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**IBM LinuxONE**  
**Introduction**  
**September 2017**

**IBM LinuxONE Emperor II**  
Frequently Asked Questions

Worldwide

**IBM**

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# IBM LinuxONE Emperor II Hardware

## What is the machine type of the IBM LinuxONE Emperor™ II?

The IBM LinuxONE Emperor II machine type is 3906.

## How is capacity served up on the LinuxONE Emperor II?

Emperor II is powered by 170 cores allowing it to support data serving at a new scale, with faster cores than x86, more cache-per-core, large memory (up to 32 TB) to support in-memory databases and analytics, and more I/O bandwidth to let you run billions of transactions per day on a single Emperor II.

## What is the IBM LinuxONE™ CPC drawer?

On the LinuxONE server, the CPC drawer contains a collection of hardware that includes main storage and one or more cores. The CPC drawer design enables maximum scalability, reliability and simplicity.

## What models were announced on the LinuxONE Emperor II?

IBM announced the following five LinuxONE Emperor II models.

- A LinuxONE Emperor II Model LM1 model can be a 1-way through 33-way – which means there are 33 orderable cores contained on one CPC drawer (plus many supporting cores in every model, including a minimum of two spare cores).
- A LinuxONE Emperor II Model LM2 model can be a 1-way through 69-way (69 orderable cores) contained in two CPC drawers.
- A LinuxONE Emperor II Model LM3 model can be a 1-way through 105-way (105 orderable cores) contained in three CPC drawers.
- A LinuxONE Emperor II Model LM4 model can be a 1-way through 141-way (141 orderable cores) contained in four CPC drawers.
- The enhanced capacity LinuxONE Emperor II Model LM5 model can be a 1-way through 170-way (170 orderable cores) contained in four CPC drawers.

Customers that reach CPC drawer limits can easily upgrade from LM1 models to LM4 models nondisruptively, i.e. without requiring a service interruption of the machine. There is no upgrade option to get to a Model LM5. The LinuxONE Emperor II Model LM5 must be an initial order only.

## What is the Integrated Facility for Linux (IFL)?

The Integrated Facility for Linux (IFL) is a processor core dedicated to running Linux® workloads on LinuxONE systems. It is supported by z/VM® virtualization and IBM Wave for z/VM virtualization management, KVM running on LinuxONE mainframes and native Linux operating systems.

Since an IFL can run many virtual servers, consolidation onto an IFL can result in lower IT costs, especially when the software licensing costs are priced per core.

## Where can I get more information on the IFL?

For more information, attributes and values, please look at the Web site:

<https://www.ibm.com/us-en/marketplace/integrated-facility-for-linux-iff>

## What are some key innovations in the LinuxONE Emperor II processor chip?

The new 10-core LinuxONE Emperor II processor chip leverages the density and efficiency of 14nm silicon-on-insulator technology to deliver increased performance and capacity across a wide range of workloads. Much of that increase results from innovations in the microprocessor design, driven by tight collaboration across hardware, firmware, and software development. These innovations include:

- LinuxONE has redesigned the cache architecture with four levels of processor cache. Bigger and faster caches help to avoid untimely swaps and memory waits while maximizing the throughput of concurrent workloads.
- The LinuxONE Emperor II offers two storage controller chips per CPC drawer, eliminating a chip crossing for many accesses to memory and shared data, thus reducing the time processors spend waiting for the data they need.
- A new set of instructions in the single instruction, multiple data (SIMD) facility helps improve efficiency of complex mathematical models and vector processing for workloads such as Java SDK8.
- The new Guarded Storage Facility (GSF) will deliver pause-less garbage collection to enable enterprise scale Java™ applications to run with fewer and shorter pauses for garbage collection on larger and larger heaps. Without GSF the application pauses can disrupt response times and limit scale.
- The LinuxONE Emperor II has optimized Simultaneous Multithreading (SMT) for superior Linux performance with new efficiency enhancements which include:
  - Better thread/resource balancing
  - Address translation redesigned to avoid stress from SMT for the translation buffer
  - Linux aware branch prediction tuning to help Linux mapping for modules, libraries and binaries
  - Performance optimized key virtualization for Linux (aka keyless guest)
  - Instruction execution protection facility to add security by preventing stack-overflow and similar attacks (malware attacks).
- SMT support has been extended to support System Assist Processors (SAPs). SAPs are multithreaded cores dedicated to I/O orchestration – x86 microprocessors must perform their own I/O.
- Security is designed into the cores, and every core has hardware accelerated encryption implementing the CP Assist for Cryptographic Function (CPACF) which provides cryptographic functions and hashing functions in support of clear-key operations. CPACF encryption rates for like modes and data sizes on LinuxONE Emperor II are four to six times faster than LinuxONE Emperor<sup>1</sup>.
- Each LinuxONE Emperor II can have up to 32 TB memory. This large amount of memory can support new workloads, data-in-memory applications, larger local buffer pools as well as efficiently process huge amounts of information for faster business insight.

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<sup>1</sup> Based on preliminary internal IBM lab measurements on a standalone dedicated system in a controlled environment and compared to the LinuxONE Emperor. Results may vary.

## **Tell me a little more about the Crypto Express 6S card that provides advanced and accelerated encryption / decryption and tamper-responding key management.**

Crypto Express6S card is a tamper-sensing and tamper-responding HSM (Hardware Security Module) providing high performance cryptographic operations. It can be configured to provide FIPS 140-2 Level 4, PKCS #11 and more. The Crypto Express6 executes at 2x the speed of its predecessor Crypto Express5S.<sup>2</sup>

## **How many security domains can an Emperor II support?**

A single Emperor II that uses FIPS142 lvl4 certified Crypto Express6S HSM (Hardware Security Manager) can provide over 1300 security domains, offering life-cycle management of security keys for the cloud. Most competing cloud HSM providers only offer FIPS142 lvl2 certification. These competing providers require allocating a single user to a full system with their installed HSM to ensure privacy in a cloud environment. In contrast, LinuxONE offers trusted multi-tenancy across its 1300 security domains, significantly improving the cost, usability and cloud experience for secure key, while also offering significantly better security.

## **How is simultaneous multithreading (SMT) implemented on the LinuxONE Emperor II and z/VM?**

Simultaneous multithreading (SMT) allows two active instruction threads per core, each dynamically sharing the core's execution resources. In z/VM, SMT management optimizes throughput by spreading a workload over the available cores until it demands the additional SMT capacity. z/VM 6.4 supports dynamically switching between one thread and two threads per core with no IPL required when enabled for SMT.

## **How much memory is available on the LinuxONE Emperor II?**

The LinuxONE Emperor II server supports up to 32 TB of real memory per server but the actual maximum physical memory sizes are related to the number of CPC drawers in the system. The minimum initial amount of memory that can be ordered is 256 GB for all models.

## **What is RAIM?**

The LinuxONE Emperor II is designed with redundant array of independent memory (RAIM) technology. RAIM is similar to what is known in the disk industry as RAID. RAIM technology provides protection for the dynamic random access memory (DRAM), dual inline memory modules (DIMMs), and at the memory channel level, delivers the most resilient memory subsystem to date.

Please note that the 32 TB maximum memory is customer-usable, RAIM-protected memory. RAIM is always active, and IBM has already factored in an additional 25% of RAIM memory (supplying redundancy) into any sizing configuration.

## **What value might I see if I purchase larger memory on the LinuxONE Emperor II?**

The LinuxONE Emperor II offers up to 32 TB of memory. This will advantage many types of users. Large memory can reduce latency and CPU cost, and thus improving operational efficiency. The

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<sup>2</sup> Based on preliminary internal IBM lab measurements on a standalone dedicated system in a controlled environment and compared to the LinuxONE Emperor. Results may vary.

additional memory can support new workloads, data-in-memory applications, efficiently process huge amounts of information for faster business insight.

z/VM 6.4 supports 2 TB of real memory to help clients keep pace with increasing business demands and thus Linux application servers, database servers, analytic and cloud workloads running native or under z/VM, may see performance benefits when taking advantage of large shared, virtualized memory.

### **What is IBM Enterprise Data Compression (zEDC) for LinuxONE Emperor?**

The zEDC Express adapter offers a compression acceleration solution designed for high performance, industry standard, compression with low CPU cost. zEDC uses an industry standard compression format which can be processed by libz/gzip. For best efficiency, it is used on large amounts of data, both when compressing and uncompressing data.

### **Do z/VM and Linux for LinuxONE support the zEDC Express?**

Yes. z/VM guest exploitation supports z/VM guests sharing the zEDC Express feature. On Linux, zEDC is supported by SLES12SP2 and RHEL7.3. Also, Java7.1 and Java8 on Linux on LinuxONE exploit zEDC to accelerate java/util/zip.zEDC.

### **What is the integrated firmware processor (IFP) of a LinuxONE Emperor II?**

The integrated firmware processor (IFP) is allocated from the pool of processors for the whole system. Unlike other cores, you don't pay for the IFP. It is solely used for infrastructure management of the PCIe adapters – such as the 10GbE RoCE Express2 and zEDC Express. It is not customer usable or 'visible'.

### **How many spare processing cores are on the LinuxONE Emperor II?**

IBM ships every LinuxONE Emperor II machine with a minimum of two spare processing cores. These spares can be shared across the drawers. The LinuxONE Emperor II offers core-level (engine-level) sparing.

### **Can any of the LinuxONE Emperor II spare processing cores be used for other purposes?**

No, the minimum allotment of LinuxONE Emperor II spare cores is exclusively reserved to provide automatic failover in the extremely unlikely event of a processor failure. Any additional spare cores above the minimum allotment can be activated for other purposes.

### **What is the logical partition (LPAR) absolute hardware capacity setting on LinuxONE Emperor II?**

Clients need the ability to limit a logical partition to a specific amount of hardware processor capacity in a way that is unaffected by subsequent physical or logical configuration changes. Introduction of firmware and software appliances creates an even greater need for this capability.

The LPAR absolute hardware capacity setting allows for specification of an absolute capacity limit for an individual logical partition. This is specified in absolute processor capacity (for example 2.5 processors). Use of this setting should allow more granular and flexible software pricing.

### **What is Absolute Capping of a logical partition (LPAR) group on LinuxONE Emperor II?**

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).

Group capping allows customer to set a cap on the physical usage of processors across a group of partitions. Using the HMC, the customer defines the group of partitions such that they are not able to consume more than the defined number of processors-worth (CP or IFLs) of capacity across the group. For example, LPARs 3, 4 and 7 form a group that is capped to not use more than seven cores.

Within a defined group, individual LPARs can also have their own independent Absolute Cap.

### **What is logical partition dynamic memory management?**

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 operating system 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.

### **What is the radiator-based cooling on the LinuxONE Emperor II?**

The LinuxONE Emperor II is designed with an environmental focus to help improve data center efficiency. It has a radiator-based air-cooled system designed for more efficient cooling and improved maintenance. A fill and drain tool is required for install and some radiator service actions.

### **Is there a water cooled option available for the LinuxONE Emperor II?**

Yes optional water cooling is available. If you have a data center that is bounded by limited power capacity or if you want to reduce server input power and the cost to remove server heat load, you should look at the water cooling option.

### **Is there still an option for overhead cabling?**

Yes, you can order overhead cabling and you can also order overhead power on the LinuxONE Emperor II.

### **Tell me about the non-raised floor option on the LinuxONE Emperor II?**

The non-raised floor option allows a LinuxONE Emperor II to be ordered and installed without a raised floor. This feature will be a great option for clients looking for 'cement' floors for disaster recovery centers, backup sites, lower-cost operations facilities. With a non-raised floor LinuxONE Emperor II, you must order overhead power, overhead cabling, and radiator-based air-cooling.

### **Why might I be interested in the rack mounted HMC or rack mounted TKE on the LinuxONE Emperor II?**

The new optional rack mounted management console can help to save space when it is a premium in data centers or help meet data center best practices.

### **Will my order on the LinuxONE Emperor II for the rack mounted HMC or rack mounted TKE include the rack?**

No. Most of our clients already had 19" racks with available space in them, so we will not provide a rack. If you need one you'll need to work with your sales rep to purchase one.

# Pervasive Encryption

## What does IBM mean by Pervasive Encryption?

At the core of every enterprise are business assets which if lost or compromised could cause irreparable damage. Core business data may be governed by regulatory requirements designed to protect data and safeguard privacy, with high penalties in the event of loss. Internal and external pressures to protect customer data have changed the perspective around how core business data should be handled.

Data becomes the new perimeter of the enterprise and must be protected. Establishing a fortified perimeter around core business data using encryption is one of the most impactful ways to help protect data and prevent loss. Pervasive encryption is enabled by administrative policy controls and is designed to be application transparent, without requiring application changes.

Pervasive encryption is a consumable approach to enable extensive encryption of data in-flight and at-rest to substantially simplify encryption and reduce costs associated with protecting data and achieving compliance mandates.

The IBM LinuxONE platform is designed to support pervasive encryption capabilities to help you protect data efficiently in the digital enterprise.

## Is there additional encryption support with z/VM V6.4?

With the PTF for APAR VM65993, planned to be available December 15, 2017, z/VM V6.4 will provide support for encrypted paging, in support of the LinuxONE Emperor II pervasive encryption philosophy of encrypting data in flight and at rest. Ciphering will occur as data moves between active memory and a paging volume owned by z/VM. Included in the support is the ability to dynamically control whether a running z/VM system is encrypting this data, as well as an option to ensure that z/VM only operates if encryption facilities are available.

## Does IBM plan to support Linux on LinuxONE data set encryption when Linux is running as a z/VM guest?

Yes, Linux dm-crypt solutions for data set encryption will run transparently on any z/VM release supporting LinuxONE Emperor II. Exploiting the IBM cryptography features of LinuxONE may result in significantly improved performance for protecting data in-flight (e.g. based on openSSL) and data at-rest (e.g. using dm-crypt). z/VM Linux guests will also be able to exploit dm-crypt using protected keys if the Linux guest is configured to have access to a dedicated CCA coprocessor.

## Is pervasive encryption applicable to Linux on LinuxONE?

Yes, pervasive encryption with Linux on LinuxONE comprises a collection of improvements of the Linux on LinuxONE crypto stack that is planned to become available over time, starting with the IBM LinuxONE Emperor II server. Note that this is not a feature that you can switch on or off.

These improvements will be transparent to existing applications and are targeted to improve the usability and performance of encrypting/decrypting data in-flight and at-rest, leveraging the improved on-processor CPACF functions of the LinuxONE server.

Data in-flight will benefit from the improvement of the openSSL cryptography library that is used by many open source applications.

Data at-rest will benefit from the end-to-end full volume encryption using dm-crypt. The Linux dm-crypt technology will be enabled to use CPACF protected keys, a wrapping-key technology that allows the usage of cryptography without ever exposing plain text keys in memory accessible by an operating system.

In addition to open source components, IBM products and product components will benefit from pervasive encryption from IBM Java and GSKit exploitation of improved CPACF functions.

IBM is working with the open source community and the Linux distribution partners to get the functionality included in Linux on LinuxONE.

The IBM Secure Service Container technology for securely deploying software appliances on IBM LinuxONE Emperor II is an additional aspect of pervasive encryption with Linux on LinuxONE.

### Could you explain more details around Linux on LinuxONE support for Pervasive Encryption?

Pervasive encryption will be enabled for Linux running on a LinuxONE Emperor II. The Emperor II is designed to perform encryption with minimal impact to SLAs, delivered via the improved on-processor cryptography (CPACF) and the new Crypto Express6S feature recommended for use with secure keys.

Linux distributions<sup>3</sup> exploiting the LinuxONE Emperor II hardware capabilities and the Crypto Express6S feature will be enabled to provide encryption with minimal impact to SLAs by taking advantage of encryption capabilities through updates to the Linux kernel and the openSSL, openCryptoki, and libica libraries.

- All encryption functions within the Linux kernel<sup>3</sup> and the openSSL, openCryptoki, and libica libraries<sup>3</sup> are planned to transparently deliver improved performance to applications and middleware.
- In addition, IBM products and product components like Java and GSKit will benefit from the improved LinuxONE Emperor II cryptographic features.
- Linux, having encryption integrated into the operating system and libraries, allows for optimized performance and transparent exploitation meaning no application changes are needed.
- Exploiting LinuxONE Emperor II can result in significantly improved performance for protecting data-in-flight (based on openSSL) and data-at-rest (using dm-crypt).
- Furthermore, Linux distributions<sup>3</sup> can benefit from the use of 'protected key' cryptography for data at-rest.
- Encrypting and decrypting complete disks (volumes) or selected partitions will be processed using protected key encryption. Protected key encryption<sup>3</sup> provides a valuable solution since it leverages CPACF for high speed on-ship cryptography and also uses wrapped secure keys generated in the Crypto Express6S. The wrapped key is never exposed to the operating system in an unwrapped plain text form.

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<sup>3</sup> IBM is working with the open source community and Linux distribution partners to get required functionality included in Linux on LinuxONE.

- Finally, Linux distributions<sup>3</sup> are expected to be able to create true random and unique cryptographic data using the new “true random number generator” with CPACF. CPACF with LinuxONE Emperor II has a true random number generator for stronger cryptographic computation that can be leveraged to create unpredictable keys.

### **Where can I get more information on Pervasive Encryption?**

There is a set of FAQs on pervasive encryption located at:

<https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=ZSQ03116USEN>

## **LinuxONE Emperor II Warranty**

### **What is proprietary diagnostic support?**

A LinuxONE comes with proprietary diagnostic support. Proprietary diagnostic support gives the full maintenance package including call home support and repair and verify (R&V) procedures to assist the IBM LinuxONE Service Support Representative (zSSR) in doing problem repairs.

### **How long is the machine entitled to proprietary support?**

The default is for the first year of warranty period and remains in effect if you purchase an IBM maintenance agreement.

### **What happens when the warranty ends and there is no maintenance agreement in place or maintenance is being provided by someone besides IBM?**

The machine reverts to a base service state. The non-IBM representative will not have access to IBM proprietary tools.

### **What is the difference between base and proprietary service state?**

Base support includes repair and verify help. The additional proprietary service state includes locating of IBM field replacement units, help indicators on replacement units, guided videos and specialized tools for zSSR use.

### **Can other service providers still fix the machine?**

Yes, but they will not have access to IBM intellectual property (i.e. proprietary diagnostic support).

### **If I am on base support, what level of support will I get if I upgrade (MES) my system?**

Base or Proprietary Service state does not change any of the MES warranty or maintenance policies presently in effect and the MES assumes the status of the machine.

### **Will I lose the call home capability if my LinuxONE is no longer on an IBM maintenance agreement?**

Yes, if the machine is no longer on warranty or does not have a valid IBM maintenance agreement in place.

## **Hardware Management Console and HMC Mobile**

### **What is the Hardware Management Console (HMC)?**

The HMC is an integrated platform management interface through which data center personnel configure, control, monitor, and manage hardware and software resources.

### **What is new about the Hardware Management Console (HMC) for LinuxONE Emperor II?**

Driving for simplification was a key goal in development of LinuxONE Emperor II. There are simplification improvements to the workspace and managing system time, new security capabilities that include Multifactor Authentication, and a new HMC Mobile application for monitor and recover action controls.

### **What are the new security capabilities of HMC?**

New security capabilities in the HMC are available with IBM LinuxONE Emperor II including multi-factor authentication, firmware integrity monitoring in support of NIST Standard 800-147B, crypto compliance levels, FTP through HMC, SNMP/BCPii API Security Controls, secure console to console communication enhancements, remote browser IP address limiting, and more.

### **Can you tell me a little more the new Multi-factor Authentication on the LinuxONE Emperor II HMC?**

The HMC will now offer an optional control of Multi-factor Authentication in addition to the userid/password controls provided today. As in it's use in other applications, if Multi-factor option is selected for a given user, that user will now be required to enter a second authentication factor using a TOTP (Time-based One-Time Password). The option will be implemented by freely available smartphone and web apps utilizing a secret key provided per HMC user.

### **What is the new HMC Mobile Interface on the LinuxONE HMC?**

New iOS and Android mobile apps are planned to be available for the HMC supporting IBM LinuxONE Emperor II, IBM LinuxONE Emperor™ and IBM LinuxONE Rockhopper™. HMC Mobile will help enable HMC users to securely monitor and manage systems from anywhere. The apps provide system and partition views, status monitoring, hardware messages, operating system messages, and the ability to receive push notifications from the HMC using the existing zRSF (IBM Systems Remote Support Facility) connection.

HMC Mobile is disabled by default and, once enabled, provides a robust set of security controls. Administrators can restrict usage to specific HMC users and IP addresses, require the use of app passwords, enable multifactor authentication, restrict the app to read-only access, and more.

### **When is the new HMC Mobile Interface available?**

The new HMC Mobile interface will be available on December 31, 2017.

## What is the new firmware integrity monitoring on the Support Element (SE) and HMC for the LinuxONE Emperor II?

The LinuxONE Emperor II will offer an enhancement on the Support Element that provides notification if tampering with booting of firmware on the server (CPC) is detected. This enhancement is designed to meet the BIOS Protection Guidelines recommended and published by the National Institute of Standards and Technology (NIST) in Special Publication 800-147B.

If tampering is detected, the Support Element will issue a customer alert via a warning or a lock of the Support Element, depending on the configuration. If “call home” support is enabled on a LinuxONE Emperor II HMC managing the Support Element, additional analysis of the Support Element will be performed and displayed by IBM Resource Link®.

In addition to this support, the HMC also has been enhanced to provide firmware integrity for attempted tamper monitoring and reporting. A newly manufactured HMC directly ordered with LinuxONE Emperor II, or at a later time, is required for this protection. Any detected events of attempted tampering will be logged and will issue a customer alert via a warning or a lock of the HMC, depending on setup configuration. In addition, if “call home” support is enabled on the HMC, supplementary analysis of events logged by the HMC will be available on IBM Resource Link.

## What is the FTP through HMC that was announced with LinuxONE Emperor II?

To maximize security features, we recommend that customers keep their IBM LinuxONE on a dedicated network with one HMC network used for that network and the second HMC network used for outward communication (IBM Support Facility, remote browsing, automation). However, for systems prior to LinuxONE Emperor II, this created a security challenge for FTP operations originating from the SE from working. A customer has had to either put their FTP server on the LinuxONE dedicated network or put their LinuxONE on their intranet network.

Starting with LinuxONE Emperor II, all FTP operations originating from the SE will be proxied through a managing HMC. This now allows the FTP SE originated operations to follow our security recommendation. In addition, all HMC/SE tasks that support FTP will provide three options of FTP: FTP, FTPS and SFTP.

- FTPS is SSL based and uses certificates to authenticate servers.
- SFTP is SSH based and uses SSH keys to authenticate servers.
- Username and passwords are required for client authentication in all 3 protocols.

## What is new about the Secure Console to Console Communications of the LinuxONE Emperor II?

HMC consoles have used anonymous cipher suites for some inter-console communication purposes. These cipher suites, while providing encryption and integrity validation, do not provide cryptographic authentication. Network security scanners can detect this, and anonymous cipher suites may not be acceptable to some customers' security policies. Starting with the IBM LinuxONE Emperor II HMC/SE, the secure console to console communications solution will no longer use anonymous cipher suites and will begin using an industry standard based password driven cryptography system. This system provides cryptographic encryption, integrity validation and authentication.

## **Power requirements (including High Voltage DC Power option)**

### **What is static power save mode for the LinuxONE Emperor II?**

Static power save mode is a function that will be standard on the LinuxONE Emperor II. You have the ability to reduce the power consumption of the LinuxONE Emperor II when full performance is not required. It can be switched on and off during runtime with no disruption to currently running workloads, aside from the change in performance. You can use power save mode for periods of lower utilization (for example weekends or third shift) or for capacity backup systems where you keep them “running” but with reduced energy consumption. And systems can quickly be brought back to full performance.

With static power save mode you do not turn off the LinuxONE Emperor II engines, but it slows down the clock speed and thus reduces power. Once the clocks are slowed, it also reduces the supply voltage to get the maximum savings possible for a given configuration.

Static power save mode is executed via commands on the HMC.

### **What is query maximum potential power on a LinuxONE Emperor II?**

Query maximum potential power is a component of the 'Manage' suite of functions from Unified Resource Manager. The function is implemented in the Support Element (SE) and can be used to calculate the maximum potential power draw of the LinuxONE Emperor II based on the configuration, the altitude of the computer room, the room temperature and the highest single fault service scenario power condition for the configuration applying reasonable tolerances. This monitoring capability can facilitate operations personnel with no LinuxONE hardware knowledge to query the maximum potential draw of the system in order to manage the overall energy draw of the data center. It is recommended that this function be used in conjunction with the Power Estimation Tool, available via Resource Link.

### **What is line cord plan ahead (FC #2000) and Balanced Power Plan Ahead (FC#3003) on a LinuxONE Emperor II?**

The line cord plan ahead option allows the ability to plan ahead for the second set of line cords. It must be the same feature selection as the initial set. The Plan Ahead function provides the means of ordering now, the hardware that will be required in the future to help avoid a disruptive hardware install in the future.

Phase currents are minimized when they are balanced among the three input phases. Balanced Power Plan Ahead is designed to allow you to order the full complement of bulk power regulators (BPRs) on any configuration, to help ensure that the configuration will be in a balanced power environment.

### **How many line cords will be required for High Voltage DC Power option on a LinuxONE Emperor II?**

The same number of line cords as are required for AC operation.

### **What nominal DC supply voltages will be supported for the LinuxONE Emperor II?**

We'll support 380 VDC – 520 VDC nominal.

## Overhead Cabling and Power

### How much additional room is needed for the overhead options on a LinuxONE Emperor II?

On the LinuxONE Emperor II, overhead cabling will add 12" (~30 cm) to the width (not depth) of the combined frames on the LinuxONE Emperor II. Side-cable "chimneys" or raceways are attached to the four corners of the system frames.

Overhead power will add approximately 20" to accommodate the power cord bend radius (there is only ~7" to the top for the unmated power connector and ~12" to the top of the mated power connector).

The LinuxONE Emperor II system's optional water connections are bottom exit only.

### Will overhead options add additional weight to the LinuxONE Emperor II?

Yes and no. At maximum configuration on the LinuxONE Emperor II, overhead cabling adds approximately 158 lbs (~70 kg) to the weight. Overhead power will add no additional weight to the LinuxONE Emperor II.

The key is that the panels are added after the machine is placed in position, and therefore doesn't have to be moved into place, and the heavier weight is not significant for floor loading.

### Will I need to have additional space in my floor cutouts because of these 'raceways' on the LinuxONE Emperor II?

Top-exit I/O cabling will add 12" of width to the LinuxONE Emperor II, but the increases will only be above the floor to the sides of the system.

### Any configuration things I should watch for when ordering overhead power or overhead I/O on the LinuxONE Emperor II?

Yes. When overhead power is selected in eConfig, it will force overhead I/O to be added. The converse is not true – overhead I/O selection will not force overhead power. Also, selection of non-raised floor option will force both – overhead power and overhead I/O.

## **LinuxONE Emperor II Water cooling option**

### **When should I consider installing water cooling on the LinuxONE Emperor II?**

A few examples are:

- If you have installed LinuxONE Emperor with the water cooling option.
- If you have a problem with hot spots in your data center, water cooling will help eliminate them.
- If you are limited on power in your data center, a water-cooled system is a way to increase server capacity without increasing power requirements.

Your power savings will vary based on the server configuration in terms of the number of processor books and I/O cards, as well as on the power and cooling used in your data center. For a well-utilized (not maximum) four-book system, you can expect to see savings up to about 6.5%.

Simply said, if you have a data center that is bounded by limited power capacity or if you want to reduce server input power and the cost to remove server heat load, you should look at the water cooling option. In addition, you should explore capabilities such as high voltage DC input.

If you are building a new data center water cooling may be an important way to get a significant reduction in energy use. When considering water cooling it's important to look at your entire data center strategy. The IBM LinuxONE is one component but even more significant improvements in removal of heat load can be achieved by implementing water cooling across your other server platforms.

### **Which LinuxONE Emperor II models will benefit most from water cooling?**

Three- and four-processor drawer systems will see the most benefit from water cooling. However, some customers with an overall water cooling strategy in their data centers may want to consider water cooling on one- or two-processor drawer systems.

### **Can I tap into my building's chilled water for LinuxONE Emperor II water cooling?**

A large number of data centers use chilled water somewhere in their cooling infrastructure, for example to provide cooling to CRAC (Computer Room Air Conditioner) or CRAH (Computer Room Air Handler) units. The chilled water requirements (temperature range, pH, hardness, contamination, particulates, etc.) for the LinuxONE Emperor II server should match the characteristics of the data center's available chilled water in most cases.

### **How long will it take me get my data center ready for a water cooled LinuxONE Emperor II system?**

It depends on whether you have chilled water in your data center (most do), how it was installed, pipe locations, and on the condition of those components. In some cases, it will be quite straightforward to get ready for installation. In other cases it may require more time.

### **What changes will I need in my floor tile cut outs for water cooling on LinuxONE Emperor II?**

There is no change to the floor cutouts for the LinuxONE Emperor II with the water cooling option – but the option will add 4 inches depth to the rear of the server.

### **Is there any change to the height of the server for water cooling on the LinuxONE Emperor II?**

No.

### **Is there any change to the weight of the server on the LinuxONE Emperor II with water cooling?**

With water cooling, the installed weight will increase approximately 75 pounds (23 kg).

### **How many Water Cooling Units (WCU) are on a water cooled LinuxONE Emperor II?**

The LinuxONE Emperor II has two Water Cooled Units (WCU), in a N+1 design.

### **Will data center water be going through my LinuxONE Emperor II server with water cooling?**

No - the water on the server side of the WCU is contained in a closed-loop system, maintained by IBM service personnel. There is a fill and drain tool delivered with the system that is used to fill the system initially and to service it if needed.

### **Is there any basic maintenance required because of water cooling on the LinuxONE Emperor II once the system is installed?**

No scheduled maintenance is required. If service is ever needed, the IBM engineer will have the appropriate tools to work with the water systems as needed.

### **What will happen if the humidity or temperature of my data center has a fluctuation – will I have a problem with condensation on internal server pipes on the LinuxONE Emperor II?**

The system has triple-redundant humidity sensors and will regulate the temperature of the internal water cooling loop safely above the dew point. Even if due to some fault the data center humidity goes above specification, the system will prevent condensation from occurring.

### **If my LinuxONE Emperor II is installed off a raised floor, can some cables exit the bottom of the machine?**

No. There is no tailgate to allow bottom exit of any power or signal cables when the machine is configured for installation off of a raised floor.

### **If my LinuxONE Emperor II is installed on a raised floor with top exit I/O specified, can I split up my I/O cables so that some exit out the top and some exit under the raised floor?**

Yes; but, note that if top exit power is also specified, power cables MUST exit the top.

# IBM Secure Service Container

## What is IBM Secure Service Container for LinuxONE Emperor II?

IBM Secure Service Container is a framework for securely building and deploying software virtual appliances on IBM LinuxONE. The IBM Secure Service Container consists of two parts:

- The aggregate operating system and middleware components which are used as a base by software solutions to build appliances
- The partition type which, along with an appliance installer, enables the secure deployment of firmware and software virtual appliances.

## What is the value of having the IBM Secure Service Container on a LinuxONE Emperor II?

An IBM exclusive, IBM Secure Service Container builds upon the industry leading isolation of LinuxONE logical partitions. The reason— even with the highest levels of peer isolation, many organizations realize they also need vertical isolation to protect sensitive data from administrative staff and contractors who manage the infrastructure. By completely restricting system administrator access to the container, IBM Secure Service Container protects against the misuse of privileged user credentials.

In addition, the IBM Secure Service Container will shorten the deployment and implementation of select firmware and software virtual appliances. It supplies a common appliance installer to ease installation of the software virtual appliance.

## Will I need to install a specific operating system to support a software virtual appliance on the LinuxONE Emperor II?

No. Solutions built on the IBM Secure Service Container framework include an embedded operating system, the necessary middleware, and the solution software; these components do not need to be installed beforehand. The solution can then be deployed as an image running on an LPAR defined in 'SSC Mode'.

## What differentiates the IBM Secure Service Container LPAR partition type on the LinuxONE Emperor II?

The IBM Secure Service Container LPAR type provides a substantial security envelope for appliances that are checked by the IBM Secure Service Container bootloader. The LPAR protects the appliance image from unauthorized modifications, and it enables security related certifications of appliances, even from system administrators.

The protected resources include delivery media (including updates), installed code (including the bootloaders), any data that is produced by the appliance and the memory on the server.

The image is kept encrypted and signed on the disk at all times.

## What type of appliances will be available for use in an IBM Secure Service Container partition on the LinuxONE Emperor II?

The IBM Blockchain Platform Enterprise and Enterprise Plus offerings are fully managed blockchain services running on IBM LinuxONE in the IBM cloud delivering a secure, isolated compute environment ideally suited for workloads with sensitive data. The IBM Blockchain Platform Enterprise solutions run in an IBM Secure Service Container.

Look for additional announcements in the future regarding other IBM offered Secure Service Container solutions.

### **Can ISVs and clients use the IBM Secure Service Container framework to securely build and host their own solutions?**

IBM intends to extend the IBM Secure Service Container framework and make it available to external users for the development of Docker container-based applications, on-premises, with industry leading container orchestration, enabling users to seamlessly integrate the mainframe with their enterprise-wide DevOps and container strategy. An IBM Secure Service Container beta program is planned to be available inviting users to partner with IBM and co-create this future offering through Design Thinking. See the <http://ibm.biz/sscbeta> website for additional information and to apply for the beta program.

# IBM Dynamic Partition Manager

## What is IBM Dynamic Partition Manager (DPM)?

IBM Dynamic Partition Manager is designed to perform simplified configuration of hardware resources for Linux users. It allows partitions to be quickly configured, along with the management of system resources including integrated dynamic I/O management, as easily as other virtualized environments. It was developed for new-to-z users working on servers with KVM on z and/or Linux as a partition-hosted operating system.

## What are the benefits of having IBM Dynamic Partition Manager (DPM)?

IBM Dynamic Partition Manager allows administrators that are new to the environment to be able to:

- Quickly create a new partition, including the I/O configuration, from a single management endpoint
- Modify system resources without disrupting running workloads
- Monitor sources of system failure incidents and conditions or events which might lead to workload degradation
- Create alarms for events, conditions, and state changes
- Update individual partition resources to adjust capacity, redundancy, availability, or isolation.

## Does IBM Dynamic Partition Manager (DPM) replace PR/SM?

No, IBM Dynamic Partition Manager is not a replacement for PR/SM – it IS PR/SM. More specifically, it is a new administrative mode of PR/SM that allows for simplified configuration of partitions, associated resources and I/O. To use the new mode, rather than the 'classic' mode of PR/SM, the machine needs to be IML'd in IBM Dynamic Partition Manager mode.

## What operating systems does IBM Dynamic Partition Manager (DPM) support?

IBM Dynamic Partition Manager supports Linux running virtualized with KVM or z/VM 6.4, or Linux running as a partition-hosted operating system.

## Are there storage/disk restrictions with IBM Dynamic Partition Manager (DPM)?

IBM Dynamic Partition Manager supports FCP storage devices. With the LinuxONE Emperor II announcement, we are announcing a Statement of Direction for FICON® ECKD™ storage devices<sup>4</sup>.

## What LinuxONE systems support IBM Dynamic Partition Manager (DPM)?

IBM Dynamic Partition Manager is supported by IBM LinuxONE Emperor II, IBM LinuxONE Emperor (2964) and IBM LinuxONE Rockhopper (2965).

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<sup>4</sup> IBM's statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM's sole discretion.

## **Anything I should be aware of when I switch LinuxONE Emperor II my server to IBM Dynamic Partition Manager (DPM)?**

IBM Dynamic Partition Manager must be activated with an IML. Also you cannot have both IBM Dynamic Partition Manager and “classic” PR/SM mode IMLed on the same server.

There is no FICON ECKD or FICON CTC support in DPM at this time. Therefore, single system image (SSI) clusters are not supported.

## **What is new on IBM Dynamic Partition Manager (DPM) with the LinuxONE Emperor II announcement?**

New support with IBM Dynamic Partition Manager is available for auto configuration of devices to simplify Linux Operating System Installation, where Linux distro installers exploit the function.

Also, Dynamic Partition Manager will support secure FTP through HMC for booting and installing an Operating system via FTP. This is really a capability of the new HMC code. For maximum security, we recommend that customers keep their LinuxONE on a dedicated network with one HMC network used for that network and the second HMC network used for outward communication (IBM Support Facility, remote browsing, automation). However, for systems prior to LinuxONE Emperor II, this created a security challenge for FTP operations originating from the SE from working. A customer can either put their FTP server on the LinuxONE dedicated network or put their LinuxONE on their intranet network. Starting with LinuxONE Emperor II, all FTP operations originating from the SE will proxy through a managing HMC. This now allows the FTP SE originated operations to follow our security recommendation.

## I/O and Networking

### You mentioned the I/O processors called SAPs. How many SAPs are on the LinuxONE Emperor II?

Yes, SAPs are multithreaded cores dedicated to I/O orchestration. This is an important design advantage for LinuxONE as x86 microprocessors must perform their own I/O operations.

The answer to how many on the server depends on the model. The standard number of SAPs provided to the customer is as follows:

- The LinuxONE Emperor II Model LM1 has five SAPs.
- The LinuxONE Emperor II Model LM2 has ten SAPs.
- The LinuxONE Emperor II Model LM3 has fifteen SAPs.
- The LinuxONE Emperor II Model LM4 has twenty SAPs.
- The LinuxONE Emperor II Model LM5 has twenty three SAPs.

Additionally, more SAPs may be acquired from the pool of available processing units within the model.

### Tell me about the new FICON Express16S+ for LinuxONE Emperor II.

FICON Express16S+ is designed with a boost in I/O rates and a reduction in single stream latency to help absorb large application and transaction spikes driven by large unpredictable analytic and mobile workloads.

With the introduction of FICON Express16S+ on the LinuxONE Emperor II, 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 LinuxONE, and Fibre Channel Protocol (FCP), the LinuxONE Emperor II servers 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+ family of adapters is exclusive to the LinuxONE Emperor II.

### Does the FICON Express16S+ continue to support Forward Error Correction (FEC)?

The FICON Express16S+ will continue to support the Forward Error Correction (FEC) feature that was introduced on the FICON Express16S on LinuxONE Emperor. The feature is a Fibre Channel standards based approach for enabling Forward Error Correction (FEC) codes to improve resilience by reducing I/O errors. The improvement provided by FEC is the same improvement that would occur if the optical signal strength would be doubled. This technology will allow LinuxONE I/O to operate at higher speeds, over longer distances, with reduced power and higher throughput, while retaining the same reliability and robustness that FICON has traditionally been known for.

## Does the LinuxONE Emperor II still support FICON Dynamic Routing?

With the LinuxONE Emperor II (and the LinuxONE Emperor and LinuxONE Rockhopper), 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 LinuxONE Emperor feature that supports dynamic routing in the Storage Area Network (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). Please check with the switch provider for their product support statement.

FICON Dynamic Routing can help clients reduce costs. It does this with the ability to share SANs between their FICON and FCP traffic (e.g. IBM's DS8870 Metro Mirror technology). It can help to improve performance due to SAN dynamic routing policies better exploiting all the available ISL bandwidth through higher utilization of the ISLs. And it can help to simplify management of their SAN fabrics due to static 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 the IBM DS8870 enables clients to use Brocade Exchange Based Routing (EBR) or CISCO OxID routing across cascaded FICON Directors to simplify configuration and capacity planning, provide persistent and repeatable performance and higher resiliency. Sharing of switches is simplified and hardware costs can be reduced in Peer to Peer Remote Copy configurations by allowing FICON and FCP to share the same switch infrastructure. As IBM's Metro Mirror technology uses FCP as the transport, FICON and Metro Mirror, will flow over the same Inter Switch Links (ISLs) and be managed with consistent fabric priority.

NOTE: FICON Dynamic Routing is not supported in multi-hop configurations.

## What are the availability advantages on the LinuxONE Emperor II with High Performance FICON Extended Distance II?

High Performance FICON for LinuxONE 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.

High Performance FICON for LinuxONE Extended Distance II on IBM DS8870 or DS8880 allows clients 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 disk subsystem is in another site.

## Does the LinuxONE Emperor II still use the PCIe I/O drawer for the I/O infrastructure?

Yes. The PCIe I/O drawer and the form factor I/O cards support a direct Peripheral Component Interconnect Express Generation 3 (PCIe Gen3) infrastructure with increased capacity, granularity, and infrastructure bandwidth, as well as increased reliability, availability, and serviceability. PCIe Gen 3 supported hardware adapters include FICON Express16S+, 10GbE RoCE Express2, OSA-Express6S and Crypto Express6S.

## What Storage Area Network (SAN) products are currently qualified to operate at 16 Gbps with LinuxONE?

The most current list of qualified SAN products are now available for review on Resource Link. <http://www.ibm.com/servers/resourcelink/>

“Sign In” with valid user ID and password. On the left, click on the "Library" link. Locate the listing of "Hardware products for servers" around the middle of the Web page. Click on the link “Switches and directors”.

## Does the LinuxONE Emperor II continue to support the FCP SAN discovery tool?

Yes. 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.

## What is the worldwide port naming (WWPN) assignments that is on the LinuxONE Emperor II?

A LinuxONE server automatically assigns worldwide port names (WWPNs) to the physical ports of an FCP channel based upon the Physical Channel ID (PCHID). When an FCP channel is moved to a different physical slot position this WWPN assignment changes. The LinuxONE Emperor II allows 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 by allowing the import/export the naming.

## What is the new NIC for the LinuxONE Emperor II?

OSA-Express6S is a new generation of Ethernet adapters being introduced for use in the PCIe I/O drawer and continues to be supported by the 16 GBps PCIe Gen3 host bus. The announcement includes an introduction of the full family of adapters - 1000BASE-T Ethernet for copper environments, in addition to 10 Gigabit Ethernet (10 GbE) and Gigabit Ethernet (GbE) for single-mode and multimode fiber optic environments. The performance characteristics are comparable to the OSA-Express5S adapters. They also retain the same form factor and port granularity - two ports per adapter for the 1000BASE-T Ethernet and Gigabit Ethernet adapters, and one port per adapter for the 10 Gigabit Ethernet adapter. The OSA-Express6S family of adapters is exclusive to the LinuxONE Emperor II (not available on LinuxONE Emperor).

## **z/VM**

### **Where can I find a full set of z/VM frequently asked questions?**

Please visit: <https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=LUQ12358USEN>

### **Where can I find a full set of IBM WAVE for z/VM frequently asked questions?**

Please visit: <https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=ZSQ03067USEN>

## **z/VM Performance**

### **What is z/VM HiperDispatch and how does it affect performance?**

z/VM HiperDispatch is the z/VM exploitation of PR/SM's Vertical CPU Management (VCM) capabilities. z/VM HiperDispatch improves CPU efficiency by causing the z/VM Control Program to run virtual servers in a manner that recognizes and exploits LinuxONE machine topology to increase the effectiveness of physical machine memory cache. This includes: a) requesting PR/SM to handle the partition's logical processors in a manner that exploits physical machine topology, b) dispatching virtual servers in a manner that tends to reduce their movement within the partition's topology, and c) dispatching multiprocessor virtual servers in a manner that tends to keep the server's virtual CPUs close to one another within the partition's topology. z/VM HiperDispatch can also improve performance by automatically tuning the logical partition's use of its logical CPUs to try to use only those logical CPUs to which it appears PR/SM will be able to deliver a full physical processor's worth of computing power. This includes: a) sensing and forecasting key indicators of workload intensity and b) automatically configuring the z/VM system not to use underpowered logical CPUs.

An article is available concerning z/VM HiperDispatch at:

<http://www.vm.ibm.com/perf/tips/zvmhd.html>

### **What is the performance improvement a z/VM customer might experience on the LinuxONE Emperor II?**

The performance ratios a z/VM customer workload might experience when migrating to LinuxONE Emperor II from older processors will vary. For the z/VM LSPR curves, a single workload having characteristics similar to the AVERAGE relative nest intensity workload was used. However, customer workloads have been shown to cover the full range from LOW to HIGH RNI workloads. Thus, it is suggested that you consider the full range of LSPR workloads.

### **Where can I read more about the performance of z/VM?**

The z/VM Performance Resources Page, located at <http://www.vm.ibm.com/perf/>, contains links to information on z/VM performance.

### **Where can I get more information on IBM's Capacity Planning Reference tool zPCR?**

<https://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1381>

## KVM

Where can I find a full set of KVM running on LinuxONE frequently asked questions?

Please visit: <https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=ZSQ03110USEN>

## Linux on IBM LinuxONE

### What are the unique advantages of running Linux on IBM LinuxONE?

Linux on LinuxONE can provide you a Linux platform that is freeing your business from IT complexity and improving the responsiveness of your systems and your people.

Linux on LinuxONE leverages open-standards and the API economy, thereby allowing to securely connect services across systems, mobile devices and other cloud platforms.

This infrastructure is known for its advantages in terms of:

- Simplicity—running up to thousands of workloads on one server,
- Flexible server provisioning,
- High utilization and sharing of resources,
- Workload integration,
- High productivity through efficient systems and life cycle management,
- And high levels of qualities of service.

The LinuxONE environment helps you extract the maximum value from your IT budget through operational efficiency, software savings, power and space savings, as well as providing highest levels of security and virus-resistance while delivering legendary system reliability.

Keeping it simple, “do more with less”.

### What makes Linux on LinuxONE an effective and efficient Linux infrastructure?

A continuous and efficient infrastructure is characterized by:

- APIs that integrate and bridge existing application strategies with future cloud and mobile apps,
- The enablement of real-time decisions that deliver great customer experiences,
- And high availability to provide always-on services.

Cloud computing, computing as a service, is the delivery of on-demand computing resources, characterized by:

- Elastic resources—scale up or down quickly and easily to meet demand
- Metered service so you only pay for what you use
- Self-service—all the IT resources you need with self-service access

Comparing these requirements with the attributes of the Linux on LinuxONE environment, it demonstrates a perfect solution. Linux on LinuxONE is designed to:

- Open APIs to unleash and amplify your core assets
- Maximum scalability to enable you to exceed customer expectations
- Support rapid deployment, configuration and management of virtual Linux servers, allowing IT staff to quickly provision, allocate, and deliver the resources
- Enable predictive analytics and highly automated management of resource to ensure quality of service
- Enable pervasive encryption with near-zero overhead for consumable data protection
- Provide ultimate security inside the physical server (EAL5+ certification)

- Ensure continuous and efficient operations without risk of downtime, providing high levels of security and governance

Enterprises can maintain on-premises control of both, new cloud and existing IT assets, to meet their needs on security, SLAs, privacy, compliance and regulatory requirements. A Linux infrastructure based on LinuxONE allows for rapid innovation and expansion of new services, which can be connected and integrated with the existing assets on LinuxONE.

### What are the potential savings of using LinuxONE?

Linux on LinuxONE can help lower your IT costs in several areas. The potential areas of cost savings are:

- **Operational management** – running up to thousands of virtual Linux servers on one LinuxONE Emperor II, can mean less effort for the systems and operational management. Think of all servers, cables, switches, routers that won't be required with a single server environment. In addition, an intelligent virtualization management can help you on your productivity. Co-locating Linux workloads side-by-side on the same LinuxONE can benefit from the co-location of data and applications - very fast internal network communication, resource sharing, and an all-encompassing high availability solution with unique arrangements for administration, security, backup and disaster recovery.
- **Workload integration and co-location** – integrating Linux workloads on the same LinuxONE can not only benefit from the co-location of data and applications. With the new API economy, the existing business competencies can be used in new ways, delivering services into next generation applications accessible via cloud services. The support of standards such as Web Services and REST with JSON is important to make it easier to build new applications. And for agility and scalability, microservices offer the architectural style to implement independently deployable units of code that communicate via APIs.
- **Business continuity** – LinuxONE provides trusted operations, it can scale up and out to meet spikes in server activity, helping to minimize costly transaction delays and potentially devastating system crashes. LinuxONE are the most securable commercial servers available, have powerful encryption, protecting your data 24/7, and they are known for helping to achieve compliance, and meet regulatory objectives. The suite of the built-in features can rapidly respond to, or even anticipate, threats to system health, helping to prevent costly system downtime. As well, high availability and disaster recovery solutions, such as IBM Spectrum Scale™ (based on GPFS™ technology), or IBM GDPS solutions, enhance the platform capabilities.
- **Security** – LinuxONE Emperor II is enabling the world of pervasive encryption or Linux<sup>5</sup>, enabling encryption with no impact to SLAs. Transparent exploitation of the fast encryption is given to the Linux workloads. Clients don't have to change their current encryption approach, they simply get consumable data protection for data in-flight and data at-rest.
- **Software licensing** – LinuxONE can support the consolidation of multiple x86 or UNIX® microprocessor cores onto a single LinuxONE core. This can result in a dramatic cost reduction, since software licensing costs for Linux are usually priced per core.

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<sup>5</sup> IBM is working with the open source community and the Linux distribution partners to get the functionality included in Linux for LinuxONE

- **Maintenance** – The maintenance costs of a single LinuxONE can replace the maintenance costs of many x86 and UNIX servers, and as mentioned above, it's not only the server maintenance, the maintenance of all the network components which aren't required in a single server environment, is omitted as well.
- **Energy and space consumption** – LinuxONE can allow for fewer servers and network components, which can help on savings in physical space and electricity consumption. LinuxONE are space-saving and highly energy-efficient servers, with the size of a refrigerator versus a full room of distributed servers.

### What are the new advantages of Linux running on an IBM LinuxONE Emperor II?

To develop an *enterprise grade Linux* platform was a key design point for the LinuxONE Emperor II. Existing server strengths have been further enhanced and new capabilities have been added:

- New consolidation savings with increased total capacity in the same footprint more, higher capacity processors, more memory, more logical partition support, and improved sharing capabilities for networking and cryptographic adapters.
- Better availability and more efficient use of critical data with the greatly expanded available redundant array of independent real memory.
- Economies of scale with simultaneous multi-threading (SMT) processor design delivering more throughput for Linux workloads.
- Improved performance of complex mathematical models, perfect for analytics processing, with Single Instruction Multiple Data (SIMD).
- Improved ability to meet Service Level Agreements with new processor chip technology re-designed, larger cache and enhanced accelerators for cryptography.
- Stronger and faster protection – pervasive encryption of data in flight and at rest - and integrity of data with the improved hardware accelerated encryption of CPACF and the new Crypto Express6S cryptographic adapter.

### Where can I get information on clients running LinuxONE in production?

You can ask your IBM or Business Partner representative for client success stories, or look at: [ibm.com/linuxone](http://ibm.com/linuxone)

### What are the IBM tested and supported Linux distributions for Linux on LinuxONE?

Canonical, Red Hat and SUSE will support LinuxONE Emperor II with Linux distributions. The tested and supported Linux distributions are shown at the “Tested Platforms” web page ([ibm.com/systems/z/os/linux/resources/testedplatforms.html](http://ibm.com/systems/z/os/linux/resources/testedplatforms.html)).

## Where can I get commercial Linux distributions for IBM LinuxONE?

Commercial distributions are available from the IBM Linux distribution partners: Canonical, Red Hat, and SUSE.

- Red Hat: [www.redhat.com/rhel](http://www.redhat.com/rhel)
- SUSE: [www.suse.com/products/systemz](http://www.suse.com/products/systemz)
- Ubuntu: [www.ubuntu.com/server](http://www.ubuntu.com/server)

IBM suggests that these distributions be your first choice for production environments because of their availability of service and support from the Linux distributors, partners or IBM Support Line.

## What IBM software products are available for Linux on LinuxONE?

IBM offers a large software portfolio for “Red Hat Enterprise Linux”, “SUSE Enterprise Linux Server” and “Ubuntu” distributions for LinuxONE, and new IBM software products are added constantly. You can ask your IBM or Business Partner representative to provide you the list with the available IBM software products.

In addition, Linux or LinuxONE is supported by many non-IBM software solutions, including SAP and Oracle (IBM Global Solutions Directory: <http://www.ibm.com/partnerworld/gsd/homepage.do>, or check the Linux distribution partner web pages), and there is a growing ecosystem of open source software available including Apache Spark, Chef, Docker, Erlang, Go, Kibana, Kubernetes, MongoDB, MariaDB, NGINX, Node.js, Open Leger, PostgreSQL, Puppet, Rails, Ruby and Wordpress (<http://ibm.com/linuxone/open-source>).

## Academic Initiative and Skills

### **I am a student and the mainframe platform is new to me. How can I learn more about it? Are there ways for students to build skills in this area?**

Students can learn more about the mainframe, and have fun while doing it too! AngelHack hosts a Master the Mainframe Contest; sponsored by IBM, that students can enter. The contest is free to join and no previous mainframe knowledge is required. Contestants win prizes while gaining unique skills that will land them in a career within Fortune 500 companies around the world. Learn more about this exciting competition on the [Master the Mainframe website](#).

Or perhaps you'd like to take a class at a local school. If so, you should check out our vast global network of schools that are a part of the IBM Z<sup>®</sup> Academic Initiative. These schools offer a variety of courses and curriculum across all areas of operating systems and application development. [Find schools](#) in your area by visiting our [Academic Initiative website](#).

IBM also provides no fee community resources that are available through [On The Hub](#).

Finally, you can connect to the growing community of mainframers young and old through the Advocacy Hub. There you will find information, games, challenges and education while connecting to the broader community. Go to [ibm.biz/zstudent](#) to get started.

### **Is there a way to get hands on experience on the actual operating system outside of an existing IBM client?**

Absolutely! We have hub systems for faculty and students to use in the classroom and community systems for developers to use just for playing around for a free trial period. Students and faculty should go to [On The Hub](#) to register for the z/OS or Linux system you need. Anyone can take advantage of the 120 day trial of Linux on z at the LinuxOne Community Cloud.

### **We're used to using VMWare for virtualization, so z/VM is new to me. How do I learn more about z/VM and Linux on z?**

If you are used to using VMWare then learning z/VM should be an easy skill to acquire. Classes on z/VM and Linux on z are available through IBM's Global Training Providers. Visit the [z/VM and Linux on z training roadmaps](#) for a complete listing of courses.

Marist College also offers an instructor led online course: [Running Linux Systems in a z/VM environment](#).

The [IBM z/VM website](#) also provides valuable resources for education and training including links to classes, tutorials, upcoming conferences and more.

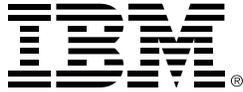
If you just want to play around, check out the free 120 day trial at the [LinuxOne Community Cloud](#).

## I have new hires joining my company and need to get them trained on z, what resources are available to help?

IBM Offers the following resources to help train new hires on IBM Z.

- The [IBM Skills Gateway](#). Explore [Learning Journey roadmaps](#) for training on z/OS®, Linux on z Systems®, z/VM, KVM and our Z hardware.
- [Mainframe Contest Learning System](#). Build mainframe skills by coding through the challenges of the Master the Mainframe Contest. No mainframe skills are required to start learning IBM Z with this fun and engaging, three-part training. Part 2 and Part 3 finishers are eligible for IBM Open Badges to proudly display on their social media homepage.

For a comprehensive listing of all of the resources available to help clients attract, train, and retain z talent, visit our [Employer's Reference Guide](#).



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