



Expanding the IBM Systems' portfolio with additions to IBM z Systems and IBM LinuxONE

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At a glance

Announcing the new IBM^(R) z13sTM and enhancements to the existing IBM z13TM.

IBM z13sTM securely delivers hybrid cloud and mobile capabilities along with cyber security within reach of small and mid-size companies. Today's announcement extends IBM z SystemsTM leadership with:

- Trusted, secure, and reliable operations for reduced business risk
 - Stronger and faster protection with integrity of data across a hybrid cloud environment with the new Crypto Express5S.
 - Enhanced public key support for constrained digital environments using cryptography for users of applications such as Google Chrome, Mozilla Firefox, and Apple iMessage, enhancing your cyber security.
 - Ability to minimize reformatting of databases with new exploitation of Visa Format Preserving Encryption (FPE) for payment processing.
 - Faster insight into the health of your LinuxTM system with new IBM zAware pattern recognition analytics extended to Linux on z SystemsTM for a step into the cognitive era.
- Traditional data serving and transactional processing
 - Up to 20 configurable processors (1.5x more than your zBC12) and 40 LPARs (compared to 30 on your zBC12), allowing businesses to scale as needed.
 - With up to 4 TB of memory, the ability to make business decisions at a faster pace and improve response times to your clients. New memory packaging and pricing open up opportunities such as in-memory data marts and in-memory analytics, giving you the necessary room to tune applications for optimal performance.
 - Economies of scale with simultaneous multithreading delivering more throughput for Integrated Facility for Linux (IFL) and z Integrated Information Processor (zIIP)-eligible workloads.
- Operational efficiency
 - With an enhanced "share all" virtualization environment for both cryptographic and networking features and LPARs, z13s helps businesses improve resource sharing while spending less on hardware capacity.
 - New optional rack-mounted Hardware Management Console, previously unavailable on the zBC12, can help to save space where it is a premium in data centers.

- Single Instruction Multiple Data (SIMD), a vector processing model providing instruction-level parallelism, can speed workloads such as analytics and mathematical modeling.
- A design for the z13s and z13™ intended to:
 - Optimize internal LPAR to LPAR communications within a CPC transparently, with no changes to applications, using Shared Memory Communications - Direct Memory Access (SMC-D).
 - Improve Time-To-Value with faster deployment and implementation of software solutions delivered as virtual software appliances and firmware appliances with z Appliance Container Infrastructure (zACI).
 - Simplify z Systems hardware and virtual infrastructure management for KVM for IBM z Systems including integrated dynamic I/O management with IBM Dynamic Partition Manager (DPM).
- Full upgradability to z13s from IBM zEnterprise[®] BC12 and zEnterprise 114, and full upgradability within the z13s family
- Full upgradability to z13 from IBM zEnterprise EC12 and zEnterprise 196, and full upgradability within the z13 family

IBM LinuxONE™ - In August 2015, IBM Introduced IBM LinuxONE, an all-Linux enterprise platform for open innovation comprising the best of Linux and open technology with the best of enterprise computing in ONE platform. LinuxONE systems are built to be the backbone of the mobile era, setting new standards in transaction volume, speed, resilience, and trust.

IBM LinuxONE includes two products -- named, given the Linux heritage, after penguins: IBM LinuxONE Emperor™ and IBM LinuxONE Rockhopper™. Today's announcement introduces the latest version of the Rockhopper offering along with enhancements to its most scalable sibling, Emperor.

- **IBM LinuxONE Emperor** - a system enabled for enterprise-grade Linux that is robust and trusted for critical workloads, delivers higher performance and throughput at a lower cost per transaction compared to x86 servers, and is integrated with new open capabilities
 - Runs on a 5.0 GHz processor
 - Supports up to 141 customer-configurable LinuxONE cores
 - Delivers I/O and high availability through 667 dedicated cores
 - Supports up to 8,000 production workload capable virtual machines in a single footprint
 - Supports a multilevel cache subsystem and 10 TB memory
 - Delivers massive I/O capability that can support 30 billion RESTful web interactions a day without fail
 - Delivers up to 2.2x the performance for the same SQL and NoSQL databases running on commodity Linux platforms
- **IBM LinuxONE Rockhopper** - an entry point for LinuxONE that embodies the same innovation, value, flexible growth options, industry-leading virtualization, trusted resiliency, secure cloud, enterprise mobility, and operational analytics capabilities as the massively scalable IBM LinuxONE Emperor
 - Runs on a 4.3 GHz processor
 - Supports up to 20 customer-configurable LinuxONE cores
 - Delivers I/O and high availability through 264 dedicated cores
 - Supports from hundreds to over a thousand production workload capable virtual machines in a single footprint
 - Supports a multilevel cache subsystem and 4 TB memory
 - Delivers significant I/O capability for medium-sized enterprises

Today's announcement highlights the following LinuxONE capabilities:

- Linux Your Way
 - Embraces the best of Linux and open technology, giving you the freedom to leverage skills, tools, and apps widely embraced by the industry.
 - Enables you to pick your hypervisor, run time, languages, management, database, and analytics.
 - Lets you run all the open source software that modern IT loves -- Ubuntu, Red Hat, SUSE, Ruby, Java™, Node.js, Chef, Docker, Mongo, PostgreSQL, Spark, plus many others -- on a system that delivers industry-leading strengths of enterprise computing.
 - Provides a rock-solid foundation for your on-premises cloud strategy.
- Linux Without Limits
 - Delivers virtualization capabilities that can result in a less complex, more economical and flexible Linux infrastructure compared to x86 servers.
- Linux Without Risks
 - Delivers high availability through component reliability, redundancy, and features that assist in providing fault avoidance and tolerance while permitting concurrent maintenance and repair.
 - Built on the innovation of IBM Systems' RAIM memory technology that has been responsible for zero visible memory failures in the last 5 years, mitigating a known problem on competitive x86 platforms.
 - Delivers Secure Sockets Layer (SSL) transactions.
 - Supports the dedicated adapter card for crypto acceleration, Crypto Express5S, for secure co-processing and bulk encryption with clear key and protected key support, helping protect sensitive keys from inadvertent disclosure.
 - Supports the cryptography ideal for resource-constrained environments such as mobile phones and smart cards while meeting stringent digital signature requirements with support for PKCS #11 standards. Additional standards for the banking and finance industry, such as ANSI, ISO, and EMV, are also supported.
 - Supports IBM Resiliency Analytics for LinuxONE (orderable as IBM zAware) for near real-time diagnostics to proactively help identify system anomalies and problems faster in the Linux operating environment.
 - Supports the IBM GDPS^(R) Appliance for clients running z/VM^(R) hypervisor and associated Linux guests, delivering multiplatform, high availability, and disaster recovery benefits in case of system, application, or network failure.
 - Supports IBM Spectrum Scale™ for Linux based on IBM GPFS™ technology for high availability through advanced clustering technologies, dynamic file system management, and data replication.

Overview

The IBM z13s and enhanced IBM z13 expand the breadth of the IBM z Systems family.

Market forces are pushing businesses to transform and meet changing industry demands. There is an explosion of digital data that requires management, movement, security, and manipulation, and it is causing strains on IT. Businesses need to take advantage of and gain insight from all that data -- in real time. Clients are demanding new services, and if the response isn't immediate, the client may move on. A business must be diligent and forward thinking and IBM can help with the infrastructure needed for the transformation. With both hardware and software, IBM can help you be competitive in the digital world of analytics, mobile, security, and hybrid cloud, helping you get ready for what the future brings.

The new IBM z13s is designed to help transform business and tackle tough real-time business challenges. It provides impressive scale in terms of memory, I/O, and

processing power in a single frame that can quickly respond to dynamic changes in business growth or fluctuations. The z13s also helps you meet your service level agreements by allowing you to deliver real-time information and insight from data that can give your business the advantage of more timely business decisions. The use of IT to change how you approach your basic core business models, such as by deploying hybrid cloud, analytics, and new appliances, can help maximize revenue while improving the client experience.

The z13s expands the breadth of the IBM z Systems family by delivering a strong range of new smaller-capacity, attractively priced models with significantly more capacity than the zBC12. With up to 4 TB of memory and up to 20 configurable processor units, the z13s will advantage traditional, hybrid, and emerging marketing users. IBM z/OS[®] supports the new processor with significant enhancements to operating system design optimized for scalability, cost savings, advanced compression capabilities, reliability, availability, and serviceability. The new multithreaded processor design benefits Linux application servers, database servers, as well as analytic and cloud workloads running in PR/SM[™] mode under z/VM, under Kernel-based Virtual Machine (KVM) for IBM z Systems, or Linux in LPAR, as well as in IBM Dynamic Partition Manager (DPM) mode under KVM for IBM z Systems or Linux in LPAR. Users may see performance benefits when taking advantage of large shared, virtualized memory without having to change footprint size or energy requirements. New clients may consolidate the footprint and reduce the energy envelope. Taking advantage of large memory can reduce latency and CPU cost, and thus improve operational efficiency -- particularly when considering today's analytical, mobile, and hybrid cloud deployments. Delivered with security and availability, the z13s provides enhancements to protect your users, your clients, and your business.

Specialty engines such as the Integrated Facility for Linux (IFL), z Integrated Information Processor (zIIP), Internal Coupling Facility (ICF), or additional System Assist Processors (SAPs) continue to help deliver greater efficiencies and help optimize the capabilities of the platform to support a broad set of applications and workloads, while helping to dramatically improve mainframe economics. The specialty engines can be used independently or can complement each other to optimize workload execution and lower costs.

Built on z Systems core values and strengths, the z13s delivers innovations and technologies to enable real-time digital business. It is designed to handle the explosive growth of increasingly mobile clients and employees, is able to leverage new and vast amounts of data for modern analytics, and can provide deeper real-time insight at the point of impact for greater business outcomes. All of this can be deployed within a secure and resilient hybrid cloud-ready infrastructure.

Today IBM is also announcing new capabilities for both the z13s and the IBM z13. A new z/OS memory-based communications convention can transparently be utilized to optimize communication between LPARs on the server. A new appliance framework can be employed for improved consumability and security when deploying new appliances. Updates to KVM for z Systems and a new optional, simplified operations interface allow better skills portability for clients with existing KVM implementations on alternative architectures and have the potential to create new possibilities for delivery of open source tools, databases, and management software to further lower the cost of Linux on z Systems deployments.

For more information on the capabilities originally introduced on the IBM z13 which are now available on the IBM z13s, refer to Hardware Announcement [AG15-0001](#), dated January 14, 2015.

IBM LinuxONE -- Linux Your Way, Linux Without Limits or Risk.

The Linux and open technology momentum is huge and driving an open standards revolution. Linux is everywhere and for good reason. It has evolved from its humble origins as technical experiments, side projects, and niche applications, to being a key part of the enterprise IT toolkit. However, the world is constantly changing. The mobile world and new app economy are driving change with unprecedented

speed and scope, and creating new requirements and expectations that have to be addressed.

As today's IT landscape is evolving rapidly, technologies such as cloud, analytics, social business, and mobile solutions are at the center of a technology shift that is rapidly driving growth and innovation. This new era represents an opportunity for companies of all sizes to reshape the value they deliver; however, cost, complexity, and risk are standing in the way. Performance, availability, and scalability of systems can further hinder the adoption of these technologies.

To run open source software and meet the rocketing demands of exploding data volumes in the mobile era, traditional infrastructures have added thousands of servers to existing data centers, creating burdens of cost, complexity, latency, and vulnerability. The complexity of a server farm can shackle innovation. While open source lets IT professionals build apps quickly, deploying the server infrastructure to make it work can consume valuable time and resources. All in all, the tension between mission-critical open source applications and the systems that run them is reaching a breaking point.

To address these growing challenges, IBM introduces the latest version of the IBM LinuxONE Rockhopper and enhancements to the IBM LinuxONE Emperor.

IBM LinuxONE servers are built to be the backbone of the mobile era, delivering significant processing compute capability and setting new standards in transaction volume, speed, resiliency, and trust. They deliver incredible I/O capacity supporting billions of web transactions a day without fail. LinuxONE servers run all the open source software that modern IT loves on a system that can meet unprecedented demand through virtually limitless scale, with fast subsecond response times, and availability to keep clients' business up and running 24x7. LinuxONE servers offer the ultimate in dependability -- these systems are designed not to fail. With the highest level of security certification for commercial servers in the industry, clients can trust LinuxONE. What does this mean for your business? It means not making your customers wait, being sure your data is protected, and not giving your competitors an edge because your IT solution failed to deliver.

Linux Your Way

A LinuxONE system embraces the best of Linux and open technology, providing the freedom to leverage the skills, tools, and apps you already know and love. You can pick your hypervisor, run time, languages, management, database, and analytics. IBM LinuxONE systems are supported by some of the biggest names out there -- Ubuntu, Red Hat, SUSE, Ruby, Java, Node.js, Chef Docker, Mongo, PostgreSQL, and Spark plus many others. You can use the products you want while leveraging the strengths of enterprise computing.

Moving all workloads to the cloud was the mantra of three years ago. However, many organizations that adopted a largely off-premises model have been reconsidering. Costs can balloon, and performance can result in a poor user experience. Now, a provider can evolve to a new model using LinuxONE as the foundation of an on-premises cloud strategy.

LinuxONE servers are built for performance. Take, for instance, the LinuxONE Emperor, which delivers up to 2.2 times the performance for the same SQL and NoSQL databases running on commodity Linux platforms. IBM has tested the Spark-Perf benchmark suite on LinuxONE Emperor, demonstrating that the platform can process up to 50% more data than distributed systems for model building. Add Apache Spark, and your system can radically simplify the development of innovative, intelligent apps that are fueled by data.

Companies can now tap into Node.js and rapidly develop secure, high-performance web and mobile applications for their customers, partners, and staff, meeting demands for the latest technology without purchasing additional hardware.

LinuxONE is flexible enough to give you the choices to build the infrastructure that is right for you, including additional support for Canonical's Ubuntu alongside current Linux distributors Red Hat and SUSE. The Kernel-based Virtual Machine

(KVM) hypervisor joins PR/SM and z/VM. From a language and a runtime standpoint, LinuxONE lets you choose from many of the industry's leading open languages, including Python, Ruby, Java, Node.js, and more.

Open source databases supported for LinuxONE include MongoDB, PostgreSQL, CouchDB, Cassandra, and MariaDB plus others. The system can support the largest single instance of MongoDB with a 1 TB footprint and still run many workloads at the same time. Analytics can be added using Apache Spark, Hadoop, and IBM InfoSphere[®] BigInsights[®]. LinuxONE also embraces Docker, the Linux-based technology for deploying, executing, and managing containers. Another new container technology supported on LinuxONE is IBM's z Appliance Container Infrastructure (zACI) which, along with an appliance installer, enables the secure, agile deployment of firmware and software appliances. The list of supported open source products goes on and will continue to expand. LinuxONE combines the best of open source with a new level of performance to meet the kind of demand generated by twenty-first century customers.

Finally, IBM LinuxONE Elastic Pricing provides LinuxONE clients with a low-risk option to get started and grow with their business. What you pay depends on what you use. Move from cap-ex to op-ex as deployment models change. In addition, SUSE has announced plans to offer elastic pricing for their Linux distribution.

Linux Without Limits or Risk

LinuxONE comes in two varieties -- named, given the Linux heritage, after penguins. At the top end is LinuxONE Emperor. The other version, LinuxONE Rockhopper, is designed to be an entry point into the LinuxONE portfolio.

LinuxONE Emperor enables enterprise-grade Linux that is robust and trusted for critical workloads, delivers higher performance and throughput at a lower cost per transaction than x86 servers, and is integrated with new open capabilities. It is available with up to 141 Linux cores supporting up to 8,000 production workload capable virtual machines in a single footprint. Emperor has one of the industry's fastest commercially available server processors, running at 5 GHz, a multilevel cache subsystem, and 10 TB of memory.

LinuxONE Rockhopper is an entry point into the LinuxONE family and offers all of the same features as Emperor. Rockhopper is available with up to 20 Linux cores, running at 4.3 GHz, supporting hundreds to over a thousand production workload capable virtual machines on a single footprint.

With demand for I/O devices reaching the tens, even hundreds of thousands of I/O devices in enterprise computing environments, I/O bandwidth is incredibly important. The IBM LinuxONE Emperor can leverage up to 667 I/O and assist processors while the IBM LinuxONE Rockhopper can support up to 264 I/O and assist processors to meet enterprise Linux clients' growing I/O and high availability needs. Additional intelligence enables routing around congestion in the I/O framework and routes around error conditions without ever affecting the application.

IBM LinuxONE delivers availability and resiliency to Linux environments by leveraging the capabilities of existing IBM z Systems enterprise computing products.

IBM Resiliency Analytics for LinuxONE (orderable as IBM zAware) is an analytics solution designed to offer near real-time diagnostics to help identify potential problems in the Linux environment. Resiliency Analytics for LinuxONE intelligently examines message logs for potential deviations, inconsistencies, or anomalies. With Resiliency Analytics for LinuxONE, organizations can address IT problems quickly, minimize availability lapses, and intervene in IT problems before they become severe.

The IBM GDPS Virtual Appliance delivers high availability and disaster recovery benefits in case of system, application, or network failures to clients running the z/VM hypervisor and associated Linux guests on LinuxONE.

IBM Spectrum Scale for Linux, based on IBM GPFS technology, is designed to provide high availability through advanced clustering technologies, dynamic file

system management, and data replication on LinuxONE. Spectrum Scale can continue to provide data access even when the cluster experiences storage or node malfunctions. Its scalability and performance are designed to meet the needs of data-intensive applications.

IBM DS8884 is a lower cost, space-saving system with advanced, easy-to-use operations and continuous availability for running critical workloads, particularly on LinuxONE Rockhopper servers.

Key prerequisites

Refer to the [Hardware requirements](#) and [Software requirements](#) sections of this announcement.

Planned availability date

- March 10, 2016
 - Features and functions for the IBM z13, IBM z13s, IBM LinuxONE Emperor, and IBM LinuxONE Rockhopper
 - IBM z13s Models N10 and N20
 - IBM LinuxONE Emperor Models L30, L63, L96, LC9, and LE1
 - IBM LinuxONE Rockhopper Models L10 and L20
 - z114 upgrades to z13s Models N10 and N20
 - z114 with zBX Model 002 upgrades to IBM z13s and zBX Model 004 stand-alone
 - zBC12 upgrades to z13s Models N10 and N20
 - zBC12 with zBX Model 003 upgrades to IBM z13s and zBX Model 004 stand-alone
 - Field-installed features and conversions on IBM z13s that are delivered solely through a modification to the machine's Licensed Internal Code (LIC)
 - Trusted Key Entry 8.1 LIC (#0878)
- April 25, 2016
 - 32GB USB Backup Media (#0848) for zEC12 Models H20, H43, H66, H89, and HA1
 - 32GB USB Backup Media (#0848) for zBC12 Models H06 and H13
- April 30, 2016
 - MES Feature support for Regional Crypto Enablement (RCE) Vendor 1 (#0901) (China only)
- June 10, 2016
 - Trusted Key Entry Rack Mount (#0097)
- June 30, 2016
 - MES features for z13s Models N10 and N20
 - MES features for LinuxONE Emperor Models L30, L63, L96, LC9, and LE1
 - MES features for LinuxONE Rockhopper Models L10 and L20
 - MES upgrades for IBM LinuxONE Emperor Lxx models to Lxx models:
 - L30 to L63, L96, LC9, or LE1
 - L63 to L96, LC9, or LE1
 - L96 to LC9 or LE1
 - LC9 to LE1
 - MES upgrades for IBM LinuxONE Rockhopper Lxx models to Lxx models:
 - L10 to L20

- z/VSE[®] Network Appliance using the z Appliance Container Infrastructure (zACI)
- September 26, 2016
 - Frame Roll MES upgrades for IBM z13s N20 to IBM z13 N30
 - MES upgrades for IBM LinuxONE Emperor Lxx models to IBM z13 Nxx models:
 - L30 to N30, N63, N96, NC9, or NE1
 - L63 to N63, N96, NC9, or NE1
 - L96 to N96, NC9, or NE1
 - LC9 to NC9 or NE1
 - LE1 to NE1
 - MES upgrades for IBM LinuxONE Rockhopper Lxx models to IBM z13s Nxx models:
 - L10 to N10 or N20
 - L20 to N20
- September 30, 2016
 - Publication: *IBM Dynamic Partition Manager (DPM) Planning Guide*, SB10-7168
- October 10, 2016
 - Hardware Management Console Tower (#0095)
 - Hardware Management Console Rack Mount (#0096)
 - Trusted Key Entry Tower (#0098)

Description

The z13s is designed to help tackle your toughest real-time business challenges. It provides impressive scale in terms of memory, I/O, and processing power in a single frame that can quickly respond to dynamic changes in business fluctuations. z13s delivers real-time analytics and hybrid cloud capabilities to companies of all sizes.

Today's announcement extends IBM z Systems leadership with z13s, offering:

- Exceptional scale in a small footprint with up to 6 CPs for **1.3x the z/OS capacity of a zBC12** and up to **20 IFLs for 2.1x total system capacity compared to the zBC12** which had a maximum of 13 IFLs. This provides an excellent platform for deploying cloud, analytics, and mobile solutions.
- Economies of scale with **simultaneous multithreading delivering more throughput** for Linux and zIIP-eligible workloads.
- **Enhanced cryptographic and partitioning offerings** that can help ensure the real-time protection and integrity of data across an enterprise cloud environment.
- **More memory, cache enhancements, and improved I/O bandwidth** to serve up more data to support exponential mobile transaction volumes.
- **Real-time insights** at the point of impact with integrated analytics and transaction processing.
- **Data and services that are securely delivered**, with minimal risk, on the most reliable platform.
- The flexibility of **hybrid cloud deployment**.
- Improved performance of complex mathematical models, perfect for analytics processing, with **Single Instruction Multiple Data (SIMD)**.
- **IBM zAware cutting-edge pattern recognition analytics** for fast insight into system health extended to Linux on z Systems.
- **IBM Integrated Coupling Adapter (ICA SR), which offers greater short-reach coupling connectivity** than existing link technologies and enables

greater overall coupling connectivity per CPC footprint than prior server generations.

- New rack-mounted Hardware Management Console (HMC) helping to **save space in the data center.**

Today's announcement also includes enhancements for both z13 and z13s:

- **Simplified appliance** implementation with z Appliance Container Infrastructure (zACI)
- **New administrative mode for Linux -- IBM Dynamic Partition Manager (DPM)**
- LPAR enhancement to provide **group physical capacity limit enforcement**
- LPAR enhancement for **dynamic memory management**
- **Regional Crypto Enablement (RCE)**
- **Common Cryptographic Architecture (CCA)** enhancements
- **Trusted Key Entry (TKE) 8.1 License Internal Code (LIC)**
- Significant improvements in overall transaction response time for Internet traffic with IBM's next-generation "network-in-a-box" technology called **Shared Memory Communications - Direct Memory Access (SMC-D)**
- **FCP SAN discovery tool** RDP data support
- OSA-ICC support for **Secure Sockets Layer**
- **Export / import physical port WWPNs for FCP Channels**
- **Improved Channel Subsystem (CSS) scalability**
- **Fibre Channel Read Diagnostic Parameter extended link service (ELS)** support
- Investment protection for **coupling** environments
- **z/OS and z/VM** enhancements
- **IBM Wave for zVM** enhancements
- **KVM for IBM z Systems** enhancements
- **z/VSE Network Appliance for z/VSE** systems running in LPAR
- **CICS^(R) Transaction Server for z/OS support**
- **Hardware Management Console (HMC)** enhancements
- **ASHRAE class A3 for robustness, data center flexibility, and energy savings**

The performance advantage

IBM Large Systems Performance Reference (LSPR) method is designed to provide comprehensive z/Architecture^(R) processor capacity ratios for different configurations of central processors (CPs) across a wide variety of system control programs and workload environments. For IBM z13s (z13s, machine type 2965), the z/Architecture processor capacity indicator is defined with three characters, one alphabetical and two numerical. The alphabetical character corresponds to the "effective" cycle time of the processor, and the numerical characters indicate the number of installed CPs. For example, the 2965-Z06 implies the base cycle time with the maximum of 6 CPs while the 2965-A01 represents the slowest "effective" cycle time with a single CP. In addition to the general information provided for z/OS V2.1, the LSPR also contains performance relationships for z/VM, KVM for IBM z™, and Linux on z Systems operating environments. The performance of a z13s (2965) processor is expected to be up to 1.3 times the performance of a zBC12 (2828) based on workload and model. The largest z13s (2965-Z06) is expected to provide up to 1.4 times the z/OS capacity of the largest zBC12 (2828-Z06). The IFL and zIIP processors on the IBM z13s also provide an optional IBM z13s multithreading technology capability; with the multithreading function enabled, the performance capacity of the IFL is expected to be up to 1.6 times the performance capacity of these processors on the zBC12; the performance capacity of the zIIP processors is expected to be up to 1.7 times the performance capacity of these processors on the zBC12. The LSPR contains the Internal Throughput Rate Ratios (ITRRs) for the IBM z13s and the previous-generation zSeries and z Systems processor families

based upon measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user may experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated.

For more detailed performance information, consult the Large Systems Performance Reference (LSPR) available on

<http://www.ibm.com/servers/resourcelink/lib03060.nsf/pages/lspindex>

Simultaneous multithreading (SMT)

Simultaneous multithreading (SMT) allows two active instruction streams per core, each dynamically sharing the core's execution resources. SMT is available on IBM z13 and IBM z13s for workloads running on the Integrated Facility for Linux (IFL) and the IBM z Integrated Information Processor (zIIP). Incremental throughput is achieved partly because the new processor chip offers intelligently implemented 2-way simultaneous multithreading.

Each eligible software operating system or hypervisor has the ability to intelligently drive SMT in a way that is best for its unique requirements. z/OS SMT management consistently drives the cores to high thread density, in an effort to reduce SMT variability and deliver repeatable performance across varying CPU utilization -- thus providing more predictable SMT capacity. z/VM SMT management optimizes throughput by spreading a workload over the available cores until it demands the additional SMT capacity.

Linux distributions starting with SLES12 SP1 and RHEL 7.2 include SMT support for customers running Linux in a partition (LPAR).

z Appliance Container Infrastructure (zACI) is a new partition type which, along with an appliance installer, enables the secure deployment of software and firmware appliances. zACI will shorten the deployment and implementation of firmware solutions or software solutions delivered as virtual software appliances. The zACI framework enforces a common set of standards and behaviors, and a new zACI partition mode for a virtual appliance -- requiring a new zACI LPAR type. The IBM zAware partition mode has been renamed to zACI, and the IBM zAware firmware will now run in this partition. There are no hardware dependencies. zACI will be delivered as part of the base code on each z13s and z13 (driver level 27).

New administrative mode for Linux -- IBM Dynamic Partition Manager (DPM)

A new administrative mode is being introduced for Linux-only CPCs for z13 and z13s with SCSI storage attached via FCP channels. IBM Dynamic Partition Manager (DPM) provides simplified z Systems hardware and virtual infrastructure management including integrated dynamic I/O management for users who intend to run KVM for IBM z Systems as hypervisor or Linux on z Systems running in a partition (LPAR). The new mode, DPM, provides simplified, consumable, and enhanced partition lifecycle and dynamic I/O management capabilities via the Hardware Management Console (HMC) to:

- Create and provision an environment -- Creation of new partitions, assignment of processors and memory, and configuration of I/O adapters (network, FCP storage, crypto, and accelerators)
- Manage the environment -- Modification of system resources without disrupting running workloads
- Monitor and troubleshoot the environment -- Source identification of system failures, conditions, states, or events that may lead to workload degradation

A CPC can be configured in either the Dynamic Partition Manager mode or PR/SM mode. The mode is enabled prior to the CPC power-on reset (POR). Dynamic Partition Manager mode requires two OSA-Express 1000BASE-T Ethernet features for primary and backup connectivity (OSA-Express5S 1000BASE-T Ethernet #0417), along with associated cabling (HW for DPM #0016).

Dynamic Partition Manager (DPM) supports Linux running in a partition (LPAR) as well as the KVM for IBM z Systems hypervisor. DPM initially does not support the z/VM hypervisor.

Next-generation availability

The IBM z13s continues the drive for continuous reliable operation provided by its predecessors with the following Reliability, Availability, and Serviceability (RAS) improvements:

- Improved soft error resilience in the processor cores
- Lane shadowing, hardware buffer retry, and independent channel recovery, which are designed to improve the DIMM interface
- Continued use of RAIM in the main memory to protect DRAM
- Improved robustness in the level 3 and level 4 cache
- Improved FRU isolation with the addition of integrated time domain reflectometry logic to chip interfaces
- Enhanced integrated sparing designed to reduce the complexity and number of repair actions

Flash Express^(R) is designed to help improve availability and handling of paging workload spikes when running z/OS V1.13 with the z/OS V1.13 RSM Enablement Offering web deliverable, and this function is integrated in z/OS V2.1 and later releases. With this support, z/OS is designed to help improve system availability and responsiveness by using Flash Express across transitional workload events such as market openings, and diagnostic data collection. z/OS is also designed to help improve processor performance by supporting middleware exploitation of pageable large (1 MB) pages. Flash Express can also be used in Coupling Facility images to provide extended capacity and availability for workloads making use of Websphere MQ Shared Queues structures, as previously announced for zEC12. Using Flash Express can help availability by reducing latency from paging delays that can occur at the start of the workday or during other transitional periods. It is also designed to help eliminate delays that can occur when collecting diagnostic data during failures. Flash Express can therefore help organizations meet their most demanding service level agreements, enabling them to compete more effectively. Flash Express is designed to be easy to configure, and to provide rapid time to value.

On IBM z13 and IBM z13s, Flash Express performance is transparently improved with the addition of a standard cache. With this cache, clients may realize performance gains without consuming additional user memory.

IBM zAware: With IBM zEnterprise zEC12 and zBC12, IBM introduced a new technology, IBM zAware, based on machine learning developed by IBM Research.

The new version of IBM zAware introduces a new generation of technology with improved analytics to provide better results. The previous version of IBM zAware required message streams with well-formed message IDs; now IBM zAware can process message streams that do not have message IDs. This opens up new possibilities going forward with the ability to handle a broader variety of unstructured data.

IBM zAware delivered on IBM z13 and IBM z13s builds on previous IBM zAware function with:

- Support for Linux on z Systems message log analysis
- Support for native or guest Linux on z Systems images
- The ability to process message streams with no message IDs

- The ability to group multiple systems that have similar operational characteristics for modeling and analysis
 - Recognition of dynamic activation and deactivation of a Linux image into a group, and appropriate modeling and analysis.
 - Aggregated sysplex view for z/OS and system views.
 - User-defined grouping. For Linux on IBM z Systems, the user can group multiple systems' data into a combined model: by workload (one for all web servers, one for all databases, and so on); by "solution" (for instance, one model for your cloud); or by VM host.
- A heat map display that provides a consolidated/aggregated/higher level view with the ability to drill down to detail views
- Improved usability and GUI functional enhancements addressing many customer requirements
 - Enhanced filtering and visualization, with better use of GUI real estate
 - Improved UI navigation
 - Display of local time in addition to UTC time
 - Enhancements based on IBM One UI guidelines
- Enhanced analytics
- A more robust data store
- Expanded browser support with Mozilla Firefox 31 and Microsoft™ Internet Explorer 9, 10, and 11

IBM zAware is designed to use near real-time continuous learning algorithms, providing a diagnostic capability intended to help clients quickly pinpoint problems, which, in turn, can lead to better availability and a more efficient system. IBM zAware uses analytics to intelligently examine z/OS or Linux on z Systems messages to find unusual patterns, inconsistencies, and variations. Large operating system environments can sometimes generate more than 25 million messages per day. This can make manual analysis time-consuming and error-prone when exceptional problems occur. IBM zAware provides a simple graphical user interface (GUI) and APIs to help clients find message anomalies quickly, which can help speed problem resolution when seconds count.

LPAR enhancement to provide group physical capacity limit enforcement

Processor Resource/Systems Manager™ (PR/SM) and the Hardware Management tool have been enhanced to support an option to limit the amount of physical processor capacity consumed by a group of logical partitions (LPARs) when a processor unit (PU) is defined as a general purpose processor (CP) or an Integrated Facility for Linux (IFL) shared across a set of LPARs.

This enhancement is designed to provide a group physical capacity limit enforced as an absolute (versus relative) limit; it is not affected by changes to the logical or physical configuration of the system. This group physical capacity limit can be specified in units of CPs or IFLs. The "Change LPAR Group Controls" and "Customize Group Profiles" tasks on the Hardware Management Console have been enhanced in support of this new function. Refer to the Hardware requirements and Software requirements sections of the *IBM z Systems Hardware Management Console Web Services API (Version 2.13.1)*, SC27-2634, publication.

This is supported in both PR/SM mode and IBM Dynamic Partition Manager (DPM) mode.

LPAR enhancement for dynamic memory management

Processor Resource/Systems Manager (PR/SM) has been enhanced to support more flexibility as to how additional physical memory is dynamically added to a logical partition. Rather than attempting to fully populate a logical partition's reserved storage element when it is initially configured online, the OS in the partition can request a single storage increment be attached (and subsequently can request

additional increments if desired). This allows a more gradual, flexible addition of memory to the partition as needed over time.

This is supported in both PR/SM mode and IBM Dynamic Partition Manager (DPM) mode.

Regional Crypto Enablement (RCE)

IBM will enable geo-specific cryptographic support that will be supplied by IBM approved vendors. China is the first geography to exploit this support to meet the cryptography requirements of Chinese clients that are required to comply with the People's Bank of China Financial IC Card Specifications (PBOC 3.0) for payment card processing. When ordered, the Regional Crypto Enablement support will reserve the I/O slot(s) for the IBM approved vendor-supplied cryptographic card(s). Clients will need to directly contact the IBM approved vendor for purchasing information.

Common Criteria Evaluation Assurance Level 5+ (EAL 5+) certification

The IBM z13s is designed for Common Criteria Evaluation Assurance Level 5+ (EAL 5+) certification for security of logical partitions running in PR/SM mode. This means that the IBM z13s is designed to prevent an application running on one operating system image on one LPAR from accessing application data running on a different operating system image on another LPAR on the server. This certification is not supported in IBM Dynamic Partition Manager (DPM) mode.

Common Cryptographic Architecture (CCA) enhancements

Visa Data Secure Platform (DSP)* -- Point to Point Encryption (P2PE)

With the z13, IBM introduced HSM support for Visa Data Secure Platform P2PE. Visa Data Secure Platform is a suite of products designed to help merchants prevent sensitive account holder data from being compromised. The z13 support included CCA-based callable services that support Visa's Standard Encryption method and the Visa Format Preserving Encryption method. This support relies on the Crypto Express5S coprocessor. The IBM z13 and IBM z13s will extend the Visa DSP support by adding a callable service that translates PIN blocks whose primary account number information has been encrypted using Visa DSP P2PE with static TDES or DUKPT keys. Support is provided for ISO-0 and ISO-3 PIN blocks.

Secure AES GCM encryption mode

Galois Counter Mode (GCM) is an authenticated encryption algorithm designed to provide both data authenticity (integrity) and confidentiality in a single operation. The algorithm can also serve as a stand-alone MAC function. With the Crypto Express5S and IBM z13 or IBM z13s, CCA will add this encryption mode support to the existing Symmetric Algorithm Encipher (CSNBSAE) and Symmetric Algorithm Decipher (CSNBSAD) callable services. Previously AES GCM was supported with clear keys through ICSF. This feature will provide a secure key option.

Interoperable ECC key derivation algorithm

The EC_Diffie-Hellman callable service is used to establish symmetric keys using a pair of ECC keys using the Elliptic Curve Diffie-Hellman (ECDH) protocol. The Crypto Express5 Coprocessor is planned to be enhanced to add an additional key derivation scheme that allows the establishment of keys with non-CCA entities, without compromising security.

The EC_Diffie-Hellman callable service creates a shared symmetric key with a pair of ECC (Elliptic Curve Cryptography) keys using the ECDH (Elliptic Curve Diffie-Hellman) protocol and the ANSX9.63 protocol static unified model key-agreement scheme. The Crypto Express5 Coprocessor is enhanced with an additional key derivation scheme that allows the establishment of keys with non-CCA entities, without compromising security.

Addition of new Key Check Value algorithm

The Key Test2 callable service generates or verifies the value of a clear or encrypted key or key part contained in an external or internal variable-length symmetric key-token, or a DES key or key part wrapped in an external TR-31 key block. With the Crypto Express5, CCA plans to support a new CMAC-based Key Check Value algorithm for use with AES and TDES keys.

The following CCA enhancements were introduced with the IBM z13 and are now available on the IBM z13s.

Visa Format Preserving Encryption (VFPE)

Support for Visa Format Preserving Encryption (VFPE) algorithms in CCA-based callable services. This support relies on the Crypto Express5S coprocessor. Format Preserving Encryption (FPE) refers to a method of encrypting data such that the resulting cipher-text has the same format and length as the input-clear text. This helps allow legacy databases to contain encrypted data of sensitive fields without having to restructure the database or applications. Supported are functions for the Visa Data Secure Platform (Visa DSP) with Point to Point Encryption technology. Three new Visa DSP-related callable services are added to the CCA API. In addition to VFPE, support for the Visa DSP standard TDES encryption method is also available. A contract with Visa, Inc. is required to use this capability. VISA is a registered trademark of Visa, Inc.

Greater than 16 domain support

Support to allow a cryptographic coprocessor to be shared across more than 16 domains, up to the maximum number of LPARs on the system. This support relies on enhanced firmware available with a minimum microcode level for the Crypto Express5S coprocessors. With the adjunct processor (AP) extended addressing (APXA) facility installed, the z Systems crypto architecture can support greater than 16 domains in an AP. Customers will have the flexibility of mapping individual LPARs to unique crypto domains or continuing to share crypto domains across LPARs.

Trusted Key Entry (TKE) 8.1 Licensed Internal Code (LIC)

The following functions are supported in the TKE 8.1 LIC:

- **Domain cloning** is planned to support a Configuration Migration Tasks application that gives administrators the ability to collect settings from one domain and apply the settings to any set of new domains. This feature significantly simplifies the process and reduces the time it takes to deploy new domains on a Host Crypto Module.
- **Launch coordinated master key role from the TKE** is planned to provide the ability to set master keys from the TKE in a way that the Key Data Sets (KDSs) are encrypted under the new master key. IBM plans to provide the ability to invoke the ICSF coordinated master key role function and now allow clients to do all master key management from the TKE.
- **Guided create features for roles and authority indexes** are intended to provide new guided create functions for both Roles and Authorities tabs for Host Cryptographic Modules. This support steps the client through the process of creating these items and greatly clarifies and simplifies the creation process.
- **Two new Certificate Authority wizards** are intended to take administrators through the process of creating all the smart cards used in a TKE zone and also take administrators through the process of creating all the smart cards needed for the Configuration Migrations Task wizards.
- **Display Crypto Module Settings**, a new TKE feature, enables you to create a report that shows the current configuration of a Host Cryptographic Module.
- **HMAC key** will enable TKE to support generation and loading of HMAC operational keys. This support will be limited to keys that are 16, 24, and 32 bytes in length.
- **Save/Restore Customized Data feature** will provide TKE with a new Privileged Mode Access ADMIN task that allows the client to save and restore

client data on the TKE. This feature can be used to move client data from one TKE workstation to another or to restore client data on a TKE.

- **Password Protect Console** will support the ability to password protect the TKE console. By default, the TKE console is not password protected. The Password Protect Console application is available only when you are signed on in Privileged Mode Access with the ADMIN user ID. This feature provides increased security for your TKE workstation.
- **Binary Key Part File utility** will provide the ability to copy key material from a binary file and place it on a smart card. This provides a simplified and faster process compared to using secure key load from the smart card PIN pad.
- **ACP Usage Information utility** allows you to track which Domain Controls (Access Control Points) were actually "checked" within a domain. If tracking is activated and an authority check is done for an ACP, the "checked" indicator is turned on. This indicator stays on until the tracking data is cleared. The TKE is used to activate, deactivate, and clear the tracking data. In addition, TKE provides a feature for displaying the tracking information for each domain.
- **Require Enhanced Host Password protection** will support the strongest possible encryption. When using HCR 77B0 or later with TKE 8.0 or later, the strongest possible encryption is used to protect the host password. The TKE uses the best encryption available for protecting the host sign-on password. However, with a new TKE 8.1 enhancement, you can configure the TKE so that it will allow a sign-on only to a system that uses the strongest encryption. IBM recommends that you install HCR 77B0 or later and configure the TKE to allow the sign-on only to systems that support the strongest host password protection.
- **Operational Key Option on Domain Groups** lets users specify where key commands are sent. Currently, when an operation key command is run from inside a domain group, the command is sent only to the master domain. IBM plans to add support to the domain group to add an attribute that indicates if operational key commands are to be sent to the master domain or all the domains in the group. The new group attribute value can be managed from the Create or Change Group features.

TKE 1U workstation

The Trusted Key Entry (TKE) introduces a new 1U workstation that is a rack-mounted system. It is a combination of hardware and software, network-connected to one or more servers, and designed to provide a secure, flexible method for master and operational key entry as well as local and remote management of the cryptographic coprocessor features (Crypto Express5S when defined as a coprocessor). It provides the same functionality as the TKE workstation but as a rack-mounted server. If the Trusted Key Entry 1U workstation is required on an IBM z13 or IBM z13s, then the TKE workstation with TKE 8.1 LIC feature (#0878) must be used. TKE workstations with TKE 8.1 LIC can also be used to control zEC12, zBC12, z196, and z114 servers.

Trusted Key Entry (TKE) 8.0 Licensed Internal Code (LIC)

The following functions were delivered with the TKE 8.0 level of LIC and are included in the base of TKE 8.1.

Crypto Express5S coprocessor support: TKE 8.0 is required for managing Crypto Express5S cryptographic coprocessors and manages them through the same Crypto Module notebook functions as previous generations of cryptographic modules. The configuration migration tasks feature of the TKE is enhanced to also support the Crypto Express5S coprocessor. You can use TKE 8.0 to collect data from previous generations of cryptographic modules and apply the data to Crypto Express5S coprocessors.

FIPS Certified Smart Card: Media for the FIPS Certified Smart Card is now included in the smart card reader and additional smart cards optional features. The new smart card media part number is 00JA710.

Crypto coprocessors with more than 16 domains: TKE 8.0 allows the management of domains beyond the current limit of 16. This support will require the

latest levels of code on the IBM z13 or IBM z13s to allow more than 16 domains on the Crypto Express5S. This support is available only with z13 or z13s.

Full function migration wizard for EP11: The full function migration wizard is designed to provide the ability to quickly and accurately collect and apply data to the Crypto Express features configured as EP11 coprocessors. This wizard previously supported CCA, however Crypto Module Group support has been removed: Crypto Module Groups are no longer supported on TKE 8.0. All group management must now be done from a Domain Group.

New master key management functions: TKE 8.0 supports two new master key management functions that are available when managing any type of master key:

1. Generate a set of master key parts wizard-like feature which allows you to create a new key part for each of the different types of master keys.
2. Load all new master keys wizard-like feature which allows you to load a new key for each of the different types of master keys.

Smart Card Readers Available indicator: TKE 8.0 displays a window title that will include information if the smart card readers are available if the application or utility has access to smart card readers.

Configure Displayed Hash Size utility: TKE 8.0 supports a configuration to allow the administrator to set the display length of certain hash values displayed on the TKE workstation. Hash types that can be affected by this function are: MDC-4, SHA-1, AES-VP, and ENC-ZERO. The Configure Display Hash Size utility is available only when you have signed on with the Privileged Mode Access user ID of ADMIN.

ECC Authority Signature Keys: TKE 8.0 allows a user to select a key strength of 320-bit ECC key when creating an Authority Signature Key that is to be assigned to an Authority Index on a Crypto Express5S coprocessor. This option is available only when you are creating an Authority Signature Key from inside a Crypto Module Notebook of a Crypto Express5S.

Print capability: TKE 8.0 has limited print support. The Configure Printers utility allows the administrator to add printers to the TKE. The only printers allowed to be added are printers that have device drivers on the TKE including the GUTENPRINT and HPLIP device driver packages. You will not be able to load your own device drivers.

New features in the Crypto Node Management (CNM) utility: The TKE Workstation Setup utility allows you to load and save user roles and profiles. The CNM utility now has stand-alone launch points for these two tasks in the Access Control pull-down menu.

ENC-Zero verification pattern for 24-byte DES operational keys: TKE 8.0 supports an ENC-Zero verification pattern that is computed and displayed with 24-byte DES operational keys.

Usability enhancements: TKE 8.0 has many usability enhancements including the ability for users to select a check box that will allow them to change their passphrase on the logon screen for a passphrase profile. Additionally, users can now select multiple items in the Hosts container, Crypto Module Groups container, or Domain Groups container of the main window of the TKE application. If more than one item is selected, you can delete all of the definitions or close all of the hosts or groups at once.

Shared Memory Communications - Direct Memory Access (SMC-D)

IBM's latest networking innovation for the z13 family of processors is new support for fast, low-latency LPAR-to-LPAR TCP/IP traffic using the Shared Memory Communications - Direct Memory Access (SMC-D) software protocol over firmware-provided Internal Shared Memory (ISM) devices. Supported by z/OS Version 2.2 and z/VM V6.3 for z/OS guest exploitation, SMC-D and ISM are designed to use shared memory areas to provide low-latency, high-bandwidth, cross-LPAR connections for applications. This support is intended to provide application-

transparent DMA communications to TCP endpoints for sockets-based connections. SMC-D is expected to provide substantial performance, throughput, response time, and CPU consumption benefits compared to standard TCP/IP communications over HiperSockets™. In IBM laboratory testing, SMC-D was shown to offer up to a 91% improvement in throughput and up to a 48% improvement in response time compared to HiperSockets for interactive workloads, with most tests showing more than a 47% decrease in CPU time.* In the same laboratory testing streaming (bulk data transfer) workloads realized up to a 789% throughput improvement along with a 90% decrease in response time and more than a 88% decrease in CPU consumption time. For more information about software support, see the [Software requirements](#) section.

* Performance improvements are based on internal IBM laboratory tests. Your results will vary.

FCP SAN discovery tool RDP data support

The FCP SAN Explorer function on the HMC has been enhanced with additional functions to facilitate SAN configuration setting and debugging. This facility can now display the name of the active fabric zone set, a list of zones an initiator is a member of, and enhanced diagnostic data for the initiator and target fabric links.

OSA-ICC support for Secure Sockets Layer

The Open Systems Adapter, when configured as an integrated console controller CHPID type (OSC) on the z13 family of processors, will now support the configuration and enablement of secure connections using the Transport Layer Security (TLS) protocol versions 1.0, 1.1, and 1.2. Server-side authentication is supported using either a self-signed certificate or customer-supplied certificate which may be signed by a customer-specified Certificate Authority. The certificates used must have an RSA key length of 2048 bits, and must be signed using SHA-256. This support will negotiate a cipher suite of AES-128 for the session key.

FICON[®] Express16S -- The next generation for FICON, zHPF, and FCP

IBM has released **a new I/O infrastructure**, introduced first on IBM z13 and now available on IBM z13s. This infrastructure will strengthen the synergy between IBM DS8880 storage and IBM z Systems servers, delivering improved, predictable, and repeatable performance, and enhanced resiliency for mission-critical environments.

With the introduction of **FICON Express16S on the IBM z13s**, you now have additional growth opportunities for your storage area network (SAN). FICON Express16S supports a link data rate of 16 gigabits per second (Gbps) and auto-negotiation to 4 or 8 Gbps for synergy with existing switches, directors, and storage devices. With support for native FICON, High Performance FICON for z Systems (zHPF), and Fibre Channel Protocol (FCP), the IBM z13s server enables you to position your SAN for even higher performance -- helping you to prepare for an end-to-end 16 Gbps infrastructure to meet the lower latency and increased bandwidth demands of your applications.

The new FICON Express16S channel will work with your existing fiber optic cabling environment, both single-mode and multimode optical cables. The FICON Express16S feature running at end-to-end 16 Gbps link speeds will provide reduced latency for large read/write operations and increased bandwidth compared to the FICON Express8S feature.

Increased performance for the zHPF protocol: In laboratory measurements using FICON Express16S in an IBM z13s with the zHPF protocol and small data transfer I/O operations, FICON Express16S operating at 16 Gbps achieved a maximum of 108,000 IOs/sec. In laboratory measurements using FICON Express16S in an IBM z13s with the zHPF protocol and a mix of large sequential read and write data transfer I/O operations, FICON Express16S operating at 16 Gbps achieved a maximum throughput of 2600 MB/sec (reads + writes) compared to a maximum of 1600 MB/sec (reads + writes) achieved with FICON Express8S operating at 8 Gbps. This represents an approximately 63% increase. This performance data was measured in a controlled environment running an I/O driver program under z/

OS. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.

Increased performance for the FCP protocol: A FICON Express16S feature, when defined as CHPID type FCP, conforms to the Fibre Channel Protocol (FCP) standard to support attachment of SCSI devices, to complement the classical storage attachment supported by FICON and zHPF channels.

In laboratory measurements using FICON Express16S in an IBM z13s with the FCP protocol for small data transfer I/O operations, FICON Express16S operating at 16 Gbps achieved a maximum of 110,000 IOs/sec compared to the maximum of 92,000 IOs/sec achieved with FICON Express8S operating at 8 Gbps.

In laboratory measurements using FICON Express16S in an IBM z13 with the FCP protocol and FICON Express16S operating at 16 Gbps, FICON Express16S achieved a maximum throughput of 2560 MB/sec (reads + writes) compared to the maximum of 1600 MB/sec (reads + writes) achieved with FICON Express8S operating at 8 Gbps. This represents approximately a 60% increase. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.

With the introduction of the FICON Express16S in an IBM z13s operating using the FCP protocol, several recommended and allowable operating characteristic values have increased, which will enable additional workload consolidation. Specifically, the recommended maximum number of NPIV hosts defined to any single physical FCP channel has increased from 32 to 64, the allowable maximum number of remote N_Ports a single physical channel can communicate with has increased from 512 to 1024, and the maximum number of LUNs addressable by a single physical channel has increased from 4096 to 8192. In support of these increases, the FCP channels have also been designed to now support 1528 concurrent I/O operations, an increase from the prior generation FCP channel limit of 764.

The FCP protocol is supported by z/VM, z/VSE, and Linux on IBM z Systems. Refer to the [Software requirements](#) section.

16Gb FICON and FC host adapters on IBM DS8880: Improve SAN performance and resiliency with faster 16Gb Fibre Channel and FICON host adapters on DS8880. For DB2[®] log writes, these new host adapters will help to improve the efficiency of the 16 Gbps zHPF and heritage FICON to reduce large log write latency, resulting in DB2 transactional latency improvements for applications and middleware, including SAP. For managed file transfer with Connect Direct these new host adapters can help to reduce elapsed times. In addition, I/O-bound batch jobs will see improved lapsed times.

FCP SAN Explorer: A new function is available on the HMC through the Problem Determination panels that provides a centralized view of SAN facilities available to an FCP channel. The tool facilitates configuration setting and debugging without requiring an operating system to be running. It does require the IBM z13 or IBM z13s to have completed an Initial Machine Load (IML) and the partitions of interest to be activated. The tool can also operate concurrently with customer I/O workloads in a nondisruptive manner. It provides an operator with a layered view of the SAN environment. Specifically, device numbers (hosts) assigned to a partition, the fabric zone members available to the host, the remote end port error statistics, the accessible logical unit numbers (LUNs), and basic LUN configuration information can be queried and displayed using this tool. This data can also optionally be exported in CSV format.

Cleaning discipline for FICON Express16S fiber optic cabling

With the introduction of 16 Gbps link data rates, it is even more critical to ensure your fiber optic cabling infrastructure performs as expected. With proper fiber optic cleaning and maintenance, you can be assured that the "data gets through." With 16 Gbps link data rates over multimode fiber optic cabling, link loss budgets and

distances are reduced. Single-mode fiber optic cabling is more "reflection sensitive." With high link data rates and single-mode fiber optic cabling there is also less margin for error. The cabling is no longer scratch-tolerant and contaminants such as dust and oil can present a problem. To keep the data flowing, proper handling of fiber trunks and jumper cables is critical as well as thorough cleaning of fiber optic connectors. Work with your data center personnel or IBM personnel to ensure you have fiber optic cleaning procedures in place.

Enabling the transition to FICON Express16S with Forward Error Correction (FEC)

Even with proper fiber optic cable cleaning discipline, errors can still occur on 16 Gbps links. FEC is a technique used for controlling errors in data transmission over unreliable or noisy communication channels. FICON Express16S channels running at 16 Gbps can take advantage of Forward Error Correction capabilities when connected to devices that support FEC. FEC allows FICON Express16S channels to operate at higher speeds, over longer distances, with reduced power and higher throughput, while retaining the same reliability and robustness that FICON channels have traditionally been known for. Clients should see fewer I/O errors, thus easing the transition to 16 Gbps links and reducing potential impact to production workloads caused by I/O errors.

Forward Error Correction Codes support on 16Gbps adapters on IBM DS8880:

For Peer to Peer Remote Copies, FEC helps to preserve data reliability. This enhancement is designed to provide the *equivalent* reliability improvement as doubling the optical signal strength.

FICON Dynamic Routing

With the IBM z13 and IBM z13s servers, FICON channels are no longer restricted to the use of static storage area network (SAN) routing policies for inter-switch links (ISLs) for cascaded FICON Directors. The z Systems feature that supports dynamic routing in the SAN is called FICON Dynamic Routing (FIDR). It is designed to support the dynamic routing policies provided by the FICON Director manufacturers, for example, Brocade's Exchange Based Routing (EBR) and Cisco's Open Exchange ID Routing (OxID). Check with the switch provider for their support statement.

FICON Dynamic Routing can help clients reduce costs by having the ability to share SANs between their FICON and FCP traffic, improve performance due to SAN dynamic routing policies that better exploit all the available ISL bandwidth through higher utilization of the ISLs, and simplify management of their SAN fabrics due to routing policies assigning different ISL routes with each power-on reset, which makes the SAN fabric performance difficult to predict. Clients will need to ensure that all devices in their FICON SAN support FICON Dynamic Routing before they implement this feature.

FICON Dynamic Routing on IBM DS8880 enables clients to use SAN dynamic routing policies across cascaded FICON Directors to simplify configuration and capacity planning, and to provide persistent and repeatable performance and higher resiliency. In Peer to Peer Remote Copy configurations, sharing of switches is simplified and hardware costs can be reduced by allowing FICON and FCP to share the same switch infrastructure. IBM's Metro Mirror technology uses FCP as the transport.

Improved High Performance FICON for z Systems (zHPF) I/O execution at distance

High Performance FICON for z Systems (zHPF) has been enhanced to allow all large write operations (> 64 KB) at distances up to 100 km to be executed in a single round trip to the control unit, thereby not elongating the I/O service time for these write operations at extended distances.

zHPF Extended Distance II on IBM DS8880: zHPF Extended Distance II allows customers to achieve service level agreements after a disaster or when a storage control unit failure causes a HyperSwap^(R) event. This capability is required especially

for GDPS HyperSwap configurations where the secondary DASD subsystem is in another site. For multisite configurations, the zHPF Extended Distance II feature can help to reduce the impact of distance on I/O response times, increasing remote data transfer with better performance when writing data remotely (remote site recovery).

Export / import physical port WWPNS for FCP channels

z Systems automatically assigns worldwide port names (WWPNs) to the physical ports of an FCP channel based upon the Physical Channel ID (PCHID), and this WWPN assignment changes when an FCP channel is moved to a different physical slot position. z13 and z13s will now allow for the modification of these default assignments, allowing FCP channels to keep previously assigned WWPNs, even after being moved to a different slot position. This capability can eliminate the need for reconfiguration of the SAN in many situations, and is especially helpful on a system upgrade.

Improved channel subsystem (CSS) scalability

The IBM z13s server has improved the channel subsystem (CSS) scalability with support for three logical channel subsystems (LCSSs) which are required to support the forty LPARs for IBM z13s, three subchannel sets (to support more devices per logical channel subsystem), and 32K devices per FICON channel up from 24K channels in the previous generation. Additionally, a third subchannel set for each logical channel subsystem (LCSS) is provided to facilitate elimination of single points of failure for storage after a disk failure by simplifying the exploitation of IBM's DS8880 Multi-target Metro Mirror storage replication with TPC-R HyperSwap.

Refer to the [Software requirements](#) section.

Fibre Channel Read Diagnostic Parameter extended link service (ELS) support

A new extended link service (ELS) command called Read Diagnostic Parameter (RDP) has been added to the Fibre Channel T11 standard to allow z Systems to obtain additional diagnostic data from the Small Form Factor Pluggable (SFP) optics located throughout the storage area network (SAN) fabric. The ultimate goal of the RDP will be to improve the accuracy of identifying a failed or failing component without unnecessarily replacing additional components in the SAN fabric (FICON cards, optics, cables, and so on).

z Systems FICON and FCP channels and the IOP code will provide a means to read this additional diagnostic data for all the ports accessed in the I/O configuration and make the data available to a z Systems partition. For z/OS clients utilizing FICON channels, z/OS will display the data with a new message and display command. For Linux on z Systems, z/VM, z/VSE, and KVM for IBM z clients utilizing FCP channels, this diagnostic data will be available in a new panel in the SAN Explorer tool.

The initial RDP support will be for data collection and display only. In the future, IBM intends to investigate the possibility of doing analysis on this collected data.

Investment protection for coupling environments

Access to a Parallel Sysplex^(R) environment

Parallel Sysplex is a synergy between hardware and software -- a highly advanced technology for clustering designed to enable the aggregate capacity of multiple z/OS systems to be applied against common workloads. z/OS combined with IBM z13, z13s, zEC12, zBC12, z196, and z114 servers, Coupling Facilities, Server Time Protocol (STP), and coupling links (ICA SR, InfiniBand) allows you to harness the power of multiple systems as though they were a single logical computing system.

Coupling links provide a path to transmit and receive Coupling Facility (CF) data as well as Server Time Protocol (STP) timekeeping messages. The CF data may be exchanged between z/OS and the CF or between CFs.

The IBM Integrated Coupling Adapter (ICA SR), introduced on the IBM z13 and now available on the IBM z13s, is a two-port, short-distance coupling fanout that utilizes a new coupling channel type: CS5. The ICA SR utilizes PCIe Gen3 technology, with x16 lanes that are bifurcated into x8 lanes for coupling. The ICA SR is designed to drive distances up to 150 m and support a link data rate of 8 Gbps. It is also designed to support up to 4 CHPIDs per port and 7 subchannels (devices) per CHPID.

ICA SR for IBM z13: The maximum number of ICA SR fanout features for IBM z13 is increased to 20 per system. The ICA SR fanout resides in the PCIe I/O fanout slot on the IBM z13 CPC drawer, which supports 10 PCIe I/O slots. Up to 10 ICA SR fanouts and up to 20 ICA SR ports are supported on an IBM z13 CPC drawer, enabling greater connectivity for short-distance coupling on a single processor node compared to prior generations.

ICA SR for IBM z13s: The maximum number of ICA SR fanout features for IBM z13s is limited to 8 per system. The ICA SR fanout resides in the PCIe I/O fanout slot on the IBM z13s CPC drawer, which supports 8 PCIe I/O slots. Up to 8 ICA SR fanouts and up to 16 ICA SR ports are supported on an IBM z13s CPC drawer, enabling greater connectivity for short-distance coupling on a single processor node compared to prior generations.

The ICA SR can be used for coupling connectivity only between IBM z13 or IBM z13s servers, and the ICA SR can connect only to another ICA SR. IBM recommends that you order ICA SR (#0172) on the IBM z13 or IBM z13s processors used in a Parallel Sysplex to help ensure coupling connectivity with future processor generations.

The ICA SR fanout requires new cabling. For distances up to 100 m, clients can choose the OM3 fiber type. For distances up to 150 m, clients must choose the OM4 fiber type. Refer to *IBM z Systems Planning for Fiber Optic Links (FICON/FCP, Coupling Links, and Open System Adapters)*, GA23-1407, and to *IBM z Systems Maintenance for Fiber Optic Links (FICON/FCP, Coupling Links, and Open System Adapters)*, SY27-7694, which can be found in the Library section of Resource Link^(R) on

<http://www.ibm.com/servers/resourcelink/svc03100.nsf?OpenDatabase>

Refer to the [Software requirements](#) section.

InfiniBand coupling links are high-speed links, up to 6 Gbps for 12x InfiniBand and up to 5 Gbps for 1x InfiniBand:

- 12x InfiniBand can be used for short distances -- up to 150 meters (492 feet). 12x IFB links support up to 7 subchannels (devices) per CHPID.
- 1x InfiniBand are used for longer distances -- up to 10 km (6.2 miles) unrepeated. 1x IFB links support up to 32 subchannels (devices) per CHPID.

HCA3-O fanout for 12x InfiniBand: 12x InfiniBand coupling links utilize the Host Channel Adapter 3 optical (HCA3-O) fanout. The HCA3-O fanout has two ports/links and is compatible with the HCA2-O fanout on zEC12, zBC12, z196, or z114 machines. HCA2-O is not supported on IBM z13 or IBM z13s.

HCA3-O LR fanout for 1x InfiniBand: 1x InfiniBand coupling links utilize the Host Channel Adapter 3 optical long reach (HCA3-O LR) fanout. The HCA3-O LR fanout has four ports/links and is compatible with the HCA2-O LR fanout on zEC12, zBC12, z196, or z114 machines, which has two ports/links. HCA2-O LR is not supported on IBM z13 or IBM z13s.

Two protocols -- 12x IFB and 12x IFB3 -- for 12x InfiniBand coupling links:

- 12x IFB3 protocol: When HCA3-Os are communicating with HCA3-Os and have been defined with four or fewer CHPIDs per port, the 12x IFB3 protocol is utilized. The 12x IFB3 protocol is designed to provide improved latency compared to the 12x IFB protocol.

- 12x IFB protocol: If more than four CHPIDs are defined per HCA3-O port or HCA3-O features are communicating with HCA2-O features on zEC12, zBC12, z196, or z114 servers, links will run with the 12x IFB protocol.

The maximum number of all HCA3 fanout features is limited to 8 per system. Internal coupling links (ICs) can also be used for internal communication between Coupling Facilities (CFs) and z/OS images on the same server.

ISC-3 links are not supported on IBM z13 or IBM z13s.

Note: The ICA SR and InfiniBand (PSIFB) link data rates do not represent the performance of the link. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload. Systems Lab Services can assist your migration to ICA SR and PSIFB coupling links by providing services to assess the impact of the migration or to assist with the implementation of the migration.

STP -- Time synchronization for Parallel Sysplex

Server Time Protocol (STP) is designed to allow events occurring in different servers to be properly sequenced in time. STP is designed for servers that have been configured in a Parallel Sysplex or a basic sysplex (without a Coupling Facility), as well as servers that are not in a sysplex but need time synchronization.

STP is a server-wide facility that is implemented in the Licensed Internal Code (LIC), presenting a single view of time to Processor Resource/Systems Manager (PR/SM). STP uses a message-based protocol in which timekeeping information is passed over externally defined coupling links between servers. The STP design introduced a concept called Coordinated Timing Network (CTN), a collection of servers and Coupling Facilities that are time-synchronized to a time value called Coordinated Server Time.

CTN can be configured in two ways:

- STP-only CTN which does not require a Sysplex Timer.
- Mixed CTN (External Time Reference (ETR) and STP) which requires a Sysplex Timer. The Sysplex Timer provides the timekeeping information in a Mixed CTN. zEC12, zBC12, z196, and z114 servers do not support attachment to a Sysplex Timer, but they can participate in a Mixed CTN that has a z10™ synchronized to the Sysplex Timer. This maintains the capability for servers to concurrently migrate from an existing ETR network to a Mixed CTN and from a Mixed CTN to an STP-only CTN.

The IBM z13 and IBM z13s can participate only in an STP-only CTN.

STP enhancements

- STP communications enabled via the IBM Integrated Coupling Adapter (ICA SR).
- Initialize Time Panel enhanced to list time zone and leap second offset as well as to indicate if the system time was set; this enables users to quickly check fields during CTN configuration.
- Set Date and Time Panel enhanced to encourage use of External Time Source to set CTN time.
- Time Zone panel enhanced with confirmation messages when setting STP time zone via adjust Time Zone panel on Current Time Server (CTS); also lists scheduled switch times for leap seconds and time zone/daylight savings time on Timing Network Tab.
- Support added for view-only STP.

Parallel Sysplex enhancements

Scalability improvements: As data sharing workloads continue to grow, the Parallel Sysplex infrastructure needs to support the increased requirements for coupling resources. To do this, IBM has increased configuration limits to support larger data sharing environments. In the Coupling Facility, IBM has added an availability enhancement that is a scalability enabler for large cache structures.

- IBM z13 and IBM z13s servers will support up to 256 Coupling CHPIDs, twice the 128 coupling CHPIDs supported on zEC12 and zBC12. This provides enhanced connectivity and scalability for a growing number of coupling channel types and facilitates consolidation of multiple sysplexes into the same set of physical servers. Note that each CF image will continue to support a maximum of 128 coupling CHPIDs.
- **z13:** Up to 141 ICF engines can be ordered on a single server across multiple Coupling Facility LPARs. This helps environments that use a server hosting multiple Coupling Facilities to support multiple Parallel Sysplexes. There is still a limit of 16 ICF engines for a single Coupling Facility LPAR.
- **z13s:** Up to 20 ICF engines can be ordered on a single server across multiple Coupling Facility LPARs. This helps environments that use a server hosting multiple Coupling Facilities to support multiple Parallel Sysplexes. There is still a limit of 16 ICF engines for a single Coupling Facility LPAR.
- CFCC Level 21 and CFCC Level 20 support the Coupling Facility use of Large Memory to improve availability for larger CF cache structures and data sharing performance with larger DB2 Group Buffer Pools (GBP). This support removes inhibitors to using large CF cache structures, enabling use of Large Memory to appropriately scale to larger DB2 local buffer pools (LBPs) and group buffer pools (GBPs) in data sharing environments.

To learn more about the performance benefits of large DB2 structures, reference *IBM zEnterprise System: Performance Report on Exploiting Large Memory for DB2 Buffer Pools with SAP* on

<http://www.ibm.com/support/techdocs/atmastr.nsf/WebIndex/WP102461>

z/OS support for the z13 and z13s

Continued tight integration between hardware and software technologies has become increasingly important to meeting the capacity and performance demands of mission-critical workloads. Accordingly, z/OS exploits many of the new functions and features of IBM z13 and z13s, including:

- z/OS V2.2 (5650-ZOS) supports the operation of zIIP processors in simultaneous multithreading (SMT) mode, with two threads per processor. This function is designed to help improve throughput for zIIP workloads and provide appropriate performance measurement, capacity planning, and SMF accounting data. This support is also available for z/OS V2.1 with PTFs, and is available on the z13 and z13s.
- z/OS V2.2 supports up to 141 processors (CPs and zIIPs) per LPAR or up to 128 physical processors (256 logical processors) per LPAR in SMT mode. z/OS V2.2 also supports up to 4 TB of real memory per LPAR. This support is also available on z/OS V2.1 with PTFs. For more information, see Software Announcement [AP15-0262](#), dated July 28, 2015, IBM z/OS Version 2 Release 2 -- Fueling the new Digital Enterprise.
- z/OS V2.2 supports the vector extension facility (SIMD) instructions available on IBM z13 and z13s servers. This support, also available for z/OS V2.1 with PTFs, is intended to help enable high-performance analytics processing, and is exploited by z/OS XML System Services; IBM 31-bit SDK for z/OS, Java Technology Edition, Version 8 (5655-DGG); IBM 64-bit SDK for z/OS, Java Technology Edition, Version 8 (5655-DGH); Enterprise PL/I for z/OS V4.5 (5655-W67); and Enterprise COBOL for z/OS V5.2 (5655-W32). IBM also exploits the 64-bit SDK for z/OS, Java Technology Edition, Version 8 in IBM WebSphere^(R) Liberty Profile for z/OS, and in the full profile of WebSphere Application Server

for z/OS, which is also expected to benefit from SIMD exploitation. For more information, refer to Software Announcement [AP15-0004](#), dated January 14, 2015, IBM 64-bit SDK for z/OS, Java Technology Edition, Version 8. Application serving with SSL could see up to 2x improvement in throughput per core with IBM 64-bit SDK for z/OS, Java Technology Edition, Version 8 on IBM z13 with SMT vs. Java 7 on zEC12.

- z/OS V2.2 provides support for up to four subchannel sets on IBM z13 servers and up to three subchannel sets on z13s servers. This helps relieve subchannel constraints, and can allow you to define larger I/O configurations that support Multi-target Metro Mirror (PPRC) along with large numbers of PPRC secondaries and Parallel Access Volume (PAV) aliases. As with the prior support for up to three subchannel sets on zEC12 and two subchannel sets on zBC12, you can define base devices, aliases, and secondaries in the first subchannel set (set zero), and define only aliases and secondaries in subchannel sets one, two, and (on z13) three. All four subchannel sets on z13 and all three subchannel sets on z13s support FICON and zHPF protocols. This support is also available for z/OS V1.13 and z/OS V2.1 with a PTF.
- Dynamic Channel path Management (DCM) support is provided for cascaded switches on z/OS V2.1 and later. This new support offers more recovery paths than are available with the previous support for cascading two switches, and is expected to help improve resiliency for clients using replication technologies such as zGlobal Mirror (XRC).
- z/OS V2.1 and later with PTFs are designed to exploit the new Read Diagnostic Parameters (RDP) extended link service (ELS) on z13 and z13s processors to retrieve and display additional information about the status of FICON fiber optic connections, and to provide health checks to help alert you to potential fiber-related problems. This support is expected to be most useful when diagnosing FICON error conditions and may also help provide early detection of trends that might indicate deteriorating connection quality, for example by enabling clients to monitor optical signal values.
- z/OS V2.2 running on IBM z13 and z13s processors with IBM System Storage^(R) DS8880 and DS8884 series devices and a minimum MCL supports a new health check for FICON Dynamic Routing. This health check is designed to check all components of a dynamic routing fabric, the channel subsystem, and disk control units to make sure that dynamic routing requirements are met if dynamic routing has been enabled for one or more FICON switches. This support, also available for z/OS V1.13 and z/OS V2.1 with PTFs, is intended to help you identify misconfiguration errors that can result in data integrity exposures.
- z/OS V2.2, and z/OS V2.1 with PTFs, supports the new LPAR group capping function provided for z13 and z13s processors. z/OS Workload Manager (WLM) is designed to provide additional information about LPAR capacity limits in SMF Type 99 records. z/OS V2.2 Communications Server supports the virtualization capability of 10GbE RoCE Express features on IBM z13 and z13s processors. This support is designed to allow you to fully utilize the ports in the RoCE feature and to share features across up to 31 z/OS images. Also, z/OS V2.2 Communications Server supports selecting between TCP/IP and RoCE transport layer protocols automatically based on traffic characteristics, and supports MTU sizes up to 4K for RoCE features. The virtualization support is also available on z/OS V2.1 with a PTF.
- In addition to support for Shared Memory Communications - RDMA (SMC-R), supported by available 10 GbE RoCE Express features, z/OS V2.2 is designed to support the new Shared Memory Communications - Direct Memory Access (SMC-D) protocol on z13, z13s, and later processors. This new protocol is designed to provide low-latency, high-bandwidth cross-LPAR connections for applications by providing application-transparent DMA communications over restricted-use shared memory to TCP endpoints for sockets-based connections. This is expected to provide a substantial performance benefit compared to both HiperSockets and TCP/IP communications over the Open Systems Adapter (OSA). In IBM laboratory testing, SMC-D was shown to offer up to a 91% improvement in throughput and up to a 48% improvement in response time compared to HiperSockets for interactive workloads, with most tests showing more than a 47% decrease in CPU time.* In the same laboratory testing streaming (bulk data transfer) workloads realized up to a 789% throughput improvement along with a 90% decrease in response time and more than an 88% decrease in

CPU consumption time. For more information about software support, see the [Software requirements](#) section.

- Full support for the Crypto Express5S (CEX5S) features is provided for z/OS V2.2 and with the Enhanced Cryptographic Support for z/OS V1R13 - z/OS V2R1 web deliverable.
- z/OS V2.2 XL C/C++ provides support for z13 and z13s processors with ARCH(11) and TUNE(11) parameters designed to take advantage of the new instructions to deliver increased optimizations for your generated code. XL C/C++ is also designed to support the Single Instruction Multiple Data (SIMD) instructions with the vector programming language extensions, and the IBM MASS (Mathematical Accelerator Subsystem) and ATLAS (Automatically Tuned Linear Algebra Software) libraries. The MASS library may be used for accelerated execution of elementary math functions and serve as a higher-performance alternative to the standard math library that is part of the z/OS XL C/C++ Runtime. The ATLAS library provides linear algebra function support for BLAS (Basic Linear Algebra Subprograms) and LAPACK (Linear Algebra PACKage) functions routinely used in Business Analytics and Optimization solutions. Together these two libraries provide a powerful framework for development of new Business Analytics workloads, porting math-intensive workloads from other platforms, and accelerating Business Analytics workloads on IBM z13. This function is also available for z/OS V2.1 XL C/C++ with a web deliverable from the z/OS download site
<http://www.ibm.com/systems/z/os/zos/tools/downloads/#webdees>
- New functions are available for Integrated Cryptographic Service Facility (ICSF) in a new Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable, which supports IBM zEnterprise EC12 (zEC12), zEnterprise BC12 (zBC12), z13, and z13s processors. The web deliverable is available for download from
<http://www.ibm.com/z/os/zos/downloads/>

This new ICSF support is designed to:

- Improve ICSF's ease of use by providing new operator commands you can use to perform certain cryptographic administrative functions. These functions include activating, deactivating, and restarting cryptographic coprocessors. This function is also intended to allow you to display status for available cryptographic devices and information about active key data sets (KDSs).
- Provide ICSF regional cryptographic enablement which enables you to use cryptographic algorithms that are required in specific geographies. This support enables the use of the SM2, SM3 & SM4 algorithms through ICSF PKCS #11 services when the algorithm is implemented by an IBM approved Cryptographic Server. ICSF is designed to connect to up to 16 IBM approved Cryptographic Servers using the TCP/IP protocol, and this capability is supported on IBM zEnterprise EC12 (zEC12) and later processors.
- Provide ICSF regional cryptographic enablement which also supports IBM approved Cryptographic Servers running in a Linux on z Systems LPAR using dedicated IBM approved PCIe-attached crypto cards. This support requires a z13 or z13s processor and the PTF for APAR OA49069, when available. This regional cryptographic enablement is intended to help Chinese banking clients comply with the People's Bank of China (PBoC) 3.0 specification.
- Additional support for the z13 and z13s is available for the Cryptographic Support for z/OS V1R13 - z/OS V2R2 (HCR77B1) web deliverable in PTFs:
 - Additional Common Cryptographic Architecture (CCA) support for:
 - A new key check value using the CMAC algorithm in the Key Test2 (CSNBKYT2) service.
 - AES Galois/Counter mode encryption in the Symmetric Algorithm Encipher (CSNBSAE) and Symmetric Algorithm Decipher (CSNBSAD) services.
 - A new key derivation algorithm in the EC_Diffie-Hellman (CSNDEDH) service.
 - A new service Encrypted PIN Translate Enhanced (CSNBPTRE) with support for PAN that is encrypted using Format Preserving Encryption. The use of this function requires a service agreement with Visa, Inc. For more information, refer to the *z/OS Licensed Program Specifications*.

This support will require Crypto Express5S coprocessors available on z13 and z13s and the PTF for APAR OA49064, when available.

- Support for the new Trusted Key Entry (TKE) 8.1 workstation, with the PTF for APAR OA49067, when available.

IBM z13 and z13s systems are supported by z/OS V1.13 (5694-A01) and z/OS Version 2 (5650-ZOS).

* Performance improvements are based on internal IBM laboratory tests. Your results will vary.

IBM Wave for z/VM (IBM Wave)

IBM Wave for z/VM (IBM Wave) dramatically simplifies the management of virtualized environments into an intuitive experience, to help reduce the cost and skills of managing z/VM and Linux environments on z Systems servers.

IBM Wave's intelligent visualization of the virtual server environment and physical infrastructure provides intuitive management of physical servers, z/VM, Linux guests, and other resources. IBM Wave provides the necessary capabilities for virtual server provisioning and can readily scale as you grow your entire enterprise. With IBM Wave, you can rapidly gain insight into your entire virtualized infrastructure topology at a glance and also accelerate the path to a highly virtualized cloud infrastructure.

IBM Wave Release 2 further expands the capabilities by delivering increased support for Linux distributions and devices, reporting and auditing, as well as enterprise-grade security and performance enhancements. The Statements of Direction for enhanced audit logging and IBM Wave server support on RHEL 7 and SLES 12 distributions have been fulfilled with the latest service update in December 2015.

IBM Wave is a comprehensive management tool designed for administrators, operators, system programmers, and more. It is now included in several virtualization solutions on z Systems and IBM Infrastructure Suite.

IBM Wave is developed using lean and agile principles, providing enhancements and new function on an ongoing basis. These enhancements are made available via periodic service packs.

z/VM support for z13 Driver D27 and z13s:

- With the PTF for APAR VM65577, z/VM V6.2 and V6.3 provide guest exploitation support for Crypto Express5S, support for >16 Crypto Express domains, and guest exploitation support for the new Regional Crypto Enablement adapters. The PTF for APAR VM65577 is available.
- With the PTF for APAR VM65716, planned to be available by March 10, 2016, z/VM V6.2 and V6.3 provide support for the following:
 - LPAR Group Absolute Capacity Capping, enabling each partition to consume capacity up to its individual limit so long as the group's aggregate consumption does not exceed its absolute capacity limit.
- With the PTF for APAR VM65716, planned to be available by March 10, 2016, z/VM V6.3 will provide support for the following:
 - Guest exploitation support of Shared Memory Communications - Direct Memory Access (SMC-D) networking within the CPC without requiring 10 GbE RoCE hardware or external switches.
 - Dynamic Memory Management improved efficiency when a dynamic memory upgrade uses only a portion of the reserved main storage for the partition by initializing and clearing just the amount of storage requested.

z/VM support for the IBM z Systems Vector Facility

With the PTF for APAR VM65733, z/VM V6.3 enables guests to exploit the Vector Facility for z/Architecture (SIMD). The Vector Facility instructions provide a powerful framework for development of new Business Analytics workloads, porting numerically intensive workloads from other platforms, and accelerating Business Analytics workloads on IBM z13 or IBM z13s. The PTF is planned to be available by March 11, 2016. Availability of this support fulfills the Statement of General Direction issued with the announcement of IBM z13 on January 14, 2015.

z/VM SMT support

With the PTF for APAR VM65586, z/VM provides host exploitation support for SMT on IBM z13 and IBM z13s, which will enable z/VM to dispatch work on up to two threads (logical CPUs) of an IFL processor core. z/VM simultaneous multithreading support is enabled only for IFL processors in a Linux only mode or z/VM mode logical partition.

z/VM exploitation of SMT enables z/VM on z13 or z13s to dispatch work on an individual thread of a core, allowing a core to be shared by two guest CPUs or z/VM Control Program tasks. This can result in increased throughput per core from more efficient use of shared core resources.

Simultaneous multithreading support is available on a z/VM system only if the facility is installed on the hardware and enabled on the z/VM system with the MULTITHREADING system configuration statement. The MULTITHREADING statement is optional, and multithreading is disabled if the statement is omitted.

z/VM host simultaneous multithreading exploitation support does not virtualize threads for guest exploitation. However, Linux guests may benefit from the host support because the first-level z/VM system is able to achieve higher throughput from the multithreaded IFL cores.

z/VM CPU pools provide a mechanism for limiting the CPU resources consumed by a group of virtual machines to a specific capacity. In an environment without SMT, these capacities are enforced in terms of a number of cores. In an SMT environment, unless the PTF for APAR VM65680 is applied, these capacities are enforced in terms of a number of threads. Consequently, it might be necessary to increase the capacities of CPU pools, in order to provide adequate resource to CPU pool members. IBM recommends applying the PTF for APAR VM65680 if SMT is enabled.

z/VM multi-VSwitch link aggregation support

With the PTFs for APARs VM65583 and PI21053, z/VM V6.3 provides multi-VSwitch link aggregation support, allowing a port group of OSA-Express features to span multiple virtual switches within a single z/VM system or between multiple z/VM systems. Sharing a link aggregation port group (LAG) with multiple virtual switches increases optimization and utilization of the OSA-Express when handling larger traffic loads. Higher adapter utilization protects customer investments, which is increasingly important as 10 gigabit deployments become more prevalent. With this support, a port group is no longer required to be dedicated to a single virtual switch.

KVM for IBM z Systems provides open source virtualization for the IBM mainframe. For more information, refer to the Software Announcement for KVM for IBM z Systems, [AP15-0256](#), dated August 17, 2015. The next release of KVM for IBM z Systems, which will become available on March 18, 2016, supports several new capabilities.

KVM for IBM z Systems V1.1.1 enhancements

- Simultaneous multithreading (SMT) exploitation for higher compute capacity and improved TCO.

- Updated Hypervisor Performance Management (HPM) for SMT exploitation to enhance policy-driven performance.
- Ability of guests to exploit the Vector Facility for z/Architecture (SIMD) to accelerate analytics type workloads.
- Hypervisor enhancements including support for iSCSI and NFS.
- Crypto exploitation to leverage hardware acceleration for cryptographic functions, improving TCO.
- Enhanced RAS capabilities:
 - Improved first failure data capture (FFDC) for easier problem determination.
 - Hypervisor and guest watchdog support for improved high availability configuration.
 - Unattended installation capability of hypervisor for ease of installation.

z/VSE Network Appliance

The z/VSE Network Appliance builds on the z/VSE Linux Fast Path (LFP) function and provides TCP/IP network access without requiring a TCP/IP stack in z/VSE. The appliance utilizes the new z Appliance Container Infrastructure (zACI) introduced on z13 and z13s servers. Compared to a TCP/IP stack in z/VSE, this can support higher TCP/IP traffic throughput while reducing the processing resource consumption in z/VSE.

The z/VSE Network Appliance is an extension of the z/VSE - z/VM IP Assist (VIA[®]) function on z114 and z196. VIA provides network access for TCP/IP socket applications running on z/VSE as a z/VM guest. With the new z/VSE Network Appliance this is available for z/VSE systems running in an LPAR. When available, the z/VSE Network Appliance will be provided as a downloadable package. It can then be deployed with the appliance installer.

In summary, the VIA function is available for z/VSE systems running as z/VM guests. The z/VSE Network Appliance is available for z/VSE systems running without z/VM in LPARs. Both provide network access for TCP/IP socket applications that use the Linux Fast Path; however, no TCP/IP stack is required on the z/VSE system, and no Linux on z Systems need to be installed.

CICS Transaction Server for z/OS support for z13 and z13s

All in-service releases of IBM CICS Transaction Server for z/OS (CICS TS) will support the z13 and z13s hardware. This gives CICS TS customers, at an appropriate level of z/OS, the potential to benefit from facilities of z13 and z13s, including:

- Simultaneous multithreading (SMT), introduced first on z Systems with IBM z13 and now available on IBM z13s. CICS TS can take advantage of SMT to help provide better throughput and offload capacity for Java workloads. SMT can allow up to two threads per core to execute simultaneously and may be used on a zIIP specialty engine.
- The exploitation by IBM SDK for z/OS Java Technology Edition, Version 8 (Java 8) of new z13 and z13s facilities, such as the Single Instruction Multiple Data (SIMD) instructions and improvements to CP Assist for Cryptographic Functions (CPACF). Java 8 is supported by CICS TS V5.3.
- Improvements in cryptographic performance, with CPACF and the new Crypto Express5S. This can benefit non-Java workloads in CICS TS.
- The capability of significantly greater amounts of redundant array of independent memory (RAIM*). This can enable greater use of CICS in-memory facilities, including:
 - Main temporary storage and the internal trace table above the bar
 - Channels and containers
 - Shared data tables

- JVM server heap storage

* Greater amounts of RAIM are intended to improve transaction response times, lower CPU costs, simplify capacity planning, and ease deployment of memory-intensive workloads.

IBM z BladeCenter Extension (zBX) Model 004

The on-site upgrade to an IBM z BladeCenter Extension (zBX) Model 004 continues to support workload optimization and integration for zEnterprise. The zBX Model 004 is available as an upgrade from an existing zBX Model 002 or Model 003. The upgrade will decouple the zBX from its controlling CPC and with the addition of redundant Support Elements, it will become a stand-alone Node within an ensemble. An ensemble must contain a z114, z196, zBC12, zEC12, z13, or z13s. Once upgraded, any available slots in an existing chassis can be used with the proper entitlements. Environmental options and optics will be available to support reconfiguration and relocation.

Hardware Management Console (HMC)

Absolute Capping of an LPAR Group

Beginning with zEC12 and zBC12 enterprises, absolute capping support was provided for an individual LPAR. Now, absolute capping for an LPAR **group** will be provided. Absolute Capping of an LPAR Group ensures that software licensing terms and conditions related to capacity are always met.

Currently, Change LPAR Group Controls allows the user to define LPAR group capacity limits, allowing one or more groups of LPARs to each have its own capacity limit. This is to ensure that groups are managed in such a way that the sum of the LPARs' CPU utilization within a group will not exceed the group's defined capacity.

This new feature adds the ability to define an absolute capping value for an entire LPAR group. The absolute cap value is specified to hundredths of a processor. A separate absolute cap value by processor type is supported within the group. When absolute capping is specified for a group this works independently of the Group Capacity value, and that LPAR Group Absolute Capping value will act as an additional control to truly enforce a maximum limit on capacity for the LPAR group.

SNMP/BCPii performance enhancements

Performance enhancements for SNMP/BCPii will be realized by allowing query or set operations for multiple attributes and/or category-based attributes via new HwmcaEnhancedGet and HwmcaEnhancedSet API interfaces. Previously, an individual API request was required for each attribute being acted upon. Additionally, a single interface attribute was limited to a single LPAR, but now a single attribute query or update API can be sent to multiple LPARs.

In addition, a new SE task will be provided to better understand which BCPii requests are being made to the SE. For BCPii there could be multiple sources of applications making BCPii requests to the SE, and this task will provide a summarized view of historical data for you to better understand the source, frequency, and interactions of the BCPii initiated requests. This will allow you to potentially tune the application requests of the multiple BCPii requesters to work towards a better performance model for their BCPii request environment.

Removal of Java Applet HMC task implementations

In the HMC 2.13.1 release, the implementations of the Operating System Messages, Integrated 3270 Console, Integrated ASCII Console, and Text Console customer tasks have been migrated from a Java Applet base to a remote browser execution scheme so that those tasks will no longer be affected by changes of Java levels on the remote workstations. In some cases the look and feel of those tasks will change slightly.

In addition, the Integrated 3270 Console has been enhanced. When multiple remote users are connected into the same HMC or different HMCs for a specific LPAR, any remote user will be able to take control of the Integrated 3270 Console session.

The changes to remove Java Applet implementations for the Operating System Messages, Integrated 3270 Console, and Integrated ASCII Console will be patched to the HMC 2.12.1 code level around the time that the HMC 2.13.1 is released. Note that the patches will slightly change the appearance and controls of the tasks being patched.

HMC 2.13.0 as well as 2.12.1 customers can take full advantage of the new implementation approach by upgrading to HMC 2.13.1.

OSA-ICC support for Secure Sockets Layer

Previously, we advised all customers who need a secure connection to install a VPN device between their server and client infrastructure. To avoid this requirement, TLS/SSL with Certificate Authentication will be added to the HMC/SE support OSC CHPID to provide a secure and validated method for connecting clients to the z Systems host.

The HMC/SE support have a new Secure TCP port field added for each LAN port on the Edit Server Configuration panel. Additionally, the Card Specific Advanced Facilities will be updated to handle the certificate management.

ASCII translation for Display/Alter storage display

Beginning with the IBM z13 and IBM z13s, Display/Alter will display an EBCDIC translation of storage to the user in addition to a hex display of the data. In HMC 2.13.1 the user will now also be able to view an ASCII translation of storage. This is very useful for operating systems such as Linux on z that handle text in ASCII.

ASHRAE class A3 for robustness, data center flexibility, and energy savings

The z13s is rated for the ASHRAE class A3 environment for all models and configurations. Class A3 allows a wider operating temperature range (including up to 40°C inlet air), as well as a wider humidity range than the previous generation's class A2 rating. This provides significant additional system robustness and safety margin for data center cooling and humidity control failures. It allows installation in a wider range of data centers, including lower-cost data centers. Energy savings are enabled in multiple ways. The increased temperature and humidity range provides the opportunity to use compressor-less cooling solutions in many locales. Additionally, the expanded temperature range allows for a data center to run at a higher temperature for some time periods with high external temperatures, reducing the required cooling infrastructure and energy usage.

Enhancements to Advanced Entry Workload License Charges (AEWLC) and Technology Transition Offerings

Coinciding with the announcement of the z13s server, IBM is making available a new Technology Transition Offering (TTO) called Technology Update Pricing for the z13s. Technology Update Pricing for the z13s offers price-performance advantages for z13s servers. IBM is also updating the "Technology Update Pricing for the z13" offering and two revised Transition Charges for Sysplexes or Multiplexes offerings to add the z13s. In addition, zSeries Entry License Charge (zELC) pricing applies to the z13s capacity setting A01, the entry z13s server.

Technology Update Pricing for the z13s extends the software price-performance provided by AEWLC for stand-alone z13s servers, and applies to eligible z/OS, z/TPF, and z/VSE operating systems and their associated middleware programs. AEWLC, zNALC, and Tiered Workload License Charges (TWLC) are the only pricing metrics available on a stand-alone z13s server, with the exception of the z13s capacity setting A01. The Entry Workload License Charges (EWLC) and the Midrange

Workload License Charges (MWLC) license options are not available for a z13s server.

When a z13s server is in an actively coupled z/OS Parallel Sysplex or z/TPF Loosely Coupled Complex, you may choose either stand-alone AEWLC pricing, aggregated AWLC pricing, or aggregated Parallel Sysplex License Charges (PSLC) pricing, subject to all applicable terms and conditions.

When a z13s server is part of a Multiplex under Country Multiplex Pricing (CMP) terms, CMLC, MzNALC, and Tiered Workload License Charges (TWLC) are the only pricing metrics available, subject to all applicable terms and conditions.

For additional information about software pricing for the z13s server, refer to Software Announcement [AP16-0007](#), dated February 16, 2016.

For more information about AWLC, CMLC, CMP, MzNALC, PSLC, zNALC, or the Transition Charges for Sysplexes or Multiplexes TTO offerings, refer to

<http://ibm.com/systems/z/swprice/>

Announcing the latest version of the IBM LinuxONE Rockhopper and enhancements to the IBM LinuxONE Emperor

IBM LinuxONE is an all-Linux enterprise platform for open innovation that combines the best of Linux and open technology with the best of enterprise computing in ONE platform. It delivers a single system built on one of the industry's fastest commercially available server processors and is built to be the backbone of the mobile era, setting new standards in transaction volume, speed, and trust.

Today's announcement extends IBM enterprise server capabilities to LinuxONE servers, offering:

- Exceptional scale with up to 20 LinuxONE cores (orderable as Integrated Facility for Linux (IFL)) for IBM LinuxONE Rockhopper, providing significant total system capacity for your Linux workloads deploying cloud, analytics, and mobile solutions
- Economies of scale with **simultaneous multithreading delivering more throughput** for Linux workloads
- **Enhanced cryptographic and partitioning offerings** that can help ensure the real-time protection and integrity of data across an enterprise cloud environment
- **More memory, cache enhancements, and expansive I/O bandwidth** to serve up more data to support exponential mobile transaction volumes
- **Real-time insights** at the point of impact with integrated analytics and transaction processing
- **Data and services that are securely delivered**, with minimal risk, on the most reliable platform
- The flexibility of **hybrid cloud deployment**
- Improved performance of complex mathematical models, perfect for analytics processing, with **Single Instruction Multiple Data (SIMD)**
- **IBM Resiliency Analytics for LinuxONE (orderable as IBM zAware) cutting-edge pattern recognition analytics** for fast insight into the system health of Linux environments
- Reduced latency for Ethernet communications with **10GbE RoCE Express**
- Rack-mounted Hardware Management Console, **helping to save space in the data center**

Today's announcement introduces new capabilities for IBM LinuxONE Emperor and IBM LinuxONE Rockhopper:

- **Simplified appliance** implementation with z Appliance Container Infrastructure (zACI)
- **New administrative mode for Linux - IBM Dynamic Partition Manager (DPM)**

- LPAR enhancement to provide **group physical capacity limit enforcement**
- LPAR enhancement for **dynamic memory management**
- **Common Cryptographic Architecture (CCA)** enhancements
- **Trusted Key Entry (TKE)** 8.1 License Internal Code (LIC)
- **FCP SAN discovery tool** RDP data support
- OSA-ICC support for **Secure Sockets Layer**
- **Export / import physical port WWPNs for FCP Channels**
- **Improved Channel Subsystem (CSS) scalability**
- **Fibre Channel Read Diagnostic Parameter extended link service (ELS) support**
- **z/VM** enhancements
- **IBM Wave** enhancements
- **KVM for IBM z Systems** enhancements
- **Hardware Management Console (HMC)** enhancements
- **ASHRAE class A3 for robustness, data center flexibility, and energy savings**

Simultaneous multithreading (SMT)

Simultaneous multithreading (SMT) allows two active instruction streams per core, each dynamically sharing the core's execution resources. Incremental throughput is achieved partly because the processor chip offers intelligently implemented 2-way simultaneous multithreading. SMT is available on IBM LinuxONE Emperor and IBM LinuxONE Rockhopper for workloads running on the core.

Each eligible software operating system or hypervisor has the ability to intelligently drive SMT in a way that is best for its unique requirements. z/VM SMT management optimizes throughput by spreading a workload over the available cores until it demands the additional SMT capacity.

Linux distributions starting with SLES12 SP1 and RHEL 7.2 include SMT support for customers running in Linux in a partition (LPAR).

z Appliance Container Infrastructure (zACI) is a new partition type which, along with an appliance installer, enables the secure deployment of software and firmware appliances. zACI will shorten the deployment and implementation of firmware solutions or software solutions delivered as virtual software appliances. The zACI framework enforces a common set of standards and behaviors, and a new zACI partition mode for a virtual appliance - requiring a new zACI LPAR type. The IBM Resiliency Analytics for LinuxONE (orderable as zAware) partition mode has been renamed to zACI, and the Resiliency Analytics for LinuxONE firmware will now run in this partition. There are no hardware dependencies. zACI will be delivered as part of the base code on each IBM LinuxONE server (driver level 27).

New administrative mode for Linux -- IBM Dynamic Partition Manager (DPM)

A new administrative mode is being introduced for IBM LinuxONE servers with SCSI storage attached via FCP channels. IBM Dynamic Partition Manager (DPM) provides simplified hardware and virtual infrastructure management including integrated dynamic I/O management for users who intend to run KVM for IBM z Systems as a hypervisor or Linux running in a partition (LPAR). The new mode, Dynamic Partition Manager, provides simplified, consumable, and enhanced partition lifecycle and dynamic I/O management capabilities via the Hardware Management Console (HMC) to:

- Create and provision an environment -- Creation of new partitions, assignment of processors and memory, and configuration of I/O adapters (network, FCP storage, crypto, and accelerators)
- Manage the environment -- Modification of system resources without disrupting running workloads
- Monitor and troubleshoot the environment -- Source identification of system failures, conditions, states, or events that may lead to workload degradation

A CPC can be configured in either the Dynamic Partition Manager mode or PR/SM mode. The mode is enabled prior to the CPC power-on reset (POR). Dynamic Partition Manager mode requires two OSA-Express 1000BASE-T Ethernet features for primary and backup connectivity (OSA-Express5S 1000BASE-T Ethernet #0417), along with associated cabling (HW for DPM #0016).

Dynamic Partition Manager (DPM) supports Linux running in a partition (LPAR) as well as the KVM for IBM z Systems hypervisor. DPM initially does not support the z/VM hypervisor.

Enterprise-grade availability

The IBM LinuxONE servers continue the drive for continuously reliable operation as with other IBM enterprise servers. They provide the following Reliability, Availability, and Serviceability (RAS) qualities of service:

- Soft error resilience in the processor cores
- Lane shadowing, hardware buffer retry, and independent channel recovery, which are designed to improve the DIMM interface
- Use of RAIM in the main memory to protect DRAM
- Robustness in the level 3 and level 4 cache
- FRU isolation with the integrated time domain reflectometry logic to chip interfaces
- Integrated sparing designed to reduce the complexity and number of repair actions

IBM zAware is an integrated, self-learning firmware IT analytics solution that helps systems and operations professionals rapidly identify problematic messages and unusual system behavior in near real-time, enabling systems administrators to use the information to take corrective actions.

IBM zAware delivered on IBM LinuxONE Emperor and IBM LinuxONE Rockhopper delivers:

- Support for LinuxONE message log analysis
- Support for native or guest LinuxONE images
- The ability to process message streams with no message IDs
- The ability to group multiple systems that have similar operational characteristics for modeling and analysis
 - Recognition of dynamic activation and deactivation of a Linux image into a group, and appropriate modeling and analysis.
 - User-defined grouping. For LinuxONE servers, the user can group multiple systems' data into a combined model: by workload (one for all web servers, one for all databases, and so on); by "solution" (for instance, one model for your cloud); or by VM host.
- A heat map display that provides a consolidated/aggregated/higher level view with the ability to drill down to detail views
- Usability and GUI functional capabilities addressing many customer requirements and IBM One UI guidelines
 - Filtering and visualization with optimized use of GUI real estate
 - Advanced UI navigation
 - Display of local time in addition to UTC time

- Advanced analytics
- A robust data store
- Browser support with Mozilla Firefox 31 and Internet Explorer 9, 10, and 11

IBM zAware is designed to use near real-time continuous learning algorithms, providing a diagnostic capability intended to help clients quickly pinpoint problems, which, in turn, can lead to better availability and a more efficient system. IBM zAware uses analytics to intelligently examine LinuxONE messages to find unusual patterns, inconsistencies, and variations. Large operating system environments can sometimes generate more than 25 million messages per day. This can make manual analysis time-consuming and error-prone when exceptional problems occur. IBM zAware provides a simple graphical user interface (GUI) and APIs to help clients find message anomalies quickly, which can help speed problem resolution when seconds count.

LPAR enhancement to provide group physical capacity limit enforcement

Processor Resource/Systems Manager (PR/SM) and the Hardware Management tool have been enhanced to support an option to limit the amount of physical processor capacity consumed by a group of logical partitions (LPARs) when a processor unit (PU) is defined as a core shared across a set of LPARs.

This enhancement is designed to provide a group physical capacity limit enforced as an absolute (versus relative) limit; it is not affected by changes to the logical or physical configuration of the system. This group physical capacity limit can be specified in units of IFLs. The "Change LPAR Group Controls" and "Customize Group Profiles" tasks on the Hardware Management Console have been enhanced in support of this new function. Refer to the Hardware requirements and Software requirements sections of the *IBM z Systems Hardware Management Console Web Services API (Version 2.13.1)*, SC27-2634, publication.

This is supported in both PR/SM mode and IBM Dynamic Partition Manager (DPM) mode.

LPAR enhancement for dynamic memory management

Processor Resource/Systems Manager (PR/SM) has been enhanced to support more flexibility as to how additional physical memory is dynamically added to a logical partition. Rather than attempting to fully populate a logical partition's reserved storage element when it is initially configured online, the OS in the partition can request a single storage increment be attached (and subsequently can request additional increments if desired). This allows a more gradual, flexible addition of memory to the partition as needed over time.

This is supported in both PR/SM mode and IBM Dynamic Partition Manager (DPM) mode.

Common Criteria Evaluation Assurance Level 5+ (EAL 5+) certification

The IBM LinuxONE servers are designed for Common Criteria Evaluation Assurance Level 5+ (EAL 5+) certification for security of logical partitions running in PR/SM mode. This means that the IBM LinuxONE servers are designed to prevent an application running on one operating system image on one LPAR from accessing application data running on a different operating system image on another LPAR on the server. This certification is not supported in IBM Dynamic Partition Manager (DPM) mode.

Common Cryptographic Architecture (CCA) enhancements

Secure AES GCM encryption mode

Galois Counter Mode (GCM) is an authenticated encryption algorithm designed to provide both data authenticity (integrity) and confidentiality in a single operation. The algorithm can also serve as a stand-alone MAC function. With the Crypto

Express5S and IBM LinuxONE Emperor or IBM LinuxONE Rockhopper, CCA will add this encryption mode support to the existing Symmetric Algorithm Encipher (CSNBSAE) and Symmetric Algorithm Decipher (CSNBSAD) callable services. Previously AES GCM was supported with clear keys through ICSF. This feature will provide a secure key option.

Interoperable ECC key derivation algorithm

The EC_Diffie-Hellman callable service is used to establish symmetric keys using a pair of ECC keys using the Elliptic Curve Diffie-Hellman (ECDH) protocol. The Crypto Express5 Coprocessor is planned to be enhanced to add an additional key derivation scheme that allows the establishment of keys with non-CCA entities, without compromising security.

The EC_Diffie-Hellman callable service creates a shared symmetric key with a pair of ECC (Elliptic Curve Cryptography) keys using the ECDH (Elliptic Curve Diffie-Hellman) protocol and the ANSX9.63 protocol static unified model key-agreement scheme. The Crypto Express5 Coprocessor is enhanced with an additional key derivation scheme that allows the establishment of keys with non-CCA entities, without compromising security.

Addition of new Key Check Value algorithm

The Key Test2 callable service generates or verifies the value of a clear or encrypted key or key part contained in an external or internal variable-length symmetric key-token, or a DES key or key part wrapped in an external TR-31 key block. With the Crypto Express5, CCA plans to support a new CMAC-based Key Check Value algorithm for use with AES and TDES keys.

Greater than 16 domain support

Support to allow a cryptographic coprocessor to be shared across more than 16 domains, up to the maximum number of LPARs on the system. This support relies on enhanced firmware available with a minimum microcode level for the Crypto Express5S coprocessors. With the adjunct processor (AP) extended addressing (APXA) facility installed, the LinuxONE crypto architecture can support greater than 16 domains in an AP. Customers will have the flexibility of mapping individual LPARs to unique crypto domains or continuing to share crypto domains across LPARs.

Trusted Key Entry (TKE) 8.1 Licensed Internal Code (LIC)

The following functions are supported in the TKE 8.1 LIC:

- **Domain Cloning** is planned to support a Configuration Migration Tasks application that gives administrators the ability to collect settings from one domain and apply the settings to any set of new domains. This feature significantly simplifies the process and reduces the time it takes to deploy new domains on a Host Crypto Module.
- **Launch coordinated master key role from the TKE** is planned to provide the ability to set master keys from the TKE in a way that the Key Data Sets (KDSs) are encrypted under the new master key. IBM plans to provide the ability to invoke the ICSF coordinated master key role function and now allow clients to do all master key management from the TKE.
- **Guided create features for roles and authority indexes** are designed to provide new guided create functions to be added to both Roles and Authorities tabs for Host Cryptographic Modules. This support steps the client through the process of creating these items and greatly clarifies and simplifies the creation process.
- **Two new certificate authority wizards** are intended to take administrators through the process of creating all the smart cards used in a TKE zone and also taking administrators through the process of creating all the smart cards needed for the Configuration Migrations Task wizards.
- **Display Crypto Module Settings**, a new TKE feature, enables you to create a report that shows the current configuration of a Host Cryptographic Module.

- **HMAC key** will enable TKE to support generation and loading of HMAC operational keys. This support will be limited to keys that are 16, 24, and 32 bytes in length.
- **Save/Restore Customized Data feature** will provide TKE with a new Privileged Mode Access ADMIN task that allows the client to save and restore client data on the TKE. This feature can be used to move client data from one TKE workstation to another or to restore client data on a TKE.
- **Password Protect Console** will support the ability to password protect the TKE console. By default, the TKE console is not password protected. The Password Protect Console application is available only when you are signed on in Privileged Mode Access with the ADMIN user ID. This feature provides increased security for your TKE workstation.
- **Binary Key Part File Utility** will provide the ability to copy key material from a binary file and place it on a smart card. This provides a simplified and faster process compared to using secure key load from the smart card PIN pad.
- **ACP Usage Information utility** allows you to track which Domain Controls (Access Control Points) were actually "checked" within a domain. If tracking is activated and an authority check is done for an ACP, the "checked" indicator is turned on. This indicator stays on until the tracking data is cleared. The TKE is used to activate, deactivate, and clear the tracking data. In addition, TKE provides a feature for displaying the tracking information for each domain.
- **Require Enhanced Host Password protection** will support the strongest possible encryption. When using HCR 77B0 or later with TKE 8.0 or later, the strongest possible encryption is used to protect the host password. The TKE uses the best encryption available for protecting the host sign-on password. However, with a new TKE 8.1 enhancement, you can configure the TKE so that it will allow a sign-on only to a system that uses the strongest encryption. IBM recommends that you install HCR 77B0 or later and configure the TKE to allow the sign-on only to systems that support the strongest host password protection.
- **Operational Key Option on Domain Groups** lets users specify where key commands are sent. Currently, when an operation key command is run from inside a domain group, the command is sent only to the master domain. IBM plans to add support to the domain group to add an attribute that indicates if operational key commands are to be sent to the master domain or all the domains in the group. The new group attribute value can be managed from the Create or Change Group features.

TKE 1U workstation

The Trusted Key Entry (TKE) introduces a new 1U workstation that is a rack-mounted system. It is a combination of hardware and software, network-connected to one or more servers, and designed to provide a secure, flexible method for master and operational key entry as well as local and remote management of the cryptographic coprocessor features (Crypto Express5S when defined as a coprocessor). It provides the same functionality as the TKE workstation but as a rack-mounted server. If the Trusted Key Entry 1U workstation is required on an IBM LinuxONE server, then the TKE workstation with TKE 8.1 LIC feature (#0878) must be used.

Trusted Key Entry (TKE) 8.0 Licensed Internal Code (LIC)

The following functions were delivered with the TKE 8.0 level of LIC and are included in the base of TKE 8.1.

Crypto Express5S coprocessor support: TKE 8.0 is required for managing Crypto Express5S cryptographic coprocessors and manages them through the same Crypto Module notebook functions as previous generations of cryptographic modules. The configuration migration tasks feature of the TKE is enhanced to also support the Crypto Express5S coprocessor. You can use TKE 8.0 to collect data from previous generations of cryptographic modules and apply the data to Crypto Express5S coprocessors.

FIPS Certified Smart Card: Media for the FIPS Certified Smart Card is now included in the smart card reader and additional smart cards optional features. The new smart card media part number is 00JA710.

Crypto coprocessors with more than 16 domains: TKE 8.0 allows the management of domains beyond the current limit of 16. This support will require the latest levels of code on the IBM LinuxONE Emperor and IBM LinuxONE Rockhopper to allow more than 16 domains on the Crypto Express5S.

Full function migration wizard for EP11: The full function migration wizard is designed to provide the ability to quickly and accurately collect and apply data to the Crypto Express features configured as EP11 coprocessors. This wizard previously supported CCA, however Crypto Module Group support has been removed. Crypto Module Groups are no longer supported on TKE 8.0. All group management must now be done from a Domain Group.

New master key management functions: TKE 8.0 allows support of two new master key management functions that are available when managing any type of master key:

1. Generate a set of master key parts wizard-like feature which allows you to create a new key part for each of the different types of master keys.
2. Load all new master keys wizard-like feature which allows you to load a new key for each of the different types of master keys.

Smart Card Readers Available indicator: TKE 8.0 displays a window title that will include information if the smart card readers are available if the application or utility has access to smart card readers.

Configure Displayed Hash Size utility: TKE 8.0 supports a configuration to allow the administrator to set the display length of certain hash values displayed on the TKE workstation. Hash types that can be affected by this function are MDC-4, SHA-1, AES-VP, and ENC-ZERO. The Configure Display Hash Size utility is available only when you have signed on with the Privileged Mode Access user ID of ADMIN.

ECC Authority Signature Keys: TKE 8.0 allows a user to select a key strength of 320-bit ECC key when creating an Authority Signature Key that is to be assigned to an Authority Index on a Crypto Express5S coprocessor. This option is available only when you are creating an Authority Signature Key from inside a Crypto Module Notebook of a Crypto Express5S.

Print capability: TKE 8.0 has limited print support. The Configure Printers utility allows the administrator to add printers to the TKE. The only printers allowed to be added are printers that have device drivers on the TKE including the GUTENPRINT and HPLIP device driver packages. You will not be able to load your own device drivers.

New features in the Crypto Node Management (CNM) utility: The TKE Workstation Setup utility allows you to load and save user roles and profiles. The CNM utility now has stand-alone launch points for these two tasks in the Access Control pull-down menu.

ENC-Zero verification pattern for 24-byte DES operational keys: TKE 8.0 supports an ENC-Zero verification pattern that is computed and displayed with 24-byte DES operational keys.

Usability enhancements: TKE 8.0 has many usability enhancements including the ability for users to select a check box that will allow them to change their passphrase on the logon screen for a passphrase profile. Additionally, users can now select multiple items in the Hosts container, Crypto Module Groups container, or Domain Groups container of the main window of the TKE application. If more than one item is selected, you can delete all of the definitions or close all of the hosts or groups at once.

FCP SAN discovery tool RDP data support

The FCP SAN Explorer function on the HMC has been enhanced with additional functions to facilitate SAN configuration setting and debugging. This facility can now display the name of the active fabric zone set, a list of zones an initiator is a member of, and enhanced diagnostic data for the initiator and target fabric links.

OSA-ICC support for Secure Sockets Layer

The Open Systems Adapter, when configured as an integrated console controller CHPID type (OSC) on IBM LinuxONE servers, will support the configuration and enablement of secure connections using the Transport Layer Security (TLS) protocol versions 1.0, 1.1, and 1.2. Server-side authentication is supported using either a self-signed certificate or customer-supplied certificate which may be signed by a customer-specified Certificate Authority. The certificates used must have an RSA key length of 2048 bits, and must be signed using SHA-256. This support will negotiate a cipher suite of AES-128 for the session key.

FICON Express16S -- The next generation for FICON, zHPF, and FCP

IBM has released **a new I/O infrastructure**, now available on IBM LinuxONE Emperor and IBM LinuxONE Rockhopper. This infrastructure will strengthen the synergy between IBM DS8880 storage and IBM LinuxONE servers, delivering improved, predictable, and repeatable performance, and enhanced resiliency for mission-critical environments.

With the introduction of **FICON Express16S on the IBM LinuxONE servers**, you have significant growth opportunities for your SAN. FICON Express16S supports a link data rate of 16 gigabits per second (Gbps) and auto-negotiation to 4 or 8 Gbps for synergy with existing switches, directors, and storage devices. With support for native FICON, High Performance FICON for z Systems servers (zHPF), and Fibre Channel Protocol (FCP), the IBM LinuxONE Emperor and IBM LinuxONE Rockhopper servers enable you to position your SAN for even higher performance -- helping you to prepare for an end-to-end 16 Gbps infrastructure to meet the lower latency and increased bandwidth demands of your applications.

The new FICON Express16S channel will work with your existing fiber optic cabling environment, both single-mode and multimode optical cables. The FICON Express16S feature running at end-to-end 16 Gbps link speeds will provide reduced latency for large read/write operations and increased bandwidth compared to the FICON Express8S feature.

Increased performance for the zHPF protocol: In laboratory measurements using FICON Express16S in an IBM enterprise server with the zHPF protocol and small data transfer I/O operations, FICON Express16S operating at 16 Gbps achieved a maximum of 108,000 I/Os/sec. In laboratory measurements, using FICON Express16S in an IBM enterprise server with the zHPF protocol and a mix of large sequential read and write data transfer I/O operations, FICON Express16S operating at 16 Gbps achieved a maximum throughput of 2600 MB/sec (reads + writes) compared to a maximum of 1600 MB/sec (reads + writes) achieved with FICON Express8S operating at 8 Gbps. This represents an approximately 63% increase. This performance data was measured in a controlled environment running an I/O driver program under z/OS. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.

Increased performance for the FCP protocol: A FICON Express16S feature, when defined as CHPID type FCP, conforms to the Fibre Channel Protocol (FCP) standard to support attachment of SCSI devices, to complement the classical storage attachment supported by FICON and zHPF channels.

In laboratory measurements using FICON Express16S in an IBM enterprise server with the FCP protocol for small data transfer I/O operations, FICON Express16S

operating at 16 Gbps achieved a maximum of 110,000 IOs/sec compared to the maximum of 92,000 IOs/sec achieved with FICON Express8S operating at 8 Gbps.

In laboratory measurements using FICON Express16S in an IBM enterprise server with the FCP protocol and FICON Express16S operating at 16 Gbps, FICON Express16S achieved a maximum throughput of 2560 MB/sec (reads + writes) compared to the maximum of 1600 MB/sec (reads + writes) achieved with FICON Express8S operating at 8 Gbps. This represents approximately a 60% increase. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.

With the introduction of the FICON Express16S in an IBM LinuxONE server operating using the FCP protocol, several recommended and allowable operating characteristic values have increased, which will enable additional workload consolidation. Specifically, the recommended maximum number of NPIV hosts defined to any single physical FCP channel has increased from 32 to 64, the allowable maximum number of remote N_Ports a single physical channel can communicate with has increased from 512 to 1024, and the maximum number of LUNs addressable by a single physical channel has increased from 4096 to 8192. In support of these increases, the FCP channels have also been designed to now support 1528 concurrent I/O operations, an increase from the prior generation FCP channel limit of 764.

The FCP protocol is supported by LinuxONE Systems. Refer to the [Software requirements](#) section.

16Gb FICON and FC host adapters on IBM DS8880: Improve SAN performance and resiliency with faster 16Gb Fibre Channel and FICON host adapters on DS8880. For DB2 log writes, these new host adapters will help to improve the efficiency of the 16 Gbps zHPF and heritage FICON to reduce large log write latency, resulting in DB2 transactional latency improvements for applications and middleware, including SAP. For managed file transfer with Connect Direct these new host adapters can help to reduce elapsed times. In addition, I/O-bound batch jobs will see improved elapsed times.

FCP SAN Explorer: A new function is available on the HMC through the Problem Determination panels that provides a centralized view of SAN facilities available to an FCP channel. The tool facilitates configuration setting and debugging without requiring an operating system to be running. It does require the IBM LinuxONE Emperor and IBM LinuxONE Rockhopper to have completed an Initial Machine Load (IML) and the partitions of interest to be activated. The tool can also operate concurrently with customer I/O workloads in a nondisruptive manner. It provides an operator with a layered view of the SAN environment. Specifically, device numbers (hosts) assigned to a partition, the fabric zone members available to the host, the remote end port error statistics, the accessible logical unit numbers (LUNs), and basic LUN configuration information can be queried and displayed using this tool. This data can also optionally be exported in CSV format.

Cleaning discipline for FICON Express16S fiber optic cabling

With the introduction of 16 Gbps link data rates, it is even more critical to ensure your fiber optic cabling infrastructure performs as expected. With proper fiber optic cleaning and maintenance, you can be assured that the "data gets through." With 16 Gbps link data rates over multimode fiber optic cabling, link loss budgets and distances are reduced. Single-mode fiber optic cabling is more "reflection sensitive." With high link data rates and single-mode fiber optic cabling there is also less margin for error. The cabling is no longer scratch-tolerant and contaminants such as dust and oil can present a problem. To keep the data flowing, proper handling of fiber trunks and jumper cables is critical as well as thorough cleaning of fiber optic connectors. Work with your data center personnel or IBM personnel to ensure you have fiber optic cleaning procedures in place.

Enabling the transition to FICON Express16S with Forward Error Correction (FEC)

Even with proper fiber optic cable cleaning discipline, errors can still occur on 16 Gbps links. FEC is a technique used for controlling errors in data transmission over unreliable or noisy communication channels. FICON Express16S channels running at 16 Gbps can take advantage of Forward Error Correction capabilities when connected to devices that support FEC. FEC allows FICON Express16S channels to operate at higher speeds, over longer distances, with reduced power and higher throughput, while retaining the same reliability and robustness that FICON channels have traditionally been known for. Clients should see fewer I/O errors, thus easing the transition to 16 Gbps links and reducing potential impact to production workloads caused by I/O errors.

Forward Error Correction Codes support on 16Gbps adapters on IBM DS8880:

For Peer to Peer Remote Copies, FEC helps to preserve data reliability. This enhancement is designed to provide the *equivalent* reliability improvement as doubling the optical signal strength.

FICON Dynamic Routing

With IBM LinuxONE Emperor and IBM LinuxONE Rockhopper servers, FICON channels do not have to use static SAN routing policies for ISLs for cascaded FICON Directors. The LinuxONE feature that supports dynamic routing in the SAN is called FICON Dynamic Routing (FIDR). It is designed to support the dynamic routing policies provided by the FICON Director manufacturers, for example, Brocade's Exchange Based Routing (EBR) and Cisco's Open Exchange ID Routing (OxID). Check with the switch provider for their support statement.

FICON Dynamic Routing can help clients reduce costs by having the ability to share SANs between their FICON and FCP traffic, improve performance due to SAN dynamic routing policies that better exploit all the available ISL bandwidth through higher utilization of the ISLs, and simplify management of their SAN fabrics due to routing policies assigning different ISL routes with each power-on reset, which makes the SAN fabric performance difficult to predict. Clients will need to ensure that all devices in their FICON SAN support FICON Dynamic Routing before they implement this feature.

FICON Dynamic Routing on IBM DS8880 and IBM DS8884 enables clients to use SAN dynamic routing policies across cascaded FICON Directors to simplify configuration and capacity planning, and to provide persistent and repeatable performance and higher resiliency. In Peer to Peer Remote Copy configurations, sharing of switches is simplified and hardware costs can be reduced by allowing FICON and FCP to share the same switch infrastructure. IBM's Metro Mirror technology uses FCP as the transport.

Improved High Performance FICON for z Systems (zHPF) I/O execution at distance

High Performance FICON for z Systems (zHPF) has been enhanced to allow all large write operations (> 64 KB) at distances up to 100 km to be executed in a single round trip to the control unit, thereby not elongating the I/O service time for these write operations at extended distances.

zHPF Extended Distance II on IBM DS8880: zHPF Extended Distance II allows customers to achieve service level agreements after a disaster or when a storage control unit failure causes a HyperSwap event. This capability is required especially for GDPS HyperSwap configurations where the secondary DASD subsystem is in another site. For multisite configurations, the zHPF Extended Distance II feature can help to reduce the impact of distance on I/O response times, increasing remote data transfer with better performance when writing data remotely (remote site recovery).

Export / import physical port WWPNs for FCP channels

LinuxONE servers automatically assign worldwide port names (WWPNs) to the physical ports of an FCP channel based upon the Physical Channel ID (PCHID), and this WWPN assignment changes when an FCP channel is moved to a different physical slot position. LinuxONE will allow for the modification of these default assignments, allowing FCP channels to keep previously assigned WWPNs, even after being moved to a different slot position. This capability can eliminate the need for reconfiguration of the SAN in many situations, and is especially helpful on a system upgrade.

Improved channel subsystem (CSS) scalability

The IBM LinuxONE Emperor has channel subsystem (CSS) scalability with support for six logical channel subsystems (LCSSs) which are required to support the eighty-five LPARs for IBM LinuxONE Emperor, four subchannel sets (to support more devices per logical channel subsystem), and 32K devices per FCP channel. Additionally, a fourth subchannel set for each logical channel subsystem (LCSS) is provided to facilitate elimination of single points of failure for storage after a disk failure by simplifying the exploitation of IBM's DS8870 Multi-target Metro Mirror storage replication with TPC-R HyperSwap.

The IBM LinuxONE Rockhopper channel subsystem (CSS) scalability will support up to three logical channel subsystems (LCSSs) which are required to support the forty LPARs for IBM LinuxONE Rockhopper, three subchannel sets (to support more devices per logical channel subsystem), and 32K devices per FCP channel. Additionally, a third subchannel set for each logical channel subsystem (LCSS) is provided to facilitate elimination of single points of failure for storage after a disk failure by simplifying the exploitation of IBM's DS8880 Multi-target Metro Mirror storage replication with TPC-R HyperSwap.

Refer to the [Software requirements](#) section.

Fibre Channel Read Diagnostic Parameter extended link service (ELS) support

A new extended link service (ELS) command called Read Diagnostic Parameter (RDP) has been added to the Fibre Channel T11 standard to allow IBM LinuxONE servers to obtain additional diagnostic data from the Small Form Factor Pluggable (SFP) optics located throughout the SAN fabric. The ultimate goal of the RDP will be to improve the accuracy of identifying a failed or failing component without unnecessarily replacing additional components in the SAN fabric (FICON cards, optics, cables, and so on).

LinuxONE FCP channels and the IOP code will provide a means to read this additional diagnostic data for all the ports accessed in the I/O configuration and make the data available to a LinuxONE partition. For LinuxONE, z/VM, and KVM for IBM z Systems clients utilizing FCP channels, this diagnostic data will be available in a new panel in the SAN Explorer tool.

The initial RDP support will be for data collection and display only. In the future, IBM will investigate the possibility of doing analysis on this collected data.

10GbE RoCE Express

The 10 Gigabit Ethernet (10GbE) RoCE Express feature can be used in a LinuxONE system to provide an alternative to the Open Systems Adapter (OSA) for 10GbE Ethernet communications. Utilizing Single Root I/O Virtualization (SR-IOV), a single adapter can be shared across 31 Linux images.

STP -- Time synchronization

Server Time Protocol (STP) is designed to allow events occurring in different servers to be properly sequenced in time. STP is designed for servers that need time synchronization.

STP is a server-wide facility that is implemented in the Licensed Internal Code (LIC), presenting a single view of time to Processor Resource/Systems Manager (PR/SM). STP uses a message-based protocol in which timekeeping information is passed over externally defined links between servers. The STP design introduced a concept called Coordinated Timing Network (CTN), a collection of servers that are time-synchronized to a time value called Coordinated Server Time. A CTN can be configured as an STP-only CTN.

STP enhancements

- Initialize Time Panel enhanced to list time zone and leap second offset as well as to indicate if the system time was set; this enables users to quickly check fields during CTN configuration.
- Set Date and Time Panel enhanced to encourage use of External Time Source to set CTN time.
- Time Zone panel enhanced with confirmation messages when setting STP time zone via adjust Time Zone panel on Current Time Server (CTS); also lists scheduled switch times for leap seconds and time zone/daylight savings time on Timing Network Tab.
- Support added for view-only STP.

IBM Wave for z/VM

IBM Wave for z/VM (IBM Wave) dramatically simplifies the management of virtualized environments into an intuitive experience, to help reduce the cost and skills of managing z/VM and Linux environments on LinuxONE servers.

IBM Wave's intelligent visualization of the virtual server environment and physical infrastructure provides intuitive management of physical servers, z/VM, Linux guests, and other resources. IBM Wave provides the necessary capabilities for virtual server provisioning and can readily scale as you grow your entire enterprise. With IBM Wave, you can rapidly gain insight into your entire virtualized infrastructure topology at a glance and also accelerate the path to a highly virtualized cloud infrastructure.

IBM Wave Release 2 further expands the capabilities by delivering increased support for Linux distributions and devices, reporting and auditing, as well as enterprise-grade security and performance enhancements. The Statements of Direction for enhanced audit logging and IBM Wave server support on RHEL 7 and SLES 12 distributions have been fulfilled with the latest service update in December 2015.

IBM Wave is a comprehensive management tool designed for administrators, operators, system programmers, and more. It is now included in several virtualization solutions on LinuxONE and IBM Infrastructure Suite.

IBM Wave is developed using lean and agile principles, providing enhancements and new function on an ongoing basis. These enhancements are made available via periodic service packs.

z/VM support for the IBM LinuxONE Driver D27:

- With the PTF for APAR VM65577, z/VM V6.2 and V6.3 provide guest exploitation support for Crypto Express5S, support for > 16 Crypto Express domains, and guest exploitation support for the new Regional Crypto Enablement adapters. The PTF for APAR VM65577 is available.
- With the PTF for APAR VM65716, planned to be available by March 10, 2016, z/VM V6.2 and V6.3 provide support for the following:

- LPAR Group Absolute Capacity Capping, enabling each partition to consume capacity up to its individual limit so long as the group's aggregate consumption does not exceed its absolute capacity limit.
- With the PTF for APAR VM65716, planned to be available by March 10, 2016, z/VM V6.3 will provide support for the following:
 - Dynamic Memory Management improved efficiency when a dynamic memory upgrade uses only a portion of the reserved main storage for the partition by initializing and clearing just the amount of storage requested.

z/VM support for the IBM LinuxONE Vector Facility

With the PTF for APAR VM65733, z/VM V6.3 enables guests to exploit the Vector Facility for z/Architecture (SIMD). The Vector Facility instructions provide a powerful framework for development of new Business Analytics workloads, porting numerically intensive workloads from other platforms, and accelerating Business Analytics workloads on IBM LinuxONE servers. The PTF is planned to be available by March 11, 2016.

z/VM SMT support

With the PTF for APAR VM65586, z/VM provides host exploitation support for SMT on IBM LinuxONE Emperor and IBM LinuxONE Rockhopper, which will enable z/VM to dispatch work on up to two threads (logical CPUs) of an IFL processor core. z/VM simultaneous multithreading support is enabled only for IFL processors in a Linux only mode or z/VM mode logical partition.

z/VM exploitation of SMT enables z/VM on IBM LinuxONE to dispatch work on an individual thread of a core, allowing a core to be shared by two guest CPUs or z/VM Control Program tasks. This can result in increased throughput per core from more efficient use of shared core resources.

Simultaneous multithreading support is available on a z/VM system only if the facility is installed on the hardware and enabled on the z/VM system with the MULTITHREADING system configuration statement. The MULTITHREADING statement is optional, and multithreading is disabled if the statement is omitted.

z/VM host simultaneous multithreading exploitation support does not virtualize threads for guest exploitation. However, Linux guests may benefit from the host support because the first-level z/VM system is able to achieve higher throughput from the multithreaded IFL cores.

z/VM CPU pools provide a mechanism for limiting the CPU resources consumed by a group of virtual machines to a specific capacity. In an environment without SMT, these capacities are enforced in terms of a number of cores. In an SMT environment, unless the PTF for APAR VM65680 is applied, these capacities are enforced in terms of a number of threads. Consequently, it might be necessary to increase the capacities of CPU pools, in order to provide adequate resource to CPU pool members. IBM recommends applying the PTF for APAR VM65680 if SMT is enabled.

z/VM multi-VSwitch link aggregation support

With the PTFs for APARs VM65583 and PI21053, z/VM V6.3 provides multi-VSwitch link aggregation support, allowing a port group of OSA-Express features to span multiple virtual switches within a single z/VM system or between multiple z/VM systems. Sharing a link aggregation port group (LAG) with multiple virtual switches increases optimization and utilization of the OSA-Express when handling larger traffic loads. Higher adapter utilization protects customer investments, which is increasingly important as 10 gigabit deployments become more prevalent. With this support, a port group is no longer required to be dedicated to a single virtual switch.

KVM for IBM z Systems provides open source virtualization for the IBM LinuxONE servers. For more information, refer to the Software Announcement for KVM for IBM z Systems and IBM LinuxONE, [AP15-0256](#), dated August 17, 2015. With the next

release of KVM for IBM z Systems and IBM LinuxONE, IBM intends to support several new capabilities.

KVM for IBM z Systems and IBM LinuxONE systems enhancements

- Simultaneous multithreading (SMT) exploitation for higher compute capacity and improved TCO.
- Updated Hypervisor Performance Management (HPM) for SMT exploitation to enhance policy-driven performance.
- Ability of guests to exploit the Vector Facility for z/Architecture (SIMD) to accelerate analytics type workloads.
- Hypervisor enhancements including support for iSCSI and NFS.
- Crypto exploitation to leverage hardware acceleration for cryptographic functions, improving TCO.
- Enhanced RAS capabilities:
 - Improved first failure data capture (FFDC) for easier problem determination.
 - Hypervisor and guest watchdog support for improved high availability configuration.
 - Unattended installation capability of hypervisor for ease of installation.

Hardware Management Console (HMC)

Absolute Capping of an LPAR Group

Absolute capping for an LPAR **group** will be provided on LinuxONE servers. Absolute Capping of an LPAR Group ensures that software licensing terms and conditions related to capacity are always met.

This feature provides the ability to define an absolute capping value for an entire LPAR group. The absolute cap value is specified to hundredths of a processor. A separate absolute cap value by processor type is supported within the group. When absolute capping is specified for a group this works independently of the Group Capacity value, and that LPAR Group Absolute Capping value will act as an additional control to truly enforce a maximum limit on capacity for the LPAR group.

Removal of Java Applet HMC task implementations

In the HMC 2.13.1 release, the implementations of the Operating System Messages, Integrated 3270 Console, Integrated ASCII Console, and Text Console customer tasks have been migrated from a Java Applet base to a remote browser execution scheme so that those tasks will no longer be affected by changes of Java levels on the remote workstations. In some cases the look and feel of those tasks will change slightly.

In addition, the Integrated 3270 Console has been enhanced. When multiple remote users are connected into the same HMC or different HMCs for a specific LPAR, any remote user will be able to take control of the Integrated 3270 Console session.

The changes to remove Java Applet implementations for the Operating System Messages, Integrated 3270 Console, and Integrated ASCII Console will be patched to the HMC 2.12.1 code level around the time that the HMC 2.13.1 is released. Note that the patches will slightly change the appearance and controls of the tasks being patched.

HMC 2.13.0 as well as 2.12.1 customers can take full advantage of the new implementation approach by upgrading to HMC 2.13.1.

OSA-ICC support for Secure Sockets Layer

Previously, IBM advised all customers who need a secure connection to install a VPN device between their server and client infrastructure. To avoid this requirement,

TLS/SSL with Certificate Authentication will be added to the HMC/SE support OSC CHPID to provide a secure and validated method for connecting clients to the LinuxONE host.

The HMC/SE support has a new Secure TCP port field added for each LAN port on the Edit Server Configuration panel. Additionally, the Card Specific Advanced Facilities will be updated to handle the certificate management.

ASCII translation for Display/Alter storage display

On LinuxONE servers, Display/Alter will display an EBCDIC translation of storage to the user in addition to a hex display of the data. In HMC 2.13.1 the user will now also be able to view an ASCII translation of storage. This is very useful for operating LinuxONE systems that handle text in ASCII.

ASHRAE class A3 for robustness, data center flexibility, and energy savings

The LinuxONE Rockhopper is rated for the ASHRAE class A3 environment for all models and configurations. Class A3 allows a wider operating temperature range (including up to 40°C inlet air), as well as a wider humidity range than the previous generation's class A2 rating. This provides significant additional system robustness and safety margin for data center cooling and humidity control failures. It allows installation in a wider range of data centers, including lower-cost data centers. Energy savings are enabled in multiple ways. The increased temperature and humidity range provides the opportunity to use compressor-less cooling solutions in many locales. Additionally, the expanded temperature range allows for a data center to run at a higher temperature for some time periods with high external temperatures, reducing the required cooling infrastructure and energy usage.

Product positioning

IBM z13s

The newest member of the IBM z Systems family, the z13s, is designed to deliver new levels of performance and capacity for small to mid-size companies; whereas the z13 is targeted to larger companies. From the microprocessor to the software that exploits it, the z13 and z13s are designed to enable the digital era for hybrid cloud, mobile, and advanced analytics capabilities. Users are able to efficiently store, manage, retrieve, and analyze vast amounts of data for business insight without unnecessary cost or complexity. Additionally, z13s and z13 both bring trusted security and reliability at every level for critical business processes and applications, and protect data that is the most valuable resource of your business.

Analytics offers the opportunity to anticipate demand and infuse systematic processing into every new solution. A key value is the integration of analytics with business-critical transactions to deliver real-time insights for the next best action, at the most impactful time. Examples include being able to send offers to shoppers based on loyalty status and buying history, or providing up-sell or cross-sell opportunities, or understanding the potential for fraud when your client's credit card is being used inconsistently with prior purchases or in locations not consistent with the client's physical location. The z13s offers up to 4 TB of RAIM memory while the z13 offers up to 10 TB of RAIM memory; both offer 2x system I/O bandwidth. Both on-chip and feature compression help to serve up more of the right data at the critical point of impact. The z13 and z13s are designed for real-time transactional analytics.

Mobile applications are no longer just about consumer applications; they are enabling how we transact business and do our jobs. They are now connected to the Internet of Things, gathering data and transacting with not only smartphones, but numerous other devices that sense and monitor physical conditions, machines, and infrastructure. What used to be a single retail banking transaction that would have involved an account lookup and withdrawal, has been transformed into something else, often kicking off 10x or more incremental transactions to improve the client experience and offer your business the opportunity to conduct more business. To

keep up with the volume and pace of supporting mobile applications, you need a back-end infrastructure that is fast, accurate, and secure. z13s can scale up to 20 configurable cores, z13 can scale up to 141 configurable cores, and both include intelligent I/O with workload management, enhanced error correction capability, and improved recovery. Both z13 and z13s offer next-generation security enhancements including a performance improvement on the Crypto Express5S to support the mobile world. z13s and z13 are designed for secure transactional growth.

Everyone is looking for ways to leverage the cloud and to provide greater levels of efficiency through new IT delivery models. City governments can ensure effective administration of citizen services. Universities can provide students virtual desktops with flexible, reliable, and secure access. Insurers can rapidly develop and provide new offerings at lower costs. But challenges exist in scale, speed, and management of cloud deployments. z13s is designed for scaling with throughput improvement for Integrated Facility for Linux and IBM z Integrated Information Processor specialty engines using simultaneous multithreading. Simultaneous multithreading is also available on z13s. z13s and z13 deliver the infrastructure with z Systems qualities of service for enterprise-grade Linux on either z/VM or KVM for IBM z. IBM zAware can now proactively detect anomalies in message logs for Linux on z Systems to provide an improved availability solution to help maximize service levels. With z13s and z13, IBM is committed to open standards and has enhanced sharing of I/O and networking features. Implementation of the GDPS Appliance for Linux offers business continuity in support of cloud. z13s and z13 enable the rapid and flexible development and delivery of new offerings and are designed for efficiency and trusted hybrid cloud services.

z13s and z13 continue to provide heterogeneous platform investment protection with the updated IBM z BladeCenter Extension (zBX) Model 004 and IBM z Unified Resource Manager. Enhancements to the zBX include the uncoupling of the zBX from the server and installing redundant Support Elements (SEs) into the zBX. zBX Model 002 and Model 003 can be upgraded to the zBX Model 004.

IBM LinuxONE

IBM LinuxONE is built to be the backbone of the mobile era, setting new standards in transaction volume, speed, resilience, and trust. It scales to support 30 billion web transactions a day without fail. It's designed to deliver fast subsecond response times and dependability, which means it's a system designed not to fail. With the highest level of security certification for commercial servers in the industry, clients can trust LinuxONE. What does this mean for your business? It means not making your customers wait, being sure your data is protected, and never giving your competitors a chance because your IT solution failed to deliver.

LinuxONE is designed to provide a robust, securable, available Linux-focused platform for mission-critical workloads, and to deliver the scale for new app economy deployments via mobile or the cloud. LinuxONE builds on a strong heritage of enterprise platform development within IBM focused on Linux and shares components with other IBM systems offerings. While the processor, memory, and cache are shared components with z Systems, and the I/O subsystem leverages POWER^(R) processors, the user experience is very different.

One example is Elastic Pricing, which is available only on LinuxONE systems. As Linux infrastructure buyers decide on which infrastructure to deploy their application on, they have a choice between on-premises and off-premises infrastructures. LinuxONE Elastic Pricing plays a role in this analysis and is designed to give buyers the ability to pay as they grow in a cloud-pricing model for on-premises infrastructure. Another example is how LinuxONE systems come bundled with IBM Resiliency analytics for LinuxONE (orderable as IBM zAware) and IBM Wave (if purchased with z/VM).

The commonality of components is a thing to be embraced as it enables IBM to leverage the best components in the industry to deliver different solutions focused on different requirements being driven by different market dynamics.

LinuxONE can leverage the best of the IBM Systems portfolio and package these components to deliver the best platform for the dynamics of open source applications and databases such as MongoDB, PostgreSQL, MariaDB, and Cloudant^(R), delivered on Linux as an operating system, be that Red Hat, SUSE, or Ubuntu, all the time being laser focused on performance, availability, scale, and security.

Statement of general direction

IBM Wave support for Canonical Ubuntu distributions for IBM z Systems and IBM LinuxONE

IBM intends to provide support for the planned Canonical Ubuntu distributions with IBM Wave in future service packs. This support is planned to be staged, initially supporting virtual servers with Canonical Ubuntu. Support of the installation and execution of the IBM Wave server (IBM WAVESRV) on Canonical Ubuntu distributions is planned to be delivered within the service stream.

Removal of an option for the way shared logical processors are managed under PR/SM LPAR

The IBM z13 and IBM z13s will be the last servers to support selection of the option to "Do not end the timeslice if a partition enters a wait state" when the option to set a processor runtime value has been previously selected in the CPC RESET profile. The CPC RESET profile applies to all shared logical partitions on the machine, and is not selectable by the logical partition.

Removal of support for the HCA3-O fanout for 12x IFB InfiniBand coupling links for mid-range z Systems

The IBM z13s will be the last mid-range z Systems server to support HCA3-O (#0171) 12x IFB InfiniBand coupling links. Mid-range z Systems enterprises should continue migrating to the Integrated Coupling Adapter (ICA-SR) (#0172) for high-speed short-range coupling connectivity.

Note: zBC12 and zEC12 enterprises will not have short-distance coupling connectivity to the mid-range z Systems generation following IBM z13s; migration to the Integrated Coupling Adapter (ICA SR) (#0172) on IBM z13, IBM z13s, and future server generations will need to be considered for future connectivity.

Note: The next generation high-end z Systems server following IBM z13 will continue to support HCA3-O (#0171) 12x IFB InfiniBand coupling links.

Reduced support for the CPU Measurement Facility Problem-State counter set on IBM z Systems and IBM LinuxONE servers

The CPU Measurement Facility (CPUMF) provides four CPU counter sets on each server (basic, problem-state, crypto-activity, and extended). Counters in the CPU counter sets count CPU activities on a logical CPU basis, incrementing for specific activities by one for each CPU cycle when the CPU is in the operating state, and the counter set is active. The problem-state counter set consists of 6 counter values, one of which is the instruction count, which counts the total number of instructions executed when the CPU is in the problem state. IBM z13, IBM z13s, IBM LinuxONE Emperor, and IBM LinuxONE Rockhopper will be the last server generations to support 6 counters in the problem-state counter set. On future servers, the number of implemented counters in the problem-state counter set will be reduced to 1: the problem state instruction count.

Removal of support for SCSI IPL from FCP attached optical media

The IBM z13, IBM z13s, IBM LinuxONE Emperor, and IBM LinuxONE Rockhopper will be the last servers to support load type "SCSI" for Initial Program Load from FCP attached optical media (for example, installation DVDs). Load type "SCSI" will continue to be supported for IPL from FCP disks.

For loading from optical media, clients should instead use the "Load from Removable Media, or Server" and select "Local removable media device (CD/DVD-ROM drive)" as the source of the software. Alternatively, operating system software or utility programs may also be loaded from a server that can be accessed using FTP (using the "Load from Removable Media, or Server" task, and selecting "FTP Source" as the source of the software).

IBM's statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM's sole discretion. Information regarding potential future products is intended to outline our general product direction and it should not be relied on in making a purchasing decision. The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code, or functionality. Information about potential future products may not be incorporated into any contract. The development, release, and timing of any future features or functionality described for our products remain at our sole discretion.

Reference information

For more information about the IBM z13 announced on January 14, 2015, refer to Hardware Announcement [AG15-0001](#), dated January 14, 2015.

For more information about z/OS V2.2 announced on July 28, 2015, refer to Software Announcement [AP15-0262](#), dated July 28, 2015.

For more information on KVM for IBM z Systems announced on August 17, 2015, refer to Software Announcement [AP15-0256](#), dated August 17, 2015.

For more information on the z/VM V6.4 Preview, refer to Software Announcement [AP16-0008](#), dated February 16, 2016.

For more information on the Technology Transition Offerings for the IBM z13s, refer to Software Announcement [AP16-0007](#), dated February 16, 2016.

Product number

The following models and feature codes are now available for the IBM z13 (MT 2964), in addition to those announced on January 14, 2015.

Description	Machine Type	Model	Feature
IBM z13	2964	N30	
		N63	
		N96	
		NC9	
		NE1	
HW for DPM			0016
HMC Tower			0095
HMC Rack Mount			0096
TKE Rack Mount			0097
TKE Tower			0098
TKE 8.1 LIC			0878
5280 GB Memory			2507
On/Off CoD Act 100 IFL Day			9874
Description	Machine Type	Model	Feature
RCE Vendor 1			0901

The following feature codes are now available on the IBM z13s (MTM 2965).

Description	Machine Type	Model	Feature
IBM z13s	2965	N10	
		N20	
MTU 1 - D			0001
MTU 100 - D			0002
MTU 1 - V			0003
MTU 100 - V			0004
GTU 1 - D			0005
GTU 100 - D			0006
GTU 1 - V			0007
GTU 100 - V			0008
GTU 1000 - D			0009
GTU 1000 - V			0010
HW for DPM			0016
Manage FW Suite			0019
Automate FW Suite			0020
Ensemble Membership Flag			0025
HMC w/Dual EN			0092
HMC Rack Mount			0094
HMC Tower			0095
HMC Rack Mount			0096
TKE Rack Mount			0097
TKE Tower			0098
1 CPE Capacity Unit			0116
100 CPE Capacity Unit			0117
10000 CPE Capacity Unit			0118
1 CPE Capacity Unit-IFL			0119
100 CPE Capacity Unit-IFL			0120
1 CPE Capacity Unit-ICF			0121
100 CPE Capacity Unit-ICF			0122
1 CPE Capacity Unit-zIIP			0125
100 CPE Capacity Unit-zIIP			0126
1 CPE Capacity Unit-SAP			0127
100 CPE Capacity Unit-SAP			0128
CPC			0146

Description	Machine Type	Model	Feature
I/O Cage Full Card Airflow			0114
Fanout Airflow			0165
HCA3-O LR fanout for 1x IFB			0170
HCA3-O fanout for 12x IFB			0171
ICA SR fanout			0172
PCIe fanout Gen3			0173
Fanout airflow PCIe			0174
US English			0235
France			0236
German/Austrian			0237
LA Spanish			0238
Spain			0239
Italian			0240
French Canadian			0241
Portuguese			0242
UK English			0243
Norwegian			0244
Sweden Finland			0245
Netherlands			0246
Belgian French			0247
Denmark			0248
Swiss French/ German			0249
PCIe Interconnect Gen3			0401
Flash Express			0403
FICON Express8S 10Km LX			0409
FICON Express8S SX			0410
10 GbE RoCE Express			0411
OSA-Express5S GbE LX			0413
OSA-Express5S GbE SX			0414
OSA-Express5S 10 GbE LR			0415
OSA-Express5S 10 GbE SR			0416
OSA-Express5S 1000BASE-T			0417
FICON Express16S LX			0418
FICON Express16S SX			0419
zEDC Express			0420
Read-Only Media Option			0845
TKE workstation			0847
32GB USB backup media			0848
TKE 8.1 LIC			0878
Crypto Express5S			0890

Description	Machine Type	Model	Feature
TKE Smart Card Reader			0891
TKE addl smart cards			0892
4767 TKE Crypto Adapter			0894
Description	Machine Type	Model	Feature
RCE Vendor 1			0901
Description	Machine Type	Model	Feature
UID Label for DoD			0998
IBM zAware			0011
IBM zAware 2pack			1012
IBM zAware 4pack			1013
IBM zAware 6pack			1014
IBM zAware 10 pack			1015
IBM zAware DR 2pack			1017
IBM zAware DR 4pack			1018
IBM zAware DR 6pack			1019
IBM zAware DR 10pack			1020
STP Enablement			1021
EMEA Special Operations			1022
16 GB Mem DIMM(5/feat)			1620
32 GB Mem DIMM(5/feat)			1621
64 GB Mem DIMM(5/feat)			1622
128 GB Mem DIMM(5/feat)			1623
LICCC Ship Via Net Ind			1750
3x 16GB Capacity Incr			1887
3x 8GB Capacity Incr			1888
3x 8GB Carry Forward			1889
Mega 16GB Capacity Incr			1890
Mega 8GB Capacity Incr			1891
Mega 8GB Carry Forward			1892
16GB Memory Capacity Incr			1899
8GB Memory Capacity Incr			1903
8GB FTR Converted Memory			1904

Description	Machine Type	Model	Feature
8GB Preplanned memory			1993
16GB Preplanned memory			1996
64 GB Memory			3616
72 GB Memory			3617
80 GB Memory			3618
88 GB Memory			3619
120 GB Memory			3623
152 GB Memory			3624
184 GB Memory			3625
216 GB Memory			3626
248 GB Memory			3627
280 GB Memory			3640
312 GB Memory			3641
344 GB Memory			3642
408 GB Memory			3643
472 GB Memory			3644
536 GB Memory			3645
600 GB Memory			3646
728 GB Memory			3647
856 GB Memory			3648
984 GB Memory			3649
Flat Panel Display			6096
Balanced Power Plan Ahead			3003
BPD Pair			3012
BPR Pair			3013
Internal Battery IBF			3215
Universal Lift Tool/ Ladder			3105
Universal Lift Tool upgr kit			3103
Serv Docs Optional Print			0033
CPACF Enablement			3863
PCIe I/O Drawer			4032
Top Exit Cabling			7920
Side Covers			7921
FQC Bracket & Mounting Hdw			7932
LC Duplex 6.6ft Harness			7933
Non Raised Floor Support			7998
4-in-1 Bolt Down Kit			8021
Bolt Down Kit NRF			8022
0-Way Processor A00			3700

Description	Machine Type	Model	Feature
1-Way Processor A01			3701
1-Way Processor B01			3702
1-Way Processor C01			3703
1-Way Processor D01			3704
1-Way Processor E01			3705
1-Way Processor F01			3706
1-Way Processor G01			3707
1-Way Processor H01			3708
1-Way Processor I01			3709
1-Way Processor J01			3710
1-Way Processor K01			3711
1-Way Processor L01			3712
1-Way Processor M01			3713
1-Way Processor N01			3714
1-Way Processor O01			3715
1-Way Processor P01			3716
1-Way Processor Q01			3717
1-Way Processor R01			3718
1-Way Processor S01			3719
1-Way Processor T01			3720
1-Way Processor U01			3721
1-Way Processor V01			3722
1-Way Processor W01			3723
1-Way Processor X01			3724
1-Way Processor Y01			3725
1-Way Processor Z01			3726
2-Way Processor A02			3727
2-Way Processor B02			3728
2-Way Processor C02			3729
2-Way Processor D02			3730
2-Way Processor E02			3731

Description	Machine Type	Model	Feature
2-Way Processor F02			3732
2-Way Processor G02			3733
2-Way Processor H02			3734
2-Way Processor I02			3735
2-Way Processor J02			3736
2-Way Processor K02			3737
2-Way Processor L02			3738
2-Way Processor M02			3739
2-Way Processor N02			3740
2-Way Processor O02			3741
2-Way Processor P02			3742
2-Way Processor Q02			3743
2-Way Processor R02			3744
2-Way Processor S02			3745
2-Way Processor T02			3746
2-Way Processor U02			3747
2-Way Processor V02			3748
2-Way Processor W02			3749
2-Way Processor X02			3750
2-Way Processor Y02			3751
2-Way Processor Z02			3752
3-Way Processor A03			3753
3-Way Processor B03			3754
3-Way Processor C03			3755
3-Way Processor D03			3756
3-Way Processor E03			3757
3-Way Processor F03			3758
3-Way Processor G03			3760
3-Way Processor H03			3761
3-Way Processor I03			3762
3-Way Processor J03			3763

Description	Machine Type	Model	Feature
3-Way Processor K03			3764
3-Way Processor L03			3765
3-Way Processor M03			3766
3-Way Processor N03			3767
3-Way Processor O03			3768
3-Way Processor P03			3769
3-Way Processor Q03			3770
3-Way Processor R03			3771
3-Way Processor S03			3772
3-Way Processor T03			3773
3-Way Processor U03			3774
3-Way Processor V03			3775
3-Way Processor W03			3776
3-Way Processor X03			3777
3-Way Processor Y03			3778
3-Way Processor Z03			3779
4-Way Processor A04			3780
4-Way Processor B04			3781
4-Way Processor C04			3782
4-Way Processor D04			3783
4-Way Processor E04			3784
4-Way Processor F04			3785
4-Way Processor G04			3786
4-Way Processor H04			3787
4-Way Processor I04			3788
4-Way Processor J04			3789
4-Way Processor K04			3790
4-Way Processor L04			3791
4-Way Processor M04			3792
4-Way Processor N04			3793
4-Way Processor O04			3794

Description	Machine Type	Model	Feature
4-Way Processor P04			3795
4-Way Processor Q04			3796
4-Way Processor R04			3797
4-Way Processor S04			3798
4-Way Processor T04			3799
4-Way Processor U04			3800
4-Way Processor V04			3801
4-Way Processor W04			3802
4-Way Processor X04			3803
4-Way Processor Y04			3804
4-Way Processor Z04			3805
5-Way Processor A05			3806
5-Way Processor B05			3807
5-Way Processor C05			3808
5-Way Processor D05			3809
5-Way Processor E05			3810
5-Way Processor F05			3811
5-Way Processor G05			3812
5-Way Processor H05			3813
5-Way Processor I05			3814
5-Way Processor J05			3815
5-Way Processor K05			3816
5-Way Processor L05			3817
5-Way Processor M05			3818
5-Way Processor N05			3819
5-Way Processor O05			3820
5-Way Processor P05			3821
5-Way Processor Q05			3822
5-Way Processor R05			3823
5-Way Processor S05			3824
5-Way Processor T05			3825

Description	Machine Type	Model	Feature
5-Way Processor U05			3826
5-Way Processor V05			3827
5-Way Processor W05			3828
5-Way Processor X05			3829
5-Way Processor Y05			3830
5-Way Processor Z05			3831
6-Way Processor A06			3832
6-Way Processor B06			3833
6-Way Processor C06			3834
6-Way Processor D06			3835
6-Way Processor E06			3836
6-Way Processor F06			3837
6-Way Processor G06			3838
6-Way Processor H06			3839
6-Way Processor I06			3840
6-Way Processor J06			3841
6-Way Processor K06			3842
6-Way Processor L06			3843
6-Way Processor M06			3844
6-Way Processor N06			3845
6-Way Processor O06			3846
6-Way Processor P06			3847
6-Way Processor Q06			3848
6-Way Processor R06			3849
6-Way Processor S06			3850
6-Way Processor T06			3851
6-Way Processor U06			3852
6-Way Processor V06			3853
6-Way Processor W06			3854
6-Way Processor X06			3855
6-Way Processor Y06			3856

Description	Machine Type	Model	Feature
6-Way Processor Z06			3857
CP-A			6273
CP-B			6274
CP-C			6275
CP-D			6276
CP-E			6277
CP-F			6278
CP-G			6279
CP-H			6280
CP-I			6281
CP-J			6282
CP-K			6283
CP-L			6284
CP-M			6285
CP-N			6286
CP-O			6287
CP-P			6288
CP-Q			6289
CP-R			6290
CP-S			6291
CP-T			6292
CP-U			6293
CP-V			6294
CP-W			6295
CP-X			6296
CP-Y			6297
CP-Z			6298
IFL			1924
ICF			1925
SAP (optional)			1926
zIIP			1927
Unassigned IFL			1928
A00 Capacity Marker			9227
A01 Capacity Marker			9228
B01 Capacity Marker			9229
C01 Capacity Marker			9230
D01 Capacity Marker			9231
E01 Capacity Marker			9232
F01 Capacity Marker			9233
G01 Capacity Marker			9234
H01 Capacity Marker			9235
I01 Capacity Marker			9236
J01 Capacity Marker			9237
K01 Capacity Marker			9238

Description	Machine Type	Model	Feature
L01 Capacity Marker			9239
M01 Capacity Marker			9240
N01 Capacity Marker			9241
O01 Capacity Marker			9242
P01 Capacity Marker			9243
Q01 Capacity Marker			9244
R01 Capacity Marker			9245
S01 Capacity Marker			9246
T01 Capacity Marker			9247
U01 Capacity Marker			9248
V01 Capacity Marker			9249
W01 Capacity Marker			9250
X01 Capacity Marker			9251
Y01 Capacity Marker			9252
Z01 Capacity Marker			9253
A02 Capacity Marker			9254
B02 Capacity Marker			9255
C02 Capacity Marker			9256
D02 Capacity Marker			9257
E02 Capacity Marker			9258
F02 Capacity Marker			9259
G02 Capacity Marker			9260
H02 Capacity Marker			9261
I02 Capacity Marker			9262
J02 Capacity Marker			9263
K02 Capacity Marker			9264
L02 Capacity Marker			9265
M02 Capacity Marker			9266
N02 Capacity Marker			9267
O02 Capacity Marker			9268
P02 Capacity Marker			9269

Description	Machine Type	Model	Feature
Q02 Capacity Marker			9270
R02 Capacity Marker			9271
S02 Capacity Marker			9272
T02 Capacity Marker			9273
U02 Capacity Marker			9274
V02 Capacity Marker			9275
W02 Capacity Marker			9276
X02 Capacity Marker			9277
Y02 Capacity Marker			9278
Z02 Capacity Marker			9279
A03 Capacity Marker			9280
B03 Capacity Marker			9281
C03 Capacity Marker			9282
D03 Capacity Marker			9283
E03 Capacity Marker			9284
F03 Capacity Marker			9285
G03 Capacity Marker			9286
H03 Capacity Marker			9287
I03 Capacity Marker			9288
J03 Capacity Marker			9289
K03 Capacity Marker			9290
L03 Capacity Marker			9291
M03 Capacity Marker			9292
N03 Capacity Marker			9293
O03 Capacity Marker			9294
P03 Capacity Marker			9295
Q03 Capacity Marker			9296
R03 Capacity Marker			9297
S03 Capacity Marker			9298
T03 Capacity Marker			9299
U03 Capacity Marker			9300

Description	Machine Type	Model	Feature
V03 Capacity Marker			9301
W03 Capacity Marker			9302
X03 Capacity Marker			9303
Y03 Capacity Marker			9304
Z03 Capacity Marker			9305
A04 Capacity Marker			9306
B04 Capacity Marker			9307
C04 Capacity Marker			9308
D04 Capacity Marker			9309
E04 Capacity Marker			9310
F04 Capacity Marker			9311
G04 Capacity Marker			9312
H04 Capacity Marker			9313
I04 Capacity Marker			9314
J04 Capacity Marker			9315
K04 Capacity Marker			9316
L04 Capacity Marker			9317
M04 Capacity Marker			9318
N04 Capacity Marker			9319
O04 Capacity Marker			9320
P04 Capacity Marker			9321
Q04 Capacity Marker			9322
R04 Capacity Marker			9323
S04 Capacity Marker			9324
T04 Capacity Marker			9325
U04 Capacity Marker			9326
V04 Capacity Marker			9327
W04 Capacity Marker			9328
X04 Capacity Marker			9329
Y04 Capacity Marker			9330
Z04 Capacity Marker			9331

Description	Machine Type	Model	Feature
A05 Capacity Marker			9332
B05 Capacity Marker			9333
C05 Capacity Marker			9334
D05 Capacity Marker			9335
E05 Capacity Marker			9336
F05 Capacity Marker			9337
G05 Capacity Marker			9338
H05 Capacity Marker			9339
I05 Capacity Marker			9340
J05 Capacity Marker			9341
K05 Capacity Marker			9342
L05 Capacity Marker			9343
M05 Capacity Marker			9344
N05 Capacity Marker			9345
O05 Capacity Marker			9346
P05 Capacity Marker			9347
Q05 Capacity Marker			9348
R05 Capacity Marker			9349
S05 Capacity Marker			9350
T05 Capacity Marker			9351
U05 Capacity Marker			9352
V05 Capacity Marker			9353
W05 Capacity Marker			9354
X05 Capacity Marker			9355
Y05 Capacity Marker			9356
Z05 Capacity Marker			9357
A06 Capacity Marker			9358
B06 Capacity Marker			9359
C06 Capacity Marker			9360
D06 Capacity Marker			9361
E06 Capacity Marker			9362

Description	Machine Type	Model	Feature
F06 Capacity Marker			9363
G06 Capacity Marker			9364
H06 Capacity Marker			9365
I06 Capacity Marker			9366
J06 Capacity Marker			9367
K06 Capacity Marker			9368
L06 Capacity Marker			9369
M06 Capacity Marker			9370
N06 Capacity Marker			9371
O06 Capacity Marker			9372
P06 Capacity Marker			9373
Q06 Capacity Marker			9374
R06 Capacity Marker			9375
S06 Capacity Marker			9376
T06 Capacity Marker			9377
U06 Capacity Marker			9378
V06 Capacity Marker			9379
W06 Capacity Marker			9380
X06 Capacity Marker			9381
Y06 Capacity Marker			9382
Z06 Capacity Marker			9383
Additional CBU Test			6805
Total CBU Years Ordered			6817
CBU Records Ordered			6818
Single CBU CP-Year			6820
25 CBU CP-Year			6821
Single CBU IFL-Year			6822
25 CBU IFL-Year			6823
Single CBU ICF-Year			6824
25 CBU ICF-Year			6825
Single CBU zIIP-Year			6828
25 CBU zIIP-Year			6829

Description	Machine Type	Model	Feature
Single CBU SAP-Year			6830
25 CBU SAP-Year			6831
CBU Replenishment			6832
Capacity for Planned Event			6833
OPO Sales Flag			6835
OPO Sales Flag Alteration			6836
Multi Order Ship Flag			9000
Multi Order Rec Only-NB			9001
Multi Order Rec Only-MES			9002
RPO Action Flag			9003
Downgraded PUs Per Request			9004
On/Off CoD Act IFL Day			9888
On/Off CoD Act 100 IFL Day			9874
On/Off CoD Act ICF Day			9889
On/Off CoD authorization			9896
On/Off CoD Act Cap CP Day			9897
Perm upgr authorization			9898
CIU Activation (Flag)			9899
On Line CoD Buying (Flag)			9900
On/Off CoD Act zIIP Day			9908
On/Off CoD Act SAP Day			9909
CBU authorization			9910
CPE authorization			9912
OPO sales authorization			9913
1 MSU day			9917
100 MSU days			9918
10000 MSU days			9919
1 IFL day			9920
100 IFL days			9921
1 ICF day			9922
100 ICF days			9923
1 zIIP day			9924
100 zIIP days			9925
1 SAP day			9928
100 SAP days			9929
Height Reduce Ship			9975

Description	Machine Type	Model	Feature
Height Reduce for Return			9976
Description	Machine Type	Model	Feature
14ft HiLoV 3Ph Cut Top Exit			8970
14ft HiLoV 1Ph Cut Top Exit			8972
14ft 380-520V DC Cut Cord			8964
14ft 380-520V Cut TE			8974
14t Hi/LoV 3 Ph Cut Cord			8988
14ft HiLoV 1 Ph Cut Cord			8991
14ft HiV 3Ph Cut line-LSZH			8998
Description	Machine Type	Model	Feature
IBM z13s	2965	N20	
Second CPC			1045
1112 GB Memory			3650
1240 GB Memory			3651
1368 GB Memory			3652
1496 GB Memory			3653
1624 GB Memory			3654
1752 GB Memory			3655
1880 GB Memory			3656
2008 GB Memory			3657
2264 GB Memory			3658
2520 GB Memory			3659
2776 GB Memory			3660
3032 GB Memory			3661
3288 GB Memory			3662
3544 GB Memory			3663
3800 GB Memory			3664
4056 GB Memory			3665
Description	Machine Type	Model	Feature
IBM z13s	2965	N10	
Model N10 Air Cooled			1043
		N20	
Model N20 Air Cooled			1044

Features that may carry forward on an upgrade:

The following features are not orderable on the IBM z13s models. If they are installed at the time of an upgrade to the IBM z13s, they may be retained.

Description	Machine Type	Model	Feature
IBM z13s	2965	N10	
		N20	
HCA2-C Fanout			0162
IFB-MP Daughter Card			0326
STI-A8 Mother Card			0327
Flash Express			0402

Description	Machine Type	Model	Feature
OSA-Express4S 1 GbE LX			0404
OSA-Express4S 1 GbE SX			0405
OSA-Express4S 10 GbE LR			0406
OSA-Express4S 10 GbE SR			0407
Addl smart cards			0884
TKE Smart Card Reader			0885
I/O Drawer			4000
FICON Express8 10KM LX			3325
FICON Express8 SX			3326
Universal Lift Tool/Ladder			3759
Description	Machine Type	Model	Feature
14ft HiV 1ph cut line LSZH			8999

Notes:

1. Memory DIMMs do NOT carry forward.
2. Support Elements do NOT carry forward.

The following models and feature codes are now available on the IBM LinuxONE Emperor (MT 2964).

Description	Machine Type	Model	Features
IBM LinuxONE Emperor	2964		
		L30	
		L63	
		L96	
		LC9	
		LE1	
MTU 1 - D			0001
MTU 100 - D			0002
MTU 1 - V			0003
MTU 100 - V			0004
GTU 1 - D			0005
GTU 100 - D			0006
GTU 1 - V			0007
GTU 100 - V			0008
GTU 1000 - D			0009
GTU 1000 - V			0010
HW for DPM			0016
HMC w/Dual EN			0092
HMC Rack Mount			0094
HMC Tower			0095
HMC Rack Mount			0096
TKE Rack Mount			0097
TKE Tower			0098

1 CPE Capacity Unit		0116
100 CPE Capacity Unit		0117
10000 CPE Capacity Unit		0118
1 CPE Capacity Unit-IFL		0119
100 CPE Capacity Unit-IFL		0120
1 CPE Capacity Unit-SAP		0127
100 CPE Capacity Unit-SAP		0128
<hr/>		
A Fr Radiator		4027
A Fr Water		4028
<hr/>		
Fanout Airflow		0165
PCIe fanout Gen3		0173
Fanout airflow PCIe		0174
<hr/>		
Manage FW Suite		0019
Automate FW Suite		0020
Ensemble membership		0025
<hr/>		
IBM zAware		0011
IBM zAware 10 pack		1010
IBM zAware DR 10 pack		1011
<hr/>		
PCIe Interconnect Gen3		0401
Flash Express		0403
FICON Express8S 10Km LX		0409
FICON Express8S SX		0410
10 GbE RoCE Express		0411
OSA-Express5S GbE LX		0413
OSA-Express5S GbE SX		0414
OSA-Express5S 10 GbE LR		0415
OSA-Express5S 10 GbE SR		0416
OSA-Express5S 1000BASE-T		0417
FICON Express16S LX		0418
FICON Express16S SX		0419
zEDC Express		0420

Read-Only Media Option	0845
TKE workstation	0847
4767 TKE Crypto Adapter	0894
32GB USB backup media	0848
TKE 8.1 LIC	0878
Crypto Express5S	0890
TKE Smart Card Reader	0891
TKE addl smart cards	0892
<hr/>	
UID Label for DoD	0998
STP Enablement	1021
EMEA Special Operations	1022
<hr/>	
16 GB Mem DIMM(5/feat)	1610
32 GB Mem DIMM(5/feat)	1611
64 GB Mem DIMM(5/feat)	1612
128 GB Mem DIMM(5/feat)	1613
<hr/>	
LICCC Ship Via Net Ind	1750
32GB Memory Capacity Incr	1898
16GB Memory Capacity Incr	1899
32GB Preplanned memory	1990
16GB Preplanned memory	1996
Line Cord Plan Ahead	2000
<hr/>	
64 GB Memory	2427
96 GB Memory	2429
128 GB Memory	2431
160 GB Memory	2433
192 GB Memory	2435
256 GB Memory	2439
320 GB Memory	2441
384 GB Memory	2443
448 GB Memory	2445
544 GB Memory	2484
640 GB Memory	2485
736 GB Memory	2486
832 GB Memory	2487
928 GB Memory	2488
1056 GB Memory	2489
1184 GB Memory	2490
1312 GB Memory	2491
1440 GB Memory	2492
1696 GB Memory	2493

1952 GB Memory		2494
2208 GB Memory		2495
2464 GB Memory		2496
US English		0235
France		0236
German/Austrian		0237
LA Spanish		0238
Spain		0239
Italian		0240
French Canadian		0241
Portuguese		0242
UK English		0243
Norwegian		0244
Sweden Finland		0245
Netherlands		0246
Belgian French		0247
Denmark		0248
Swiss French/ German		0249
Flat Panel Display		6096
Balanced Power Plan Ahead		3003
BPD Pair		3010
BPR Pair		3011
Internal Battery IBF		3214
Fill and Drain Kit		3380
Fill and Drain adapter kit		3379
Universal Lift Tool/ Ladder		3105
Universal Lift Tool upgr kit		3103
Serv Docs Optional Print		0033
CPACF Enablement		3863
PCIe I/O Drawer		4012
14ft Water Hose		7801
FQC Bracket & Mounting Hdw		7929
LC Duplex 6.6ft Harnesses		7930
LC Duplex 8.5ft Harness		7931
LC Duplex 12ft Harness		7936
Top Exit I/O Cabling		7942
Side Covers		7949
Non Raised Floor Support		7998

4-in-1 Bolt Down Kit			8018
3-in-1 Bolt Down Kit-W			8019
Bolt Down Kit NRF			8020
Description	Machine Type	Model	Feature
14ft 380-570V DC cut TE cd			8948
14ft LoV 3ph cut TE cord			8949
14ft HiV 3ph cut TE cord			8951
14ft 380-570V DC cut cord			8965
14ft LoV 3ph cut line cord			8982
14ft HiV 3ph cut line cord			8988
14ft 200-240V 3ph cut-LSZH			8996
14ft HiV 3ph cut line-LSZH			8998
Description	Machine Type	Model	Feature
Multi Order Ship Flag			9000
Multi Order Rec Only-NB			9001
Multi Order Rec Only-MES			9002
RPO Action Flag			9003
Downgraded PUs Per Request			9004
On/off CoD Act 100 IFL Day			9874
On/Off CoD Act IFL Day			9888
On/Off CoD authorization			9896
Perm upgr authorization			9898
CIU Activation (Flag)			9899
On Line CoD Buying (Flag)			9900
On/Off CoD Act SAP Day			9909
CBU authorization			9910
CPE authorization			9912
OPO sales authorization			9913
1 MSU day			9917
100 MSU days			9918
10000 MSU days			9919
1 IFL day			9920
100 IFL days			9921
1 SAP day			9928
100 SAP days			9929
Weight Distribution Kit			9970

Height Reduce Ship			9975
Height Reduce for Return			9976
CP4			1915
IFL			1919
SAP (optional)			1921
Unassigned IFL			1923
Additional CBU Test			6805
Total CBU Years Ordered			6817
CBU Records Ordered			6818
Single CBU IFL-Year			6822
25 CBU IFL-Year			6823
Single CBU SAP-Year			6830
25 CBU SAP-Year			6831
CBU Replenishment			6832
Capacity for Planned Event			6833
OPO Sales Flag			6835
OPO Sales Flag Alteration			6836
0-Way Processor CP4			8100
1-Way Processor CP4			8101
400 Capacity Marker			9492
401 Capacity Marker			9493
Description	Machine Type	Model	Feature
IBM LinuxONE Emperor	2964	L30	
Model L30 - Air Cooled			1046
Model L30 - Water Cooled			1047
IBM LinuxONE Emperor	2964	L63	
Model L63 - Air Cooled			1048
Model L63 - Water Cooled			1049
IBM LinuxONE Emperor	2964	L96	
Model L96 - Air Cooled			1050
Model L96 - Water Cooled			1051
IBM LinuxONE Emperor	2964	LC9	
Model LC9 - Air Cooled			1052
Model LC9 - Water Cooled			1053

IBM LinuxONE Emperor	2964	LE1	
Model LE1 - Air Cooled			1054
Model LE1 - Water Cooled			1055
Description	Machine Type	Model	Feature
IBM LinuxONE Emperor	2964	L63	
		L96	
		LC9	
		LE1	
2720 GB Memory			2497
2976 GB Memory			2498
3232 GB Memory			2499
3488 GB Memory			2500
3744 GB Memory			2501
4000 GB Memory			2502
4256 GB Memory			2503
4512 GB Memory			2504
4768 GB Memory			2505
5024 GB Memory			2506
Description	Machine Type	Model	Feature
IBM LinuxONE Emperor	2964	L96	
		LC9	
		LE1	
5280 GB Memory			2507
5536 GB Memory			2508
5792 GB Memory			2509
6048 GB Memory			2510
6560 GB Memory			2511
7072 GB Memory			2512
7584 GB Memory			2513
Description	Machine Type	Model	Feature
IBM LinuxONE Emperor	2964	LC9	
		LE1	
8096 GB Memory			2514
8608 GB Memory			2515
9120 GB Memory			2516
9632 GB Memory			2517
10144 GB Memory			2518

The following models and feature codes are now available on the IBM LinuxONE Rockhopper (MT 2965).

Description	Machine Type	Model	Feature
IBM LinuxONE Rockhopper	2965	L10	
		L20	
MTU 1 - D			0001
MTU 100 - D			0002
MTU 1 - V			0003
MTU 100 - V			0004
GTU 1 - D			0005

GTU 100 - D		0006
GTU 1 - V		0007
GTU 100 - V		0008
GTU 1000 - D		0009
GTU 1000 - V		0010
<hr/>		
HW for DPM		0016
<hr/>		
Manage FW Suite		0019
Automate FW Suite		0020
Ensemble membership Flag		0025
<hr/>		
HMC w/Dual EN		0092
HMC Rack Mount		0094
HMC Tower		0095
HMC Rack Mount		0096
TKE Rack Mount		0097
TKE Tower		0098
<hr/>		
1 CPE Capacity Unit		0116
100 CPE Capacity Unit		0117
10000 CPE Capacity Unit		0118
1 CPE Capacity Unit-IFL		0119
100 CPE Capacity Unit-IFL		0120
1 CPE Capacity Unit-SAP		0127
100 CPE Capacity Unit-SAP		0128
<hr/>		
CPC		0146
<hr/>		
Fanout Airflow		0165
PCIe fanout Gen3		0173
Fanout airflow PCIe		0174
<hr/>		
US English		0235
France		0236
German/Austrian		0237
LA Spanish		0238
Spain		0239
Italian		0240
French Canadian		0241
Portuguese		0242
UK English		0243
Norwegian		0244
Sweden Finland		0245
Netherlands		0246
Belgian French		0247
Denmark		0248

Swiss French/ German			0249
PCIe Interconnect Gen3			0401
Flash Express			0403
FICON Express8S 10Km LX			0409
FICON Express8S SX			0410
10 GbE RoCE Express			0411
OSA-Express5S GbE LX			0413
OSA-Express5S GbE SX			0414
OSA-Express5S 10 GbE LR			0415
OSA-Express5S 10 GbE SR			0416
OSA-Express5S 1000BASE-T			0417
FICON Express16S LX			0418
FICON Express16S SX			0419
zEDC Express			0420
Read-Only Media Option			0845
TKE workstation			0847
32GB USB backup media			0848
TKE 8.1 LIC			0878
Crypto Express5S			0890
TKE Smart Card Reader			0891
TKE addl smart cards			0892
Description	Machine Type	Model	Feature
UID Label for DoD			0998
IBM zAware			0011
IBM zAware 2pack			1012
IBM zAware 4pack			1013
IBM zAware 6pack			1014
IBM zAware 10 pack			1015
IBM zAware DR 2pack			1017
IBM zAware DR 4pack			1018
IBM zAware DR 6pack			1019
IBM zAware DR 10pack			1020
STP Enablement			1021
EMEA Special Operations			1022

16 GB Mem DIMM(5/feat)	1620
32 GB Mem DIMM(5/feat)	1621
64 GB Mem DIMM(5/feat)	1622
128 GB Mem DIMM(5/feat)	1623
LICCC Ship Via Net Ind	1750
3x 16GB Capacity Incr	1887
3x 8GB Capacity Incr	1888
Mega 16GB Capacity Incr	1890
Mega 8GB Capacity Incr	1891
16GB Memory Capacity Incr	1899
8GB Memory Capacity Incr	1903
8GB Preplanned memory	1993
16GB Preplanned memory	1996
64 GB Memory	3616
72 GB Memory	3617
80 GB Memory	3618
88 GB Memory	3619
120 GB Memory	3623
152 GB Memory	3624
184 GB Memory	3625
216 GB Memory	3626
248 GB Memory	3627
280 GB Memory	3640
312 GB Memory	3641
344 GB Memory	3642
408 GB Memory	3643
472 GB Memory	3644
536 GB Memory	3645
600 GB Memory	3646
728 GB Memory	3647
856 GB Memory	3648
984 GB Memory	3649
Flat Panel Display	6096
Balanced Power Plan Ahead	3003
BPD Pair	3012
BPR Pair	3013
Internal Battery IBF	3215
Universal Lift Tool/ Ladder	3105
Lift Tool Upgr kit	3103

Serv Docs Optional Print		0033
CPACF Enablement		3863
PCIe I/O Drawer		4032
Top Exit Cabling		7920
Side Covers		7921
FQC Bracket & Mounting Hdw		7932
LC Duplex 6.6ft Harness		7933
Non Raised Floor Support		7998
4-in-1 Bolt Down Kit		8021
Bolt Down Kit NRF		8022
0-Way Processor A00		3700
1-Way Processor C01		3703
CP-A		6273
CP-C		6275
IFL		1924
SAP (optional)		1926
Unassigned IFL		1928
A00 Capacity Marker		9227
C01 Capacity Marker		9230
Additional CBU Test		6805
Total CBU Years Ordered		6817
CBU Records Ordered		6818
Single CBU IFL-Year		6822
25 CBU IFL-Year		6823
Single CBU SAP-Year		6830
25 CBU SAP-Year		6831
CBU Replenishment		6832
Capacity for Planned Event		6833
OPO Sales Flag		6835
OPO Sales Flag Alteration		6836
Multi Order Ship Flag		9000
Multi Order Rec Only-NB		9001
Multi Order Rec Only-MES		9002
RPO Action Flag		9003

Downgraded PUs Per Request			9004
On/Off CoD Act IFL Day			9888
On/Off CoD Act 100 IFL Day			9874
On/Off CoD authorization			9896
Perm upgr authorization			9898
CIU Activation (Flag)			9899
On Line CoD Buying (Flag)			9900
On/Off CoD Act SAP Day			9909
CBU authorization			9910
CPE authorization			9912
OPO sales authorization			9913
1 MSU day			9917
100 MSU days			9918
10000 MSU days			9919
1 IFL day			9920
100 IFL days			9921
1 SAP day			9928
100 SAP days			9929
Height Reduce Ship			9975
Height Reduce for Return			9976
Description	Machine Type	Model	Feature
14ft HiLoV 3Ph Cut Top Exit			8970
14ft HiLoV 1Ph Cut Top Exit			8972
14ft 380-520V DC Cut Cord			8964
14ft 380-520V Cut TE			8974
14t Hi/LoV 3 Ph Cut Cord			8988
14ft HiLoV 1 Ph Cut Cord			8991
14ft HiV 3Ph Cut line-LSZH			8998
Description	Machine Type	Model	Feature
IBM LinuxONE Rockhopper	2965	L20	
Second CPC			1045
1112 GB Memory			3650
1240 GB Memory			3651
1368 GB Memory			3652
1496 GB Memory			3653
1624 GB Memory			3654
1752 GB Memory			3655
1880 GB Memory			3656
2008 GB Memory			3657

2264 GB Memory			3658
2520 GB Memory			3659
2776 GB Memory			3660
3032 GB Memory			3661
3288 GB Memory			3662
3544 GB Memory			3663
3800 GB Memory			3664
4056 GB Memory			3665
Description	Machine Type	Model	Feature
IBM LinuxONE Rockhopper	2965	L10	
Model L10 Air Cooled			1056
		L20	
Model L20 Air Cooled			1057
Description	Machine Type	Model	Feature
IBM zEnterprise EC12	2827	H20	
		H43	
		H66	
		H89	
		HA1	
TKE 8.1 LIC			0878
32GB USB Backup Media			0848
IBM zEnterprise BC12	2828	H06	
		H13	
TKE 8.1 LIC			0878
32GB USB Backup Media			0848

The following features are available on LinuxONE Machines (2965: L10, L20; 2964: L30, L63, L96, LC9, LE1) but are not supported by IBM and are not warranted (that is, they are provided by IBM as is):

- 0025 Ensemble membership
- 0403 Flash Express

Model conversions

From		To		Description	
M/T	Model	M/T	Model		
2818	M05	2965	N10	(*)	M05 to N10
2818	M05	2965	N20	(*)	M05 to N20
2818	M10	2965	N10	(*)	M10 to N10
2818	M10	2965	N20	(*)	M10 to N20
2828	H06	2965	N10	(*)	H06 to N10

From		To		Description	
M/T	Model	M/T	Model		
2828	H06	2965	N20	(*)	H06 to N20
2828	H13	2965	N10	(*)	H13 to N10
2828	H13	2965	N20	(*)	H13 to N20
2965	N10	2965	N20	(*)	N10 to N20
2965	N20	2964	N30	(*)	N20 to N30 air
2965	L10	2965	L20	(*)	L10 to L20
2965	L10	2965	N10	(*)	L10 to N10
2965	L10	2965	N20	(*)	L10 to N20
2965	L20	2965	N20	(*)	L20 to N20
2964	L30	2964	L63	(*)	L30 air to L63 air
2964	L30	2964	L96	(*)	L30 air to L96 air
2964	L30	2964	LC9	(*)	L30 air to LC9 air
2964	L30	2964	LE1	(*)	L30 air to LE1 air
2964	L63	2964	L96	(*)	L63 air to L96 air
2964	L63	2964	LC9	(*)	L63 air to LC9 air
2964	L63	2964	LE1	(*)	L63 air to LE1 air
2964	L96	2964	LC9	(*)	L96 air to LC9 air
2964	L96	2964	LE1	(*)	L96 air to LE1 air
2964	LC9	2964	LE1	(*)	LC9 air to LE1 air
2964	L30	2964	L63	(*)	L30 water to L63 water
2964	L30	2964	L96	(*)	L30 water to L96 water
2964	L30	2964	LC9	(*)	L30 water to LC9 water
2964	L30	2964	LE1	(*)	L30 water to LE1 water
2964	L63	2964	L96	(*)	L63 water to L96 water
2964	L63	2964	LC9	(*)	L63 water to LC9 water
2964	L63	2964	LE1	(*)	L63 water to LE1 water

From		To		Description	
M/T	Model	M/T	Model		
2964	L96	2964	LC9	(*)	L96 water to LC9 water
2964	L96	2964	LE1	(*)	L96 water to LE1 water
2964	LC9	2964	LE1	(*)	LC9 water to LE1 water
2964	L30	2964	N30	(*)	L30 air to N30 air
2964	L30	2964	N63	(*)	L30 air to N63 air
2964	L30	2964	N96	(*)	L30 air to N96 air
2964	L30	2964	NC9	(*)	L30 air to NC9 air
2964	L30	2964	NE1	(*)	L30 air to NE1 air
2964	L63	2964	N63	(*)	L63 air to N63 air
2964	L63	2964	N96	(*)	L63 air to N96 air
2964	L63	2964	NC9	(*)	L63 air to NC9 air
2964	L63	2964	NE1	(*)	L63 air to NE1 air
2964	L96	2964	N96	(*)	L96 air to N96 air
2964	L96	2964	NC9	(*)	L96 air to NC9 air
2964	L96	2964	NE1	(*)	L96 air to NE1 air
2964	LC9	2964	NC9	(*)	LC9 air to NC9 air
2964	LC9	2964	NE1	(*)	LC9 air to NE1 air
2964	LE1	2964	NE1	(*)	LE1 air to NE1 air
2964	L30	2964	N30	(*)	L30 water to N30 water
2964	L30	2964	N63	(*)	L30 water to N63 water
2964	L30	2964	N96	(*)	L30 water to N96 water
2964	L30	2964	NC9	(*)	L30 water to NC9 water
2964	L30	2964	NE1	(*)	L30 water to NE1 water
2964	L63	2964	N63	(*)	L63 water to N63 water
2964	L63	2964	N96	(*)	L63 water to N96 water

From		To		Description	
M/T	Model	M/T	Model		
2964	L63	2964	NC9	(*)	L63 water to NC9 water
2964	L63	2964	NE1	(*)	L63 water to NE1 water
2964	L96	2964	N96	(*)	L96 water to N96 water
2964	L96	2964	NC9	(*)	L96 water to NC9 water
2964	L96	2964	NE1	(*)	L96 water to NE1 water
2964	LC9	2964	NC9	(*)	LC9 water to NC9 water
2964	LC9	2964	NE1	(*)	LC9 water to NE1 water
2964	LE1	2964	NE1	(*)	LE1 water to NE1 water

(*) Parts removed or replaced become the property of IBM and must be returned.

Feature conversions

The feature conversion list for IBM z13s is now available in the *Library* section of Resource Link.

This list can be obtained at Resource Link by accessing the following website

<http://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/2965FeatureConversions?OpenDocument>

Using the instructions on the Resource Link panels, obtain a user ID and password. Resource Link has been designed for easy access and navigation.

Publications

Publications for machine types 2964 (IBM z13, IBM LinuxONE Emperor) and 2965 (IBM z13s, IBM LinuxONE Rockhopper) are listed below as follows.

The following publications are available now in the *Library* section of Resource Link:

Title	Order number
IBM z13 Installation Manual for Physical Planning	GC28-6938
IBM z13s Installation Manual for Physical Planning (IMPP)	GC28-6953
PR/SM Planning Guide	SB10-7162
IOCP User's Guide for ICP	SB10-7163
Planning for Fiber Optic Links	GA23-1407

The following publications are shipped with the product and will be available at planned availability in the *Library* section of Resource Link:

Title	Order number
IBM z13 Installation Manual	GC28-6936
IBM z13s Installation Manual	GC28-6952
IBM z13 Service Guide	GC28-6937

Title	Order number
IBM z13s Service Guide	GC28-6955
Service Guide for TKE Workstations	GC28-6942
Systems Safety Notices	G229-9054
IBM z13 Safety Inspection	GC28-6935
IBM z13s Safety Inspection	GC28-6954
Systems Environmental Notices and User Guide	Z125-5823
z Systems Statement of Limited Warranty	GC28-6946
License Agreement for Machine Code	SC28-6872
License Agreement for Machine Code Addendum for Cryptography	GC27-2635

The following publications will be available at planned availability in the *Library* section of Resource Link:

Title	Order number
Integrating the HMC's Broadband RSF into your Enterprise	SC28-6951
Application Programming Interfaces	SB10-7164
Capacity on Demand User's Guide	SC28-6943
Common Information Model (CIM) Management Interface	SB10-7165
CHPID Mapping Tool User's Guide	GC28-6947
Service Guide for HMC (FC 0096)	GC28-6962
Hardware Management Console Web Services API (V2.13.1)	SC27-2634
IBM z13 Parts Catalog	GC28-6939
IBM z13s Parts Catalog	GC28-6956
SCSI IPL - Machine Loader Messages	SC28-6948
Service Guide for HMCs and SEs	GC28-6944
Service Guide for Support Element (FC 4027, FC 4028, FC 0146)	GC28-6961
Stand-Alone IOCP User's Guide	SB10-7166
Ensemble Workload Resource Group Management Guide	GC27-2633
Ensemble Planning Guide	GC27-2631
IBM z Advanced Workload Analysis Reporter (IBM zAware) Guide V2.0	SC27-2632
OSA-Express Customer Guide and Reference	SA22-7935
OSA/SF on the Hardware Management Console	SC14-7580
FICON CTC Reference	SB10-7167
Maintenance Information for Fiber Optic Links	SY27-7694
Hardware Management Console Security	SC28-6960
IBM Dynamic Partition Manager Planning Guide	SB10-7168

Resource Link

Publications for IBM z Systems and IBM LinuxONE can be obtained at Resource Link by accessing the following website

<http://www.ibm.com/servers/resourcelink>

Using the instructions on the Resource Link panels, obtain a user ID and password. Resource Link has been designed for easy access and navigation.

HMC and SE console documentation

At planned availability, the Hardware Management Console (HMC) and Support Element (SE) console documentation (Version 2.13.1) will be available from

IBM Knowledge Center (select z Systems and then select your product from the navigation bar).

IBM Knowledge Center provides you with a single information center where you can access product documentation for IBM systems hardware, operating systems, and server software. Through a consistent framework, you can efficiently find information and personalize your access. IBM Knowledge Center is at

<http://www.ibm.com/support/knowledgecenter>

The following Redbooks^(R) publications are available now:

Title	Document number
IBM z13 Technical Guide	SG24-8251
IBM z13 and z13s Technical Introduction	SG24-8250
IBM z Systems Functional Matrix	REDP-5157
IBM z13s Technical Guide	SG24-8294

To download these Redbooks publications, go to

<http://www.redbooks.ibm.com/Redbooks.nsf/pages/zEnterprise?Open>

For other IBM Redbooks publications, refer to

<http://www.redbooks.ibm.com/>

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The Publications Center is a worldwide central repository for IBM product publications and marketing material with a catalog of 70,000 items. Extensive search facilities are provided. A large number of publications are available online in various file formats, which can currently be downloaded.

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For details on available IBM Resiliency Services[™], contact your IBM representative or visit

<http://www.ibm.com/services/continuity>

For details on education offerings related to specific products, visit

http://www.ibm.com/services/learning/ites.wss/zz/en?pageType=tp_search_new

Technical information

EMC conformance

EMC conformance - IBM z13, IBM z13s, IBM LinuxONE Emperor, and IBM LinuxONE Rockhopper

- FCC 47 CFR Part 15 (USA)
- ICES-003 (Canada)
- EN55022 and EN 55024 (CE Mark Compliance for European Union Countries)
- Korean KN22, KN24 & KN61000-X Series (Korean EMC Standards)
- VCCI EMI Regulations (Japan)
- Taiwan BSMI CNS13438 (Taiwan EMC Standard)
- AS/NZS CISPR 22 (Australia and New Zealand)
- GB 9254 & GB 17625.1 if applicable (People's Republic of China EMC Standards)
- SASO No. EMC.CVG (Saudi Arabia)
- GOST 51318.22, GOST 30805.24, GOST R 51317.3.X Series (Russia, Belarus, Kazakhstan EMC Standards)

EMC conformance - IBM z BladeCenter Extension

- FCC 47 CFR Part 15 (USA)
- ICES-003 (Canada)
- EN55022 and EN 55024 (CE Mark Compliance for European Union Countries)
- Korean KN22, KN24 & KN61000-X Series (Korean EMC Standards)
- VCCI EMI Regulations (Japan)
- Taiwan BSMI CNS13438 (Taiwan EMC Standard)
- AS/NZS CISPR 22 (Australia and New Zealand)
- GB 9254 & GB 17625.1 if applicable (People's Republic of China EMC Standards)
- SASO No. EMC.CVG (Saudi Arabia)
- GOST 51318.22, GOST 30805.24, GOST R 51317.3.X Series (Russia, Belarus, Kazakhstan EMC Standards)

Specified operating environment

Physical specifications

Physical specifications - IBM z13s or IBM LinuxONE Rockhopper Single Frame Air Cooled Machine

Dimensions (rounded to the nearest 0.1 in or 0.1 cm):

Systems with all covers

	Depth	Width	Height
Inches	63.0	31.0	79.3
Centimeter	160.0	78.7	201.3
Inches (O/H IO cable exit)	63.0	36.6	84.8*
Centimeter (O/H IO cable exit)	160.0	93.0	215.3

* The height with overhead I/O cable exit differs from the standard height only with the optional optical cable organizer feature installed.

Systems with all covers and height reduction

	Depth	Width	Height
Inches	63.0	31.0	70.3
Centimeter	160.0	78.7	178.5

Approximate weight:

System with IBF feature

	New Build Minimum System Weight		New Build Maximum System Weight	
	Model N10 (Min. # of CPC Drawer Coupling Fanouts, No I/O Drawer)	Model L10 (1 I/O Drawer)	Model N20 with 2nd CPC Drawer* (Max # of CPC Drawer Coupling Fanouts, Max # of I/O Drawers)	Model L20 with 2nd CPC drawer* (Max # of I/O Drawers)
kg	792	873	1222	1215
lb	1746	1925	2693	2679
kg (O/H IO cable exit)	828	909	1257	1251
lb (O/H IO cable exit)	1824	2003	2771	2757

System without IBF feature

	New Build Minimum System Weight		New Build Maximum System Weight	
	Model N10 (Min. # of CPC Drawer Coupling Fanouts, No I/O Drawer)	Model L10 (1 I/O Drawer)	Model N20 with 2nd CPC Drawer* (Max # of CPC Drawer Coupling Fanouts, Max # of I/O Drawers)	Model L20 with 2nd CPC drawer* (Max # of I/O Drawers)
kg	697	778	1126	1120
lb	1536	1715	2483	2469
kg (O/H IO cable exit)	732	813	1162	1155
lb (O/H IO cable exit)	1614	1793	2561	2547

* Maximum system weight does not include mid-range Earthquake Kit feature (which weighs 120 lbs or 55 kg)

Physical specifications - IBM z13 or IBM LinuxONE Emperor Air Cooled Machine

Dimensions (rounded to the nearest 0.1 in or 0.1 cm):

	Depth	Width	Height
Inches	73.5	61.6	79.3
Centimeter	186.7	156.5	201.3
Inches (O/H IO cable exit)	73.5	72.7	84.8*
Centimeter (O/H IO cable exit)	186.7	184.7	215.3

* The height with overhead I/O cable exit differs from the standard height only with the optional optical cable organizer feature installed.

System with covers and reduction

	Depth	Width	Height
Inches	73.5	61.6	70.3
Centimeter	186.7	156.5	178.5

Each frame with one side cover and without packaging

	Depth	Width	Height
Inches	50.0	30.7	79.3
Centimeter	127.0	78.0	201.3

Each frame on casters with one side cover and with packaging (domestic)

	Depth	Width	Height
Inches	57.4	32.4	79.8
Centimeter	145.8	82.2	202.6

Each frame with one side cover and with packaging (ARBO crate)

	Depth	Width	Height
Inches	63.4	36.5	87.6
Centimeter	161.0	92.7	222.5

Approximate weight:

System with IBF feature

	New Build Minimum System Weight		New Build Maximum System Weight	
	Model N30 (Min. # of CPC Drawer Coupling Fanouts, No I/O Drawer)	Model L30 (1 I/O Drawer)	Model NE1* (Max # of CPC Drawer Coupling Fanouts, Max # of I/ O Drawers)	Model LE1* (Max # of I/ O Drawers)
kg	1513	1594	2714	2702
lb	3334	3513	5983	5955
kg (O/H IO cable exit)	1584	1665	2785	2772
lb (O/H IO cable exit)	3490	3669	6139	6111

System without IBF feature

	New Build Minimum System Weight		New Build Maximum System Weight	
	Model N30 (Min. # of CPC Drawer Coupling Fanouts, No I/O Drawer)	Model L30 (1 I/O Drawer)	Model NE1* (Max # of CPC Drawer Coupling Fanouts, Max # of I/ O Drawers)	Model LE1* (Max # of I/ O Drawers)
kg	1310	1391	2410	2397
lb	2887	3006	5313	5285
kg (O/H IO cable exit)	1381	1462	2481	2468
lb (O/H IO cable exit)	3043	3222	5469	5441

* Maximum system weight does not include high-end Earthquake Kit feature (which weighs 180 lbs or 82 kg)

To ensure installability and serviceability in non-IBM industry-standard racks, review the installation planning information for any product-specific installation requirements.

The DC Power feature has no effect on the machine dimensions and weight.

Physical specifications - IBM z13or IBM LinuxONE Emperor Water Cooled Machine

Dimensions (rounded to the nearest 0.1 in or 0.1 cm):

	Depth	Width	Height
Inches	77.5	61.6	79.3
Centimeter	196.9	156.5	201.3
Inches (O/H IO cable exit)	77.5	72.7	84.8*
Centimeter (O/H IO cable exit)	196.9	184.7	215.3

* The height with overhead I/O cable exit differs from the standard height only with the optional optical cable organizer feature installed.

System with covers and reduction

	Depth	Width	Height
Inches	77.5	61.6	70.3
Centimeter	196.9	156.5	178.5

Each frame with one side cover and without packaging

	Depth	Width	Height
Inches	54.0	30.7	79.3
Centimeter	137.2	78.0	201.3

Each frame on casters with one side cover and with packaging (domestic)

	Depth	Width	Height
Inches	61.4	32.4	79.8
Centimeter	156.0	82.2	202.6

Each frame with one side cover and with packaging (ARBO crate)

	Depth	Width	Height
Inches	68.0	36.5	87.6
Centimeter	172.7	92.7	222.5

Approximate weight:

System with IBF feature

	New Build Minimum System Model N30 or L30 No I/O Drawer	New Build Maximum System Model NE1 or LE1 Max # of I/O Drawers
kg	1546	2737
lb	3408	6034
kg (O/H IO cable exit)	1600	2791
lb (O/H IO cable exit)	3528	6154

System without IBF feature

	New Build Minimum System Model N30 or L30 No I/O Drawer	New Build Maximum System Model NE1 Max # of I/O Drawers
kg	1343	2433
lb	2961	5363

	New Build Minimum System Model N30 or L30 No I/O Drawer	New Build Maximum System Model NE1 Max # of I/O Drawers
kg (O/H IO cable exit)	1398	2487
lb (O/H IO cable exit)	3081	5483

To ensure installability and serviceability in non-IBM industry-standard racks, review the installation planning information for any product-specific installation requirements.

The DC Power feature has no effect on the machine dimensions and weight.

Physical specifications - IBM z BladeCenter Extension

Dimensions:

Each rack with standard covers as installed:

	Depth	Width	Height
Inches	43.3	25.5	79.8
Centimeter	109.9	64.8	202.7

Palletized rack (Americas)

	Depth	Width	Height
Inches	51.0	32.9	78.8
Centimeter	129.5	91.2	200.0

Palletized rack (Asia Pacific)

	Depth	Width	Height
Inches	51.0	32.9	83.6
Centimeter	129.5	91.2	212.5

Approximate weight per rack:

	Maximum System Model 004 with 28 blades per rack
kg	675
lb	1490

Operating environment

Operating environment - IBM z13s or IBM LinuxONE Rockhopper Single Frame Air Cooled Machine

Temperature:

- 5° to 40°C (41° to 104°F) for all models up to 900 meters above sea level; maximum ambient reduces 1°C per 300 meters and 900 meters

Relative Humidity: 8% to 85%

Wet Bulb (Caloric Value): 28°C (82.4°F) Operating Mode

Max Dew Point: 24°C (75.2°F) Operating Mode

Electrical Power (maximum)

Utility	N10 or L10	N20 or L20	N20 or L20 (with 2nd CPC Drawer)	Power Factor
200-240 VAC	5.35 kVA	8.18 kVA	9.46 kVA	0.992
380-415 VAC	5.67 kVA	8.65 kVA	9.89 kVA	0.951
480 VAC	6.07 kVA	9.25 kVA	10.49 kVA	0.909

Utility	N10 or L10	N20 or L20	N20 or L20 (with 2nd CPC Drawer)	Power Factor
400 VDC	5.28 kW	8.07 kW	9.29 kW	-

Capacity of Exhaust: 3050 cubic meters / hour (1820 CFM)

Noise level:

- Typical Configuration (Model N20 or L20 1 Drawer)
 - Declared A-Weighted Sound Power Level, LWAd(B) = 7.4
 - Declared A-Weighted Sound Pressure Level, LpAm(dB) = 56
- Maximum Configuration (Model N20 or L20 2 Drawers)
 - Declared A-Weighted Sound Power Level, LWAd(B) = 7.6
 - Declared A-Weighted Sound Pressure Level, LpAm(dB) = 58

Leakage and Starting Current: 30 mA / 85 A (approximately 100 microseconds)

- IEC-60950-1 (CB Certificate and CB Test Report)
- Australia and New Zealand C-Tick Mark, Class A
- Taiwan BSMI CNS13438, Class A
- China GB 9254-1998, GB17625.1-1998, GB17625.2-1999, Class A
- Korea KCC, Class A

To ensure installability and serviceability in non-IBM industry-standard racks, review the installation planning information for any product-specific installation requirements.

Operating environment - IBM z13 or IBM LinuxONE Emperor Air Cooled Machine

Temperature:

- 10° to 35°C (50° to 95°F) for all models up to 900 meters above sea level; maximum ambient reduces 1°C per 300 meters and 900 meters

Relative Humidity: 20% to 80%

Wet Bulb (Caloric Value): 25°C (77°F) Operating Mode

Max Dew Point: 21°C (69.8°F) Operating Mode

Electrical Power (maximum)

Utility	N30 or L30	N63 or L63	N96 or L96	NC9 or LC9	NE1 or LE1	Power Factor
200-240 VAC	9.9 kVA	18.0 kVA	22.4 kVA	27.1 kVA	27.4 kVA	0.996
380-415 VAC	10.1 kVA	18.5 kVA	23.0 kVA	27.8 kVA	28.1 kVA	0.978
480 VAC	10.5 kVA	19.1 kVA	23.8 kVA	28.8 kVA	29.1 kVA	0.958
400 VDC	9.6 kW	17.6 kW	21.8 kW	26.4 kW	26.7 kW	-

Capacity of Exhaust: 6370 cubic meters / hour (3800 CFM)

Noise level:

- Typical Configuration (Model N63 or L63)
 - Declared A-Weighted Sound Power Level, LWAd(B) = 7.8
 - Declared A-Weighted Sound Pressure Level, LpAm(dB) = 59

- Maximum Configuration (Model NE1 or LE1)
 - Declared A-Weighted Sound Power Level, LWAd(B) = 8.2
 - Declared A-Weighted Sound Pressure Level, LpAm(dB) = 63

Leakage and Starting Current: 70 mA / 170 A (approximately 100 microseconds)

- IEC-60950-1 (CB Certificate and CB Test Report)
- Australia and New Zealand C-Tick Mark, Class A
- Taiwan BSMI CNS13438, Class A
- China GB 9254-1998, GB17625.1-1998, GB17625.2-1999, Class A
- Korea KCC, Class A

To ensure installability and serviceability in non-IBM industry-standard racks, review the installation planning information for any product-specific installation requirements.

Operating environment - IBM z13 or IBM LinuxONE Emperor Water Cooled Machine

Temperature:

- 10° to 35°C (50° to 95°F) for all models up to 900 meters above sea level; maximum ambient reduces 1°C per 300 meters and 900 meters

Relative Humidity: 20% to 80%

Wet Bulb (Caloric Value): 25°C (77°F) Operating Mode

Max Dew Point: 21°C (69.8°F) Operating Mode

Electrical Power (maximum)

Utility	N30 or L30	N63 or L63	N96 or L96	NC9 or LC9	NE1 or LE1	Power Factor
200-240 VAC	9.5 kVA	17.4 kVA	21.5 kVA	25.5 kVA	25.8 kVA	0.996
380-415 VAC	9.7 kVA	17.8 kVA	22.0 kVA	26.2 kVA	26.4 kVA	0.978
480 VAC	10.1 kVA	18.4 kVA	22.8 kVA	27.1 kVA	27.4 kVA	0.958
400 VDC	9.2 kW	16.9 kW	20.9 kW	24.9 kW	25.1 kW	-

Capacity of Exhaust: 5950 cubic meters / hour (3500 CFM)

Noise level:

- Typical Configuration (Model N63 or L63)
 - Declared A-Weighted Sound Power Level, LWAd(B) = 7.4
 - Declared A-Weighted Sound Pressure Level, LpAm(dB) = 57
- Maximum Configuration (Model NE1 or LE1)
 - Declared A-Weighted Sound Power Level, LWAd(B) = 7.6
 - Declared A-Weighted Sound Pressure Level, LpAm(dB) = 60

Leakage and Starting Current: 70 mA / 170 A (approximately 100 microseconds)

- IEC-60950-1 (CB Certificate and CB Test Report)
- Australia and New Zealand C-Tick Mark, Class A
- Taiwan BSMI CNS13438, Class A
- China GB 9254-1998, GB17625.1-1998, GB17625.2-1999, Class A

- Korea KCC, Class A

To ensure installability and serviceability in non-IBM industry-standard racks, review the installation planning information for any product-specific installation requirements.

Operating Environment - IBM z BladeCenter Extension

Temperature:

- 10° to 32°C (50° to 89°F) for all models up to 900 meters above sea level; maximum ambient reduces 1°C per 300 meters above 900 meters

Relative Humidity: 8 to 80% (percent)

Wet Bulb (Caloric Value): 23°C (73°F) Operating Mode

Max Dew Point: 17°C (62.6°F) - Operating Mode

Electrical Power: All values are maximums for the specified solution size. Power factor is approximately unity for all cases.

- 12.1 kW, 14 blades
- 21.7 kW, 28 blades
- 31.3 kW, 42 blades
- 40.9 kW, 56 blades
- 50.5 kW, 70 blades
- 60.1 kW, 84 blades
- 69.7 kW, 98 blades
- 79.3 kW, 112 blades

Acoustical Noise Level for 28 blade configuration and standard door set:

- Declared A-Weighted Sound Power Level, LWAd (B) = 7.9
- Declared A-Weighted Sound Pressure Level, LpAm (dB) = 61

Acoustical Noise Level for 28 blade configuration and acoustic rear door (#0543):

- Declared A-Weighted Sound Power Level, LWAd (B) = 7.5
- Declared A-Weighted Sound Pressure Level, LpAm (dB) = 57

Acoustical Noise Level for 56 blade configuration and standard door set:

- Declared A-Weighted Sound Power Level, LWAd (B) = 8.1
- Declared A-Weighted Sound Pressure Level, LpAm (dB) = 63

Acoustical Noise Level for 56 blade configuration and acoustic rear door (#0543):

- Declared A-Weighted Sound Power Level, LWAd (B) = 7.7
- Declared A-Weighted Sound Pressure Level, LpAm (dB) = 59

Acoustical Noise Level for 112 blade configuration and standard door set:

- Declared A-Weighted Sound Power Level, LWAd (B) = 8.3
- Declared A-Weighted Sound Pressure Level, LpAm (dB) = 65

Acoustical Noise Level for 112 blade configuration and acoustic rear door (#0543):

- Declared A-Weighted Sound Power Level, LWAd (B) = 7.9
- Declared A-Weighted Sound Pressure Level, LpAm (dB) = 61

Hardware requirements

The hardware requirements for the IBM z Systems and IBM LinuxONE servers, features, and functions are identified. **A new driver level is required.** HMC (V2.13.1) plus MCLs and the Support Element (V2.13.1) are available on March 10, 2016.

You should review the PSP buckets for minimum Machine Change Levels (MCLs) and software PTF levels before IPLing operating systems.

HMC system support

The new functions available on the Hardware Management Console (HMC) 2.13.1, as described, apply exclusively to z13 and z13s. However, the HMC 2.13.1 will also support the systems listed in the table below.

Family	Machine Type	Firmware Driver	SE Version
z13	2964	27	2.13.1
z13s	2965	27	2.13.1
Emperor	2964	27	2.13.1
Rockhopper	2965	27	2.13.1
z13	2964	22	2.13.0
zBC12	2828	15	2.12.1
zEC12	2827	15	2.12.1
z114	2818	93	2.11.1
z196	2817	93	2.11.1
z10 BC	2098	79	2.10.2
z10 EC	2097	79	2.10.2
z9 ^(R) BC	2096	67	2.9.2
z9 EC	2094	67	2.9.2

Peripheral hardware and device attachments

IBM devices previously attached to IBM System z114, z196, zBC12, zEC12 and zSeries servers are supported for attachment to IBM z13, IBM z13s, IBM LinuxONE Emperor, and IBM LinuxONE Rockhopper channels, unless otherwise noted. The subject I/O devices must meet the FICON and Fibre Channel Protocol (FCP) architectures to be supported. I/O devices that meet OEMI architecture requirements are supported only using an external converter. Prerequisite Engineering Change Levels may be required. For further detail, contact IBM service personnel.

While the z13, z13s, LinuxONE Emperor, and LinuxONE Rockhopper support devices as described above, IBM does not commit to provide support or service for an IBM device that has reached its End of Service effective date as announced by IBM.

Note: IBM cannot confirm the accuracy of performance, compatibility, or any other claims related to non-IBM products. Questions regarding the capabilities of non-IBM products should be addressed to the suppliers of those products.

Information on switches and directors qualified for IBM z Systems FICON and FCP channels can be found in the Library section of Resource Link

<https://www.ibm.com/servers/resourcelink>

Software requirements

IBM z13 and IBM z13s require at a minimum:

- z/OS V2.2 with PTFs
- z/OS V2.1 with PTFs.
- z/OS V1.13 with PTFs.

- z/OS V1.12 with required maintenance (compatibility support only) and extended support agreement.

Note: z/OS V1.12 supports IBM z13 and IBM z13s, however, z/OS V1.12 support was withdrawn September 30, 2014. After that date, an IBM Software Support Services - Service extension for z/OS V1.12 is required. Speak with your IBM representative for details. No exploitation of new IBM z13 and IBM z13s system function is available with z/OS V1.12. Certain functions and features of the IBM z13 and IBM z13s system require later releases of z/OS. For the complete list of software support, see the PSP buckets and the Software requirements section. For more information on the IBM Software Support Services for z/OS V1.12, see Services Announcement [AS14-0008](#), dated June 24, 2014.

- z/VM V6.4. z/VM V6.4 is not yet being announced for availability but is being previewed at this time. For more information on the z/VM V6.4 preview, see Software Announcement [AP16-0008](#), dated February 16, 2016. IBM intends, following announcement and availability of z/VM V6.4, that IBM z13 and IBM z13s will support z/VM V6.4.
- z/VM V6.3 with PTFs.
- z/VM V6.2 with PTFs.
- z/VSE V6.1 with PTFs.
- z/VSE V5.2 with PTFs.
- z/VSE V5.1 with PTFs.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SUSE Linux Enterprise Server (SLES) for System z^(R): SLES 12 or SLES 11.
 - Red Hat Enterprise Linux (RHEL) for System z: RHEL 7 or RHEL 6.
 - Ubuntu 16.04 LTS.

For recommended distribution levels refer to

<http://www.ibm.com/systems/z/os/linux/resources/testedplatforms.html>

The following software requirements are listed for features and capabilities supported on IBM z13 and IBM z13s.

* Following z/VM V6.4 announcement and availability, IBM intends that z/VM V6.4 will support this feature. See each feature or capability for specific support details.

Simultaneous multithreading (SMT) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 with PTFs.
- z/VM V6.4.*
- z/VM V6.3 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 SP1.
 - RHEL 7.2.
 - Existing distribution of Linux on z Systems can benefit from SMT in a z/VM host.

Single Instruction Multiple Data (SIMD) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 with PTFs.

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 SP1.
 - IBM is working with its Linux distribution partners to include support in future RHEL distribution releases.

IBM Dynamic Partition Manager (DPM) requires at a minimum:

- KVM for IBM z Systems V1.1.1.
- Linux on z Systems
 - SLES 12 or SLES 11.
 - RHEL 7 or RHEL 6.

Shared Memory Communications - Direct Memory Access (SMC-D) requires at a minimum:

- z/OS V2.2 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- Linux on z Systems
 - IBM is working with its Linux distribution partners to include support in future distribution releases.

Improved Channel Subsystem (CSS) scalability requires at a minimum:

- z/OS V2.2 with PTFs.
- z/OS V2.1 with PTFs.
- z/OS V1.13 with PTFs.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3 with PTFs.
- z/VM V6.2 with PTFs.

LPAR enhancement to provide group physical capacity limit enforcement requires at a minimum:

- z/OS V2.2 with PTFs.
- z/OS V2.1 with PTFs.
- z/VM V6.4.*
- z/VM V6.3 with PTFs.

LPAR enhancement to dynamic memory management requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3 with PTFs.

FICON Express8S (CHPID type FC) when utilizing IBM z13 and IBM z13s FICON or Channel-To-Channel (CTC) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.

- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.
 - For recommended distribution levels refer to
<http://www.ibm.com/systems/z/os/linux/resources/testedplatforms.html>

FICON Express8S (CHPID type FC) for support of zHPF single-track operations requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express8S (CHPID type FC) for support of zHPF multi-track operations requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express8S (CHPID type FCP) for support of SCSI devices requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express8S (CHPID type FCP) support of hardware data router requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.
 - For recommended distribution levels refer to <http://www.ibm.com/systems/z/os/linux/resources/testedplatforms.html>

T10-DIF support by the FICON Express8S and FICON Express8 features when defined as CHPID type FCP requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service (DIF and DIX) or SLES 11 SP3 with service (DIF and DIX).
 - RHEL 7.1 with service (DIF and DIX) or RHEL 6.6 with service (DIF only).

FICON Express16S (CHPID type FC) when utilizing FICON or Channel-To-Channel (CTC) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:

- SLES 12 with service or SLES 11 SP3 with service.
- RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FC) for support of zHPF single-track operations requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FC) for support of zHPF multi-track operations requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FCP) for support of SCSI devices requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FCP) support of hardware data router requires at a minimum:

- z/VM V6.4 for guest exploitation.*

- z/VM V6.3 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

T10-DIF support by the FICON Express16S features when defined as CHPID type FCP requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service (DIF and DIX) or SLES 11 SP3 with service (DIF and DIX).
 - RHEL 7.1 with service (DIF and DIX) or RHEL 6.6 with service (DIF only).

OSA-Express4S GbE LX (#0404) and GbE SX (#0405) require at minimum:

CHPID type OSD with exploitation of two ports per CHPID or one port per CHPID:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express4S 10 GbE LR (#0406) and 10 GbE SR (#0407) require at a minimum:

CHPID type OSD:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.

- z/TPF V1.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

CHPID type OSX for access control to the intraensemble data network (IEDN) from IBM z13 and IBM z13s to Unified Resource Manager functions:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 to define, modify, and delete OSX CHPID types when z/VM is the controlling LPAR for dynamic I/O.*
- z/VM V6.3 to define, modify, and delete OSX CHPID types when z/VM is the controlling LPAR for dynamic I/O.
- z/VM V6.2 to define, modify, and delete OSX CHPID types when z/VM is the controlling LPAR for dynamic I/O.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express4S 1000BASE-T Ethernet (#0408) requires at minimum:

CHPID type OSC supporting TN3270E and non-SNA DFT with exploitation of two ports per CHPID:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.

CHPID type OSD with exploitation of two ports per CHPID or without maximum port exploitation (one port on the PCIe adapter is available for use):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.

- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

Inbound workload queuing for Enterprise Extender (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Checksum offload for IPv6 packets (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Checksum offload for LPAR-to-LPAR traffic for IPv4 and IPv6 packets (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Large Send for IPv6 packets (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

CHPID type OSE supporting 4 or 2 ports per feature:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.

- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.

CHPID type OSM for intranode management network (INMN):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 to define, modify, and delete CHPID type OSM when z/VM is the controlling LPAR for dynamic I/O.*
- z/VM V6.3 to define, modify, and delete CHPID type OSM when z/VM is the controlling LPAR for dynamic I/O.
- z/VM V6.2 to define, modify, and delete CHPID type OSM when z/VM is the controlling LPAR for dynamic I/O.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

CHPID type OSN for OSA-Express for NCP (does not use ports; all communication is LPAR-to-LPAR):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express5S GbE LX (#0413) and GbE SX (#0414) require at minimum:

CHPID type OSD with exploitation of two ports per CHPID or without maximum port exploitation (one port on the PCIe adapter is available for use):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.

- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express5S 10 GbE LR (#0415) and 10 GbE SR (#0416) require at a minimum:

CHPID type OSD:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

CHPID type OSX for access control to the intraensemble data network (IEDN) from IBM z13 and IBM z13s to Unified Resource Manager functions:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 to define, modify, and delete OSX CHPID types when z/VM is the controlling LPAR for dynamic I/O.*
- z/VM V6.3 to define, modify, and delete OSX CHPID types when z/VM is the controlling LPAR for dynamic I/O.
- z/VM V6.2 to define, modify, and delete OSX CHPID types when z/VM is the controlling LPAR for dynamic I/O.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express5S 1000BASE-T Ethernet (#0417) requires at minimum:

CHPID type OSC supporting TN3270E and non-SNA DFT with exploitation of two ports per CHPID:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.

CHPID type OSD with exploitation of two ports per CHPID or without maximum port exploitation (one port on the PCIe adapter is available for use):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

Inbound workload queuing for Enterprise Extender (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.

Checksum offload for IPv6 packets (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Checksum offload for LPAR-to-LPAR traffic for IPv4 and IPv6 packets (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Large Send for IPv6 packets (CHPID type OSD):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

CHPID type OSE supporting 4 or 2 ports per feature:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.

CHPID type OSM for intranode management network (INMN):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 to define, modify, and delete CHPID type OSM when z/VM is the controlling LPAR for dynamic I/O.*
- z/VM V6.3 to define, modify, and delete CHPID type OSM when z/VM is the controlling LPAR for dynamic I/O.
- z/VM V6.2 to define, modify, and delete CHPID type OSM when z/VM is the controlling LPAR for dynamic I/O.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

CHPID type OSN for OSA-Express for NCP (does not use ports; all communication is LPAR-to-LPAR):

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13.
- z/OS V1.12. Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4.*

- z/VM V6.3.
- z/VM V6.2.
- z/VSE V6.1.
- z/VSE V5.2.
- z/VSE V5.1.
- z/TPF V1.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

IBM Integrated Coupling Adapter (ICA SR) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 or V1.13 with PTFs.
- z/VM V6.4 to define, modify, and delete CHPID type CS5 when z/VM is the controlling LPAR for dynamic I/O. *
- z/VM V6.3 with PTFs to define, modify, and delete CHPID type CS5 when z/VM is the controlling LPAR for dynamic I/O.
- z/VM V6.2 with PTFs to define, modify, and delete CHPID type CS5 when z/VM is the controlling LPAR for dynamic I/O.

Support for 256 Coupling CHPIDs requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 or V1.13 with PTFs.
- z/VM 6.4 for guest exploitation.*
- z/VM 6.3 with PTFs for guest exploitation.
- z/VM 6.2 with PTFs for guest exploitation.

Crypto Express5S (#0890) Toleration, which treats Crypto Express5S as cryptographic coprocessors and accelerators, requires at a minimum:

- z/OS V2.1 with PTFs.
- z/OS V1.13 with PTFs.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- z/VSE V6.1.
- z/VSE V5.2 with PTFs.
- z/VSE V5.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.
 - For CCA secure-key cryptography with Linux on z Systems, clients can download the CCA 5.0 rpm and its readme (with recommended distribution levels required for use with CCA 5.0) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>
 - For EP11 secure-key cryptography with Linux on z Systems, clients can download the EP11 1.1 rpm and its readme (with recommended distribution levels required for use with EP11 1.1) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>

Crypto Express5S (#0890) support of greater than 16 domains requires at a minimum:

- z/OS V2.2.
- z/OS V2.1
 - with the Enhanced Cryptographic Support for z/OS V1R13 - z/OS V2R1 web deliverable installed or
 - with PTFs
- z/OS V1.13
 - with the Enhanced Cryptographic Support for z/OS V1R13 - z/OS V2R1 web deliverable installed or
 - with PTFs
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- z/VSE V6.1.
- z/VSE V5.2 with PTFs.
- z/VSE V5.1 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems: latest maintenance levels of:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.7 with service.
 - For CCA secure-key cryptography with Linux on z Systems, clients can download the CCA 5.0 rpm and its readme (with recommended distribution levels required for use with CCA 5.0) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>
 - For EP11 secure-key cryptography with Linux on z Systems, clients can download the EP11 1.1 rpm and its readme (with recommended distribution levels required for use with EP11 1.1) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>

Crypto Express5S (#0890) support of Visa Format Preserving Encryption requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 with the Enhanced Cryptographic Support for z/OS V1R13 - z/OS V2R1 web deliverable installed.
- z/OS V1.13 with the Enhanced Cryptographic Support for z/OS V1R13 - z/OS V2R1 web deliverable installed.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems: No distribution supported except for CCA.
- Linux on z Systems with CCA 5.0. Clients can download the CCA 5.0 rpm and its readme (with recommended distribution levels required for use with CCA 5.0) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>

Crypto Express5S (#0890) support of Visa Data Secure Platform (DSP)* - Point to Point Encryption (P2PE), Secure AES GCM encryption mode, Interoperable ECC key derivation algorithm, and Addition of new Key Check Value Algorithm requires at a minimum:

- z/OS V2.2 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/OS V2.1 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/OS V1.13 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.

Trusted Key Entry (TKE) 8.1 Licensed Internal Code (LIC) (#0878) in order to manage Crypto Express5S requires at a minimum:

- z/OS V2.2 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/OS V2.1 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/OS V1.13 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.

Software support for Regional Crypto Enablement (RCE) (#0901) requires at a minimum:

- z/OS V2.2 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/OS V2.1 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/OS V1.13 with the Cryptographic Support for z/OS V1R13 - z/OS V2R2 web deliverable installed with PTFs.
- z/VM V6.4 for z/OS guest exploitation.*
- z/VM V6.3 with PTFs for z/OS guest exploitation.
- z/VM V6.2 with PTFs for z/OS guest exploitation.
- Clients will need to directly contact the approved vendor for required software.

10GbE RoCE Express (#0411) for Shared Memory Communications - Remote Direct Memory Access (SMC-R) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 with PTFs.
- z/OS V1.13 with PTFs (compatibility support only).
- z/OS V1.12 with PTFs (compatibility support only). Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- Linux on z Systems:
 - IBM is working with its Linux distribution partners to include support in future distribution releases.

10GbE RoCE Express (#0411) for Ethernet communications (which does not require a peer OSA) including Single Root I/O Virtualization (SR-IOV) requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 with PTFs.
- z/OS V1.13 with PTFs (compatibility support only).
- z/OS V1.12 with PTFs (compatibility support only). Note: See z/OS V1.12 note at the beginning of the Software Requirements.
- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- Linux on z Systems: Currently limited to experimental support in:
 - SLES 12 or SLES11 SP3 with latest maintenance.
 - RHEL 7.0.

XL C/C++ support of ARCH(11) and TUNE(11) parameters requires at a minimum:

- z/OS V2.2.
- z/OS V2.1 with a web deliverable from the z/OS download site
<http://www.ibm.com/systems/z/os/zos/tools/downloads/#webdees>

Transactional memory requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on z Systems:
 - SLES 12 or SLES 11 SP3.
 - RHEL 7 or RHEL 6.4.

IBM zAware requires at a minimum:

- For monitored z/OS servers:
 - z/OS V2.2.
 - z/OS V2.1.
 - z/OS V1.13 with PTFs.

Note: z/OS V1.13 LPARs on prior server generations (for example, z196, z114, or z10) can provide data to the IBM zAware LPAR if they have the PTFs installed and are configured to exploit IBM zAware.
- z/VM V6.4 in support of monitoring Linux on z Systems guests.*
- z/VM V6.3 with PTFs in support of monitoring Linux on z Systems guests.
- z/VM V6.2 with PTFs in support of monitoring Linux on z Systems guests.
- The following browsers are supported for the GUI: Firefox 31 and Internet Explorer 9,10, and 11.

Flash Express requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs and the z/OS V1.13 RSM Enablement Offering web deliverable installed. The web deliverable is available on
<http://www.ibm.com/systems/z/os/zos/downloads/>
- Linux on z Systems:
 - SLES 12 or SLES 11 SP3.
 - RHEL 7 or RHEL 6.4.

zEDC Express (#0420) for compression acceleration requires at a minimum:

- z/OS V2.2 with the "zEnterprise Data Compression (zEDC) for z/OS" feature of z/OS.
- z/OS V2.1 with the "zEnterprise Data Compression (zEDC) for z/OS" feature of z/OS.
- z/VM 6.4 for guest exploitation.*
- z/VM 6.3 with PTFs for guest exploitation.
- Linux on z Systems:
 - IBM is working with its Linux distribution partners to include support in future distribution releases.

2 GB Large Pages requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs and the z/OS V1.13 RSM Enablement Offering web deliverable installed. The web deliverable is available on

<http://www.ibm.com/systems/z/os/zos/downloads/>

- zTPF V1.1 with PTFs.

z/OS global resource serialization (GRS) support for FICON CTCs requires at a minimum:

- z/OS V2.2.
- z/OS V2.1.
- z/OS V1.13 with PTFs.
- z/OS V1.12 with PTFs. Note: See z/OS V1.12 note at the beginning of the Software Requirements.

IBM LinuxONE Emperor and IBM LinuxONE Rockhopper require at a minimum:

- z/VM V6.4. z/VM V6.4 is not yet being announced for availability but is being previewed at this time. For more information on the z/VM V6.4 preview, see Software Announcement [AP16-0008](#), dated February 16, 2016. IBM intends, following announcement and availability of z/VM V6.4, that IBM LinuxONE Emperor and IBM LinuxONE Rockhopper will support z/VM V6.4.
- z/VM V6.3 with PTFs.
- z/VM V6.2 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SUSE Linux Enterprise Server (SLES) for System z: SLES 12 or SLES 11.
 - Red Hat Enterprise Linux (RHEL) for System z: RHEL 7 or RHEL 6.
 - Ubuntu 16.04 LTS.

For recommended distribution levels refer to

<http://www.ibm.com/systems/z/os/linux/resources/testedplatforms.html>

The following software requirements are listed for features and capabilities supported on IBM LinuxONE servers.

* Following z/VM V6.4 announcement and availability, IBM intends that z/VM V6.4 will support this feature. See each feature or capability for specific support details.

Simultaneous multithreading (SMT) requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3 with PTFs.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE
 - SLES 12 SP1.
 - RHEL 7.2.
 - Existing distribution of Linux on z Systems can benefit from SMT in a z/VM host.

Single Instruction Multiple Data (SIMD) requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE

- SLES 12 SP1.
- IBM is working with its Linux distribution partners to include support in future RHEL distribution releases.

IBM Dynamic Partition Manager (DPM) requires at a minimum:

- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE
 - SLES 12 or SLES 11.
 - RHEL 7 or RHEL 6.

Improved Channel Subsystem (CSS) scalability requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3 with PTFs.
- z/VM V6.2 with PTFs.

LPAR enhancement to provide group physical capacity limit enforcement requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3 with PTFs.

LPAR enhancement to dynamic memory management requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3 with PTFs.

FICON Express8S (CHPID type FC) when utilizing IBM LinuxONE Emperor and IBM LinuxONE Rockhopper FICON or Channel-To-Channel (CTC) requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.
 - For recommended distribution levels refer to

<http://www.ibm.com/systems/z/os/linux/resources/testedplatforms.html>

FICON Express8S (CHPID type FC) for support of zHPF single-track operations requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express8S (CHPID type FC) for support of zHPF multitrack operations requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express8S (CHPID type FCP) for support of SCSI devices requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express8S (CHPID type FCP) support of hardware data router requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

T10-DIF support by the FICON Express8S and FICON Express8 features when defined as CHPID type FCP requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service (DIF and DIX) or SLES 11 SP3 with service (DIF and DIX).
 - RHEL 7.1 with service (DIF and DIX) or RHEL 6.6 with service (DIF only).

FICON Express16S (CHPID type FC) when utilizing FICON or Channel-To-Channel (CTC) requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FC) for support of zHPF single-track operations requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FC) for support of zHPF multi-track operations requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FCP) for support of SCSI devices requires at a minimum:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

FICON Express16S (CHPID type FCP) support of hardware data router requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

T10-DIF support by the FICON Express16S features when defined as CHPID type FCP requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service (DIF and DIX) or SLES 11 SP3 with service (DIF and DIX).
 - RHEL 7.1 with service (DIF and DIX) or RHEL 6.6 with service (DIF only).

OSA-Express4S GbE LX (#0404) and GbE SX (#0405) require at minimum:

CHPID type OSD with exploitation of two ports per CHPID or one port per CHPID:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express4S 10 GbE LR (#0406) and 10 GbE SR (#0407) require at a minimum:

CHPID type OSD:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express4S 1000BASE-T Ethernet (#0408) requires at minimum:

CHPID type OSC supporting TN3270E and non-SNA DFT with exploitation of two ports per CHPID:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.

CHPID type OSD with exploitation of two ports per CHPID or without maximum port exploitation (one port on the PCIe adapter is available for use):

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

Inbound workload queuing for Enterprise Extender (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Checksum offload for IPv6 packets (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.

- z/VM V6.2 for guest exploitation.

Checksum offload for LPAR-to-LPAR traffic for IPv4 and IPv6 packets (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Large Send for IPv6 packets (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

CHPID type OSE supporting 4 or 2 ports per feature:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.

CHPID type OSN for OSA-Express for NCP (does not use ports; all communication is LPAR-to-LPAR):

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express5S GbE LX (#0413) and GbE SX (#0414) require at minimum:

CHPID type OSD with exploitation of two ports per CHPID or without maximum port exploitation (one port on the PCIe adapter is available for use):

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express5S 10 GbE LR (#0415) and 10 GbE SR (#0416) require at a minimum:

CHPID type OSD:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.

- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

OSA-Express5S 1000BASE-T Ethernet (#0417) requires at minimum:

CHPID type OSC supporting TN3270E and non-SNA DFT with exploitation of two ports per CHPID:

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.

CHPID type OSD with exploitation of two ports per CHPID or without maximum port exploitation (one port on the PCIe adapter is available for use):

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

Inbound workload queuing for Enterprise Extender (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.

Checksum offload for IPv6 packets (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Checksum offload for LPAR-to-LPAR traffic for IPv4 and IPv6 packets (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

Large Send for IPv6 packets (CHPID type OSD):

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 for guest exploitation.
- z/VM V6.2 for guest exploitation.

CHPID type OSE supporting 4 or 2 ports per feature:

- z/VM V6.4.*

- z/VM V6.3.
- z/VM V6.2.

CHPID type OSN for OSA-Express for NCP (does not use ports; all communication is LPAR-to-LPAR):

- z/VM V6.4.*
- z/VM V6.3.
- z/VM V6.2.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.

Crypto Express5S (#0890) Toleration, which treats Crypto Express5S as cryptographic coprocessors and accelerators, requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.
 - For CCA secure-key cryptography with Linux on z Systems, clients can download the CCA 5.0 rpm and its readme (with recommended distribution levels required for use with CCA 5.0) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>
 - For EP11 secure-key cryptography with Linux on z Systems, clients can download the EP11 1.1 rpm and its readme (with recommended distribution levels required for use with EP11 1.1) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>

Crypto Express5S (#0890) support of greater than 16 domains requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- z/VM V6.2 with PTFs for guest exploitation.
- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 with service or SLES 11 SP3 with service.
 - RHEL 7.1 with service or RHEL 6.6 with service.
 - For CCA secure-key cryptography with Linux on z Systems, clients can download the CCA 5.0 rpm and its readme (with recommended distribution levels required for use with CCA 5.0) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>
 - For EP11 secure-key cryptography with Linux on z Systems, clients can download the EP11 1.1 rpm and its readme (with recommended distribution levels required for use with EP11 1.1) from <http://www.ibm.com/security/cryptocards/pciicc2/lonzsoftware.shtml>

10GbE RoCE Express (#0411) for Ethernet communications (which does not require a peer OSA) including Single Root I/O Virtualization (SR-IOV) requires at a minimum:

- z/VM V6.4 for guest exploitation.*
- z/VM V6.3 with PTFs for guest exploitation.
- Linux on IBM LinuxONE: Currently limited to experimental support in:
 - SLES 12 or SLES11 SP3 with latest maintenance.
 - RHEL 7.0.

Transactional memory requires at a minimum:

- KVM for IBM z Systems V1.1.1.
- Linux on IBM LinuxONE:
 - SLES 12 or SLES 11 SP3.
 - RHEL 7 or RHEL 6.4.

IBM zAware requires at a minimum:

- z/VM V6.4 in support of monitoring Linux on IBM LinuxONE guests.*
- z/VM V6.3 with PTFs in support of monitoring Linux on IBM LinuxONE guests.
- z/VM V6.2 with PTFs in support of monitoring Linux on IBM LinuxONE guests.
- The following browsers are supported for the GUI: Firefox 31 and Internet Explorer 9,10, and 11.

Flash Express (#0403) requires at a minimum:

- Linux on LinuxONE:
 - SLES 12 or SLES 11 SP3.
 - RHEL 7 or RHEL 6.4.

zEDC Express (#0420) for compression acceleration requires at a minimum:

- z/VM 6.4 for guest exploitation.*
- z/VM 6.3 with PTFs for guest exploitation.
- Linux on LinuxONE:
 - IBM is working with its Linux distribution partners to include support in future distribution releases.

Planning information

Customer responsibilities

Information on customer responsibilities for site preparation can be found in the Library section of Resource Link on

<http://www.ibm.com/servers/resourcelink>

Installability

The average installation time for a z13, z13s, LinuxONE Emperor, or LinuxONE Rockhopper is approximately 22 installer hours. This does not include planning hours. This assumes a full Solution Assurance Product Review, and implementation of the cable services have been performed. See your IBM representative for details on these services.

Security, auditability, and control

The z13, z13s, LinuxONE Emperor, and LinuxONE Rockhopper use the security and auditability features and functions of host hardware, host software, and application software.

The customer is responsible for evaluation, selection, and implementation of security features, administrative procedures, and appropriate controls in application systems and communications facilities.

Terms and conditions

Products - terms and conditions

Warranty period

One year.

The following features are available on LinuxONE Machines (2965: L10, L20; 2964: L30, L63, L96, LC9, LE1) but are not supported by IBM and are not warranted (that is, they are provided by IBM as is):

- 0025 Ensemble membership
- 0403 Flash Express

Warranty period -- IBM z BladeCenter Extension

One year.

An IBM part or feature installed during the initial installation of an IBM machine is subject to a full warranty effective on the date of installation of the machine. An IBM part or feature that replaces a previously installed part or feature assumes the remainder of the warranty period for the replaced part or feature. An IBM part or feature added to a machine without replacing a previously installed part or feature is subject to a full warranty effective on its date of installation. Unless specified otherwise, the warranty period, type of warranty service, and service level of a part or feature are the same as those for the machine in which it is installed.

Extended Warranty Service

zBX provides increased service over normal blades with the following characteristics:

- IBM intends to deliver the enhanced IBM z Systems model of service and support for all blade products that are supported for use in the zBX. The enhanced service and support for blade products is intended to be available when the blades are installed in a zBX and activated via a unique IBM z Systems feature code (feature #0612 and #0613). This service model includes 24x7 on-site support, including FRU replacement by the client's local Service Support Representative (SSR), during the zBX's warranty period. As such, a customer who installs supported blades and acquires the requisite feature code on the zBX will receive the benefits of the zBX warranty service. This practice is valid unless the customer removes the blade and requests to have such service delivered according to the blade's entitlement.
- Warranty service upgrades and post-warranty IBM maintenance contracts should not be purchased by customers when ordering a blade for installation in a zBX since IBM z Systems is providing the higher level of service for blades while they are installed in a zBX.
- For all hardware that will be installed in IBM z Systems servers serviced by IBM during their warranty period or under a post-warranty IBM maintenance service contract, there must be an active software maintenance agreement (SWMA) in place in order to service the software under its control. For example, for each POWER7^(R) blade in the zBX (feature #0612), there must be an active PowerVM^(R)

EE SWMA in place. Failure to maintain SWMA may result in IBM not being able to service that particular #0612.

- The blades will be customer supplied and customer installed in this zBX solution.

Warranty service

The specified level of maintenance service may not be available in all worldwide locations. Additional charges may apply outside IBM's normal service area. Contact your local IBM representative or your reseller for country- and location-specific information. IBM will repair the failing machine at your location and verify its operation. You must provide a suitable working area to allow disassembly and reassembly of the IBM machine. The area must be clean, well lit, and suitable for the purpose. The following service is available as warranty for your machine type.

- 24 hours per day, 7 days a week, same day response

Warranty service upgrades

If required, IBM will provide repair service depending on the types of maintenance service specified for the machine. Contact your local representative.

The following service is provided.

- 24 hours per day, 7 days a week, same day response

Usage plan machine

No

IBM hourly service rate classification

Three.

When a type of service involves the exchange of a machine part, the replacement may not be new, but will be in good working order.

General terms and conditions

Field-installable features

Yes

Model conversions

Yes

Machine installation

Installation is performed by IBM. IBM will install the machine in accordance with the IBM installation procedures for the Machine. In the United States, contact IBM at 1-800-IBM-SERV (426-7378). In other countries contact the local IBM office.

Graduated program license charges apply

No

Licensed Machine Code

IBM Licensed Internal Code (LIC) is licensed for use by a customer on a Specific Machine, designated by serial number, under the terms and conditions of the IBM Agreement for Licensed Internal Code, to enable a Specific Machine to function in accordance with its Specifications, and only for the capacity authorized by IBM and which the customer has acquired. You can obtain the agreement at

http://www.ibm.com/servers/support/machine_warranties/machine_code.html

or by contacting your IBM representative.

Specific Machine LIC Type Model

2965-N10

2965-N20

2965-L10

2965-L20

2964-L30

2964-L63

2964-L96

2964-LC9

2964-LE1

Terms for use of IBM zAware: The terms for use of IBM zAware are specified in the IBM Customer Agreement, Attachment for the IBM zAware Offering (in the US, form number Z125-8993-US). Each enterprise is required to sign this contract one time within a given country before IBM will accept an order for its first-ever instance of the IBM zAware enablement feature (feature #0011).

Cryptography technology: Cryptography technology is included with the IBM z13s, IBM LinuxONE Emperor, and IBM LinuxONE Rockhopper cryptography features. This technology is delivered through the machine's Licensed Internal Code, and requires license terms in addition to the standard IBM License Agreement for Machine Code (LMC) referenced above. These additional terms are delivered through the LMC's Addendum for Cryptography, which is available on

http://www.ibm.com/systems/support/machine_warranties/machine_code_cryptadd.html

The terms of this Cryptography Addendum are included with the LMC when a cryptography feature is included in the IBM z13s, IBM LinuxONE Emperor, or IBM LinuxONE Rockhopper order, or when a cryptography feature is carried forward as part of an MES order into IBM z13s, IBM LinuxONE Emperor, or IBM LinuxONE Rockhopper.

IBM z Systems cryptography features include Visa Format Preserving Encryption technology (FPE), which is owned by Visa. Clients who wish to use the FPE functionality of IBM z Systems cryptography features must first enter into a separate agreement with Visa for use of this advanced technology; such Clients should contact either their Visa account manager or Visa at P2PE@visa.com. Clients who use IBM z Systems cryptography features but do not make use of the FPE functionality are not required to enter into any such agreement with Visa.

Machine Code License Acceptance Requirement

Acceptance-By-Use Machine: Yes, acceptance of the Machine Code license terms is conveyed through the user's initial use of the Machine.

Other Installed Licensed Code

None

Prices

For all local charges, contact your IBM representative.

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AP distribution

Country/Region	Announced
AP IOT	
ASEAN *	Yes
India/South Asia **	Yes
Australia	Yes
Hong Kong	Yes
Macao	Yes
New Zealand	Yes
People's Republic of China	Yes
South Korea	Yes
Taiwan	Yes
Japan IOT	
Japan	Yes

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Corrections

(Corrected on July 27, 2016)

The planned availability date was improved for features 0095, 0096, and 0098.

(Corrected on May 31, 2016)

Revisions were made to the "Product number" section.

(Corrected on May 3, 2016)

Revisions were made to a planned availability date, a description of a product function, and warranty information.

(Corrected on April 19, 2016)

The planned availability date for feature 0848 was improved.