at another time you can access the data set to add more control statements and submit the data set for KGUP processing.

To create the KGUP control statements:

1. Select option 1, Create, on the Key Administration panel, as shown in Figure 135, and press ENTER.

```
CSFSAM00 ----------------- ICSF - Key Administration ---------------
OPTION ===> 1


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Dataset        - Specify datasets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key dataset
```

Figure 135. Selecting the Create Option on the Key Administration Panel

   The KGUP Control Statement Data Set Specification panel appears. See Figure 136 on page 252.

```
CSFSAE10 - ICSF - KGUP Control Statement Data Set Specification ----
COMMAND ===>

Enter control statement input data set (DDNAME = CSFIN)

   Data Set Name ===> _____________________________________________________
   Volume Serial ===> ______  (if uncataloged)


   Press ENTER to open or create and open specified data set
   Press END   to exit to the previous panel
```

Figure 136. KGUP Control Statement Data Set Specification Panel

2. Enter the name of the data set that you want to contain the control statements for KGUP processing.
   a. For partitioned data sets, specify a member name as part of the data set name.
   b. If the data set is not cataloged, you must also specify the volume serial for the data set in the Volume Serial field. This volume serial allows ICSF to access the correct volume when ICSF opens the data set.

   Note: If you specify NOPREFIX in your TSO profile, so data sets are not automatically prefixed with your userid, you must specify the fully qualified data set name within apostrophes. If you specify PREFIX without a valid prefix, your TSO userid becomes the prefix.

   Depending on your requirements, there are several options to choose from when entering the data set name. Refer to Table 16 for a list of these options and the steps to follow for each.

Table 16. Data Set Name Options

Option	Steps
To have KGUP append the control statements to an existing data set when you know the data set name and the member name	1. Specify the data set name and member name of the existing data set and press ENTER. The KGUP Control Statement Menu appears. See Figure 140 on page 255. The new control statements will be appended when any existing control statements in the data set.

Table 16. Data Set Name Options (continued)

Option	Steps
To have KGUP append the control statements to an existing data set when you know the data set name but not the member name	1. Specify the data set name of the existing data set and press ENTER. If the partitioned data set is not empty, the Member Selection List appears. See Figure 138 on page 254. 2. On the Member Selection List panel: • To select a member that already exists, place an `s` to the left of the member name in the list and press ENTER. For example, in Figure 138 on page 254 SHIFT2 is selected so the data set LARSON.CSFIN.TESTDS1P(SHIFT2) becomes the input control statement data set. • To locate a member on the selection list, type an `l` (the lowercase letter L) and the member name on the command line and press ENTER. The list moves so the member appears on the top line of the list and the cursor appears to the left of the member. • To create a new member, type `s` and the new member name on the command line and press ENTER. The KGUP Control Statement Menu appears. See Figure 140 on page 255. The new control statements will be appended when any existing control statements in the data set.
To have KGUP create a new data set	1. Specify a name for the new data set and press ENTER. The Allocation panel appears. See Figure 139 on page 254. 2. Enter the necessary information to allocate a new data set and press ENTER. The KGUP Control Statement Menu appears. See Figure 140 on page 255. The new control statements will be stored in the new data set.

Figure 137 shows an example of the KGUP Control Statement Data Set Specification panel with the partitioned data set CSFIN.TESTDS1P and a member name of TEST1.

```
CSFSAE10 - ICSF - KGUP Control Statement Data Set Specification ----
COMMAND ===>

Enter control statement input data set (DDNAME = CSFIN)

   Data Set Name ===> CSFIN.TESTDS1P(test1)_____________________________
   Volume Serial ===> ______  (if uncataloged)


   Press ENTER to open or create and open specified data set
   Press END   to exit to the previous panel
```

Figure 137. Entering a Data Set Name on the KGUP Control Statement Data Set Specification Panel

If the member TEST1 did not previously exist, ICSF creates the member. If the member already exists, ICSF appends the control statements to the end of the data set. <Prefix>.CSFIN.TESTDS1P(test1) becomes the control statement input data set.

If you specify CSFIN.TESTDS1P without the member name, the Member Selection List panel appears. See Figure 138.

```
CSFSAE12 --------- ICSF - Member Selection List --------- ROW 1 To 6 OF 6
COMMAND ===>                                                SCROLL ===> PAGE

Data Set:  LARSON.CSFIN.TESTDS1P
Select one member name only
    NAME          CREATED     CHANGED       SIZE   INIT    MOD    USERID
   PINEX1        95/08/04 96/08/05 10:44      26     24      1   LARSON
   PINEX2        95/08/04 96/07/04 11:23      14     14      0   LARSON
   KEYEX1        95/08/04 96/08/05 12:44       6      6      1   LARSON
s  SHIFT2        95/08/04 96/08/12 10:55     195    137      2   LARSON
   SHIFT3        95/08/04 96/08/05 12:44      48      4      1   LARSON
   TEST1         95/08/04 96/08/05 11:44       4      4      1   LARSON
****************************** BOTTOM OF DATA ********************************
```

Figure 138. Member Selection List Panel

If you specify a new data set name, the Allocation panel appears. See Figure 139.

```
CSFSAE11 --------------- ICSF - Allocation -------------------------
COMMAND ===> _

DATA SET NAME: LARSON.CSFIN.TESTDS1P
  Data set cannot be found.  Specify allocation parameters below.

   VOLUME SERIAL      ===> ______       (Blank for authorized default volume) *
   GENERIC UNIT       ===> ________     (Generic group name or unit address) *
   SPACE UNITS        ===> BLOCK_____   (BLKS, TRKS, or CYLS)
   PRIMARY QUANTITY   ===> 10____       (In above units)
   SECONDARY QUANTITY ===> 5_____       (In above units)
   DIRECTORY BLOCKS   ===> 10____       (Zero for sequential data set)
   RECORD FORMAT      ===> FB
   RECORD LENGTH      ===> 80
   BLOCK SIZE         ===> 6400__       (In multiples of record length)
   EXPIRATION DATE    ===> _____        (Format is YYDDD)

   ( * Only one of these fields may be specified)



   Press ENTER to allocate specified data set and continue
   Press END   to exit to the previous panel without allocating
```

Figure 139. Entering Data Set Information on the Allocation Panel

Once the data set has been selected or created, the data set becomes the control statement input data set on the KGUP Control Statement Menu, as shown in Figure 140 on page 255. The name of the control statement input data set you specified appears at the top of the panel.

From this panel, you can press END to go back to the KGUP Control Statement Data Set Specification panel. On the later panel you can either specify another data set to store control statements, or press END again to return to the Key Administration panel.

```
CSFCSM00 ----------- ICSF - KGUP Control Statement Menu ------------
OPTION ===> _

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 140. KGUP Control Statement Menu Panel

3. Choose the type of control statement you want to create and press ENTER.
   - To create an ADD, UPDATE, or DELETE control statement, select option 1. For information, see "Steps for creating ADD, UPDATE, or DELETE control statements."
   - To create a RENAME control statement, select option 2. For information, see "Steps for creating a RENAME control statement" on page 262.
   - To create a SET control statement, select option 3. For information, see "Steps for creating a SET control statement" on page 264.
   - To edit the input control statement data set, select option 4. For information, see "Steps for editing control statements" on page 266.

   When you choose the Maintain, Rename, or Set option, you access the panels to create the control statement you want. When you create a control statement, the statement is placed in the specified control statement input data set. To edit the control statements that are stored in this data set, choose the Edit option.

Steps for creating ADD, UPDATE, or DELETE control statements

When you select Maintain (option 1) on the KGUP Control Statement Menu panel, the Create ADD, UPDATE, or DELETE Key Statement panel appears. See Figure 141 on page 256.

```
CSFCSE10----- ICSF - Create ADD, UPDATE, or DELETE Key Statement ------------
Specify control statement information below

   Function ===> ______      ADD, UPDATE, or DELETE
   Algorithm ===> DES   DES or AES
   Key Type ===> ________    Outtype ===> ________    (Optional)
   Label ===> ____________________________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________
   End   ===> ____________________________________________________________

    Transport Key Label(s)
         ===> ____________________________________________________________
         ===> ____________________________________________________________
 or Clear Key               ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES
   Length of Key  ===> ___  8, 16 or 24      For AES:  16, 24, or 32
   Key Values     ===>
     ________________ ,________________ ,________________,________________
   Comment Line   ===> ____________________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 141. Create ADD, UPDATE, or DELETE Key Statement Panel

1. On the panel, fill out the fields to create the ADD, UPDATE, or DELETE control statement that you want KGUP to process. Each field on the panel corresponds to a control statement keyword. The panel helps you to create a complete, syntactically correct ADD, UPDATE, or DELETE control statement.

   The panel creates control statements according to the syntax described in "Syntax of the ADD and UPDATE Control Statements" on page 221. See that topic for more information about the control statement keywords.
2. In the Function field, select the function you want KGUP to perform.

Function	Result
ADD	Enter new key entries in the CKDS. Generate and receive key values for key distribution.
UPDATE	Change existing entries in the CKDS. Generate and receive key values for key distribution.
DELETE	Remove entries from the CKDS.

   You can just type the first letter of the function in the first position in a field on the panel. For example, in Figure 142 on page 257, `a` was entered in the Function field to specify the ADD function. ICSF recognizes the abbreviation.

   For a description of the keywords you must specify for each function, see "Using the ADD and UPDATE control statements for key management and distribution functions" on page 227.

```
-------------- ICSF - Create ADD, UPDATE, or DELETE Key Statement ------------
Specify control statement information below

   Function ===> add___      ADD, UPDATE, or DELETE
   Algorithm ===> DES   DES or AES
   Key Type ===> ________    Outtype ===> ________    (Optional)
   Label ===> ____________________________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________
   End   ===> ____________________________________________________________

    Transport Key Label(s)
         ===> ____________________________________________________________
         ===> ____________________________________________________________
 or Clear Key               ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES
   Length of Key  ===> _________________      For AES:  16, 24, or 32
   Key Values     ===>
     ________________ ,________________ ,________________,________________
   Comment Line   ===> ____________________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 142. Selecting the ADD Function on the Create ADD, UPDATE, or DELETE Key Statement Panel

3. In the Key Type field, enter the type of key you want KGUP to process with the control statement. This field represents the TYPE keyword on the control statement.

   If you leave the Key Type Field blank and press ENTER, the Key Type Selection panel appears. See Figure 143 on page 258.

```
CSFCSE12-------- ICSF - Key Type Selection Panel ----  ROW 1 TO 13 OF 11
COMMAND ===>                                                SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION

   CLRAES     Clear AES Encryption/decryption key
   CLRDES     Clear Encryption/decryption key
   DATA       Encryption/decryption key
   DATAM      Double-length MAC generation key
   DATAMV     Double-length MAC verification key
   DATAXLAT   Data-translation key
s  EXPORTER   Export key-encrypting key
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
   MAC        Message authentication key
   MACVER     Message verification key
   NULL       Dummy CKDS records
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
*******************************BOTTOM OF DATA********************************
```

Figure 143. Selecting a Key on the Key Type Selection Panel

a. Type s to the left of the key type you want to specify from the displayed list of key types.

   In Figure 143, the exporter key is selected.

b. When you have specified a key type, press ENTER to return to the Create ADD, UPDATE, or DELETE Key Statement panel, as shown in Figure 144 on page 259.

```
-------------- ICSF - Create ADD, UPDATE, or DELETE Key Statement ------------
Specify control statement information below

   Function ===> ADD___      ADD, UPDATE, or DELETE
   Algorithm ===> DES   DES or AES
   Key Type ===> EXPORTER    Outtype ===> ________    (Optional)
   Label ===> ATMBRANCH5M0001_____________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________
   End   ===> ____________________________________________________________

    Transport Key Label(s)
         ===> tkatmbranch5m0001____________________________________________
         ===> ____________________________________________________________
 or Clear Key               ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES
   Length of Key  ===> 16_  8, 16 or 24      For AES: ____________________
   Key Values     ===>
     _______________ ,_______________ ,_______________,_____________________
   Comment Line   ===> export test key ____________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 144. Completing the Create ADD, UPDATE, or DELETE Key Statement Panel

If you abbreviated the control statement function, the function now appears in its full form. The type of key you selected on the Key Type Selection panel appears in the Key Type field.

4. Specify either a label or range to identify the label of the key entry in the CKDS that you want KGUP to process.

   The Label field represents the LABEL keyword on the control statement. The Range field represents the RANGE keyword on the control statement. In the Range fields, specify the first and last label in a range of labels you want KGUP to process.

Table 17. Selecting Range and Label Options

Option	Steps
To have KGUP process only one key label	1. Specify the key label in the Label field. 2. Type `NO` in the Group Labels field.
To have KGUP process more than one key label	1. Specify the first label in the Label field. 2. Type `YES` in the Group Labels field.

5. Specify either a transport key label or `YES` in the Clear Key field.

   The Transport Key Label field represents the TRANSKEY keyword on the control statement. The Clear Key field represents the CLEAR keyword. These keywords are mutually exclusive.

   When KGUP generates a key, the program places the key value in a data set so you can send the value to another system. The other system uses the value to create the complement of the key. You send the key value as either a clear key value or a key value encrypted under a transport key.

   When KGUP imports a key value, the program may import a clear or encrypted key value. KGUP decrypts the encrypted key value from under the transport key that you specify in the Transport Key Label field.

Table 18. Selecting the Transport Key Label and Clear Key Label Options

Option	Steps
To have KGUP generate a key other than an importer key and encrypt the key value	1. Specify the label of the transport key you want KGUP to use to encrypt the key in the Transport Key Label field. 2. Type NO in the Clear Key field.
To have KGUP generate a key other than an importer key and leave the key value in the clear	1. Leave the Transport Key Label field blank 2. Type YES in the Clear Key field.
To have KGUP import an encrypted key	1. Specify the label of the transport key you want KGUP to use to dencrypt the key in the Transport Key Label field. 2. Type NO in the Clear Key field.
To have KGUP import a clear key	1. Leave the Transport Key Label field blank 2. Type YES in the Clear Key field.

6. Specify either YES or NO in the Control Vector field.

   Usually the cryptographic facility exclusive ORs a transport key with a control vector prior to the transport key encrypting a key. However, if your system is exchanging keys with a system like PCF that does not use control vectors, you need to specify that no control vector be used. If you want KGUP to generate a transport key that uses a control vector, type YES in the Control Vectors field. Otherwise type NO. If you type NO in this field, the control statement contains the NOCV keyword.
7. If you want KGUP to work with a single-length key in its processing, type YES in the Length of Key field. Otherwise, type NO. If you type YES in the field, the control statement contains the LENGTH keyword.
8. If you are entering a key value, enter the key value in the Key Values field.

   You enter the value as three values if the key is a triple-length key, two values if the key is a double-length key, or as one value if the key is a single-length key. The Key Values field represents the KEY keyword on the control statement.
9. In the Comment Line field, you can enter up to 45 characters of information about the control statement. The information appears as a comment that precedes the control statement in the input control statement data set.
10. When you enter all the information on this panel, press ENTER.

    If you entered YES in the Group Labels field, the Group Label panel appears. See Figure 145 on page 261.

```
CSFCSE11 ----------------- ICSF - Group Label Panel ------------------
COMMAND ===>

First label:

  ATMBRANCH5M0001_____________________________________________________

Enter at least one other label:

  ATMBRANCH5M0020_____________________________________________________
  ATMBRANCH5M0030_____________________________________________________
  ATMBRANCH5M0050_____________________________________________________
  _____________________________________________________________________
  _____________________________________________________________________
  _____________________________________________________________________
  _____________________________________________________________________
  _____________________________________________________________________
  _____________________________________________________________________



Press ENTER to add more labels or create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 145. Specifying Multiple Key Labels on the Group Label Panel

a. Enter any additional key labels you want KGUP to process with the control statement.

   The first label you entered in the Label field of the Create ADD, UPDATE, or DELETE Key Statement panel appears at the top of this panel. If you enter duplicate labels, an error message appears on the right side of the panel and the cursor appears on the duplicate label. If the syntax of the label is incorrect, an error message appears and the cursor appears on the incorrect label.

b. If you have more labels than will fit on this panel, press the ENTER key when you have filled each line on the panel. An additional Group Label Panel appears. Type the remaining labels and press ENTER.

   ICSF writes the control statement to the input control statement data set. You return to the Create ADD, UPDATE, or DELETE Key Statement panel.

If you entered `NO` in the Group Labels field, you do not access the Group Label panel. You remain on the Create ADD, UPDATE, or DELETE Key Statement panel.

11. Press ENTER to have ICSF write the control statement in the input control statement data set.

    If a specification in any field is incorrect, when ICSF processes the control statement it displays an appropriate message on the top line of the panel. The cursor then appears in the field with the error. To display the long version of the error message at the bottom of the panel, press the HELP key (F1). If you correct the error and press ENTER again, ICSF writes the control statement to the control statement input data set.

    If a control statement was created, the message `SUCCESSFUL UPDATE` appears on the right side of the top line of the panel, as shown in Figure 146 on page 262.

```
-------------- ICSF - Create ADD, UPDATE, or DELETE Key Statement ------------
Specify control statement information below

   Function ===> ADD___      ADD, UPDATE, or DELETE
   Algorithm ===> DES   DES or AES
   Key Type ===> EXPORTER    Outtype ===> ________    (Optional)
   Label ===> ATMBRANCH5M0001_____________________________________________
    Group Labels  ===> NO_   NO or YES
 or Range:
   Start ===> ____________________________________________________________
   End   ===> ____________________________________________________________

    Transport Key Label(s)
         ===> TKATMBRANCH5M0001____________________________________________
         ===> ____________________________________________________________
 or Clear Key               ===> NO_        NO or YES

   Control Vector ===> YES  NO or YES
   Length of Key  ===> 16 8, 16 or 24      For AES:  ____________________
   Key Values     ===>
     _______________ ,_______________ ,_______________,_____________________
   Comment Line   ===> EXPORT TEST KEY_____________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 146. Create ADD, UPDATE, or DELETE Key Statement Panel Showing Successful Update

12. If you want to create another ADD, UPDATE, or DELETE control statement, enter new information in the fields to create the control statement.
13. When you specify the information, press ENTER to place the control statement in the control statement input data set.
14. If you do not want to create another ADD, UPDATE, or DELETE control statement, press END to return to the KGUP Control Statement Menu panel.

Steps for creating a RENAME control statement

The Create RENAME Control Statement panel appears. The RENAME control statement changes the label of a key entry in a CKDS. To create a RENAME control statement:

1. Choose option 2 on the KGUP Control Statement Menu, as shown in Figure 147.

```
CSFCSM00 ----------- ICSF - KGUP Control Statement Menu ------------
OPTION ===> 2

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set
```

Figure 147. Selecting the Rename Option on the KGUP Control Statement Menu Panel

2. See Figure 148. If you leave this field blank, the On this panel, you enter information in the fields to create a RENAME control statement. This panel creates a RENAME control statement according to the syntax described in “Syntax of the RENAME Control Statement” on page 233. See that topic for more information about the RENAME control statement keywords.

```
CSFCSE20 --------- ICSF - Create RENAME Control Statement ----------
COMMAND ===>

Enter the following information:

   Existing Key Label
     _____________________________________________________________

   New Key Label
     _____________________________________________________________

   Key Type           ===> ________         Selection panel displayed if blank

   Comment Line       ===> ________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel
```

Figure 148. Create RENAME Control Statement Panel

3. In the Existing Key Label field, specify the current label on the CKDS that you want KGUP to change.
4. In the New Key Label field, specify the new label that you want to replace the existing label.
5. In the Key Type field, specify the key type of the key entry whose label you want changed. Key Type Selection panel appears. See Figure 149.

```
CSFCSE12--------- ICSF - Key Type Selection Panel ----- ROW 1 To 13 OF 11
COMMAND ===>                                            SCROLL ===> PAGE

Select one key type only
    KEY TYPE      DESCRIPTION

   CLRAES     Clear AES Encryption/decryption key
   CLRDES     Clear Encryption/decryption key
   DATA       Encryption/decryption key
   DATAM      Double-length MAC generation key
   DATAMV     Double-length MAC verification key
   DATAXLAT   Data-translation key
s  EXPORTER   Export key-encrypting key
   IMPORTER   Import key-encrypting key
   IPINENC    Input PIN-encrypting key
   MAC        Message authentication key
   MACVER     Message verification key
   NULL       Dummy CKDS records
   OPINENC    Output PIN-encrypting key
   PINGEN     PIN generation key
   PINVER     PIN verification key
*******************************BOTTOM OF DATA********************************
```

Figure 149. Selecting a Key Type on the Key Type Selection Panel

   a. Type `s` to the left of the key type you want to specify.
      In Figure 149, the exporter key is selected.

b. Press ENTER to return to the Create RENAME Control Statement panel.

   The RENAME control statement The key type you choose on the Key Type Selection panel appears in the key type field.

An example of a Create RENAME Control Statement panel which creates a control statement to change the key label JWL@SSIDEC95 to JWL@SSIJUNE96 for an exporter key is shown in Figure 150.

```
CSFCSE20 --------- ICSF - Create RENAME Control Statement ----------
COMMAND ===>

Enter the following information:

   Existing Key Label
     JWL@SSIDEC95_____________________________________________________

   New Key Label
     JWL@SSIJUNE96____________________________________________________

   Key Type           ===> ex______         Selection panel displayed if blank

   Comment Line       ===> export test key renamed_____________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel
```

Figure 150. Completing the Create RENAME Control Statement Panel

6. In the Comment Line field, you can enter up to 45 characters of information about the control statement.

   The information appears as a comment that precedes the control statement in the input control statement data set.
7. When you enter all the information on the Create RENAME Control Statement panel, press ENTER.

   ICSF writes the control statement in the input control statement data set.

   If a specification in any field is incorrect, when ICSF processes the control statement it displays an appropriate message on the top line of the panel. The cursor then appears in the field with the error. To display the long version of the error message at the bottom of the panel, press the HELP key (F1). You can correct the error and press ENTER again so ICSF can write the control statement to the control statement input data set.

   The Create SET Control Statement panel appears. If a control statement was created, the message `SUCCESSFUL UPDATE` appears on the right side of the top line of the panel.
8. To create another RENAME control statement, enter new information in the fields to create the control statement.
9. When you specify the information, press ENTER to place the control statement in the control statement input data set.
10. When you have finished creating RENAME control statements, press END to return to the KGUP Control Statement Menu panel.

Steps for creating a SET control statement

The SET control statement specifies data for KGUP to send to a KGUP exit routine. To create a SET control statement:

1. Choose option 3 on the KGUP Control Statement Menu, as shown in Figure 151.

```
CSFCSM00 ----------- ICSF - KGUP Control Statement Menu ------------
OPTION ===> 3

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set
```

Figure 151. Selecting the Set Option on the KGUP Control Statement Menu Panel

2. See Figure 152. From this panel you can creates a SET control statement. For information about the SET control statement keywords, refer to “Syntax of the SET Control Statement” on page 234.

```
CSFCSE30 ----------- ICSF - Create SET Control Statement -----------
COMMAND ===>

Specify installation data for exit processing

  Installation Data ===> ________________________________________________

  Comment Line      ===> _____________________________________________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 152. Create SET Control Statement Panel

3. In the Installation Data field, enter the data to pass to a KGUP installation exit.
4. In the Comment Line field, you can enter up to 45 characters of information about the control statement.

   The information appears as a comment that precedes the control statement in the input control statement data set.

   An example of a Create SET Control Statement panel which passes date information to the installation exit is shown in Figure 153 on page 266.

```
CSFCSE30 ----------- ICSF - Create SET Control Statement -----------
COMMAND ===>

Specify installation data for exit processing

  Installation Data ===> BRANCH0519921101199301310_____________________________

  Comment Line      ===> Branch 5 POS terminal date information_________

Press ENTER to create and store control statement
Press END   to exit to the previous panel without saving
```

Figure 153. Completing the Create SET Control Statement Panel

5. When you enter all the information on this panel, press ENTER.

   ICSF writes the control statement in the input control statement data set.

   When the control statement is created, the message SUCCESSFUL UPDATE appears on the right side of the top line of the panel.
6. Press END to return to the KGUP Control Statement Menu panel.

Steps for editing control statements

You can edit the control statement input data set that you specified for this KGUP job. The control statement input data set contains the control statements you created when you specified the control statement input data set.

To edit the control statements you created:

1. Choose option 4 on the KGUP Control Statement Menu panel, as shown in Figure 154.

```
CSFCSM00 ----------- ICSF - KGUP Control Statement Menu ------------
OPTION ===> 4

  Storage data set for control statements   (DDNAME = CSFIN)

  Data Set Name: LARSON.CSFIN.TESTDS1P(TEST2)


   Enter the number of the desired option above.

   1  Maintain       - Create ADD, UPDATE, or DELETE control statements
   2  Rename         - Create statement to RENAME entry label
   3  Set            - Create a statement to SET installation data
   4  Edit           - Edit the statement storage data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 154. Selecting the Edit Option on the KGUP Control Statement Menu Panel

The ISPF editor displays the control statement input data set. An example of a data set called LARSON.CSFIN.TESTDS1P(TEST2) with a SET, ADD, and RENAME control statement is shown in Figure 155 on page 267.

```
ISREDDE - LARSON.CSFIN.TESTDS1P(TEST2) - 00.00 -------------- COLUMNS 001 072
COMMAND ===> _                                                SCROLL ===> CSR
****** **************************** TOP OF DATA ******************************
000001 /* TEST INSTALLATION DATA                          */
000002 SET INSTDATA('This is test installation data')
000003 /* EXPORT TEST KEY                                 */
000004 ADD TYPE(EXPORTER),
000005        TRANSKEY(SENDTOBRANCH5JUNE99)
000006        LABEL(ATMBRANCH5M0001)
000007 /* EXPORT TEST KEY RENAMED                         */
000008 RENAME LABEL(JWL@SSIDEC97,JWL@SSIJUNE99) TYPE(EXPORTER)
****** ***************************** BOTTOM OF DATA ****************************
```

Figure 155. Edit Control Statement Initial Display Panel

2. You can change any information on the control statements in the data set. You can also add lines to the data set that contains comments or control statements.
3. To specify many similar control statements, copy lines in this file and edit them to create additional control statements.

   Note: The panel does not check whether the control statements that you change are syntactically correct.

   Figure 156 shows the insertion of a comment line in the file.

```
ISREDDE - LARSON.CSFIN.TESTDS1P(TEST2) - 00.00 -------------- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> CSR
****** **************************** TOP OF DATA ******************************
'' /* This comment was inserted using the editor */_
000001 /* TEST INSTALLATION DATA                          */
000002 SET INSTDATA('This is test installation data')
000003 /* EXPORT TEST KEY                                 */
000004 ADD TYPE(EXPORTER),
000005        TRANSKEY(SENDTOBRANCH5JUNE99)
000006        LABEL(ATMBRANCH5M0001)
000007 /* EXPORT TEST KEY RENAMED                         */
000008 RENAME LABEL(JWL@SSIDEC97,JWL@SSIJUNE99) TYPE(EXPORTER)
****** ***************************** BOTTOM OF DATA ****************************
```

Figure 156. Edit Control Statement Data Set with Insert

4. When you make any changes, press END to save the changes and return to the KGUP Control Statement Menu panel.

Steps for specifying data sets using the ICSF panels

When you run a KGUP job, you must specify the KGUP data sets for the program to use in its processing.

1. To access the panels to specify KGUP data sets, select option 2 on the Key Administration panel, as shown in Figure 157 on page 268, and press ENTER.

```
CSFSAM00 ----------------- ICSF - Key Administration ---------------
OPTION ===> 2


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Data Set       - Specify data sets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 157. Selecting the Specify Data Set Option on the Key Administration Panel

The Specify KGUP Data Sets panel appears. See Figure 158.

```
CSFSAE20 ---------------- ICSF - Specify KGUP Data Sets ------------
COMMAND ===> _

Enter data set names for all cryptographic files.
 Cryptographic Key         (DDNAME = CSFCKDS)
   Data Set Name ===> _____________________________________________

 Control Statement Input   (DDNAME = CSFIN)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Diagnostics               (DDNAME = CSFDIAG)  (use * for printer)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Key Output                (DDNAME = CSFKEYS)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Control Statement Output  (DDNAME = CSFSTMNT)
   Data Set Name ===> _____________________________________________
   Volume Serial ===> ______  (if uncataloged)

Press ENTER to set the data set names. Press END to exit to the previous panel.
```

Figure 158. Specify KGUP Data Sets Panel

This panel contains all the data sets that KGUP uses for input or output during processing. In the Data Set Name field under each type of data set, you specify the name of the data set for KGUP to use.

2. In the Cryptographic Key Data Set Name field, specify the name of the CKDS which contains the key entries that KGUP processes.

   You must initialize the CKDS by using the method that is described in “Initializing the CKDS and PKDS at First-Time Startup” on page 117. The data set can be any disk copy of a CKDS that is enciphered under the current master key.

3. In the Control Statement Input Data Set Name field, specify the name of the data set that contains the control statements you want KGUP to process for this job.
4. In the Volume Serial field, enter the volume serial for the data set if it is not cataloged.

   If you specified a control statement input data set on the KGUP Control Statement Data Set Specification panel, the data set name appears in the Control Statement Input Data Set Name field on this panel. If you change the data set name on this panel, it automatically changes on the KGUP Control Statement Data Set Specification panel. Refer to Figure 136 on page 252 for an example of the KGUP Control Statement Data Set Specification panel.
5. In the Diagnostics Data Set Name field, specify the name of the data set where KGUP places the image of the control statements and any diagnostic KGUP generates.

   You do not have to allocate this data set when you specify the data set in this field. If the data set does not already exist, then a job control language statement that allocates the data set can be used when you submit the job.
6. In the Volume Serial field, enter the volume serial for the data set if the data set already exists but is not cataloged.

   If you enter an * in the Diagnostics Data Set Name field, the information is printed directly to a printer instead of a data set.
7. In the Key Output Data Set Name field, specify the name of the data set that contains key values that are generated to use to create complementary key values.

   You do not have to allocate this data set when you specify the data set in this field. If the data set does not already exist, then a job control language statement that allocates the data set can be used when you submit the job.
8. In the Volume Serial field, enter the volume serial for the data set if the data set already exists but is not cataloged.
9. In the Control Statement Output Data Set Name field, specify the name of the data set that contains control statements generated to use to create complementary key values.

   You do not have to allocate this data set when you specify the data set in this field. If the data set does not already exist, then a job control language statement that allocates the data set can be used when you submit the job.
10. In the Volume Serial field, enter the volume serial for the data set if the data set already exists but is not cataloged.

    For a more complete description of each of the data sets, see “Specifying KGUP data sets” on page 242.

    The data sets that you name appear on this panel the next time you access it.

    An example of a Specify KGUP Data Sets panel with the names of data sets specified for KGUP processing is shown in Figure 159 on page 270.

```
CSFSAE20 ---------------- ICSF - Specify KGUP Data Sets ------------
COMMAND ===> _

Enter data set names for all cryptographic files.
 Cryptographic Key         (DDNAME = CSFCKDS)
   Data Set Name ===> TEST.CSFCKDS_____________________________

 Control Statement Input   (DDNAME = CSFIN)
   Data Set Name ===> CSFIN.TESTDS1P(TEST)_____________________
   Volume Serial ===> ______  (if uncataloged)

 Diagnostics               (DDNAME = CSFDIAG)  (use * for printer)
   Data Set Name ===> *________________________________________
   Volume Serial ===> ______  (if uncataloged)

 Key Output                (DDNAME = CSFKEYS)
   Data Set Name ===> TEST.CSFKEYS_____________________________
   Volume Serial ===> ______  (if uncataloged)

 Control Statement Output  (DDNAME = CSFSTMNT)
   Data Set Name ===> TEST.CSFSTMNT____________________________
   Volume Serial ===> ______  (if uncataloged)

Press ENTER to set the data set names. Press END to exit to the previous panel.
```

Figure 159. Completing the Specify KGUP Data Sets Panel

11. Press ENTER to set the data set names.
12. Press END to return to the ICSF Key Administration panel.

Steps for creating the job stream using the ICSF panels

The Set KGUP JCL Job Card panel appears. When you create the control statements and specify the data sets for KGUP processing, you submit the job to run KGUP. You submit a KGUP job stream to process control statements which modify a CKDS and output information to other data sets. The names of the data sets that KGUP uses are specified in the job stream.

1. To access the panels to create the KGUP job stream, select option 3 on the Key Administration panel, as shown in Figure 160, and press ENTER.

```
CSFSAM00 ----------------- ICSF - Key Administration ---------------
OPTION ===> 3


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Data Set       - Specify data sets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 160. Invoking KGUP by Selecting the Submit Option on the Key Administration Panel

See Figure 161. The first time you access this panel, the panel displays a JOB statement similar to the one that is shown in this example. ICSF displays your userid as the job name. From this panel you can create a job to run KGUP.

```
CSFSAE30 --------------- ICSF - Set KGUP JCL Job Card --------------
COMMAND ===> _

   S  - Submit the KGUP job stream for execution
   E  - Edit the KGUP job stream and issue the TSO SUBMIT command

        Note:  If you choose E, and want to submit the job stream with
        your changes, issue the TSO SUBMIT command before you leave the
        edit session; your updates to the job stream will NOT be saved.

   Enter or verify job statement information:

   ===> //LARSON  JOB (ACCOUNT),'NAME',MSGCLASS=C_____________________________
   ===> //*_____________________________________________________________________
   ===> //*_____________________________________________________________________
   ===> //*_____________________________________________________________________

   Enter dsname of library containing Installation Exit Module:

   ===> _____________________________________________

   Special Secure Mode       ===> NO_  NO or YES

   Press END to exit to previous panel
```

Figure 161. Set KGUP JCL Job Card Panel

2. Change the job statement according to the specifications of your installation.

   The line of the job control language that appears on this panel contains the job card that is needed to submit the job on the Job Entry Subsystem (JES). This panel displays some commonly used parameters that are installation dependent. A job name and the word JOB are the only required parameters on a job statement. All the other parameters are only required depending on your installation. You can delete or specify these parameters and add more parameters depending on the requirements of your installation. When you change the information that is displayed, ICSF saves these changes so they appear every time you display the panel.

   a. In the ACCOUNT parameter, enter accounting information as specified by your installation.
   b. In single quotes, enter the name that appears on the output of the job.
   c. In the MSGCLASS parameter, set the output class for the job log.

      When you specify the JOB statement information, the panel displays three comment lines where you can include any information about the job.
   d. If all the parameters do not fit on the first line, delete the * on the second line and continue the JOB statement parameters.

3. If your installation calls an installation exit during KGUP processing and the library containing the exit load module is not in the link list, specify the library in the “Enter dsname of library containing Installation Exit Module” field.

   Because the library must be an authorized library, the library must be defined in your installation's IEAAPFxx member.

4. If any of the control statements contain the CLEAR keyword, specify YES in the Special Secure Mode field. Otherwise, ICSF does not have to be in special secure mode, and you should specify NO in the Special Secure Mode field.
5. When you specify the necessary information, you can either:
   - Enter S to submit the job.

     KGUP creates the job stream and automatically submits the job to run the program.
   - Enter E to edit the job.

     KGUP creates the job stream and then displays the job stream on a panel in ISPF edit mode. Figure 162 shows an example of a panel in ISPF edit mode that contains a job stream to run KGUP. When ICSF creates the job stream, ICSF defines the data sets that KGUP uses in the job. It defines these data sets according to the information you specified on the Specify KGUP Data Sets Panel. Refer to Figure 159 on page 270.

     a. On this panel, you can view the job stream ICSF created and make any necessary changes to the job stream.
     b. To submit your job with the changes, you must use the TSO SUBMIT command from the edit session. Type SUBMIT on the command line and press ENTER to submit the job and run KGUP.
     c. To return to the Set KGUP JCL Job Card panel without submitting the job stream, press END.

        The job stream is not saved when you leave this panel.

```
ISREDDE - SYS88218.T095045.RA000.LARSON.R0000002 ------------ COLUMNS 001 072
COMMAND ===> _                                                SCROLL ===> CSR
****** ***************************** TOP OF DATA ******************************
000001 //LARSON  JOB (ACCOUNT),'NAME',MSGCLASS=C
000002 //*
000003 //*
000004 //*
000005 //KGUP     EXEC PGM=CSFKGUP,PARM=('NOSSM')
000006 //CSFCKDS  DD   DSN=LARSON.TEST.CSFCKDS,
000007 //              DISP=OLD
000008 //CSFIN    DD   DSN=LARSON.CSFIN.TESTDS1P(TEST),
000009 //              DISP=OLD
000010 //CSFDIAG  DD   SYSOUT=*
000011 //CSFKEYS  DD   DSN=LARSON.TEST.CSFKEYS,
000012 //              DISP=OLD
000013 //CSFSTMNT DD   DSN=LARSON.TEST.CSFSTMNT,
000014 //              DISP=OLD
****** **************************** BOTTOM OF DATA ****************************
```

Figure 162. KGUP JCL Set for Editing and Submitting (Files Exist)

Example of a KGUP job stream with existing data sets

The KGUP job stream in Figure 162 is an example of a job stream in which the data sets already exist.

In the EXEC statement of the job stream that ICSF created, the PGM parameter specifies that the job run KGUP. The PARM parameter notifies KGUP whether special secure mode is enabled. The keyword SSM indicates that the mode is enabled, and NOSSM indicates that the mode is not enabled.

The data definition (DD) statements identify the data sets that KGUP uses while processing. ICSF uses the names you provide on the Specify KGUP Data Sets

panel. The cryptographic key data set (CSFCKDS) and the control statement input data set (CSFIN) have to exist prior to ICSF generating the job stream. The other data sets do not have to already exist. In the example that is shown on this panel, all the data sets existed prior to ICSF creating the job stream.

On the DD statements, the DSN parameter specifies the data set name. ICSF uses the name you provide on the Specify KGUP Data Sets panel for the data set name. The DISP parameter indicates the data set's status. On this panel, all the data sets existed prior to ICSF creating this job stream, therefore the job stream indicates a status of OLD for the data sets.

In Figure 162 on page 272, the DD statement for the diagnosis data set (CSFDIAG) is different from the other DD statements. The SYSOUT=* parameter specifies that ICSF print the data set on the output listing.

Note: You can change the default values that are used with the job control language such as the record format and record length by changing the outline file, CSFSAJ30. The information appears in the front of CSFSAJ30. CSFSAJ30 resides in the ICSF skeleton library.

Example of a KGUP job stream with non-existing data sets

Figure 163 shows an example of a panel in ISPF edit mode that contains a KGUP job stream where certain data sets did not exist previously.

```
ISREDDE - SYS88218.T095045.RA000.LARSON.R0000003 ------------ COLUMNS 001 072
COMMAND ===> _                                               SCROLL ===> CSR
****** ***************************** TOP OF DATA ******************************
000001 //LARSON  JOB (ACCOUNT),'NAME',MSGCLASS=C
000002 //*
000003 //*
000004 //*
000005 //KGUP     EXEC PGM=CSFKGUP,PARM=('NOSSM')
000006 //CSFCKDS  DD   DSN=LARSON.TEST.CSFCKDS,
000007 //              DISP=OLD
000008 //CSFIN    DD   DSN=LARSON.CSFIN.TESTDS2P(TEST2),
000009 //              DISP=OLD
000010 //CSFDIAG  DD   DSN=LARSON.TEST.CSFDIAG,
000011 //              DISP=(,CATLG,CATLG),UNIT=SYSDA,
000012 //              DCB=(RECFM=FBA,LRECL=133,BLKSIZE=13300),
000013 //              SPACE=(TRK,(220,10),RLSE)
000014 //CSFKEYS  DD   DSN=LARSON.TEST.CSFKEYS,
000015 //              DISP=(,CATLG,CATLG),UNIT=SYSDA,
000016 //              DCB=(RECFM=FB,LRECL=208,BLKSIZE=3328),
000017 //              VOL=SER=TSO001,SPACE=(TRK,(60,10),RLSE)
000018 //CSFSTMNT DD   DSN=LARSON.TEST.CSFSTMNT,
000019 //              DISP=(,CATLG,CATLG),UNIT=SYSDA,
000020 //              DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200),
000021 //              SPACE=(TRK,(60,10),RLSE)
****** **************************** BOTTOM OF DATA ****************************
```

Figure 163. KGUP JCL Set for Editing and Submitting (Files Do Not Exist)

The job stream contains information to create the diagnosis data set (CSFDIAG), key output data set (CSFKEYS), and the control statement output data set (CSFSTMNT) that did not previously exist. On the DISP parameter, the CATLG keyword specifies that you want the data set cataloged when the job ends normally and when the job ends abnormally. The unit parameter indicates the device you

want the data set to reside on. The DCB parameter specifies the necessary data control block information such as the record format (RECFM), record length (LRECL) and block size (BLKSIZE).

When you submit the job, KGUP performs the functions you specified on the control statements. The functions KGUP performs change the CKDS. You can view the diagnostics data set to know whether KGUP successfully processed the control statements.

Steps for refreshing the active CKDS using the ICSF panels

KGUP processing affects keys that are stored on a disk copy of the CKDS. You specify the name of the data set when you submit the KGUP job. For information on specifying the disk copy of the CKDS for KGUP processing, see “Steps for specifying data sets using the ICSF panels” on page 267.

ICSF functions use an in-storage copy of the CKDS. To make the changes caused by the KGUP processing active, you replace the in-storage copy of the CKDS with the disk copy that the KGUP processing changed. You refresh the current copy of the CKDS with the changed disk copy of the CKDS. This procedure should be performed on all systems sharing the updated CKDS to ensure they all utilize the updated CKDS records.

Note: If you are running in a sysplex environment and sharing the CKDS across sysplex members, you should perform a coordinated CKDS refresh operation. Refer to “Performing a coordinated CKDS refresh” on page 198. for more information.

1. To access the panels to refresh the current CKDS, choose option 4 on the Key Administration panel, as shown in Figure 164.

```
CSFSAM00 ----------------- ICSF - Key Administration ---------------
OPTION ===> 4


   Enter the number of the desired option.

   1  Create         - Create key generator control statements

   2  Data Set       - Specify data sets for processing

   3  Submit         - Invoke Key Generator Utility Program (KGUP)

   4  Refresh        - Activate an existing cryptographic key data set


   Press ENTER to go to the selected option
   Press END   to exit to the previous panel
```

Figure 164. Selecting the Refresh Option on the Key Administration Panel

The Refresh in-storage CKDS panel appears. See Figure 165 on page 275.

```
CSFSAE40 ------------------- ICSF - Refresh in-storage CKDS --------
COMMAND ===> _

  Enter the Cryptographic Key Data Set (CKDS) to be loaded.

  Cryptographic Keys ===> TEST.CSFCKDS_____________________________


  Press ENTER to refresh the in-storage copy of CKDS
  Press END   to exit to previous panel
```

Figure 165. Refresh In-Storage CKDS

2. Enter the name of the disk copy of the CKDS to replace the current in-storage copy.

   The name of the CKDS that you chose when you specified data sets for KGUP processing on the Specify KGUP Data Sets panel, automatically appears on this panel. If you change the data set name on this panel, the data set name on the Specify KGUP Data Sets panel also changes. Refer to Figure 159 on page 270 for an example of the Specify KGUP Data Sets panel.
3. Press ENTER to replace the in-storage copy of the CKDS with the disk copy.

   Applications that are running on ICSF are not disrupted. A message stating that the CKDS was refreshed appears on the right of the top line on the panel.

   ICSF performs a MAC verification on the records when reading the CKDS into storage. If a record fails the MAC verification, the record is not loaded into storage. The operator receives a message indicating the key label and type for that record.
4. Press END to return to the Key Administration Panel.

   Note: If you restart ICSF, the name of the disk copy that you specify in the CKDSN installation option is read into storage.

Scenario of Two ICSF Systems Establishing Initial Transport Keys

This scenario describes how two ICSF systems, System A and System B, establish initial transport keys between themselves. They establish two pairs of complementary importer and exporter keys at each location, as shown in Figure 166.

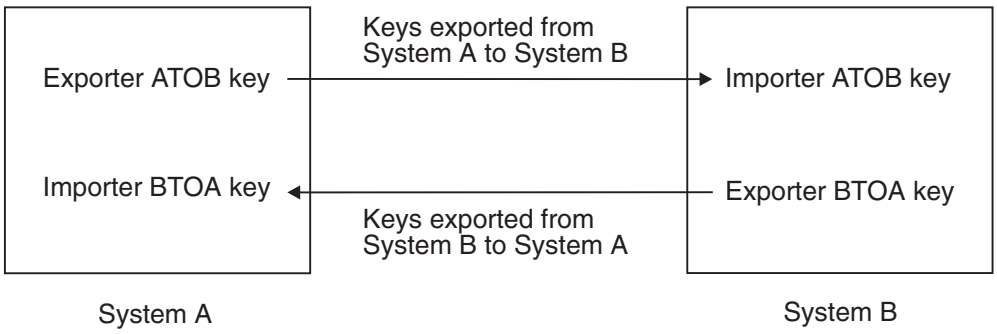

Figure 166. Key Exchange Establishment between Two ICSF Systems

The systems can use these importer and exporter keys during key exchange. First the ICSF administrators at the two locations establish the complementary transport

keys to send keys from System A to System B. These keys are the Exporter ATOB key at System A and the Importer ATOB key at System B.

The ICSF administrator at System A submits this control statement to System A's KGUP to create the Exporter ATOB key.

```
ADD  LABEL(ATOB)  TYPE(EXPORTER)  CLEAR
```

KGUP processes this control statement to generate the Exporter ATOB key and places the key in System A's CKDS. KGUP creates a record containing the clear key created for the system, and that record is written to the CSFKEYS data set. This key value must be used to create a control statement like this:

```
ADD  LABEL(ATOB)  TYPE(IMPORTER)  CLEAR,
KEY(B2403EF8125A036F,239AC35A72941EF2)
```

System A can send this control statement to System B, and System B can create the Importer ATOB key. The key value in this control statement is the clear value of the Exporter ATOB key. System A does not send this control statement to System B over the network, because the key value is a clear key value. System A has a courier deliver the control statement to System B.

The administrator at System B submits the control statement to its KGUP. KGUP processes the control statement to create the ATOB importer key. The ATOB exporter key at system A and the ATOB importer key at System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from System A to System B. When System A sends a key to System B it enciphers the key using the ATOB exporter key. When System B receives the key, System B deciphers the key using the ATOB importer key.

Then the ICSF administrators at the two locations establish the complementary transport keys to send keys from System B to System A. These keys are the Importer BTOA key at System A and the Exporter BTOA key at System B.

The ICSF administrator at System A submits this control statement to System A's KGUP to generate the Importer BTOA key.

```
ADD  LABEL(BTOA)  TYPE(IMPORTER)  TRANSKEY(ATOB)
```

KGUP processes this control statement to generate the Importer BTOA key and places the key in System A's CKDS. KGUP also creates this control statement and places the statement in the control statement output data set.

```
ADD  LABEL(BTOA)  TYPE(EXPORTER)  TRANSKEY(ATOB),
KEY(AF04C35A7F1C9636,03CBB854653A0BCF)
```

System A can send this control statement to System B and System B can use the statement to create the Exporter BTOA key. The key value in this control statement is the value of the Importer BTOA key enciphered under the Exporter ATOB key. System A can send this control statement to System B over the network, because the key value is enciphered.

The ICSF administrator at System B submits the control statement to its KGUP. The program processes the control statement to generate the Exporter BTOA key. The Importer BTOA key at System A and the Exporter BTOA key at System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from System B to System A. When System B sends a key to System A, System B enciphers the key using the Exporter BTOA key. When System A receives the key, System A deciphers the key using the Importer BTOA key.

Using these procedures two pairs of complementary transport keys are established at each facility to allow key exchange between the two facilities.

Notes:

1. During these procedures, the special secure mode at each system must be enabled, while KGUP is generating or receiving clear key values.
2. The ICSF administrator at System A can submit in the same KGUP job both the ADD control statements meant for processing at System A.
3. The ICSF administrator at System B can submit in the same KGUP job both the ADD control statements meant for processing at System B.

Scenario of an ICSF System and a PCF System Establishing Initial Transport Keys

This scenario describes how an ICSF system and a PCF system establish initial transport keys between themselves. They establish two pairs of complementary importer and exporter keys at each location, as shown in Figure 167.

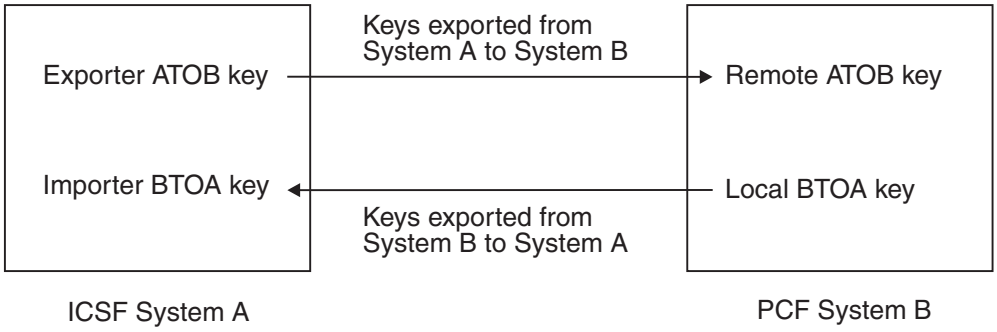

Figure 167. Key Exchange Establishment between an ICSF System and a PCF System

The systems can use these importer and exporter keys during key exchange.

First the ICSF administrators at the two locations establish the complementary transport keys to send keys from ICSF System A to PCF System B. These keys are the Exporter ATOB key at ICSF System A and the Remote ATOB key at PCF System B.

The ICSF administrator at ICSF System A submits this control statement to ICSF System A's KGUP to create the Exporter ATOB key.

```
ADD  LABEL(ATOB)  TYPE(EXPORTER)  CLEAR  NOCV
```

Note: If System B is a PCF system, the ICSF administrator must also specify the keyword SINGLE on this control statement.

KGUP processes this control statement to generate the Exporter ATOB key and places the key in ICSF System A's CKDS. KGUP also creates this control statement and places the statement in the control statement output data set.

```
ADD  LABEL(ATOB)  TYPE(IMPORTER)  CLEAR,
KEY(B2403EF8125A036F,239AC35A72941EF2)  NOCV
```

ICSF System A needs to send this control statement to PCF System B so that PCF System B can create the Remote ATOB key. The key value in this control statement is the clear value of the ATOB exporter key. ICSF System A does not send this control statement to PCF System B over the network, because the key value is a clear key value. ICSF System A has a courier deliver the control statement to System B.

The administrator at either system must change the ICSF control statement format into the PCF control statement format. The administrator could also use information from the key output data set to create the PCF control statement.

The control statement submitted at PCF System B would have this syntax:

```
REMOTE ATOB,KEY=B2403EF8125A036F,IKEY=239AC35A72941EF2,ADD
```

The administrator at PCF System B submits the control statement to the PCF key generation utility program, which processes the control statement to create the ATOB Remote key. The ATOB Exporter key at System A and the ATOB Remote key at PCF System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from ICSF System A to PCF System B. When ICSF System A sends a key to PCF System B, System A enciphers the key using the ATOB exporter key. When PCF System B receives the key, PCF System B deciphers the key using the Remote ATOB key.

Then the ICSF administrators at the two locations establish the complementary transport keys to send keys from PCF System B to ICSF System A. These keys are the Importer BTOA key at ICSF System A and the Local BTOA key at PCF System B.

The ICSF administrator at ICSF System A submits this control statement to ICSF System A's KGUP to generate the Importer BTOA key.

```
ADD  LABEL(BTOA)  TYPE(IMPORTER)  CLEAR  NOCV
```

KGUP processes this control statement to generate the Importer BTOA key and places the statement in ICSF System A's CKDS. KGUP also creates this control statement and places the statement in the control statement output data set.

```
ADD  LABEL(BTOA)  TYPE(EXPORTER)  CLEAR,
KEY(6F3463CA3FBC0626,536B1864954A0B1F)  NOCV
```

System A can send this control statement to System B, which can then use it to create the Local BTOA key. The key value in this control statement is the clear value of the BTOA importer key. ICSF System A does not send this control statement to PCF System B over the network, because the key value is a clear key value. ICSF System A has a courier deliver the control statement to PCF System B.

The administrator at either system must change the ICSF control statement format into the PCF control statement format. The administrator can also use information from the key output data set to create the PCF control statement.

The control statement submitted at PCF System B would have this syntax:

```
LOCAL BTOA,KEY=6F3463CA3FBC0626,IKEY=536B1864954A0B1F,ADD
```

The administrator at PCF System B submits the control statement to the PCF key generation utility program, which processes the control statement to generate the

Local BTOA key. The Importer BTOA key at ICSF System A and the Local BTOA key at PCF System B are complementary keys.

Note: A single PCF key generation control statement can be used to generate both Remote and Local BTOA keys, also called a CROSS key pair.

```
CROSS BTOA,KEYLOC=6F3463CA3FBC0626,IKEYLOC=536B1864954A0B1F,
          KEYREM=B2403EF8125A036F,IKEYREM=239AC35A72941EF2,ADD
```

This procedure creates a pair of complementary transport keys for keys sent from PCF System B to ICSF System A. When PCF System B sends a key to ICSF System A, System B enciphers the key, using the Local BTOA key. When ICSF System A receives the key, ICSF System A deciphers the key, using the Importer BTOA key.

By these procedures, two pairs of complementary transport keys are established at each location so that the two systems can exchange keys.

Note: During these procedures, the special secure mode should be enabled while KGUP generates or receives clear key values.

Scenario of an ICSF System and 4758 PCI Cryptographic Coprocessor Establishing Initial Transport Keys

This scenario describes how an ICSF system and a 4758 PCI Cryptographic Coprocessor establish initial transport keys between themselves. They establish two pairs of complementary importer and exporter keys at each location, as shown in Figure 168.

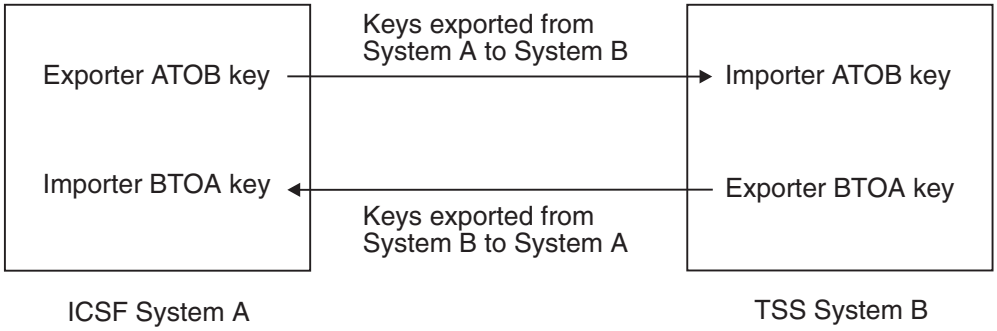

Figure 168. Key Exchange Establishment between a 4758 PCI Cryptographic Coprocessor System and an ICSF System

The systems can use these importer and exporter keys during key exchange. First, the ICSF System A administrator and the TSS System B administrator establish the complementary transport keys to send keys from ICSF System A to TSS System B. These keys are the Exporter ATOB key at System A and the Importer ATOB key at System B.

The ICSF administrator at System A submits this control statement to System A's KGUP to create the Exporter ATOB key.

```
ADD  LABEL(ATOB)  TYPE(EXPORTER)  CLEAR
```

KGUP processes this control statement to generate the Exporter ATOB key and places the key in System A's CKDS. KGUP creates a record containing the clear key created for the system, and that record is written to the CSFKEYS data set.

ICSF System A then sends this clear key to TSS System B. Because the key value is in the clear, System A has a courier deliver the key, rather than sending it over the network.

The TSS administrator at System B uses the Secure_Key_Import verb to import the ATOB importer key, because the key value is in the clear. The administrator can then use the Key_Record_Create and the Key_Record_Write verbs to place the key in TSS key storage. The ATOB exporter key at ICSF system A and the ATOB importer key at TSS System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from ICSF System A to TSS System B. When ICSF System A sends a key to TSS System B, it enciphers the key using the ATOB exporter key. When TSS System B receives the key, it deciphers the key using the ATOB importer key.

Next, the administrators at the two facilities establish the complementary transport keys to send keys from TSS System B to ICSF System A. These keys are the Importer BTOA key at ICSF System A and the Exporter BTOA key at TSS System B. The ICSF administrator at System A submits this control statement to System A's KGUP to generate the Importer BTOA key.

```
ADD  LABEL(BTOA)  TYPE(IMPORTER)  TRANSKEY(ATOB)
```

KGUP processes this control statement to generate the Importer BTOA key and places the key in System A's CKDS. The ICSF System A administrator can send this key to the TSS System B over the network, because the key value is enciphered.

The TSS administrator at System B uses Key_Import, Key_Record_Create, and the Key_Record_Write verbs to import the key and place it in TSS key storage. The Importer BTOA key at System A and the Exporter BTOA key at System B are complementary keys.

This procedure creates a pair of complementary transport keys for keys sent from TSS System B to ICSF System A. When TSS System B sends a key to ICSF System A, TSS System B enciphers the key using the Exporter BTOA key. When ICSF System A receives the key, it deciphers the key using the Importer BTOA key.

Using these procedures two pairs of complementary transport keys are established at each location to allow key exchange between the two systems.

Notes:

1. During these procedures, the special secure mode must be enabled on ICSF while KGUP is generating or receiving clear key values, and the Secure_Key_Import verb must be enabled on TSS to receive clear keys.
2. The ICSF administrator at System A can submit in the same KGUP job both the ADD control statements meant for processing at System A.

Chapter 11. Viewing and Changing System Status

This topic describes:

You define installation options, and any installation exits and installation-defined callable services to ICSF. Using the ICSF panels, you can view how these options and programs are currently defined. During master key management, you change the status of the key storage registers that contain key parts and the master keys. You can use the ICSF panels to view the status of these hardware registers. You can also use the ICSF panels to deactivate or activate your PCICC, PCIXCC, CEX2C, and CEX3C coprocessors and PCICA, CEX2A, and CEX3A accelerators.

When you check the status of an installation option, an installation exit, or an installation-defined callable service, you may decide to change how you defined the option or program. You must change the information in the installation options data set and restart ICSF to activate the change.

Displaying administrative control functions

To display administrative control functions:

1. Select option 4, ADMINCNTL, on the primary menu panel.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 4

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 169. Primary Panel

The Administrative Control panel appears, which is shown in Figure 170.

```
CSFACF00 ------------- ICSF Administrative Control Functions
COMMAND ===>
          Active CKDS: CRYPTO25.HCRICSF.CKDS
          Active PKDS: CRYPTO25.HCRICSF.PKDS
          Active TKDS: CRYPTO25.HCRICSF.TKDS

To change the status of a control, enter the appropriate character
(E - ENABLE, D - DISABLE) and press ENTER.

         Function                                  STATUS
         --------                                  ------
.  Dynamic CKDS Access                             ENABLED
.  PKA Callable Services                           ENABLED
.  Dynamic PKDS Access                             DISABLED
```

Figure 170. Administrative Control Functions Panel

On this panel, you can view these options and their values:

Dynamic CKDS Access (ENABLED or DISABLED)
Specifies whether the dynamic CKDS update services are currently enabled. You can enable or disable these services by placing an 'E' or 'D' for the function on this panel.

Value	Indication
ENABLED	The dynamic CKDS update services are enabled.
DISABLED	The dynamic CKDS update services are disabled.

PKA Callable Services (ENABLED or DISABLED)
Specifies whether the use of PKA callable services is currently enabled. You can enable or disable these services by placing an 'E' or 'D' for the function on this panel.

Value	Indication
ENABLED	PKA callable services are enabled.
DISABLED	PKA callable services are disabled.

Note: The PKA callable services control will not appear on the panel if your system has a CEX3C coprocessor.

Dynamic PKDS Access (ENABLED or DISABLED)
Specifies whether the use of Dynamic PKDS Access callable services are currently enabled. You can enable or disable these services by by placing an 'E' or 'D' for the function on this panel.

Value	Indication
ENABLED	The Dynamic PKDS Access callable services are enabled.
DISABLED	The Dynamic PKDS Access callable services are enabled.

Note: Access to the functions performed using this panel can be controlled by setting up profiles in the CSFSERV class for both CSFRSWS and CSFSSWS.

Displaying coprocessor or accelerator status - CCF, PCICC, PCICA

Use the ICSF panels to view the status of the coprocessors or accelerators. To display the status:

1. Select option 1, COPROCESSOR MGMT, on the Primary Option panel, as shown in Figure 171.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 1

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 171. Selecting Coprocessor Status on the Primary Menu Panel

2. The Coprocessor Management panel appears. Refer to Figure 172 on page 284.

```
CSFCMP00 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                 STATUS
-----------  ------------------------------          -------

_ A06                                                 ACTIVE
_ A07                                                 ACTIVE
_ C0         E589C396944007A6 5D40369997A386F4        ONLINE
_ C1         0AA379BFD2387960 0367DC04533125FF        ONLINE
_ P00        41-00YE1                                 ONLINE
_ P01        41-00K11                                 ONLINE
_ P02        41-0A355                                 ONLINE
_ P03        41-0BA3F                                 ONLINE
_ P04        41-0RT2T                                 DEACTIVATED
_ P05        41-00342                                 DISABLED
_
```

Figure 172. Coprocessor Management Panel

On this panel, you can view these options and their values:

Coprocessor
The prefix indicates the type of cryptographic coprocessor or accelerator.

The prefix	Represents a
A	PCI Cryptographic Accelerator
C	Cryptographic Coprocessor Feature
P	PCI Cryptographic Coprocessor

Some servers allow you to partition the processor unit into two sides (side 0 and side 1). The individual central processors, processor storage arrays, and the channel subsystems are associated with side 0 or side 1. The unit on Side 0 is called Coprocessor C0, and the one on Side 1 is called Coprocessor C1.

Module ID/Serial Number
The module ID is the unique 128-bit value that was generated for the CCF during the manufacturing process.The serial number is a number for the PCI Cryptographic Coprocessor.

Status
This field displays the status of the PCICC, the PCICA and the CCF.

State	Indication
ACTIVE (PCICC)	The verification pattern for the SYM-MK matches the verification pattern of the DES master key on the server's Cryptographic Coprocessor Feature. The hash pattern for the ASYM-MK matches the hash pattern of the Signature Master Key (SMK) register on the server's Cryptographic Coprocessor Feature. Requests for services can then be routed to either cryptographic coprocessor.
ACTIVE (PCICA)	The PCICA is available for work.
ACTIVE (CCF)	The DES master key is valid.

ONLINE (PCICC)
The PCI Cryptographic Coprocessor is online, but one or both of the master key verification patterns or hash patterns do not match those of the server's Cryptographic Coprocessor Feature. Requests for services cannot be routed to the PCI Cryptographic Coprocessor.

ONLINE (CCF)
The DES master key is not valid.

OFFLINE (PCICC and PCICA)
A PCICC or PCICA may be physically present but it is not available to the operating system. Either it has never been configured online or it has been configured offline by an operator command from the hardware support element.

Note: If a PCICC or PCICA card is configured offline from the Support Element, this status display may not be updated automatically. Users will need to hit enter on this panel to get the latest status.

DISABLED (PCICC and CCF)
The PCI Cryptographic Coprocessor or the Cryptographic Coprocessor Feature has been disabled by the TKE workstation.

DEACTIVATED (PCICC and PCICA)
The PCI Cryptographic Coprocessor or the PCI Cryptographic Accelerator has been deactivated from the Coprocessor Management panel.

TEMP UNAVAILABLE (PCICC and PCICA)
An unexpected error has been returned from the card. The system goes into recovery to try to reset the card. If the reset is successful, the card is usable again. The user will have to press ENTER to refresh the status.

HARDWARE ERROR (PCICC and PCICA)
The reset from a TEMP UNAVAILABLE condition was not successful and the card is unusable.

HARDWARE ERROR (CCF)
A hardware error has been detected.

UNKNOWN: CODE = cccc/ssss (PCICC)
The PCICC has returned an unrecognizable code in response to an attempt to determine its status. The return/reason code appears as the value of CODE.

Displaying coprocessor or accelerator status - PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A

Use the ICSF panels to view the status of the coprocessors. To display coprocessor status:

1. Select option 1, COPROCESSOR MGMT, on the Primary Option panel, as shown in Figure 173 on page 286.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 1

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 173. Selecting for Coprocessor Status on the Primary Menu Panel

2. The Coprocessor Management panel appears.

```
CSFGCMP0 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

                Serial
 CoProcessor    Number         Status   AES   DES   ECC   RSA
 -----------   ---------       ------   ---   ---   ---   ----
__ H00                        ACTIVE
__ G01          00000001      ONLINE    U     U     U     U
__ G02          00000002      ACTIVE    C     U     U     C
__ G03          00000003      ACTIVE    C     U     A     C
__ G04          00000004      ACTIVE    C     C     A     C
__ G05          00000005      ONLINE    U     C     E     U
__ E06          00000006      ACTIVE    C     C     -     C
__ G07          00000007      OFFLINE
```

Figure 174. Coprocessor Management Panel

On this panel, you can view these options and their values:

Coprocessor
The prefix indicates the type of cryptographic coprocessor or accelerator.

The prefix	Represents a
A	PCI Cryptographic Accelerator
X	PCIXCC
E	CEX2C
F	CEX2A
G	CEX3C

H CEX3A

Serial Number
The serial number is a number for the PCIXCC, CEX2C, or CEX3C.

Status
This field displays the status of the PCIXCC, CEX2C, CEX3C, PCICA, CEX2A, or CEX3A.

State	Indication
ACTIVE (PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A)	The verification pattern for the SYM-MK matches the verification pattern of the CKDS.
ACTIVE (PCICA, CEX2A, CEX3A)	The accelerator is available for work.
ONLINE (PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A)	The coprocessor is online, but the verification pattern for the SYM-MK or AES-MK does not match the verification pattern of the CKDS.
OFFLINE (PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A)	The coprocessor or accelerator may be physically present but it is not available to the operating system. Either it has never been configured online or it has been configured offline by an operator command from the hardware support element. **Note:** If a card is configured offline from the Support Element, this status display may not be updated automatically. Users will need to hit enter on this panel to get the latest status.
DISABLED (PCIXCC, PCICA, CEX2C, CEX2A, CEX3C, and CEX3A)	The coprocessor or accelerator has been disabled by the TKE workstation.
DEACTIVATED (PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A)	The coprocessor or accelerator has been deactivated from the Coprocessor Management panel.
TEMP UNAVAILABLE (PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A)	An unexpected error has been returned from the card. The system goes into recovery to try to reset the card. If the reset is successful, the card is usable again. The user will have to press ENTER to refresh the status on the panel.
HARDWARE ERROR (PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A)	The reset from a TEMP UNAVAILABLE condition was not successful and the card is unusable.
UNKNOWN: CODE = cccc/ssss (PCIXCC, CEX2C, CEX3C)	The coprocessor has returned an unrecognizable code in response to an attempt to determine its status. The return/reason code appears as the value of CODE.
AES DES ECC RSA	The state of the master keys in the coprocessor . The state can be U (uninitialized - the current master key register is empty), C (correct - the current master key matches the MKVP in the key data set but the master key is not active), A (active - the master

key is active and requests using this master key will be processed by the coprocessor) or E (error - the current master key do not match the MKVP in the key data set). A hyphen (-) in the state area indicates the key type is not supported.

Changing coprocessor or accelerator status - CCF, PCICC, and PCICA

You can change the status of your PCI cryptographic coprocessors and accelerators, either activating or deactivating them. From the primary menu, select option 1, COPROCESSOR MGMT, and the Coprocessor Management panel is displayed (Figure 175).

```
CSFCMP00 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                  STATUS
-----------  -------------------------------          -------

D A06                                                  ACTIVE
_ A07                                                  ACTIVE
_ C0         E589C396944007A6 5D40369997A386F4         ONLINE
_ C1         0AA379BFD2387960 0367DC04533125FF         ONLINE
_ P00        41-00YE1                                  ONLINE
_ P01        41-00K11                                  ONLINE
_ P02        41-0A355                                  ONLINE
_ P03        41-0BA3F                                  ONLINE
_ P04        41-0RT2T                                  DEACTIVATED
_ P05        41-00342                                  DISABLED
_
```

Figure 175. Coprocessor Management Panel

There are action characters that can be entered on the left of the PCI coprocessor or accelerator number.

Character	Indication
D	Makes a PCICC or PCICA unavailable. The status becomes DEACTIVATED. When the request is made, the status of the PCICC/PCICA may be anything except OFFLINE or DEACTIVATED.
A	Makes available a PCICC or PCICA previously deactivated by a 'D' action character. When the request is made, if the PCICC is online and the master keys are correct, the status will be ACTIVE. If the master keys are incorrect, the status will be ONLINE. When the request is completed successfully, the status of the PCICA is ACTIVE.

Changing coprocessor or accelerator status - PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A

You can change the status of your cryptographic coprocessors and accelerators, either activating or deactivating them. From the primary menu, select option 1, COPROCESSOR MGMT, and the Coprocessor Management panel is displayed (Figure 176 on page 289).

```
CSFGCMP0 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

                Serial
 CoProcessor    Number         Status   AES   DES   ECC   RSA
 -----------   ---------       ------   ---   ---   ---   ----
__ H00                         ACTIVE
__ G01          00000001       ONLINE    U     U     U     U
__ G02          00000002       ACTIVE    C     U     U     C
__ G03          00000003       ACTIVE    C     U     A     C
D  G04          00000004       ACTIVE    C     C     A     C
__ G05          00000005       ONLINE    U     C     E     U
__ E06          00000006       ACTIVE    C     C     -     C
__ G07          00000007       OFFLINE
```

Figure 176. Coprocessor Management Panel

There are action characters that can be entered on the left of the PCI coprocessor or accelerator number.

Character	Indication
D	Makes a coprocessor or accelerator unavailable. The status becomes DEACTIVATED. When the request is made, the status of the coprocessor or accelerator may be anything except OFFLINE.
A	Makes available a coprocessor or accelerator previously deactivated by a 'D' action character. For a PCIXCC, CEX2C, or CEX3C, if the coprocessor is online and the master keys are correct, the status will be ACTIVE when the request is made. If the master keys are incorrect, the state will be ONLINE. For a PCICA, the status will be ACTIVE when the request completes successfully.

Deactivating the last coprocessor

If there are no PCIXCCs, CEX2Cs, or CEX3Cs active, most callable services will fail and most TSO panel utilities will be unavailable. To prevent deactivating the last coprocessor by accident, this panel appears:

```
CSFCMP60  ---------------- ICSF Deactivate Last Coprocessor -------------
COMMAND ===>

The coprocessor(s) selected would deactivate all active and online
coprocessors. Are you sure you wish to deactivate the last coprocessor?









Press ENTER to confirm the deactivate request.
Press END   to cancel the deactivate request.
```

Figure 177. Coprocessor Management Panel

Displaying coprocessor hardware status - CCF and PCICC

You can use the ICSF panels to view the status of the cryptographic coprocessor key registers, the PCI cryptographic coprocessor, the master key verification patterns, and other information about the cryptographic hardware.

When you enter and activate a DES master key, you change the status of the registers. The cryptographic facility contains several key registers. The master key register contains the active DES master key. For the CCF, the auxiliary key register contains either the old DES master key or a new DES master key prior to it being activated and transferred to the master key register. For the PCICC, there are three registers: one for the old master key, one for the new and one for the current. When you have a PCICC, the old master key is not lost when a new master key is loaded.

In addition, there are also registers for the PKA master keys. When you enter a master key, the Cryptographic Coprocessor Feature or the PCI Cryptographic Coprocessor calculates a verification pattern and a hash pattern for the master key. You can use these patterns to identify master keys.

You can use the panels to display the conditions of the key registers and the verification pattern and hash patterns for the master keys. You may use this information for master key management.

To display coprocessor hardware status:

1. From the Coprocessor Management panel, select the coprocessors to be processed by typing an 'S'.

```
 CSFCMP00 ---------------- ICSF Coprocessor Management -------------
 COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                 STATUS
-----------  -------------------------------         -------

_ A06                                                 ACTIVE
_ A07                                                 ACTIVE
S C0         E589C396944007A6 5D40369997A386F4        ACTIVE
_ C1         0AA379BFD2387960 0367DC04533125FF        ONLINE
S P00        41-00YE1                                 ONLINE
_ P01        41-00K11                                 ONLINE
_ P02        41-0A355                                 ACTIVE
_ P03        41-0BA3F                                 ONLINE
_ P04        41-0RT2T                                 DEACTIVATED
_ P05        41-00342                                 DISABLED
_
```

Figure 178. Selecting the coprocessor on the Coprocessor Management Panel

2. The Coprocessor Hardware Status panel appears (Figure 179 on page 292). When more than two coprocessors are requested, the status display can be scrolled left and right to show the other coprocessors. You can scroll to the left using PFKey 10 and to the right with PFKey 11.

```
CSFCMP10 ----------- ICSF - Coprocessor Hardware Status  ----------------
OPTION ===>

                                                      CRYPTO DOMAIN: 0

REGISTER STATUS                COPROCESSOR C0          COPROCESSOR P00
                                                       More:    +
Crypto Serial Number or         :  E589C39694407A60    41-00YE1
     Module Id                  :  5D40C39997A396F0
Status                          :  ACTIVE              ONLINE
DES/Symmetric-Keys Master Key
  New master key register       : FULL                 PART FULL
    Verification pattern        : 1972BB5791BB2430     2342352352352352
    Hash pattern                : 0123456789ABCDEF     A17B93C44D24681A
                                : 9691BDA1970BDAA2     806427AAC91221CC
  Old master key register       : EMPTY                EMPTY
    Verification pattern        :
    Hash pattern                :
                                :
  Current master key register   : VALID                VALID
    Verification pattern        : CA6B408A02371B1D     261AAB8A02371705
    Hash pattern                : 41DF774FF81547D0     562A5202F8154331
                                : 090ABC4539727511     4093990AB1202451
PKA Signature/Asymmetric-Keys Master Key
  New master key register       : N/A                  PART FULL
    Hash pattern                :                      234235236236234D
                                :                      5678567856785678
  Old master key register       : N/A                  EMPTY
    Hash pattern                :
                                :
  Current master key register   : VALID                VALID
    Hash pattern                : 9691BDA1970BDAA2     9691BDA1970BDAA2
                                : 1972BB5791BB2430     1972BB5791BB2430
PKA Key Management Master Key register
    Hash pattern                : 123412341241234D     N/A
                                : 5678567856785678
Special Secure Mode             : Enabled              N/A
Environment Control Mask        : FBFEFCF0             N/A
Crypto Configuration Control    : EF569412CD91AB78     N/A
                                : 1F25A78BC88ED77A


 Press ENTER to refresh the hardware status display.
 Press END   to exit to the previous menu.
```

Figure 179. Coprocessor Hardware Status Panel

The coprocessor hardware status fields on this panel contain this information:

CRYPTO DOMAIN
This field displays the value that is specified for the DOMAIN keyword in the installation options data set at ICSF startup. This is the domain in which your system is currently working. It specifies which one of several separate sets of master key registers you can currently access. A system programmer can use the DOMAIN keyword in the installation options data set to specify the domain value to use at ICSF startup. For more information see the DOMAIN installation option.

Crypto Serial Number or Module ID
The serial number is a number for the PCI Cryptographic Coprocessor. The module ID is the unique 128-bit value that was generated for the CCF during the manufacturing process.

Status

This field displays the status of the CCF and the PCICC.

State	Indication
ACTIVE (PCICC)	The verification pattern for the SYM-MK matches the verification pattern of the DES master key on the server's Cryptographic Coprocessor Feature. The hash pattern for the ASYM-MK matches the hash pattern of the Signature Master Key (SMK) register on the server's Cryptographic Coprocessor Feature. Requests for services can then be routed to either cryptographic coprocessor.
ACTIVE (CCF)	The DES master key is valid.
ONLINE (PCICC)	The PCI Cryptographic Coprocessor is online, but one or both of the master key verification patterns or hash patterns do not match those of the server's Cryptographic Coprocessor Feature. Requests for services cannot be routed to the PCI Cryptographic Coprocessor.
ONLINE (CCF)	The DES master key is not valid.

DES/Symmetric-Keys Master KEY

New Master Key Register

This field shows the state of the new master key register.

This key register can be in any of these states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

For the CCF, the new master key is held in an auxiliary key register. This auxiliary key register can contain either a new master key or an old master key. Therefore, a new master key and the old master key cannot coexist.

For the PCICC, there can be an old, new and current master key.

Verification Pattern

When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key

registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Hash Pattern

If the master key register is not EMPTY, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using multiple cryptographic coprocessors, you enter the same master key into all units. If the status of the new master key registers are valid, the master key register hash patterns for each unit should match, because the patterns verify the same key.

Old Master Key register

This field shows the states of the DES and symmetric keys old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore, never transferred a master key to the old master key register. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

For the CCF, the old/new master key register is actually the auxiliary master key register. The auxiliary master key register can contain either the new master key or the old master key; therefore a new master key and an old master key cannot coexist at the same time. If an old master key exists, it is lost when you enter a new one.

For the PCICC, there can be an old, new and current master key.

Verification Pattern

When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the DES verification patterns for each unit should match, because the patterns verify the same key.

Hash Pattern

If the master key register is not EMPTY, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using multiple cryptographic coprocessors, you enter the same master key into all units. If the status of the new master key registers are valid, the master key register hash patterns for each unit should match, because the patterns verify the same key.

Current Master Key register
This field shows the states of the DES and symmetric-keys master key register.

State	Indication
EMPTY	You have never entered and set an initial DES/symmetric-keys master key on the coprocessor. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new PKA or symmetric master key on this coprocessor and chosen either the set or change option.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Hash Pattern
If the master key register is not EMPTY, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using multiple cryptographic coprocessors, you enter the same master key into all units. If the status of the new master key registers are valid, the master key register hash patterns for each unit should match, because the patterns verify the same key.

PKA Signature/Asymmetric Master Key

New Master Key register (PCICC only)
This field shows the state of the asymmetric new master key register.

This key register can be in any of these states:

State	Indication
EMPTY	You have not entered any key parts for the initial asymmetric master key, or you have just transferred the contents of this register into the asymmetric master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.

Hash Pattern
If the master key register is not EMPTY, a hash pattern is displayed.

Old Master Key register (PCICC only)
This field shows the states of the asymmetric keys old master key register.

State	Indication
EMPTY	You have never changed the asymmetric master key and, therefore, never transferred an asymmetric-keys master key to the asymmetric-keys old master key register. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the asymmetric master key. The asymmetric master key that was current when you changed the master key was placed in the asymmetric old master key register.

Hash Pattern
If the old asymmetric master key register is valid, the panel displays a hash pattern for the asymmetric old master key.

Current Master Key register
This field shows the states of the PKA signature master key and asymmetric master key register.

State	Indication
EMPTY	You have never entered an initial PKA signature master key or an asymmetric master key on the coprocessor. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new PKA signature master key or asymmetric master key on this coprocessor.

Hash Pattern
If the PKA signature master key and asymmetric master key registers are valid, the panel displays a hash pattern for the key. When you enter a new PKA signature master key and asymmetric-keys master key, *record the hash pattern* that appears on the panel. When the PKA signature master key and asymmetric master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using other PCI Cryptographic Coprocessors and one or more Cryptographic Coprocessor Features, the asymmetric master key must be the same on all the PCI cards, and must also be the same as the Signature master key in the Cryptographic Coprocessor Feature. If the status of all these cryptographic coprocessors is valid, the MK hash patterns for each unit should match, because the patterns verify the same key.

Note: An audit trail of the hash patterns that the PCI Cryptographic Coprocessor calculates appears in SMF record type 82.

PKA Key Mangement Master Key register (CCF only)

Hash pattern
You have entered a PKA key management master key and the hash pattern for the key register is shown here.

Special Secure Mode (CCF only)
This field shows if the special secure mode is enabled or disabled. Special secure mode is a lower form of security. This mode allows you to use KGUP to enter clear keys, produce clear PINs, use the secure key import callable

service, and initialize the CKDS. Special secure mode is enabled automatically when you send a KGUP request, provided that the SSM installation option is set to YES.

Environment Control Mask (CCF only)
The environment control mask contains controls for a subset of the components for each domain. This field shows the value of this control.

Note: Selected bits can be changed by the TKE workstation.

Crypto Configuration Control (CCF only)
The crypto configuration control contains controls to enable and disable all the major components of the crypto modules. This field shows the value of this control.

See Appendix A, “CCC Bit Assignments,” on page 393 for some selected values.

Note: The CCC cannot be changed.

Displaying coprocessor hardware status - PCIXCC, CEX2C, and CEX3C

You can use the ICSF panels to view the status of the cryptographic coprocessor key registers, the master key verification patterns, and other information about the cryptographic hardware. You can use this information for master key management.

When you enter and activate an AES, DES, ECC or RSA master key, you change the status of the registers. The cryptographic facility contains three key registers: one for the old master key, one for the new, and one for the current. The current master key register contains the active master key. When you have a PCIXCC, CEX2C, or CEX3C, the old master key is not lost when a new master key is loaded.

To display coprocessor hardware status:

1. From the Coprocessor Management panel, select the coprocessors to be processed by typing an 'S'.

```
CSFGCMP0 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

                Serial
 CoProcessor    Number         Status      AES   DES   ECC   RSA
 -----------   ---------       ------      ---   ---   ---   ----
__ A06                         ACTIVE
__ H07                         ACTIVE
__ X05          42-K0011       ACTIVE       -     A     -     C
s  G02          42-K0111       ONLINE       C     C     C     C
s  E04          42-K0043       DEACTIVATED  -     C     -     C
__ X05          42-K0058       DISABLED     -     -     -     -
```

Figure 180. Selecting the coprocessor on the Coprocessor Management Panel

2. The Coprocessor Hardware Status panel appears (Figure 181 on page 298). When more than two coprocessors are requested, the status display can be scrolled down to show the other coprocessors. You can scroll down using

PFKey 8 and up using PFKey 7.

```
CSFCMP40 ----------- ICSF - Coprocessor Hardware Status  ----------------
OPTION ===>

                                                      CRYPTO DOMAIN: 8


REGISTER STATUS                  COPROCESSOR G02

 Crypto Serial Number          : 42-K0111
 Status                        : ACTIVE
AES Master Key
   New Master Key register     : EMPTY
     Verification pattern      :
   Old Master Key register     : VALID
     Verification pattern      : BF494FF74B86343F
   Current Master Key register : VALID
     Verification pattern      : 2058C870E9D3194F

DES Master Key
   New Master Key register     : EMPTY
     Verification pattern      :
     Hash pattern              :
                               :
   Old Master Key register     : VALID
     Verification pattern      : 1D08F1C67A1B709A
     Hash pattern              : 2B0C723D1AB9C948
                               : E9C9E32E7FF3B7F4
   Current Master Key register : VALID
     Verification pattern      : CA6B408A02371B1D
     Hash pattern              : DF3A50AE35466123
                               : 96EF557E8BD074C1
ECC Master Key
   New Master Key register     : EMPTY
     Verification pattern      :
   Old Master Key register     : VALID
     Verification pattern      : 9999999999999999
   Current Master Key register : VALID
     Verification pattern      : 9999999999999999

RSA Master Key
   New Master Key register     : EMPTY
     Verification pattern      :
                               :
   Old Master Key register     : VALID
     Verification pattern      : EF4C65754B5088C2
                               : 2D03480BC7B952B2
   Current Master Key register : VALID
     Verification pattern      : E83F158521FEEA23
                               : 986CC9483DAFD711
```

Figure 181. Coprocessor Hardware Status Panel

The coprocessor hardware status fields on this panel contain this information:

CRYPTO DOMAIN
This field displays the value that is specified for the DOMAIN keyword in the installation options data set at ICSF startup. This is the domain in which your system is currently working. It specifies which one of several separate sets of master key registers you can currently access. A system programmer can use

the DOMAIN keyword in the installation options data set to specify the domain value to use at ICSF startup. For more information see the DOMAIN installation option.

Crypto Serial Number
The serial number is a number for the PCIXCC, CEX2C, or CEX3C.

Status
This field displays the status of the PCIXCC, CEX2C, or CEX3C.

State	Indication
ACTIVE	The verification pattern for the DES-MK matches the verification pattern of the CKDS. Requests for services can be routed to the coprocessor.
ONLINE	The coprocessor is online. The DES-MK verification pattern does not match the verification pattern in the CKDS. Requests for services cannot be routed to the coprocessor.

DES Master Key

New Master Key Register
This field shows the state of the DES new master key register.

This key register can be in any of these states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

For the PCIXCC, CEX2C, or CEX3C, there can be an old, new and current master key.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Hash Pattern
If the master key register is not EMPTY, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using multiple cryptographic coprocessors, you enter the same master key into all units. If the status of the new master key registers are valid, the master key register hash patterns for each unit should match, because the patterns verify the same key.

Old Master Key register

This field shows the states of the DES old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore, never transferred a master key to the old master key register. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

For the PCIXCC, CEX2C, or CEX3C, there can be an old, new and current master key.

Verification Pattern

When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the DES-MK verification patterns for each unit should match, because the patterns verify the same key.

Hash Pattern

If the master key register is not EMPTY, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using multiple cryptographic coprocessors, you enter the same master key into all units. If the status of the new master key registers are valid, the master key register hash patterns for each unit should match, because the patterns verify the same key.

Current Master Key register

This field shows the states of the DES master key register.

State	Indication
EMPTY	You have never entered and set an initial symmetric master key. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new symmetric master key on this coprocessor and chosen either the set or change option.

Verification Pattern

When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part

has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Hash Pattern
If the master key register is not EMPTY, the panel displays a hash pattern for the key. When you enter a new master key, record the hash pattern that appears on the panel. When the master key becomes active, you can compare the hash patterns to ensure that the one you entered and set is in the master key register.

If your system is using multiple cryptographic coprocessors, you enter the same master key into all units. If the status of the new master key registers are valid, the master key register hash patterns for each unit should match, because the patterns verify the same key.

AES Master Key

New Master Key Register
This field shows the state of the new master key register.

This key register can be in any of these states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.
FULL	You have entered an entire new master key, but have not transferred it to the master key register yet.

For the CEX2C or CEX3C, there can be an old, new and current master key.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Old Master Key register

This field shows the states of the AES old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore,

never transferred a master key to the old master key register. Or you have zeroized the domain from a TKE workstation or the Support Element.

VALID You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

For the CEX2C or CEX3C, there can be an old, new and current master key.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the AES-MK verification patterns for each unit should match, because the patterns verify the same key.

Current Master Key register
This field shows the states of the AES master key register.

State	Indication
EMPTY	You have never entered and set an initial symmetric master key. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new symmetric master key on this coprocessor and chosen either the set or change option.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

ECC Master Key

New Master Key Register
This field shows the state of the new master key register.

This key register can be in any of these states:

State	Indication
EMPTY	You have not entered any key parts for the initial master key, or you have just transferred the contents of this register into the master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.

FULL You have entered an entire new master key, but have not transferred it to the master key register yet.

For the CEX2C or CEX3C, there can be an old, new and current master key.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

Old Master Key register

This field shows the states of the ECC old master key register.

State	Indication
EMPTY	You have never changed the master key and, therefore, never transferred a master key to the old master key register. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the master key. The master key that was current when you changed the master key was placed in the old master key register.

For the CEX2C or CEX3C, there can be an old, new and current master key.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the ECC-MK verification patterns for each unit should match, because the patterns verify the same key.

Current Master Key register
This field shows the states of the ECC master key register.

State	Indication
EMPTY	You have never entered and set an initial symmetric master key. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new symmetric master key on this coprocessor and chosen either the set or change option.

Verification Pattern
When you use the master key panels to enter a new master key, *record the verification pattern* that appears for the master key when the final key part

has been entered. You can compare the verification pattern you record with this one to ensure that the key entered and the key in the new master key register are the same.

If your system is using multiple cryptographic coprocessors, you must enter the same master key into all units. If the status of the new master key registers are valid, the NMK verification patterns for each unit should match, because the patterns verify the same key.

RSA Master Key

New Master Key register
This field shows the state of the RSA new master key register.

This key register can be in any of these states:

State	Indication
EMPTY	You have not entered any key parts for the initial RSA master key, or you have just transferred the contents of this register into the RSA master key register. Or you have RESET the registers. Or you have zeroized the domain from a TKE workstation or the Support Element.
PART FULL	You have entered one or more key parts but not the final key part.

Verification Pattern
If the master key register is not EMPTY, a verification pattern is displayed.

Old Master Key register
This field shows the state of the RSA old master key register.

State	Indication
EMPTY	You have never changed the RSA master key and, therefore, never transferred an RSA master key to the RSA old master key register. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have changed the RSA master key. The RSA master key that was current when you changed the master key was placed in the RSA old master key register.

Verification Pattern
If the old asymmetric master key register is valid, the panel displays a verification pattern for the RSA old master key.

Current Master Key register
This field shows the states of the RSA master key register.

State	Indication
EMPTY	You have never entered an initial RSA master key on the coprocessor. Or you have zeroized the domain from a TKE workstation or the Support Element.
VALID	You have entered a new RSA master key on this coprocessor.

Verification Pattern
If the RSA master key registers are valid, the panel displays a verification pattern for the key. When you enter a new RSA master key, *record the verification pattern* that appears on the panel. When the RSA master key

becomes active, you can compare the verification patterns to ensure that the one you entered and set is in the master key register.

The RSA master key must be the same on all the PCI X cards. If the status of all these cryptographic coprocessors is valid, the MK verification patterns for each unit should match, because the patterns verify the same key.

Note: An audit trail of the verification patterns that the PCIXCC, CEX2C, or CEX3C calculates appears in SMF record type 82.

Displaying installation options

Installation options enable you to specify certain modes and conditions to ICSF. For example, if your installation specifies YES for the SSM option, you can enable special secure mode. You specify installation options in the installation options data set. The ICSF startup procedure, specifies the installation options data set to be used for that start of ICSF. The options become active, when you start ICSF. You can use the panels to view each installation option and its current value.

To display installation options:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 182.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 3

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 182. Selecting the Installation Options on the Primary Menu Panel

The Installation Options panel appears. Refer to Figure 183 on page 306.

```
CSFSOP00 ----------- ICSF - Installation Options --------------
COMMAND ===> 1

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  EXITS    -  Display Installation exits and exit options
  3  SERVICES -  Display Installation Defined Services
```

Figure 183. Installation Options Panel

2. Select option 1, Options, on the Installation Options panel.
   The Installation Option Display panel, which is shown in Figure 184, appears.

```
CSFSOP10 ----------- ICSF - Installation Option Display  ROW 1 TO 14 OF 15
COMMAND ===>                                                SCROLL ===> PAGE
       Active CKDS: CRYPTOR2.HCRICSF.CKDS
       Active PKDS: CRYPTOR2.HCRICSF.PKDS
       Active TKDS: CRYPTOR2.HCRICSF.TKDS
  OPTION                                              CURRENT VALUE
 --------                                             -------------
  CHECKAUTH    RACF check authorized callers              YES
  COMPAT       Allow CUSP/PCF Compatibility               NO
  DOMAIN       Current domain index or usage domain index 0
  KEYAUTH      Key Authentication in effect               YES
  CKTAUTH      CKT Authentication                         NO
  SSM          Allow Special Secure Mode                  YES
  TRACEENTRY   Number of trace entries active             599
  USERPARM     User specified parameter data              USERPARM
  REASONCODES  Source of callable services reason codes   ICSF
  SYSPLEXCKDS  Sysplex consistency for CKDS updates       YES,FAIL(YES)
  SYSPLEXPKDS  Sysplex consistency for PKDS updates       NO,FAIL(NO)
  SYSPLEXTKDS  Sysplex consistency for TKDS updates       YES,FAIL(YES)
  FIPSMODE     Operate PKCS #11 in FIPS 140-2 mode        YES,FAIL(YES)
  DEFAULTWRAP  Default symmetric key wrapping - internal  ENHANCED
  DEFAULTWRAP  Default symmetric key wrapping - external  ORIGINAL
  WAITLIST     Source of CICS Wait List if CICS installed default

****************************** BOTTOM OF DATA ********************************
```

Figure 184. Installation Options Display Panel

This panel displays the keyword for each installation option, a brief description, and the current value of the option.

You may want to change the current value of an installation option. To change and activate an installation option, you must change the option value in the installation options data set and restart ICSF. For integrity reasons, a change of the DOMAIN option also requires a re-IPL of MVS. For a complete description of these installation options and the installation options data set, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

The installation options data set that the system uses at ICSF startup contains keywords and their values which specify certain installation options. On this panel, you can view these options and their values:

Active CKDS: (data-set-name)
This specifies the name of the CKDS the system uses during the startup of ICSF. On the Installation Options Display panel, this data set name is called the active CKDS.

Active PKDS: (data-set-name)
This specifies the name of the PKDS the system uses during the startup of ICSF.

Active TKDS: (data-set-name)
This specifies the name of the TKDS the system uses during the startup of ICSF.

CHECKAUTH(YES or NO)
Indicates whether ICSF performs access control checking of Supervisor State and System Key callers. If you specify CHECKAUTH(YES), ICSF issues RACROUTE calls to perform the security access control checking and the results are logged in RACF SMF records. If you specify CHECKAUTH(NO), the authorization checks against resources in the CSFSERV class are not performed resulting in a significant performance enhancement for supervisor state and system key callers. However, the authorization checks are not logged in the RACF SMF records. If you do not specify the CHECKAUTH option, the default is CHECKAUTH(NO).

Value	Indication
YES	ICSF checks Supervisor State and System Key callers.
NO	ICSF does not check Supervisor State and System Key callers, resulting in significant performance enhancement for applications that use ICSF callable services.

COMPAT(YES, NO, or COEXIST)
Indicates whether ICSF is running in compatibility mode, noncompatibility mode, or coexistence mode with the Programmed Cryptographic Facility (PCF). If you do not specify the COMPAT option, the default value is COMPAT(NO).

Value	Indication
YES	ICSF is running in compatibility mode, which means you can run CUSP and PCF applications on ICSF because ICSF supports the CUSP and PCF macros in this mode. You do not have to reassemble CUSP and PCF applications to do this. However, you cannot start CUSP or PCF at the same time as ICSF on the same MVS system.
NO	ICSF is running in noncompatibility mode, which means that you run PCF applications on PCF and ICSF applications on ICSF. You cannot run PCF applications on ICSF, because ICSF does not support the PCF macros in this mode. You can start PCF at the same time as ICSF on the same z/OS operating system. You can start ICSF and then start PCF or you can start PCF and then start CSF. You should use noncompatibility mode unless you are migrating from PCF to ICSF.
COEXIST	ICSF is running in coexistence mode. In this mode you can run a PCF application on PCF, or you can reassemble the PCF application to run on ICSF. To do this, you reassemble the application against coexistence macros that are shipped with ICSF. In this mode, you can start PCF at the same time as ICSF on the same MVS system.

DOMAIN(n)

Allows you to access one of several separate sets of master key registers. Each domain contains these master key registers:

- A master key register that contains the active DES master key
- For the CCF, there is an auxiliary DES master key register that holds either the old or new master key
- If you have a PCICC, there are symmetric master key registers that hold both the old and new master key
- If you have a PCIXCC, CEX2C, or CEX3C, there are symmetric master key registers that hold both the old and new master key
- A PKA key management master key register
- A PKA signature master key register
- If you have a PCICC, there are ASYM-MK registers for the new, old, and current master key.
- If you have a PCIXCC, CEX2C, or CEX3C, there are ASYM-MK registers for the new, old, and current master key.

You can use domains to have separate master keys for different purposes.

You can use domains in basic mode or with PR/SM logical partition (LPAR) mode. In basic mode, you access only one domain at a time. You can specify a different master key in each domain. For example, you might have one master key for production operations and a different master key for test operations. In LPAR mode, you can have a different domain for each partition. The number you specify is the number of the domain to be used for this start of ICSF.

The DOMAIN parameter is an optional parameter in the installation options data set. It is required if more than one domain is specified as the usage domain on the PR/SM panels or if running in native mode. If you assign multiple domains to an LPAR, you can have separate master keys for different purposes.

You use the Crypto page of the Customize Activation Profile to assign a usage domain index (0 to 15) to a logical partition and enable cryptographic functions. The DOMAIN number you specify in the installation options data set while running in a partition must be the same number as the usage domain index specified for the partition on the Crypto page. For more information about logical partitions, see *zSeries PR/SM Planning Guide*.

To change and activate the other installation options, you must restart ICSF. In compatibility or coexistence mode, to change and activate the DOMAIN option, you must also re-IPL MVS. A re-IPL ensures that a program does not use a key that has been encrypted under a different master key to access a cryptographic service.

KEYAUTH(YES, NO or DISABLED)

Indicates whether or not ICSF should authenticate a key entry when it retrieves one from the in-storage cryptographic key data set. If you do not specify the KEYAUTH option, the default value is KEYAUTH(NO).

Value	Indication
YES	ICSF authenticates the keys. ICSF generates a message authentication code (MAC) for each key entry in the CKDS whenever it creates or updates the key entry. ICSF also performs a MAC verification to ensure that the entry was not changed.
NO	ICSF does not authenticate keys retrieved from the in-storage CKDS. ICSF gains a small enhancement of performance.

DISABLED
Record level authentication is disabled in the active CKDS, or the active CKDS is a variable-length CKDS. This option is disabled.

CKTAUTH(YES, NO or DISABLED)
Indicates whether or not ICSF should authenticate each CKDS record when it is read from DASD to create or refresh the in-storage CKDS. If you do not specify the CKTAUTH option, the default value is CKTAUTH(NO).

Value	Indication
YES	If CKTAUTH(YES) - the MAC authentication code in each record will be authenticated when the record is read from DASD to create or refresh the in-storage CKDS.
NO	If CKTAUTH(NO) - MAC authentication is bypassed.
DISABLED	Record level authentication is disabled in the active CKDS, or the active CKDS is a variable-length CKDS. This option is disabled.

SSM(YES or NO)
Indicates whether or not an installation can ever enable special secure mode during the running of ICSF. This mode lowers the security of your system. It allows you to input clear keys by using KGUP, produce clear PINs, use the Secure Key Import callable service and the initial use of Pass Phrase. SSM(YES) for Pass Phrase is only required for CCF systems. If you do not specify the SSM option, the default value is SSM(NO).

Value	Indication
YES	Special secure mode is enabled. For z/OS ICSF, SSM(YES) must be specified in order to use KGUP, Secure Key Import callable service, Clear PIN Generate and the initial use of Pass Phrase. SSM(YES) for Pass Phrase is only required for CCF systems.
NO	You cannot enable the special secure mode.

TRACEENTRY(n)
Specifies the number, `n`, of trace buffers to allocate for ICSF tracing. `n` is a decimal value. The range of valid values is 100 through 10000.

If you do not specify the TRACEENTRY option, the default value is TRACEENTRY(1000).

USERPARM(value)
Displays the value of an 8-byte field that is defined for installation use. ICSF stores this value in the CCVT_USERPARM field of the Cryptographic Communication Vector Table (CCVT). An application program or installation exit can examine this field and use it to set system environment information.

REASONCODES(ICSF or TSS)
Specifies which set of reason codes the application interface returns.

Value	Indication
ICSF	ICSF reason codes are returned.
TSS	TSS reason codes are returned.

ICSF is the default.

SYSPLEXCKDS(YES or NO,FAIL(YES or NO))
Displays the current value of the SYSPLEXCKDS option. The values of the

option can be YES or NO, with the default being NO. If SYSPLEXCKDS(NO,FAIL(fail-option)) is specified, no XCF signalling will be performed when an update to a CKDS record occurs. If SYSPLEXCKDS(YES,FAIL(fail-option)) is specified, the support described in "CKDS management in a sysplex" on page 191 will occur.

The fail-option can be specified as either YES or NO. If FAIL(YES) is specified then ICSF initialization will end abnormally if the request during ICSF initialization to join the ICSF sysplex group fails. If FAIL(NO) is specified, then ICSF initialization processing will continue even if the request to join the ICSF sysplex group fails. This system will not be notified of updates to the CKDS by other members of the ICSF sysplex group. The default is SYSPLEXCKDS(NO,FAIL(NO)).

SYSPLEXPKDS(YES or NO,FAIL(YES or NO))
Displays the current value of the SYSPLEXPKDS option. The values of the option can be YES or NO, with the default being NO. If SYSPLEXPKDS(NO,FAIL(fail-option)) is specified, no XCF signalling will be performed when an update to a PKDS record occurs. If SYSPLEXPKDS(YES,FAIL(fail-option)) is specified, the support described in "PKDS management in a sysplex" on page 207 will occur.

The fail-option can be specified as either YES or NO. If FAIL(YES) is specified then ICSF initialization will end abnormally if the request during ICSF initialization to join the ICSF sysplex group fails. If FAIL(NO) is specified, then ICSF initialization processing will continue even if the request to join the ICSF sysplex group fails. This system will not be notified of updates to the PKDS by other members of the ICSF sysplex group. The default is SYSPLEXPKDS(NO,FAIL(NO)).

SYSPLEXTKDS(YES or NO,FAIL(YES or NO))
Displays the current value of the SYSPLEXTKDS option. The values of the option can be YES or NO, with the default being NO. If SYSPLEXTKDS(NO,FAIL(fail-option)) is specified, no XCF signalling will be performed when an update to a TKDS record occurs. If SYSPLEXTKDS(YES,FAIL(fail-option)) is specified, the support described in "TKDS management in a sysplex" on page 212 will occur.

The fail-option can be specified as either YES or NO. If FAIL(YES) is specified then ICSF initialization will end abnormally if the request during ICSF initialization to join the ICSF sysplex group fails. If FAIL(NO) is specified, then ICSF initialization processing will continue even if the request to join the ICSF sysplex group fails. This system will not be notified of updates to the TKDS by other members of the ICSF sysplex group. The default is SYSPLEXTKDS(NO,FAIL(NO)).

FIPSMODE(YES or COMPAT or NO,FAIL(fail-option))
Indicates whether z/OS PKCS #11 services must run in compliance with the Federal Information Processing Standard Security Requirements for Cryptographic Modules, referred to as FIPS 140-2. FIPS 140-2, published by the National Institute of Standards and Technology (NIST), is a standard that defines rules and restrictions for how cryptographic modules should protect sensitive or valuable information.

By configuring z/OS PKCS #11 services to operate in compliance with FIPS 140-2 specifications, installations or individual applications can use the z/OS PKCS #11 services in a way that allows only the cryptographic algorithms (including key sizes) approved by the standard, and restricts access to the

algorithms that are not approved. For more information, refer to *z/OS Cryptographic Services ICSF Writing PKCS #11 Applications*.

DEFAULTWRAP(internal_wrapping_method,external_wrapping_method)
Specifies the default key wrapping for DES keys. Any token generated or updated by a service will be wrapped using the specified method unless overridden by rule array keyword or a skeleton token. The default wrapping method for internal and external tokens is specified independently.

Valid values for *internal_wrapping_method* and *external_wrapping_method* are:

ORIGINAL
Specifies the original CCA token wrapping be used: ECB wrapping for DES.

ENHANCED
Specifies the new X9.24 compliant CBC wrapping used. Note that the enhanced wrapping method requires a z196 with a CEX3C.

WAITLIST(value)
Displays the current value of the WAITLIST option. If WAITLIST is coded, the value will be 'dataset' and a second line will contain the name of the specified Wait List data set. If WAITLIST is not coded, the value will be 'default'. If the data set specified by the WAITLIST option cannot be allocated or opened, the value will also be 'default'.

For more information about the ICSF startup procedure and installation options, see *z/OS Cryptographic Services ICSF System Programmer's Guide*. At any time while you are running ICSF, you can check the current value of these installation options.

The installation exits and installation-defined callable services are also specified in the installation options data set, but they are not displayed on this panel. For a description of how to display the installation exit information, see “Displaying installation exits” on page 318. For a description of how to display installation-defined callable service information, see “Displaying installation-defined callable services” on page 324.

Displaying PCICC coprocessor roles

Use the ICSF panels to display the coprocessor role for the coprocessor. All the access control points enabled will be listed.

1. Select option 1, COPROCESSOR MGMT, on the Primary Option panel, as shown in Figure 185 on page 312.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 1

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 185. Selecting for Coprocessor Status on the Primary Menu Panel

2. The Coprocessor Management panel appears. Refer to Figure 186.

```
 CSFCMP00 ---------------- ICSF Coprocessor Management -------------
 COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, R, and S. See the help panel for details.

COPROCESSOR  MODULE ID/SERIAL NUMBER                 STATUS
-----------  ------------------------------          -------

_ A06                                                 ACTIVE
_ A07                                                 ACTIVE
_ C0         E589C396944007A6 5D40369997A386F4        ACTIVE
_ C1         0AA379BFD2387960 0367DC04533125FF        ACTIVE
_ P00        41-00YE1                                 ONLINE
R P01        41-00K11                                 ACTIVE
_ P02        41-0A355                                 ACTIVE
_ P03        41-0BA3F                                 ONLINE
_ P04        41-0RT2T                                 DEACTIVATED
_ P05        41-00342                                 DISABLED
_
```

Figure 186. Coprocessor Management Panel

3. Select the PCICC by entering an 'R' to the left of the coprocessor. Press enter and the Status Display panel appears (Figure 187 on page 313).

   Note: The coprocessor role can be changed with a TKE workstation. See *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

```
Access Control Manager - Read role
Authorize UDX
Clear New ASYM Master Key Register
Clear New DES Master Key Register
Clear PIN Encrypt
Clear PIN Generate - GBP
Clear PIN Generate - Interbank
Clear PIN Generate - VISA PVV
Clear PIN Generate - 3624
Clear PIN Generate Alternate - VISA PVV
Clear PIN Generate Alternate - 3624 Offset
Combine ASYM Master Key Parts
Combine DES Master Key Parts
Control Vector Translate
Cryptographic Variable Encipher
Data Key Export
Data Key Export - Unrestricted
Data Key Import
Data Key Import - Unrestricted
Digital Signature Generate
Diversified Key Generate - single length or same halves
Diversified Key Generate - CLR8-ENC
Diversified Key Generate - SESS-XOR
Diversified Key Generate - TDES-DEC
Diversified Key Generate - TDES-ENC
DATAM Key Management Control
DES Key Token Change
Encrypted PIN Generate - GBP
Encrypted PIN Generate - Interbank
Encrypted PIN Generate - 3624
Encrypted PIN Translate - Reformat
Encrypted PIN Translate - Translate
Encrypted PIN Verify - GBP
Encrypted PIN Verify - Interbank
Encrypted PIN Verify - VISA PVV
Encrypted PIN Verify - 3624
Generate CVV
Key Export
Key Export - Unrestricted
Key Generate - OP,IM,EX
Key Generate - OPIM,OPEX,IMEX,etc.
Key Generate - OPIM,OPEX,IMEX,etc. extended
Key Generate - SINGLE-R
Key Import
Key Import - Unrestricted
Key Part Import - first key part
Key Part Import - middle and last
Key Part Import - Unrestricted
Key Test
Key Translate
```

Figure 187. Coprocessor Role Status Display Panel

```
Load First ASYM Master Key Part
Load First DES Master Key Part
MAC Generate
MAC Verify
Prohibit Export
PKA Decrypt
PKA Encrypt
PKA Key Generate
PKA Key Generate - Clear
PKA Key Generate - Clone
PKA Key Import
PKA Key Token Change RTCMK
Reencipher CKDS
Retained Key Delete
Retained Key List
Secure Key Import - DES,IM
Secure Key Import - DES,OP
Secure Messaging for Keys
Secure Messaging for PINs
Set ASYM Master Key
Set DES Master Key
Symmetric Key Export - DES, PKCS-1.2
Symmetric Key Export - DES, ZERO-PAD
Symmetric Key Generate - DES, PKA92
Symmetric Key Generate - DES, PKCS-1.2
Symmetric Key Generate - DES, ZERO-PAD
Symmetric Key Import - DES, PKA92 KEK
Symmetric Key Import - DES, PKCS-1.2
Symmetric Key Import - DES, ZERO-PAD
SET Block Compose
SET Block Decompose
SET Block Decompose - PIN Extension IPINENC
SET Block Decompose - PIN Extension OPINENC
UKPT - PIN Verify, PIN Translate
Verify CVV
```

Figure 188. Coprocessor Role Status Display Panel – part 2

Displaying PCIXCC, CEX2C, and CEX3C coprocessor roles

Use the ICSF panels to display the coprocessor role for the coprocessor. All the access control points enabled will be listed.

1. Select option 1, COPROCESSOR MGMT, on the Primary Option panel, as shown in Figure 189 on page 315.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility  ---------
OPTION ===> 1

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 189. Selecting for Coprocessor Status on the Primary Menu Panel

2. The Coprocessor Management panel appears. Refer to Figure 190.

```
CSFGCMP0 ---------------- ICSF Coprocessor Management -------------
COMMAND ===>

Select the coprocessors to be processed and press ENTER.
Action characters are: A, D, E, K, R, and S. See the help panel for details.

                Serial
 CoProcessor    Number         Status   AES   DES   ECC   RSA
 -----------   ---------       ------   ---   ---   ---   ----
__ H00                         ACTIVE
__ G01          00000001       ONLINE    U     U     U     U
__ G02          00000002       ACTIVE    C     U     U     C
__ G03          00000003       ACTIVE    C     U     A     C
R  G04          00000004       ACTIVE    C     C     A     C
__ G05          00000005       ONLINE    U     C     E     U
__ E06          00000006       ACTIVE    C     C     -     C
__ G07          00000007       OFFLINE
```

Figure 190. Coprocessor Management Panel

3. Select the PCIXCC, CEX2C, or CEX3C by entering an 'R' to the left of the coprocessor. Press enter and the Status Display panel appears (Figure 191 on page 316).

   Note: A TKE is required in order to change the coprocessor role. See *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

```
 CSFCMP30 ---------------- ICSF Status Display -------------
 COMMAND ===>

Enabled access control points from the default role for X02, domain 0.

Access Control Manager - Read role
Authorize UDX
Clear Key Import/Multiple Clear Key Import - DES
Clear New AES Master Key
Clear New DES Master Key Register
Clear new ECC Master Key Register
Clear new RSA Master Key Register
Clear PIN Encrypt
Clear PIN Generate - GBP
Clear PIN Generate - Interbank
Clear PIN Generate - VISA PVV
Clear PIN Generate - 3624
Clear PIN Generate Alternate - VISA PVV
Clear PIN Generate Alternate - 3624 Offset
Combine AES Master Key Parts
Combine DES Master Key Parts
Combine RSA Master Key Parts
Control Vector Translate
Cryptographic Variable Encipher
Data Key Export
Data Key Export - Unrestricted
Data Key Import
Data Key Import - Unrestricted
Decipher - DES
Digital Signature Generate
Digital Signature Verify
Diversified Key Generate - single length or same halves
Diversified Key Generate - CLR8-ENC
Diversified Key Generate - SESS-XOR
Diversified Key Generate - TDES-DEC
Diversified Key Generate - TDES-ENC
Diversified Key Generate - TDES-XOR
Diversified Key Generate - TDESEMV2/TDESEMV4
DATAM Key Management Control
DES Key Token Change
Encipher - DES
Encrypted PIN Generate - GBP
Encrypted PIN Generate - Interbank
Encrypted PIN Generate - 3624
Encrypted PIN Translate - Reformat
Encrypted PIN Translate - Translate
Encrypted PIN Verify - GBP
Encrypted PIN Verify - Interbank
Encrypted PIN Verify - VISA PVV
Encrypted PIN Verify - 3624
Generate CVV
Key Export
Key Export - Unrestricted
Key Generate - OP,IM,EX
Key Generate - OPIM,OPEX,IMEX,etc.
Key Generate - OPIM,OPEX,IMEX,etc. extended
Key Generate - SINGLE-R
```

Figure 191. Coprocessor Role Status Displayed for a system without TKE connected

```
CSFCMP30 ---------------- ICSF Status Display -------------
COMMAND ===>

Key Import
Key Import - Unrestricted
Key Part Import - first key part
Key Part Import - middle and last
Key Part Import - ADD-PART
Key Part Import - COMPLETE
Key Part Import - RETRKPR
Key Part Import - Unrestricted
Key Test
Key Translate
Load First AES Master Key Part
Load First DES Master Key Part
Load First ECC Master Key Part
Load First RSA Master Key Part
Load Middle or Last ECC Master Key Part
Multiple Clear Key Import/Multiple Secure Key Import - AES
MAC Generate
MAC Verify
NOCV KEK usage for export-related functions
NOCV KEK usage for import-related functions
Prohibit Export
Prohibit Export Extended
PCF CKDS conversion utility
PIN Change/Unblock - change EMV PIN with IPINENC
PIN Change/Unblock - change EMV PIN with OPINENC
PKA Decrypt
PKA Encrypt
PKA Key Generate
PKA Key Generate - Clear
PKA Key Generate - Clone
PKA Key Generate - Permit Regeneration Data
PKA Key Generate - Permit Regeneration Data Retain
PKA Key Import
PKA Key Import - Import an External Trusted Block
PKA Key Token Change RTCMK
PKA Key Translate - from source EXP KEK to target EXP KEK
PKA Key Translate - from source IMP KEK to target EXP KEK
PKA Key Translate - from source IMP KEK to target IMP KEK
PKA Key Translate - from CCA RSA to SC CRT Format
PKA Key Translate - from CCA RSA to SC ME Format
PKA Key Translate - from CCA RSA to SC Visa Format
Reencipher CKDS
Remote Key Export - Gen or export a non-CCA node Key
Retained Key Delete
Retained Key List
Secure Key Import - DES,IM
Secure Key Import - DES,OP
Secure Messaging for Keys
Secure Messaging for PINs
```

Figure 192. Coprocessor Role Status Displayed for a system without TKE connected - part 2

```
Set AES Master Key
Set DES Master Key
Set ECC Master Key
Set RSA Master Key
Symmetric Algorithm Decipher - secure AES keys
Symmetric Algorithm Encipher - secure AES keys
Symmetric Key Export - AES, PKCSOAEP, PKCS-1.2
Symmetric Key Export - AES, ZERO-PAD
Symmetric Key Export - DES, PKCS-1.2
Symmetric Key Export - DES, ZERO-PAD
Symmetric Key Generate - AES, PKCSOAEP, PKCS-1.2
Symmetric Key Generate - AES, ZERO-PAD
Symmetric Key Generate - DES, PKA92
Symmetric Key Generate - DES, PKCS-1.2
Symmetric Key Generate - DES, ZERO-PAD
Symmetric Key Import - AES, PKCSOAEP, PKCS-1.2
Symmetric Key Import - AES, ZERO-PAD
Symmetric Key Import - DES, PKA92 KEK
Symmetric Key Import - DES, PKCS-1.2
Symmetric Key Import - DES, ZERO-PAD
SET Block Compose
SET Block Decompose
SET Block Decompose - PIN Extension IPINENC
SET Block Decompose - PIN Extension OPINENC
Transaction Validation - Generate
Transaction Validation - Verify CSC-3
Transaction Validation - Verify CSC-4
Transaction Validation - Verify CSC-5
Trusted Block Create - Activate an Inactive Block
Trusted Block Create - Create Block in Inactive form
UKPT - PIN Verify, PIN Translate
Verify CVV
```

Figure 193. Coprocessor Role Status Displayed for a system without TKE connected – part 3

Displaying installation exits

ICSF provides invocation points where you can use installation exits to perform processing that is specific to your installation. For example, ICSF provides a preprocessing and postprocessing exit invocation for each ICSF callable service. You can write and define an exit to set return codes at postprocessing of a callable service.

You must define each installation exit in the installation options data set. You define the ICSF name for the exit, the load module name of the exit, and the action ICSF takes if the exit fails. You can use the panels to view the ICSF name for each exit invocation. For a defined exit, you view the exit's load module name and fail options.

ICSF provides these types of exits:
- ICSF mainline exits
- Key generator utility program exit
- Callable services exits
- Cryptographic Key Data Set (CKDS) Conversion program exit
- Single-record, read-write exit
- CKDS retrieval exit
- Security exits

The mainline exits are called when you start and stop ICSF. The key generator utility program exit is called during key generator utility program processing. The callable services exits are called during each of the callable services. The CKDS conversion program exit is called during conversion of CUSP or PCF CKDS to ICSF CKDS format. The single-record, read-write exit is called when an access to a single record is made to a disk copy of the CKDS. The security exits are called during initialization and stopping of ICSF, during a call to a callable service, and during access of a CKDS entry.

For a detailed description of the ICSF exits, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

To display installation exits:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 194.

```
CSF@PRIM ---- Integrated Cryptographic Service Facility ---------
OPTION ===> 3

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 194. Selecting the Installation Options and Hardware Status Option on the Primary Menu Panel

The Installation Options panel appears. Refer to Figure 195.

```
CSFSOP00 ----------- ICSF - Installation Options --------
OPTION ===> 2

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  EXITS    -  Display Installation exits and exit options
  3  SERVICES -  Display Installation Defined Services
```

Figure 195. Installation Options Panel

2. Select option 2, Exits, on the Installation Options panel.

The first of the Installation Exits Display panels appears. Refer to Figure 196.

```
CSFSOP30 ------ ICSF - Installation Exits Display ---- ROW 1 TO 18 OF 70
COMMAND ===>

ICSF NAME      LOAD MODULE      OPTIONS
-------------  -----------      -------
 CSFAEGN                        *** No Exit Name was specified ***
 CSFAKEX                        *** No Exit Name was specified ***
 CSFAKIM                        *** No Exit Name was specified ***
 CSFAKTR                        *** No Exit Name was specified ***
 CSFATKN                        *** No Exit Name was specified ***
 CSFCKDS                        *** No Exit Name was specified ***
 CSFCKI                         *** No Exit Name was specified ***
 CSFCKM                         *** No Exit Name was specified ***
 CSFCONVX                       *** No Exit Name was specified ***
 CSFCPA                         *** No Exit Name was specified ***
 CSFCPE                         *** No Exit Name was specified ***
 CSFCSG                         *** No Exit Name was specified ***
 CSFCSV                         *** No Exit Name was specified ***
 CSFCTT                         *** No Exit Name was specified ***
 CSFCTT1                        *** No Exit Name was specified ***
 CSFCVE                         *** No Exit Name was specified ***
 CSFCVT                         *** No Exit Name was specified ***
 CSFDCO                         *** No Exit Name was specified ***
 CSFDEC                         *** No Exit Name was specified ***
 CSFDEC1                        *** No Exit Name was specified ***
 CSFDKG                         *** No Exit Name was specified ***
 CSFDKM                         *** No Exit Name was specified ***
 CSFDKX                         *** No Exit Name was specified ***
 CSFDSG                         *** No Exit Name was specified ***
 CSFDSV                         *** No Exit Name was specified ***
 CSFDVPI                        *** No Exit Name was specified ***
 CSFECO                         *** No Exit Name was specified ***
 CSFEDC         USEREDC         NONE - Take no action, if this exit fails
```

Figure 196. First Installation Exits Display Panel

The Installation Exits Display panel displays the ICSF name for all the possible installation exits your installation can write.

3. Scroll through the screens, to view all of the installation exits.

   The system programmer specified the exit identifier, the load-module-name, and the failure option for each exit your installation uses with the EXIT keyword in the installation options data set. On this panel, you can view information about any exit that is specified in the installation options data set. The exit identifier is the ICSF name for the exit.

   Table 19 shows the names for some general ICSF exits. Table 20 on page 321 and Table 21 on page 323 show the ICSF name for each callable service exit.

Table 19. General ICSF Exits and Exit Identifiers

General ICSF Exit	**Exit Identifier**
Conversion Exit	**CSFCONVX**
Cryptographic Key Data Set Retrieval Exit	**CSFCKDS**
Key Generator Utility Program Exit	**CSFKGUP**
Mainline Exits	**CSFEXIT2, CSFEXIT3, CSFEXIT4, CSFEXIT5**

Table 19. General ICSF Exits and Exit Identifiers (continued)

General ICSF Exit	Exit Identifier
Security Initialization Exit Point	**CSFESECI**
Security Key Exit Point	**CSFESECK**
Security Service Exit Point	**CSFESECS**
Security Termination Exit Point	**CSFESECT**
Single-record, Read-write Exit Point	**CSFSRRW**

Table 20. Callable Service and its Exit Identifier

Service	Exit Identifier
ANSI X9.17 EDC generate	**CSFAEGN**
ANSI X9.17 Key Export	**CSFAKEX**
ANSI X9.17 Key Import	**CSFAKIM**
ANSI X9.17 Key Translate	**CSFAKTR**
ANSI X9.17 Transport Key Partial Notarize	**CSFATKN**
Clear PIN Encrypt	**CSFCPE**
Clear PIN Generate Alternate	**CSFCPA**
Clear Key Import	**CSFCKI**
Cipher/Decipher	**CSFEDC**
Cipher Text Translate	**CSFCTT**
Cipher Text Translate (with ALET)	**CSFCTT1**
Control Vector Translate	**CSFCVT**
Cryptographic Variable Encipher	**CSFCVE**
CVV Key Combine	**CSFCKC**
Data Key Import	**CSFDKM**
Decode	**CSFDCO**
Decipher	**CSFDEC**
Decipher (with ALET)	**CSFDEC1**
Data Key Export	**CSFDKX**
Digital Signature Generate	**CSFDSG**
Digital Signature Verify	**CSFDSV**
Diversified Key Generate	**CSFDKG**
ECC Diffie-Hellman	**CSFEDH**
Encode	**CSFECO**
Encipher under Master Key	**CSFEMK**
Encipher	**CSFENC**
Encipher (with ALET)	**CSFENC1**
Encrypted PIN Generate	**CSFEPG**
HMAC Generate	**CSFHMG**
HMAC Verify	**CSFHMV**
Key Export	**CSFKEX**
Key Generate	**CSFKGN**

Table 20. Callable Service and its Exit Identifier (continued)

Service	Exit Identifier
Key Generate2	**CSFKGN2**
Key Import	**CSFKIM**
Key Part Import	**CSFKPI**
Key Part Import2	**CSFKPI2**
Key Record Create	**CSFKRC**
Key Record Create2	**CSFKRC2**
Key Record Delete	**CSFKRD**
Key Record Read	**CSFKRR**
Key Record Read2	**CSFKRR2**
Key Record Write	**CSFKRW**
Key Record Write2	**CSFKRW2**
Key Test	**CSFKYT**
Key Test2	**CSFKYT2**
Key Test Extended	**CSFKYTX**
Key Translate	**CSFKTR**
MAC Generate	**CSFMGN**
MAC Generate (with ALET)	**CSFMGN1**
MAC Verify	**CSFMVR**
MAC Verify (with ALET)	**CSFMVR1**
MDC Generate	**CSFMDG**
MDC Generate (with ALET)	**CSFMDG1**
Multiple Clear Key Import	**CSFCKM**
Multiple Secure Key Import	**CSFSCKM**
One-Way Hash Generate	**CSFOWH**
One-Way Hash Generate (with ALET)	**CSFOWH1**
PCI Interface	**CSFPCI**
PIN Change/Unblock	**CSFPCU**
PIN Generate	**CSFPGN**
PIN Generate	**CSFPGN**
PIN Translate	**CSFPTR**
PIN Verify	**CSFPVR**
PKA Decrypt	**CSFPKD**
PKA Encrypt	**CSFPKE**
PKA Key Generate	**CSFPKG**
PKA Key Import	**CSFPKI**
PKA Key Token Change	**CSFPKTC**
PKA Key Translate	**CSFPKT**
PKDS Record Create	**CSFPKRC**
PKDS Record Delete	**CSFPKRD**
PKDS Record Read	**CSFPKRR**

Table 20. Callable Service and its Exit Identifier (continued)

Service	Exit Identifier
PKDS Record Write	**CSFPKRW**
Prohibit Export	**CSFPEX**
Prohibit Export Extended	**CSFPEXX**
Random Number Generate	**CSFRNG**
Random Number Generate Long	**CSFRNGL**
Remote Key Export	**CSFRKX**
Restrict Key Attribute	**CSFRKA**
Retained Key Delete	**CSFRKD**
Retained Key List	**CSFRKL**
Secure Key Import	**CSFSKI**
Secure Key Import2	**CSFSKI2**
Secure Messaging for Keys	**CSFSKY**
Secure Messaging for PINs	**CSFSPN**
SET Block Compose	**CSFSBC**
SET Block Decompose	**CSFSBD**
Symmetric Algorithm Decipher	**CSFSAD**
Symmetric Algorithm Encipher	**CSFSAE**
Symmetric Key Generate	**CSFSYG**
Symmetric Key Import	**CSFSYI**
Symmetric Key Import2	**CSFSYI2**
Symmetric Key Export	**CSFSYX**
Symmetric MAC Generate	**CSFSMG**
Symmetric MAC Generate (with ALET)	**CSFSMG1**
Symmetric MAC Verify	**CSFSMV**
Symmetric MAC Verify (with ALET)	**CSFSMV1**
Transaction Validation	**CSFTRV**
Transform CDMF Key	**CSFTCK**
Trusted Block Create	**CSFTBC**
TR-31 Export	**CSFT31X**
TR-31 Import	**CSFT31I**
User Derived Key	**CSFUDK**
VISA CVV Service Generate	**CSFCSG**
VISA VISA CVV Service Verify	**CSFCSV**

Table 21. Compatibility Service and its Exit Identifier

Service	Exit Identifier
Encipher under Master Key	**CSFEMK**
CUSP/PCF GENKEY Service	**CSFGKC**
CUSP/PCF RETKEY Service	**CSFRTC**
Cipher/Decipher	**CSFEDC**

The load module name is the name of the module that contains the exit. The LOAD MODULE column on the panel lists the load module name for each exit. The OPTIONS column on this panel lists the action to occur if the exit fails.

4. To change the module name or failure option of an exit or add a new exit when viewing this panel, access the installation options data set. In the data set, change how you specified an exit or specify a new exit and restart ICSF.

Displaying installation-defined callable services

ICSF provides callable services to perform cryptographic functions. You can write a callable service to perform a function unique to your installation. In the installation options data set, you must define each installation-defined callable service. You specify a number to identify the service to ICSF, and you specify the load module that contains the service. You can use the panels to view the number and module name for each installation-defined callable service.

To run an installation-defined service, you must:
- Write the service.
- Define the service.
- Write a service stub and link it with your application program.

For more information about writing, defining, and running an installation-defined service, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

To display information about installation-defined callable services:

1. Select option 3, OPSTAT, on the Primary Option panel, as shown in Figure 197.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility ---------
OPTION ===> 3

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 197. Selecting the Installation Options and Hardware Status Option on the Primary Menu Panel

The Installation Options panel appears. Refer to Figure 198 on page 325.

```
CSFSOP00 ----------- ICSF - Installation Options --------
OPTION ===> 3

Enter the number of the desired option above.

  1  OPTIONS  -  Display Installation Options
  2  EXITS    -  Display Installation exits and exit options
  3  SERVICES -  Display Installation Defined Services
```

Figure 198. Installation Options Panel

2. Select option 3, Services, on the Installation Options Status panel.
   The Installation Defined Services panel appears. Refer to Figure 199.

```
CSFSOP40 -------- ICSF - Installation Defined Services --- ROW 1 TO 8 OF 8
COMMAND ===>

  SERVICE NUMBER        INSTALLATION NAME
  --------------        -----------------

         1               SERVICE1
         3               SERVICE3
         5               SERVICE5
         6               SERVICE6
         8               SERVICE8
        11               SERVICEB
        13               SERVICED
***************************BOTTOM OF DATA************************************
```

Figure 199. Installation-Defined Services Display Panel

The system programmer used the SERVICE keyword in the installation options data set to specify the service-number, the load-module-name, and fail-option for each service. The service number identies the service to ICSF. The load-module-name identifies the module that contains the installation-defined service. The Installation Name column on the panel lists the load-module-name for each installation service.

The panel displays the service number and the corresponding installation name for each installation-defined service that is specified in the installation options data set.

Note: If your installation does not have any installation-defined callable services and you select option 3, the message NO GENERIC SERVICES displays and you remain on the Installation Options panel.

At ICSF start up, you define an installation options data set that contains the options your installation wants to use. The options specify certain modes and conditions on your ICSF system. You specify the keyword and value for each option in the installation options data set. You specify the data set name in the startup procedure. When you start ICSF, the options become active.

Chapter 12. Managing User Defined Extensions

User Defined Extensions (UDX) support allows you to request implementation of a customized cryptographic callable service. This support is available for the PCICC, PCIXCC, CEX2C, and CEX3C. User Defined Extensions are ICSF functions developed for your installation with the help of IBM Global Services. Contact IBM Global Services for any problems with UDX.

With a special contract with IBM, you can develop and load your own UDXs for the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196.

Note: A TKE Workstation is required to enable the access control points for UDXs.

You must define your routine to ICSF in the Installation Options Data Set. For more detailed information on the Installation Options Data Set and the UDX keyword, see *z/OS Cryptographic Services ICSF System Programmer's Guide*.

The UDX callable service load module is loaded during ICSF startup. Use the ICSF panels to perform UDX authorization processing.

You can perform these tasks:

- Display a list of UDX ids of all authorized UDXs on a specific PCICC, PCIXCC, CEX2C, or CEX3C
- Display a list of all PCICCs, PCIXCCs, CEX2Cs, or CEX3Cs on which a specific UDX is authorized
- Authorize a UDX on any PCI cryptographic coprocessor in the system

```
CSF@PRIM --------- Integrated Cryptographic Service Facility -------
OPTION ===> 9

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 200. Selecting the UDX MGMT Option on the ICSF Primary Menu Panel

Once you have selected option 9, this panel is displayed:

```
CSFUDX00 --------- OS/390 ICSF - User Defined Extensions Management -------
OPTION ===>

Enter the number of the desired option.

  1  Display the authorized UDXs for a coprocessor

  2  Display the coprocessors where a UDX is authorized

  3  Authorize a UDX
```

Figure 201. User Defined Extensions Management Panel

Display UDXs for a coprocessor

A panel similar to Figure 202 is displayed when option 1 is selected. If you are running on a IBM @server zSeries 990 or IBM @server zSeries z890, you will see a list of PCIXCCs/CEX2Cs. For a z9 EC or z9 BC, you will see a list of CEX2Cs. For the z10 EC and z10 BC you will see a list of CEX2Cs and CEX3Cs. For the z196, you will see a list of CEX3Cs.

```
CSFUDX10 ----- ICSF - Authorized UDX Coprocessor Selection   Row 1 to 1 of 6
COMMAND ===>                                                SCROLL===> PAGE

Select the coprocessor to be queried and press ENTER.

  COPROCESSOR        SERIAL NUMBER        STATUS
  -----------        -------------        ------

  P00                41-00YE1             ACTIVE
  P01                41-00K11             ACTIVE
  P02                41-0A355             ACTIVE
  P03                41-0BA3F             ACTIVE
  P04                41-0RT2T             ACTIVE
  P07                41-00B4M             ACTIVE
```

Figure 202. Authorized UDX Coprocessor Selection Panel

Select the coprocessor you wish to query. Use an **s** to select the coprocessor. Only one coprocessor can be selected. A panel similar to Figure 203 on page 329 is displayed.

```
CSFUDX20 --------- ICSF - Authorized UDXs               Row 1 to 1 of 3
COMMAND ===>                                           SCROLL===> PAGE

For Cryptographic Coprocessor P00, the following UDXs are authorized:

  UDX id        Service Module       Comment
  ------        --------------       -------

  XD            UDXSABCD             PIN processing extensions
  XE            UDXSEFGH             Multiple hash generate service
  YH            UDXSIJKL             Secure messaging key generate
 ******************************Bottom of data******************************
```

Figure 203. Authorized UDXs Panel

This panel shows the authorized User Defined Extensions for the coprocessor selected. The UDX id is the two character code. The service module is the z/OS load module specified in the UDX keyword in the ICSF Installation Options Data Set. The comment is also specified in the UDX keyword.

Display coprocessors for a UDX

This panel is displayed when option 2 is selected from the User Defined Extensions Management Panel.

```
CSFUDX30  --------- ICSF - Coprocessors for Authorized UDXs ----------------
COMMAND ===>

Enter the two character id of the User Defined Extension to be queried.

  UDX id ===>
```

Figure 204. Coprocessors for Authorized UDXs Panel

Use this panel to specify the User Defined Extension id to be queried. A panel similar to Figure 205 appears.

```
CSFUDX40 --------- ICSF - Coprocessors for Authorized UDX      Row 1 to 1 of 3
COMMAND ===>                                                  SCROLL===> PAGE

User Defined Extension XX is authorized on the following coprocessors:

 COPROCESSOR        SERIAL NUMBER        STATUS
  -----------        -------------        ------

  P00                41-00YE1             ACTIVE
  P01                41-00K11             ACTIVE
  P04                41-0RT2T             ACTIVE
 ***********************************Bottom of data**************************
```

Figure 205. Coprocessors for Authorized UDXs Panel

Authorize a UDX

A panel similar to Figure 206 on page 330 is displayed when option 3 is selected from the User Defined Extensions Management Panel. If you are running on a z890 or z990, you will see a list of PCIXCCs/CEX2Cs. If you are running on a z9 EC or z9 BC, you will see a list of CEX2Cs. If you are running on a z10 EC and z10 BC,

you will see a list of CEX2Cs and CEX3Cs. If you are running on a z196, you will see a list of CEX3Cs.

```
CSFUDX50 --------- ICSF - Authorize User Defined Extension --  Row 1 to 1 of 6
COMMAND ===>                                                  SCROLL===> PAGE

UDX id ==>
Password==>

Select the coprocessors to be processed and press ENTER.

  COPROCESSOR        SERIAL NUMBER        STATUS
   -----------        -------------        ------

   P00                41-00YE1             ACTIVE
   P01                41-00K11             ACTIVE
   P02                41-0A355             ACTIVE
   P03                41-0BA3F             ONLINE
   P04                41-0RT2T             ACTIVE
   P07                41-00B4M             ACTIVE
    ******************************Bottom of data**************************
```

Figure 206. Authorize UDXs Panel

If your UDX was developed for your installation by IBM Global Services, you may have been provided a password associated with the UDX.

Use this panel to authorize a specific User Defined Extension on one or more PCI Cryptographic Coprocessors. (UDXs on PCIXCCs, CEX2Cs, and CEX3Cs do not require authorization via this panel.)

Enter the the two character id in the UDX id field. Enter the sixteen hexadecimal characters of the password in the Password field. Use an **s** to select the coprocessors where the UDX will be authorized.

Chapter 13. Using the Utility Panels to Encode and Decode Data

Encoding data is enciphering data by using a clear key. Decoding data is deciphering data by using the same clear key that enciphered the data. You can use the utility panels to encode and decode data.

Note: ICSF must be active with a valid master key to use the encode and decode options. Encode and decode are available only on a DES-capable server or processor. CDMF-only systems cannot use encode and decode.

Steps for encoding data

To encode data:

1. Select option 5, UTILITY, on the Primary Option panel, and press ENTER. Refer to Figure 207.

```
CSF@PRIM ----- Integrated Cryptographic Service Facility ---------
OPTION ===> 5

Enter the number of the desired option.

  1  COPROCESSOR MGMT    -  Management of Cryptographic Coprocessors
  2  MASTER KEY MGMT     -  Master key set or change, CKDS/PKDS processing
  3  OPSTAT              -  Installation options
  4  ADMINCNTL           -  Administrative Control Functions
  5  UTILITY             -  ICSF Utilities
  6  PPINIT              -  Pass Phrase Master Key/KDS Initialization
  7  TKE                 -  TKE Master and Operational key processing
  8  KGUP                -  Key Generator Utility processes
  9  UDX MGMT            -  Management of User Defined Extensions

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Press ENTER to go to the selected option.
Press END   to exit to the previous menu.
```

Figure 207. Selecting the Utilities Option on the Primary Menu Panel

The Utilities panel appears. See Figure 208 on page 332.

```
CSFUTL00 -------------- ICSF - Utilities --------------------------
OPTION ===> 1


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 208. Selecting the Encode Option on the Utilities Panel

2. Select option 1, Encode, on this panel.
   The Encode panel appears. See Figure 209.

```
CSFECO00 -------------- ICSF - Encode -----------------------------
COMMAND ===>


Enter data below:

  Clear Key       ===>  0000000000000000   Clear Key Value
  Plaintext       ===>  0000000000000000   Data to be encoded
  Ciphertext         :  0000000000000000   Output from the encode
```

Figure 209. Encode Panel

3. In the Clear Key field, enter the clear value of the key you want ICSF to use to encode the data.
4. In the Plaintext field, enter the data in hexadecimal form that you want ICSF to encode.
5. Press ENTER.
   ICSF uses the clear key and the DES algorithm to encode the data. The encoded data is displayed in the Ciphertext field.
6. Press END to return to the Utilities panel.
7. Press END to return to the Primary Option panel.

Steps for decoding data

To decode data:

1. Select option 5, UTILITY, on the Primary Option panel and press ENTER.
   The Utilities panel appears. See Figure 210 on page 333.

```
CSFUTL00 -------------- ICSF - Utilities --------------------------
OPTION ===> 2


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
```

Figure 210. Selecting the Decode Option on the Utilities Panel

2. Select option 2, Decode, on this panel.

   The Decode panel appears. See Figure 211.

```
CSFECO00 -------------- ICSF - Decode -----------------------------
COMMAND ===>


Enter data below:

  Clear Key       ===>  0000000000000000   Clear Key Value
  Ciphertext      ===>  0000000000000000   Data to be decoded
  Plaintext          :  0000000000000000   Output from the decode
```

Figure 211. Decode Panel

3. In the Clear Key field, enter the clear value of the key you want ICSF to use to decode the data. This needs to be the same key value that was used to encode the data.
4. In the Ciphertext field, enter the data in hexadecimal form that you want ICSF to decode.
5. Press ENTER.

   ICSF uses the clear key and the DES algorithm to decode the data. The decoded data is displayed in the Plaintext field.
6. Press END to return to the Utilities panel.
7. Press END to return to the Primary Option panel.

Chapter 14. Using the Utility Panels to Manage Keys in the PKDS

This capability enhances the ICSF utilities panel, option 6 PKDSKEYS, to provide PKDS key management capability. This new function gives customers the ability to:

- Generate an RSA key pair PKDS record
- Delete an existing PKDS record
- Export an existing public key to an X.509 certificate stored in an MVS physically sequential data set
- Import a public key from an X.509 certificate stored in an MVS physically sequential data set.

These functions are intended for use with the Encryption Facility, but may be used for other purposes.

To use the full function of the ICSF PKDS Key Management panels, you must have a PCICC, PCIXCC, CEX2C, or CEX3C cryptographic coprocessor. If you do not have one of these coprocessors, you cannot generate key pairs using the panels.

RACF Protecting ICSF Services used by the New Panels

ICSF uses these ICSF callable services to create or delete PKDS records and export or import RSA keys to X.509 certificates:

CSNDKRR
Ensures that the specified PKDS label does not already exist.

CSNDPKB
Builds the skeleton key token.

CSNDKRC
Creates the PKDS record.

CSNKRD
Deletes the PKDS record.

CSNDKRR
Reads the record from the PKDS.

CSNDPKX
Extracts only the public key from the record.

CSNBOWH
Hashes the to-be-signed portion of the generated certificate.

CSNDDSG
Signs the hash.

If you are using RACF or a similar security product, ensure that the security administrator authorizes ICSF to use these services and any cryptographic keys that are input. For information about ICSF callable services, see Introducing Symmetric Key Cryptography and Using Symmetric Key Callable Services in *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Follow these steps to manage keys in the PKDS.

Select option 6, PKDSKEYS, on the ICSF Utilities panel as shown in Figure 212.

```
CSFUTL00 ---------------- ICSF - Utilities --------------------------
OPTION ===> 6


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
  7  PKCS11 TOKEN  -  Manage PKCS11 tokens




Press ENTER to go to the selected option.
Press END to exit to the previous menu.
```

Figure 212. Selecting the PKDSKEYS option on the ICSF Utilities Panel

If option 6 is selected on the utilities panel, the ICSF - PKDS Keys is presented:

```
CSFPKY00 ---------------- ICSF - PKDS Keys --------------------------

COMMAND ===>

    Enter the RSA record's label for the actions below
     ==>


    Select one of the following actions then press ENTER to process:

    -  Generate a new RSA key pair record
       Enter the key length  ===>          512, 1024, 2048, 3072 or 4096
       Enter Private Key Name (optional)
        ==>

    -  Delete the existing public key or key pair RSA record

    -  Export the RSA record's public key to a certificate data set
       Enter the DSN  ===>
       Enter desired subject's common name (optional)
        CN=

    -  Create a RSA public key record from an input certificate.
       Enter the DSN  ===>
```

Figure 213. ICSF PKDS Keys Panel

From this panel you can manage RSA key entries in the PKDS. To create a new record or manage an existing PKDS record, supply the PKDS key label and then select an action.

Supported actions:

- Generate a new RSA public/private PKDS key pair record
- Delete an existing key record
- Export a public key to an X.509 certificate for importation elsewhere
- Import a public key from an X.509 certificate received from elsewhere

Generate a new RSA public/private PKDS key pair record

The key pair generated may be used to encrypt and recover archive data. It may also be used to recover encrypted data transmitted to you by another party.

- The key length in bits must be specified (512, 1024, 2048, 3072 or 4096).
- The private key name may also be specified, but is optional.
- Blank is the default for the private key name.
- Callable services:
  - CSNDKRR - ensures that the specified PKDS label doesn't already exist
  - CSNDPKB - builds the skeleton key token
  - CSNDPKG - generates the key pair
  - CSNDKRC - creates the PKDS record

Note:

1. The key pair created may be used for generating and verifying digital signatures and key management.
2. The public exponent used for all keys generated through this service is X'010001'.

Delete an existing key record

This service may be used to delete any PKDS record, whether or not created by this utility.

- If Delete is selected, a new popup panel Delete PKDS Key Confirmation (CSFPKY0P) is displayed forcing the user to confirm the delete.
- Callable services:
  - CSNDKRD - deletes the PKDS record

Note: If a public or private key pair record is deleted, any data encrypted with the private key will no longer be recoverable.

Export a public key to an X.509 certificate for importation elsewhere

This service is used to encase the public half of a public/private key PKDS record into an X.509 digital certificate so that it may be sent to another party. Then you may receive data from another party enciphered under the public key which you may recover using the same PKDS record.

- The certificate created will be stored in an MVS physical sequential data set.
- The output data set will be created by the service with RECFM(V B).
- You must supply the data set name where the certificate is to be stored.
- The data set should not exist prior to export.
  - If the data set exists prior to export, its contents will be destroyed and the data set reallocated new.
- The data set can not be a PDS or PDS member.
- You may specify a value for the subject's common name in the certificate, if desired.
  - If no value is specified, the PKDS record's label will be used as the common name.
- Callable services:
  - CSNDKRR - reads the record from the PKDS

– CSNDPKX - extracts just the public key from the record
– CSNBOWH - hashes the to-be-signed portion of the generated certificate
– CSNDDSG - signs the hash

Note:

1. The key record specified must be a public or private key pair record and must support signing.
2. The certificate's validity date range is hard coded to be July 1, 2005 - December 31, 2040 UTC.
3. The certificate created will be self-signed and DER encoded (binary).

Import a public key from an X.509 certificate received from elsewhere

This service is used to build a public PKDS key record from an X.509 digital certificate sent to you by another party. Once complete, you may send the other party data enciphered under the public which the other party can recover.

- The data set name supplied must contain the certificate
- The certificate must be a single DER encoded certificate.
- Base64 encoded certificates are not supported.
- The data set containing the certificate must be physical sequential with RECFM(V B).
- The data set can not be a PDS or PDS member.
- Callable services:
  – CSNDPKB - builds the public key token
  – CSNDKRC - creates the PKDS record

Note: No signature check is performed on the certificate.

Processing Indicators

Success

When Generate or Delete is specified and the function is successful, the PKDS Key Request Successful panel is presented:

```
CSFPKY01 ------------- ICSF - PKDS Key Request Successful----------------

COMMAND ===>

Label ==> PKDS.LABEL



Key function completed successfully

Press ENTER or END to return to the previous menu.
```

Figure 214. PKDS Key Request Successful

When Export is specified and the function is successful, the PKDS Public Key Export Successful panel is presented:

```
CSFPKY03 -------------- ICSF - PKDS Public Key Export Successful---------------

COMMAND ===>

Label ==> PKDS.LABEL

Output Data Set ===> 'DATA SET NAME'


Export to certificate successful.  Binary (DER) certificate created.

Press ENTER or END to return to the previous menu.
```

Figure 215. PKDS Public Key Export Successful

When these options are specified and the function is successful, these panels are generated:

- Generate or Delete - PKDS Key Request Successful Panel (CSFPKY01)
- Export - PKDS Public Key Export Successful Panel (CSFPKY03)
- Import - Public Key Import Successful Panel (CSFPKY05)

When Import is specified and the function is successful, the PKDS Public Key Import Successful panel is presented:

```
CSFPKY05 ---------------------- ICSF - PKDS Public Key Import Successful----------------

COMMAND ===>

Label ==> PKDS.LABEL

Input Data Set ===> 'DATA SET NAME'


Import from certificate successful.  Public key PKDS entry created.

Press ENTER or END to return to the previous menu.
```

Figure 216. PKDS Public Key Import Successful

Failure

For the various functions, these expected errors will generate an error message without presenting a new panel:

1. Panel input errors (for example, not specifying a PKDS label to work with)
2. ICSF not active
3. Authorization failures (all functions)
4. Incorrect label syntax (all functions)
5. PKDS label already exists (Generate and Import only)
6. PKDS label not found (Delete and Export only)
7. Specifying a PDS member (Import and Export only)
8. Can't export a public key only PKDS record (Export only)

Unexpected ICSF callable service errors from any function, cause the PKDS Key Request Failed Panel to appear.

```
CSFPKY02 ------------------------ ICSF - PKDS Key Request Failed -------------------

COMMAND ===>

Label ==> PKDS.LABEL




Key function failed
ICSF RETURN CODE: ret-code  REASON CODE: rsn-code

See the z/OS Cryptographic Services ICSF Application Programmer's Guide for
information on these return and reason codes.

Press ENTER or END to return to the previous menu.
```

Figure 217. PKDS Key Request Failed

Non-ICSF related errors for Export cause the PKDS Public Key Export Failure Panel to appear.

```
CSFPKY04 ----------------- ICSF - PKDS Public Key Export Failure --- <error-msg>

COMMAND ===>

Label ==> PKDS.LABEL

Output Data Set ===> 'PKDS.LABEL'



Export to certificate failed.  Press PF1 for more information.

Press ENTER or END to return to the previous menu.
```

Figure 218. PKDS Public Key Export Failure

Non-ICSF related errors for Import cause the PKDS Public Key Import Failure Panel to appear.

```
CSFPKY06 ----------------- ICSF - PKDS Public Key Import Failure --- <error-msg>

COMMAND ===>

Label ==> PKDS.LABEL

Input Data Set ===> 'DATA SET NAME'



Import from certificate failed.  Press PF1 for more information.

Press ENTER or END to return to the previous menu.
```

Figure 219. PKDS Public Key Import Failure

Chapter 15. Using PKCS11 Token Browser Utility Panels

PKCS #11 is a standard set of programming interfaces for cryptographic functions. A subset of these functions is supported by ICSF. In the context of PKCS #11, a token is a representation of a cryptographic device, such as a smart card reader.

The PKCS11 token browser allows management of PKCS #11 tokens and objects in the TKDS. The PKCS11 token browser is option 7 PKCS11 TOKEN on the ICSF utilities panel. The user must have SAF authority to manage tokens and SAF authority to a token to manage the objects of a token (see "RACF Protecting ICSF Services used by the Token Browser Utility Panels").

RACF Protecting ICSF Services used by the Token Browser Utility Panels

CRYPTOZ is a resource class defined in RACF in support of PKCS #11. Access to PKCS #11 tokens in ICSF is controlled by the CRYPTOZ class, with different access levels as well as a differentiation between standard users and security officers. For each token, there are two resources in the CRYPTOZ class for controlling access to tokens:

- The resource USER.*token-name* controls the access of the User role to the token
- The resource SO.*token-name* controls the access of the Security Officer (SO) role to the token.

A user's access level to each of these resources (read, update, or control) determines the user's access level to the token.

There are six possible token access levels. Three are defined by the PKCS #11 standard, and three are unique to z/OS®. The PKCS #11 token access levels are:

- User R/O: Allows the user to read the token including its private objects, but the user cannot create new token or session objects or alter existing ones.
- User R/W: Allows the user read/write access to the token object including its private objects.
- SO R/W: Allows the user to act as the security officer for the token and to read, create, and alter public objects on the token.

The token access levels unique to z/OS are:

- Weak SO: A security officer that can modify the CA certificates contained in a token but not initialize the token. (For example, a system administrator who determines the trust policy for all applications on the system.)
- Strong SO: A security officer that can add, generate or remove private objects in a token. (For example, a server administrator.)
- Weak User: A User that cannot change the trusted CAs contained in a token. (For example, to prevent an end-user from changing the trust policy of his or her token.)

Table 22 on page 342 shows how a user's access level to a token is derived from the user's access level to a resource in the SAF CRYPTOZ class.

Table 22. Token access levels

	SAF access level		
CRYPTOZ resource	**READ**	**UPDATE**	**CONTROL**
SO.*token-label*	Weak SO Can read, create, delete, modify, and use public objects	SO R/W Same ability as Weak SO plus can create and delete tokens	Strong SO Same ability as SO R/W plus can read but not use (see Note1) private objects; create, delete, and modify private objects
USER.*token-label*	User R/O Can read and use (see Note 1) public and private objects	Weak User Same ability as User R/O plus can create, delete, and modify private and public objects. Cannot add, delete, or modify certificate authority objects	User R/W Same ability as Weak User plus can add, delete, and modify certificate authority objects

Notes:

1. "Use" is defined as any of these:
   - Performing any cryptographic operation involving the key object; for example C_Encrypt
   - Searching for key objects using sensitive search attributes
   - Retrieving sensitive key object attributes.

   The sensitive attribute for a secret key is CKA_VALUE. The sensitive attribute for the Diffie Hellman, DSA, and Elliptic Curve private key objects is CKA_VALUE. The sensitive attributes for RSA private key objects are CKA_PRIVATE_EXPONENT, CKA_PRIME_1, CKA_PRIME_2, CKA_EXPONENT_1, CKA_EXPONENT_2, and CKA_COEFFICIENT.
2. The CRYPTOZ resources can be defined as "RACF-DELEGATED" if required. For information about delegated resources, see *z/OS Security Server RACF Security Administrator's Guide*.
3. If the CSFSERV class is active, ICSF performs access control checks on the underlying callable services. The user must have READ access to the appropriate CSFSERV class resource. Table 23 lists the resources in the CSFSERV class for token services.
4. READ access is required for token management via RACDCERT or gskkyman command. To manage tokens through the token browser panels, you'll need READ access to services listed in Table 23.

Table 23. Resources in the CSFSERV class for token services

Name of resource	Service
CSF1GAV	Get object attributes
CSF1SAV	Update object attributes
CSF1TRC	Token or object creation
CSF1TRD	Token or object deletion
CSF1TRL	Token or object find

5. Although the use of generic profiles is permitted for the CRYPTOZ class, we recommend that you do not use a single generic profile to cover both the SO.*token-label* and USER.*token-label* resources. You should not do this, because another resource (FIPSEXEMPT.*token-label*, which is described in *z/OS Cryptographic Services ICSF Writing PKCS #11 Applications*) can be used to indicate whether compliance with the FIPS 140-2 standard is desired at the token level. Creating a profile that uses generic characters to match both the SO and USER portion of the resource names (for example *.*token-label*) will also inadvertently match the FIPSEXEMPT.token-label resource and can have unintended consequences.

Token browser panel utility

Follow these steps to use the PKCS11 token browser panel utility.

Select option 7, PKCS11 TOKEN, on the ICSF Utilities panel as shown in Figure 220.

```
CSFUTL00 ---------------- ICSF - Utilities -------------------------
OPTION ===> 7


Enter the number of the desired option.

  1  ENCODE        -  Encode data
  2  DECODE        -  Decode data
  3  RANDOM        -  Generate a random number
  4  CHECKSUM      -  Generate a checksum and verification and
                      hash pattern
  5  PPKEYS        -  Generate master key values from a pass phrase
  6  PKDSKEYS      -  Manage keys in the PKDS
  7  PKCS11 TOKEN  -  Management of PKCS11 tokens









Press ENTER to go to the selected option.
Press END to exit to the previous menu.

OPTION ===>
```

Figure 220. Selecting the PKCS11 TOKEN option on the ICSF Utilities Panel

Token Browser main panel

If option 7 is selected on the utilities panel, the ICSF Token Management - Main Menu is presented:

```
CSFTBR00  ------------ ICSF Token Management - Main Menu ----------

  1  Create a new token
  2  Delete an existing token
  3  Manage an existing token
  4  List existing tokens

  Full or partial token name ____________________________________

Press ENTER to go to the selected option.
Press END to exit to the previous menu.

OPTION ===> 4
```

Figure 221. ICSF Token Management - Main Menu Panel

Token Create Successful

If option 1 is selected on the Main Menu panel, the ICSF - PKCS11 Token Create Successful menu is presented:

```
CSFTBR01 -------- ICSF - PKCS11 Token Create Successful ----------

Token name ==> token_name

Token creation completed successfully.

Press END to exit to the previous menu.

COMMAND ===>
```

Figure 222. ICSF Token Management - PKCS11 Token Create Successful panel

Token Delete Confirmation

If option 2 is selected on the Main Menu panel, the ICSF - Delete Confirmation menu is presented:

```
CSFTBR02 ----- ICSF - Delete Confirmation -----

Are you sure you want to delete token token_name?

===> Y      Enter Y to confirm

COMMAND ===>
```

```
CSFTBR02 ----- ICSF - Delete Confirmation -----

Are you sure you want to delete this object?

===> Y      Enter Y to confirm

COMMAND ===>
```

Figure 223. ICSF Token Management - PKCS11 Token Delete Confirmation panel

Token Delete Successful

If option Y is selected for delete token token_name on the ICSF - Delete Confirmation panel, the ICSF - PKCS11 Token Delete Successful menu is presented:

```
CSFTBR03 -------- ICSF - PKCS11 Token Delete Successful -----------

Token name ==> token_name

Token was deleted successfully.

Press END to exit to the previous menu.

COMMAND ===>
```

Figure 224. ICSF Token Management - PKCS11 Token Delete Successful panel

Object Delete Successful

If option Y is selected for delete this object on the ICSF - Delete Confirmation panel, the ICSF - PKCS11 Object Delete Successful menu is presented:

```
CSFTBR04 -------- ICSF - PKCS11 Object Delete Successful ---------

Object was deleted successfully.

Press END to exit to the previous menu.

COMMAND ===>
```

Figure 225. ICSF Token Management - PKCS11 Object Delete Successful panel

List Token panel

If option 4 is selected on the Main Menu panel, the ICSF Token Management - List Token menu is presented:

```
CSFTBR10 ------------ ICSF Token Management - List Tokens ---- Row 1 to 4 of 4

  Select a token to manage(M) or delete(D) then press ENTER

  Press END to return to the previous menu.

M SAMPLE.TOKEN
_ TOKEN.BOB
_ TOKEN.FRED
_ TOKEN.FRED.SECONDARY


COMMAND ===>
```

Figure 226. ICSF Token Management - List Token Panel

Note: Only tokens that you have authorization for are displayed.

Token Details panel

If manage (M) is selected on the List Tokens panel, the ICSF Token Management - Token Details menu is presented:

```
CSFTBR20 ------------ ICSF Token Management - Token Details -----------

Token name: SAMPLE.TOKEN
Manufacturer: z/OS PKCS11 API
Model: HCR7740
Serial Number: 0
Number of objects: 7

Select objects to process then press ENTER

Press END to return to the previous menu.

--------------------------------------------------------------------------------
_ Object 1         DATA          PRIVATE: TRUE       MODIFIABLE: TRUE
   LABEL:          Data for lastpass
   APPLICATION:    90893E31
   OBJECT ID:      Not-specified
   VALUE:          0123456789ABCDEF



_ Object 2         CERTIFICATE   PRIVATE: FALSE      MODIFIABLE: TRUE
                                 DEFAULT: TRUE       CATEGORY: Unspecified
   LABEL:          Certificate XGH52
   SUBJECT:        OU=PKCS11 Test End-Entity, O=IBM, C=US
   ID:             E7C7C8F5F260C6C360D5D9E36DF3
   ISSUER:         OU=PKCS11 Test CA, O=IBM, C=US
   SERIAL NUMBER:  01

_ Object 3         ????          PRIVATE: ????       MODIFIABLE: ????

  NOT AUTHORIZED TO BROWSE




_ Object 4         SECRET KEY    PRIVATE: TRUE       MODIFIABLE: TRUE
                                 EXTRACTABLE: TRUE   SENSITIVE: FALSE
   LABEL:          bulk data key9EC3
   ID:             F6F4E7E9F4F5C6F3
   KEY TYPE:       DES2
   VALUE LEN:      16
   USAGE FLAGS:    Enc(T),Sign(T),Wrap(F),Derive(F),Dec(T),Verify(T),Unwrap(F)

_ Object 5         PUBLIC KEY    PRIVATE: FALSE      MODIFIABLE: TRUE
   LABEL:          public key cx021A
   SUBJECT:        Not-specified
   ID:             83A7F0F2F1C1
   MODULUS:        86E1B7C7594E4B6B963C4A1D361A23839567A993D05FC0F2D6C0EB1E...
   MODULUS BITS:   1024
   USAGE FLAGS:    Enc(F),Verify(T),VerifyR(F),Wrap(T),Derive(F)

_ Object 6         PRIVATE KEY   PRIVATE: TRUE       MODIFIABLE: TRUE
                                 EXTRACTABLE: TRUE   SENSITIVE: FALSE
   LABEL:          privatekey cx021A
   SUBJECT:        Not-specified
   ID:             83A7F0F2F1C1
   MODULUS:        86E1B7C7594E4B6B963C4A1D361A23839567A993D05FC0F2D6C0EB1E...
   USAGE FLAGS:    Dec(F),Sign(T),SignR(F),Unwrap(T),Derive(F)

_ Object 7:        DOMAIN PARAMS  PRIVATE: FALSE   MODIFIABLE: TRUE
     LABEL:         My DSA Domain Parameters
     KEY TYPE:      DSA
     PRIME BITS:    1024
     PRIME:         51c3d4df9048626B9AD71EF6F3234554df9048626B9AD71EF6F3...
     SUB PRIME:     df9048626B9AD71EF6F33081890df9048626B9AD
     BASE:          B9AD71EF6F3234554df9048626B9AD71EF0B9AD71EF6F3234554...

COMMAND ===>
```

Figure 227. ICSF Token Management - Token Details panel

Data Object Details panel

If a data object is selected on the Token Details panel, the ICSF Token Management - Data Object Details menu is presented:

```
CSFTBR34 ----------- ICSF Token Management -   Data Object Details ------------

Object 1       from token label: SAMPLE.TOKEN

Select an Action:

  1  Modify one or more fields with the new values specified
  2  Delete the entire object
-------------------------------------------------------------------------------
                                                                        More:     +
   OBJECT CLASS:                   DATA
   PRIVATE:                        TRUE
   MODIFIABLE:                     TRUE
   LABEL:                          Data for lastpass
                         New value:
   APPLICATION:                    90893E31
                         New value:
   ID:                             F6F4E7E9F4F5C6F3
                         New value:
   OBJECT ID:                      Not-specified
   VALUE:
      0123456789ABCDEF

Press ENTER to process.
Press END to exit to the previous menu.

COMMAND ===>
```

Figure 228. ICSF Token Management - Data Object Details panel

Certificate Object Details panel

If a certificate object is selected on the Token Details panel, the ICSF Token Management - Certificate Object Details menu is presented:

```
CSFTBR30 --------- ICSF Token Management - Certificate Object Details ---------

Object 2      from token label: SAMPLE.TOKEN

Select an Action:
  1  Process select DER fields(*) using external command.
       Enter UNIX command pathname (formatter must accept input from STDIN):
       ____________________________________________________________________
  2  Modify one or more fields with the new values specified
  3  Delete the entire object

--------------------------------------------------------------------------------
                                                                      More:     +
   OBJECT CLASS:                   CERTIFICATE
   PRIVATE:                        FALSE
   MODIFIABLE:                     TRUE
   LABEL:                          Certificate XGH52
                       New value:
   CERTIFICATE TYPE:               X.509
   TRUSTED:                        TRUE
   SUBJECT*:                       OU=PKCS11 Test End-Entity, O=IBM, C=US

   ID:                             E7C7C8F5F260C6C360D5D9E36DF3
                       New value:
   ISSUER*:                        OU=PKCS11 Test CA, O=IBM, C=US

   SERIAL NUMBER:                  01
   CERTIFICATE CATEGORY:           Unspecified
                       New value: Unspecified   User   Authority   Other
   APPLICATION:                    90893E31-SDE455A
   DEFAULT:                        TRUE
                       New value: FALSE
   VALUE*:
     3082026B308201D4A003020102020101  |0..k0..........|
     300D06092A864886F70D010105050030  |0...*.H........0|
     34310B3009060355040613025553310C  |41.0...U....US1.|
     300A060355040A130349424D31173015  |0...U....IBM1.0.|
     060355040B130E504B43533131205465  |..U....PKCS11 Te|
     7374204341301E170D30363034313830  |st CA0...0604180|
     34303030305A170D3037303431393033  |40000Z..07041903|
     353935395A303C310B30090603550406  |5959Z0<1.0...U..|
     13025553310C300A060355040A130349  |..US1.0...U....I|
     424D311F301D060355040B1316504B43  |BM1.0...U....PKC|
     5331312054657374204564E642D456E74  |S11 Test End-Ent|
     69747930819F300D06092A864886F70D  |ity0..0...*.H...|
     010101050003818D0030818902818100  |.........0......|
     AAA38A1F45C93C1772C5AC223A1DAE32  |....E.<.r.."...2|
     F932C5347931CFF6696D9A4205A5957D  |.2.4y1..im.B...}|
     8CD83CEFD719E82DDEF5E4C5FB53E89D  |..<....-.....S..|
     80927186B89A619756CF75500CCD5C47  |..q...a.V.uP..\G|
     9F46E01C76EAD0061ABF8CB2357C9603  |.F..v.......5|..|
     3CC1E7E464BF4289AE0AD51E9FA2E86C  |<...d.B........l|
     C80504552C2E35C0F5BE4F13ACEC8253  |...U,.5...O....S|


Press ENTER to process.
Press END to exit to the previous menu.

COMMAND ===>
```

Figure 229. ICSF Token Management - Certificate Object Details panel

Secret Key Object Details panel

If a secret key object is selected on the Token Details panel, the ICSF Token Management - Secret Key Object Details menu is presented:

```
CSFTBR33 --------- ICSF Token Management - Secret Key Object Details ----------

Object 4       from token label: SAMPLE.TOKEN

Select an Action:

  1  Modify one or more fields with the new values specified
  2  Delete the entire object
-------------------------------------------------------------------------------
                                                                        More:     +
   OBJECT CLASS:                   SECRET KEY
   PRIVATE:                        TRUE
   MODIFIABLE:                     TRUE
   LABEL:                          bulk data key9EC3
                         New value:
   ID:                             F6F4E7E9F4F5C6F3
                         New value:
   KEY TYPE:                       DES2
   START DATE:                     Not-specified
                         New value:               YYYYMMDD
   END DATE:                       Not-specified
                         New value:               YYYYMMDD
   DERIVE:                         FALSE
   LOCAL:                          FALSE
   KEY GEN MECHANISM:              UNAVAILABLE INFORMATION
   ENCRYPT:                        TRUE
                         New value: FALSE
   VERIFY:                         TRUE
                         New value: FALSE
   WRAP:                           FALSE
                         New value: TRUE
   DECRYPT:                        TRUE
                         New value: FALSE
   SIGN:                           TRUE
                         New value: FALSE
   UNWRAP:                         FALSE
                         New value: TRUE
   EXTRACTABLE:                    TRUE         (Cannot be changed from FALSE
                         New value: FALSE         to TRUE)
   SENSITIVE:                      FALSE        (Cannot be changed from TRUE
                         New value: TRUE          to FALSE)
   ALWAYS SENSITIVE:               FALSE
   NEVER EXTRACTABLE:              FALSE
   VALUE:                          NOT DISPLAYABLE
   VALUE LEN:                      16
   FIPS140                         FALSE
   APPLICATION:                    90893E31

Press ENTER to process.
Press END to exit to the previous menu.

COMMAND ===>
```

Figure 230. ICSF Token Management - Secret Key Object Details panel

Public Key Object Details panel

If a public key object is selected on the Token Details panel, the ICSF Token Management - Public Key Object Details panel is presented:

```
CSFTBR31 --------- ICSF Token Management - Public Key Object Details ----------

Object 5      from token label: SAMPLE.TOKEN

Select an Action:
  1  Process select DER fields(*) using external command
        Enter UNIX command pathname (formatter must accept input from STDIN):
        ____________________________________________________________________
  2  Modify one or more fields with the new values specified
  3  Delete the entire object

--------------------------------------------------------------------------------
                                                                        More:     +
   OBJECT CLASS:                   PUBLIC KEY
   PRIVATE:                        FALSE
   MODIFIABLE:                     TRUE
   LABEL:                          public key cx021A
                       New value:
   TRUSTED:                        TRUE
   SUBJECT*:                       Not-specified

   ID:                             83A7F0F2F1C1
                       New value:
   KEY TYPE:                       RSA
   START DATE:                     20050103
                       New value:               YYYYMMDD
   END DATE:                       20071231
                       New value:               YYYYMMDD
   DERIVE:                         FALSE
   LOCAL:                          FALSE
   KEY GEN MECHANISM:              UNAVAILABLE INFORMATION
   ENCRYPT:                        FALSE
                       New value: TRUE
   VERIFY:                         TRUE
                       New value: FALSE
   VERIFY RECOVER:                 FALSE
                       New value: TRUE
   WRAP:                           TRUE
                       New value: FALSE
   FIPS140                         FALSE
   APPLICATION:                    90893E31
   MODULUS BITS:                   4096
   PUBLIC EXPONENT:
      010001
   MODULUS:
      F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D
      18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC
      662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61
      5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805
      CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E
      69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888
      C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B
      95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562
      3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376
      CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF
      26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73
      C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0
      A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD
      7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0
      10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553
      1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753
COMMAND ===>
```

Figure 231. ICSF Token Management - Public Key Object Details panel

The format of the ICSF Token Management - Public Key Object Details panel will differ slightly depending on the type of key (RSA, DSA, Diffie-Hellman, or Elliptic Curve) selected.

Table 24. Information displayed in Public Key Object Details panel for RSA, DSA, Diffie-Hellman, and Elliptic Curve keys

For this type of key:	Identified in the panel's KEY TYPE field as:	The panel will contain fields for:
RSA	RSA	The RSA modulus size, the public key exponent, and the RSA modulus. For example: MODULUS BITS: 4096 PUBLIC EXPONENT: 010001 MODULUS: F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D 18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC 662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61 5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805 CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E 69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888 C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B 95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562 3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376 CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF 26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73 C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0 A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD 7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0 10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553 1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753
DSA	DSA	The DSA prime *p*, subprime *q*, base *g*, and public value. For example: PRIME: 2A5C655610E93CF27FF5B65B7FF69DDE1A4780C6D71012304869CFDFC3285F5A ED4493E75E438DD4A107CAE127AB8FC6B842A20AB4877C34166CA9D1F510EB33 C8193EA4A391526169262C9F4369274C682339DFB17B599B587F7B99B1AB37C9 4490C4837B5656776E9FFDA073EAED869B19F7E197970DBE5665E8F87F964C57 SUBPRIME: DF9048626B9AD71EF6F33081890DF9048626B9AD BASE: F21C09419230CAD25CB4C865BAF7A3FE59AAEC7D97A12D8C787C29D699F6650A D7DF6D09412C3727F4DB1F269B8C62433CCBBD52E651E5444D0A00834F6B4CCE 1362CDDD387DC31501C9E4E5DBE9F42CFB8E0DB77CA121C4E612843DA035D4E1 1D4CD1CF81076A7BED411ECE6B9851936D08A5F651DC7FF3414EEB73109DFE40 VALUE: 3992F874061239B0A0B2E52BDBC33237A1CEAB624B613AD91D23CDCCFC58D575 1CB5FE0364D37BF74721AA5473DD1ECC2E65B82138BE7103477C438B3486C548 0CCAD36D7882C9659CA32744E776DE894193953F6DF32C8AC3ACFC0A364A641A A19B74BDC43E6EC84D8CB409B46A82D666A7F963D31A2CC897B971D378959509

Table 24. Information displayed in Public Key Object Details panel for RSA, DSA, Diffie-Hellman, and Elliptic Curve keys (continued)

For this type of key:	Identified in the panel's KEY TYPE field as:	The panel will contain fields for:
Diffie-Hellman	DH	The Diffie-Hellman prime *p*, base *g*, and public value. For example: PRIME: F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D 18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC 662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61 5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805 CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E 69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888 C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B 95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562 BASE: 3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376 CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF 26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73 C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0 A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD 7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0 10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553 1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753 VALUE: 2A5C655610E93CF27FF5B65B7FF69DDE1A4780C6D71012304869CFDFC3285F5A ED4493E75E438DD4A107CAE127AB8FC6B842A20AB4877C34166CA9D1F510EB33 C8193EA4A391526169262C9F4369274C682339DFB17B599B587F7B99B1AB37C9 4490C4837B5656776E9FFDA073EAED869B19F7E197970DBE5665E8F87F964C57 F21C09419230CAD25CB4C865BAF7A3FE59AAEC7D97A12D8C787C29D699F6650A D7DF6D09412C3727F4DB1F269B8C62433CCBBD52E651E5444D0A00834F6B4CCE 1362CDDD387DC31501C9E4E5DBE9F42CFB8E0DB77CA121C4E612843DA035D4E1 1D4CD1CF81076A7BED411ECE6B9851936D08A5F651DC7FF3414EEB73109DFE40
Elliptic Curve	EC	The elliptic curve parameters and the elliptic curve point. For example: _ EC PARAMS*: Named Curve – secp521r1 _ EC POINT*: 3992F874061239B0A0B2E52BDBC33237A1CEAB624B613AD91D23CDCCFC58D575 1CB5FE0364D37BF74721AA5473DD1ECC2E65B82138BE7103477C438B3486C548 0CCAD36D7882C9659CA32744E776DE894193953F6DF32C8AC3ACFC0A364A641A A19B74BDC43E6EC84D8CB409B46A82D666A7F963D31A2CC897B971D378959509 30818902818100 8B53

Private Key Object Details panel

If a private key object is selected on the Token Details panel, the ICSF Token Management - Private Key Object Details panel is presented:

```
CSFTBR32 --------- ICSF Token Management - Private Key Object Details ---------

Object 6      from token label: SAMPLE.TOKEN

Select an Action:
  1  Process select DER fields(*) using external command
       Enter UNIX command pathname (formatter must accept input from STDIN):
       ____________________________________________________________________
  2  Modify one or more fields with the new values specified
  3  Delete the entire object

--------------------------------------------------------------------------------
                                                                      More:     +
   OBJECT CLASS:                  PRIVATE KEY
   PRIVATE:                       TRUE
   MODIFIABLE:                    TRUE
   LABEL:                         privatekey cx021A
                      New value:
   SUBJECT*:                      Not-specified

   ID:                            83A7F0F2F1C1
                      New value:
   KEY TYPE:                      RSA
   START DATE:                    20050103
                      New value:               YYYYMMDD
   END DATE:                      20071231
                      New value:               YYYYMMDD
   DERIVE:                        FALSE
   LOCAL:                         FALSE
   KEY GEN MECHANISM:             UNAVAILABLE INFORMATION
   DECRYPT:                       FALSE
                      New value: TRUE
   SIGN:                          TRUE
                      New value: FALSE
   SIGN RECOVER:                  FALSE
                      New value: TRUE
   UNWRAP:                        TRUE
                      New value: FALSE
   EXTRACTABLE:                   TRUE          (Cannot be changed from FALSE
                      New value: FALSE          to TRUE)
   SENSITIVE:                     FALSE         (Cannot be changed from TRUE
                      New value: TRUE           to FALSE)
```

Figure 232. ICSF Token Management - Private Key Object Details panel – Part 1

```
   ALWAYS SENSITIVE:              FALSE
   NEVER EXTRACTABLE:             FALSE
   FIPS140                        FALSE
   APPLICATION:                   90893E31
   PRIVATE EXPONENT:              Not displayable
   PRIME 1:                       Not displayable
   PRIME 2:                       Not displayable
   EXPONENT 1:                    Not displayable
   EXPONENT 2:                    Not displayable
   COEFFICIENT:                   Not displayable
   PUBLIC EXPONENT:
      010001
   MODULUS:
      F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D
      18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC
      662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61
      5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805
      CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E
      69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888
      C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B
      95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562
      3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376
      CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF
      26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73
      C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0
      A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD
      7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0
      10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553
      1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753
Press ENTER to process.
Press END to exit to the previous menu.

COMMAND ===>
```

Figure 233. ICSF Token Management - Private Key Object Details panel – Part 2

The format of the ICSF Token Management - Private Key Object Details panel will differ slightly depending on the type of key (RSA, DSA, Diffie-Hellman, or Elliptic Curve) selected.

Table 25. Information displayed in Private Key Object Details panel for RSA, DSA, Diffie-Hellman, and Elliptic Curve keys

For this type of key:	Identified in the panel's KEY TYPE field as:	The panel will contain fields for:

RSA	RSA	Non-displayable private key information, the public key exponent, and the RSA modulus. For example:
		`PRIVATE EXPONENT: Not displayable`
		`PRIME 1: Not displayable`
		`PRIME 2: Not displayable`
		`EXPONENT 1: Not displayable`
		`EXPONENT 2: Not displayable`
		`COEFFICIENT: Not displayable`
		`PUBLIC EXPONENT:`
		`010001`
		`MODULUS:`
		`F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D`
		`18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC`
		`662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61`
		`5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805`
		`CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E`
		`69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888`
		`C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B`
		`95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562`
		`3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376`
		`CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF`
		`26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73`
		`C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0`
		`A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD`
		`7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0`
		`10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553`
		`1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753`

DSA	DSA	The private key value (not displayable), the DSA prime *p*, subprime *q*, and base *g*. For example:
		`VALUE: Not displayable`
		`PRIME:`
		`2A5C655610E93CF27FF5B65B7FF69DDE1A4780C6D71012304869CFDFC3285F5A`
		`ED4493E75E438DD4A107CAE127AB8FC6B842A20AB4877C34166CA9D1F510EB33`
		`C8193EA4A391526169262C9F4369274C682339DFB17B599B587F7B99B1AB37C9`
		`4490C4837B5656776E9FFDA073EAED869B19F7E197970DBE5665E8F87F964C57`
		`SUBPRIME:`
		`DF9048626B9AD71EF6F33081890DF9048626B9AD`
		`BASE:`
		`F21C09419230CAD25CB4C865BAF7A3FE59AAEC7D97A12D8C787C29D699F6650A`
		`D7DF6D09412C3727F4DB1F269B8C62433CCBBD52E651E5444D0A00834F6B4CCE`
		`1362CDDD387DC31501C9E4E5DBE9F42CFB8E0DB77CA121C4E612843DA035D4E1`
		`1D4CD1CF81076A7BED411ECE6B9851936D08A5F651DC7FF3414EEB73109DFE40`

Diffie-Hellman	DH	The private key value (not displayable), the size of the private key, and the Diffie-Hellman prime *p* and base *g*. For example:
		`VALUE: Not displayable`
		`VALUE BITS: 160`
		`PRIME:`
		`F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D`
		`18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC`
		`662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61`
		`5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805`
		`CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E`
		`69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888`
		`C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B`
		`95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562`
		`BASE:`
		`3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376`
		`CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF`
		`26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73`
		`C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0`
		`A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD`
		`7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0`
		`10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553`
		`1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753`

Table 25. Information displayed in Private Key Object Details panel for RSA, DSA, Diffie-Hellman, and Elliptic Curve keys (continued)

For this type of key:	Identified in the panel's KEY TYPE field as:	The panel will contain fields for:

Elliptic Curve	EC	The elliptic curve point. For example:
		`VALUE: Not displayable`
		`_ EC PARAMS*: Named Curve – secp521r1`

Domain Parameters Object Details panel

If a domain parameter object is selected on the Token Details panel, the ICSF Token Management - Domain Parameters Object Details menu is presented:

```
CSFTBR41 --------- ICSF Token Management - Domain Parameters Object Details -------

Object 10 from token label: TEMP.JAVA.TOKEN

Select an Action: _
  1. Modify one or more highlighted fields with the new values specified
  2. Delete the entire object

--------------------------------------------------------------------------------

   OBJECT CLASS:           DOMAIN PARAMETERS
   PRIVATE:                TRUE
   MODIFIABLE:             TRUE
   LABEL:                  My DSA Domain Parameters
              New value: ____________________________
   KEY TYPE:               DSA
   LOCAL:                  FALSE
   APPLICATION:            Some UNIX Application
   PRIME BITS:             1024
   PRIME:
      2A5C655610E93CF27FF5B65B7FF69DDE1A4780C6D71012304869CFDFC3285F5A
      ED4493E75E438DD4A107CAE127AB8FC6B842A20AB4877C34166CA9D1F510EB33
      C8193EA4A391526169262C9F4369274C682339DFB17B599B587F7B99B1AB37C9
      4490C4837B5656776E9FFDA073EAED869B19F7E197970DBE5665E8F87F964C57
   SUBPRIME:
      DF9048626B9AD71EF6F33081890DF9048626B9AD
   BASE:
      F21C09419230CAD25CB4C865BAF7A3FE59AAEC7D97A12D8C787C29D699F6650A
      D7DF6D09412C3727F4DB1F269B8C62433CCBBD52E651E5444D0A00834F6B4CCE
      1362CDDD387DC31501C9E4E5DBE9F42CFB8E0DB77CA121C4E612843DA035D4E1
      1D4CD1CF81076A7BED411ECE6B9851936D08A5F651DC7FF3414EEB73109DFE40
```

Figure 234. ICSF Token Management - Domain Parameters Object Details panel

The format of the ICSF Token Management - Domain Parameters Object Details panel will differ slightly depending on the domain parameter (DSA or Diffie-Hellman) selected.

Table 26. Information displayed in Domain Parameters Object Details panel for DSA and Diffie-Hellman domain parameters

For this type of key:	Identified in the panel's KEY TYPE field as:	The panel will contain fields for:
DSA	DSA	The DSA prime *p*, subprime *q*, and base *g*. For example: KEY TYPE: DSA LOCAL: FALSE APPLICATION: Some UNIX Application PRIME BITS: 1024 PRIME: 2A5C655610E93CF27FF5B65B7FF69DDE1A4780C6D71012304869CFDFC3285F5A ED4493E75E438DD4A107CAE127AB8FC6B842A20AB4877C34166CA9D1F510EB33 C8193EA4A391526169262C9F4369274C682339DFB17B599B587F7B99B1AB37C9 4490C4837B5656776E9FFDA073EAED869B19F7E197970DBE5665E8F87F964C57 SUBPRIME: DF9048626B9AD71EF6F33081890DF9048626B9AD BASE: F21C09419230CAD25CB4C865BAF7A3FE59AAEC7D97A12D8C787C29D699F6650A D7DF6D09412C3727F4DB1F269B8C62433CCBBD52E651E5444D0A00834F6B4CCE 1362CDDD387DC31501C9E4E5DBE9F42CFB8E0DB77CA121C4E612843DA035D4E1 1D4CD1CF81076A7BED411ECE6B9851936D08A5F651DC7FF3414EEB73109DFE40
Diffie-Hellman	DH	The Diffie-Hellman prime *p* and base *g*. For example: KEY TYPE: DH LOCAL: FALSE APPLICATION: Some UNIX Application PRIME BITS: 2048 PRIME: F35F5EF1E1AC5D5289A7EB6340E41FDA18695CBBB2EB5E27BC3FA1C0FA0D215D 18F017AEA80631223A2F268304894246BE8F629BEF7DB621B1E1C5F90D00F1AC 662119D2179DC02F20966591E39079D7A621F522F29451F4663E664D830A2F61 5E51A722EE6124F102A8334B113426A86028F6DC1F0D4F05EBE4AE9F57BA6805 CE54B8C4C1866870110D3550689E435A6EDDA1FFA74D46C77C8850F7716EAF6E 69AD03FBFBBCC5990EDDF8C1A34D607AC3B7728D7E6ABBDA566A626980E0D888 C83661867992AF0EE415CA3B392C40D5138A18E983784676736A67D82F69D12B 95778A0CF92F752338CB811E1C68FBC04E8D9471B487C14942945AD6B345B562 BASE: 3EACCC1C25742C25924612B407869788F3236AF037B7D7EBBB03C0FB6529A376 CF8161AACAA0B9C3D285D772C71B78264B56DE152B8B70975CE8B57D3EB048FF 26629B0A1756A4004418B6AED201AC6831CB0F555B4C1CA4721F96272C741F73 C439C3312C180BA67F5EAF823673904C78A6440A29A900B7F1C301C9FE9E7EB0 A7B286943B62AF22995CA15A1AC4FE3AB28C3C53629C581A97773CDAA6A366AD 7EA29F4128D7EF45FC8D8C7A35FE51B87A3F14CCF0E5B3A7B7F80AB5A72EDAB0 10B582BB67A9048FFEE3631D50661E8FDC22E6754CAE46E06AC70F16667A7553 1C83C61047605D205C14E0032BC0C2E611B54AE1EF2DEFA67B4AEC8181910753

Chapter 16. Using the ICSF Utility Program CSFEUTIL

This topic contains Programming Interface Information.

ICSF provides a utility program, CSFEUTIL, that performs certain functions that can also be performed using the administrator's panels.

The program that executes CSFEUTIL must be APF-authorized.

The utility can be used for installations with cryptographic coprocessors. You can run the utility program to perform these tasks:

- Reencipher a disk copy of a CKDS
- Change the master key (AES or DES)
- Refresh the in-storage CKDS
- Initialize a CKDS and load DES and PKA master keys using a pass phrase

  Starting with release HCR7780, there are two formats of the CKDS: a fixed-length record (supported by all releases of ICSF) and a new, variable-length record (supported by HCR7780 and later releases). Both formats are supported by the CSFEUTIL utility program.

  Restriction: You cannot use this utility to initialize a CKDS (and load DES and PKA master keys using a pass phrase) on the z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196.

  On the supported hardware, the utility only loads DES and PKA master keys on the CCF. If you have a PCICC as part of the configuration, the SYM-MK is not loaded.

You invoke the program as a batch job or from another program. To invoke the program as a batch job, use JCL. You specify different parameters on the EXEC statement depending on the task you want the utility program to perform. If the CSFEUTIL invocation from the batch job fails, you will need to invoke CSFEUTIL from another program to obtain the reason code from General Purpose Register 0 along with the return code in General Purpose Register 15. To invoke the program from another program, use standard MVS linkages like LINK, ATTACH, LOAD, and CALL.

Note: “CSFWEUTL” on page 365 provides sample code.

For information about using the utility program to reencipher a disk copy of a CKDS and change the master key, see “Reenciphering a disk copy of a CKDS and changing the master key.” For information about using the program to refresh the in-storage CKDS, see “Refreshing the in-storage CKDS using a utility program” on page 361.

Reenciphering a disk copy of a CKDS and changing the master key

This topic describes how to use the utility program to reencipher a disk copy of a CKDS and to change a master key.

Notes:

1. Prior to performing any function that affects the current CKDS, such as reenciphering, refreshing, or changing the master key, consider temporarily disallowing dynamic CKDS update services. For more information, refer to “Steps for disallowing dynamic CKDS updates during CKDS administration

updates" on page 216. If a CKDS reencipher is to be performed on a CKDS which is shared by members of a sysplex, dynamic CKDS updates should be disabled on all sysplex systems until the master key has been changed and the newly reenciphered CKDS is active on all systems sharing the CKDS

2. If the CKDS contains HMAC keys, it must be reenciphered on a system with a CEX3C and the Sept. 2010 or later licensed internal code.

1. When you change a master key, you must first reencipher any disk copies of the CKDSs under the new master key in the new master key register.

   You can reencipher a CKDS either using the panels or the utility program.

   Notes:

   a. In compatibility or co-existence mode, you can use the utility program to reencipher a CKDS but not to change the master key. To change the master key using the utility program, you must be in noncompatibility mode.
   b. When invoking the master key reencipher you need access to the CSFMVR profile in the CSFSERV class.

2. Invoke the program as a batch job or from another program.

   You pass the same parameters whether you call the program as a batch job or from another program.

3. Pass the names of the CKDSs upon which to perform the task and the name of the task to perform.

   When you invoke the utility program from another program, General Register 1 must contain a pointer to the address of a data area whose structure is as follows:

   ```
   Bytes 0-1: Length of the parameter string in binary
   Bytes 2-n: The parameter string
   ```

   The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.

4. To reencipher a disk copy of a CKDS, pass these parameters in this order:
   a. The name of the disk copy of the CKDS to reencipher.
   b. The name of an empty disk copy of the CKDS to contain the reenciphered keys.
   c. The name for the task: REENC.

   Note: The input CKDS and the output CKDS must have the same VSAM attributes.

5. To reencipher the CKDS using JCL, use JCL like this example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='OLD.CKDS,NEW.CKDS,REENC'
   ```

   The first parameter passed, OLD.CKDS, is the name of the disk copy to reencipher. The second parameter, NEW.CKDS, is the name of an empty disk copy of the CKDS where you want ICSF to place the reenciphered keys.

6. When you reencipher all the disk copies of the CKDSs under the new master key, make the new master key active by changing the master key.

   The utility program activates the new master key and reads a disk copy of a CKDS reenciphered under the new master key into storage.

7. To change a master key, pass these parameters in this order:
   a. The name of the disk copy of the CKDS to read into storage.
   b. The name for the task: CHANGE.

8. To change the master key using JCL, use JCL like this example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='NEW.CKDS,CHANGE'
   ```

The utility program reads the new master key into the master key register to make that master key active. The program also reads into storage a disk copy of the CKDS that you specify. This CKDS should be reenciphered under the new master key that you are making the current master key. The first parameter passed, NEW.CKDS, is the name of the disk copy of the CKDS that you want ICSF to read into storage.

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The return codes and reason codes are explained in "Return and reason codes for the CSFEUTIL program" on page 362.

Refreshing the in-storage CKDS using a utility program

This topic describes how to use the CSFEUTIL program to refresh an in-storage CKDS.

1. Invoke the program from a batch job or from another program.
2. You pass the same parameters whether you call the program as a batch job or from another program.
3. Pass the names of the CKDSs to perform the task and the name for the task. When you invoke the utility program from another program, General Register 1 must contain a pointer to the address of a data area whose structure is as follows:

   ```
   Bytes 0-1: Length of the parameter string in binary
   Bytes 2-n: The parameter string
   ```

   The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.
4. To refresh an in-storage CKDS, pass these parameters in this order:
   - The name of the disk copy of the CKDS that you want read into storage
   - The name for the task: REFRESH
5. To refresh the CKDS using JCL, use JCL like this example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='NEW.CKDS,REFRESH'
   ```

   The first parameter passed, NEW.CKDS, is the name of the disk copy of the CKDS that you want read into storage.

Note: If a CKDS refresh is to be performed on a CKDS which is shared by members of a sysplex, dynamic CKDS updates should be disabled on all sysplex systems until the master key has been changed and the newly reenciphered CKDS is active on all systems sharing the CKDS

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The return codes and reason codes are explained in "Return and reason codes for the CSFEUTIL program" on page 362.

Loading DES and PKA master keys using a pass phrase

This topic describes how to use the CSFEUTIL program to load DES and PKA master keys using a pass phrase. This will allow an automated setup of ICSF for an automated electronic delivery process.

Restriction: This is not supported on a z990, z890, z9 EC, z9 BC, z10 EC, z10 BC, and z196.

The CKDS must be created and empty. See *z/OS Cryptographic Services ICSF System Programmer's Guide* for this information.

Note: This only initializes the CCF. It will not initialize the PCICC.

The default pass phrase supplied is `Change this Pass Phrase`.

1. Invoke the program from a batch job or from another program.
2. You pass the same parameters whether you call the program as a batch job or from another program.
3. Pass the name of the CKDS to perform the task and the name for the task. When you invoke the utility program from another program, General Register 1 must contain a pointer to the address of a data area whose structure is as follows:

   ```
   Bytes 0-1: Length of the parameter string in binary
   Bytes 2-n: The parameter string
   ```

   The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.
4. To load a pass phrase, pass these parameters in this order:
   - The name of the CKDS
   - An optional 16–64 character pass phrase
   - The name for the task: PPINIT
5. To load the pass phrase using JCL (with the default pass phrase), use JCL like this example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='CSF.CSFCKDS,PPINIT'
   ```
6. To load the pass phrase using JCL (and using your own pass phrase), use JCL like this example:

   ```
   //STEP EXEC PGM=CSFEUTIL,PARM='CSF.CSFCKDS,different pass phrase,PPINIT'
   ```

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The return codes and reason codes are explained in “Return and reason codes for the CSFEUTIL program.”

Return and reason codes for the CSFEUTIL program

When you invoke the CSFEUTIL program as a batch job, you receive the return code in a message when the job completes. The meanings of the return codes are:

Return Code	Meaning
0	Process successful.
4	Parameters are incorrect.

8	RACF authorization check failed.
12	Process unsuccessful.
68 or 72	CKDS processing has failed. An error was detected in the new KDS.
100 or 104	CKDS processing has failed. An error was detected in the old KDS.
101 or 105	CKDS processing has failed. An error occurred while processing a KDS record. For a 101 return code, consult the Return Code 8 reason codes in the *z/OS Cryptographic Services ICSF Application Programmer's Guide*. For a 105 return code, consult the Return Code 12 reason codes in the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The following list describes the meaning of the reason codes. If a particular reason code is not listed, refer to the listing of ICSF and TSS return and reason codes in the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Return code 0 has these reason codes:

Reason Code	Meaning
36132	CKDS reencipher/Change MK processed only tokens encrypted under the DES master key.
36136	CKDS reencipher/Change MK processed only tokens encrypted under the AES master key.
36140	CKDS reencipher/Change MK processed tokens encrypted under the DES and AES master key.

Return code 8 has these reason codes:

Reason Code	Meaning
3114	Another refresh utility request is executing, and this utility request will not be allowed to run.
16000	Invoker has insufficient RACF access authority to perform function.

Return code 12 has these reason codes:

Reason Code	Meaning
36000	Unable to change master key. Check hardware status.
36008	Crypto master key register(s) in improper state.
36020	Input CKDS is empty or not initialized (authentication pattern in the control record is invalid).
36036	The new master key register for Coprocessor 1 (C1) is not full, but C0 is ready and the current master key is valid.
36040	The new master key register for C0 is not full, but C1 is ready and the current master key is valid.
36044	The master key authentication pattern for the CKDS does not match the authentication pattern of the coprocessors, which are not equal.

36048 The master key authentication pattern for the CKDS does not match the authentication pattern of either of the coprocessors, which are not equal.

36052 A valid new master key is present in C0, but its authentication pattern does not match that of C1 or the CKDS, which are equal.

36056 A valid new master key is present in C1, but its authentication pattern does not match that of C0 or the CKDS, which are equal.

36060 The new master key register(s) is/are not full.

36064 Both new master key registers are full but not equal.

36068 The input KDS is not enciphered under the current master key.

36076 The new master key register for C0 is not full, but the CPUs are online.

36080 The new master key register for C1 is not full, but the CPUs are online.

36084 The master key register cannot be changed since ICSF is running in compatibility mode.

36104 Option not available. There were no Cryptographic Coprocessors available to perform the service that was attempted.

36108 PKA callable services are enabled, and the PKDS is the active PKDS as specified in the options data set.

36120 The CKDS is unusable. The CKDS does not support record level authentication.

36124 The CKDS is unusable. The CKDS only supports encrypted AES keys and encrypted DES support is required.

36128 The CKDS is unusable. The CKDS does not support encrypted DES keys which is required.

36160 The attempt to reencipher the CKDS failed because there is an enhanced token in the CKDS.

36001 A variable-length record format CKDS cannot be used on a system with a Cryptographic Coprocessor Feature.

36168 The LRECL attribute of the input CKDS doesn't match the LRECL of the output CKDS.

Return code 72 or 104 has these reason codes:

Reason Code	Meaning
6008	A service routine has failed. The service routines that may be called are: **CSFMGN** MAC generation **CSFMVR** MAC verification **CSFMKVR** Master key verification
6012	The single-record, read-write installation exit (CSFSRRW) returned a return code greater than 4.

6016 An I/O error occurred reading or writing the CKDS.

6020 The CSFSRRW installation exit abended and the installation options EXIT keyword specifies that the invoking service should end.

6024 The CSFSRRW installation exit abended and the installation options EXIT keyword specifies that ICSF should end.

6028 The CKDS access routine could not establish the ESTAE environment.

6040 The CSFSRRW installation exit could not be loaded and is required.

6044 Information necessary to set up CSFSRRW installation exit processing could not be obtained.

6048 The system keys cannot be found while attempting to write a complete CKDS data set.

6052 For a write CKDS record request, the current master key verification pattern (MKVP) does not match the CKDS header record MKVP.

6056 The output CKDS is not empty.

36001 A variable-length record format CKDS cannot be used on a system with a Cryptographic Coprocessor Feature.

36168 The LRECL attribute of the input CKDS doesn't match the LRECL of the output CKDS.

Note: It is possible that you will receive MVS reason codes rather than ICSF reason codes, for example, if the reason code indicates a dynamic allocation failure. For an explanation of Dynamic Allocation reason codes, see *z/OS MVS Programming: Authorized Assembler Services Guide*.

CSFWEUTL

CSFWEUTL invokes CSFEUTIL. CSFWEUTL is a sample program that contains sample JCL to assemble the sample program, sample link edit JCL to put the assembled sample program into an authorized library, and sample JCL that will invoke the sample program.

```
//<NAME>   JOB  <JOB CARD PARAMETERS>
//*******************************************************************
//*                                                                 *
//*    Licensed Materials - Property of IBM                         *
//*    5694-A01                                                     *
//*    (C) Copyright IBM Corp. 2004                                 *
//*                                                                 *
//*                                                                 *
//* This file contains a sample program (CSFWEUTL), sample JCL      *
//* to assemble the sample program, sample link edit JCL to put     *
//* the assembled sample program into an authorized library, and    *
//* lastly sample JCL that will invoke the sample program.          *
//*                                                                 *
//* CSFWEUTL: Invokes CSFEUTIL                                      *
//*                                                                 *
//* DESCRIPTION:                                                    *
//* CSFEUTIL is an ICSF utility program that can perform certain    *
//* functions that can be performed by using the administrator's    *
//* panels.  The requested function is passed in the "PARM=..."     *
//* parameter.  Refer to the ICSF Administrator's Guide for         *
//* more information on CSFEUTIL functions.                         *
//*                                                                 *
```

```
//* However, when running the ICSF CSFEUTIL, sometimes error        *
//* conditions may occur. The type of error is qualified by the     *
//* contents of register 15 and register 0 upon program exit.       *
//* Unfortunately, only register 15 (return code) is externalized   *
//* when running these utilities from a batch JCL interface.        *
//*                                                                 *
//* CSFWEUTL will call CSFEUTIL and pass any specified function in  *
//* the "PARM=...  " parameter to CSFEUTIL.  On return from         *
//* CSFEUTIL, a WTO (write to operator) is issued containing        *
//* the return and reason codes.                                    *
//*                                                                 *
//* CAUTION:                                                        *
//* This file contains four sample sections.  Before using this     *
//* sample, you have to make the following changes.                 *
//*                                                                 *
//* USER ACTIONS REQUIRED:                                          *
//* 1.Add the job parameters to meet your system requirements.      *
//*                                                                 *
//* 2.In the ASSEMBLE JCL, change the SYSLIB DSN to match your      *
//*   installation specific data set names.                         *
//*                                                                 *
//* 3.No changes are needed in the CSFWEUTL assembler code.         *
//*   This CSFWEUTL assembler code needs to reside in the           *
//*   SYSLIB DSN indicated in the ASSEMBLER JCL.                    *
//*                                                                 *
//* 4.In the LKED JCL, for SYSLMOD DD statement, specify the        *
//*   installation specific authorized library dataset name that    *
//*   is to contain the CSFWEUTIL assembled code.                   *
//*                                                                 *
//* 5.In the LKED JCL, for SYSLIB DD statement, specify your        *
//*   installation specific ICSF library dataset name.              *
//*   Change CSF to the appropriate high-level qualifier if you     *
//*   choose to not use the default.  If you use an edit or         *
//*   CHANGE command, be sure to include the period at the end      *
//*   of the high-level qualifier.                                  *
//*                                                                 *
//* 6.In the CSFWEUTL EXEC JCL, for the STEPLIB DSN, specify the    *
//*   same dataset name as was indicated in the SYSLMOD DSN         *
//*   statement in the LKED JCL.                                    *
//*                                                                 *
//* 7.In the CSFWEUTL EXEC JCL, for the PARM='....'  specify the    *
//*   requested function for CSFEUTIL.                              *
//*                                                                 *
//* 8.Users may want to separate the CSFWEUTL EXEC JCL into a       *
//*   separate JOB.                                                 *
//*                                                                 *
//* NOTES:                                                          *
//* 1.This job should be rerun with every new release of ICSF.      *
//*                                                                 *
//*******************************************************************
//*        JCL to assemble CSFWEUTL                                 *
//*******************************************************************
//* ASSEMBLER
//C        EXEC PGM=ASMA90,REGION=4M
//SYSLIB   DD   DSN=SYS1.MACLIB,DISP=SHR
//         DD   DSN=SYS1.MODGEN,DISP=SHR
//SYSUT1   DD   DSN=&&SYSUT1,SPACE=(4096,(120,120),,,ROUND),UNIT=VIO,
//             DCB=BUFNO=1
//SYSPRINT DD   SYSOUT=*
//SYSLIN   DD   DSN=&&LIN,DISP=(NEW,PASS),SPACE=(TRK,(2,2)),UNIT=SYSDA
//SYSIN    DD   *
*********************************************************************
*          CSFWEUTL assembler code                                  *
*********************************************************************

         TITLE 'CSFWEUTL   - ICSF CSFEUTIL INVOKER'
         PRINT GEN
```

```
*********************************************************************
*                                                                   *
* FUNCTION :  ICSF CSFEUTIL CALLER UTILITY                          *
*                                                                   *
* DESCRIPTIVE NAME : ICSF CSFEUTIL CALL ROUTINE                     *
*                                                                   *
* VERSION : RELEASE  1  LEVEL 000                                   *
*                                                                   *
* OBJECTIVE :                                                       *
*                                                                   *
* CSFEUTIL UTILITY :                                                *
*                                                                   *
*   THIS PROGRAM ACCEPTS AN INVOCATION PARM THEN CALLS CSFEUTIL     *
*   PASSING THAT PARM. REGISTER 15 AND 0 ARE FORMATTED ON RETURN    *
*   IF NOT ZERO.  A WRITE TO OPERATOR IS THEN ISSUED.               *
*                                                                   *
*                                                                   *
* DEPENDENCIES :                                                    *
*                                                                   *
*       1. UNDER OS/390 OPERATING SYSTEM                            *
*       2. UNDER IBM S/390                                          *
*       3. LANGUAGE : IBM S/390 ASSEMBLER                           *
*       4. ICSF UP AND ACTIVE                                       *
*                                                                   *
* ENTRY POINT :  CSFWEUTL                                           *
*                                                                   *
* INPUT ARGUMENTS : INVOCATION PARM PASSED TO CSFEUTIL              *
*                                                                   *
*                                                                   *
* OUTPUT ARGUMENTS :                                                *
*                                                                   *
*     NONE                                                          *
*                                                                   *
* FUNCTION INPUT ARGUMENTS :                                        *
*                                                                   *
*     NONE                                                          *
*                                                                   *
* FUNCTION OUTPUT (RETURNS) :                                       *
*                                                                   *
*     RETCODE      R15SAVE                        (FULLWORD)        *
*                                                                   *
* EXIT-NORMAL RETURN CODE : 0                                       *
*                                                                   *
* EXIT-ERROR RETURN CODE : VALID RANGE 1 - 255                      *
*                                                                   *
* EXTERNAL-REFERENCES : NONE                                        *
*                                                                   *
* CHANGE ACTIVITY : NONE                                            *
*                                                                   *
*********************************************************************
R0       EQU   0
R1       EQU   1                       WORK REGISTER/CALL PARMS
R2       EQU   2                       WORK REGISTER
R3       EQU   3                       WORK REGISTER
R4       EQU   4                       WORK REGISTER
R5       EQU   5                       WORK REGISTER
R6       EQU   6                       WORK REGISTER
R7       EQU   7                       WORK REGISTER
R8       EQU   8                       WORK REGISTER
R9       EQU   9                       WORK REGISTER
R10      EQU   10                      WORK REGISTER
R11      EQU   11                      SECOND BASE REGISTER
R12      EQU   12                      BASE REGISTER
R13      EQU   13                      SAVE AREA CHAIN
R14      EQU   14                      RETURN ADDRESS
R15      EQU   15                      ENTRY POINT/RETURN CODE
         EJECT
```

```
CSFWEUTL CSECT
         USING CSFWEUTL,R12,R11        SET UP BASE REGISTER
         LA    R2,4095                       SET INCREMENT 4K
         LA    R2,1(R2)
         STM   R14,R12,12(R13)         SAVE REGISTERS
         LR    R12,R15                 SET UP ADDRESSABILITY
         LA    R11,0(R2,R12)                 SET SECOND BASE REG
         LA    R2,SAVEAREA
         ST    R13,4(R2)
         LR    R13,R2
         ST    R1,R1SAVE
         L     R4,0(R1)                GET INVOCATION PARM ADDRESS
         LH    R3,0(R4)                LOAD PARM LENGTH
         LTR   R3,R3                   ANY PARMS?
         BZ    NOPARM                  NO...BRANCH
         STH   R3,PARMLEN              SAVE PARM LENGTH
         BCTR  R3,0                    DECREMENT FOR EX
         LA    R4,2(R4)                POINT PAST LENGTH
         EX    R3,PARMSAVE             MOVE PARM TO INVOCATION FIELD
         B     START                   BRANCH AROUND CONSTANTS
         DC    C'** CSFWEUTL **'       MODULE
         DC    C'** &SYSDATE **'       ASM DATE
         DC    C'** &SYSTIME **'       ASM TIME
         DC C'CSFWEUTL : ICSF CSFEUTIL INVOCATION'
         DC C'    (C) COPYRIGHT IBM CORP. 2004 '
         DC C'LICENSED MATERIAL - PROGRAM PROPERTY OF IBM '
         EJECT
START    DS    0H
         OI    LINKPARM,X'80'          SET LAST PARM INDICATOR
         LA    R1,LINKPARM             LOAD PARM ADDRESS
         L     R15,=V(CSFEUTIL)        LOAD CSFEUTIL
         BALR  R14,R15                 INVOKE IT
         LTR   R15,R15                 ANY RETURN CODE?
         BZ    RETURN                  NO, ALL DONE
         ST    R0,R0SAVE               SAVE R0
         ST    R15,R15SAVE             SAVE R15
         L     R3,R15SAVE
         CVD   R3,DBWD                 DISPLAY R15 IN DECIMAL
         UNPK  UNPACK8(8),DBWD+4(4)
         OI    UNPACK8+7,X'F0'
         MVC   NOTZERO+23(8),UNPACK8
         L     R3,R0SAVE
         CVD   R3,DBWD                 DISPLAY R0 IN DECIMAL
         UNPK  UNPACK8(8),DBWD+4(4)
         OI    UNPACK8+7,X'F0'
         MVC   NOTZERO+37(8),UNPACK8
NOTZERO  WTO   'CSFWEUTL  R15: XXXXXXXX  R0: XXXXXXXX'
         B     RETURN
NOPARM   DS    0H
         WTO   'CSFWEUTL : NO PARAMETERS SPECIFIED'
         B     RETURN
RETURN   DS    0H
         L     R15,R15SAVE             GET CSFEUTIL RC
         L     R13,4(R13)
         ST    R15,16(13)
         LM    R14,R12,12(R13)
         BR    R14
         SPACE 3
PARMSAVE MVC   SAVEPARM(0),0(R4)
         SPACE 3
SAVEAREA DS    18F
R0SAVE   DS    F
R1SAVE   DS    F
R15SAVE  DS    F
DBWD     DS    D
UNPACK8  DS    D
         TITLE 'WORK AREAS'
```

```
         SPACE 3
         LTORG
         SPACE 3
LINKPARM DC    A(PARMLEN)
         DS    0D
PARMLEN  DC    H'0'
SAVEPARM DC    XL256'00'
         SPACE 3
         END   CSFWEUTL
//*******************************************************************
//*       JCL to link edit CSFWEUTL                                 *
//*******************************************************************
/*
//LKED     EXEC PGM=HEWL,PARM='MAP,LET,LIST,AC(1)',COND=(8,LT,C)
//SYSLIN   DD   DSN=&&LIN,DISP=(OLD,PASS)
//         DD   DDNAME=SYSIN
//SYSLMOD  DD   DSN=USER.STEPLIB,DISP=OLD
//SYSPRINT DD   SYSOUT=*
//SYSLIB   DD   DSN=CSF.SCSFMOD0,DISP=SHR
//*****************************************************
//SYSIN    DD   *
 NAME CSFWEUTL(R)
//*******************************************************************
//*       JCL to invoke CSFWEUTL                                    *
//*******************************************************************
/*
//CSFWEUTL EXEC PGM=CSFWEUTL,REGION=512K,
//         PARM='CSF.EXAMPLE.CKDS,REFRESH'
//STEPLIB  DD   DSN=USER.STEPLIB,DISP=SHR
//*
```

Chapter 17. Using the ICSF Utility Program CSFPUTIL

This topic contains Programming Interface Information.

ICSF provides a utility program, CSFPUTIL, that performs certain functions that can also be performed using the administrator's panels.

You can run the utility program to perform these tasks:
- Reencipher a PKDS
- Refresh the in-storage copy of the PKDS

You invoke the program as a batch job or from another program. To invoke the program as a batch job, use JCL. You specify different parameters on the EXEC statement depending on the task you want the utility program to perform. To invoke the program from another program, use standard MVS linkages like LINK, ATTACH, LOAD, and CALL.

For information about using the utility program to reencipher a disk copy of a PKDS, see "Reenciphering a PKDS." For information about using the program to refresh the in-storage copy of the PKDS, see "Refreshing the in-storage copy of the PKDS" on page 372.

Reenciphering a PKDS

You can reencipher a PKDS either using the panels or the utility program.

1. Invoke the program as a batch job or from another program.

   You pass the same parameters whether you call the program as a batch job or from another program.
2. Pass the names of the PKDSs upon which to perform the task and the name of the task to perform.

   When you invoke the utility program from another program, General Register 1 must contain a pointer to the address of a data area whose structure is as follows:

   ```
   Bytes 0-1: Length of the parameter string in binary
   Bytes 2-n: The parameter string
   ```

   The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.
3. To reencipher a PKDS, pass these parameters in this order:
   a. The name of the PKDS to reencipher.
   b. The name of an empty PKDS to contain the reenciphered keys.
   c. The name for the task: RECIPHER.
4. To reencipher the PKDS using JCL, use JCL like this example:

   ```
   //STEP EXEC PGM=CSFPUTIL,PARM='OLD.PKDS,NEW.PKDS,RECIPHER'
   ```

   The first parameter passed, OLD.PKDS, is the name of the PKDS to reencipher. The second parameter, NEW.PKDS, is the name of an empty PKDS where you want ICSF to place the reenciphered keys.
5. When you reencipher all the PKDSs under the new master key, refresh the PKDS.

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. The return codes are explained in “Return and reason codes for the CSFPUTIL program.”

Refreshing the in-storage copy of the PKDS

This topic describes how to use the CSFPUTIL program to refresh the in-storage copy of the PKDS.

1. Invoke the program from a batch job or from another program.

   You pass the same parameters whether you call the program as a batch job or from another program.
2. When you invoke the utility program from another program, General Register 1 must contain a pointer to the address of a data area whose structure is as follows:

   ```
   Bytes 0-1: Length of the parameter string in binary
   Bytes 2-n: The parameter string
   ```

   The parameter string is the same as that which you would specify using the PARM keyword on the EXEC JCL statement if you invoked the program as a batch job.
3. To refresh in-storage copy of the PKDS, pass this parameter:
   - The name for the task: REFRESH
   - Optional: the name of the disk copy of the PKDS you want read into storage. If no data set is specified, the active PKDS will be used.
4. To refresh the PKDS using JCL, use JCL like this example:

   ```
   //STEP EXEC PGM=CSFPUTIL,PARM='REFRESH,NEW.PKDS'
   ```

   The second parameter, NEW.PKDS, is the name of the disk copy of the PKDS that you want read into storage.
5. To refresh the active PKDS using JCL, use JCL like this example:

   ```
   //STEP EXEC PGM=CSFPUTIL,PARM='REFRESH'
   ```

When you invoke the program as a batch job, you receive the return code in a message when the job completes. You do not receive a reason code with the return code. The return codes are explained in “Return and reason codes for the CSFPUTIL program.”

Return and reason codes for the CSFPUTIL program

When you invoke the CSFPUTIL program as a batch job, you receive the return code in a message when the job completes. The following list describes the meanings of the return codes. Additional return codes are described in “Return and reason codes for the CSFEUTIL program” on page 362.

Return Code	Meaning
0	Process successful.
2	Partially successful. Job completed but some tokens have not been reenciphered.
4	Parameters are incorrect. A possible cause of the error is that the parameter 'ACTIVATE' was used. That parameter is no longer supported; use 'REFRESH'.
8	RACF authorization failed.

12, 72, or 104 PKDS processing has failed. A return code 72 indicates the error was detected with the new KDS. A return code 104 indicates the error was detected with the old KDS.

When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The meaning of the reason codes are as follows:

Return code 0 has these reason codes:

Reason Code	Meaning
36137	PKDS reencipher/Change MK processed only tokens encrypted under the RSA master key.
36138	PKDS reencipher/Change MK processed only tokens encrypted under the ECC master key.
36139	PKDS reencipher/Change MK processed tokens encrypted under the RSA and ECC master keys.

Return code 8 has this reason code:

Reason Code	Meaning
3114	Another refresh utility request is executing, and this utility request will not be allowed to run.

Return code 12 has this reason code:

Reason Code	Meaning
36116	PKDS specified for reencipher or activate has incorrect dataset attribute

An abend 18F Reason code x'300' occurs with a JCL error.

CSFWPUTL

CSFWPUTL invokes CSFPUTIL. CSFWPUTL is a sample program that contains sample JCL to assemble the sample program, sample link edit JCL to put the assembled sample program into an authorized library, and sample JCL that will invoke the sample program.

```
//<NAME>   JOB  <JOB CARD PARAMETERS>
//*******************************************************************
//*                                                                 *
//*    Licensed Materials - Property of IBM                         *
//*    5694-A01                                                     *
//*    (C) Copyright IBM Corp. 2004                                 *
//*                                                                 *
//*                                                                 *
//* This file contains a sample program (CSFWPUTL), sample JCL      *
//* to assemble the sample program, sample link edit JCL to put     *
//* the assembled sample program into an authorized library, and    *
//* lastly sample JCL that will invoke the sample program.          *
//*                                                                 *
//* CSFWPUTL: Invokes CSFPUTIL                                      *
//*                                                                 *
//* DESCRIPTION:                                                    *
//* CSFPUTIL is an ICSF utility program that can perform certain    *
//* functions that can be performed by using the administrator's    *
//* panels.  The requested function is passed in the "PARM=..."     *
//* parameter.  Refer to the ICSF Administrator's Guide for         *
```

```
//* more information on CSFPUTIL functions.                          *
//*                                                                  *
//* However, when running the ICSF CSFPUTIL, sometimes error         *
//* conditions may occur. The type of error is qualified by the      *
//* contents of register 15 and register 0 upon program exit.        *
//* Unfortunately, only register 15 (return code) is externalized    *
//* when running these utilities from a batch JCL interface.         *
//*                                                                  *
//* CSFWPUTL will call CSFPUTIL and pass any specified function in   *
//* the "PARM=...  " parameter to CSFPUTIL.  On return from          *
//* CSFPUTIL, a WTO (write to operator) is issued containing         *
//* the return and reason codes.                                     *
//*                                                                  *
//* CAUTION:                                                         *
//* This file contains four sample sections.  Before using this      *
//* sample, you have to make the following changes.                  *
//*                                                                  *
//* USER ACTIONS REQUIRED:                                           *
//* 1.Add the job parameters to meet your system requirements.       *
//*                                                                  *
//* 2.In the ASSEMBLE JCL, change the SYSLIB DSN to match your       *
//*   installation specific data set names.                          *
//*                                                                  *
//* 3.No changes are needed in the CSFWPUTL assembler code.          *
//*   This CSFWPUTL assembler code needs to reside in the            *
//*   SYSLIB DSN indicated in the ASSEMBLER JCL.                     *
//*                                                                  *
//* 4.In the LKED JCL, for SYSLMOD DD statement, specify the         *
//*   installation specific authorized library dataset name that     *
//*   is to contain the CSFWPUTIL assembled code.                    *
//*                                                                  *
//* 5.In the LKED JCL, for SYSLIB DD statement, specify your         *
//*   installation specific ICSF library dataset name.               *
//*   Change CSF to the appropriate high-level qualifier if you      *
//*   choose to not use the default.  If you use an edit or          *
//*   CHANGE command, be sure to include the period at the end       *
//*   of the high-level qualifier.                                   *
//*                                                                  *
//* 6.In the CSFWPUTL EXEC JCL, for the STEPLIB DSN, specify the     *
//*   same dataset name as was indicated in the SYSLMOD DSN          *
//*   statement in the LKED JCL.                                     *
//*                                                                  *
//* 7.In the CSFWPUTL EXEC JCL, for the PARM='....'  specify the     *
//*   requested function for CSFPUTIL.                               *
//*                                                                  *
//* 8.Users may want to separate the CSFWPUTL EXEC JCL into a        *
//*   separate JOB.                                                  *
//*                                                                  *
//* NOTES:                                                           *
//* 1.This job should be rerun with every new release of ICSF.       *
//*                                                                  *
//*******************************************************************
//*        JCL to assemble CSFWPUTL                                  *
//*******************************************************************
//* ASSEMBLER
//C        EXEC PGM=ASMA90,REGION=4M
//SYSLIB   DD   DSN=SYS1.MACLIB,DISP=SHR
//         DD   DSN=SYS1.MODGEN,DISP=SHR
//SYSUT1   DD   DSN=&&SYSUT1,SPACE=(4096,(120,120),,,ROUND),UNIT=VIO,
//             DCB=BUFNO=1
//SYSPRINT DD   SYSOUT=*
//SYSLIN   DD   DSN=&&LIN,DISP=(NEW,PASS),SPACE=(TRK,(2,2)),UNIT=SYSDA
//SYSIN    DD   *
*******************************************************************
*          CSFWPUTL assembler code                                 *
*******************************************************************
```

```
         TITLE 'CSFWPUTL   - ICSF CSFPUTIL INVOKER'
         PRINT GEN
*********************************************************************
*                                                                   *
* FUNCTION :  ICSF CSFPUTIL CALLER UTILITY                          *
*                                                                   *
* DESCRIPTIVE NAME : ICSF CSFPUTIL CALL ROUTINE                     *
*                                                                   *
* VERSION : RELEASE  1  LEVEL 000                                   *
*                                                                   *
* OBJECTIVE :                                                       *
*                                                                   *
* CSFPUTIL UTILITY :                                                *
*                                                                   *
*   THIS PROGRAM ACCEPTS AN INVOCATION PARM THEN CALLS CSFPUTIL     *
*   PASSING THAT PARM. REGISTER 15 AND 0 ARE FORMATTED ON RETURN    *
*   IF NOT ZERO.  A WRITE TO OPERATOR IS THEN ISSUED.               *
*                                                                   *
*                                                                   *
* DEPENDENCIES :                                                    *
*                                                                   *
*       1. UNDER OS/390 OPERATING SYSTEM                            *
*       2. UNDER IBM S/390                                          *
*       3. LANGUAGE : IBM S/390 ASSEMBLER                           *
*       4. ICSF UP AND ACTIVE                                       *
*                                                                   *
* ENTRY POINT :  CSFWPUTL                                           *
*                                                                   *
* INPUT ARGUMENTS : INVOCATION PARM PASSED TO CSFPUTIL              *
*                                                                   *
*                                                                   *
* OUTPUT ARGUMENTS :                                                *
*                                                                   *
*     NONE                                                          *
*                                                                   *
* FUNCTION INPUT ARGUMENTS :                                        *
*                                                                   *
*     NONE                                                          *
*                                                                   *
* FUNCTION OUTPUT (RETURNS) :                                       *
*                                                                   *
*     RETCODE      R15SAVE                        (FULLWORD)        *
*                                                                   *
* EXIT-NORMAL RETURN CODE : 0                                       *
*                                                                   *
* EXIT-ERROR RETURN CODE : VALID RANGE 1 - 255                      *
*                                                                   *
* EXTERNAL-REFERENCES : NONE                                        *
*                                                                   *
* CHANGE ACTIVITY : NONE                                            *
*                                                                   *
*********************************************************************
R0       EQU   0
R1       EQU   1                       WORK REGISTER/CALL PARMS
R2       EQU   2                       WORK REGISTER
R3       EQU   3                       WORK REGISTER
R4       EQU   4                       WORK REGISTER
R5       EQU   5                       WORK REGISTER
R6       EQU   6                       WORK REGISTER
R7       EQU   7                       WORK REGISTER
R8       EQU   8                       WORK REGISTER
R9       EQU   9                       WORK REGISTER
R10      EQU   10                      WORK REGISTER
R11      EQU   11                      SECOND BASE REGISTER
R12      EQU   12                      BASE REGISTER
R13      EQU   13                      SAVE AREA CHAIN
R14      EQU   14                      RETURN ADDRESS
```

```
R15      EQU   15                     ENTRY POINT/RETURN CODE
         EJECT
CSFWPUTL CSECT
         USING CSFWPUTL,R12,R11       SET UP BASE REGISTER
         LA    R2,4095                      SET INCREMENT 4K
         LA    R2,1(R2)
         STM   R14,R12,12(R13)        SAVE REGISTERS
         LR    R12,R15                SET UP ADDRESSABILITY
         LA    R11,0(R2,R12)                SET SECOND BASE REG
         LA    R2,SAVEAREA
         ST    R13,4(R2)
         LR    R13,R2
         ST    R1,R1SAVE
         L     R4,0(R1)               GET INVOCATION PARM ADDRESS
         LH    R3,0(R4)               LOAD PARM LENGTH
         LTR   R3,R3                  ANY PARMS?
         BZ    NOPARM                 NO...BRANCH
         STH   R3,PARMLEN             SAVE PARM LENGTH
         BCTR  R3,0                   DECREMENT FOR EX
         LA    R4,2(R4)               POINT PAST LENGTH
         EX    R3,PARMSAVE            MOVE PARM TO INVOCATION FIELD
         B     START                  BRANCH AROUND CONSTANTS
         DC    C'** CSFWPUTL **'      MODULE
         DC    C'** &SYSDATE **'      ASM DATE
         DC    C'** &SYSTIME **'      ASM TIME
         DC C'CSFWPUTL : ICSF CSFPUTIL INVOCATION'
         DC C'    (C) COPYRIGHT IBM CORP. 2004 '
         DC C'LICENSED MATERIAL - PROGRAM PROPERTY OF IBM '
         EJECT
START    DS    0H
         OI    LINKPARM,X'80'         SET LAST PARM INDICATOR
         LA    R1,LINKPARM            LOAD PARM ADDRESS
         L     R15,=V(CSFPUTIL)       LOAD CSFPUTIL
         BALR  R14,R15                INVOKE IT
         LTR   R15,R15                ANY RETURN CODE?
         BZ    RETURN                 NO, ALL DONE
         ST    R0,R0SAVE              SAVE R0
         ST    R15,R15SAVE            SAVE R15
         L     R3,R15SAVE
         CVD   R3,DBWD                DISPLAY R15 IN DECIMAL
         UNPK  UNPACK8(8),DBWD+4(4)
         OI    UNPACK8+7,X'F0'
         MVC   NOTZERO+23(8),UNPACK8
         L     R3,R0SAVE
         CVD   R3,DBWD                DISPLAY R0 IN DECIMAL
         UNPK  UNPACK8(8),DBWD+4(4)
         OI    UNPACK8+7,X'F0'
         MVC   NOTZERO+37(8),UNPACK8
NOTZERO  WTO   'CSFWPUTL  R15: XXXXXXXX  R0: XXXXXXXX'
         B     RETURN
NOPARM   DS    0H
         WTO   'CSFWPUTL : NO PARAMETERS SPECIFIED'
         B     RETURN
RETURN   DS    0H
         L     R15,R15SAVE            GET CSFPUTIL RC
         L     R13,4(R13)
         ST    R15,16(13)
         LM    R14,R12,12(R13)
         BR    R14
         SPACE 3
PARMSAVE MVC   SAVEPARM(0),0(R4)
         SPACE 3
SAVEAREA DS    18F
R0SAVE   DS    F
R1SAVE   DS    F
R15SAVE  DS    F
DBWD     DS    D
```

```
UNPACK8  DS    D
         TITLE 'WORK AREAS'
         SPACE 3
         LTORG
         SPACE 3
LINKPARM DC    A(PARMLEN)
         DS    0D
PARMLEN  DC    H'0'
SAVEPARM DC    XL256'00'
         SPACE 3
         END   CSFWPUTL
//*******************************************************************
//*       JCL to link edit CSFWPUTL                                 *
//*******************************************************************
/*
//LKED     EXEC PGM=HEWL,PARM='MAP,LET,LIST,AC(1)',COND=(8,LT,C)
//SYSLIN   DD   DSN=&&LIN,DISP=(OLD,PASS)
//         DD   DDNAME=SYSIN
//SYSLMOD  DD   DSN=USER.STEPLIB,DISP=OLD
//SYSPRINT DD   SYSOUT=*
//SYSLIB   DD   DSN=CSF.SCSFMOD0,DISP=SHR
//*****************************************************
//SYSIN    DD   *
 NAME CSFWPUTL(R)
//*******************************************************************
//*       JCL to invoke CSFWPUTL                                    *
//*******************************************************************
/*
//CSFWPUTL EXEC PGM=CSFWPUTL,REGION=512K,
//         PARM='CSF.EXAMPLE.PKDS,REFRESH'
//STEPLIB  DD   DSN=USER.STEPLIB,DISP=SHR
//*
```

Chapter 18. Using the ICSF Utility Program CSFDUTIL

ICSF provides a utility program, CSFDUTIL, that reads through a CKDS or PKDS and generates a report for duplicate key tokens.

Using the Duplicate Token Utility

There is no panel interface to this utility. The key data set must be specified as either a CKDS or a PKDS.

1. Invoke the program as a batch job
2. You must have READ authority to the CSFDUTIL resource in the CSFSERV class.

   To generate a report for a CKDS with the fully qualified data set name of ICSF.HCR7751.CKDS, use this JCL example:

```
//DUTIL     EXEC PGM=CSFDUTIL
//SYSOUT    DD SYSOUT=*
//SYSIN     DD *
  CKDSN(ICSF.HCR7751.CKDS)
/*
//
```

The supported option is either:

```
CKDSN(fully-qualified-CKDS-name)
```

or

```
PKDSN(fully-qualified-PKDS-name)
```

When you invoke the program as a batch job, you receive the return and reason code in a message when the job completes. The return codes are explained in “Return and reason codes for the CSFDUTIL program” on page 380.

The data set name is assumed to be fully-qualified.

Note: Prior to analyzing the current CKDS or PKDS, consider temporarily disallowing dynamic CKDS and PKDS update services. For more information, refer to "Steps for disallowing dynamic CKDS updates during KGUP updates". If the analysis is to be performed on a CKDS or PKDS which is shared by members of a sysplex, dynamic updates of the CKDS and PKDS should be disabled on all sysplex systems until the analysis job is complete.

CSFDUTIL output

The CKDS information that is written out has the format:

Table 27. CKDS information from CSFDUTIL

Column	Value
1 - 64	Key label
67 - 74	Key type from the KDS record
77 - 84	Creation date. yyyymmdd
87 - 94	Creation time. hhmmssth
97 - 104	Last update date. yyyymmdd
107 - 114	Last update time. hhmmssth

The PKDS information that is written out has the format:

Table 28. PKDS information from CSFDUTIL

Column	Value
1 - 64	Key label
67 - 74	Creation date. yyyymmdd
77 - 84	Creation time. hhmmssth
87 - 94	Last update date. yyyymmdd
97 - 104	Last update time. hhmmssth

Return and reason codes for the CSFDUTIL program

When you invoke the CSFDUTIL program as a batch job, you receive the return code in a message when the job completes. The meanings of the return codes are:

Return Code	Meaning
0	Processing completed successful.
4	Parameters are incorrect.
8	RACF authorization check failed.
12	Processing unsuccessful. Additional messages issued.
16	Processing unsuccessful. Additionally, there was an error issuing diagnostic messages.
20	An ABEND occurred.

When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The meaning of the reason codes are as follows:

Return code 0 has this reason code:

Reason Code	Meaning
0	Processing completed successfully.

Return code 4 has this reason code:

Reason Code	Meaning
32	There was an error in the options provided. See the output for details.

Return code 8 has this reason code:

Reason Code	Meaning
1600	Invoker has insufficient RACF access authority to use this service.

Return code 12 has these reason codes:

Reason Code	Meaning
6016	An IO error has occurred. See the output for details.
6028	There was an error establishing an ESTAE.

6032	There was a error allocating a data set or DD. See the output for details.
6036	There was an error deallocating a data set or DD. See the output for details.

Return code 16 has the same reason code as return code 12, but indicates that an error occurred in writing to the output in addition to the initial error.

Return code 20 has this reason code:

Reason Code	Meaning
4	An abnormal ending occurred. Contact your system programmer or the IBM Support Center.

CSFWDUTL

CSFWDUTL is a batch job that invokes the duplicate utilities program (CSFDUTIL). It can be found in SYS1.SAMPLIB.

```
//<NAME>   JOB  <JOB CARD PARAMETERS>
//*******************************************************************
//*                                                                 *
//*    Licensed Materials - Property of IBM                         *
//*    5694-A01                                                     *
//*    Copyright IBM Corp. 2008                                     *
//*                                                                 *
//*                                                                 *
//* This file contains sample JCL to invoke the Duplicate Token     *
//* Utility program (CSFDUTIL).                                     *
//*                                                                 *
//* CSFWDUTL: Invokes CSFDUTIL                                      *
//*                                                                 *
//* DESCRIPTION:                                                    *
//* CSFDUTIL is an ICSF utility program that searches the CKDS or   *
//* PKDS for duplicate key tokens.  This utility is not available   *
//* from the ICSF PANELS.  Refer to the ICSF Administrator's        *
//* Guide for more information on CSFDUTIL functions.               *
//*                                                                 *
//* CSFWDUTL calls CSFDUTIL and passes the requested function into  *
//* the utility using the SYSIN dd statement.                       *
//*                                                                 *
//* CAUTION:                                                        *
//* Before using this sample, you have to make the following        *
//* changes.                                                        *
//*                                                                 *
//* USER ACTIONS REQUIRED:                                          *
//* 1.Add the job parameters to meet your system requirements.      *
//* 2.If necessary change the parameter value to the key data set   *
//*   you want to examine.                                          *
//*                                                                 *
//*******************************************************************
//*       JCL to invoke CSFDUTIL                                    *
//*******************************************************************
//CSFWDUTL EXEC PGM=CSFDUTL
//SYSOUT    DD  SYSOUT=*
//SYSIN     DD  *
  CKDSN(CSF.CSFCKDS)
/*
```

Chapter 19. Rewrapping DES key token values in the CKDS using the utility program CSFCNV2

ICSF provides a utility program, CSFCNV2, that will rewrap all encrypted DES tokens in the CKDS.

Note: You can also use the CSFCNV2 utility to convert a fixed-length record format CKDS to a variable-length record format. For more information on this capability of the CSFCNV2 utility, refer to *z/OS Cryptographic Services ICSF System Programmer's Guide*.

As described in "DES key wrapping" on page 25, there are two methods for wrapping the key value in a DES key token. The original method encrypts DES tokens using triple DES encryption. An enhanced wrapping method, introduced in FMID HCR7780 and designed to be ANSI X9.24 compliant, bundles the keys with other token data and encrypts the keys and associated data using triple DES encryption.

Using the CSFCNV2 utility, you can rewrap all encrypted key tokens in the CKDS using the enhanced or the original method. The results will be written to a new CKDS.

There is no panel interface for this utility. It can be invoked as a batch job and requires a z196 with a CEX3C.

To rewrap encrypted key tokens in an existing CKDS and write the results to a new CKDS, use the following JCL code as an example:

```
//STEP EXEC PGM=CSFCNV2,PARM='WRAP-xxx,OLD.CKDS,NEW.CKDS'
```

Where:

WRAP-*xxx*
: Specifies the wrapping method to use.

  WRAP-ECB
  : The original wrapping method. If you specify this option, be aware that the access control point "CKDS Conversion2 utility - Convert from enhanced to original" must be enabled. This access control point is not enabled in the ICSF coprocessor role. It can only be enabled using TKE.

  WRAP-ENH
  : The enhanced wrapping method.

  ENH-ONLY
  : The enhanced wrapping method will be used and the control vector in tokens will be updated to indicate that token can not be rewrapped to the original method.

OLD.CKDS
: The name of the disk copy of the CKDS to process.

NEW.CKDS
: The name of an empty disk copy of the CKDS to contain the rewrapped keys.

The CSFV0560 message in the joblog will indicate the results of processing.

Return Code	Meaning
0	Process successful.
4	Minor error occurred.
8	RACF authorization check failed.
12	Process unsuccessful.
60 or 92	CKDS processing has failed. A return code 60 indicates the error was detected in the new KDS. A return code 92 indicates the error was detected with the old KDS.

When the program is invoked from another program, the invoking program receives the reason code in General Register 0 along with the return code in General Register 15. The following list describes the meaning of the reason codes. If a particular reason code is not listed, refer to the listing of ICSF and TSS return and reason codes in the *z/OS Cryptographic Services ICSF Application Programmer's Guide*.

Return code 0 has this reason code:

Reason Code	Meaning
36132	CKDS reencipher/Change MK processed only tokens encrypted under the DES master key.

Return code 4 has these reason codes:

Reason Code	Meaning
0	Parameters are incorrect.
4004	Rewrapping is not allowed for one or more keys.
36112	CKDS conversion completed successfully but some tokens could not be rewrapped because the control vector prohibited rewrapping from the enhanced wrapping method.
36164	Input CKDS is already in the variable-length record format. No conversion is necessary.

Return code 8 has this reason code:

Reason Code	Meaning
16000	Invoker has insufficient RACF access authority to perform function.

Return code 12 has these reason codes:

Reason Code	Meaning
0	ICSF has not been started
11060	The required cryptographic coprocessor was not active or the master key has not been set
36000	Unable to change master key. Check hardware status.
36008	Crypto master key register(s) in improper state.
36020	Input CKDS is empty or not initialized (authentication pattern in the control record is invalid).

36036	The new master key register for Coprocessor 1 (C1) is not full, but C0 is ready and the current master key is valid.
36040	The new master key register for C0 is not full, but C1 is ready and the current master key is valid.
36044	The master key authentication pattern for the CKDS does not match the authentication pattern of the coprocessors, which are not equal.
36048	The master key authentication pattern for the CKDS does not match the authentication pattern of either of the coprocessors, which are not equal.
36052	A valid new master key is present in C0, but its authentication pattern does not match that of C1 or the CKDS, which are equal.
36056	A valid new master key is present in C1, but its authentication pattern does not match that of C0 or the CKDS, which are equal.
36060	The new master key register(s) is/are not full.
36064	Both new master key registers are full but not equal.
36068	The input KDS is not enciphered under the current master key.
36076	The new master key register for C0 is not full, but the CPUs are online.
36080	The new master key register for C1 is not full, but the CPUs are online.
36084	The master key register cannot be changed since ICSF is running in compatibility mode.
36104	Option not available. There were no Cryptographic Coprocessors available to perform the service that was attempted.
36108	PKA callable services are enabled, and the PKDS is the active PKDS as specified in the options data set.
36120	The CKDS is unusable. The CKDS does not support record level authentication.
36124	The CKDS is unusable. The CKDS only supports encrypted AES keys and encrypted DES support is required.
36128	The CKDS is unusable. The CKDS does not support encrypted DES keys which is required.
36160	The attempt to reencipher the CKDS failed because there is an enhanced token in the CKDS.
36168	A CKDS has an invalid LRECL value for the requested function. For wrapping, the input and output CKDS LRECLs must be the same.
36172	The level of hardware required to perform the operation is not available.

Return code 60 or 92 has these reason codes:

Reason Code	**Meaning**
3078	The CKDS was created with an unsupported LRECL.
5896	The CKDS does not exist.

6008 A service routine has failed.

The service routines that may be called are:

CSFMGN
MAC generation

CSFMVR
MAC verification

CSFMKVR
Master key verification

6012 The single-record, read-write installation exit (CSFSRRW) returned a return code greater than 4.

6016 An I/O error occurred reading or writing the CKDS.

6020 The CSFSRRW installation exit abended and the installation options EXIT keyword specifies that the invoking service should end.

6024 The CSFSRRW installation exit abended and the installation options EXIT keyword specifies that ICSF should end.

6028 The CKDS access routine could not establish the ESTAE environment.

6040 The CSFSRRW installation exit could not be loaded and is required.

6044 Information necessary to set up CSFSRRW installation exit processing could not be obtained.

6048 The system keys cannot be found while attempting to write a complete CKDS data set.

6052 For a write CKDS record request, the current master key verification pattern (MKVP) does not match the CKDS header record MKVP.

6056 The output CKDS is not empty.

Note: It is possible that you will receive MVS reason codes rather than ICSF reason codes, for example, if the reason code indicates a dynamic allocation failure. For an explanation of Dynamic Allocation reason codes, see *z/OS MVS Programming: Authorized Assembler Services Guide*

Chapter 20. Using ICSF Health Checks

The IBM Health Checker for z/OS is used to identify potential problems before they impact availability or cause outages. The Health Checker outputs messages to notify the user of the problems and suggests actions to be taken. The messages can be merely informational, or they can indicate a risk to the operation of the product.

ICSF provides a set of health checks to inform the user of potential ICSF problems. The checks include both migration checks and status checks. A migration check is designed to warn of changes in a current or pending ICSF release that could negatively impact usage. A status check provides information on the state of ICSF.

The ICSF Health Checks are:

- ICSFMIG7731_ICSF_RETAINED_RSAKEY
- ICSFMIG_DEPRECATED_SERV_WARNINGS
- ICSF_COPROCESSOR_STATE_NEGCHANGE

Accessing the ICSF Health Checks

The Health Checks can be accessed using the System Display and Search Facility (SDSF) option in ISPF. SDSF provides a CK option to access the Health Checker:

```
HQX7780 -----------------  SDSF PRIMARY OPTION MENU  ------------------------

.DA    Active users                     .INIT  Initiators
.I     Input queue                      .PR    Printers
.O     Output queue                     .PUN   Punches
.H     Held output queue                .RDR   Readers
.ST    Status of jobs                   .LINE  Lines
                                        .NODE  Nodes
.LOG   System log                       .SO    Spool offload
.SR    System requests                  .SP    Spool volumes
.MAS   Members in the MAS               .NS    Network servers
.JC    Job classes                      .NC    Network connections
.SE    Scheduling environments
.RES   WLM resources                    .RM    Resource monitor
.ENC   Enclaves                         .CK    Health checker
.PS    Processes
                                        .ULOG  User session log
.END   Exit SDSF
```

Selecting the Health Checker (CK) option displays the available checks. The checks are displayed alphabetically by name. The ICSF checks start with ‘ICSF’.

```
SDSF HEALTH CHECKER DISPLAY  SY1
PREFIX=*  DEST=(ALL)  OWNER=*  SYSNAME=
NP .NAME                              .CheckOwner  .State             .Status
     GRS_EXIT_PERFORMANCE               IBMGRS       ACTIVE(ENABLED)   SUCCESSFUL
     GRS_GRSQ_SETTING                   IBMGRS       ACTIVE(DISABLED)  ENV N/A
     GRS_MODE                           IBMGRS       ACTIVE(DISABLED)  ENV N/A
     GRS_RNL_IGNORED_CONV               IBMGRS       ACTIVE(DISABLED)  ENV N/A
     GRS_SYNCHRES                       IBMGRS       ACTIVE(ENABLED)   SUCCESSFUL
     ICSF_COPROCESSOR_STATE_NEGCHANGE IBMICSF      ACTIVE(ENABLED)   SUCCESSFUL
     ICSFMIG_DEPRECATED_SERV_WARNINGS IBMICSF      INACTIVE(ENABLED) INACTIVE
     ICSFMIG7731_ICSF_RETAINED_RSAKEY IBMICSF      INACTIVE(ENABLED) INACTIVE
     IEA_ASIDS                          IBMSUP       ACTIVE(ENABLED)   SUCCESSFUL
     IEA_LXS                            IBMSUP       ACTIVE(ENABLED)   SUCCESSFUL
     IOS_CAPTUCB_PROTECT                IBMIOS       ACTIVE(ENABLED)   SUCCESSFUL
     IOS_CMRTIME_MONITOR                IBMIOS       ACTIVE(ENABLED)   SUCCESSFUL
     IOS_MIDAW                          IBMIOS       ACTIVE(ENABLED)   SUCCESSFUL
     IOS_STORAGE_IOSBLKS                IBMIOS       ACTIVE(ENABLED)   SUCCESSFUL
```

The coprocessor state degradation check is enabled when ICSF is started and will monitor the coprocessor states on a daily basis until deactivated. The two migration checks are inactive when ICSF is started and must be activated to perform their checks.

ICSFMIG7731_ICSF_RETAINED_RSAKEY

Type: Migration

Initial State: Inactive

Interval: One Time

This is a migration check. The check detects the presence of retained keys on the cryptographic coprocessors. Retained keys will not be supported in subsequent releases of ICSF. Existing retained keys will become unusable.

Retained keys are listed by coprocessor. The generated Health Checker report lists the coprocessor serial number and the retained key label. Existing retained keys must be replaced with RSA keys stored in the PKDS rather than retained on the coprocessor.

The check output is obtained by selecting (s) on the Health Checker menu:

```
CHECK(IBMICSF,ICSFMIG7731_ICSF_RETAINED_RSAKEY)
START TIME: 05/20/2011 08:16:29.689677
CHECK DATE: 20071201  CHECK SEVERITY: LOW
Coprocessor
  Serial     Retained key label
-------------------------------------------------------------------------
93X06020  HCR7750.RKEY.RSA.CRT.1024MOD
93X06020  HCR7750.RKEY.RSA.CRT.1024MOD.SIGONLY

* Low Severity Exception *

CSFH0003E Cryptographic coprocessors were examined and found to
possess retained RSA Keys.

  Explanation:  Coprocessors online to this system were found to possess
    one or more retained RSA keys, implying retained RSA keys are
    potentially being used on this system. ICSF is deprecating its
    retained RSA key support.
```

```
  System Action:  There is no effect on the system.

  Operator Response:  Report this exception to the System Programmer.

  System Programmer Response:  Alert the installation security
    Administrator and application and middleware administrators for this
    system.

  Problem Determination:  Investigate the cryptographic services
    utilized by the workload executed on this system and determine which
    application and middleware products use retained RSA key services
    for key management use that would depend upon the key labels in the
    report. Develop an immediate strategy to remove any dependencies on
    creating new ICSF-supported retained RSA keys prior to migration to
    ICSF release level HCR7750, and an eventual strategy to remove any
    dependencies on ICSF-supported retained key interfaces.

  Source:  Integrated Cryptographic Service Facility (ICSF)

  Reference Documentation:  z/OS Cryptographic Services Integrated
    Cryptographic Service Facility: Systems Programmers Guide (HCR7750
    and later).

  Automation:  n/a

  Check Reason:  Detects use of retained RSA private keys.
```

ICSFMIG_DEPRECATED_SERV_WARNINGS

Type: Migration

Initial State: Inactive

Interval: Daily

This is a migration check. The check detects the use of services which will not be supported in subsequent releases of ICSF. The check is not active when ICSF is started and must be activated to perform the check. Once activated the check will be performed on a daily basis.

The check output is obtained by selecting (s) the check on the Health Checker menu. If the check determines that deprecated services are being used then an exception is generated.

The check output is obtained by selecting (s) on the Health Checker menu:

```
CHECK(IBMICSF,ICSFMIG_DEPRECATED_SERV_WARNINGS)
START TIME: 05/20/2011 08:33:39.248906
CHECK DATE: 20110320  CHECK SEVERITY: LOW

* Low Severity Exception *

CSFH0011I Cryptographic Service CSFAKEX is currently used,
but support for this service is being removed in subsequent releases.

  Explanation:  The specified callable service is not being supported in
    subsequent releases, thus in the future workloads using the service
    may fail.

  System Action:  There is no effect on this system.

  Operator Response:  Report this exception to the System Programmer.
```

```
  System Programmer Response:  Alert the installation security
    Administrator and application/middleware administrators for this
    system.

  Problem Determination:  Investigate applications using this service
    and determine appropriate actions to remove or replace the use of
    this service.

  Source:  Integrated Cryptographic Service Facility (ICSF)

  Reference Documentation:  z/OS Cryptographic Services Integrated
    Cryptographic Service Facility: Application Programmers Guide
    (HCR7790 and later).

  Automation:  n/a

  Check Reason:  Detects use of deprecated callable service.

END TIME: 05/20/2011 08:35:40.308973  STATUS: EXCEPTION-LOW
```

The deprecated services checked in this release are listed below. These are not supported on post zSeries 900 hardware.

- CSFAEGN
- CSFAKEX
- CSFAKIM
- CSFAKTR
- CSFATKN
- CSFCTT
- CSFCTT1
- CSFTCK
- CSFUDK
- CSFPKSC

ICSF_COPROCESSOR_STATE_NEGCHANGE

Type: Status

Initial State: Active

Interval: Daily

This is a status check. The check detects a degradation in the state of any cryptographic coprocessor or accelerator on the system. The check is activated during the initialization of ICSF. The check is performed on a daily basis.

A state degradation is reported by AP number for the cryptographic coprocessor or accelerator. The states are described in the “Displaying coprocessor or accelerator status - PCIXCC, PCICA, CEX2C, CEX3C, CEX2A, and CEX3A” on page 285. A state degradation has a possible negative impact on the operation of ICSF and the dependent cryptographic workload. The cause of the change should be understood.

The check output is obtained by selecting (s) on the Health Checker menu:

```
CHECK(IBMICSF,ICSF_COPROCESSOR_STATE_NEGCHANGE)
START TIME: 05/23/2011 14:33:49.364933
CHECK DATE: 20110320  CHECK SEVERITY: MEDIUM

* Medium Severity Exception *
```

```
CSFH0010E Coprocessor or Accelerator with AP number 35
has changed from ACTIVE state to OFFLINE state.

  Explanation:  The Coprocessor or accelerator state has degraded since
    the last check.

  System Action:  This has a possible negative impact on the operation
    of ICSF and the dependent cryptographic workload.

  Operator Response:  Report this exception to the System Programmer.

  System Programmer Response:  Alert the installation security
    Administrator to determine the impact of the change in coprocessor
    state.

  Problem Determination:  Refer to the ICSF Coprocessor Management and
    hardware status panels and the support element (SE) panel for
    further information regarding the coprocessors.

  Source:  Integrated Cryptographic Service Facility (ICSF)

  Reference Documentation:  z/OS Cryptographic Services Integrated
    Cryptographic Service Facility: Systems Programmers Guide.

  Automation:  n/a

  Check Reason:  Detects degradation in coprocessor state.

END TIME: 05/23/2011 14:37:36.608096  STATUS: EXCEPTION-MED
```

Appendix A. CCC Bit Assignments

These are some of the hardware CCC (crypto configuration control) definitions. You can view these values from the coprocessor hardware status panel (see Figure 179 on page 292). You are not able to change these values.

Note: The CCC applies only to the Cryptographic Coprocessor Feature. You do not see CCC definitions on the panel for the PCIXCC, CEX2C, or CEX3C.

BIT	***Meaning***
6	indicates TKE can be supported.
37 - 38	indicates triple DES and AES are supported.

Bits 80 through 127 (the right-most bits on the hardware status panel) form a pattern indicating the key length that is allowed.

When these bits are `07F7F 0F7F7`, the maximum RSA key management key length is 512 bits.

When these bits are `0FFFF 0FFFF`, the maximum RSA key management key length is 1024 bits.

Appendix B. Control Vector Table

Note: The Control Vectors used in ICSF are exactly the same as in CCA and the TSS publication.

The master key enciphers all keys operational on your system. A transport key enciphers keys that are distributed off your system. Prior to a master key or transport key enciphering a key, ICSF exclusive ORs both halves of the master key or transport key with a control vector. The same control vector is exclusive ORed to the left and right half of a master key or transport key.

Also, if you are entering a key part, ICSF exclusive ORs each half of the key part with a control vector prior to placing the key part into the CKDS.

Each type of key on ICSF (except the master key) has either one or two unique control vectors associated with it. The control vector that ICSF exclusive ORs the master key or transport key with depends on the type of key the master key or transport key is enciphering. For double-length keys, a unique control vector exists for each half of a specific key type. For example, there is a control vector for the left half of an input PIN-encrypting key, and a control vector for the right half of an input PIN-encrypting key.

If you are entering a key part into the CKDS, ICSF exclusive ORs the key part with the unique control vector(s) associated with the key type. ICSF also enciphers the key part with two master key variants for a key part. One master key variant enciphers the left half of the key part, and another master key variant enciphers the right half of the key part. ICSF creates the master key variants for a key part by exclusive ORing the master key with the control vectors for key parts. These procedures protect key separation.

Table 29 displays the default value of the control vector that is associated with each type of key. For keys that are double-length, ICSF enciphers a unique control vector on each half. Control vectors indicated with an "*" are supported by the CCF.

Table 29. Default Control Vector Values

Key Type	Control Vector Value (Hex) Value for Single-length Key or Left Half of Double-length Key	Control Vector Value (Hex) Value for Right Half of Double-length Key
*AKEK	00 00 00 00 00 00 00 00	
CIPHER	00 03 71 00 03 00 00 00	
CIPHER (double length)	00 03 71 00 03 41 00 00	00 03 71 00 03 21 00 00
CVARDEC	00 3F 42 00 03 00 00 00	
CVARENC	00 3F 48 00 03 00 00 00	
CVARPINE	00 3F 41 00 03 00 00 00	
CVARXCVL	00 3F 44 00 03 00 00 00	
CVARXCVR	00 3F 47 00 03 00 00 00	
*DATA	00 00 00 00 00 00 00 00	
DATAC	00 00 71 00 03 41 00 00	00 00 71 00 03 21 00 00
*DATAM generation key (external)	00 00 4D 00 03 41 00 00	00 00 4D 00 03 21 00 00

Table 29. Default Control Vector Values (continued)

Key Type	Control Vector Value (Hex) Value for Single-length Key or Left Half of Double-length Key	Control Vector Value (Hex) Value for Right Half of Double-length Key
*DATAM key (internal)	00 05 4D 00 03 00 00 00	00 05 4D 00 03 00 00 00
*DATAMV MAC verification key (external)	00 00 44 00 03 41 00 00	00 00 44 00 03 21 00 00
*DATAMV MAC verification key (internal)	00 05 44 00 03 00 00 00	00 05 44 00 03 00 00 00
*DATAXLAT	00 06 71 00 03 00 00 00	
DECIPHER	00 03 50 00 03 00 00 00	
DECIPHER (double-length)	00 03 50 00 03 41 00 00	00 03 50 00 03 21 00 00
DKYGENKY	00 71 44 00 03 41 00 00	00 71 44 00 03 21 00 00
ENCIPHER	00 03 60 00 03 00 00 00	
ENCIPHER (double-length)	00 03 60 00 03 41 00 00	00 03 60 00 03 21 00 00
*EXPORTER	00 41 7D 00 03 41 00 00	00 41 7D 00 03 21 00 00
IKEYXLAT	00 42 42 00 03 41 00 00	00 42 42 00 03 21 00 00
*IMP-PKA	00 42 05 00 03 41 00 00	00 42 05 00 03 21 00 00
*IMPORTER	00 42 7D 00 03 41 00 00	00 42 7D 00 03 21 00 00
*IPINENC	00 21 5F 00 03 41 00 00	00 21 5F 00 03 21 00 00
*MAC	00 05 4D 00 03 00 00 00	
MAC (double-length)	00 05 4D 00 03 41 00 00	00 05 4D 00 03 21 00 00
*MACVER	00 05 44 00 03 00 00 00	
MACVER (double-length)	00 05 44 00 03 41 00 00	00 05 44 00 03 21 00 00
OKEYXLAT	00 41 42 00 03 41 00 00	00 41 42 00 03 21 00 00
*OPINENC	00 24 77 00 03 41 00 00	00 24 77 00 03 21 00 00
*PINGEN	00 22 7E 00 03 41 00 00	00 22 7E 00 03 21 00 00
*PINVER	00 22 42 00 03 41 00 00	00 22 42 00 03 21 00 00

Notes:

1. The external control vectors for DATAC, double-length MAC generation and MAC verification keys are also referred to as data compatibility control vectors.
2. Double-length MAC and MACVER keys can now by specified by these key types on the IBM @server zSeries 990, z890, z9 EC and z9 BC.

Appendix C. Supporting Algorithms and Calculations

This appendix shows various algorithms and calculations that are used in cryptographic systems.

Checksum Algorithm

To enter a key or a master key manually, you enter key parts. When you enter a key part, you enter two key part halves and a checksum for the key part. The checksum is a two-digit number you calculate using the key part and the checksum algorithm.

When you enter the key part and the checksum, ICSF calculates the checksum for the key part you entered. If the checksum you enter and the checksum ICSF calculates do not match, you did not enter the key part correctly and should reenter it. When you enter a key part, you need to calculate the checksum. You can use the ICSF utility panels that are described in Chapter 6, “Managing Master Keys - CCF and PCICC,” on page 99 or the checksum algorithm that is described in this appendix.

In the checksum algorithm, you use these operations:

- Sum Operation

  The addition table in Figure 235 on page 398 defines the sum operation. The sum of two hexadecimal digits i and j is the entry at the intersection of the column i and the row j. For example, the sum of A and 6 is C.

Sum	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	0	3	2	5	4	7	6	9	8	B	A	D	C	F	E
2	2	3	0	1	6	7	4	5	A	B	8	9	E	F	C	D
3	3	2	1	0	7	6	5	4	B	A	9	8	F	E	D	C
4	4	5	6	7	0	1	2	3	C	D	E	F	8	9	A	B
5	5	4	7	6	1	0	3	2	D	C	F	E	9	8	B	A
6	6	7	4	5	2	3	0	1	E	F	C	D	A	B	8	9
7	7	6	5	4	3	2	1	0	F	E	D	C	B	A	9	8
8	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7
9	9	8	B	A	D	C	F	E	1	0	3	2	5	4	7	6
A	A	B	8	9	E	F	C	D	2	3	0	1	6	7	4	5
B	B	A	9	8	F	E	D	C	3	2	1	0	7	6	5	4
C	C	D	E	F	8	9	A	B	4	5	6	7	0	1	2	3
D	D	C	F	E	9	8	B	A	5	4	7	6	1	0	3	2
E	E	F	C	D	A	B	8	9	6	7	4	5	2	3	0	1
F	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

Figure 235. Addition Table

- Shift Operation

  The shift table in Figure 236 defines the shift operation. The shift of digit i is denoted by H(i). For example, the shift of 5 is H(5) = E.

i	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
H(i)	0	C	1	D	2	E	3	F	4	8	5	9	6	A	7	B

Figure 236. Shift Table

In this description of the algorithm, the two hexadecimal digits of the checksum are represented by P1 and P2 for the set of 32 hexadecimal digits D(1,2,.....,32). The letter i represents the increment.

To calculate the checksum, use this algorithm:

1. Set i = 0, and set P1 and P2 = 0 (hexadecimal).
2. Let P1 = Sum of P1 and D(i + 1). Let P2 = Sum of P2 and D(i + 2).
3. Let P1 = H(P1). Let P2 = H(P2).
4. Let i = i + 2. If i < 32, go to step 2; otherwise, go to step 5.
5. P1 equals the first checksum digit. P2 equals the second checksum digit.

Algorithm for calculating a verification pattern

To enter a master key or operational key manually, you enter key parts. When you enter a key part, ICSF displays a verification pattern for that key part on a panel. To verify that you entered the key part correctly, you can use the value of the key part you enter to calculate the verification pattern. Check that the verification pattern you calculate matches the verification ICSF calculates.

To calculate this verification pattern, use this algorithm:

1. If the key part is an operational key part, exclusive OR the key part with the control vector for the key part's key type. See Appendix B, “Control Vector Table,” for a listing of control vectors by key type. If the key part is a master key part, do not exclusive OR it with a control vector.
2. Use the DES algorithm to encrypt the left half of the key part (either master key part or modified operational key part) under the key `4545 4545 4545 4545`.
3. Exclusive OR the result of step 2 with the left half of the key part.
4. Use the result of step 3 as the DES key in the DES algorithm to encrypt the right half of the key part.
5. Exclusive OR the result of step 4 with the right half of the key part.

The resulting 64-bit value is the verification pattern.

The verification pattern for the master key appears on the Coprocessor Selection and Hardware Status panels. If a master key register is full, the panels display the master key verification pattern. The verification patterns for two identical master keys are the same. You can use the verification patterns to verify that master keys in two different key storage units are the same.

ICSF records a master key verification pattern in the SMF record when you enter a master key part or activate a master key. The ICSF SMF record also records a verification pattern when you enter an operational key part.

AES master key verification pattern algorithm

The AES master key verification pattern is calculated by:

1. Appending X'01' to the clear key value of 32-byte master key (01 || key value)
2. Generating the SHA-256 hash of the 33-byte string

The first eight bytes of the hash is the verification pattern

Algorithm for calculating an authentication pattern

When you initialize a CKDS, ICSF uses the current master key and the authentication pattern algorithm to calculate an authentication pattern for the CKDS. ICSF places the value of the authentication pattern in the header record of the CKDS.

At ICSF startup, ICSF uses the authentication pattern to verify that the master key enciphers the current CKDS specified at ICSF startup. It compares the authentication pattern that is stored in the CKDS with the authentication pattern it calculates for the master key. If the authentication patterns do not match, ICSF startup fails, and ICSF gives you a message that states that the master key is not valid.

To calculate the authentication pattern, ICSF uses this algorithm:

1. Encrypt the left half of the master key under the key 6767 6767 6767 6767, using the DES algorithm.
2. Exclusive OR the result of step 1 with the original left half of the key.
3. Use the result of step 2 as the DES key in the DES algorithm to encrypt the right half of the master key.
4. Exclusive OR the result of step 3 with the original right half of the master key.

The resulting 64-bit value is the authentication pattern.

Pass Phrase Initialization master key calculations

The values for the DES and PKA master keys are calculated in this manner:

1. ICSF appends a two-byte constant, X'AB45', to the pass phrase, and generates the MD5 hash for the string by using an initial hash value of X'23A0BE487D9BD32003424FAAA34BCE00'. The first eight bytes of the result of this calculation become the last eight bytes of the PKA signature master key and the last eight bytes of the calculation become the last eight bytes of the PKA key management master key.
2. ICSF generates the DES master key value by appending a four-byte constant, X'551B1B1B', to the pass phrase, and generating the MD5 hash for the string using the hash that results from Step 1 as the initial hash value.
3. ICSF appends a three-byte constant, X'2A2A88', to the pass phrase and generates the MD5 hash for the string using the output hash of Step 2 as the initial hash value. The result of this calculation becomes the first 16 bytes of PKA signature master key.
4. ICSF appends a one-byte constant, X'94' to the pass phrase, and generates the MD5 hash for the string using the output hash of Step 3 as the initial hash value. The result of this calculation becomes the first 16 bytes of the PKA key management master key.
5. ICSF appends a five-byte constant X'C1C5E2D4D2' to the pass phrase, and generates the SHA-256 hash for the string using the output hash of Step 4 as the initial hash value. The result of this calculation becomes the 32-byte AES master key.
6. ICSF appends a seven-byte constant X'C5D3D3C9D7E2C5' to the pass phrase and generates the SHA-256 hash for the string using the output hash of Step 5 as the initial hash value. The result of this calculation becomes the 32-byte ECC master key.

Note: If the SMK=KMMK option is selected or defaulted, the KMMK is not used.

The MDC–4 Algorithm for Generating Hash Patterns

The MDC-4 algorithm calculation is a one-way cryptographic function that is used to compute the hash pattern of a key part. MDC uses encryption only, and the default key is 5252 5252 5252 5252 2525 2525 2525 2525.

Notations Used in Calculations

The MDC calculations use this notation:

eK(X) Denotes DES encryption of plaintext X using key K

|| Denotes the concatenation operation

XOR Denotes the exclusive-OR operation

:= Denotes the assignment operation

T8<1> Denotes the first 8–byte block of text

T8<2> Denotes the second 8–byte block of text, and so on

KD1, KD2, IN1, IN2, OUT1, OUT2
Denote 64–bit quantities

MDC-1 Calculation

The MDC-1 calculation, which is used in the MDC-4 calculation, consists of this procedure:

```
MDC-1 (KD1, KD2, IN1, IN2, OUT1, OUT2);
   Set KD1mod := set bit 1 and bit 2 of KD1 to "1" and "0", respectively.
   Set KD2mod := set bit 1 and bit 2 of KD2 to "0" and "1", respectively.
   Set F1 := IN1 XOR eKD1mod(IN1)
   Set F2 := IN2 XOR eKD2mod(IN2)
   Set OUT1 := (bits 0..31 of F1) || (bits 32..63 of F2)
   Set OUT2 := (bits 0..31 of F2) || (bits 32..63 of F1)
End procedure
```

MDC-4 Calculation

The MDC-4 calculation consists of this procedure:

```
MDC-4 (n, text, KEY1, KEY2, MDC);
   For i := 1, 2,...n do
      Call MDC-1(KEY1,KEY2,T8<i>,T8<i>,OUT1,OUT2)
      Set KEY1int := OUT1
      Set KEY2int := OUT2
      Call MDC-1(KEY1int,KEY2int,KEY2,KEY1,OUT1,OUT2)
      Set KEY1 := OUT1
      Set KEY2 := OUT2
   End do
   Set output MDC := (KEY1 || KEY2)
End procedure
```

Appendix D. PR/SM Considerations during Key Entry

If you use logical partition (LPAR) mode provided by the Processor Resource/System Manager (PR/SM), you may have additional considerations when performing these tasks:

- Entering keys
- Displaying hardware status
- Using the public key algorithm
- Using a TKE Workstation

These additional considerations depend on your processor hardware. For example, LPAR mode permits you to have multiple logical partitions and each logical partition (LP) can have access to the crypto CP for key entry. Therefore, at any given time, multiple LPs can perform key entry procedures.

This appendix gives some basic information on using ICSF in LPAR mode. For more detailed information on configuring and running in LPAR mode, refer to the *zSeries PR/SM Planning Guide* and the *S/390 Hardware Management Console Guide*.

Allocating Cryptographic Resources to a Logical Partition

Logical Partitions (LPs) operate independently but can share access to the same cryptographic coprocessor, just as they can share access to I/O devices and any other central processor resources. When you activate the LP, you can specify which cryptographic functions are enabled for that LP. The cryptographic resources available to the LP and the way you allocate them to the LP depends on the server or processor your are using.

Allocating Resources on z/990 or z890

For z9 EC, z9 BC and IBM System z10 Enterprise Class only CEX2C and CEX2A are supported.

To dynamically enable use of a new PCIXCC/CEX2C or PCICA/CEX2A coprocessor to a partition requires that:

- At least one usage domain index be defined to the logical partition.
- The usage domain list is a subset of the control domain list.
- The cryptographic coprocessor number(s) be defined in the partition Candidate list.

The same usage domain index may be defined more than once across multiple logical partitions. However, the cryptographic coprocessor number coupled with the usage domain index specified must be unique across all active logical partitions.

The same cryptographic coprocessor number and usage domain index combination may be defined for more than one logical partition. In such a configuration, only one of the logical partitions can be active at any time. This may be used, for example, to define a configuration for backup situations.

Table 30 on page 404 illustrates a simplified configuration map.

Each row identifies a logical partition and each column a cryptographic coprocessor, installed or in plan. Each cell, indicates the Usage Domain Index number(s) planned to be assigned to the partition in its image profile (it is recommended to work from a spreadsheet). There is a potential conflict when, for a given row, different cells contain more than once the same domain number.

Table 30. Planning LPARs domain and cryptographic coprocessor

coprocessor ID	**AP0**	**AP1**	**AP2**	**AP3**	**AP4**	**AP5**	**AP6**	...
type	PCICA or PCIXCC or CEX2C	PCICA or PCIXCC or CEX2C	PCICA or PCIXCC or CEX2C	PCICA or PCIXCC or CEX2C	PCICA or PCIXCC or CEX2C	PCICA or PCIXCC or CEX2C	PCICA or PCIXCC or CEX2C	
LPAR lp0	0	0				0	0	
LPAR lp1			0	0	0			
LPAR lp2	0	0	0	0	0			
LPAR lp4	4 14	4 14	4 14	4 14	4 14	4 14	4 14	
LPAR lp5				1	1	1	1	
.../...								

Up to 30 partitions can be defined and active, and each coprocessor has 16 domains. Within a row, the domain index number(s) specified are identical since the domain index applies to all cryptographic coprocessors selected in the partition Candidate list. In the example:

- Logical partitions lp0 and lp1 use domain 0 but are assigned different cryptographic coprocessors. The combination domain number and cryptographic coprocessor number is unique across partitions. Both partitions lp0 and lp1 can both be active at the same time.
- Logical partition lp4 uses domain 4 and 14. Since no other partition uses the same domain numbers, there is no conflict.
- Logical partition lp5 uses domain 1 and no other partition uses the same domain number. Again, there is no conflict.
- Logical partitions lp2 use domain 0, on the set of cryptographic coprocessors already used by lp0 and lp1. Partition lp2 cannot be active concurrently with lp0 or lp1. However, this may be a valid configuration to cover for backup situations.

Allocating Resources on CCF Systems

You use the Hardware Master Console tasks to enable various cryptographic functions for an LP. To assign a control domain index and usage domain index and initially enable cryptographic functions for an LP, use the Crypto page of the Customize Activation Profiles task. On the Crypto page you can enable these functions to the LP:

- Public key algorithm (PKA) function
- Cryptographic functions
  - Special secure mode
  - Public key secure cable (PKSC) and Integrated Cryptographic Service Facility (ICSF)
    - Modify authority (only enabled in one LPAR partition at a time)
    - Query signature controls
    - Query transport controls

These functions are hierarchically applied. For instance, if you do not enable cryptographic functions for the LP, you cannot enable any of the functions below it on the list. To enable basic ICSF functions, you must select these parameters on the crypto page:

- Usage domain index

  The number you select for usage domain index must match the domain number that is entered in the installation options data set for this LP.
- Enable cryptographic functions
- Enable public key secure cable (PKSC) and Integrated Cryptographic Service Facility (ICSF)

Once an LP is activated, you can then use the Change LPAR Crypto task to change the cryptographic functions that are enabled for that LP. This task has a page for each LP.

Entering the Master Key or Other Keys in LPAR Mode

To perform key entry from the TKE workstation, you must use a logical partition that already has key entry enabled.

In certain situations, ICSF clears the master key registers so the master key value is not disclosed. ICSF clears the master keys in all the logical partitions. The CKDSs and PKDSs are still enciphered under the master keys. To recover the keys in the CKDSs and PKDSs, you must reenter and activate the DES, SYM-MK, ASYM-MK and PKA master keys.

To restore the master keys, first ensure that key entry is enabled for all usage domain indexes for which you need to reenter the master keys. Since multiple domains can have key entry enabled, the domains may already be enabled. Reenter and activate the master key for all usage domain indexes. You can do this either through the Clear Master Key Part Entry panels or the TKE workstation.

Reusing or Reassigning a Domain

In the course of business, you may find it necessary to reuse or reassign a domain that is currently active. If this is the case, there are several steps to perform. It is a good security practice to zeroize the domain secrets, which includes retained keys and master keys.

Run the retained key delete service in the domain to remove them.

You can zeroize the master key with the TKE workstation or with TSO panels. For information on the TKE process, see *z/OS Cryptographic Services ICSF TKE Workstation User's Guide*.

If you are using the TSO panels, follow the procedure in “Steps for changing master keys” on page 126 or “Steps for changing master keys” on page 173 for your DES, SYM-MK, ASYM-MK and PKA master keys. Your key type should equal DES or SYM-MK and the key value should be all zeros.

```
CSFDKE10 -------------- ICSF - Clear Master Key Entry ---------
COMMAND ===>

             CCF DES/PCICC SYM-MK new master key register     : EMPTY
             CCF Signature/PCICC ASYM-MK master key register  : FULL
             CCF Key management master key register           : FULL


 Specify information below
   Key Type  ===> DES      (DES, SMK, KMMK, ALL-PKA)

   Part      ===> FIRST        (RESET, FIRST, MIDDLE, FINAL)


   Checksum  ===> 00

   Key Value ===> 0000000000000000
             ===> 0000000000000000
             ===> 0000000000000000   (SMK, KMMK and ALL-PKA only)
```

Figure 237. The Clear Master Key Entry Panel - CCF and PCICC

```
CSFDKE50------------- ICSF - Clear Master Key Entry -----------------
COMMAND ===>

             Symmetric-keys new master key register     : EMPTY
             Asymmetric-keys new master key register    : FULL

  Specify information below
    Key Type  ===> SYM-MK           (SYM-MK, ASYM-MK)

    Part      ===>  FIRST           (RESET, FIRST, MIDDLE, FINAL)

    Checksum  ===> 00

    Key Value ===> 0000000000000000
              ===> 0000000000000000
              ===> 0000000000000000   (ASYM-MK only)



  Press ENTER to process.
  Press END   to exit to the previous menu.
```

Figure 238. The Clear Master Key Entry Panel - PCIXCC, CEX2C, and CEX3C

Appendix E. Callable services affected by key store policy

This table provides application programmers guidance on parameters covered by the key store policy controls.

Only the names of the 31-bit versions of the callable services are listed. However, 64-bit versions of the callable services and the ALET qualified versions of the services are also covered by the key store policy. The callable services that are affected by the TOKEN_CHECK key store policy controls are in the table below.

Table 31. Callable services and parameters affected by key store policy

ICSF callable service	31-bit name	Parameter checked
ANSI X9.17 key export	CSNAKEX	source_data_key_1_identifier source_data_key_2_identifier source_key_encrypting_key_identifier transport_key_identifier
ANSI X9.17 key import	CSNAKIM	transport_key_identifier
ANSI X9.17 key translate	CSNAKTR	inbound_transport_key_identifier outbound_transport_key_identifier
ANSI X9.17 transport key	CSNATKN	source_transport_key_identifier
Cipher text translate	CSNBCTT	key_identifier_in key_identifier_out
Clear PIN encrypt	CSNBCPE	PIN_encrypting_key_identifier
Clear PIN generate alternate	CSNBCPA	PIN_encryption_key_identifier PIN_generation_key_identifier
Clear PIN generate	CSNBPGN	PIN_generation_key_identifier
Control vector translate	CSNBCVT	KEK_key_identifier source_key_token array_key_left array_key_right
CVV key combine	CSNBCKC	key_a_identifier key_b_identifier
Cryptographic variable encipher	CSNBCVE	c_variable_encrypting_key_identifier
Data key export	CSNBDKX	source_key_identifier exporter_key_identifier
Data key import	CSNBDKM	source_key_token importer_key_identifier
Decipher	CSNBDEC	key_identifier

Table 31. Callable services and parameters affected by key store policy (continued)

ICSF callable service	31-bit name	Parameter checked
Digital signature generate	CSNDDSG	PKA_private_key_identifier
Digital signature verify	CSNDDSV	PKA_public_key_identifier
Diversified key generate	CSNBDKG	generating_key_identifier generated_key_identifier
ECC Diffie-Hellman	CSNDEDH	private_key_identifier private_KEK_key_identifier public_key_identifier output_KEK_key_identifier
Encipher	CSNBENC	key_identifier
Encrypted PIN generate	CSNBEPG	PIN_generating_key_identifier outbound_PIN_encrypting_key_identifier
Encrypted PIN translate	CSNBPTR	input_PIN_encrypting_key_identifier output_PIN_encrypting_key_identifier
Encrypted PIN verify	CSNBPVR	input_PIN_encrypting_key_identifier PIN_verifying_key_identifier
HMAC generate	CSNBHMG	key_identifier
HMAC verify	CSNBHMV	key_identifier
Key export	CSNBKEX	source_key_identifier exporter_key_identifier
Key generate	CSNBKGN	KEK_key_identifier_1 KEK_key_identifier_2
Key import	CSNBKIM	source_key_token importer_key_identifier
Key test	CSNBKYT	key_identifier
Key test2	CSNBKYT2	key_identifier
Key test extended	CSNBYTX	key_identifier kek_key_identifier
Key translate	CSNBKTR	input_KEK_key_identifier output_KEK_key_identifier
Key translate2	CSNBKTR2,	input_key_token input_KEK_identifier output_KEK_identifier
MAC generate	CSNBMGN	key_identifier
MAC verify	CSNBMGN	key_identifier

Table 31. Callable services and parameters affected by key store policy (continued)

ICSF callable service	31-bit name	Parameter checked
Multiple secure key import	CSNBSKM	key_encrypting_key_identifier
PIN Change/Unblock	CSNBPCU	authentication_issuer_master_key_identifier encryption_issuer_master_key_identifier new_reference_PIN_key_identifier current_reference_PIN_key_identifier
PKA decrypt	CSNDPKD	PKA_key_identifier
PKA encrypt	CSNDPKE	PKA_key_identifier
PKA key generate	CSNDPKG	transport_key_identifier
PKA key import	CSNDPKI	importer_key_identifier
PKA key translate	CSNDPKT	source_key_identifier source_transport_key_identifier target_transport_key_identifier
PKA key token change	CSNDPKTC	key_identifier
PKA public key extract	CSNDPKX	source_key_identifier target_public_key_token
Prohibit export	CSNBPEX	key_identifier
Prohibit export extended	CSNBPEXX	source_key_token, kek_key_identifier
Remote key export	CSNDRKX	trusted_block_identifier transport_key_identifier importer_key_identifier source_key_identifier
Restrict key attribute	CSNBRKA	key_identifier
Secure key import	CSNBSKI	importer_key_identifier key_identifier
Secure messaging for keys	CSNBSKY	input_key_identifier key_encrypting_key_identifier secmsg_key_identifier
Secure messaging for PINs	CSNBSPN	PIN_encrypting_key_identifier secmsg_key_identifier
SET block compose	CSNDSBC	RSA_public_key_identifier DES_key_block RSA_OAEP_block

Table 31. Callable services and parameters affected by key store policy (continued)

ICSF callable service	31-bit name	Parameter checked
SET block decompose	CSNDSBD	RSA_private_key_identifier DES_key_block (one or two tokens)
Symmetric algorithm decipher	CSNBSAD	key_identifier
Symmetric algorithm encipher	CSNBSAE	key_identifier
Symmetric key decipher	CSNBSYD	key_identifier
Symmetric algorithm encipher	CSNBSYE	key_identifier
Symmetric key export	CSNDSYX	DATA_key_identifier RSA_public_key_identifier
Symmetric key generate	CSFSYG	key_encrypting_key_identifier RSA_public_key_identifier DES_enciphered_key_token
Symmetric key import	CSNDSYI	RSA_enciphered_key RSA_private_key_identifier
Symmetric key import2	CSNDSYI2	RSA_private_key_identifier
Transaction validation	CSNBTRV	transaction_key_identifier
Transform CDMF key	CSNBTCK	source_key_identifier kek_key_identifier
Trusted block create	CSNDTBC	input_block_identifier transport_key_identifier
TR-31 Export	CSNBT31X	source_key_identifier unwrap_kek_identifier wrap_kek_identifier
TR-31 Import	CSNBT31I	unwrap_kek_identifier, wrap_kek_identifier
User derived key	CSFUDK	derivation_key_identifier source_key_identifier
VISA CVV service generate	CSNBCSG	CVV_key_A_Identifier CVV_key_B_Identifier
VISA CVV service verify	CSNBCSV	CVV_key_A_Identifier CVV_key_B_Identifier

The callable services that are affected by the no duplicates key store policy controls are listed in the table below.

Table 32. Callable services that are affected by the no duplicates key store policy controls

ICSF callable service	31-bit name	Parameter checked
Key part import	CSNBKPI	key_identifier
Key record write	CSNBKRW	key_token
PKA Key Generate	CSNDPKG/CSNFPKG	generated_key_token
PKA Key Import	CSNDPKI/CSNFPKI	source_key_identifier
PKDS record create	CSNDKRC/CSNFKRC	token
PKDS record read	CSNDKRR	token
PKDS record write	CSNDKRW	key_token
Trusted Block Create	CSNDTBC	input_block_identifier

Summary of Key Store Policy (KSP) and Enhanced Keylabel Access Control interactions

For services that are passed a label, the key store policy will not affect the SAF check, so only Granular Keylabel Access Controls and CSNDSYX Access Controls will have an effect:

Table 33. Key Store Policy (KSP) and Enhanced Keylabel Access Control interactions (label)

	No CSNDSYX Access Controls for algorithm	CSNDSYX Access Controls for algorithm	No Granular Keylabel Access Controls	Granular Keylabel Access Controls
CSNDSYX: DATA key identifier	label SAF check is done against CSFKEYS	label SAF check is done against XCSFKEY	n/a	n/a
CSNDSYX: RSA key identifier and all other services passed a label	n/a	n/a	label SAF check is done against CSFKEYS for READ access	label SAF check is done against CSFKEYS for appropriate access

For services that are passed a token:

Table 34. Key Store Policy (KSP) and Enhanced Keylabel Access Control interactions (token)

	No KSP	KSP			
		No CSNDSYX Access Controls for algorithm	CSNDSYX Access Controls for algorithm	No Granular Keylabel Access Controls	Granular Keylabel Access Controls
CSNDSYX: DATA key identifier	no SAF check is done	KSP SAF checks are done against CSFKEYS	KSP SAF checks are done against XCSFKEY	n/a	n/a

Table 34. Key Store Policy (KSP) and Enhanced Keylabel Access Control interactions (token) (continued)

	No KSP	**KSP**			
		No CSNDSYX Access Controls for algorithm	**CSNDSYX Access Controls for algorithm**	**No Granular Keylabel Access Controls**	**Granular Keylabel Access Controls**
CSNDSYX: RSA key identifier and all other services passed a label	no SAF check is done	n/a	n/a	KSP SAF checks are done against CSFKEYS	KSP SAF checks are done against CSFKEYS

Note: The levels used by Granular Keylabel Access Controls will also be applied to KSP checks (that is, if the CKDS labels matching a token were checked with UPDATE access, CSF-CKDS-DEFAULT will also be checked with UPDATE access)

Appendix F. Questionable (Weak) Keys

If any of the eight-byte parts of the new master-key compares equal to one of the weak DES-keys, the service fails.

These are considered questionable DES keys:

```
01 01 01 01 01 01 01 01 / weak /
FE FE FE FE FE FE FE FE / weak /
1F 1F 1F 1F 0E 0E 0E 0E / weak /
E0 E0 E0 E0 F1 F1 F1 F1 / weak /
01 FE 01 FE 01 FE 01 FE /semi-weak /
FE 01 FE 01 FE 01 FE 01 /semi-weak /
1F E0 1F E0 0E F1 0E F1 /semi-weak /
E0 1F E0 1F F1 0E F1 0E /semi-weak /
01 E0 01 E0 01 F1 01 F1 /semi-weak /
E0 01 E0 01 F1 01 F1 01 /semi-weak /
1F FE 1F FE 0E FE 0E FE /semi-weak /
FE 1F FE 1F FE 0E FE 0E /semi-weak /
01 1F 01 1F 01 0E 01 0E /semi-weak /
1F 01 1F 01 0E 01 0E 01 /semi-weak /
E0 FE E0 FE F1 FE F1 FE /semi-weak /
FE E0 FE E0 FE F1 FE F1 /semi-weak /
1F 1F 01 01 0E 0E 01 01 /possibly semi-weak /
01 1F 1F 01 01 0E 0E 01 /possibly semi-weak /
1F 01 01 1F 0E 01 01 0E /possibly semi-weak /
01 01 1F 1F 01 01 0E 0E /possibly semi-weak /
E0 E0 01 01 F1 F1 01 01 /possibly semi-weak /
FE FE 01 01 FE FE 01 01 /possibly semi-weak /
FE E0 1F 01 FE F1 0E 01 /possibly semi-weak /
E0 FE 1F 01 F1 FE 0E 01 /possibly semi-weak /
FE E0 01 1F FE F1 01 0E /possibly semi-weak /
E0 FE 01 1F F1 FE 01 0E /possibly semi-weak /
E0 E0 1F 1F F1 F1 0E 0E /possibly semi-weak /
FE FE 1F 1F FE FE 0E 0E /possibly semi-weak /
FE 1F E0 01 FE 0E F1 01 /possibly semi-weak /
E0 1F FE 01 F1 0E FE 01 /possibly semi-weak /
FE 01 E0 1F FE 01 F1 0E /possibly semi-weak /
E0 01 FE 1F F1 01 FE 0E /possibly semi-weak /
01 E0 E0 01 01 F1 F1 01 /possibly semi-weak /
1F FE E0 01 0E FE F1 01 /possibly semi-weak /
1F E0 FE 01 0E F1 FE 01 /possibly semi-weak /
01 FE FE 01 01 FE FE 01 /possibly semi-weak /
1F E0 E0 1F 0E F1 F1 0E /possibly semi-weak /
01 FE E0 1F 01 FE F1 0E /possibly semi-weak /
01 E0 FE 1F 01 F1 FE 0E /possibly semi-weak /
1F FE FE 1F 0E FE FE 0E /possibly semi-weak /
E0 01 01 E0 F1 01 01 F1 /possibly semi-weak /
FE 1F 01 E0 FE 0E 10 F1 /possibly semi-weak /
FE 01 1F E0 FE 01 0E F1 /possibly semi-weak /
E0 1F 1F E0 F1 0E 0E F1 /possibly semi-weak /
FE 01 01 FE FE 01 01 FE /possibly semi-weak /
E0 1F 01 FE F1 0E 01 FE /possibly semi-weak /
E0 01 1F FE F1 01 0E FE /possibly semi-weak /
FE 1F 1F FE FE 0E 0E FE /possibly semi-weak /
1F FE 01 E0 E0 FE 01 F1 /possibly semi-weak /
01 FE 1F E0 01 FE 0E F1 /possibly semi-weak /
1F E0 01 FE 0E F1 01 FE /possibly semi-weak /
01 E0 1F FE 01 F1 0E FE /possibly semi-weak /
01 01 E0 E0 01 01 F1 F1 /possibly semi-weak /
1F 1F E0 E0 0E 0E F1 F1 /possibly semi-weak /
1F 01 FE E0 0E 01 FE F1 /possibly semi-weak /
01 1F FE E0 01 0E FE F1 /possibly semi-weak /
1F 01 E0 FE 0E 01 F1 FE /possibly semi-weak /
01 1F E0 FE 01 E0 F1 FE /possibly semi-weak /
```

```
01 01 FE FE 01 01 FE FE /possibly semi-weak /
1F 1F FE FE 0E 0E FE FE /possibly semi-weak /
FE FE E0 E0 FE FE F1 F1 /possibly semi-weak /
E0 FE FE E0 F1 FE FE F1 /possibly semi-weak /
FE E0 E0 FE FE F1 F1 FE /possibly semi-weak /
E0 E0 FE FE F1 F1 FE FE /possibly semi-weak /
```

Appendix G. Accessibility

Publications for this product are offered in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when using PDF files, you may view the information through the z/OS Internet Library Web site or the z/OS Information Center. If you continue to experience problems, send an e-mail to mhvrcfs@us.ibm.com or write to:

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
U.S.A.

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide Vol I* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer or Library Server versions of z/OS books in the Internet library at:

`http://www.ibm.com/systems/z/os/zos/bkserv/`

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This ICSF Administrator's Guide is intended to help the ICSF administrator manage the cryptographic keys.

This book primarily documents information that is NOT intended to be used as a Programming Interface of OS/390 ICSF.

This book also documents intended Programming Interfaces that allow the customer to write programs to obtain the services of OS/390 ICSF. This information is identified where it occurs, either by an introductory statement to a topic or by the following marking:

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