IBM z Systems

z13s and z13 GA2

Large Systems Update
Stockholm       November 8, 2016
Copenhagen    November 10, 2016

Charles F. Webb, IBM Fellow, z Systems Development
IBM z13s and IBM LinuxONE Rockhopper (2965)

Performance delivered through multiple dimensions

**HARDWARE**
- 43% more total capacity
- 2X performance boost for cryptographic coprocessors
- Up to 50% improvement for generic apps with Java8 using SIMD and SMT
- 50-80% more bandwidth per I/O domain
- 2X increase in channel speed
- 8X increase in memory
- 2x increase in cache

**SOFTWARE**
- Faster decision making with data-in-memory
- Less exposure to regulatory penalties
- Hundreds of production capable virtual machines
- Faster data sharing between systems
- More scale for mobile transactions
- Faster fraud detection
- Lower cloud cost

Hardware / software integration leads to richer optimization
## Introducing the IBM z13s and IBM LinuxONE Rockhopper

### Performance and scale helping improve client experience
- Up to 20 configurable cores
- Larger cache for improved data serving
- New SIMD vector facility for faster mathematical computation
- Up to 4 TB memory to reduce latency (8X more than zBC12)
- Simultaneous multithreading expand IFL and zIIP\(^1\) capacity
- Industry-leading resilient and intelligent I/O
- Improved network-in-a-box communications\(^2\)

### Focused on enterprise Linux
- Extending Linux to wider audience with Linux/KVM on mainframe
- Continuous data availability for z/OS and Linux guests hosted by z/VM with new GDPS Appliance
- Faster diagnosis with IBM zAware – now extended to Linux on z
- IBM Dynamic Partition Manager simplifies management

### Better Economics, Flexibility and Efficiency
- 43% more total capacity
- 33% more logical partitions to host more cloud tenants (40 vs. 30)
- 4x data access with zEDC
- Rack mounted HMC and TKE
- Lowering costs and raising RAS with ASHRAE A3 envelope

### Fortified cyber security for less risk
- Improved recovery time using zHPF
- Insure protection and integrity with next generation cryptography
- New PCIe based short range coupling links\(^1\)
- Secure deployment of software virtual appliances
- Use of cryptography algorithms and equipment from selected providers in conjunction with z Systems in specific countries\(^1\)

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1. Not available on LinuxONE servers
2. HiperSockets and SMC-D for z/OS, HiperSockets for Linux

IBM z13s
Machine Type: 2965
Models: N10 and N20

IBM LinuxONE Rockhopper
Models: L10 and L20
Introducing the IBM z13 and IBM LinuxONE Emperor

**Performance and scale helping improve client experience**

- 141 configurable cores
- Larger cache for improved data serving
- New SIMD vector facility for faster mathematical computation
- Up to 10 TB memory to reduce latency (3X more than zEC12)
- Simultaneous multithreading expand IFL and zIIP\(^1\) capacity
- Industry-leading resilient and intelligent I/O
- **Improved network-in-a-box communications**\(^2\)

**Focused on enterprise Linux**

- Extending Linux to wider audience with Linux/KVM on mainframe
- Continuous data availability for z/OS and Linux guests hosted by z/VM with new GDPS Appliance
- Faster diagnosis with IBM zAware – now extended to Linux on z
- IBM Dynamic Partition Manager simplifies management experience

**Better Economics, Flexibility and Efficiency**

- 40% more total capacity
- 40% more logical partitions to host more cloud tenants (85 vs. 60)
- 4x data access with zEDC
- Rack mounted HMC and TKE

**Fortified cyber security for less risk**

- Improved recovery time using zHPF
- Insure protection and integrity with next generation cryptography
- New PCIe based short range coupling links\(^1\)
- Secure deployment of software virtual appliances
- Use of cryptographic algorithms and equipment from select providers in conjunction with z Systems in specific countries\(^1\)

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\(^1\) Not available on LinuxONE servers

\(^2\) HiperSockets and SMC-D for z/OS, HiperSockets for Linux

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IBM z13

Machine Type: 2964

Models:

N30, N63, N96, NC9, NE1

IBM LinuxONE Emperor

L30, L63, L96, LC9, LE1
• Scale with **simultaneous multi-threading delivering more throughput** for Linux and zIIP-eligible workloads

• Larger **caches to optimize** data serving environments

• **Vector processing** using Single Instruction Multiple Data (SIMD) delivers accelerated analytics processing for mathematical models

• Faster processing and higher throughput of secure transactions with up to **2X more throughput on cryptographic coprocessor**

• **Compress more data** helping to save disk space and cut data transfer time with improved **on chip hardware compression**

• **Better and faster memory management and execution time** with new hardware instructions and functional facilities to optimize compilers
- Up to seven active cores (PUs) per chip
  - 4.3 GHz (4.2 GHz zBC12)
- L1 cache/core
  - 96 KB I-cache (64 KB on zBC12)
  - 128 KB D-cache (96 KB on zBC12)
- L2 cache/core
  - 2 MB (I) + 2 MB (D) eDRAM split private L2 cache (1 MB + 1 MB on zBC12)
- On-chip 64 MB eDRAM L3 Cache (24 MB on zBC12)
  - Shared by all cores
- I/O buses
  - One GX++ I/O bus
  - Two PCIe I/O buses
- Memory Controller (MCU)
  - Interface to controller on memory DIMMs
  - Supports RAIM design

- 14S0 22nm SOI Technology
  - 17 layers of metal (SC)
- Chip Area
  - 678.8 mm²
  - 28.4 x 23.9 mm
  - 17,773 power pins
  - 1,603 signal I/Os
- CMOS 14S0 22nm SOI Technology
  - 15 layers of metal
- Chip Area –
  - 678 mm²
- eDRAM Shared L4 Cache
  - 480 MB (Model N10)
    - [twice the zBC12]
  - 960 MB (Model N20)
  - 1920 MB (Model N20 – two drawer)

Interconnects
- To L3 on PU chips in node
- To L4 SC (node–node) in drawer (N20)
- To L4 SC nodes in remote drawer (N20 2 drawer)
# z13s Processor Features by Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Drawers/PUs</th>
<th>CPs</th>
<th>IFLs/(\text{uIFLs})</th>
<th>zIIPs</th>
<th>ICFs</th>
<th>Std SAPs</th>
<th>Optional SAPs</th>
<th>Std. Spares</th>
<th>IFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>N10</td>
<td>1/13</td>
<td>6</td>
<td>0-10 0-9</td>
<td>0-6</td>
<td>0-10</td>
<td>2</td>
<td>0-2</td>
<td>0</td>
<td>1</td>
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<tr>
<td>N20</td>
<td>2/26</td>
<td>6</td>
<td>0-20 0-19</td>
<td>0-13</td>
<td>0-20</td>
<td>3</td>
<td>0-3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>N20 2 Drwr</td>
<td>2/52</td>
<td>6</td>
<td>0-20 0-19</td>
<td>0-13</td>
<td>0-20</td>
<td>3</td>
<td>0-3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

- The maximum number of logical ICFs supported in a CF logical partition is 16.
- The integrated firmware processor (IFP) is used for PCIe I/O support functions

1. At least one CP, IFL, or ICF must be purchased in every machine
2. Two zIIPs may be purchased for each CP purchased if PUs are available. This remains true for sub-capacity CPs and for “banked” CPs.
3. On an upgrade from z114 or zBC12, installed zAAPs are converted to zIIPs by default. (Option: Convert to another engine type)
4. “\(\text{uIFL}\)” stands for Unassigned IFL
5. The IFP is conceptually an additional, special purpose SAP
Two Physical Nodes

- Two PU chips per node
- One SC chip per node

RAIM Memory
- Four Memory Controllers: One per PU
- Five DDR3 DIMM slots per Controller
- Populated DIMM slots: 20
- SC and CP Chip Interconnects
- X-bus: SC and CPs to each other (same node)
- S-bus: SC to SC chip in the same drawer
- Four Physical Nodes
- Chips
  - Two PU chips per node
  - One SC chip per node
- RAIM Memory
  - Four Memory Controllers: Two per Drawer
  - Five DDR3 DIMM slots per Controller
  - Populated DIMM slots: 40
  - SC and CP Chip Interconnects

The 2\textsuperscript{nd} CPC Drawer will prefer to fill with ICFs and IFLs and primarily attempt to use the memory in that drawer.
What can you do with 8X the memory?

Improve ease of use and performance!

- Accommodate growing workloads without changes to applications

  *Helps to reduce CPU usage by avoiding I/O*

- Reduce need for admin to fine tune memory definitions

  *Leverage tuning capabilities in Linux, DB2®, IMS™ and CICS®*

**Typical Client Use Cases:**

- More memory can help free up cycles to build richer transactions for improved user experience (i.e. fraud detection)
- Keeping the entire Cognos® Dynamic Cubes application online in memory allows for faster decision making
- Large memory allows taking advantage of larger Java heaps without an increase in paging
- Additional memory improves IBM MQ® V8 ability to manage the increasing messaging volumes generated by mobile and cloud apps

**DB2:** Use more memory to cache more data to reduce response time, increase transaction rates, and reduce CPU usage

Data movement rates at least 20%* faster for IBM MQ V8

Even small amounts of additional memory can have huge benefits improving response time 18%*

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* Redbook: Benefits of Configuring More Memory in the z/OS Software Stack (REDP-5238-00)

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Specialty engines expand the use of the server
While lowering the cost of ownership

Linux core

• Dedicated Linux core on z Systems and LinuxONE servers
• **IT optimization and cloud computing** delivering enhanced economics
• Supported by z/VM and KVM virtualization, tooling such as IBM Wave and third parties and the Linux distributions

zIIP*

• **Relieves** central processors of running specific workloads
• Optimized for strategic web based applications with support for Java™ and XML processing
• Focused on data and supporting workloads can help connect, manage, extend, and protect data

Coupling Facility

• CF allows multiple processors to access the same data
• New with z13s is support for 256 CHPIDs (2X available on zBC12 & zEC12)
• **New PCIe** based short range coupling links

Linux cores and zIIPs get throughput increase with simultaneous multithreading

* Supports 2:1 ratio for zIIP to CP
* No LinuxONE support for zIIPs or Coupling Facilities
Fortified defenses for cyber security

Leveraging z Systems cryptographic capability can help reduce risk and enhance the security of workloads.

- Save space with new Rack mounted Trusted Key Entry (TKE)
- Next gen multi-factor authentication in z/OS® 2.1 leverages mobile devices to help detect attacks and abuse of z Systems resources
- Supports the use of cryptography algorithms and equipment from selected providers in conjunction with z Systems in specific countries *
- Secure console connectivity - Protect sensitive data by using Transport Layer Security support in the OSA-Integrated Console Controller (OSA-ICC)
- Securely transfer more data across the internet
- Extend enhanced public key support for constrained digital environments using hardware accelerated ECC
- Avoid reformatting of databases with new exploitation of VISA format preserving encryption (VFPE) for payment processing
## Protect, share, communicate, connect

I/O and networking for z13s and z13 and LinuxONE

### Availability and Clustering
- **New Fibre channel** Read Diagnostic Parameters
- Coupling Links
  - **New** PCIe short range link
  - InfiniBand® Coupling Links – 1x and 12x
- STP **enhanced** user interface

### Efficient and Secure Data Access
- **New** zHPF – Extended Distance II
- zEDC Express
- Flash Express
- **New** FICON Express16S
- FICON Express8S and carry forward only – FICON Express8
- **New** Crypto Express5S

### Linking Up to Speed Up
- 10GbE RoCE Express
- OSA-Express5S & carry forward only of OSA-Express4S
- HiperSocket™
- **New** Shared Memory Communication – Direct Memory Access

Improved I/O backbone to drive transaction throughput
50-80% more bandwidth per I/O demand

= available on Linux for z and LinuxONE
Technical innovations that transform your business

Innovation for change

- **Simplified operational management**
  Simplified LPAR and I/O management for Linux running in a partition or virtualized with KVM

- **Built in appliance support**
  Ease management and deployment of software virtual appliances
  i.e. Faster connection to Linux middleware for z/VSE

- **Faster memory-to-memory communications**
  Optimized “within-the-box” communications for up to 61% CPU savings for FTP file transfers

- **Proactive Systems Health Analytics**
  Increase availability using leading-edge pattern recognition detects unusual application or system behaviors in Linux or z/OS for faster problem resolution

New for z13 too!

Now IBM Secure Service Container

IBM Dynamic Partition Manager

z Appliance Container Infrastructure

Shared Memory Communications – Direct Memory Access

IBM zAware

= available on Linux for z and LinuxONE
IBM Dynamic Partition Manager
Simplified configuration for Linux users

• Allows quick configuration and management of system resources as easily as other virtualized environments
• Developed for servers with KVM on z and/or Linux as a partition-hosted operating system

Benefits for users new to z Systems:
• Quickly create a new partition, including the I/O configuration, from a single management end-point
• 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

• Provides the technology foundation that enables IaaS and secure, private clouds
• Quickly configure and manage system resources using an industry standard UI

• Not available for z/OS, z/VM, z/VSE or z/TPF
• Does not support IBM zAware
• Used with FCP Storage only
A software virtual appliance is a solution where all the components (except hardware) are bundled together.

A new zACI partition mode (LPAR) enables hosting a software virtual appliance.

The first exploiter will be the firmware offering IBM zAware which will use the zACI LPAR.

The first software virtual appliance will be z/VSE Network Appliance - used by z/VSE® for faster connection to Linux middleware.

Potential future appliances:

- Integrated Analytics – Investigate and diagnose problems faster, predict and prevent problems and optimize the systems within the z IT environment *

- Security – provide remote crypto functions in an easy to deploy appliance that allows client to leverage z Systems cryptographic hardware across platforms*

Value of zACI:

Simplifies usage – no management of the individual component members

zACI protects the solution – appliance can not be altered

Easy configuration with APIs and web interfaces

*All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

= available on Linux for z and LinuxONE
### IBM Secure Service Container
**The Base Infrastructure to Host and Build Software Appliances**

<table>
<thead>
<tr>
<th>Insecurity of Privileged Users</th>
<th>80% Of threats are internal¹</th>
<th>58% Of IT Operations and Security Managers believe their organizations are unnecessarily granting access to individuals beyond their roles and responsibilities¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Simplified, fast deployment and management of packaged solutions</td>
<td></td>
<td></td>
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<tr>
<td>• Tamper protection during appliance installation and runtime</td>
<td></td>
<td></td>
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<tr>
<td>• Confidentiality of data and code running in appliance – at flight and at rest</td>
<td></td>
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<tr>
<td>• Management via Remote APIs (RESTful) and web interfaces</td>
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<tr>
<td>• Enables appliances to be delivered via distribution channels</td>
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</tr>
</tbody>
</table>

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1. [https://www.forcepoint.com/resources/industry-analyst-reports/2016-study-insecurity-privileged-users](https://www.forcepoint.com/resources/industry-analyst-reports/2016-study-insecurity-privileged-users)

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### The Right Access for the Right Users

**IBM Secure Service Container Protects Against Misuse of Privileged User Credentials**

Operating environments and data are protected against access and abuse by root users, system administrator credentials, and other privileged user access.
• Shared Memory Communications – Direct Memory Access (SMC-D) optimizes z/OS for improved performance in *within-the-box* communications versus standard TCP/IP over HiperSockets or Open System Adapter

**Typical Client Use Cases:**

• Valuable for multi-tiered work co-located onto a single z Systems server without requiring extra hardware

• Any z/OS TCP sockets based workload can seamlessly use SMC-D without requiring any application changes

**SMC Applicability Tool (SMCAT) is available to assist in gaining additional insight into the applicability of SMC-D (and SMC-R) for your environment**

Up to 61% CPU savings for FTP file transfers across z/OS systems versus HiperSockets*

Up to 9x improvement in throughput with more than a 88% decrease in CPU consumption and a 90% decrease in response time for streaming workloads versus using HiperSockets*

Up to 91% improvement in throughput and up to 48% improvement in response time for interactive workloads versus using HiperSockets*

* All performance information was determined in a controlled environment. Actual results may vary. Performance information is provided "AS IS" and no warranties or guarantees are expressed or implied by IBM.
**Based on internal IBM benchmarks in a controlled environment using z/OS V2R1 Communications Server FTP client and FTP server, transferring a 1.2GB binary file using SMC-R (10GbE RoCE Express feature) vs. standard TCP/IP (10GbE OSA Express4 feature). The actual CPU savings any user will experience may vary.**

**All performance information was determined in a controlled environment. Actual results may vary. Performance information is provided “AS IS” and no warranties or guarantees are expressed or implied by IBM.**

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**Shared Memory Communications architecture**

**Faster communications that preserve TCP/IP qualities of service**

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**Memory-to-memory communications using high speed protocols and direct memory placement of data for faster communications**

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**Shared Memory Communications**

**Remote Direct Memory Access (SMC-R)**

- Use the RoCE Express hardware feature to enable shared memory communications between two servers
- Up to 50% CPU savings for FTP file transfers across z/OS systems versus standard TCP/IP *
  - z/OS V2.2 Communications Server now automatically selects between TCP/IP and RoCE

**Shared Memory Communications**

**Direct Memory Access (SMC-D)**

- Use firmware-based Internal Shared Memory to optimize inter-system operating system communications LPAR to LPAR
- Valuable for multi-tiered work co-located onto a single z Systems server without requiring extra hardware
- Up to 61% CPU savings for FTP file transfers across z/OS systems versus HiperSockets **

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**Any z/OS TCP sockets-based workload can seamlessly use SMC-R or SMC-D without application changes**

SMC Applicability Tool (SMCAT) helps assess benefit of SMC-R and SMC-D for your environment

Connection level security is preserved with SMC-R and SMC-D

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* Based on internal IBM benchmarks in a controlled environment using z/OS V2R1 Communications Server FTP client and FTP server, transferring a 1.2GB binary file using SMC-R (10GbE RoCE Express feature) vs. standard TCP/IP (10GbE OSA Express4 feature). The actual CPU savings any user will experience may vary.

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IBM DS8884 – Entry-level storage for the z13s and LinuxONE

For clients running critical workloads needing high end functionality on a lower cost, flexible and space savings solution

- Speed analytics with 1.5x faster DB2 performance with new infrastructure
- Provide 24x7 access to data and applications through greater than six-nines availability with industry-leading disaster recovery capabilities
- Enable systems of insight and cloud environments with a low cost solution designed with more than 3X the capacity of the DS6000® at a lower cost
- Streamline operations and reduce cost with a 30 percent smaller footprint – built using IBM standard 19” rack
Protecting your investment in technology – Mid Range systems

- **Upgrades (Serial number preserved) allowed**
  - From z114 and zBC12 to the z13s
  - From LinuxONE Rockhopper (2828) to the zBC12
  - From LinuxONE Rockhopper (2965) to the z13s

- **Migration Offerings allowed**
  - From z114 and zBC12 to the z13s

- **Net New with trade-in**
  - From LinuxONE Rockhopper (2828) to the LinuxONE Rockhopper (2965)
  - From LinuxONE Rockhopper (2828) to the z13s

- **Technology Exchange/Hybrids not supported**

- Elastic pricing available for LinuxONE Rockhopper (2828 & 2965)
  - Clients can pay for what they use and cancel after one year with no capital depreciation impact

- On demand offerings offer temporary or permanent growth when you need and are available for both z Systems and LinuxONE

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1IBM's intent is to deliver its LinuxONE server client's with a level of investment protection that simply recognizes a trade-in value for a clients existing LinuxONE Emperor or LinuxONE Rockhopper that can be applied towards the purchase of a new Emperor or Rockhopper. The trade-in option, where needed, will be special bid based on affordability and is not guaranteed.
### z/OS Version 2.2
- Extreme scalability with support for up to 40 LPARS (85 LPARs for z13)
- Strengthened security - faster Cryptography and digitally signed audit records
- Up to 4 TB memory per z/OS image
- Simplified management with entitled web-based console

### z/VSE Version 6.1
- Faster I/O with FICON Express 16S with link rate of 16 Gbps
- Performance and functional enhancements for online processing
- Improved network security with firewall functionality
- Better HW Encryption with Crypto Express5S
- Wide portfolio using Linux on z

### Linux
- Multithreading with SMT may allow for per core software savings
- Ability to host and manage more workloads efficiently / cost-effectively
- Automatic identification of unusual messages
- Integrated continuous availability & disaster recovery solution
- Introducing Canonical Ubuntu in addition to SUSE Linux Enterprise Server (SLES) and Red Hat Enterprise Linux (RHEL) for more choice

### z/TPF
- Management of extreme transaction volumes up to hundreds of thousands of transactions per second
- Fast / consistent response across predictable and unpredictable peaks
- Low cost per transaction for large applications and memory tables
- Centralized database handling routines to effectively manage databases
- Application interface enables high speed access to persistent data
Hypervisors and virtualization for z Systems

PR/SM-LPARs

- **Virtualization capabilities built into the system**
- **PR/SM** manages and virtualizes all the installed and enabled system resources as a single large SMP system
- **Full sharing of the installed resources** with high efficiency and very low overhead
- **High scalability** with support for up to 40 (for z13s) or 80 (for z13) logical partitions
- IBM Dynamic Partition Manager **simplifies management experience**
- Ensured **workload separation** based on highest EAL5+ security certification

**z/VM v6.4**
- Enables **extreme scalability, security and efficiency** creating cost savings opportunities
- **Ease Migration** with upgrade in place infrastructure provides a seamless migration path from previous z/VM releases (z/VM 6.2 and z/VM 6.3) to the latest version
- **Operational improvements** by enhancing z/VM to provide ease of use
- **SCSI** for guest attachment of printers, disk drives, scanners and other peripherals, and host or guest attachment of disk drives
- IBM Wave for z/VM **simplifies the management** of virtual Linux servers from a single user interface

**KVM on z Systems v1.1**
- **Support new analytics workloads** with Single Instruction Multiple Data (SIMD) for competitive advantage
- **Deliver higher compute capacity** with support for Simultaneous Multithreading (SMT) to meet new business requirements
- **RAS support enhanced for problem determination and high availability** setup to reduce down time and quickly react to business needs
- **Secure and protect** business data with Crypto exploitation
Ease Migration with upgrade in place infrastructure provides a seamless migration path from previous z/VM releases (z/VM 6.2 and z/VM 6.3) to the latest version

Operation improvements by enhancing z/VM to provide ease of use improvements requested by clients such as querying service of the running hypervisor and providing environment variables to allow client programming automation based on systems characteristics and client settings

Staying relevant by anticipating exploitation of future hardware performance improvements and to remain current with the latest technology

SCSI (Small Computer System Interface) improvements for guest attachment of disks and other peripherals, and host or guest attachment of disk drives to z Systems and LinuxONE systems:

- Improve RAS capabilities within the z/VM SCSI subsystem for greater resiliency for SCSI devices behind an SVC (SAN Volume Controller)
- Increase efficiency and reduce complexity by allowing Flash Systems to be directly attached for z/VM system use without the need for an SVC
- Enable ease of use by enhancing management for SCSI devices to provide information needed about device configurations characteristics

Increased scalability by exploiting Guest Enhanced DAT to allow guests to take advantage of large (1MB) pages, decreasing the memory and overhead required to perform address translation

Modernize CMS Pipelines functionality to adopt 20 years of development since the original Pipelines integration

Customer Choice of Linux Distribution with planned support for Canonical Ubuntu distribution in addition to Red Hat and SUSE
IBM z Systems: Innovation – Integrated by design

1 Open Source and Linux bring a wealth of new management tools, languages, databases, etc. to z Systems – there are just a few listed on this chart.
Questions?

Tak!

Tack!

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