

z/OS
3.1

Introduction and Release Guide



Note

Before using this information and the product it supports, read the information in [“Notices” on page 51.](#)

This edition applies to IBM® z/OS® 3.1 (5655-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

Last updated: 2024-01-20

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How to provide feedback to IBM

We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information. For more information, see [How to send feedback to IBM](#).

z/OS information

This information explains how z/OS references information in other documents and on the web.

When possible, this information uses cross-document links that go directly to the topic in reference using shortened versions of the document title. For complete titles and order numbers of the documents for all products that are part of z/OS, see *z/OS Information Roadmap*.

To find the complete z/OS library, go to [IBM Documentation \(www.ibm.com/docs/en/zos\)](http://www.ibm.com/docs/en/zos).

Summary of changes

This information includes terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations for the current edition are indicated by a vertical line to the left of the change.

Note: IBM z/OS policy for the integration of service information into the z/OS product documentation library is documented on the z/OS Internet Library under [IBM z/OS Product Documentation Update Policy](http://www.ibm.com/docs/en/zos/latest?topic=zos-product-documentation-update-policy) (www.ibm.com/docs/en/zos/latest?topic=zos-product-documentation-update-policy).

Summary of changes for z/OS 3.1

The following content is new, changed, or no longer included in z/OS 3.1.

New

October 2023

- Updated [“z/OS Authorized Code Scanner \(zACS\)”](#) on page 19 with a link to the documentation.
- Support for the usage of PKCS #12 files protected with the PBES2 (Password Based Encryption Scheme 2) algorithm is added to System SSL with APAR OA64899, which also applies to z/OS 2.5. See [“System SSL: Usage of PKCS #12 files protected with the PBES2 \(Password Based Encryption Scheme 2\) algorithm with 256-bit AES-CBC encryption”](#) on page 32.

September 2023

- The z/OS 3.1 Upgrade Workflow provides the steps for upgrading to z/OS 3.1 from your currently supported z/OS system. For more information, see [“z/OS 3.1 Upgrade Workflow”](#) on page 21.
- Most elements and components in z/OS 3.1 are designed for use with IBM Semeru Runtime Certified Edition for z/OS, Version 11 (5655-DGJ). For more information, see [“IBM Semeru 11 support”](#) on page 23.
- A new base element, XML Toolkit for z/OS, is added. For more information, see [“XML Toolkit for z/OS”](#) on page 12.
- DFSMStvs is now included as a base feature. Previously it was an optional feature. For more information, see [“DFSMStvs”](#) on page 6.
- BCP has new functions to consider.
 - The AI Base Component for IBM z/OS, part of the AI Framework for IBM z/OS, is added. For more information, see [“AI Framework for IBM z/OS”](#) on page 24.
 - For Real Storage Manager (RSM), dedicated real memory pools provide a way to assign memory directly to the application at job-step start, while ensuring that the memory remains with the job step until it ends. For more information, see [“Real Storage Manager \(RSM\) considerations”](#) on page 25.
 - For Workload management (WLM):
 - [“WLM implicit long-term CPU protection”](#) on page 26
 - [“AI-powered WLM batch initiator management”](#) on page 26
 - For Unicode, the character conversion from Unicode/EBCDIC encoding to ISO-2022-JP encoding is enhanced. For more information, see [“ISO-2022 Unicode standards”](#) on page 25.
 - For Validated Boot, support is added in z/OS 3.1 and z/OS 2.5. For more information, see [“Validated Boot considerations”](#) on page 26.
 - For z/OS Workload Interaction Correlator, see [“z/OS Workload Interaction Correlator”](#) on page 27.
- Authorized Code Scanner has new functions to consider.

- [“Authorized Code Monitor \(zACM\)” on page 24](#)
- [“Extended scanning for vulnerabilities” on page 24](#)
- z/OS Communications Server has new functions to consider. For more information, see [“Communications Server new functions to consider” on page 27](#)
 - [“Simplification” on page 28](#)
 - [“Hardware support” on page 28](#)
 - [“Scalability and performance” on page 30](#)
 - [“Enhancing security” on page 29](#)
 - [“Scalability and performance” on page 30](#)
 - [“Application development” on page 31](#)
- Cryptographic Services has new functions to consider for ICSF.
 - [“AES Cipher key generation and HMAC key generation and import” on page 31](#)
 - [“ICSF can perform hashing operations using the BCrypt hashing algorithm” on page 31](#)
 - [“Key part control for the Master Key Entry utility” on page 31](#)
 - [“Two new ICSF health checks: ICSF_STATUS and ICSF_CLEAR_KEYS” on page 32](#)
- Cryptographic Services has new functions to consider for System SSL.
 - [“System SSL: Domain-based certificate verification” on page 32](#)
 - [“TLS V1.3 sysplex session ticket caching” on page 33](#)
 - [“GSKKMAN’s use of stash file support instead of prompting for password entry” on page 33](#)
 - [“System SSL support for x25519 and x448 key exchanges have been added for Transport Layer Security TLS V1.0 through TLS V1.2” on page 33](#)
- Data Set File System is available. For more information, see [“Data Set File System \(DSFS\)” on page 33](#).
- For DFSMSdftp, the following enhancements are added:
 - A new z/OS callable service, Cloud Data Access (CDA), enables access to data in cloud object stores and adds the ability to incorporate cloud object data into z/OS workloads. For more information, see [“Cloud Data Access \(CDA\)” on page 34](#).
 - Catalog enhancements simplify ICF Catalog recovery, improves Catalog management and maintenance, and simplifies Catalog Address Space (CAS) startup. For more information, see [“Catalog enhancements” on page 34](#).
- For Hardware Configuration Manager (HCM), see [“Support for IBM Semeru 11” on page 34](#).
- For IBM Z® Deep Neural Network Library, see [“IBM Z Deep Neural Network Library” on page 34](#).
- InfoPrint has new functions to consider:
 - [“Extended address volume \(EAV\) support” on page 35](#)
 - [“Sendmail enhancements” on page 35](#)
- ISPF has new functions to consider:
 - [“Enhancements for ISPF PDSE V2 member generations” on page 36](#)
 - [“ISPF enhancement for pervasive encryption data set allocation” on page 36](#)
 - [“Case-insensitive sort for ISPF UNIX directory list” on page 36](#)
 - [“Externalize HILITE values to ISPF z variables” on page 36](#)
- JES2 has new functions to consider:
 - [“JES2 policy persistence” on page 37](#)
 - [“JES2 policy expansion” on page 37](#)
 - [“JES2 SMF 1153 record” on page 37](#)

- [“JES2 job notifications” on page 38](#)
- [“JES2 policy extension” on page 38](#)
- [“JES2 job level resource limits and resource groups” on page 38](#)
- [“JES2 AI job selection” on page 39](#)
- [“JES2 compliance data reporting” on page 39](#)
- [“JES2 64-bit checkpoint versions” on page 39](#)
- For Language Environment®, you can determine whether high-level language applications such as COBOL, PL/I, and Java™ are running in the 31-bit or 64-bit interoperability environment. For more information, see [“COBOL-Java interoperability for Language Environment” on page 40](#).
- For Network File System (NFS):
 - Support is added for Application Transparent-Transport Layer Security (AT-TLS). See [“NFS Server AT-TLS enhancement ” on page 40](#).
 - Enhancements prevent file handles from expiring after restarting the server. See [“NFS Server restart recovery for NFSv4 ” on page 40](#).
- For Resource Management Facility (RMF):
 - Distributed Data Server (DDS) now uses 64-bit Java for memory constraint relief. See [“64-bit Java for memory constraint relief” on page 41](#).
 - A web-based interface simplifies the collection of metrics and reports. See [“ Web-based interface for metrics and reports” on page 41](#).
- New SDSF panels (MFD, MFJ, and MFM) provide different views of the data that is collected by the Module Fetch Monitor (MFM). You can use the new panels to provide better insight into the modules that are used on your system and optimize system performance. See [“New SDSF Module Fetch Monitor \(MFM\) panels” on page 41](#).
- Security Server (RACF) has new functions to consider.
 - [“RACF database encryption” on page 42](#)
 - [“RACF password phrase interval support” on page 42](#)
 - [“RACF custom fields” on page 42](#)
 - [“RACF SETROPTS APPLAUDIT ” on page 43](#)
 - [“RACF health checks” on page 43](#)
- z/OS SMP/E and z/OSMF Software Management (z/OSMF) provide the ability to digitally sign and verify the signature of GIMZIP software packages that are delivered both electronically and physically on all supported z/OS releases. See [“Security for signed packages” on page 43](#).
- IBM Tivoli® Directory Server for z/OS has an updated Java requirement. For more information, see [“Updated Java requirement” on page 44](#).
- The Open XL C/C++ compiler is available. See [“Open XL C/C++ 1.1 compiler component” on page 44](#).
- For z/OSMF Software Management (z/OSMF):
 - [“CFRM Policy Editor enhancements” on page 46](#)
 - [“Analyzing WLM service definitions with Policy Advisor” on page 46](#)
 - [“Security simplification” on page 46](#)
- z/OS Change Tracker can be used as a z/OSMF plug-in. See [“Interactive GUI front-end from the z/OSMF desktop ” on page 45](#).
- For z/OS Data Gatherer:
 - [“SMF Explorer with Python” on page 45](#)
- For z/OS UNIX:
 - [“zsh - The Z shell” on page 46](#)

- [“Enhanced skulker performance” on page 47](#)
- [“Merged view of files and directories with the union file system \(UFS\)” on page 47](#)
- [“New and changed z/OS UNIX utilities” on page 47](#)

Changed

September 2023 release

- z/OS OpenSSH is updated to OpenSSH 8.4p1. Previously, the product was based on OpenSSH 7.6p1. See [“z/OS OpenSSH” on page 13](#) and [“Support for OpenSSH 8.4p1” on page 41](#).

Deleted

September 2023 release

- Information about Bulk Data Transfer (BDT) is deleted because it is no longer available.
- Information about Distributed FileManager (DFM) is deleted because it is no longer available as of z/OS 3.1.
- Information about JES3 is deleted because it is no longer available.

Chapter 1. z/OS elements and features

z/OS base elements

z/OS provides function that is equivalent to the following elements. For the version and release numbers of those elements that also exist as separately orderable products, see *z/OS Planning for Installation*.

For an extra set of integrated features that is available on an optional basis, see [“z/OS optional features” on page 2](#).

The following base elements are included in z/OS:

- Alternate Library for REXX.
- Base Control Program (BCP)
- Common Information Model (CIM)
- Communications Server
- Cryptographic Services (includes ICSF, PKI Services, and System SSL)
- Data Set File System (DSFS)
- DFSMSdfp
- DFSMStvs
- EREP
- ESCON Director Support
- First Failure Support Technology/MVS (FFST/MVS)
- GDDM (includes PCLK and OS/2 Link)
- Hardware Configuration Definition (HCD)
- High Level Assembler (HLASM)
- IBM HTTP Server - Powered by Apache (includes IBM HTTP Server NA Secure)
- IBM Tivoli Directory Server for z/OS
- IBM z/OS Liberty Embedded
- z/OS Management Facility (z/OSMF)
- ICKDSF (Device Support Facility)
- IBM Z Deep Neural Network Library (zDNN)
- Integrated Security Services
- ISPF
- JES2
- Language Environment
- Metal C Runtime Library
- MICR/OCR
- Network File System (NFS)
- Runtime Library Extensions
- SMP/E
- Terminal Input Output Controller (TIOC)
- Time Sharing Option/Extensions (TSO/E)
- XML Toolkit for z/OS

- z/OS Container Extensions (zCX)
- z/OS Data Gatherer
- z/OS File System (zFS)
- z/OS Font Collection
- z/OS OpenSSH
- z/OS UNIX System Services
- z/OS Xvfb
- 3270 PC File Transfer Program

z/OS optional features

Some optional features are not priced, but priced as well as unpriced features are included in z/OS integration-testing. All priced, host-based features are capable of being dynamically enabled or disabled. For the version and release levels of those features that also exist independently, see [*z/OS Planning for Installation*](#).

The following is a list of z/OS optional features:

- DFSMSdss
- DFSMSshsm
- DFSMSrmm
- DFSORT
- GDDM-PGF
- GDDM-REXX
- Hardware Configuration Manager (HCM)
- High Level Assembler (HLASM) Toolkit
- IBM z/OS Change Tracker
- IBM z/OS Workload Interaction Correlator
- Infoprint Server
- Resource Measurement Facility (RMF)
- Restricted Use Common Service Area (RUCSA)
- System Display and Search Facility (SDSF)
- Security Server (includes RACF®)
- XL C/C++
- z/OS Authorized Code Scanner (zACS)
- z/OS Security Level 3 (includes IBM Tivoli Directory Server for z/OS Security Level 3, Network Authentication Service Security Level 3, Communications Server Security Level 3, and System Secure Sockets Layer (SSL) Security Level 3)
- z/OS Advanced Data Gatherer
- zEnterprise® Data Compression (zEDC)

Chapter 2. z/OS base elements descriptions

The following is a description of each base element in z/OS.

Alternate Library for REXX

Alternate Library for REXX enables users who do not have the REXX on IBM Z[®] library installed to run compiled REXX programs. It contains a language processor that transforms the compiled programs and runs them with the REXX interpreter, which is shipped as part of the z/OS operating system.

Software developers are no longer required to distribute the Alternate Library for REXX with their compiled REXX programs. Customers who have the REXX on IBM Z[®] Library installed will gain the performance benefits of running compiled REXX, while those customers who have the Alternate Library for REXX installed may still run the programs as interpreted.

By using the Alternate Library for REXX with z/OS, software developers gain the benefits of shipping compiled REXX programs without the source code:

- Maintenance of the program is simplified since the code can not be modified inadvertently.
- Compiled programs can be shipped in load module format, simplifying packaging and installation.
- The Alternate Library for REXX does not need to be shipped and installed with the software program.
- Maintenance of the Alternate Library for REXX is handled by the z/OS system administrator.

BCP (Base Control Program)

The backbone of the z/OS system is the Multiple Virtual Storage (MVS[™]) Base Control Program with JES2. These provide the essential services that make z/OS the system of choice when you need to process your workloads reliably, securely, with complete data integrity and without interruption.

Unicode support

The Unicode Standard is the universal character encoding standard used for representation of text for computer processing; it provides the capacity to encode all of the characters used for the written languages of the world. z/OS Unicode support is based on Version 6.0 of the Unicode Standard, although earlier versions are supported by some services. Review each individual service to see the Unicode Standard versions supported. z/OS Unicode Services supports the following services:

- Character conversion
- Case conversion
- Normalization
- Collation
- Stringprep
- Bidirectional transformation
- Conversion information service
- Dynamic locale service

Find summary and complete details about these services in [*z/OS Unicode Services User's Guide and Reference*](#).

z/OS XML System Services

z/OS XML System Services is an integrated component of the BCP. It is a system-level XML parser intended for use by system components, middleware, and applications that need a simple, efficient, non-validating XML parser. It provides a buffer-in, buffer-out processing model in which the document to parse is provided by the caller in one buffer; the z/OS XML System Services parser creates a parsed record stream in another buffer, also provided by the caller. Large documents can be processed by replenishing the input buffer with more data, and reusing the output buffer or specifying a new one when it is filled. z/OS XML System Services is invoked as a callable service and provides an assembler interface for callers to use. It is accessible from normal environments such as batch and z/OS Unix System Services, as well as from more esoteric environments such as SRB mode and cross-memory.

Common Information Model (CIM)

The Common Information Model (CIM) is a standard data model for describing and accessing systems management data in heterogeneous environments. It allows system administrators or vendors to write applications (CIM monitoring clients) that measure system resources in a network with different operating systems and hardware. With z/OS CIM, it is possible to use the DMTF CIM open standard for systems management, which is also implemented on further major server platforms (for example, Linux®, Linux on System x, i5/OS, or AIX®).

z/OS CIM implements the CIM server, which is based on the OpenPegasus open source project. A CIM client invokes the CIM server, which, in turn, collects z/OS data from the system and returns it to the calling client. To get the z/OS data, the CIM server invokes a CIM provider which retrieves the data from z/OS system resources.

The metrics that are obtained by this API are common across server platforms so you can use it to create end-to-end monitoring applications.

Communications Server

IP

IP (formerly known as IBM TCP/IP) is a set of industry standard protocols and applications that allow you to share data and computing resources with other computers, both IBM and non-IBM. UNIX applications use IP. By using IP commands at your workstation, you can perform tasks and communicate easily with a variety of other systems and workstations. IP allows you to perform tasks independent of the computer type. Some common uses of IP include: electronic mail, file transfer, remote logon, and the Internet.

IP CICS® Sockets

IP CICS Sockets, which is integrated into the base TCP/IP stack, provides the ability to use the generalized application programming interface (API) and socket applications in COBOL, PL/I, and assembler.

IP IMS Sockets

IMS IP support, also integrated into the base TCP/IP stack, allows the development of peer-to-peer applications in which IMS and an IP-connected peer form a client/server relationship. Using this support, IMS can be either client or server.

This element consists of three parts:

- The Sockets Extended application programming interface. Using this API, IMS message processing programs can communicate with remote IP-connected hosts using socket protocol.
- If IMS is acting as the server, the IMS Listener can be used to collect incoming transaction requests from remote IP-connected hosts and schedule IMS message processing programs to service these requests.
- The IBM Assist module provides support for the IMS application programmer who wishes to code IP client/server application programs using the IMS API. When used, this optional function intercepts IMS message queue calls and replaces them with socket calls.

SNA

Formerly known as VTAM®, Systems Network Architecture (SNA) is a network communication access method and provides Advanced Peer-to-Peer Networking (APPN). SNA is the interface between application programs in a host processor and other resources in an SNA network, and links peer users of the network. It establishes and terminates sessions between users of the network, forwarding session data to and from each session partner.

In addition to establishing and terminating sessions, it activates and deactivates resources under its control, including application programs and devices to which SNA is directly attached. SNA also maintains information on the network configuration, active sessions, and network conditions.

To help users control a network, SNA receives commands from an operator to perform network services. Through operator messages, the operator is kept informed about those services and about any network conditions.

Cryptographic Services

Cryptographic Services includes ICSF, PKI Services, and System SSL, and provides cryptographic functions for data secrecy, data integrity, personal identification, digital signatures, and the management of cryptographic keys.

ICSF and PKI Services are provided through the combination of secure cryptographic hardware, the ICSF cryptographic API, and the ICSF administration interface. ICSF supports the Common Cryptographic Architecture (CCA), as well as the DES algorithm, RSA public key cryptography, and the Digital Signature Standard. Cryptographic services support a wide variety of applications with high performance, security, and availability.

Additional functions include:

- Trusted Key Entry - The key entry unit for master keys has been replaced by a secure channel version implemented on a workstation known as the Trusted Key Entry Workstation. The unit is an optional cost feature.
- Commercial Data Masking Facility supports privacy functions.
- Public Key API (PKA Support) provides additional formatting or message digest standards.
- Public Key Cryptography Standards #11 (PKCS #11).

Public Key Infrastructure Services (PKI Services) allows you to establish a PKI infrastructure and serve as a certificate authority for your internal and external users, issuing and administering digital certificates in accordance with your own organization's policies. You can use a PKI Services application to request and obtain certificates through their own Web browsers, while your authorized PKI administrators approve, modify, or reject these requests through their own Web browsers. The Web applications provided with PKI Services are customizable, and a programming exit is also included for advanced customization. The approval for certificate requests can be manual or automatic if additional authentication such as RACF user IDs, is provided. You can issue certificates for different purposes, such as virtual private network (VPN) devices, smart cards, and secure e-mail, through different types of templates. PKI Services supports Public Key Infrastructure for X.509 version 3 (PKIX) and Common Data Security Architecture (CDSA) cryptographic standards.

System SSL supports the SSL V2.0, SSL V3.0, TLS (Transport Layer Security) V1.0, TLS V1.1, TLS V1.2, and TLS V1.3 protocols. TLS V1.3 is the latest version of the secure sockets layer protocol.

z/OS provides a set of SSL C/C++ callable application programming interfaces that, when used with the z/OS Sockets APIs, provide the functions required for applications to establish this secure sockets communications.

In addition to providing the API interfaces to exploit the Secure Sockets Layer and Transport Layer Security protocols, System SSL is also providing a suite of Certificate Management APIs. These APIs give the capability to create/manage your own certificate databases, utilize certificates stored in key database and key rings for purpose other than SSL and to build/process PKCS #7 standard messages.

DFSMSdfp

DFSMSdfp provides the foundation for:

Storage management

DFSMSdfp includes ISMF, an interactive facility that lets you define and maintain policies to manage your storage resources. These policies help to improve the use of storage devices, and to increase levels of service for user data, with minimal effort required from users. SMS manages these policies for the operating system. You can also use the NaviQuest tool under ISMF to help you migrate to SMS, maintain your SMS configuration, and perform many testing, implementation, and reporting tasks in batch.

Tape mount management

SMS provides a means for implementing tape mount management, a methodology for improving tape usage and reducing tape costs. This methodology involves intercepting selected tape data set allocations through the SMS automatic class selection (ACS) process, and redirecting them to a DASD buffer. Once on DASD, these data sets can be migrated to a single tape or small set of tapes, thereby reducing the overhead associated with multiple tape mounts.

Data management

DFSMSdfp helps you store and catalog information on DASD, optical, and tape resources, so that it can be quickly identified and retrieved from the system. You can use the catalog search interface, now part of DFSMSdfp, to access the catalog.

Program management

DFSMSdfp combines programs into executable modules, prepares them to run on the operating system, stores them in libraries, and reads them into storage for execution.

Device management

DFSMSdfp is involved in defining your input and output devices to the system, and in controlling the operation of those devices in the z/OS environment.

Distributed data access

Distributed data access allows all authorized systems and users in a network to exploit the powerful features of system-managed storage, or automated storage management provided by DFSMS.

The z/OS UNIX System Services (z/OS UNIX) file system works in conjunction with z/OS UNIX to provide a full UNIX environment within the z/OS system. z/OS becomes a full-feature UNIX client or server when coupled with the z/OS Network File System (z/OS NFS). With the z/OS UNIX file system, z/OS programs can directly access UNIX data. When the z/OS NFS client and z/OS UNIX are used together, z/OS can act as a client and access data from any remote system, including another z/OS or UNIX system that is connected using a TCP/IP network served by a Network File System server.

DFSMSStvs

DFSMS Transactional VSAM Services (DFSMSStvs) enables running batch jobs concurrently with CICS online transactions to allow updates to the shared VSAM data sets. Multiple batch jobs and online transactions can be run against the same VSAM data sets. DFSMSStvs ensures data integrity for concurrent batch updates while CICS provides it for online updates. Prior to z/OS 3.1, it was an optional feature.

Environmental Record Editing and Printing Program (EREP)

The Environmental Record Editing and Printing Program (EREP) edits and prints reports for the records placed in the error recording data set (ERDS), helping IBM service representatives fix problems.

ESCON Director Support

When your installation uses ESCON directors, the ESCON Director Device Support feature enables reporting of ESCON director device errors to z/OS.

FFST/MVS (First Failure Support Technology/MVS)

FFST/MVS provides immediate notification and first failure data capture for software events. FFST/MVS also incorporates its own technology by including software probes in its own code. When one of these probes is triggered, FFST/MVS issues a symptom string that describes the event.

FFST/MVS provides the following services for IBM products:

- Customized dumps
- Symptom strings
- Symptom records
- Messages
- Network notification

GDDM (includes PCLK and OS/2 LINK)

GDDM provides presentation services and device-driving capability. GDDM has a powerful application-programming interface for creating, displaying, and storing vector graphics, images and alphanumerics. GDDM drives displays, printers and plotters, and includes several utilities for end users. GDDM's excellence as a graphics program and device driver is recognized worldwide, and as a result it is used extensively as a graphics enabler by other licensed programs, including other elements of z/OS.

HCD (Hardware Configuration Definition)

HCD is used to define both the operating system configuration and the processor hardware configuration for a system. Because HCD validates data when it is defined rather than when a device is accessed, inconsistencies can be corrected right away and unplanned system outages resulting from inconsistent definitions avoided. The defined configuration can be used to POR/IPL or dynamically reconfigure your system.

HLASM (High Level Assembler)

High Level Assembler integrates almost all functions of past assemblers. It also provides extensions and improvements including:

- Many new and expanded cross reference facilities and diagnostics that enable substantial savings in time and in human and machine resources, and support integration of HLASM into tool and development environments.
- Numerous language enhancements that improve the speed and accuracy of application development and the quality and reliability of the resulting code.
- Assembly-time options extensions and enhancements that allow increased flexibility and precision in controlling the processes you use to manage application development.

HLASM helps to maximize the productivity of application programmers by relieving them of many tedious and unproductive tasks that can now be done by the assembler itself and helps organizations avoid the necessity for converting existing -- and working -- applications from Assembler Language to other languages.

IBM HTTP Server - Powered by Apache

The IBM HTTP Server - Powered by Apache is a full-featured web server. This element was previously known as a base element of z/OS under the names Lotus® Domino® Go, the Internet Connection Secure Server (ICSS), and the Internet Connection Server (ICS).

Included in IBM HTTP Server - Powered by Apache is IBM HTTP Server North America (NA) Secure. With IBM HTTP Server - Powered by Apache, IBM HTTP Server NA Secure uses Secure Sockets Layer (SSL) to provide secure communications over an open communications network, such as the Internet. The HTTP

server uses SSL to initiate a secure connection between the client and itself. The server then uses SSL to decrypt and encrypt all of the information in the client request and the server response.

IBM Tivoli Directory Server for z/OS (IBM TDS for z/OS)

IBM Tivoli Directory Server for z/OS (IBM TDS for z/OS) provides secure access for applications and systems on the network to directory information held on z/OS using the Lightweight Directory Access Protocol (LDAP). This component consists of the LDAP server, LDAP client, and utilities.

IBM z/OS Liberty Embedded

z/OS includes a copy of the IBM Liberty server stack for sharing between IBM z/OS elements. This base element is supported for use by IBM products only. It is not intended for use by customer applications.

IBM Z Deep Neural Network Library

IBM Z Deep Neural Network library (zDNN) is a software library that provides high-level C APIs, which enable simplified exploitation of the IBM Z Integrated Accelerator for AI by AI frameworks and libraries. The IBM zDNN library provides APIs for the deep learning and machine learning primitives that are accelerated by the IBM Z Integrated Accelerator for AI. AI framework developers, AI compiler developers, as well as runtime providers, can leverage the zDNN accelerated primitive APIs to drive the exploitation of the IBM Z Integrated Accelerator for AI through the Neural Network Processor Assist (NNPA) facility instruction. The zDNN library enables high-level language exploitation of the optimized NNPA implementation for matrix multiplication, convolution, activation functions, and many other standard DNN primitives.

ICKDSF (Device Support Facility)

ICKDSF enables you to perform functions needed for the installation and use of IBM DASD. You can also use it to perform service functions, error detection, and media maintenance.

Integrated Security Services

Integrated Security Services includes:

Network Authentication Service

Network Authentication Service, which is based on Kerberos Version 5, provides Kerberos security services. These services include native Kerberos application programming interface (API) functions, including the Generic Security Service application programming interface (GSS-API) functions defined in Internet RFC 2078, Generic Security Service Application Program Interface, Version 2 and Internet RFC 2744, Generic Security Service API Version 2: C-bindings. Network Authentication Service performs authentication as a trusted third-party authentication service by using conventional shared secret-key cryptography. Network Authentication Service provides a means of verifying the identities of principals, without relying on authentication by the host operating system, without basing trust on host addresses, without requiring physical security of all the hosts on the network, and under the assumption that packets traveling along the network can be read, modified, and inserted at will.

ISPF

ISPF provides facilities for all aspects of host-based software development.

- Programmers can use ISPF to develop and document batch and interactive programs.
- Data center administrators and system programmers can monitor and control program libraries, and communicate with MVS through TSO commands, CLISTs, or REXX EXECs.
- Users can work with interactive applications called *dialogs*.

ISPF has three major components.

Dialog Manager (DM)

The Dialog Manager (DM) provides services to dialogs and users. These services include:

- Display
- Variable services
- Input and output
- User and application profiles
- Table management
- System interface services
- Dialog testing and debugging aids

Program Development Facility (PDF)

The Program Development Facility (PDF) provides services to assist dialog or application developers. These include

- Edit and Browse functions
- A wide range of foreground and batch compilers
- Data set and catalog utilities
- TSO command interfaces
- Data set search and compare functions.

Software Configuration and Library Manager (SCLM)

The Software Configuration and Library Manager (SCLM) is a tool that automatically controls, maintains, and tracks all of the software components of the application throughout the development cycle.

On May 15, 2018, IBM issued a statement of direction that the Software Configuration and Library Management (SCLM) component of ISPF is functionally stabilized. While it will continue to be maintained and supported, it will not be enhanced with new features in the future.

JES2

JES2 accepts the submission of work for the BCP. Major JES2 functions and design features include:

- The interpretation of job control language (JCL) statements
- The disposition of output
- A single-system image
- The ability to run multiple copies of JES2 (poly-JES)
- JES2 WLM for Sysplex

Language Environment

Language Environment provides common services and language-specific routines in a single runtime environment. It ensures consistent and predictable results for your language applications, independent of the language they are written in.

Language Environment is the prerequisite runtime environment for applications that are generated with the following IBM compiler products:

- z/OS XL C/C++ (feature of z/OS)
- z/OS C/C++
- OS/390® C/C++
- C/C++ for MVS/ESA
- C/C++ for z/VM®
- XL C/C++ for z/VM

- AD/Cycle C/370
- IBM Toolkit for Swift on z/OS
- VisualAge® for Java, Enterprise Edition for OS/390
- Enterprise COBOL for z/OS
- Enterprise COBOL for z/OS and OS/390
- COBOL for OS/390 & VM
- COBOL for MVS & VM (formerly COBOL/370)
- Enterprise PL/I for z/OS
- Enterprise PL/I for z/OS and OS/390
- VisualAge PL/I
- PL/I for MVS & VM (formerly PL/I MVS & VM)
- VS FORTRAN and FORTRAN IV (in compatibility mode)
- IBM Open Enterprise SDK for Go

Language Environment supports the VS FORTRAN compiler's object/load module compatibility, which means FORTRAN load modules can be run under Language Environment and object code can be link-edited with Language Environment and run under it. Language Environment also provides a set of assembler macros for running assembler language routines.

Language Environment supports, but is not required for, an interactive debug tool for debugging applications in your native z/OS environment. The interactive IBM Debug Tool is available with the latest release of the PL/I compiler or this product can be ordered separately for use with the IBM XL C/C++, COBOL, and PL/I compilers on z/OS.

Some benefits are that you can:

- Mix old code with new code.
- Handle conditions, such as program checks or abends, in your COBOL programs without having to use assembler.
- Share common runtime services.
- Run applications that conform to the POSIX 1003.1 standard or the X/Open Single UNIX Specification, also known as UNIX 95 or XPG4.2.
- Access CICS and IMS transactions and data through a C, COBOL, or PL/I server from any client in your network.
- Perform interlanguage communication more efficiently.
- Manage storage dynamically for your C/C++, COBOL, and PL/I routines with a common storage manager.
- Access a rich set of math services.

Metal C Runtime Library

The Metal C runtime library element provides a set of header files and functions for use with the XL C METAL compiler option.

The XL C METAL compiler option generates code that does not require access to the Language Environment support at run time. Instead, the METAL option provides C-language extensions that allow you to specify assembly statements that call system services directly. Using these language extensions, you can provide almost any assembly macro, and your own function prologs and epilogs, to be embedded in the generated HLASM source file. When you understand how the METAL-generated code uses MVS linkage conventions to interact with HLASM code, you can use this capability to write freestanding programs.

Prior to the introduction of Metal C runtime library, all z/OS XL C compiler-generated code required Language Environment. In addition to depending on the C runtime library functions that are available only with Language Environment, the generated code depended on the establishment of an overall execution

context, including the heap storage and dynamic storage areas. These dependencies prohibit you from using the XL C compiler to generate code that runs in an environment where Language Environment did not exist.

MICR/OCR

MICR/OCR provides the device support code for the following devices:

- 1287/1288 - IBM Optical reader and page reader respectively
- 3540 - IBM Disk device
- 3886 - IBM Optical Character reader
- 3890 - IBM Magnetic Ink Reader
- 3895 - IBM Printer device

Network File System (NFS)

The z/OS NFS server acts as an intermediary to read, write, create or delete z/OS UNIX files and MVS data sets that are maintained on a z/OS host system. The remote MVS data sets or z/OS UNIX files are mounted from the host processor to appear as local directories and files on the client system. This server makes the strengths of a z/OS host processor (storage management, high-performance disk storage, security, and centralized data) available to the client platforms.

The NFS uses the communication services provided by TCP/IP, a suite of protocols that includes the remote procedure call (RPC) and external data representation (XDR) protocols. RPC allows a program on one machine to start a procedure on another machine, as if the procedure is local. XDR resolves the differences in data representation of different machines. The NFS, then, can be used for file sharing between platforms and file serving (as a data repository).

Runtime Library Extensions

Runtime Library Extensions delivers the following libraries and utilities to support existing programs:

Common Debug Architecture (CDA) Libraries

Introduced in z/OS V1R5, CDA provides a consistent format for debug information on z/OS. The CDA Libraries provide a set of APIs to access this information.

c89 Utility

This utility compiles, assembles, and binds z/OS UNIX System Services C/C++ and assembler applications.

UNIX System Laboratories (USL) Libraries

The USL I/O Stream Library provides the standard input and output capabilities for C++. The USL Complex Mathematics Library provides the facilities to manipulate complex numbers and to perform standard mathematical operations

Note: The UNIX System Laboratories (USL) I/O Stream Library and Complex Mathematics Library are still supported on z/OS. Although support for these classes is not being removed at this time, it is recommended that you migrate to the Standard C++ `iostream` and `complex` classes. This is especially important if you are migrating other USL streaming classes to Standard C++ Library streaming classes, because combining USL and Standard C++ Library streams in one application is not recommended. For more information about the Standard C++ I/O Stream Library, see [Standard C++ Library Reference](#).

SMP/E

SMP/E is a tool for installing and maintaining software, and for managing the inventory of software that has been installed. SMP/E provides a consistent and reliable method for installing and upgrading the software in a z/OS system.

Time Sharing Option/Extensions (TSO/E)

TSO Extensions is a base interactive interface that provides non-DP professionals, end users, system and application programmers, and administrators with an extensive set of commands, services, facilities and programming languages to do productive work on z/OS, and helps to ease systems management. TSO/E is an integral part of z/OS, and serves as a platform for other elements, such as HCD and ISPF.

Terminal Input Output Controller (TIOC)

TIOC is the interface between TSO and VTAM. It allows TSO to communicate with the terminal hardware.

XML Toolkit for z/OS

XML Toolkit for z/OS provides XML technology to assist customers in integrating vertical/industry-specific data formats, structures, schemas, and metadata to ensure industry compliance of data representation and content. Some of its key uses include categorizing and tagging data for exchange in disparate environments, as well as transforming ad hoc unstructured data to XML records, enabling you to search, cross-reference, and share records. XML Toolkit for z/OS includes the XML Parser, C++ Edition and the XSLT Processor, C++ Edition.

- The XML Parser, C++ Edition is a port of IBM's XML4C parser. It is tested and packaged for use on z/OS. XML4C is based on open source code from the Xerces Apache project of the Apache Software Foundation.
- The XSLT Processor, C++ Edition is a port of IBM's XSLT4C XSLT processor (formerly known as LotusXSL-C++). It is tested and packaged for use on z/OS. The processor is an implementation of the W3C recommendations for XSL Transformations (XSLT) Version 1.0 and XML Path Language (XPath) Version 1.0. XSLT4C is based on open source code from the Xalan Apache project of the Apache Software Foundation. It allows users to transform XML documents into other formats.

z/OS Data Gatherer

The Data Gatherer function that was previously part of the RMF feature is included as a z/OS base element. The z/OS Data Gatherer collects z/OS resource usage and performance data and provides the following base functionality:

- SMF type 70 subtype 1 records are written to the SMF buffer and to SMF data sets or log streams. Note that these records are required as input to IBM software pricing tools.
- The Sysplex Data Server API can be used to access Monitor II and SMF type 70 subtype 1 record data.
- The z/OS Data Gatherer API, GRBSMFR, and the Sysplex Data Server API, ERB3XDRS, can be used to retrieve any SMF record type and Monitor III data from SMF and Monitor III VSAM data sets.

For information about the impact of the z/OS Data Gatherer on z/OS installation and migration, see:

- *z/OS Program Directory*
- *z/OS Planning for Installation*
- *z/OS Upgrade Workflow*

z/OS File System (zFS)

The z/OS File System (zFS) support provides a physical file system (PFS). zFS file systems contain files and directories that are accessed with the z/OS application programming interfaces. They can be mounted into the z/OS UNIX hierarchy along with other local (or remote) file system types such as TFS and NFS.

z/OS Font Collection

The z/OS Font Collection consists of character sets, coded fonts, and Advanced Function Presentation (AFP) code pages for printing documents. The z/OS Font Collection includes these fonts:

- AFP outline fonts
- AFP raster fonts, including a complete set of IBM expanded core fonts and a set of Math, PI, and Sonoran 240-pel raster fonts
- TrueType and OpenType fonts, including a prebuilt resource access table (RAT) that can be used for AFP printing

z/OS Management Facility (z/OSMF)

IBM z/OS Management Facility (z/OSMF) provides system management functions in a task-oriented, web browser-based user interface with integrated user assistance so that you can more easily manage the day-to-day operations and administration of your z/OS systems. By streamlining some traditional tasks and automating others, z/OSMF can help to simplify some areas of z/OS system management.

z/OSMF provides a framework for managing various aspects of a z/OS system through a web browser interface.

z/OSMF presents a single point of control for:

- Viewing, defining, and updating policies that affect system behavior
- Monitoring the performance of the systems in your enterprise
- Managing your z/OS software
- Performing problem data management tasks
- Consolidating your z/OS management tools.

With z/OSMF, you can communicate with the z/OS system through a web browser, so you can access and manage your z/OS system from anywhere. Multiple users can log in to z/OSMF from different computers, different browsers, or multiple instances of the same browser.

For more information about z/OSMF, see the following resources:

- Topics on configuration and security in [*IBM z/OS Management Facility Configuration Guide*](#)
- Topics on programming interfaces, such as z/OS REST services, in [*IBM z/OS Management Facility Programming Guide*](#)
- z/OSMF online help for comprehensive user assistance information. You can access the online help by clicking the help link from any z/OSMF user interface (UI) page.

z/OS OpenSSH

z/OS OpenSSH is a port of Open Source Software release OpenSSH 8.4p1 and provides secure encryption for both remote login and file transfer.

z/OS OpenSSH includes the following utilities:

- `ssh`, a z/OS client program for logging into a z/OS shell. It can also be used to log into other platform's UNIX shells. It is an alternative to `rlogin`.
- `scp` for copying files between networks. It is an alternative to `rcp`.
- `sftp` for file transfers over an encrypted ssh transport. It is an interactive file transfer program similar to `ftp`.
- `sshd`, a daemon program for ssh that listens for connections from clients. The z/OS OpenSSH implementation of `sshd` supports both SSH protocol versions 1 and 2 simultaneously.

The default `sshd` configuration only runs protocol version 2.

Other basic utilities such as `ssh-add`, `ssh-agent`, `ssh-keysign`, `ssh-keyscan`, `ssh-keygen` and `sftp-server` are also included.

To ensure secure encrypted communications, OpenSSH uses ciphers such as AES, Blowfish and 3DES.

z/OS OpenSSH provides the following z/OS extensions:

- System Authorization Facility (SAF) key ring. z/OS OpenSSH can be configured to allow z/OS OpenSSH keys to be stored in SAF key rings.
- Multilevel security. It is a security policy that allows the classification of data and users based on a system of hierarchical security levels combined with a system of non-hierarchical security categories.
- System Management Facility (SMF). z/OS OpenSSH can be configured to collect SMF Type 119 records for both the client and the server.
- Hardware Cryptographic Support. OpenSSH can be configured to choose Integrated Cryptographic Service Facility (ICSF) callable service for implementing the applicable SSH session ciphers and HMACs.

For more information about migrating from older releases of OpenSSH to the newest release, see the step called "OpenSSH: Accommodate a new level of OpenSSH" in the z/OS Upgrade Workflow (which is part of the z/OS product). Prior levels of the z/OS Upgrade Workflows are available online at [z/OSMF workflows](https://github.com/IBM/IBM-Z-zOS/tree/main/zOS-Workflow) for the z/OS platform (github.com/IBM/IBM-Z-zOS/tree/main/zOS-Workflow)

z/OS UNIX System Services (X/Open UNIX 95 functions)

z/OS UNIX System Services Application Services (Shell, Utilities, and Debugger)

Shell and Utilities provides the standard command interface familiar to interactive UNIX users. z/OS includes all of the commands and utilities specified in the X/Open Company's Single UNIX Specification, also known as UNIX 95 or XPG4.2. This feature will allow your UNIX programmers and other users to interact with z/OS as a UNIX system without necessarily having to learn the z/OS command language or other interactive interfaces. The z/OS UNIX Services Debugger provides a set of commands that allow a C language program to be debugged interactively. The command set is familiar to many UNIX users.

z/OS UNIX System Services Kernel

These services add the world of open UNIX-based computing to the z/OS operating system. With Language Environment, they support industry standards for C programming, shell and utilities, client/server applications, and the majority of the standards for thread management and the X/Open Single UNIX Specification. Application developers and interactive users using these interfaces can exploit the capabilities of z/OS without having to understand z/OS itself. The combination of open computing and z/OS allows the transparent exchange of data, easy portability of applications, cross-network management of data and applications, and the exploitation of traditional MVS system strengths in an open environment.

z/OS Xvfb

Xvfb is an X server that can run on machines with no display hardware and no physical input devices. It emulates a dumb frame buffer using virtual memory. X server and other command-line options are available for use with Xvfb.

3270 PC File Transfer Program

This program transfers files from the host to the workstation for off-line data manipulation or transfers local data for storage on the host.

Chapter 3. z/OS optional features descriptions

The following is a description of each optional feature in z/OS.

DFSMS features (DFSMSdss, DFSMShsm, and DFSMSrmm)

DFSMSdss

DFSMSdss is a DASD data and space management tool. DFSMSdss can be used to copy and move data sets between volumes; dump and restore data sets, entire volumes, or tracks; convert data sets and volumes to and from SMS management; compress partitioned data sets; release unused space in data sets; and consolidate free space and data sets on volumes.

DFSMShsm

DFSMShsm is a DASD storage management and productivity tool for managing low-activity and inactive data. It improves DASD use by automatically managing space and data availability in a storage hierarchy. Working with SMS, DFSMShsm performs space management and availability management of data sets as directed by their management class attributes.

DFSMSrmm

With DFSMSrmm, you can manage your removable media as one enterprise-wide library across systems. DFSMSrmm manages your installation's tape volumes and the data sets on those volumes. DFSMSrmm manages all tape media, such as cartridge system tapes and 3420 reels, as well as other removable media you define to it. For example, DFSMSrmm can record the shelf location for optical disks and track their vital record status; it does not manage the objects on optical disks.

DFSORT

DFSORT is IBM's high performance sort, merge, copy, analysis, and reporting product for z/OS. This high-speed, flexible data processing tool provides fast and efficient sorting, merging, copying, reporting and analysis of business information, as well as versatile data manipulation at the record, field and bit level.

DFSORT is designed to optimize the efficiency and speed with which operations are completed through synergy with processor, device, and system features (for example, memory objects, hiperspace, data space, striping, compression, extended addressing, DASD and tape device architecture, processor memory, processor cache, and so on) and other products (for example, The SAS System**, COBOL, PL/I, IDCAMS BLDINDEX, and so on).

DFSORT includes the high-performance ICEGENER facility, the versatile ICETOOL utility, multiple output and reporting capability with the powerful OUTFIL feature, the time-saving ability to use Symbols for fields and constants in DFSORT and ICETOOL statements, and much more.

For more information about DFSORT, visit [DFSORT Home Page \(www.ibm.com/storage/dfsor\)](http://www.ibm.com/storage/dfsor).

GDDM-PGF

GDDM-PGF (Presentation Graphics Facility), a set of programs for creating presentation material in a variety of styles, provides:

Interactive Chart Utility

The Interactive Chart Utility (ICU), an easy-to-use end-user program for creating business charts.

Vector Symbol Editor

The (VSE), a means of creating and modifying symbols for use with the ICU or other GDDM functions.

An application programming interface

An application programming interface that enables programs to call either the ICU or a set of presentation-graphics routines for chart creation.

Online Presentation Services (OPS)

GDDM-PGF now incorporates an enhanced presentation-producing capability, Online Presentation Services (OPS). GDDM-OPS provides a command interface, which is simple and easy to use, yet which is also powerful enough to allow the very concise creation of high-quality presentations. These can then be used from displays (perhaps using the built-in automatic scrolling feature), or can be saved for printing or plotting.

Typical applications of GDDM-OPS are:

- Public presentations using a video monitor or projector
- Educational sessions for private or public display
- Scrollable interactive presentations of business charts
- Production of high-quality foils.

GDDM-REXX

GDDM-REXX/MVS is a productivity tool that enables programmers to prototype GDDM applications and to create small routines and utility programs quickly and easily.

Hardware Configuration Manager (HCM)

Hardware Configuration Manager (HCM) is a PWS-based client/server interface to z/OS Hardware Configuration Definition (HCD). It combines the logical and physical aspects of z/OS hardware configuration management. In addition to defining the logical connections (accomplished via HCD), you can also manage the physical aspects of your configuration.

All updates are done with HCM's intuitive graphical user interface, and all changes are written into the IODF and fully validated for accuracy and completeness by HCD, avoiding unplanned system outages that are due to incorrect definitions.

High Level Assembler Toolkit

This toolkit provides a powerful set of capabilities to improve application development, debugging, and recovery.

The Toolkit provides six components:

- A disassembler, which converts binary machine language to assembler language source statements.
- A flexible source-code analysis and cross-referencing tool to help determine variable and macro usage, analyze high-level control flows, and locate specific uses of arbitrary strings of characters in single or multiple modules.
- A workstation-based program analysis tool that displays control-flow graphs and source-code views within single programs or across entire application modules.
- A powerful and sophisticated low-level symbolic debugger for applications that are written Editsin assembler and other compiled languages. It handles programs using 24, 31, and 64-bit addressing. (It does not support debugging privileged or supervisor-state code.)
- A rich set of macro instructions that implement a complete menu of the most widely used structured-programming constructs (for example, IF/ELSE/ELSEIF, DO/ITERATE/ASMLEAVE, CASE, SEARCH, SELECT/WHEN/OTHRWISE). These macros simplify and clarify coding, and help eliminate errors in writing additional labels and branch instructions.
- A versatile file searching and comparison tool (SuperC) that scans or compares single file or groups of files with an extensive set of selection and rejection criteria.

Infoprint Server

Infoprint Server consists of several components that support printing on a z/OS system:

Print Interface

This component accepts print requests from z/OS UNIX System Services and remote systems in your IP network. It allocates output data sets on the JES2 spool for printing.

NetSpool

This component receives print output from VTAM applications and allocates output data sets on the JES2 spool for printing.

Transform Manager

This component calls separate IBM transform products to transform data to and from Advanced Function Presentation (AFP) format. For example, IBM transform products can transform PCL, PDF, PostScript, SAP R/3, and Xerox data to AFP format, and can transform AFP data to PCL, PDF, and PostScript format.

IP PrintWay

This component sends output data from the JES2 spool to remote printers or print servers in your IP or SNA network. IP PrintWay can also send output data to email destinations. You can run IP PrintWay in basic or extended mode. In extended mode, IP PrintWay provides better performance, improved usability, and more function.

Printer Inventory

This component provides a single set of printer definitions that all the components of Infoprint Server use. The Printer Inventory also contains printer customization information that Print Services Facility (PSF) for z/OS uses.

Infoprint Central

This component is a web application that lets help desk operators and other authorized users work with print jobs on the JES spool, printers controlled by IP PrintWay extended mode or PSF, NetSpool logical units, and job selection rules. It also lets users see Infoprint Server system status and printer definitions in the Printer Inventory.

Infoprint Port Monitor for Windows

This component sends documents and job attributes from Windows systems to Infoprint Server for printing on any printers that are defined in the Infoprint Server Printer Inventory.

Resource Measurement Facility (RMF)

The Resource Measurement Facility (RMF) feature generates performance reports based on the data provided by the z/OS Advanced Data Gatherer feature. Generation of RMF reports with sysplex scope is only supported if the RMF feature is enabled on all systems in the Parallel Sysplex®.

Note: Enabling the RMF feature also implicitly enables the z/OS Advanced Data Gatherer feature.

With RMF, you can choose between reports about activities and delays, and can focus on storage, I/O or processor data. A wide range of options allows selection of the relevant information, including the attainment of Workload Manager goals.

The RMF monitors present snap-shot and short-term reports real-time in ISPF dialogs with on-line help, and you can have the results printed if you wish. The RMF Postprocessor provides long-term reports for detailed analysis of historical data gathered by RMF. These reports can be printed or displayed.

In addition to host-based reporting functions in RMF, there are other components available that offer reporting capabilities at the workstation. The RMF PM Java Edition provides an interface between the workstation and the z/OS sysplex through a TCP/IP connection that gives you the flexibility to create unique scenarios to monitor the performance of your sysplex. The Spreadsheet Reporter, running on your Windows workstation, gives you the ability to extract reports from RMF Postprocessor output to convert them into a common spreadsheet format and allows your spreadsheet application to use the RMF data. This function enables you to integrate RMF data into your business process. It also means you can easily produce presentation graphics which illustrate performance analysis results.

Restricted use common service area (RUCSA)

For installations that cannot eliminate user-key (8 - 15) common storage usage, RUCSA provides a way to isolate user-key common storage to a select set of users, thus controlling or eliminating the security risk associated with common user-key storage.

SDSF (System Display and Search Facility)

SDSF provides you with information to monitor, manage and control your z/OS system. SDSF provides an easy and efficient way to control job processing (hold, release, cancel and purge jobs) and to control devices (such as printers, lines and initiators). It allows you to monitor jobs while they are running and browse output without printing it. You can also browse the system log, including the sysplex-wide operations log. SDSF provides sort, filter, arrange, search, and print functions to help you locate and organize information. Single-character commands eliminate the need to learn and remember complex system commands. You can easily change characteristics of an object, such as a job or node, by typing over a displayed value. An optional action bar and pop-up windows make it easy to find and use SDSF functions. You can establish security for SDSF using its own security parameters, or with IBM's standard interface, SAF (System Authorization Facility). You can access SDSF function through REXX execs or Java programs.

SDSF provides complete online help and an interactive tutorial.

Security Server

The Security Server includes:

Resource Access Control Facility (RACF)

RACF provides a strong security base that enables the Security Server element of z/OS to incorporate additional components that aid in securing your system as you make your business data and applications accessible by your intranet, extranets, or the internet.

XL C/C++

This language-centered XL C/C++ application development environment on the z/OS platform includes a C compiler, a C++ compiler, and C/C++ application development utilities. This feature exploits the C/C++ runtime environment and library of runtime services available with the Language Environment and Runtime Library Extensions elements of z/OS.

z/OS Advanced Data Gatherer

The Advanced Data Gatherer function that was previously part of the RMF feature was moved to a new z/OS optional feature. When enabled, the z/OS Advanced Data Gatherer feature augments the z/OS Data Gatherer element and provides the following functionality:

- System administrators can configure the z/OS Data Gatherer to write type 70 - 78 records to the SMF buffer and to SMF data sets or log streams.
- Application programs can access collected Monitor II, Monitor III, and SMF type 70 - 78 record data via the Sysplex Data Server and z/OS Data Gatherer APIs.

Note: Enabling the z/OS Advanced Data Gatherer feature also implicitly enables the z/OS Workload Interaction Correlator feature.

For information about the impact of the z/OS Advanced Data Gatherer on z/OS installation and migration, see:

- *z/OS Program Directory*
- *z/OS Planning for Installation*
- *z/OS Upgrade Workflow*

z/OS Authorized Code Scanner (zACS)

The IBM z/OS Authorized Code Scanner (zACS) dynamically scans authorized code and provides diagnostic information for subsequent investigation as needed.

For more information about z/OS Authorized Code Scanner, see [z/OS Authorized Code Scanner Guide](#).

z/OS Change Tracker

As IBM continues to provide a suite of robust tools to help system programmers manage z/OS, IBM is offering IBM z/OS Change Tracker, a comprehensive configuration change management tool for tracking, controlling, and managing changes in software, as a priced feature of z/OS V2R5.

With a simple control interface to identify, manage, and audit configuration files, IBM z/OS Change Tracker can help you with aspects of the change configuration management experience, including software management and resiliency.

Today, monitoring hundreds of software configuration files can be a manual and tedious process, making it difficult to do so without the right tools and leaving the potential for undesired or unintentional system configuration changes. With IBM z/OS Change Tracker, system programmers can easily identify and control configuration assets. This priced feature includes a planned automatic backup capability for configuration assets, which can help to support a resilient environment. IBM z/OS Change Tracker can also help system programmers quickly understand the differences between two groups of data sets or volumes to see whether deployment of software results in identical copies.

IBM z/OS Change Tracker offers the following capabilities:

- Real-time, system-wide software configuration change tracking and control for system libraries, across all LPARs in a sysplex.
- Automatic versioning of identified system control data sets, including customization of the number of backups.
- Member-level recovery and reporting of real-time changes.
- Capabilities to roll back and undo unplanned or unsuccessful updates of the changed library members.
- Comparisons between snapshots of system control data sets, or even entire volumes, with differences identified, which can help to ensure that software deployments are successful.

For more information about IBM z/OS Change Tracker, see the following resources:

- [IBM z/OS Change Tracker \(www.ibm.com/support/z-content-solutions/zos-change-tracker/\)](http://www.ibm.com/support/z-content-solutions/zos-change-tracker/)
- [IBM z/OS Change Tracker Guide and Reference](#)

z/OS Security Level 3

z/OS Security Level 3 includes IBM Tivoli Directory Server for z/OS Security Level 3 (new in z/OS V1R8; replaces LDAP Security Level 3), Network Authentication Service Security Level 3, Communications Server Security Level 3 (new in z/OS 3.1), and System Secure Sockets Layer (SSL) Security Level 3.

z/OS Workload Interaction Correlator

IBM z/OS Workload Interaction Correlator is an optional feature that enables a product, such as a z/OS component, middleware, or application, that runs in multiple instances that are distributed across multiple address spaces to generate high-frequency, summarized, system-wide and compartmental data. Products can use z/OS Workload Interaction Correlator services to generate SMF correlator records every 5 seconds. The correlator records contain data about the products' activities in a standardized, synchronized, contextualized format.

Records from z/OS Workload Interaction Correlator produce a summary view of the component's activities across address spaces of similar priority and CPU usage and highlight data from exceptional

address spaces. These records are generated on a synchronized, high-frequency 5-second interval across multiple products.

Analytics tools, such as IBM z/OS Workload Interaction Navigator, can analyze these records across z/OS components, middleware, and applications to detect and correlate anomalies. Presenting an organized progression of interacting anomalies reduces the time and expertise needed to diagnose a performance problem. When an action is taken to solve or mitigate the performance problem, the system programmer can verify that the fix is behaving as expected by comparing the results before and after the implementation of the action.

Note: Enabling the z/OS Resource Measurement Facility (RMF) or the z/OS Advanced Data Gatherer feature also implicitly enables the z/OS Workload Interaction Correlator feature.

For information about z/OS Workload Interaction Correlator, see:

- *z/OS Planning for Installation*
- *z/OS Workload Interaction Correlator*
- [IBM z/OS Workload Interaction Correlator in z/OS MVS System Management Facilities \(SMF\)](#)
- [z/OS Workload Interaction Correlator in z/OS MVS Programming: Authorized Assembler Services Guide](#)

zEnterprise Data Compression (zEDC) for z/OS

For previous IBM Z servers, zEDC for z/OS provided exploitation of the zEDC Express[®] adapter for hardware data compression.

On the IBM z15[®]™ and later servers, the zEDC Express adapter (feature code #0420) is no longer supported or required. The zEDC compression functions are transferred to the processor chip, which is referred to as IBM Integrated Accelerator for z Enterprise Data Compression (zEDC). Support is available on z/OS V2R1, z/OS V2R2, z/OS V2R3, and z/OS V2R4 when running on z15.

Data that was compressed with zEDC Express can be decompressed with IBM Integrated Accelerator for zEDC. Also, IBM Integrated Accelerator for zEDC compressed data can be decompressed on z14 and earlier servers.

As was done previously for zEDC, parmlib member IFAPRDxx is used to enable compression. However, with IBM Integrated Accelerator for zEDC compression on the z15, you use IFAPRDxx only for enabling asynchronous processing (by using the FPZ4 authorized services). Entitlement of the zEDC priced feature of z/OS is not required for using zlib-based functions.

Chapter 4. What is new in z/OS 3.1

The following major enhancements were introduced in z/OS 3.1. Some enhancements require customization actions before you can use them. This information helps ensure that you can locate the documents that describe the customization actions.

Note: The document lists for each function are not exhaustive and generally omit links to purely reference books for items that include system messages, system codes, and data areas.

z/OS system-level new functions to consider

This information describes z/OS system-level enhancements in z/OS 3.1.

z/OS Upgrade Workflows

The z/OS Upgrade Workflow provides the steps for upgrading to the latest release of z/OS from your currently supported system. In the workflow, you perform a z/OS upgrade as an interactive, step-by-step process.

The z/OS Upgrade Workflow uses the latest functions in z/OSMF to provide a smooth upgrade experience.

For more information, see the following topics:

- [“z/OS 3.1 Upgrade Workflow” on page 21](#)
- [“IBM z16 Upgrade Workflow” on page 22](#)

z/OS 3.1 Upgrade Workflow

Description

The z/OS 3.1 Upgrade Workflow provides the steps for upgrading to z/OS 3.1 from your currently supported z/OS system.

The z/OS 3.1 Upgrade Workflow uses the latest functions in z/OSMF to provide a smooth upgrade experience. In the workflow, discovery functions run automatically to further streamline your upgrade experience. Only the upgrade actions that apply to your particular system are identified in the z/OSMF user interface (UI).

The z/OS 3.1 Upgrade Workflow is available in a choice of two z/OSMF workflows, depending on whether you are upgrading a system from z/OS 2.5 or z/OS 2.4:

- `zOS3.1_From_zOS2.5_Upgrade_Workflow.xml`
- `zOS3.1_From_zOS2.4_Upgrade_Workflow.xml`

Select the workflow that applies to your upgrade path and download it to your z/OS system. Then, create the workflow, as described in [z/OS Upgrade Workflow](#).

IBM provides the upgrade workflows as part of the z/OS product. Updates and fixes for the upgrade workflows are delivered through the standard z/OS service process. To obtain the latest PTFs for the z/OS 3.1 Upgrade Workflow, run the SMP/E REPORT MISSINGFIX command on your z/OS systems and specify a FIXCAT value of "IBM.Coexistence.z/OS.3.1".

The z/OS 3.1 Upgrade Workflow can be run on z/OS releases V2R4, V2R5, and 3.1.

Functional enhancements:

The z/OS 3.1 Upgrade Workflow includes the following functional enhancements:

- Runs the SMP/E MISSINGFIX report to determine whether any applicable fix category (FIXCAT) APARs should be installed.

- Discovers which upgrade-related APARs are installed, then automatically skip steps for which no actions are required if a given APAR is installed.
- Presents upgrade actions in the order in which you must perform them, rather than grouped by z/OS element. This enhancement makes it easier for you to track your progress at each stage of the upgrade, as follows:

Phase 1: Actions to perform before installing z/OS 3.1

Upgrade actions that you can perform on your existing ("old") system so that you have fewer actions to perform after you install the new release of z/OS. You do not need the z/OS 3.1 level of code to make these changes, and the changes do not require the z/OS 3.1 level of code to run after they are completed.

Phase 2: Actions to perform before the first IPL of z/OS 3.1

Upgrade actions that you can perform after you have installed z/OS 3.1, but before the first time you IPL. These actions require the z/OS 3.1 level of code to be installed, but do not require it to be active on your system.

Phase 3: Actions to perform after the first IPL of z/OS 3.1

Upgrade actions that you can perform only after you have IPLed z/OS 3.1. You need a running z/OS 3.1 system to perform these actions.

When change was introduced:

- z/OS 3.1 (with APAR OA65089)
- z/OS V2R5 (with APAR OA65089)
- z/OS V2R4 (with APAR OA65089)

Reference information:

- [z/OS Upgrade Workflow](#)

IBM z16 Upgrade Workflow

Description

The IBM Z platform is recognized for its security, resiliency, performance, and scale—relied upon by businesses around the globe for mission-critical workloads and as an essential element of their hybrid cloud infrastructure. IBM z16™, the first IBM Z system that is built with the IBM Telum Processor, extends the platform's capabilities and adds new value with innovative technologies that businesses require as they digitally transform their enterprises.

The IBM z16 uses a 19-inch form factor and industry-standardized power and networking hardware, which easily aligns with the modern cloud data center.

The IBM z16 family of mainframes includes the following hardware models:

- Machine type 3931, with five feature codes to represent the processor capacity. The feature codes are 0667, 0668, 0668, 0669, and 0670 with (respectively) 39, 82, 125, 168, and 200 processors. This system is configurable as a one-to-four 19-inch frame system.
- Machine type 3932 (model A02 and AGZ), with four feature codes to represent the processor capacity. The feature codes are 0672, 0673, 0674, and 0675 with (respectively) 5, 16, 32, and 68 processors.

z/OS3.1 can run on the IBM z16 server, and on the earlier IBM zSystems servers, IBM z15, z14™, and z14 ZR1.

The IBM z16 Upgrade Workflow contains the upgrade steps for the IBM z16 server, including the IBM z16 A02 and AGZ. These include considerations, restrictions, and actions to take before and after you receive your server, and a checklist of items that are planned to be discontinued on future servers.

In the workflow, references to "z16" pertain to all processor configurations of the IBM z16, unless otherwise noted.

The IBM z16 Upgrade Workflow is provided and maintained with z/OS PTFs that are assigned the following SMP/E fix categories (FIXCATs). IBM z16 A01 installations must use the FIXCATs for machine type 3931. IBM z16 A02 and AGZ installations must use the FIXCATs for both machine types (3931 and 3932).

- Required service for IBM z16 Model A01 (machine type 3931):
 - IBM.Device.Server.z16-3931.RequiredService
- Required service for IBM z16 Model A02 and AGZ (machine type 3932):
 - IBM.Device.Server.z16-3931.RequiredService
 - IBM.Device.Server.z16A02-3932.RequiredService

After the PTFs are installed, you can create the workflow on your z/OS system, as described in [z/OS Upgrade Workflow](#).

When change was introduced:

- z/OS 3.1
- z/OS V2R5 (with APAR OA64653)
- z/OS V2R4 (with APAR OA64653)

Reference information:

[z/OS Upgrade Workflow](#)

IBM Semeru 11 support

Description

Most elements and components in z/OS 3.1 are designed for use with IBM Semeru Runtime Certified Edition for z/OS, Version 11 (5655-DGJ). This SDK supports the Java 11 language specification, and enables Java 11 compliant applications to be ported to z/OS. The SDK includes the JZOS library for Java batch deployments and exploitation of z/OS system services (launcher and toolkit). Other z/OS specific extensions, such as integration with z/OS access control of cryptographic services and resources (keys/certificates), and support for Z hardware security modules, are planned to be introduced over time through service refreshes.

For the specific software dependencies for each z/OS element, see [z/OS Planning for Installation](#).

z/OS 3.1 supports Java 8 for your applications and will continue to do so over the Java 8 lifecycle.

IBM Semeru 11 is the most current level of Java available on z/OS, although IBM issued a statement of direction indicating a plan to deliver IBM Semeru Java 17 in [Software Announcement 222-248 \(www.ibm.com/docs/en/announcements/statement-direction-semeru-version-17?region=US\)](#), dated September 27 2022.

When change was introduced:

z/OS 3.1

Reference information:

[z/OS Planning for Installation](#)

z/OS compliance data collection

Description

z/OS is enhanced to enable the collection of compliance data from Cross system coupling facility (XCF) and JES2, as follows:

SMF record type 1154, subtype 113

Cross system coupling facility (XCF) compliance data

SMF record type 1154, subtype 114

JES2 compliance data

This data can be integrated into solutions, such as the IBM Z Security and Compliance Center.

This support requires PTFs for z/OS 3.1 and prior releases. The PTFs are identified by a fix category that is designated specifically for Compliance data collection support named `IBM.Function.Compliance.DataCollection`. Use this fix category to identify and install the specific PTFs that enable compliance data collection.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS MVS System Management Facilities \(SMF\)](#)
- [SMF 1154 subtype 51 record \(www.ibm.com/docs/en/zsc/1.2.0?topic=srt1-smf-1154-subtype-51-record-dfmsdfp-ickdsf-compliance-evidence\)](http://www.ibm.com/docs/en/zsc/1.2.0?topic=srt1-smf-1154-subtype-51-record-dfmsdfp-ickdsf-compliance-evidence)
- [IBM Z Security and Compliance Center Guide](#)

Authorized Code Scanner new functions to consider

Authorized Code Monitor (zACM)

Description:

z/OS Authorized Code Monitor (zACM) monitors for potential vulnerabilities without disrupting the system.

Release introduced:

z/OS 3.1

Reference information:

[z/OS Authorized Code Scanner Guide](#)

Extended scanning for vulnerabilities

Description:

To provide greater coverage of potential vulnerabilities, scanning is extended to include AC(1) code in MVS data sets and z/OS UNIX files.

Release introduced:

z/OS 3.1

Reference information:

[z/OS Authorized Code Scanner Guide](#)

BCP (MVS) new functions to consider

AI Framework for IBM z/OS

Description:

IBM delivers foundational AI capabilities that are designed to support the AI infusion within z/OS to help optimize IT processes, simplify management, improve performance, and reduce skill requirements.

The AI Framework for IBM z/OS (z/OS AI Framework) includes a set of underlying AI capabilities designed to support prebuilt AI model life cycles with a focus on model operationalization. The z/OS AI Framework provides built-in functionality to ingest and prepare data needed for training and inferencing in order to deploy and manage AI assets. It also allows you to control and manage the AI capabilities in an intuitive manner without a need for additional AI or data science skills. With this, you can deploy, control, and manage AI use cases that are intended to leverage the z/OS AI Framework, which is geared towards augmenting z/OS with intelligence that enables system self-management. These capabilities are planned to be delivered iteratively and will provide optimization of IT processes, enable intelligent operations, and strengthen the IBM strategic direction of providing intelligent infrastructure.

The AI Base Component for IBM z/OS, a new component of the z/OS BCP element and part of the z/OS AI Framework, enables AI use case providers to use AI models without the need for frequent updates to the latest technologies. This allows traditional components to use z/OS macros to connect to the underlying REST APIs within the z/OS AI Framework.

When change was introduced:

z/OS 3.1

Reference information:

[*Infusing AI into IBM z/OS*](#)

Real Storage Manager (RSM) considerations

Dedicated real memory pools

Description:

Dedicated memory usage can improve the behavior of applications that have a high memory requirement. Assigning dedicated memory to an application can improve its behavior by ensuring that it doesn't have to compete with other applications for real memory. Applications that can benefit from dedicated memory on z/OS 3.1 include zCX containers, Db2® buffer pools, SVC memory dump, Java workloads, and analytic applications. In addition, dedicated memory on z/OS 3.1 supports the use of all frame types (2 GB, 1 MB, and 4 KB) for real storage greater than 4 TB.

When change was introduced:

z/OS 3.1

Reference information:

- [*z/OS MVS Initialization and Tuning Guide*](#)
- [*z/OS Container Extensions*](#)
- [*z/OS Planning for Installation*](#)
- [*z/OS MVS Programming: Authorized Assembler Services Guide*](#)

Unicode considerations

Description:

INITCAP case conversion support and Unicode standard 9.0 support is now available.

Release introduced:

z/OS 3.1

Reference information:

- [*z/OS Unicode Services User's Guide and Reference*](#)

ISO-2022 Unicode standards

Description:

The character conversion from Unicode/EBCDIC encoding to ISO-2022-JP encoding is enhanced by inserting the ASCII/Roman escape sequence at the beginning of the target buffer when the escape sequence is needed.

When change was introduced:

z/OS 3.1

Reference information:

- [*31-bit mapping in z/OS Unicode Services User's Guide and Reference*](#)
- [*64-bit mapping in z/OS Unicode Services User's Guide and Reference*](#)

Validated Boot for z/OS considerations

Validated Boot considerations

Description:

Validated Boot for z/OS is a solution that uses digital signatures to provide an initial program load (IPL)-time check that validates that IPL data is intact, not tampered with, and originated from a trusted source. It also enables detection of unauthorized changes to software executables.

By using Validated Boot for z/OS, you have the ability to meet regulatory compliance standards, including National Information Assurance Partnership (NIAP) certification, that are required for certain secure software deployment scenarios. Additionally, you can detect both accidental and malicious IPL data changes earlier, thus reducing the impact of outages and stopping certain kinds of attacks.

Validated Boot for z/OS is implemented with updates to several elements, including MVS, IPCS, Program Management (Binder), and RACF.

- Validated boot print utility (IEABVPRT) provides information about a validated boot IPL.

Release introduced:

- Validated Boot for z/OS IBM z16, with z/OS 2.5 or higher for the target system.
- z/OS 2.5 with the PTF for APAR OA63507.

Reference information:

[Validated Boot for z/OS \(www.ibm.com/support/z-content-solutions/validated-boot-for-zos/\)](http://www.ibm.com/support/z-content-solutions/validated-boot-for-zos/)

Workload management (WLM) considerations

WLM implicit long-term CPU protection

Description:

Assigning long-term CPU protection to critical work ensures that less important work will generally have a lower dispatch priority. Doing so is essential for CPU-sensitive work and protects business-critical workloads from CPU constraints. In addition to explicitly specifying the **CPU Critical** option in the WLM service definition, z/OS 3.1 WLM now automatically assigns long-term CPU protection. That is, the **CPU Critical** option is assigned:

- Implicitly to any work of importance 1 (or importance 2 when a boost is in effect) for the first period of any service class, no matter if this is a single or multi-period service class. This is also valid while boost is in effect. Parameters in the IEAOPTxx member make it possible to modify these importance levels or even disable implicit CPU protection.
- For any work in single-period service classes that have the **CPU Critical** option explicitly set in the WLM service definition (base definition or service class overrides).

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS MVS Planning: Workload Management](#)
- [z/OS MVS Initialization and Tuning Reference](#)

AI-powered WLM batch initiator management

Description:

IBM is augmenting WLM with AI to optimize the management of IBM Z workloads. These iteratively delivered capabilities will allow z/OS to intelligently predict upcoming batch workload and react by allocating an appropriate number of initiators. This is designed to optimize system resources and batch management, thus eliminating overhead from manual fine-tuning and trial-and-error approaches. AI-powered WLM batch initiator management is the initial use case leveraging the AI Framework for IBM z/OS.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS MVS Planning: Workload Management](#)
- [Infusing AI into IBM z/OS](#)

z/OS Workload Interaction Correlator considerations

z/OS Workload Interaction Correlator

Description:

z/OS Workload Interaction Correlator enables z/OS components and middleware to generate cost-effective and enriched summary data. In z/OS 3.1:

- Clients on z/OS 2.4 or later with an RMF license or z/OS 2.5 or later with an Advanced Data Gatherer license are entitled to use the z/OS Workload Interaction Correlator at no additional charge. For more information on this entitlement and to view IBM recommended best practices for proactive problem diagnosis, see the flash, [IBM Best Practice: Always Collect Correlator SMF Records \(www.ibm.com/support/pages/system/files/inline-files/Correlator%20Flash%20d040522_v2.pdf\)](http://www.ibm.com/support/pages/system/files/inline-files/Correlator%20Flash%20d040522_v2.pdf).
- z/OS Workload Interaction Correlator support for z/OS Workload Interaction Navigator Inspector enables subject matter experts to proactively identify workload anomalies so they have an opportunity to diagnose and address these anomalies before workload impacts, critical situations, and outages occur. Correlator enables Inspector analysis over the last 8 weeks to transform activity anomalies with context into anomaly signatures and correlate and prioritize them based on workload resilience risk.
- z/OS component exploitation of z/OS Workload Interaction Correlator has been extended to include I/O Supervisor (IOS), providing you with 5-second synchronized, micro-summary, enriched I/O data. This enhancement provides subject matter experts, using IBM z/OS Workload Interaction Navigator, the insights needed to reactively diagnose and proactively avoid I/O-related workload impacts, critical situations, and outages.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APAR
- z/OS 2.4 with APAR

Reference information:

- [z/OS Workload Interaction Correlator](#)
- [z/OS MVS System Management Facilities \(SMF\)](#)

Communications Server new functions to consider

Support considerations

Description: z/OS Communications Server includes the following enhancement for support considerations.

- **Support considerations in 3.1**

z/OS 3.1 Communications Server removes support for the following functions:

- Removal of DEVICE/LINK/HOME configuration for OSA
- Withdrawal of support of VTAM LSA and TCP/IP LCS devices

z/OS 3.1 Communications Server removes several migration health checks:

- ZOSMIGV2R5_NEXT_CS_OSADLH
- ZOSMIGV2R5_NEXT_CS_LSA

When change was introduced: z/OS 3.1

Reference information: See *z/OS Communications Server: New Function Summary* for detailed descriptions that include any applicable restrictions, dependencies, and steps on using the functions:

Simplification

Description: z/OS Communications Server includes the following enhancements for simplification:

- **Communications Server exploitation of the IBM Function Registry for z/OS**

z/OS 3.1 Communications Server is enhanced to register VTAM general information with the IBM Function Registry for z/OS. This information allows you to understand the extent of SNA application activity in your network.

When change was introduced: z/OS 3.1 and with SNA APAR OA63555 for z/OS V2R4 and z/OS V2R5.

Reference information: See the following topics in *z/OS Communications Server: New Function Summary* for detailed descriptions that include any applicable restrictions, dependencies, and steps on using the functions:

- Communications Server exploitation of the IBM Function Registry for z/OS

Hardware support

Description: z/OS Communications Server includes the following enhancements for hardware:

- **OSA-Express Enhanced Inbound Blocking (EIB)**

z/OS 3.1 Communications Server is enhanced to support OSA-Express Enhanced Inbound Blocking (EIB). It is a QDIO performance enhancement that might be beneficial for OSA interfaces with a high volume of inbound network bulk or streaming traffic.

Restriction:

QDIO Enhanced Inbound Blocking is supported on OSA-Express7s on IBM z16 or later systems (with supporting MCL).

When change was introduced: z/OS 3.1 and with TCP/IP APAR PH44281 and SNA APAR OA62831 for z/OS V2R4 and z/OS V2R5.

- **Communications Server support for RoCE Express3**

z/OS 3.1 Communications Server extends the Shared Memory Communications over Remote Direct Memory Access (SMC-R) function to support the next generation IBM RoCE Express3 feature. The IBM RoCE Express3 feature allows TCP/IP stacks on different LPARs within the same central processor complex (CPC) to leverage the power of these state-of-the-art adapters to optimize network connectivity for mission critical workloads by using Shared Memory Communications technology.

Incompatibilities: This function does not support IPAQENET interfaces that are defined by using the DEVICE, LINK, and HOME statements. Convert your IPAQENET definitions to use the INTERFACE statement to enable this support.

Dependencies: This function requires the IBM z16 or later systems.

When change was introduced: z/OS 3.1 and with TCP/IP APAR PH34117 for z/OS V2R5 and with TCP/IP APAR PH34117 and SNA APAR OA60855 for z/OS V2R3 and z/OS V2R4.

Reference information: See the following topics in *z/OS Communications Server: New Function Summary* for detailed descriptions that include any applicable restrictions, dependencies, and steps on using the functions:

- *OSA-Express Enhanced Inbound Blocking (EIB)*
- *Communications Server support for RoCE Express3*

Enhancing security

z/OS Communications Server includes the following security enhancements:

- **z/OS UNIX syslogd support for secure logging over TCP**

z/OS 3.1 Communications Server provides syslog daemon support to receive and send messages over the network using TCP. These TCP connections can be protected with AT-TLS.

Restriction: The syslog daemon supports receiving and sending messages with octet-counted framing over TCP connections. The syslog daemon does not support receiving or sending messages with traditional (non-transparent) framing over TCP connections.

Dependencies: Syslogd is an AT-TLS aware application. To secure messages received by syslogd over a TCP connection, an AT-TLS server rule must be configured for the connection. To secure messages sent by syslogd over a TCP connection, an AT-TLS client rule must be configured for the connection.

When change was introduced: z/OS 3.1 and with TCPIP APAR PH47666 for z/OS V2R5.

- **AT-TLS Currency with System SSL**

z/OS 3.1 Communications Server provides AT-TLS support for TLS Version 1.3 sysplex session ticket caching. AT-TLS support is also provided for domain-based server certificate validation during an SSL/TLS session negotiation.

Dependency: To use TLS Version 1.3 sysplex session tickets, GSKSRVR must be started for all systems in the sysplex acting as AT-TLS servers for the workload.

When change was introduced: z/OS 3.1 and with TCPIP APAR PH49284 and Network Configuration Assistant APAR PH53064 for z/OS V2R5.

- **AT-TLS support for x25519 and x448 key exchange for TLSv1.2**

z/OS 3.1 Communications Server provides AT-TLS support for a TLSv1.2 server to specify which elliptic curves can be used for the handshake key exchange when an ephemeral ECDH (Elliptic curve Diffie-Hellman) cipher is used. Support is also added for the x25519 and x448 curves for TLSv1.2 handshake key exchange. These updates also apply to TLSv1.0 and TLSv1.1.

Restriction: For TLSv1.0, TLSv1.1, and TLSv1.2, curves x25519 and x448 are not enabled by default and must be configured explicitly both for the AT-TLS client and server.

When change was introduced: z/OS 3.1 and with TCPIP APAR PH45902 and Network Configuration Assistant APAR PH47400 for z/OS V2R5.

- **Support for SMF compliance evidence**

z/OS 3.1 Communications Server generates new SMF type 1154 records that provide compliance evidence for the TCP/IP stack (subtype 1), FTP daemon (subtype 2), TN3270E Telnet server (subtype 3), and CSSMTP client (subtype 4).

This data can be helpful in determining compliance with various industry regulations and standards.

These records are generated whenever an Event Notification Facility (ENF) 86 signal is emitted by a system in the sysplex and the ENF 86 parameter list includes the local z/OS system name. The ENF 86 signal is triggered by a z/OSMF Compliance REST API.

Dependencies:

- The TCP/IP stack must be active to provide the TCP/IP stack compliance evidence SMF record.
- The FTP daemon must be active to provide the FTP daemon compliance evidence SMF record.
- The TN3270E Telnet server must be active to provide TN3270E Telnet server compliance evidence SMF records (one per server port).
- CSSMTP must be active to provide the CSSMTP client compliance evidence record.

When change was introduced: z/OS 3.1 and with TCPIP APAR PH37372 for z/OS V2R4 and V2R5.

- **FTP server JES access control**

z/OS 3.1 Communications Server supports a new SAF resource in the SERVAUTH class to control which users are allowed to access FTP JES mode. When the SERVAUTH class is active and a profile is defined for the EZB.FTP.sysname.ftpdemonname.ACCESS.JES SAF resource, only users with permission to the profile are allowed to access FTP JES mode.

Dependency: The SERVAUTH class must be active for the EZB.FTP.sysname.ftpdemonname.ACCESS.JES SAF resource to provide access controls.

When change was introduced: z/OS 3.1 and with TCPIP APAR PH42618 for z/OS V2R3, z/OS V2R4, and z/OS V2R5.

• IBM zERT Network Analyzer Enhanced Upgrade Support

For z/OS 3.1, the IBM zERT Network Analyzer streamlines release-to-release migration with new dialogs to import application and database connection settings from a supported previous release. In addition, new database schema tooling is provided to upgrade an existing supported IBM zERT Network Analyzer database to the current schema release and version.

Dependency: The migration enhancements can only be used if you use the IBM zERT Network Analyzer plugin on a supported previous release (z/OS V2R4 or z/OS V2R5).

When change was introduced: z/OS 3.1

• IBM zERT Network Analyzer passphrase and password management support

The IBM z/OS 3.1 zERT Network Analyzer supports the use of passphrases up to 100 characters to connect to the Db2 for z/OS database. The IBM zERT Network Analyzer includes additional enhancements in the **Database Settings** panel to clear existing database credentials to allow for easier switching to a different database user ID.

When change was introduced: z/OS 3.1 and with APAR PH43119 for z/OS V2R4 and V2R5 and APAR PH43118 for z/OS V2R3.

Reference information: See the following topics in [z/OS Communications Server: New Function Summary](#) for detailed descriptions that include any applicable restrictions, dependencies, and steps on using the functions:

- *z/OS UNIX syslogd support for secure logging over TCP*
- *AT-TLS currency with System SSL*
- *AT-TLS support for x25519 and x448 key exchange for TLSv1.2*
- *Support for SMF compliance evidence*
- *FTP server JES access control*
- *IBM zERT Network Analyzer passphrase and password management support*
- *IBM zERT Network Analyzer Enhanced Upgrade Support*

Scalability and performance

z/OS Communications Server includes the following enhancements for scalability and performance:

- **Persistent Pause Support for Sysplex Distributor DVIPAs** - With z/OS 3.1, z/OS Communications Server is enhanced to pause and resume sysplex distribution to specific z/OS application servers, irrespective of the state of the application, the target stack or LPAR and across sysplex failovers.

When change was introduced: z/OS 3.1

Reference information: See the following topic in [z/OS Communications Server: New Function Summary](#) for detailed descriptions that include any applicable restrictions, dependencies, and steps on using the functions:

- *Persistent Pause Support for Sysplex Distributor DVIPAs*

Application development

z/OS Communications Server includes the following enhancements for application, middleware, and workload enablement:

- **Communications Server Support for 64-bit Java** - z/OS 3.1 Communications Server enhances the FTP client API for Java support to 64-bit Java environments.

When change was introduced: z/OS 3.1

Reference information: See the following topics in *z/OS Communications Server: New Function Summary* for detailed descriptions that include any applicable restrictions, dependencies, and steps on using the functions:

- *Communications Server Support for 64-bit Java*

Cryptographic Services new functions to consider

ICSF

This topic describes new ICSF function in z/OS.

AES Cipher key generation and HMAC key generation and import

Description:

The ICSF CKDS KEYS Utility has been updated to allow for the generation of an AES Cipher key as well as the generation and importing of an HMAC key.

When change was introduced:

z/OS 3.1

Reference information:

z/OS Cryptographic Services ICSF Administrator's Guide

ICSF can perform hashing operations using the BCrypt hashing algorithm

Description:

The One-Way Hash Generate (CSNBOWH or CSNBOWH1 and CSNEOWH or CSNEOWH1) service has been updated to support the BCrypt hashing algorithm.

When change was introduced:

z/OS 3.1

Reference information:

- *z/OS Cryptographic Services ICSF Application Programmer's Guide*
- *z/OS Cryptographic Services ICSF System Programmer's Guide*

Key part control for the Master Key Entry utility

Description:

With z/OS 3.1, ICSF will allow security administrators to assign ownership of CCA master key parts to specific individuals. Using newly created SAF resources, the administrator can restrict entry of specific key parts to individual users when the master key parts are entered using the ICSF ISPF Master Key Entry panels. This allows a crypto or security administrator to distribute the knowledge of the master key parts across a set of individuals so that no single person knows the full master key value, which is in support of multiple security standards.

When change was introduced:

z/OS 3.1

Reference information:

- *z/OS Cryptographic Services ICSF Application Programmer's Guide*

- [z/OS Cryptographic Services ICSF System Programmer's Guide](#)
- [z/OS Cryptographic Services ICSF Messages](#)

Two new ICSF health checks: ICSF_STATUS and ICSF_CLEAR_KEYS

Description:

The availability of ICSF is critical for elements of z/OS that use the services for sending crypto requests to Crypto Express coprocessors. If ICSF is not available, some components will default to software crypto, so it is important that there is an automated means of indicating to system administrators that ICSF is available. The ICSF_STATUS health check periodically determines the current status of ICSF and outputs a message. Based on this check, the ICSF administrator can be made aware that ICSF is currently active, currently inactive, or if ICSF ended abnormally.

For cryptographic key material, most standards require the keys to be encrypted outside the Hardware Security Module so that the clear key value is not available or at risk. Because it is possible that legacy clear keys could exist in ICSF key data sets, a new health check has been created that will scan the data sets looking for clear key objects. The ICSF_CLEAR_KEYS health check determines if there are clear keys found in the CKDS, PKDS, or TKDS and outputs a message. Based on this check, the ICSF administrator can be made aware if any keys in the CKDS, PKDS, or TKDS are not secure. In addition, the CSFKDSL (Key Dataset List) service has been updated to provide a programmatic way to scan a key data set for clear key objects.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS Cryptographic Services ICSF Administrator's Guide](#)
- [IBM Health Checker for z/OS User's Guide](#)

System SSL

System SSL: Usage of PKCS #12 files protected with the PBES2 (Password Based Encryption Scheme 2) algorithm with 256-bit AES-CBC encryption

Description:

System SSL allows the usage of PKCS #12 files protected with the PBES2 (Password Based Encryption Scheme 2) algorithm with 256-bit AES-CBC encryption when importing or exporting certificates and private keys.

When change was introduced:

- z/OS 3.1 with APAR OA64899
- z/OS 2.5 with APAR OA64899

Reference information:

[z/OS Cryptographic Services System SSL Programming](#)

System SSL: Domain-based certificate verification

Description:

System SSL provides domain-based server certificate validation during an SSL/TLS session negotiation.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APAR OA63164

Reference information:

[z/OS Cryptographic Services System SSL Programming](#)

TLS V1.3 sysplex session ticket caching

Description:

System SSL allows for TLS V1.3 sessions that are established on one server to be resumed on another server on the same or different system in the sysplex. If server applications are enabled for the TLS V1.3 sysplex session ticket caching, the System SSL started task, GSKSRVR, stores the session information to allow other server applications to resume previously established TLS V1.3 sessions.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APAR OA63252

Reference information:

[*z/OS Cryptographic Services System SSL Programming*](#)

GSKKYMAN's use of stash file support instead of prompting for password entry

Description:

System SSL's gskkyman utility, when executed in command line mode, accepts the key database file stash file or provided password in place of the password prompt when dealing with a key database file or PKCS #12 file.

When change was introduced:

z/OS 3.1

Reference information:

- [*z/OS Cryptographic Services System SSL Programming*](#)

System SSL support for x25519 and x448 key exchanges have been added for Transport Layer Security TLS V1.0 through TLS V1.2

Description:

System SSL has been enhanced to provide the ability for TLS V1.0, TLS V1.1, and TLS V1.2 client and server connections to use x25519 or x448 curves for their key exchanges when utilizing ephemeral Elliptic Curve Diffie Hellman ciphers. TLS V1.0, TLS V1.1, and TLS V1.2 server configurations can limit the acceptable elliptic curves for the key exchange.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APAR OA61783, which also applies to z/OS 2.4

Reference information:

- [*z/OS Cryptographic Services System SSL Programming*](#)

Data Set File System (DSFS) new functions to consider

Data Set File System (DSFS)

Description:

With Data Set File System (DSFS), z/OS UNIX applications can access data sets by presenting the data sets as a tree-structured file system that is mounted at mount point /dsfs in the z/OS UNIX file system tree.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APAR OA62150

Reference information:

[z/OS Data Set File System Administration](#)

DFSMSdfp new functions to consider

Cloud Data Access (CDA)

Description:

A new z/OS callable service, Cloud Data Access (CDA), enables access to data in cloud object stores and adds the ability to incorporate cloud object data into z/OS workloads.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS DFSMSdfp Utilities](#)
- [z/OS MVS Programming: Callable Services for High-Level Languages](#)

Catalog enhancements

Description:

New enhancements in Catalog provide simplified ICF Catalog recovery, improved Catalog management and maintenance, and simplified Catalog Address Space (CAS) startup.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS DFSMS Access Method Services Commands](#)
- [z/OS DFSMSdfp Advanced Services](#)
- [z/OS MVS Initialization and Tuning Reference](#)
- [z/OS DFSMS Managing Catalogs](#)
- [z/OS MVS System Management Facilities \(SMF\)](#)

Hardware Configuration Manager (HCM) new functions to consider

Support for IBM Semeru 11

Description

Hardware Configuration Manager (HCM) is updated to use IBM Semeru Runtime Certified Edition for z/OS, Version 11 (5655-DGJ). This change provides additional scalability for larger I/O configurations.

When change was introduced:

z/OS 3.1

Reference information:

[z/OS Planning for Installation](#)

IBM Z Deep Neural Network Library new functions to consider

IBM Z Deep Neural Network Library

Description:

z/OS 3.1 extends the AI ecosystem by supporting a prominent AI portfolio with the ability to deploy AI co-located with z/OS applications, designed for low latency response times. Using the latest version of z/OS with the latest IBM Z hardware, AI workloads leverage the IBM Z Integrated Accelerator for AI, based on optimized compilers and libraries such as:

- IBM Z Deep Neural Network Library (zDNN) provides high-level libraries that enable frameworks and model compilers to utilize the IBM Z Integrated Accelerator for AI. It includes among others the standard IBM Z software interface to the IBM Z Integrated Accelerator for AI. This IBM-provided C library delivers a set of APIs that address requirements of the IBM Z Integrated Accelerator for AI like the data transformation. zDNN is packaged with z/OS. It is also available on Linux on Z which provides a particular benefit, as it enables acceleration in frameworks for z/OS using z/OS Container Extensions (zCX).
- IBM Z Artificial Intelligence Data Embedding Library, a set of APIs and a collection of packages designed to build and process vector embedding models on z/OS.
- IBM Z Artificial Intelligence Optimization Library, zAIO, provides an interface to core functions intended to be used to implement database queries embedded with AI information that are expressed as semantic queries. The zAIO library takes advantage of different hardware accelerators. Depending on certain characteristics of the input and parameters, along with the hardware environment in which the application is running, the library may choose to perform certain operations within software, Single Instruction Multiple Data (SIMD) via OpenBLAS, or the IBM Z Integrated Accelerator for AI with zDNN.

Integrated with zDNN, the IBM Z Artificial Intelligence Data Embedding Library and zAIO build an AI library stack which is leveraged to support AI solutions like IBM SQL Data Insights, an AI-powered Db2 feature that combines deep learning in AI with advanced IBM Z technologies to infuse the Db2 engine with SQL-based semantic queries on user tables and views.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APARs
- z/OS 2.4 with APARs

Reference information:

[zDNN Programming Guide and Reference](#)

Infoprint Server new functions to consider

Extended address volume (EAV) support

Description:

Infoprint Server supports data sets located on extended address volumes.

When change was introduced:

With the PTF for APAR OA61742, this function is available in z/OS V3.1.

Reference information:

[z/OS Infoprint Server User's Guide](#)

Sendmail enhancements

Description:

Two new attributes provide an option for removing the sender's userid@domainname or replacing it with a user-supplied address. The reply address can also be set with a user-supplied address.

When change was introduced:

With the PTF for APAR OA62221, this function is available in z/OS V3.1.

Reference information:

[z/OS Infoprint Server User's Guide](#)

Integrated Security Services new functions to consider

For security-related products, see “Security Server (RACF) new functions to consider” on page 42 and “Cryptographic Services new functions to consider” on page 31.

ISPF new functions to consider

Enhancements for ISPF PDSE V2 member generations

Description:

ISPF support for PDSE V2 member generations is enhanced to allow the specification of generation numbers in the Edit and View panels and on the Edit and Browse primary commands BROWSE, EDIT, and VIEW. Additionally, a "generation list" can be viewed for members with generations, allowing the use of line commands to access commonly used functions for desired generations. Select ISPF services are also enhanced with additional member generations information.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS ISPF Dialog Developer's Guide and Reference](#)
- [z/OS ISPF Edit and Edit Macros](#)
- [z/OS ISPF Messages and Codes](#)
- [z/OS ISPF Planning and Customizing](#)
- [z/OS ISPF Reference Summary](#)
- [z/OS ISPF Services Guide](#)
- [z/OS ISPF User's Guide Vol I](#)
- [z/OS ISPF User's Guide Vol II](#)

ISPF enhancement for pervasive encryption data set allocation

Description:

ISPF support for pervasive encryption is enhanced by allowing the provision of the data set key label on the ISPF Allocate Data Set panel.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS ISPF Messages and Codes](#)
- [z/OS ISPF User's Guide Vol II](#)

Case-insensitive sort for ISPF UNIX directory list

Description:

Viewing of large UNIX directory lists in ISPF is simplified by providing an option for a case-insensitive sort for the z/OS UNIX Directory List Utility.

When change was introduced:

z/OS 3.1

Reference information:

[z/OS ISPF User's Guide Vol II](#)

Externalize HILITE values to ISPF z variables

Description:

The following Edit Hilite z variables have been externalized: ZHIAUTO(ON/OFF) auto language determination ZHILANG(name of LANGUAGE) ZHICOLOR(ON/OFF/DO/IF/LOGIC) ZHIPAREN(ON/OFF) ZHIFIND(ON/OFF) ZHICURSR(ON/OFF)

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS ISPF Planning and Customizing](#)
- [z/OS ISPF Edit and Edit Macros](#)
- [z/OS ISPF Dialog Developer's Guide and Reference](#)
- [z/OS ISPF Reference Summary](#)

JES2 new functions to consider

JES2 policy persistence

Description:

Starting in z/OS 2.4, JES2 is updated to store JES2 Policies in the JES2 checkpoint data set, allowing policies to be available on all members of the JES2 MAS. The JES2 command and initialization statement CKPTSPACE contains a new keyword CDINUM, which controls the number of checkpoint structures available to store JES2 Policies.

This function was new for z/OS 2.5 but the description was not included in [z/OS Introduction and Release Guide](#) at that time.

When change was introduced:

- z/OS 2.5
- z/OS 2.4 with PTFs for APARs OA59665, OA58190, and OA63458 applied

Reference information:

- [z/OS JES2 Messages](#)
- [z/OS JES2 Commands](#)
- [z/OS JES2 Initialization and Tuning Reference](#)
- [z/OS JES2 Installation Exits](#)

JES2 policy expansion

Description:

Support for JES2 policies is expanded, starting in z/OS 2.4, by the creation of two new policy types: SYSOUTGroup and PreConversion. These new policies provide additional points in the phases of job processing for customizing JES2 processing of z/OS jobs and system output, without programming installation exit programs.

This function was new for z/OS 2.5 but the description was not included in [z/OS Introduction and Release Guide](#) at that time.

When change was introduced:

- z/OS 2.5
- z/OS 2.4 with PTFs for APAR OA61230 applied

Reference information:

[z/OS JES2 Installation Exits](#)

JES2 SMF 1153 record

Description:

For z/OS 2.5, JES2 is updated to generate a new type of SMF record, SMF Record Type 1153, for reporting JES2 resource usage and limits data.

This function was new for z/OS 2.5 but the description was not included in [z/OS Introduction and Release Guide](#) at that time.

When change was introduced:

z/OS 2.5

Reference information:

[*z/OS MVS System Management Facilities \(SMF\)*](#)

JES2 job notifications

Description:

The asynchronous job completion notification function of the z/OSMF jobs REST interface provides additional HTTP job notifications, helping to simplify the tracking of progress through the life cycle of a job. The job notifications being provided identify when a job is eligible for execution and when a job is selected for execution by a JES or WLM initiator. JES2 and z/OS also support indicating a server that is the target of job completion notifications by specifying a notification URL on the z/OSMF REST Jobs API or passing a parameter on the allocation of the JES2 internal reader during job submission. This interface is designed to post the specified URL when a job completes normally or abnormally. The asynchronous job completion notification function of the z/OS REST jobs API has removed the dependency on Common Information Model (CIM) and Common Event Adapter (CEA), thus simplifying configuration. It also issues the notifications for jobs that fail early in input phase processing and reissues notifications if the target URL is not available when the job completes.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with PTFs for APARs OA61231, OA62084, OA62796, and OA63581 applied

Reference information:

- [*z/OS JES2 Commands*](#)
- [*z/OS JES2 Initialization and Tuning Guide*](#)
- [*z/OS JES2 Initialization and Tuning Reference*](#)
- [*z/OS JES Application Programming*](#)

JES2 policy extension

Description:

The JES2 Policy function provides a non-assembler based facility for extending JES2. It is enhanced in z/OS 3.1 to improve the flexibility and usability of JES2 policies by:

- Implementing new policy type Job Input, which provides analysis and customization of key job attributes as part of job input processing, much like existing JES2 installation exits 20/50.
- Supporting the use of variables in the submitter environment within JES2 policies.
- Providing the ability to substitute system symbols utilized in JES2 policies.

When change was introduced:

z/OS 3.1

Reference information:

[*z/OS JES2 Installation Exits*](#)

JES2 job level resource limits and resource groups

Description:

In z/OS 3.1, JES2 provides some default policies around spool consumption. These policies monitor the use of spool. In addition, the user can define Job level Resource Limits through JES2 job classes that specify resource usage limits of key JES2 resources for a single job, helping to avoid resource exhaustion. If limits are exceeded, a defined or default action can be taken against the job. The default action is WAIT (wait for more resource), other actions are FAIL (fail the resource allocation), or NONE (issue a message, take no action).

In z/OS 3.1, JES2 also provides the capability to associate a set of jobs with a new structure called a resource group. Once a resource group is defined using new JES2 commands, the user can create a JES2 policy of a new type JobCreate, and that policy can be used during input processing to assign jobs to defined resource groups. JES2 then tracks the utilization of resources of jobs in the resource group, and the user can gain an understanding of the total resource usage of jobs in the group, allowing for better workload management.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS JES2 Commands](#)
- [z/OS JES2 Initialization and Tuning Guide](#)
- [z/OS JES2 Initialization and Tuning Reference](#)
- [z/OS JES2 Installation Exits](#)
- [z/OS JES2 Macros](#)
- [z/OS MVS Using the Subsystem Interface](#)
- [z/OS MVS System Codes](#)
- [z/OS MVS Diagnosis: Reference](#)

JES2 AI job selection

Description:

JES2 is updated in z/OS 3.1 to provide infrastructure to support infusing AI into the operating system. Several JES system symbols have been created to help support AI prediction of upcoming batch workload.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS JES2 Installation Exits](#)
- [z/OS JES Application Programming](#)
- [z/OS MVS System Management Facilities \(SMF\)](#)
- [z/OS MVS Using the Subsystem Interface](#)

JES2 compliance data reporting

Description:

JES2 is participating in the enhanced compliance support in z/OS by generating SMF 1154 subtype 114 records to begin reporting JES2 compliance evidence data.

When change was introduced:

z/OS 3.1

Reference information:

[z/OS MVS System Management Facilities \(SMF\)](#)

JES2 64-bit checkpoint versions

Description:

JES2 is updated to store checkpoint versions in 64-bit private storage, where storage pages of checkpoint data can be shared among checkpoint versions, instead of copying storage pages to checkpoint versions. This update reduces copying storage pages and helps lower CPU usage.

Language Environment

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with PTFs for APAR OA61750 applied

Reference information:

None.

Language Environment new functions to consider

COBOL-Java interoperability for Language Environment

Description:

The callable services CEEMICT is introduced for high-level language applications such as COBOL, PL/I, Java, and others to determine whether they are running in the 31-bit or 64-bit interoperability environment.

When change was introduced:

z/OS 3.1

Reference information:

- [CEEMICT—Manage the interoperability state of the current task](#) in *z/OS Language Environment Programming Reference*
- [__le_ceemict\(\)](#) — [Manage the interoperability state of current task](#) in *z/OS C/C++ Runtime Library Reference*

NFS new functions to consider

NFS Server AT-TLS enhancement

Description:

The z/OS NFS Server is now an AT-TLS-aware application when the NFSv4 protocol is used.

When change was introduced:

z/OS 2.5 with APAR OA62357

Reference information:

- [Configuring AT-TLS](#) in *z/OS Network File System Guide and Reference*
- [AT-TLS](#) in *z/OS Network File System Guide and Reference*

NFS Server restart recovery for NFSv4

Description:

Previously, the mvsmnt attribute helped recover only the file system of the mount point but not any additional file systems that were accessed under the NFS mount. Now all NFS Version 4 file handles for all file systems accessed under a mount point using mvsmnt can be recovered.

When change was introduced:

z/OS 2.4 with APAR OA62860

Reference information:

- [Processing attributes syntax](#) in *z/OS Network File System Guide and Reference*

OpenSSH new functions to consider

Support for OpenSSH 8.4p1

Description:

Previously, z/OS OpenSSH was a port of Open Source Software release OpenSSH 7.6p1. In 3.1, z/OS OpenSSH is upgraded to OpenSSH 8.4p1.

Release introduced:

z/OS 3.1

Reference information:

[*z/OS OpenSSH User's Guide*](#)

Resource Measurement Facility (RMF) new functions to consider

64-bit Java for memory constraint relief

Description:

To provide higher security, Distributed Data Server (DDS) is enhanced to use 64-bit Java for memory constraint relief.

When change was introduced:

z/OS 3.1

Reference information:

- [*z/OS Resource Measurement Facility User's Guide*](#)
- [*z/OS Resource Measurement Facility Report Analysis*](#)
- [*z/OS Resource Measurement Facility Programmer's Guide*](#)

Web-based interface for metrics and reports

Description:

A web-based user interface for Monitor III Metrics and Reports is available.

When change was introduced:

z/OS 3.1

Reference information:

- [*z/OS Resource Measurement Facility User's Guide*](#)
- [*z/OS Resource Measurement Facility Report Analysis*](#)
- [*z/OS Resource Measurement Facility Programmer's Guide*](#)

SDSF new functions to consider

New SDSF Module Fetch Monitor (MFM) panels

Description:

The SDSF Module Fetch Monitor gathers information about module fetches on your system. Information collected includes the module name, the containing data set, the job name that caused the fetch to occur, and the performance statistics of the fetch. The new SDSF panels MFD, MFJ, and MFM provide different views of the data that is collected by the monitor. You can use them to provide better insight into the modules used on your system and optimize system performance.

When change was introduced:

z/OS 3.1

Reference information:

- [*z/OS SDSF Operation and Customization*](#)
- [*z/OS SDSF User's Guide*](#)

Security Server (RACF) new functions to consider

RACF database encryption

Description:

The RACF database encryption function supports the encryption of a RACF database, which is migrated to VSAM linear data set, a format, which is consistent with the existing structure of a RACF data set. With this support, the RACF VSAM data set can be shared among z/OS systems in additional specified configurations. In further support of high availability, RACF allows an installation to suppress, on an application-by-application basis, the prompting for an additional password or password phrase attempt for a SPECIAL user who exceeds the installation limit for consecutive incorrect password attempts.

When change was introduced:

z/OS 3.1 and z/OS V2R5

Reference information:

- [*z/OS Security Server RACF System Programmer's Guide*](#)
- [*z/OS Security Server RACF Security Administrator's Guide*](#)
- [*z/OS Security Server RACF Auditor's Guide*](#)
- [*z/OS Security Server RACF Diagnosis Guide*](#)
- [*z/OS Security Server RACF Data Areas*](#)
- [*z/OS Security Server RACROUTE Macro Reference*](#)

RACF password phrase interval support

Description:

RACF Password Phrase Interval Support provides a new separate password phrase-specific change interval, which can be different than the existing password interval and supports longer values. The password phrase interval can be set with the new PHRASEINT keyword at the system level with the SETROPTS command and at the user level with the PASSWORD or PHRASE commands.

When change was introduced:

z/OS 3.1 and z/OS V2R5 with the PTF for APAR OA61951.

Reference information:

- [*z/OS Security Server RACF General User's Guide*](#)
- [*z/OS Security Server RACF Macros and Interfaces*](#)
- [*z/OS Security Server RACF Command Language Reference*](#)
- [*z/OS Security Server RACF Security Administrator's Guide*](#)
- [*z/OS Security Server RACF Data Areas*](#)
- [*z/OS Security Server RACROUTE Macro Reference*](#)
- [*z/OS Security Server RACF Callable Services*](#)

RACF custom fields

Description

In support of application enablement, RACF adds support to allow security administrators to identify the user-related custom fields that should be anchored in the user's Accessor Environment Element

(ACEE) at logon time. Problem-state applications can retrieve this information by using the R_GetInfo callable service (IRRSGI00) without incurring RACF database I/O.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS Security Server RACF System Programmer's Guide](#)
- [z/OS Security Server RACF Macros and Interfaces](#)
- [z/OS Security Server RACF Command Language Reference](#)
- [z/OS Security Server RACF Security Administrator's Guide](#)
- [z/OS Security Server RACF Data Areas](#)
- [z/OS Security Server RACROUTE Macro Reference](#)
- [z/OS Security Server RACF Callable Services](#)

RACF SETROPTS APPLAUDIT

Description:

In support of application enablement, RACF extends the existing SETROPTS APPLAUDIT function to apply to all z/OS applications, and not just APPC/MVS applications. This enhancement enables clients to collect SMF records for successful application logons, in support of regulations like PCI-DSS.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS Security Server RACF System Programmer's Guide](#)
- [z/OS Security Server RACF Macros and Interfaces](#)
- [z/OS Security Server RACF Command Language Reference](#)
- [z/OS Security Server RACF Security Administrator's Guide](#)
- [z/OS Security Server RACF Auditor's Guide](#)
- [z/OS Security Server RACF Data Areas](#)
- [z/OS Security Server RACROUTE Macro Reference](#)
- [z/OS Security Server RACF Callable Services](#)

RACF health checks

Description:

The RACF_PASSWORD_CONTROLS health check is updated to add support for the password phrase interval, which supports longer values.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS Security Server RACF Messages and Codes](#)
- [IBM Health Checker for z/OS User's Guide](#)

SMP/E new functions to consider

Security for signed packages

Description:

z/OS SMP/E and z/OSMF Software Management provide the ability to digitally sign and verify the signature of GIMZIP software packages that are delivered both electronically and physically, on

all supported z/OS releases. This capability, which is designed for nonrepudiation and authenticity, ensures that a software package is not modified since it was created and is signed by the expected provider.

The choice to do this additional verification is optional. Your installation can do so upon receipt of the software package, if the software provider has chosen to use this additional capability. All z/OS product packages from IBM use this optional signing; there is no option in Shopz that you need to specify to receive signed software packages.

When change was introduced:

z/OS 3.1

Reference information:

- [z/OS Planning for Installation](#)
- [z/OS SMP/E Commands](#)
- [z/OS SMP/E Reference](#)
- [z/OS SMP/E User's Guide](#)

IBM Tivoli Directory Server for z/OS new functions to consider

Updated Java requirement

Description:

The **ldapdiff** utility requires IBM Semeru Runtime Certified Edition for z/OS, Version 11 to be installed on the system.

When change was introduced:

z/OS 3.1

Reference information:

- [Using a Java keystore or RACF key ring for ldapdiff in z/OS IBM Tivoli Directory Server Administration and Use for z/OS](#)
- [The ldapdiff utility in z/OS IBM Tivoli Directory Server Administration and Use for z/OS](#)

XL C/C++ new functions to consider

Open XL C/C++ 1.1 compiler component

Description:

Open XL C/C++ 1.1 is an optional compiler for z/OS clients that have enabled the priced, optional XL C/C++ compiler feature on z/OS 3.1. This compiler is ideal for porting distributed applications and to improve and simplify C/C++ 64-bit application development for the IBM z/OS UNIX Systems Services environment. IBM Open XL C/C++ 1.1 for z/OS 3.1 is a web deliverable compiler that can be accessed from the z/OS Downloads website.

Release introduced:

z/OS 3.1

Reference information:

[z/OS downloads \(www.ibm.com/systems/z/os/zos/downloads\)](http://www.ibm.com/systems/z/os/zos/downloads)

XML Toolkit for z/OS new functions to consider

XML Toolkit V1.11 included in z/OS 3.1

Description:

XML Toolkit V1.11 is a new element in z/OS 3.1. For an overview, see [“XML Toolkit for z/OS” on page 12](#).

Release introduced:

z/OS 3.1

Reference information:[XML Toolkit for z/OS User's Guide \(www.ibm.com/downloads/cas/BWWVRW2G\)](http://www.ibm.com/downloads/cas/BWWVRW2G)

z/OS Change Tracker new functions to consider

Interactive GUI front-end from the z/OSMF desktop

Description:

The IBM z/OS Change Tracker plug-in provides an interactive GUI front-end from the z/OSMF desktop. The plug-in includes a Monitored Resources view for managing protected resources, and other features such as viewing the change history of data sets, member-level backup and recovery, and member check-in and checkout.

When change was introduced:

z/OS 3.1

Reference information:[*IBM z/OS Change Tracker Guide and Reference*](#)

z/OS Data Gatherer new functions to consider

SMF Explorer with Python

Description:

z/OS has a rich collection of SMF records that can be automatically generated from the operating system regarding many details about your installation and the activities of your z/OS systems. With z/OS 3.1, IBM delivers an SMF data access and analysis package leveraging Python. This enables applying data science and AI against SMF data. The SMF Explorer with Python is designed to help you access SMF data simply by using z/OS Data Gatherer REST API services. It is focused on helping you extract insights, leveraging state-of-the-art and data science-relevant technologies like Python and Jupyter Notebooks. This capability helps to strengthen the IBM focus on using data and AI to extract valuable insights.

SMF Explorer with Python is designed to help novice system administrators, IT operators, and new users such as data scientists and data engineers to:

- Get easy access to SMF data
- Better understand and interpret this data
- Leverage Python to apply data exploration and visualize data
- Use AI methods to extract insights that go beyond traditional analytics tools

You do not need deep z/OS skills to access and process the data. To optimize the user experience, Jupyter Notebook tutorials are available to guide you on how to fetch, process, and visualize SMF raw data to enable graphical analysis.

SMF Explorer with Python uses z/OS Data Gatherer REST API services as a starting point of z/OS monitoring integration and enables you to develop, implement, and use machine learning and AI solutions for continuous systems monitoring and anomaly detection.

When change was introduced:

- z/OS 3.1
- z/OS 2.5 with APAR

Reference information:[IBM SMF Explorer \(ibm.github.io/IBM-SMF-Explorer/\)](https://ibm.github.io/IBM-SMF-Explorer/)

[z/OS Management Facility \(z/OSMF\) new functions to consider](#)

CFRM Policy Editor enhancements

Description:

The z/OSMF CFRM Policy Editor is enhanced to enable performing CF structure sizing with higher efficiency. Additional enhancements include the ability to import CFRM Policy Data from text files, exporting policy data into text files or CSV format, comparing data between two CFRM policies within the editor, and bulk copying structures.

When change was introduced:

z/OS 3.1

Reference information:

- [IBM z/OS Management Facility Configuration Guide](#)
- [IBM z/OS Management Facility Programming Guide](#)
- [z/OSMF Sysplex Management](#)

Analyzing WLM service definitions with Policy Advisor

Description:

The Policy Advisor view provides support to analyze a WLM service definition that has collected SMF performance measurements while your service policy was active. Data visualizations are provided to compare your definition with actual performance data and suggest potential improvements for unfavorable goal settings.

When change was introduced:

z/OS 3.1

Reference information:

[z/OSMF Workload Management task](#)

Security simplification

Description:

New REST APIs are introduced to ensure that security requirements for a product or function are satisfied, and to help fix missing security configurations.

When change was introduced:

z/OS 3.1

Reference information:

- [Security Configuration Assistant services in IBM z/OS Management Facility Programming Guide](#)
- [z/OSMF Security Assistant](#)

[z/OS UNIX System Services new functions to consider](#)

zsh - The Z shell

Description:

zsh is a UNIX command interpreter (shell) that is used as an interactive login shell and as a shell script command processor. It has command-line editing, built-in spelling correction, programmable command completion, shell functions (with autoloading), a history mechanism, and a host of other features.

When change was introduced:

V3R1

Reference information:

[zsh - The Z shell in z/OS UNIX System Services Command Reference](#)

Enhanced skulker performance

Description:

The skulker utility is rewritten in REXX. It is also enhanced to automatically delete the directories that it empties and to return without exiting when a nonzero return code is returned.

When change was introduced:

V3R1

Reference information:

[skulker - Remove old files from a directory](#) in *z/OS UNIX System Services Command Reference*

Merged view of files and directories with the union file system (UFS)

Description:

The union file system (UFS) provides a merged view of two or more directories. It works on top of other file systems.

When change was introduced:

- V3R1
- V2R5 with the PTF for OA61759 applied

Reference information:

[Managing the union file system](#) in *z/OS UNIX System Services Planning*

New and changed z/OS UNIX utilities

Description:

Two new utilities are added.

- The **readlink** utility shows the actual path of the symbolic link.
- The **banner** utility displays character strings in large letters on the standard output.

Minor enhancements are made to the following utilities:

- The **su** utility is enhanced to write messages to the system log, viewable by syslogd, for every successful and failed attempt to switch utility. This enhancement provides an auditing element to the **su** utility.
- The **date** utility supports Julian date conversion.
- The **find** utility can separate file names in the output with a null character (a zero byte), which allows file names to be interpreted correctly if they contain spaces or newlines.
- You can use the **grep** utility to do a recursive search in directories.

When change was introduced:

z/OS 3.1

Reference information:

- [banner - Make large letters](#) in *z/OS UNIX System Services Command Reference*
- [date - Display the date and time](#) in *z/OS UNIX System Services Command Reference*
- [find - Find a file that meets specified criteria](#) in *z/OS UNIX System Services Command Reference*
- [grep - Search a file for a specified pattern](#) in *z/OS UNIX System Services Command Reference*
- [readlink - Print resolved symbolic links or canonical file names](#) in *z/OS UNIX System Services Command Reference*
- [su - Change the user ID associated with a session](#) in *z/OS UNIX System Services Command Reference*

Appendix A. Accessibility

Accessible publications for this product are offered through [IBM Documentation for z/OS \(www.ibm.com/docs/en/zos\)](http://www.ibm.com/docs/en/zos).

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- For information about software support lifecycle, see: [IBM Lifecycle Support for z/OS \(www.ibm.com/software/support/systemsz/lifecycle\)](http://www.ibm.com/software/support/systemsz/lifecycle)
- For information about currently-supported IBM hardware, contact your IBM representative.

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Product Number: 5655-ZOS

GA32-0887-60

