IBM z16 Technical Overview

Kenny Stine
IBM zSystems Technical Specialist
Washington System Center
kjstine@us.ibm.com

Trademarks

The following are trademarks of the International Business Machines Corporation in the United States, other countries, or both.

Not all common law marks used by IBM are listed on this page. Failure of a mark to appear does not mean that IBM does not use the mark nor does it mean that the product is not actively marketed or is not significant within its relevant market.

Those trademarks followed by ® are registered trademarks of IBM in the United States; all others are trademarks or common law marks of IBM in the United States.

For a more complete list of IBM Trademarks, see https://www.ibm.com/legal/copytrade :

*BladeCenter®, CICS®, DataPower®, Db2®, e business(logo)®, ESCON, eServer, FICON®, IBM®, IBM (logo)®, IMS, MVS, OS/390®, POWER6®, POWER6+, POWER7®, Power Architecture®, PowerVM®, PureFlex, PureSystems, S/390®, ServerProven®, Sysplex Timer®, System p®, System p5, System x®, z Systems®, System z9®, System z10®, WebSphere®, X-Architecture®, z13™, z13s™, **IBM z14™**, **IBM z15™**, z16 ™, z Systems™, z9®, z10, z/Architecture®, z/OS®, z/VM®, z/VSE®, zEnterprise®, zSeries®, IBM Z®, IBM LinuxONE III™, IBM LinuxONE Emperor™, IBM LinuxONE Rockhopper™

The following are trademarks or registered trademarks of other companies.

Adobe, the Adobe logo, PostScript, and the PostScript logo are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States, and/or other countries.
Cell Broadband Engine is a trademark of Sony Computer Entertainment, Inc. in the United States, other countries, or both and is used under license therefrom.
Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.
Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.
Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.
UNIX is a registered trademark of The Open Group in the United States and other countries.
Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.
ITIL is a registered trademark, and a registered community trademark of the Office of Government Commerce, and is registered in the U.S. Patent and Trademark Office.
IT Infrastructure Library is a registered trademark of the Central Computer and Telecommunications Agency, which is now part of the Office of Government Commerce.

*** All other products may be trademarks or registered trademarks of their respective companies.**

Notes:

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

IBM hardware products are manufactured Sync new parts, or new and serviceable used parts. Regardless, our warranty terms apply.

All customer examples cited or described in this presentation are presented as illustrations of the manner in which some customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics will vary depending on individual customer configurations and conditions.

This publication was produced in the United States. IBM may not offer the products, services or features discussed in this document in other countries, and the information may be subject to change without notice. Consult your local IBM business contact for information on the product or services available in your area.

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

Information about non-IBM products is obtained Sync the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Prices subject to change without notice. Contact your IBM representative or Business Partner for the most current pricing in your geography.

Table of Content

IBM z16 Announcement Dates

IBM z16 availability Dates – Driver Level 51

- General Availability – May 31st, 2022
- New features and functions for the IBM z16 (Type number: 3931)
  - IBM z16 Model A01:
    - Features: Max39, Max82, Max125, Max168, Max200
  - IBM z15 air/water-cooled upgrades to IBM z16 (air to air, water to air)
  - IBM z14 air/water-cooled upgrades to IBM z16 (air to air, water to air)
  - Field installed features and conversions on IBM z15 that are delivered solely through a modification to the machine's Licensed Internal Code (LIC)
  - TKE 10.0 LIC (FC 0882)
  - TKE HW (new order, w/4770 Cryptographic Adapter):
    - Tower: FC 0057
    - Rack mount: FC 0058
    - TKE FCs 0087 and 0088 TKEs can be carried forward and converted by replacing the installed Crypto adapter card with a 4770 Crypto adapter card FC 0851.
    - TKE FCs 0085 and 0086 TKEs can be carried forward and converted by replacing the installed Crypto adapter card with a 4770 Crypto adapter card FC 0851.
    - If the TKE code level is less than the current level shipping, new TKE code (10.0 TKE LIC) will be shipped for all TKEs installed.
  - System Recovery Boost (Stage 3) enhancements
  - Hardware Management Appliance (HMA, FC 0129)

IBM z16

IBM z16 availability Dates – Driver Level 51

- MES orders cannot be placed until July 1, 2022
  - TKE Rack Mount (#0057) on IBM z15
  - TKE Tower (#0058) on IBM z15
  - TKE 10.0 LIC (#0882) on IBM z15

- BPA Power Orders will ship starting September 13 2022

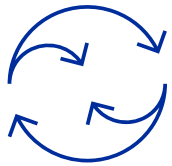
- IBM z16 to IBM z16 all remaining Loose Piece MES orders - September 30 2022

IBM z16

Design Principles

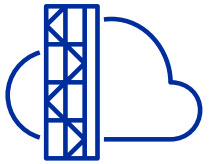
IBM z16 ™ is built to build

We built a powerful and secure platform for business.
Let's build the future of yours.



Predict and Automate for Increased Decision Velocity

Secure with a Cyber Resilient System



Modernize with Hybrid Cloud

IBM z16 Overview

IBM z16 with the IBM Telum Processor

Flexible compute design

- Available in one to four 19” frames based on capacity needs
- Two power options – iPDU for electrical efficiency and Bulk Power Assembly, no internal Battery Feature
- Industry’s first quantum-safe system with new Crypto Express8S card

IBM Telum Processor

- 7nm technology, 5.2GHz, 4 Dual Chip Modules (DCM) per CPC drawer
- 8 Cores/Chip, 2 Chips/DCM
- Up to 200 client configurable cores
- New integrated AI Accelerator capability of processing up to 300B deep learning inference request per day with 1ms latency
- 11% single-thread performance improvement and 17% maximum system capacity growth over IBM z15™
- 25% more processor capacity per drawer over IBM z15

Memory

- Up to 40TB RAM memory
- 25% more memory capacity per drawer over IBM z15
- Transparent memory encryption
- 32TB memory per LPAR, 2x more per LPAR than IBM z15

To the Data

- 54% increase in throughput with new FICON Express32S compared to IBM z15 FICON Express 16S
- 25% improvement in Coupling Facility write requests over IBM z15 for short reach coupling express links
- Execute up to 14 million encrypted FCP read IOPS using the IBM Fibre Channel Endpoint Security solution
- Up to 25 billion encrypted z/OS OLTP transactions per day.

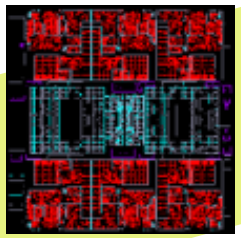
IBM z16

Machine type: 3931
Model A01

CPC Drawers	Client PUs	Max Memory
1	39	10 TB
2	82	20 TB
3	125	30 TB
4	168	40 TB
4 (Max)	200	40 TB

IBM Z – Processor Roadmap

32 nm
IBM zEC12
8/2012



Leadership Single Thread, Enhanced Throughput

Improved out-of-order

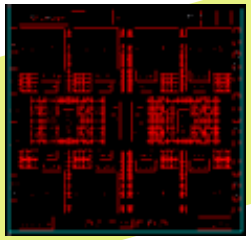
Transactional Memory

Dynamic Optimization

2 GB page support

Step Function in System Capacity

22 nm
IBM z13
1/2015



Leadership System Capacity and Performance

Modularity & Scalability

Dynamic SMT

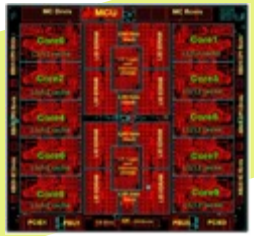
Supports two instruction threads

SIMD

PCIe attached accelerators

Business Analytics Optimized

14 nm
IBM z14
7/2017



Pervasive encryption

Low latency I/O for acceleration of transaction processing for DB2 on z/OS

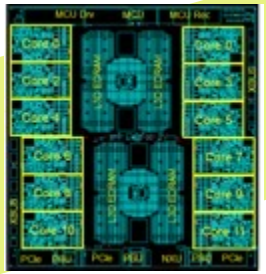
Pause-less garbage collection for enterprise scale JAVA applications

New SIMD instructions

Optimized pipeline and enhanced SMT

Virtual Flash Memory

14 nm
IBM z15
9/2019



Focus on power efficiency and new on-chip architectures

Improved and enlarged caches

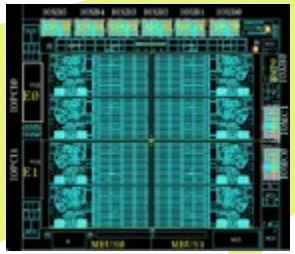
Optimized Out-of-Order architecture

Binary Floating point enhancements

IBM Integrated Accelerator for zEDC (On-chip compression support (DEFLATE))

Enhanced Cryptographic Coprocessor (CPACF)

7 nm
IBM z16
4/2022



New cache hierarchy

New multi-chip fabric

On-chip AI accelerator shared by all cores

Transparent memory encryption

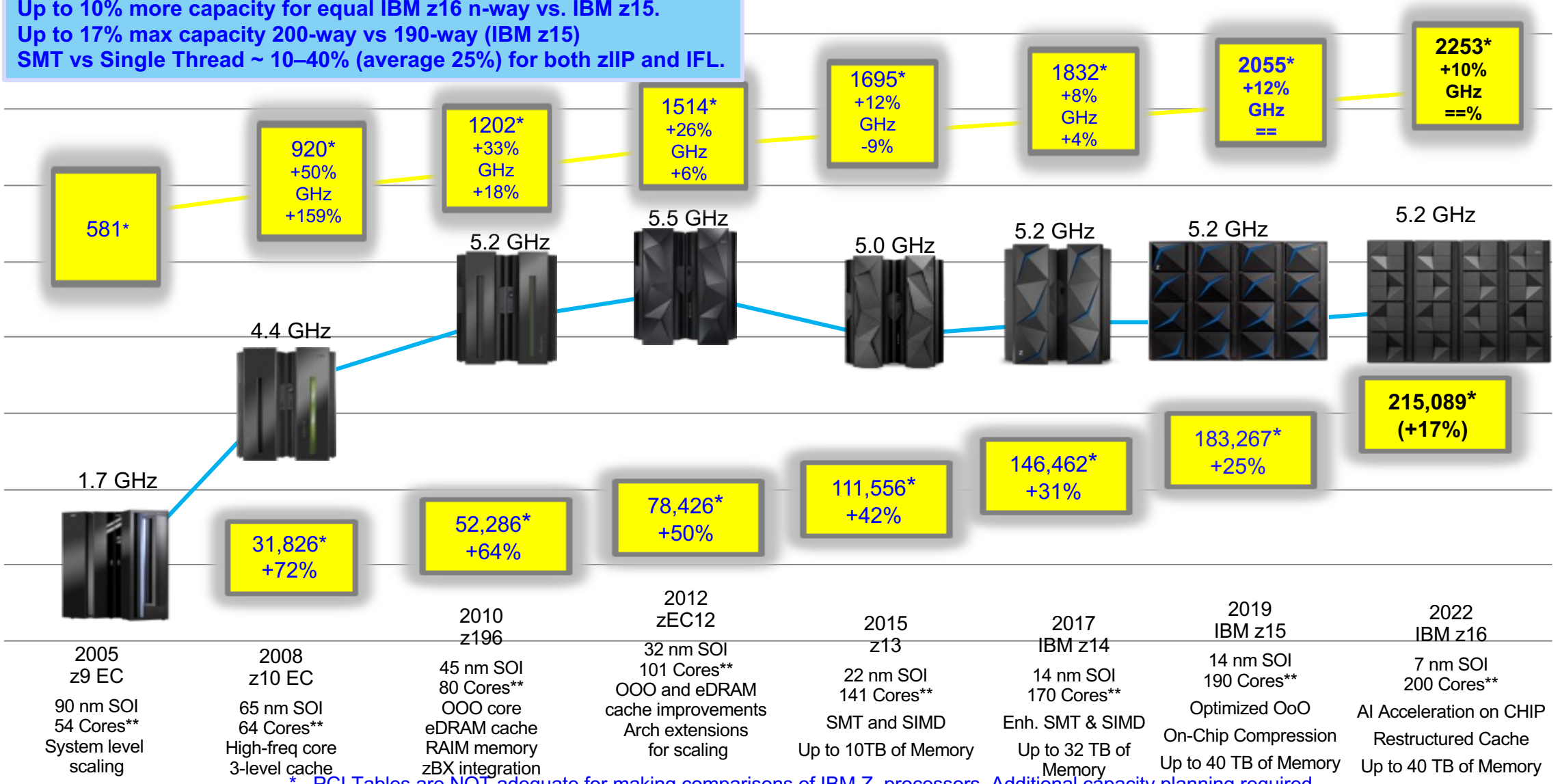
COBOL performance enhancements

Coupling/sysplex enhancements

25% more processor and memory capacity per drawer over IBM z15

IBM z16 Continues the CMOS Mainframe Heritage

Up to 10% more capacity for equal IBM z16 n-way vs. IBM z15.
Up to 17% max capacity 200-way vs 190-way (IBM z15)
SMT vs Single Thread ~ 10–40% (average 25%) for both zIIP and IFL.

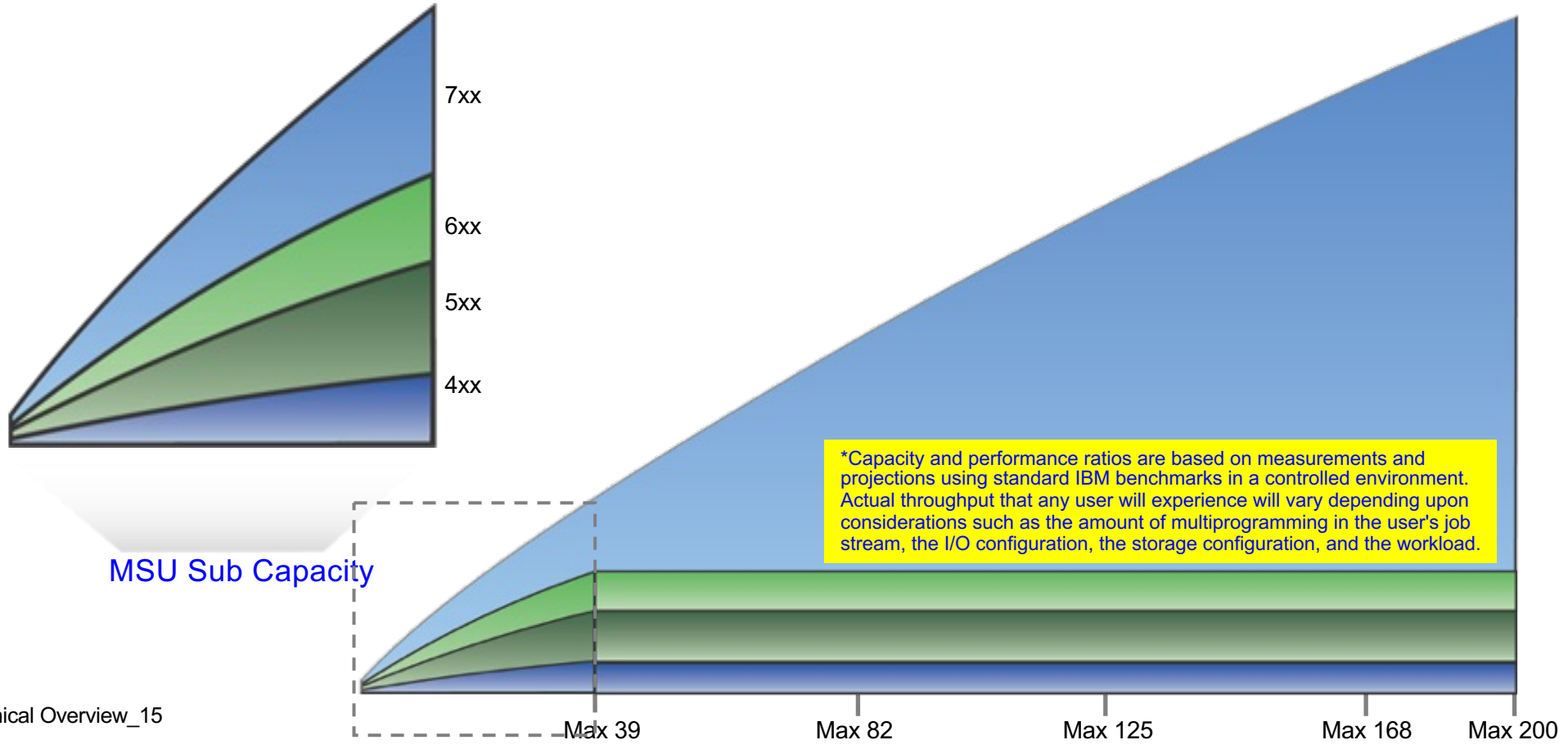


* PCI Tables are NOT adequate for making comparisons of IBM Z processors. Additional capacity planning required
** Number of PU cores for customer use

IBM z16 Full and Sub-Capacity CP Offerings

CP Capacity – Relative to Full Capacity Uni
701 = 100% ≈ 2,253 PCI
601 ≈ 66% ≈ 1,496 PCI
501 ≈ 41% ≈ 937 PCI
401 ≈ 12% ≈ 280 PCI

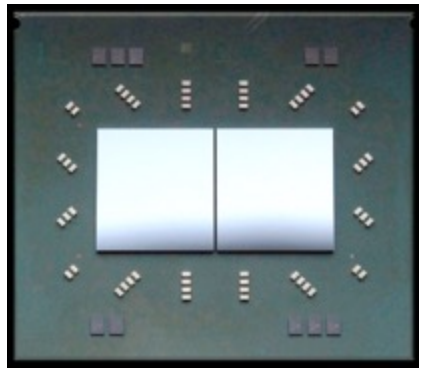
- **Subcapacity CPs, up to 39 may be ordered (317 total capacity levels). If more CPs are ordered, all must be full 7xx capacity.**
- **All CPs on an IBM z16 CPC must be the same capacity (except during Recovery Boost periods).**
- **All specialty engines are full capacity.**
- **zIIP to CP ratio – 2:1 and is the same for CPs of any capacity (except during System Recovery Boost periods).**



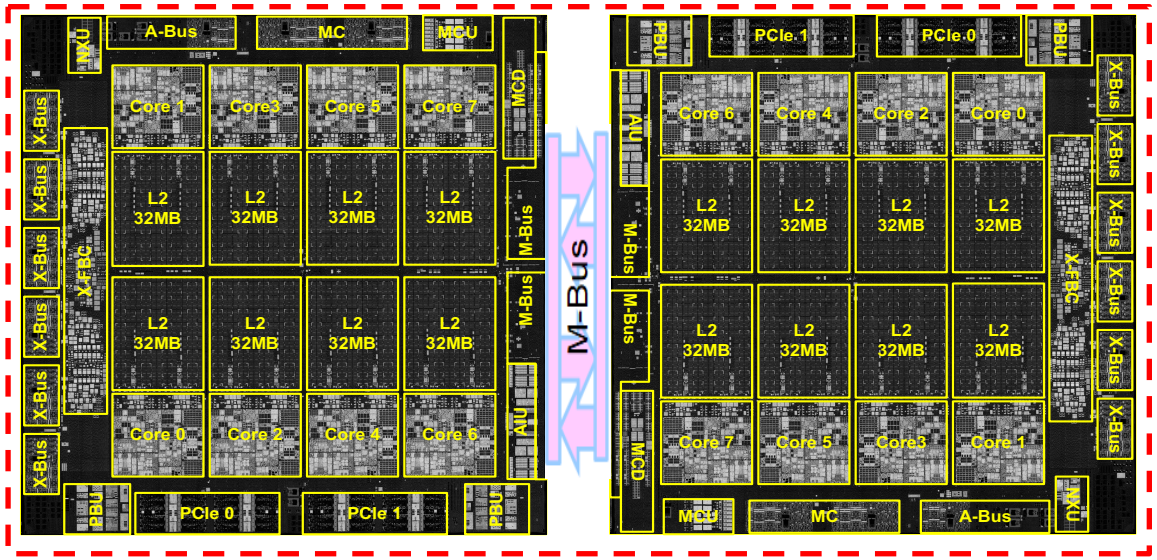
IBM z16 Processor Design and Structure

IBM z16Dual Chip Module

- 2 Telum chips per DCMs
- Telum chips connected by highspeed Mbus
  - 2 sets of 700 signals between Telum Chips
  - ~166 GB/s bandwidth in each set

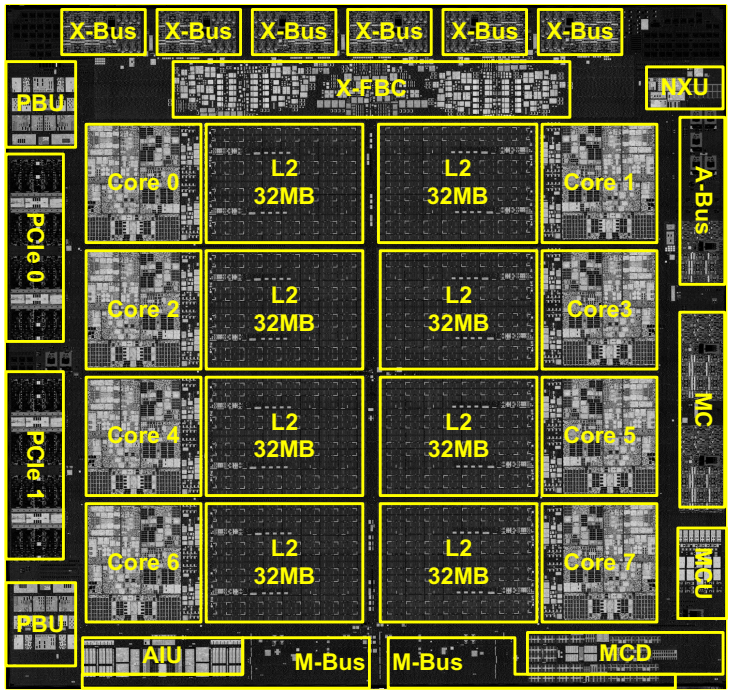


- Each DCM has:
  - up to 15 active cores
  - up to 16 DDIMMs of memory
  - 3 PCIe Adapter connections
  - Up to 1 SMP Connection (to other CPC Drawers)
    - ~50 GB/s bandwidth between drawers
  - 12 Xbus connections
    - 6 per Telum chip to all the other Telum chips in a drawer
      - ~35 GB/s Bandwidth per link
      - ~120 GB/s bandwidth between DCMs



*Speed and performance data based on running at max CP frequency in laboratory test

8-Core Processor Chip Detail (Telum)



- **7nm FinFET Technology**
  - 8 cores per CP
  - 18.8 miles of wire
  - ~ 23mm x 22 mm
  - Up to 2 PCIe buses, and 8 DDIMMS
  - 22.5B transistors versus 9.2B on z15

- **8 Telum chips per CPC Drawer in 4 DCMs**
- **Up to 8 active cores per Telum Chip**
- **Up to 200 active cores per system**
- **Added Integrated Accelerator for AI**

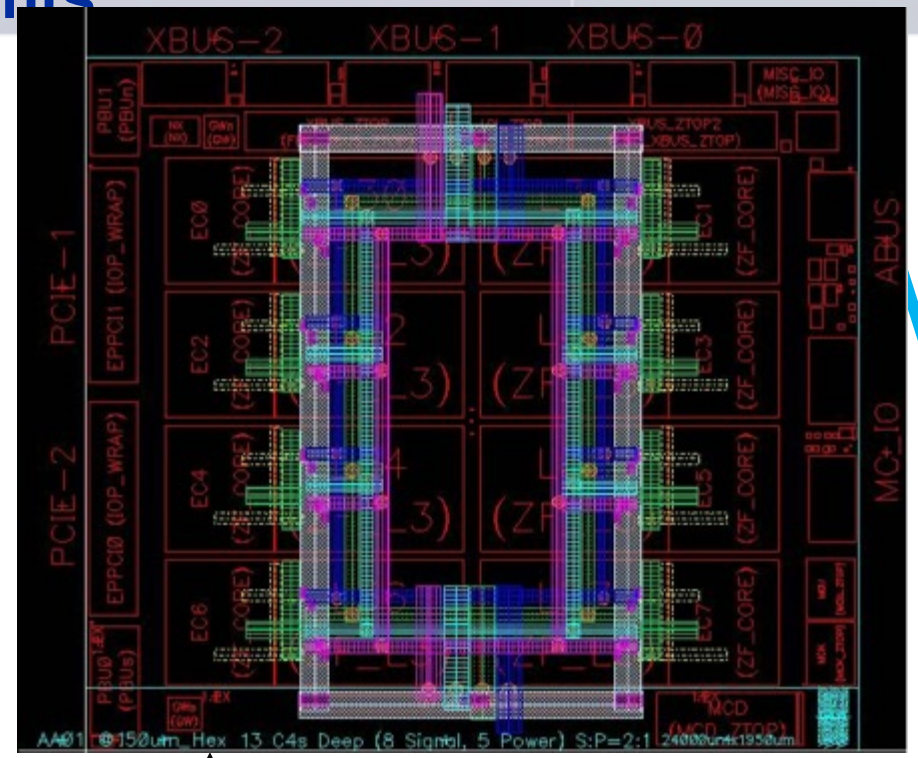
- **On Core L1 Cache**
  - Private 128K L1I and 128K L1D

- **On Core/Chip L2 Cache**
  - Each core has access to a private 32 MB cache
  - Up to 16MB of each cache can be used by other cores as virtual cache depending on the current activity
  - L2 cache of an inactive core becomes shared virtual L3 cache by the active cores of the chip
  - L2 cache of an inactive core of another CP can become virtual L4 cache

- **I/O buses**
  - Each CP chip will support up to 2 Gen-5 PCIe buses

8-Core Processor Chip Design & Improvements

- **General performance enhancements**
  - New Cache/TLB Design
  - Branch prediction improvements
  - System Coherency Fabric Manager
  - On-Chip ring among all cores of a CP
- **Merge/Sort Accelerators**
  - Introduced with the z15 CD announcement
- **Per-CP chip GZIP compression**
  - zEDC replacement (introduced on z15)
- **Per-CP chip Integrated Accelerator for AI**
  - New functionality with the IBM z16
- **In-Line Memory Encryption**
  - Enabled by default
  - Encryption keys managed internally



Integrated AI Accelerator – combining compute & data movers

On Chip AI Accelerator

Aggregate of >6 TFLOPS / chip

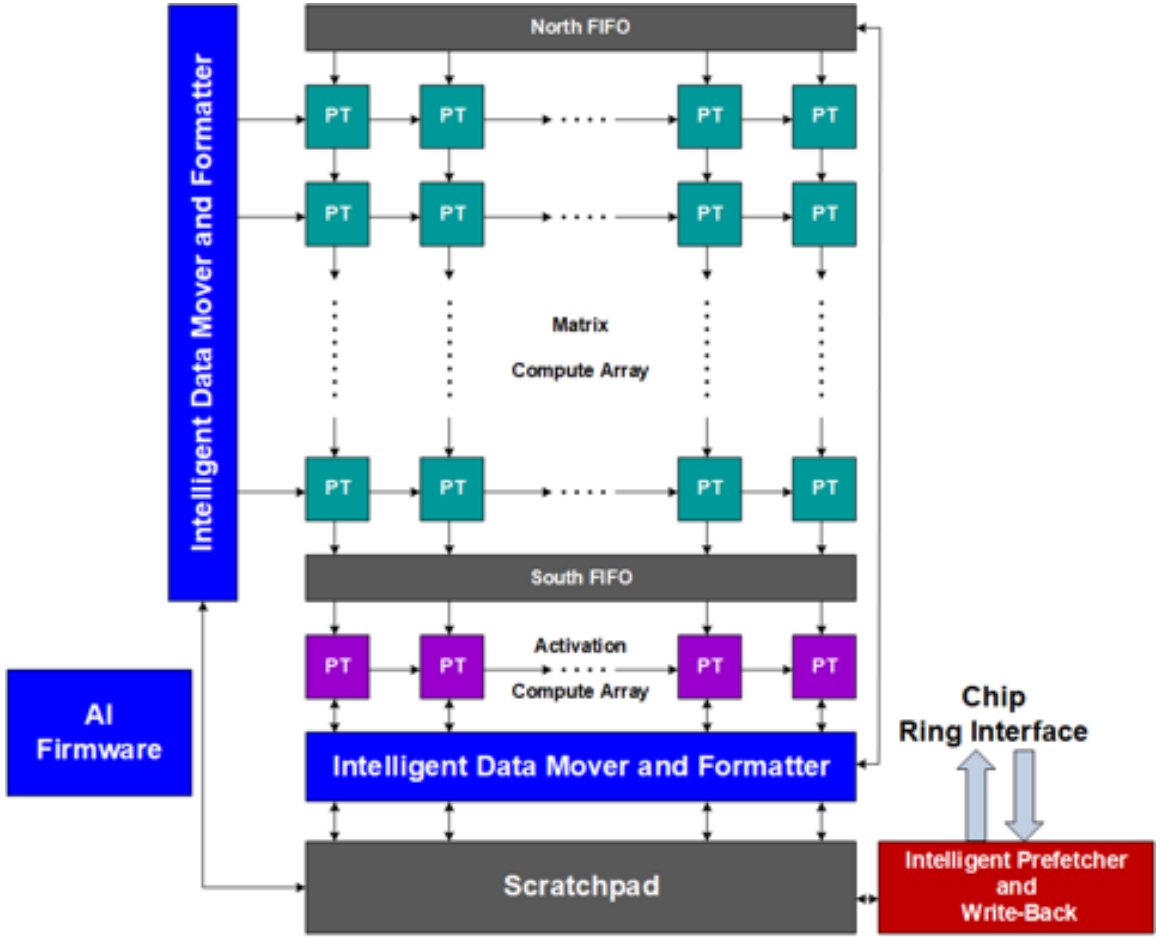
- Over 200 TFLOPS on 32-chip system

Compute Arrays

- 128 processor tiles with 8-way FP-16 FMA SIMD
  - Optimized for matrix multiplication and convolution
- 32 processor tiles with 8-way FP-16/FP-32 SIMD
  - Optimized for activation functions & complex operations

Intelligent Prefetcher and Data Movers

- 200+ GB/s read/store bandwidth from/to cache
- 600+ GB/s bandwidth between engines
- Multi-zone scratchpad for concurrent load, execution and store



IBM z16 MES Upgrades

- **IBM z16 to IBM z16 upgrades**
  - IBM z16 Concurrent upgrade from Max 39 to Max82 to Max125
    - Max39, Max82, Max125, and Max168 each adds additional CPC Drawers
    - Max200 is implemented in 4 drawers
    - No MES upgrade to Max168 or Max200
  - Additional I/O Drawers
    - Based on available space in current frames and/or I/O expansion frames
- **Any z15 T01 to any IBM z16**
  - Conversion from water cooled to radiator cooled
- **Any z14 M01- M05 to any IBM z16**
  - Conversion from water cooled to radiator cooled

New Features and Functionality

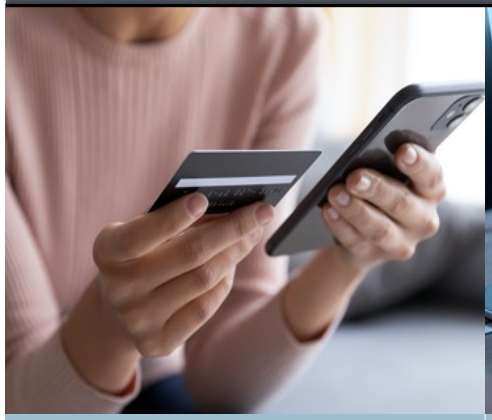
IBM z16: Predict and automate for increased decision velocity

Prevent fraud before it happens by scoring up to 100% of transactions in real-time without impacting SLA's

Insights at unprecedented speed and scale means every customer interaction can now be a personalized experience

Leveraging AI, in operational processes can proactively identify and stop outages before they occur

Use Cases by Industry



Banking

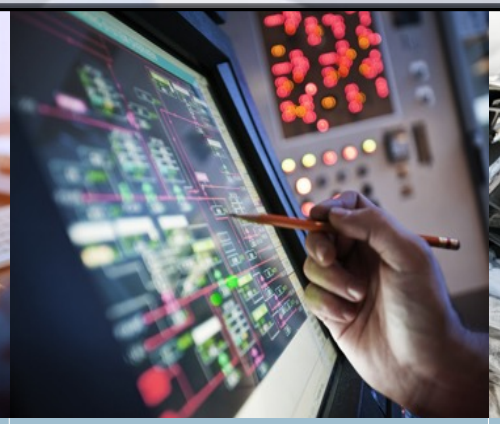
Examples

- Compliance Testing: account ID take over and identity theft
- Gaming the system – reward cards and account openings
- Interest rate forecasting
- Loan processing & approval

Finance

Examples

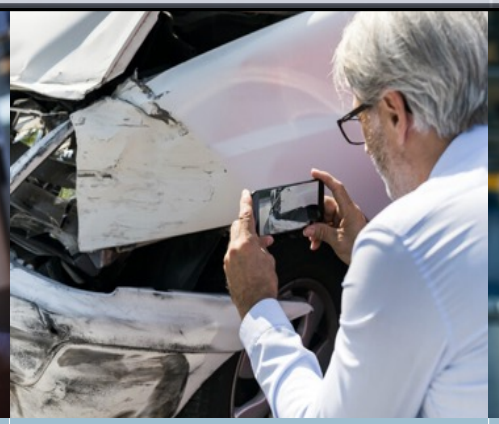
- Enable point-of-sale payment processing with fraud detection
- Financial crimes detection, anti-money laundering (AML)
- Wealth management with predictive models



Trading

Examples

- High frequency trading analytics
- Algorithmic trading
- Clearing & Settlements



Insurance

Examples

- Real-time fraud detection for claims and images
- Claims adjudication
- Pricing & actuarial analysis for better risk assessment

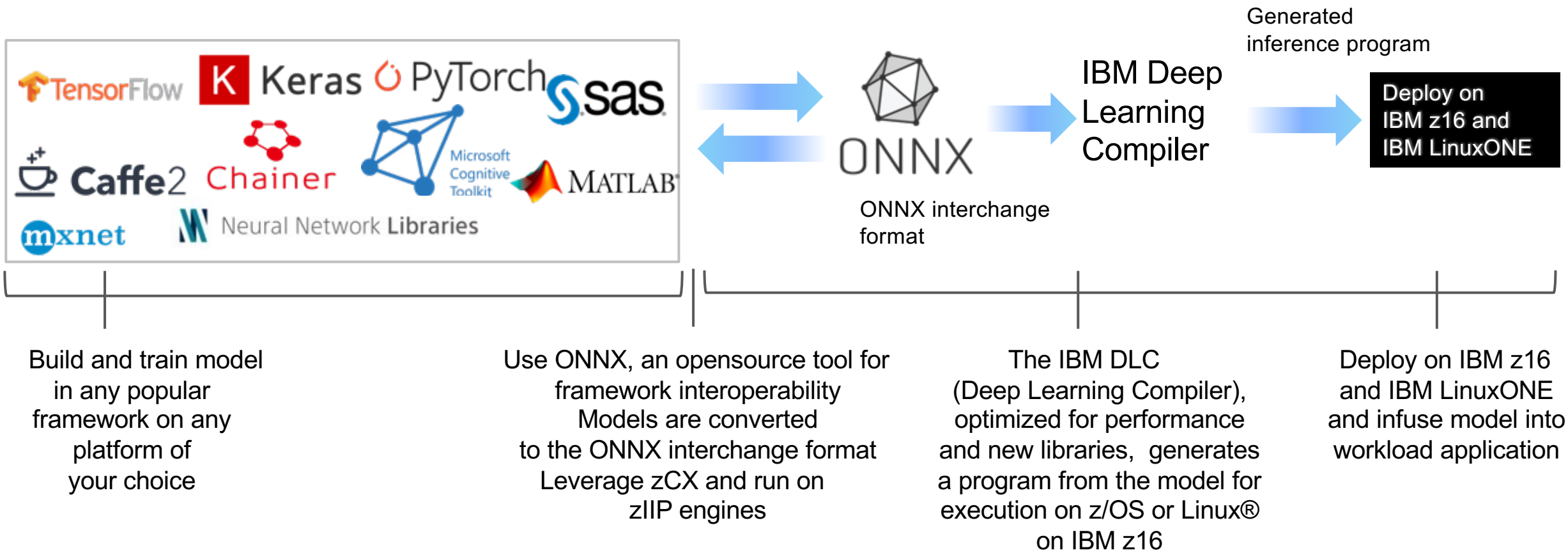
Other

Examples

- Supply Chain
- Payroll processing
- Manufacturing
- Scientific research
- Computer design
- Biosecurity
- Mining
- Healthcare

Seamlessly leverage AI accelerator on IBM z16

- Bring machine learning & deep learning models to IBM z16 with ONNX/DLC
- Exploit IBM Integrated Accelerator for AI for best inference performance.
- Repeatable practice for different vendors to leverage IBM z16 and Integrated Accelerator for AI

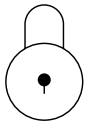


We are entering a new cryptographic era

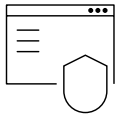
There will be a time when the power of quantum may crack public key cryptographic security protection …

Your data and security is already at risk for quantum-attacks

Harvest now, decrypt later
schemes are underway to collect data now for decryption when quantum computers are powerful enough



Replacing most of the public-key systems
currently in use will take 5 to 15 years



Lifetime of data
means that sensitive data generated today that is not protected with quantum-safe algorithms is at risk now

IBM z16 industry-first quantum-safe system

Quantum-safe technology and key management services were developed to help protect data and keys against a potential future quantum attack like harvest now, decrypt later

Quantum-Safe System	Protect Sensitive Data	Create Crypto Inventory
Industry first quantum-safe system protected by quantum-safe technologies through multiple layers of firmware. Helps protect IBM z16 firmware from quantum attacks through a built-in dual signature scheme with no changes required.	New Crypto Express8S HSM with quantum-safe APIs to enable you to start now to future proof your applications and data. Modernize existing and build new applications leveraging quantum-safe cryptography along with classical cryptography for a dual scheme approach as recommended by NIST.	Discover where and what crypto is used in applications to aid in developing a crypto inventory for migration and modernization planning. New crypto discovery features in IBM Application Discovery and Delivery Intelligence (ADDI) to discover crypto usage in applications. Using ADDI can improve productivity up to 30%.[1]

1 See sources in notes

IBM Flexible Capacity for Cyber Resiliency

Designed to help organizations proactively reduce the impact of downtime by dynamically shifting their critical workloads to an alternate site for business continuity

Greater Flexibility	Complete Client Control	Simplified Compliance
Dynamically shift production capacity between z16 systems at different sites within seconds Can be used for proactive outage avoidance, business continuity compliance, disaster recovery and DR test scenarios. Be confident that production workloads can be seamlessly shifted to an alternate site and still meet production SLAs.	Remotely transfer capacity – no on-site personnel required after initial set up. Flexibility over duration of capacity transfer, production can remain at the alternate site for up to one year. Fully automatable using solutions such as GDPS. Integrates with System Recovery Boost for faster system and workload startup	Simplify business continuity compliance and improve audit readiness by using the same procedures for both for DR testing and real unplanned disasters. Automate and test recovery procedures for unplanned outages to provide near-continuous availability and disaster recovery.

Business continuity is a key aspect of cyber resiliency

Proactive Outage Avoidance

With extreme weather events becoming more and more frequent, a proactive approach to delivering continuous service is needed.

You need to be able to migrate your critical workloads to an alternate site before your business gets impacted.

Disaster Recovery and DR Testing

In the event of an unplanned outage, including cyber attacks, the ability to rapidly restore operations and service is paramount.

The ability to test that production workloads can be shifted and run at full capacity is critical for ensuring continuous availability during unplanned outages is key.

Business Continuity Compliance

Regulation around business continuity and disaster recovery policies are increasing and becoming more stringent.

These regulations mandate that businesses be able to switch over full production loads to a secondary data center and operate there for extended periods of time.

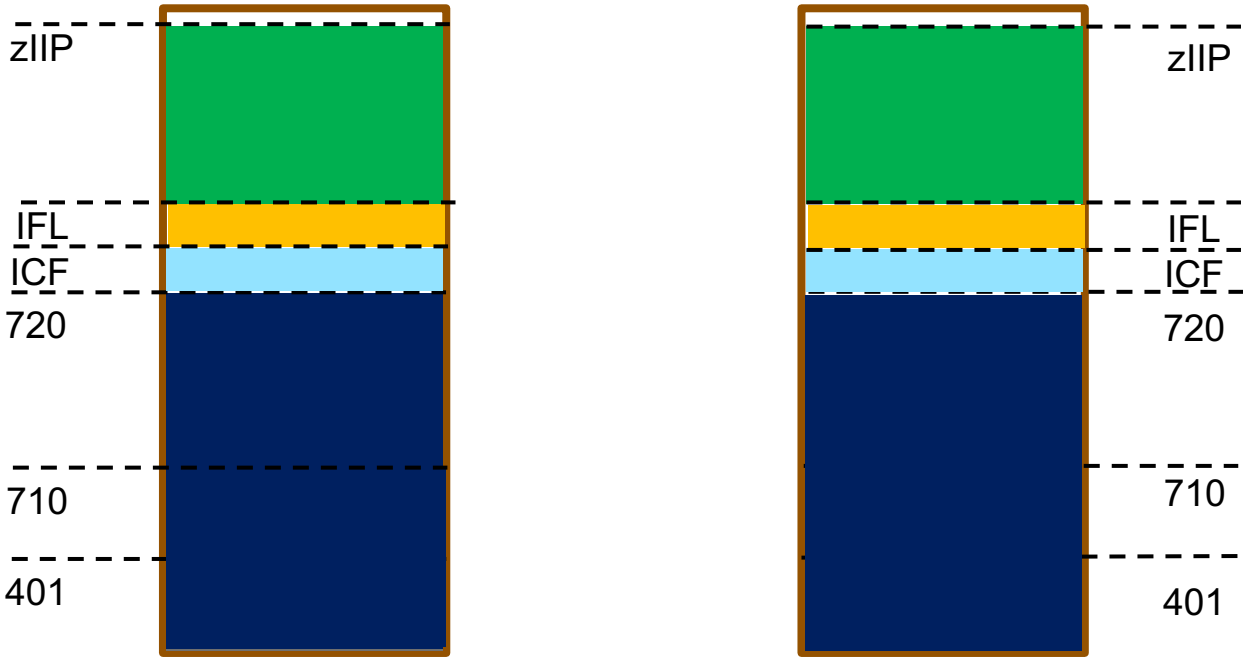
Site Facility Maintenance

Site facility and building maintenance is an ongoing activity for businesses. Upgrading for environmental, health, and safety purposes or other improvements sometimes requires closures.

The ability to continue to provide 24x7 service to your customers is more important than ever.

Site A

Site B



Configuration
CP: 720
zIIPs: 10
ICF: 4
IFL: 4
ACP: 401
UzIIP: 10
UICF: 4
UIFL: 4

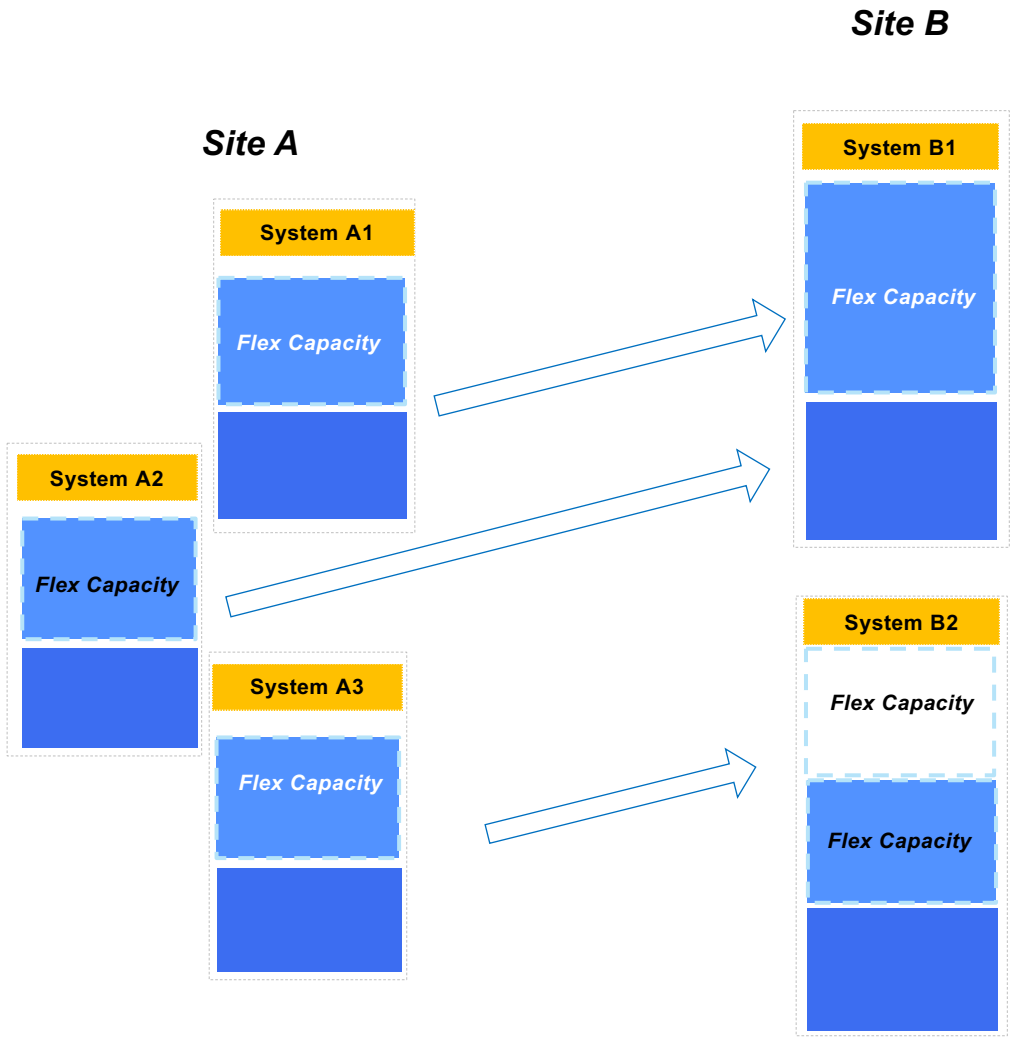
Configuration
CP: 401
zIIPs: 0
ICF: 0
IFL: 0

Flex Record
CP: 20
IFL: 4
ICF: 4
zIIPS: 10
Capacity indicator: 7

Flex Record
CP: 20
IFL: 4
ICF: 4
zIIPS: 10
Capacity indicator: 7

Multi-system environment

- Multi-system example:
  - A1, A2, A3 moved to B1, B2
- Example shows all capacity from
  - A1 and A2 moved to B1
  - A3 moved to B2
- Movement would not necessarily have to be ‘all to one’ – could be split
- RULE: Total capacity active on all systems after swap cannot exceed total capacity active prior to swap.
  - Sum all active capacities (Base + Flex Capacity)
  - Done for all engine types
  - Exceeding the purchased capacity will be charged
- Monitoring to ensure compliance is done



IBM System Recovery Boost

Over **95%** of IBM z15 customers with System Recovery Boost eligible systems, are using System Recovery Boost to unleash additional processing capacity.[1]

Introduced with IBM z15

Faster shutdown and startup
Accelerate the shutdown, restart and recovery of images, middleware environments and client workloads to accelerate return to pre-shutdown SLAs.[2]

Faster sysplex recovery
Accelerate Parallel Sysplex recovery processes to minimize disruption and expedite return to steady-state operations.

Faster GDPS automation
Drive faster and more efficient GDPS automation actions to rapidly reconfigure and recover your environment.

Faster elimination of backlog
Utilize additional capacity for a fixed period during recovery, so you can process backlog faster after planned or unplanned downtime.

New with IBM z16

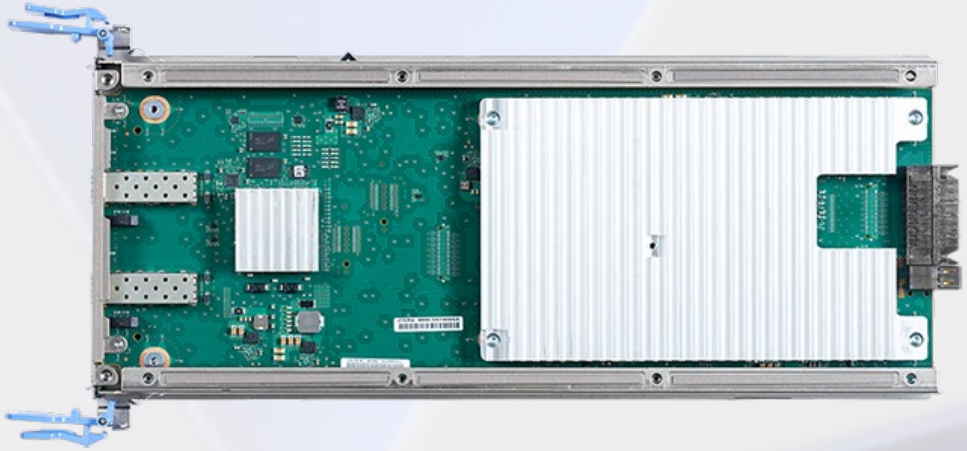
Faster middleware restart
Accelerate the restart and recycle of client-specified middleware environments to rapidly return to steady-state operations up to 35% faster.[3]

Faster SVC dump processing
Accelerate the SVC dump capture process so you can gather the diagnostics and return to normal operations up to 30% faster.[4]

Faster Hyperswap Config Load
Accelerate the process of loading hyperswap configuration and policy information and to reduce the system impact while the load is in progress.

[1,2,3,4] See claims in notes

Supported I/O Features



Storage connectivity

Description	Feature Code	New Build / Carry Forward	Ports	Maximum Feature Quantity
FICON Express16S+ LX	0427	Carry Forward	2	192
FICON Express16S+ SX	0428	Carry Forward	2	192
FICON Express16SA LX	0436	Carry Forward	2	192
FICON Express16SA SX	0437	Carry Forward	2	192
FICON Express 32S LX	**0461**	**New Build**	**2**	**192**
FICON Express 32S SX	**0462**	**New Build**	**2**	**192**
zHyperLink Express	0431	Carry Forward	2	16
zHyperLink Express1.1	**0451**	**New Build** / Carry Forward	**2**	**16**

IBM z16-Qualified 3rd Party FICON Switches

Partner	FICON Switches Supported		Firmware Supported
	Broadcom Name	IBM Name	
Broadcom/ Brocade	X7-8	SAN512B-7	FOS 9.0.1x
	X7-4	SAN256B-7	
	G720	SAN64B-7	
	X6-8	SAN512B-6	FOS 8.2.3x or FOS 9.0.1x
	X6-4	SAN256B-6	
	G620	SAN64B-6	
	Cisco Name	**IBM Name**	
Cisco	MDS 9710	SAN384C-6	NX-OS 8.4(2b) or NX-OS 8.4(2c)
	MDS 9706	SAN192C-6	
	MDS 9250i	SAN50C-R	

Note: for up-to-date hardware support and service dates, please visit the End-of-Life pages for Cisco and Broadcom.

Network connectivity: OSA

Description	Feature Code	New Build / Carry Forward	Ports	Maximum Feature Quantity
OSA Express6S GbE LX	0422	Carry Forward	2	48
OSA Express6S GbE SX	0423	Carry Forward	2	48
OSA Express6S 10GbE LR	0424	Carry Forward	1	48
OSA Express6S 10GbE SR	0425	Carry Forward	1	48
OSA Express6S 1000BASE-T	0426	Carry Forward	2	48
OSA Express7S GbE LX	0442	Carry Forward	2	48
OSA Express7S GbE SX	0443	Carry Forward	2	48
OSA Express7S 10GbE LR	0444	Carry Forward	1	48
OSA Express7S 10GbE SR	0444	Carry Forward	1	48
OSA Express7S 1000BASE-T	0446	Carry Forward	2	48
OSA Express7S 1.1 25GbE SR	0449	Carry Forward	1	48

Network connectivity: OSA (continued)

Description	Feature Code	New Build / Carry Forward	Ports	Maximum Feature Quantity
OSA Express7S 1.2 GbE LX	0454	New Build	2	48
OSA Express7S 1.2 GbE SX	0455	New Build	2	48
OSA Express7S 1.2 10GbE LR	0456	New Build	1	48
OSA Express7S 1.2 10GbE SR	0457	New Build	1	48
OSA Express7S 1.2 1000BASE-T	0458	New Build	2	48
OSA Express7S 1.2 25GbE SR	0459	New Build	1	48
OSA Express7S 1.2 25GbE LR	0460	New Build	1	48

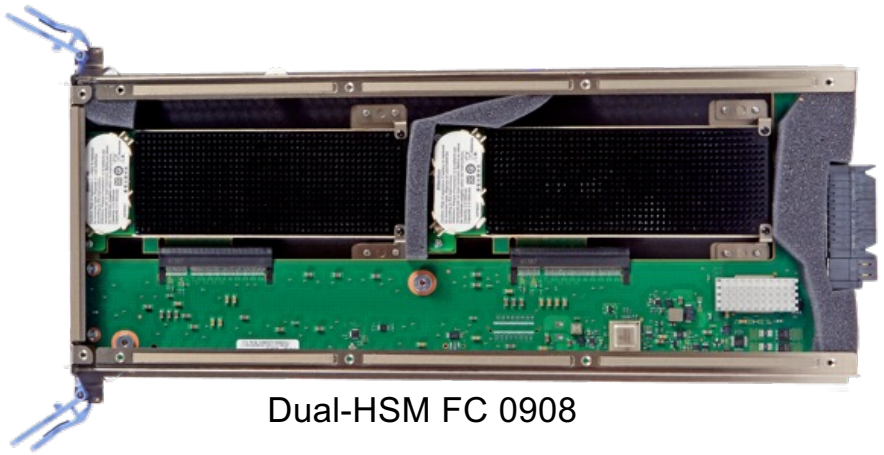
Network connectivity: RoCE

Description	Feature Code	New Build / Carry Forward	Ports	Maximum Feature Quantity
10GbE RoCE Express2	0412	Carry Forward	2	16
10GbE RoCE Express2.1	0432	Carry Forward	2	16
25GbE RoCE Express2	0430	Carry Forward	1	16
25GbE RoCE Express2.1	0450	Carry Forward	1	16
10GbE RoCE Express3 SR	**0440**	**New Build**	**2**	**16**
10GbE RoCE Express3 LR	**0441**	**New Build**	**2**	**16**
25GbE RoCE Express3 SR	**0452**	**New Build**	**2**	**16**
25GbE RoCE Express3 LR	**0453**	**New Build**	**2**	**16**

Crypto Express8S

- Two new adapters designed for the IBM z16:
  - Feature code **0909** (one HSM)
    - Maximum of **16** per A01
  - Feature code **0908** (two HSMs)
    - Maximum of **30** per A01 (**60** HSMs)
- A mix of adapters can be ordered for new build and carry forward; maximum combined total: **16**
- Supports up to **85** domains and **5100** virtual HSMs

- New cards provide Quantum-Safe Root of Trust
  - Designed for **2X** performance improvement
  - Performs AES, DES/TDES, RSA, ECC SHA-1, SHA-2, & other crypto operations
  - Supports new Quantum-Safe Dilithium and Kyber algorithms



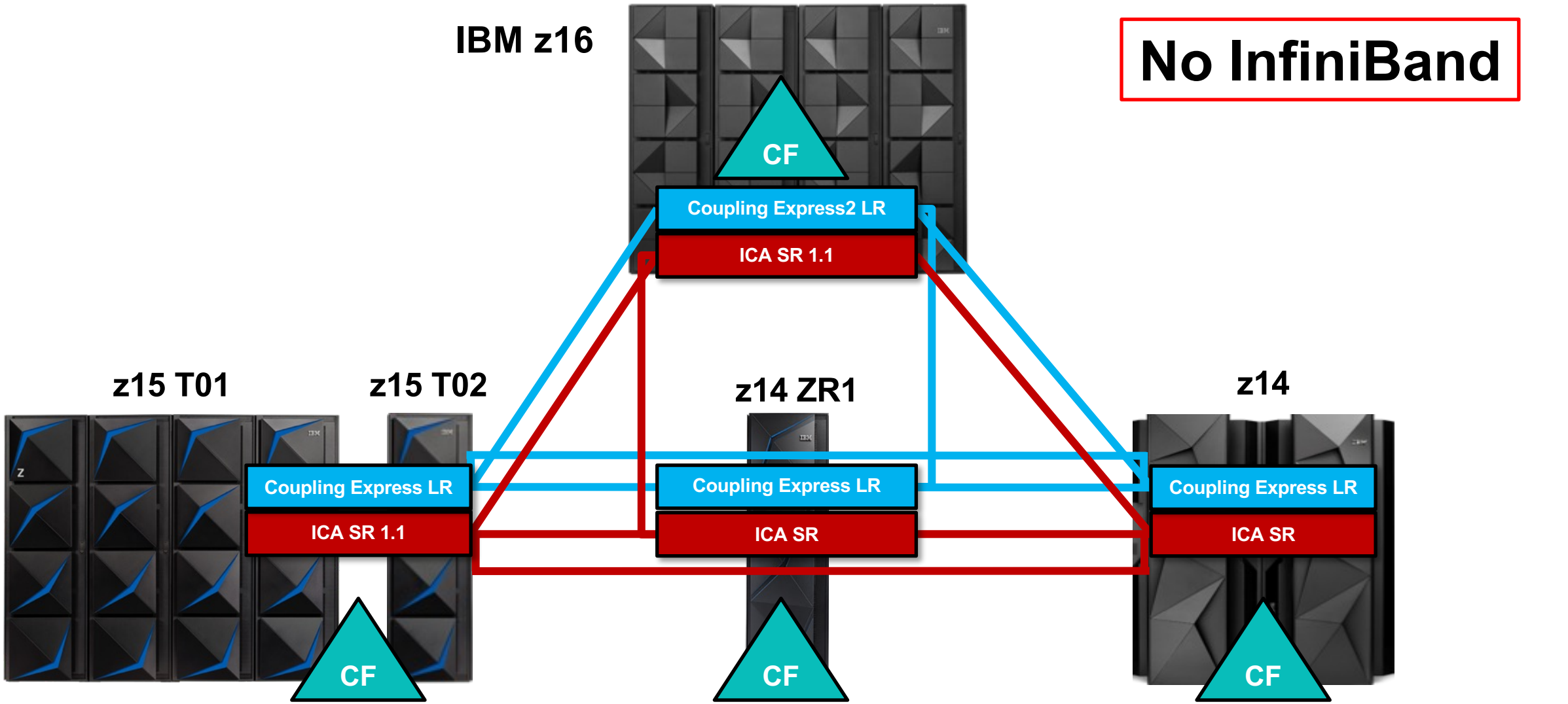
Dual-HSM FC 0908

IBM z16 Coupling

Coupling connectivity

Description	Feature Code	New Build / Carry Forward	Ports	Maximum Feature Quantity
Integrated Coupling Adapter Short Reach (ICA SR)	0172	Carry Forward	2	48
Integrated Coupling Adapter Short Reach 1.1 (ICA SR1.1)	**0176**	**New Build** / Carry Forward	**2**	**48**
Coupling Express2 LR	**0434**	**New Build**	**2**	**32**

IBM z16 coupling connectivity



Power and Cooling

Power options

- Two power options with the IBM z16:
  - **Intelligent Power Distribution Unit (iPDU)**
  - **Bulk Power Assembly (BPA)**
- All cabling routed to back of frame; top and bottom power and I/O exit available
- The IBM z16 is the last system to support BPA power
- BPA-powered IBM z16 systems will **not be available to order at GA**
- BPA-powered systems running at temperatures above the recommended range may experience performance throttling
- *Balanced Power Plan Ahead* feature eliminates downtime for system upgrades

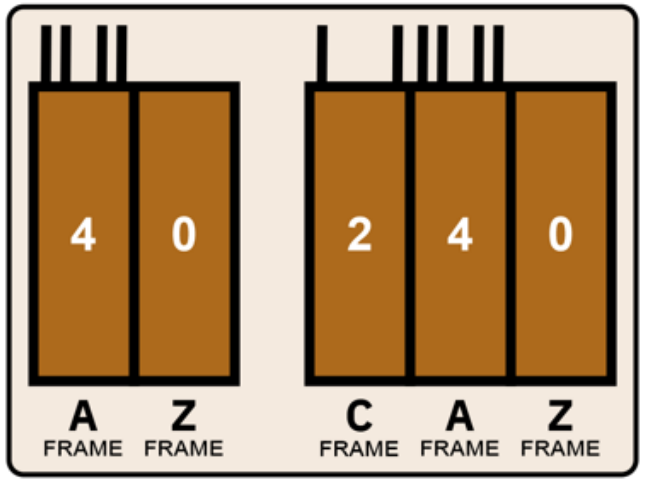
Feature	iPDU	BPA
Number of line cords	2, 4, 6, or 8	2 or 4
Max. PCIe+ I/O drawers	12	10
200-240 VAC (4 wire), 60A	Yes	Yes
380-415 VAC (5 wire), 30/32A	Yes	Yes
480 VAC (5 wire Wye)	No	Yes
Phase loss immunity	No	Yes
Internal Battery Feature	No	No
Water Cooling Unit	No	No
Balanced Power	No	Yes

Power line cords (rear view)

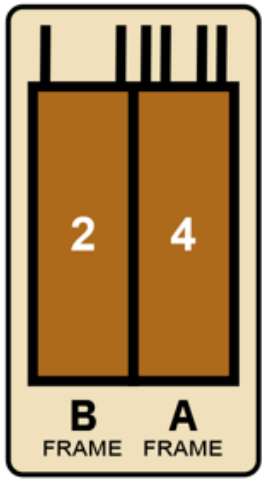
iPDU Power

4 line cords are required in the A Frame if more than 1 CPC drawer

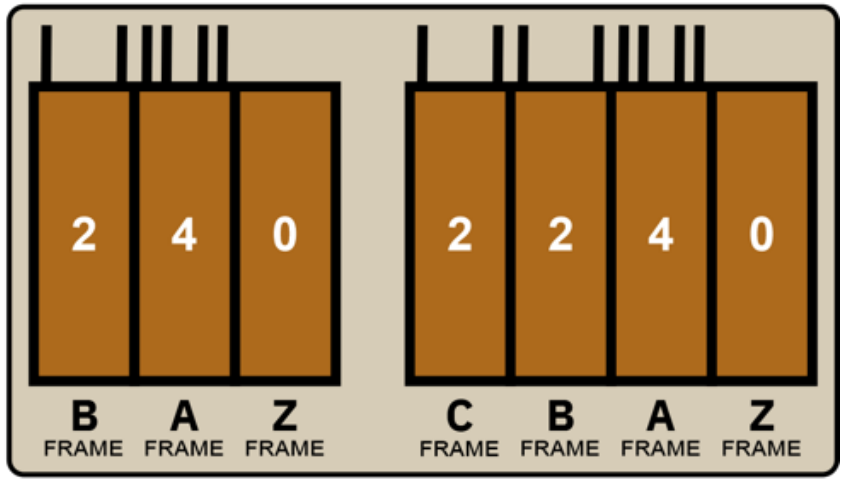
I/O Expansion



CPC Expansion
Factory Build Only

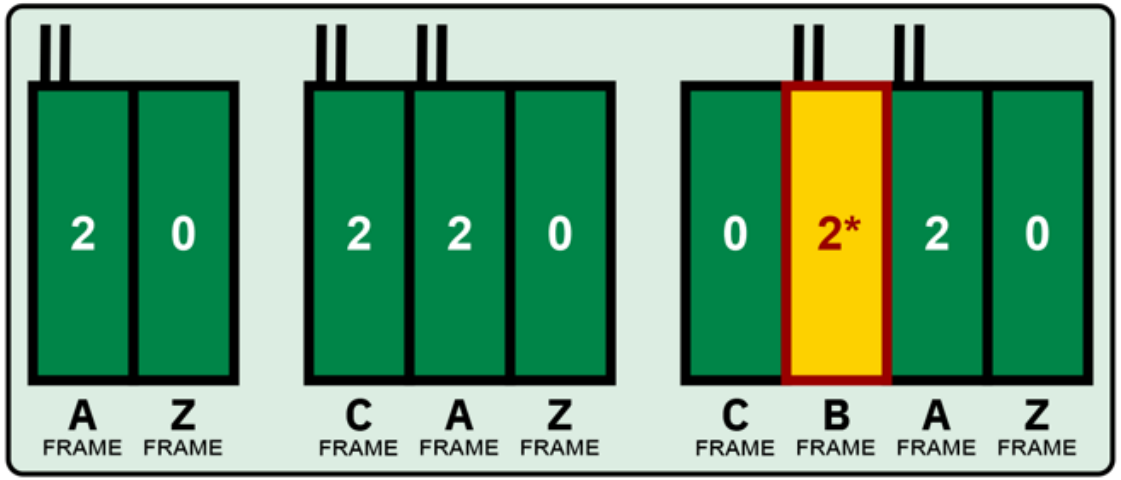


CPC and I/O Expansion
Factory Build Only

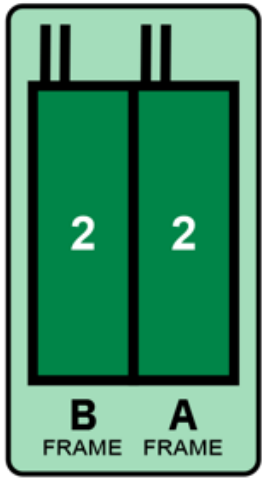


BPA Power

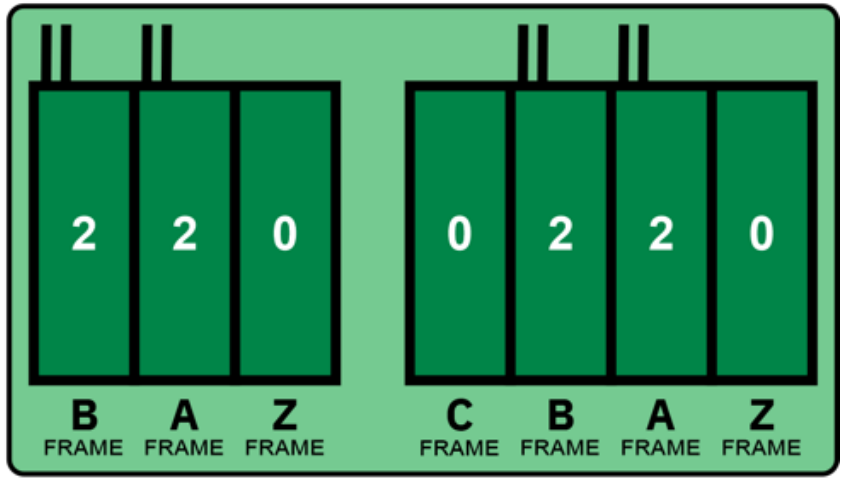
I/O Expansion



CPC Expansion
Factory Build Only



CPC and I/O Expansion
Factory Build Only



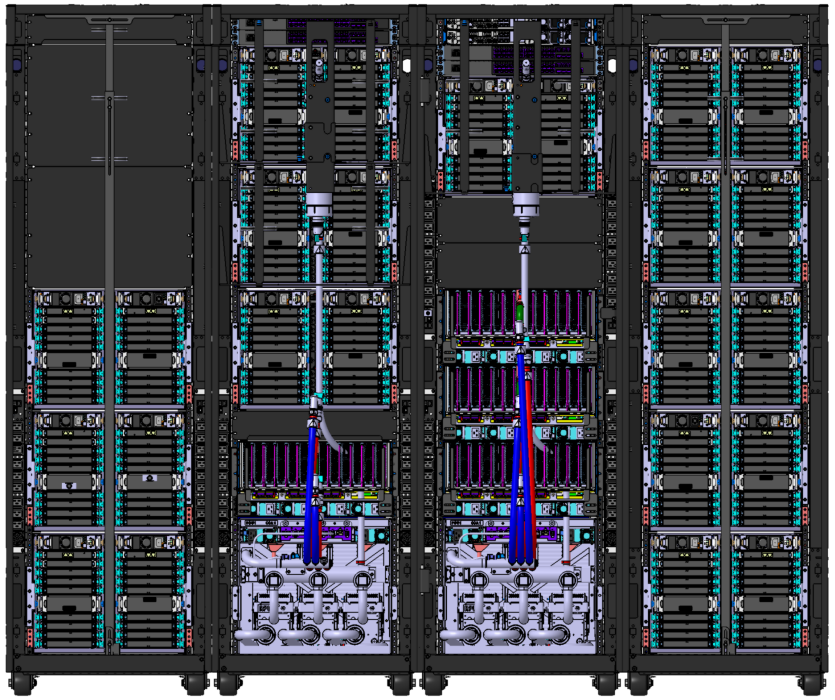
** Special BPA B Frame plan-ahead - contains no CPC drawers or cooling*

IBM z16 (3931-A01)

Physical Planning and Configuration

Configuration Overview

- **IBM z16 is designed with flexibility built into the configuration**
  - System can only come with internal radiator cooling
  - Customer has the option to use Bulk Power Assembly (BPA) or Power distribution Unit (iPDU) based power for operation. (configuration dependent)
    - SOD Fulfilled: IBF feature ***not*** available on IBM z16.
    - SOD Issued: This is the last system to support BPA power
  - Up to four frames possible depending on the amount of CP and I/O cards ordered
    - Allowing up to a max of 4 CPC drawers and 12 I/O drawers
    - ***By default, systems reserve space for up to 2 additional CPC drawers*** in the A Frame Reserve CPC FCs: 2981/2982
      - Clients may not be able to add additional CPC drawers if they override plan ahead features.



IBM z16 Configuration: PDU based single frame Rear View

Max 39

- 2 line cords required
- Up to 39 CPs
- Up to 3 I/O Drawers (48 I/O Cards) without CPC Reserve FCs 2981 and 2982

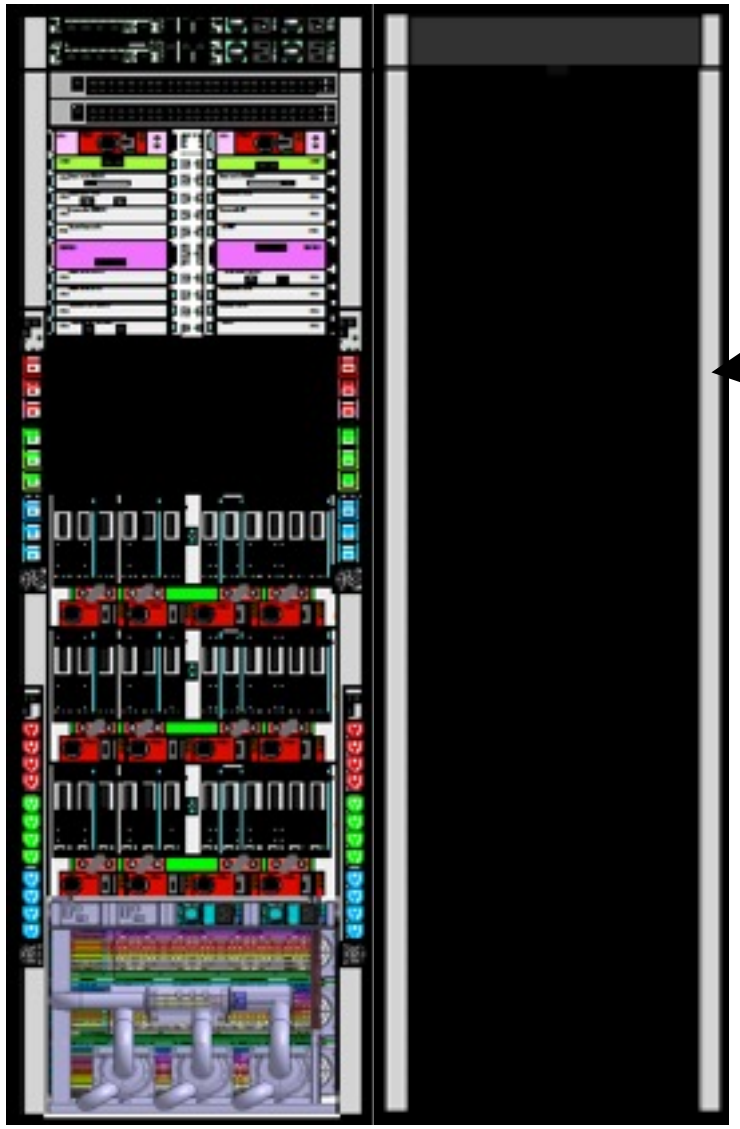
Max 82

- 4 line cords required
- Up to 82 CPs
- Up to 2 I/O Drawers (32 I/O Cards) without CPC Reserve FC 2982

Max 125

- 4 line cords required
- Up to 125 CPs
- 1 I/O Drawers (16 I/O Cards)
- **Default A-Frame configuration** with CPC Reserve FCs 2981 and/or 2982

IBM z16 Configuration: PDU based I/O Expansion Rear View



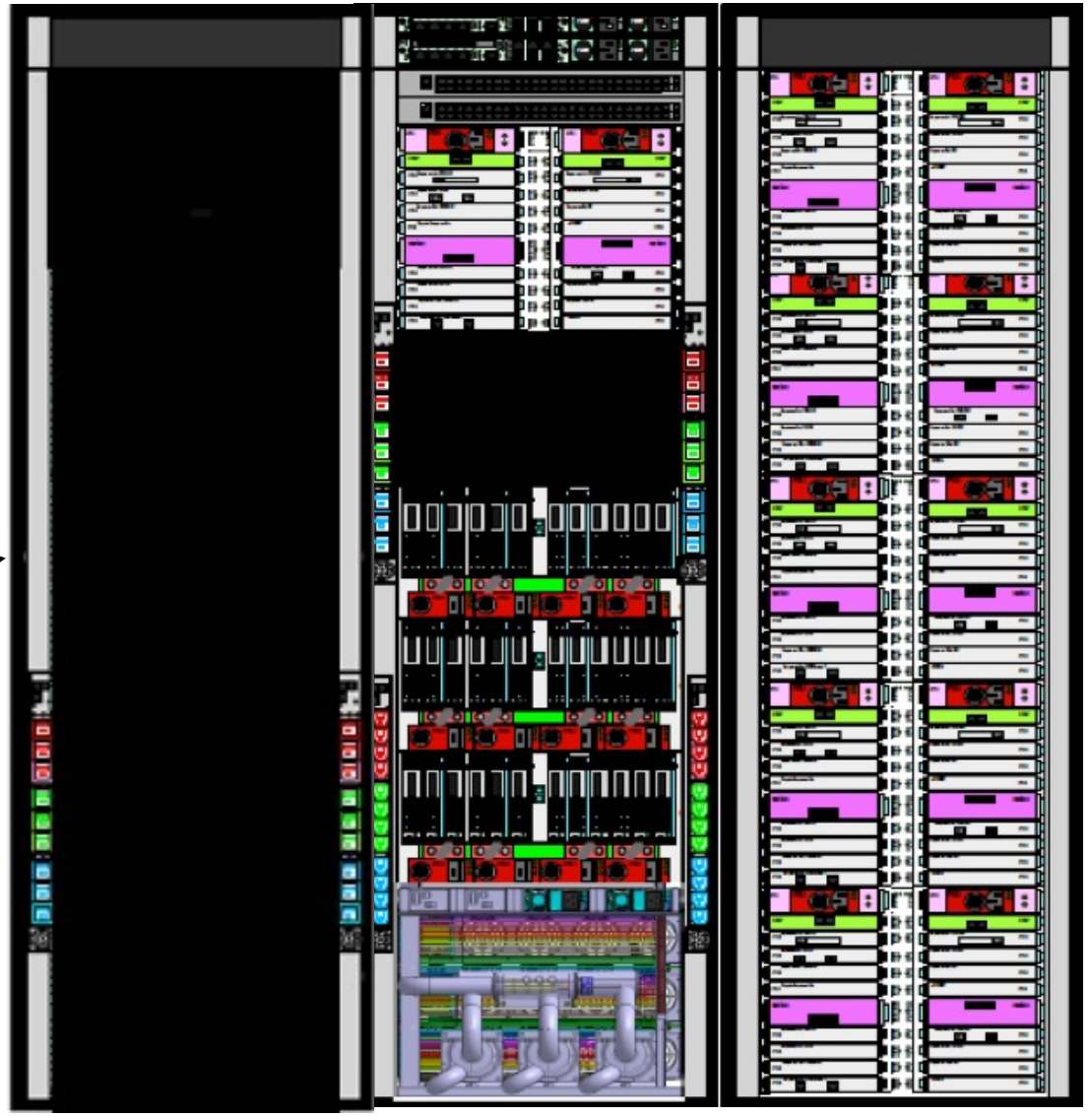
Max 39/82/125

- 4 line cords required
- From 39 to 125 CPs
- 2-7 I/O Drawers (112 I/O Cards Max)

Max 82/125

- 6 line cords required
- Up to 125 CPs
- 7-12 I/O Drawers (192 I/O Cards Max)

Max39 can only plug
6 I/O drawers



IBM z16 Configuration: PDU based CP Expansion Rear View

Max 168/200

- 6 line cords required
- 168 or 200 CPs (**Factory Build Only**)
- 1-4 I/O Drawers (64 I/O Cards Max)

IBM z16 Configuration: PDU base I/O and CP Expansion

Max 168/200

- 4 frame expansion
- 8 line cords required
- 168-200 CPs (**Factory Build Only**)
- 9-12 I/O Drawers (192 I/O Cards Max)

Max 168/200

- 3 Frame Expansion
- 6 line cords required
- 168-200 CPs (**Factory Build Only**)
- 4-9 I/O Drawers (144 I/O Cards Max)

Cabling Design and Management

- **I/O Cable Management**
  - Clients should plan for extra slack in I/O cables for the IBM z16
  - Upgrades from the z15
    - Some cables may move due to new I/O drawer placement
  - Upgrades from the z14
    - All cables will move to the rear of the system
    - Cables may move to different frame locations

Note: No Fibre Trunking Service (FTS)
Contact approved trunking vendors

Power and I/O cabling management

- Three top & bottom exit feature codes available to support power and I/O cabling:

- **FC 7898 – Top Exit Cabling with Top Hat**
  - Includes additional “Top Hat” hardware for strain relief, cable organization, or flat sealing surface if required for hot/cold data center aisle containment
  - Must be ordered when planning to use Fiber Quick Connect brackets egressing out the top of the system

- **FC 7816 – Top Exit Cabling without Top Hat**
  - Ordered for clients intending to egress cables out of the top of system without Top Hat hardware
  - Does not support Fiber Quick Connect Brackets on top of frame

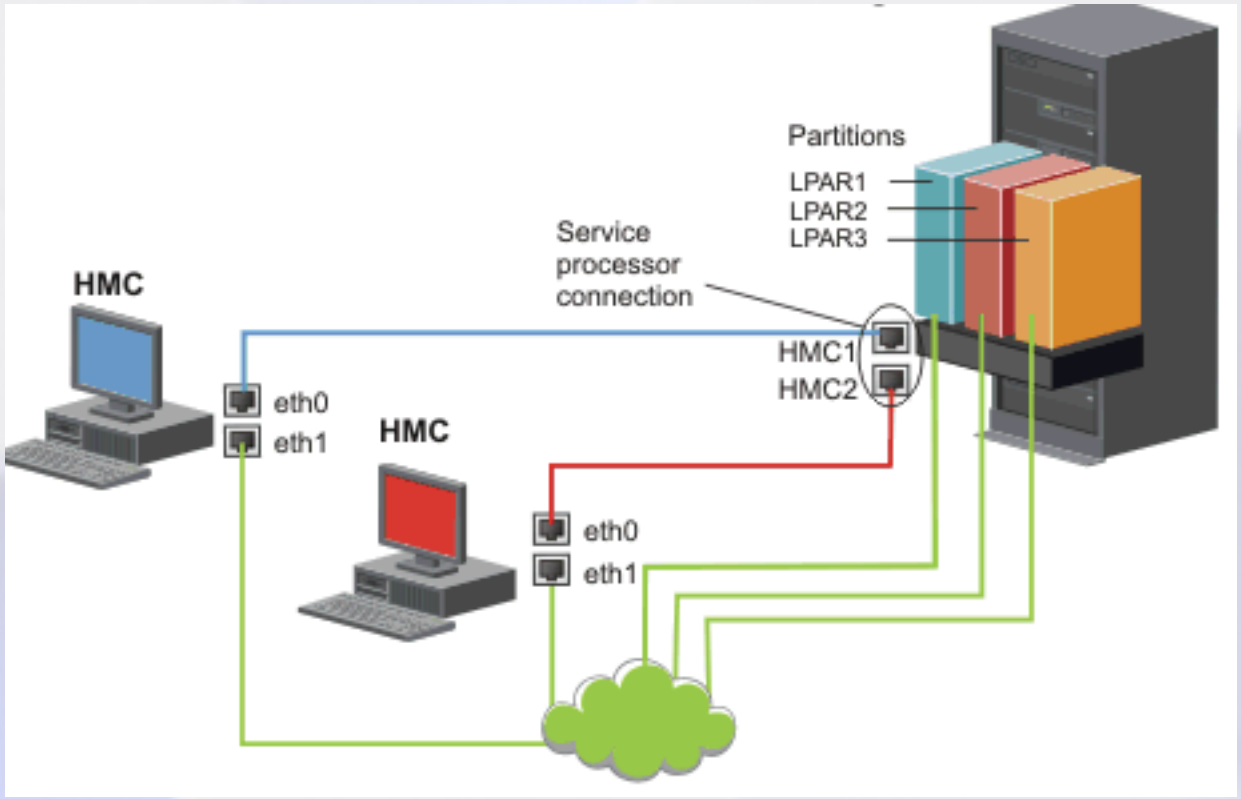
- **FC 7899 – Bottom Exit Cabling**
  - **Must be ordered** to allow cabling or power in and out of the bottom of the frame for raised floor installation
  - Can be used with Fiber Quick Connect brackets at bottom of the frame
  - If not ordered, bottom seal plate will ship with system and I/O and power cabling cannot exit bottom of frame

- **FC 5827 – Fiber Quick Connect**
  - Optional feature provides brackets at top and/or bottom of system for cable organization and structured cabling
  - **Does not** ship trunking cables; clients will have to work with third-party providers to acquire and install cables

Cabling feature code combinations

Customer Environment	Bottom Exit Cabling	Top Exit Cabling	Feature Codes to be Ordered	Additional Comments
Raised Floor	Yes	No	7899 only	Bottom FQC support only
Raised Floor	Yes	Yes, no Top Hat	7899 & 7816	Bottom FQC support only
Raised Floor	Yes	Yes, with Top Hat	7899 & 7898	Top & bottom FQC support
Raised Floor	No	Yes, no Top Hat	7816 only	No FQC support; ships bottom seal plate
Raised Floor	No	Yes, with Top Hat	7898 only	Top FQC support only; ships bottom seal plate
Non-Raised Floor	No (not supported)	Yes, no Top Hat	7998 & 7816	No FQC support; ships bottom seal plate
Non-Raised Floor	No (not supported)	Yes, with Top Hat	7998 & 7898	Top FQC support only; ships bottom seal plate

IBM z16
HMC/SE



HMC/SE Changes

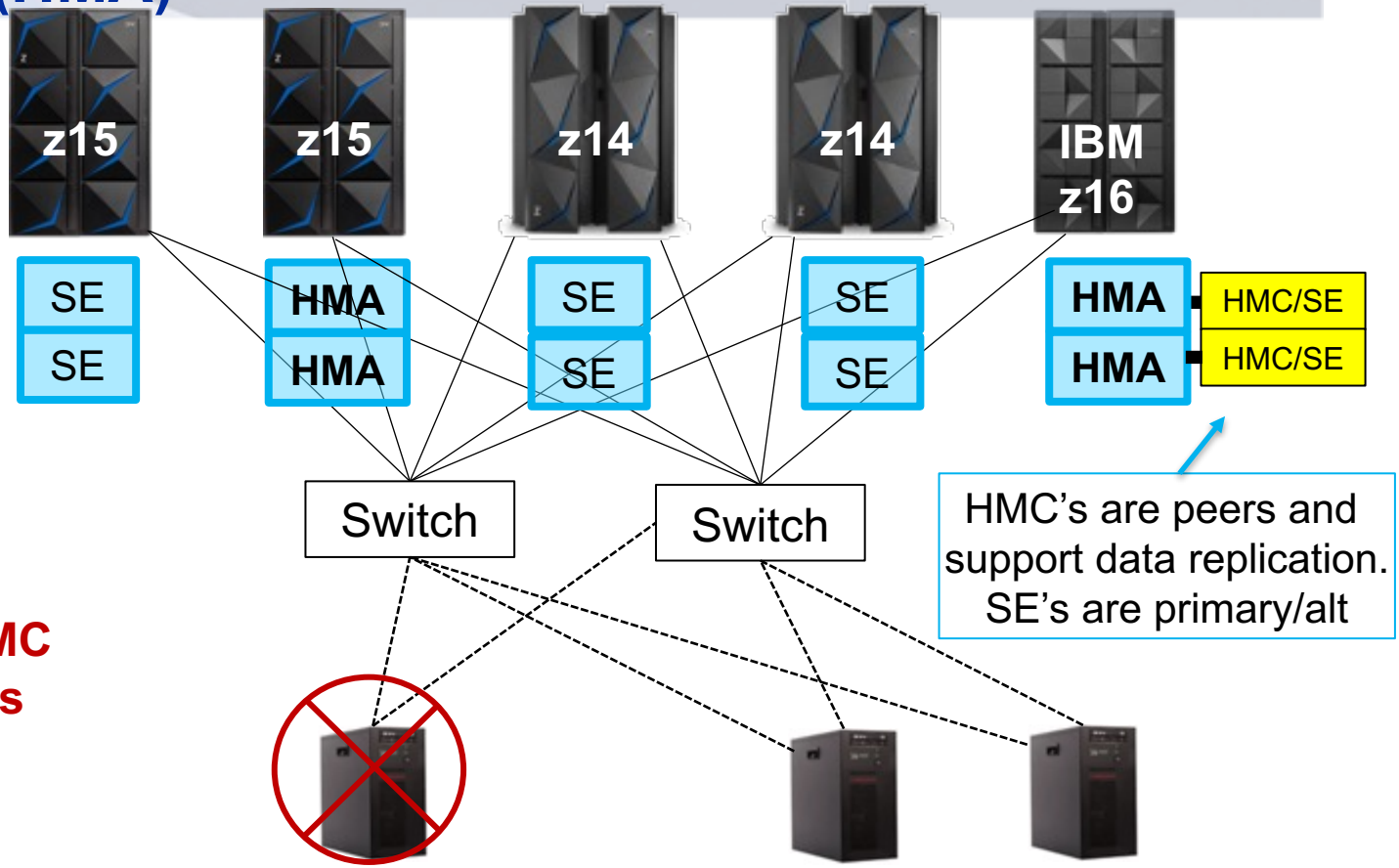
- **Not offered with IBM z16 2.16.0**
  - Stand alone HMCs
    - Carry forward of old standalone HMCs Allowed
  - TLS 1.0 and 1.1
  - UserIDs: ADVANCED, OPERATOR, STORAGEADMIN, and SYSPROG
- **Default UserIDs**
  - Reducing the number of IDs to ACSADMIN and SERVICE
  - Requiring that all the IDs to have unique password at installation.
- **HMC Logon Enhancements for PCI-DSS**
- **STP n-Mode power imminent disruption signal/fail over option.**
  - New option to configure for n-mode power PTS (Primary Time Server) to BTS (Backup Time Server) failover
- **IBM Z Certificate**
  - HMC task will by default set expiration of system certificates to 398 days
  - Users will need to refresh these certificates if used
  - HMC will post hardware messages warning when it will expire
- **TLS 1.3 support added**
  - Clients will be able to use 1.2 or 1.3
- **Multi-Factor Authentication support**
  - Added support for z/VM and Linux on Z
- **Channel Pending state**
  - New functionality will configure selected adapters off then on, one at a time.
  - As long as adapters are defined redundantly to a LPAR this can execute without LPAR interruption
- **Report a Problem**
  - Individual LPAR targets can be used for task

Hardware Management Appliance (HMA)

- The HMC code runs as an appliance on two high performance top of rack servers. One HMA feature code provides two HMAs.

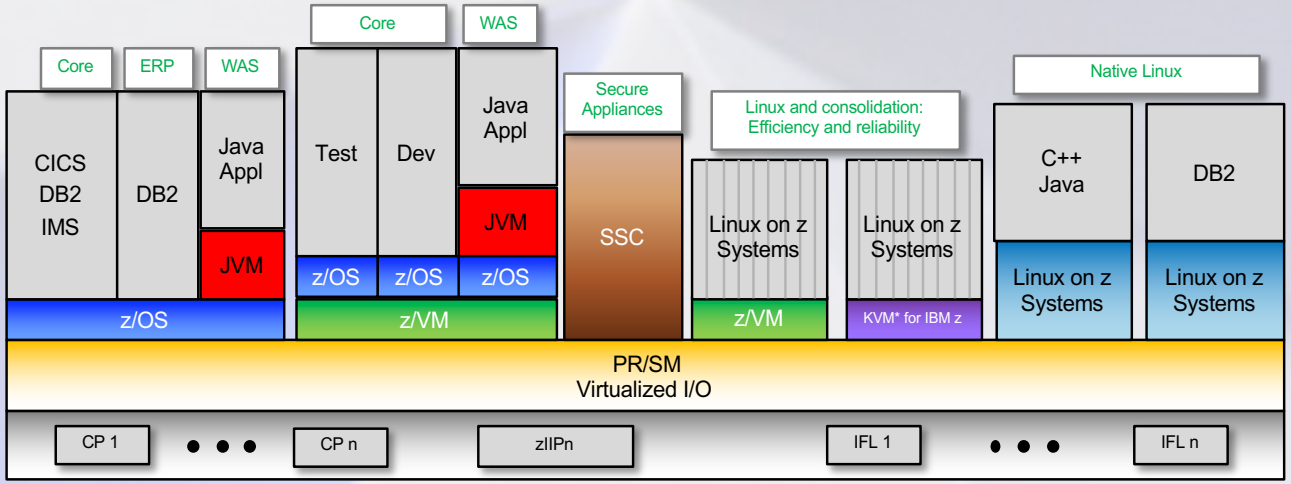
- Logon to HMC remotely from your browser.
- Logon to Support Element from the HMC.

- FC0129 (new feature code)
  - Optional feature code
  - No external HMCs unless carried forward
  - Last machine to support carry forward HMC
  - One HMA feature code provides two HMAs
  - New MES available for HMA



Add V2.16.0 code to existing HMCs.
No charge.
Obtain from the SSR at GA.

IBM z16
Operating Systems



IBM z16 operating system support

z/OS

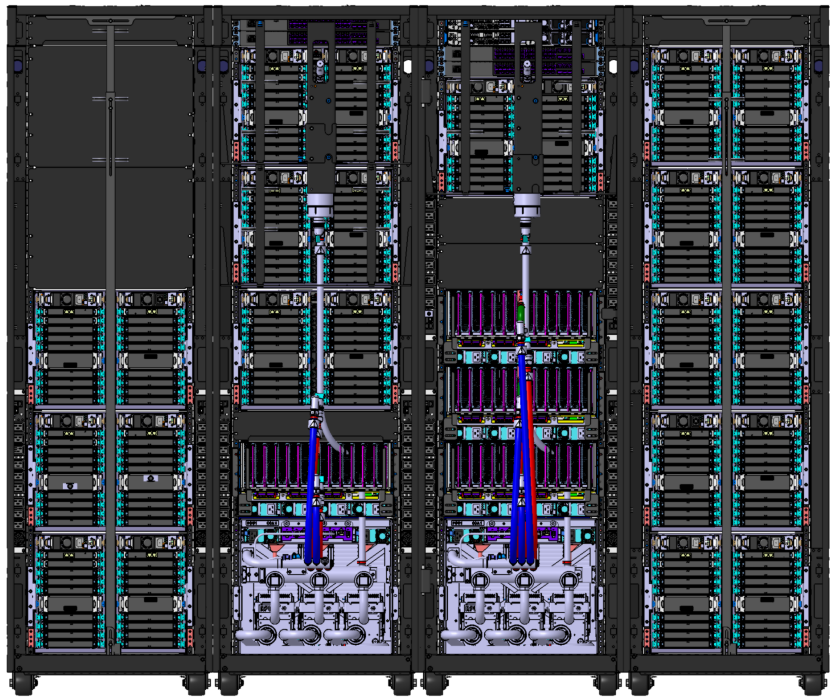
- z/OS 2.5 with PTFs
- z/OS 2.4 with PTFs
- z/OS 2.3 with PTFs
- z/OS 2.2 (compatibility only)
  - –IBM Software Support Services purchase

z/VM

- z/VM 7.2 with PTFs
- z/VM 7.1 with PTFs

z/VSE

- z/VSE 6.2



z/TPF

- z/TPF 1.1 with PTFs

Linux on IBM Z

Minimum Distributions:

- SUSE SLES 15 SP3
- SUSE SLES 12 SP5
- Red Hat RHEL 8.4
- Red Hat RHEL 7.9
- Canonical Ubuntu 20.04.0x LTS

IBM cannot legally discuss IBM z16 exploitation prior to GA from distributors.

Officially Tested list here.

Statements of Direction

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

Statements of General Direction

- **Removal of support for OSE CHPID type**: IBM z16 will be the last IBM Z server to support OSE networking channels. IBM Z support for the Systems Network Architecture (SNA) protocol being transported natively out of the server using OSA-Express 1000BASE-T adapters configured as channel type OSE will be eliminated after IBM z16. Client applications that rely on the SNA protocol and use OSE networking channels as the transport, as opposed to FICON CTC, must either migrate to TCP/IP, or the networking configuration of the operating system image must be updated to make use of some form of SNA over IP technology, where possible, such as z/OS Enterprise Extender.

- **Removal of support for OSA-Express 1000BASE-T hardware adapters**: IBM z16 will be the last IBM Z server to support OSA Express 1000BASE-T hardware adapters (FC 0426, FC 0446, and FC 0458). Definition of all valid OSA CHPID types will be allowed only on OSA-Express GbE adapters, and potentially higher bandwidth fiber Ethernet adapters, on future servers.

Statements of General Direction

- **Removal of support for Linux on IBM Z direct access of the OSA-Express family of Ethernet adapters**: In the future, IBM plans to shift from OSA-Express to PCIe-based networking devices like RoCE Express as the target strategic adapter type for IBM Z direct access networking connection to Linux operating systems. MES updates between generations are planned to be supported. Linux on IBM Z clients that indirectly access the OSA-Express adapter family through the z/VM Virtual Switch (VSwitch) will be unaffected by this change. Linux on IBM Z networking currently supports two Ethernet networking connectivity options: the OSA-Express adapter family and the RoCE Express adapter family. Use of PCIe-based networking devices as provided by the RoCE Express adapter family is aligned with the deployment model for Linux on other architectural platforms, facilitates use of broader existing Linux ecosystem tooling, and eases the effort to enable exploitation of industry hardware optimizations and integrate into industry software-defined networking models and tools, including Red Hat OpenShift Container Platform (OCP). Clients are strongly encouraged to plan accordingly for their adoption of RoCE Express adapters for IBM Z networking connectivity. IBM plans to continue to work toward common networking adapters for all operating systems on IBM Z, IBM LinuxONE, and Linux on IBM Z.

Statements of General Direction

- **Capacity on Demand (CoD) legacy automation**: IBM z16 is planned to be the last server family to support Legacy CoD unique/record type automation interfaces. Clients should begin migrating to the new CoD flexible record structure interface. Prior to the IBM z10, automation interfaces for CoD were unique for each record type. The IBM z10 introduced new automation interfaces for CoD, which used flexible record structures that could apply to any CoD temporary record, and attributes of temporary capacity records are returned as an XML structure.

- **Firmware update process**: IBM z16 is planned to be the last server family to support IBM service support representatives (SSRs) on-site performing firmware updates without an additional premium service contract. The IBM Z Remote Code Load (RCL) option, which was introduced on the IBM z15, is available without an additional premium service contract. With the IBM z15, and now with IBM z16, clients can request an RCL or they can choose the SSR onsite method for their firmware update. IBM recommends clients to try the RCL option on the IBM z15 or IBM z16 to see that IBM provides the same quality service through RCL.

Statements of General Direction

- **Removal of support of the transactional execution and constrained transactional execution facility:** In a future IBM Z hardware system family, the transactional execution and constrained transactional execution facility will no longer be supported. Users of the facility on current servers should always check the facility indications before use.

- **z/OS Containers and Kubernetes orchestration support for IBM z/OS applications and workloads:** IBM has previously announced the intention to provide clients with capabilities that will help accelerate their transformation to greater portability and agility in a hybrid cloud environment by delivering z/OS Containers and Kubernetes orchestration support for IBM z/OS applications and workloads. To deliver on this capability, IBM intends to provide a beta program for z/OS 2.5 clients to begin their container journey with z/OS UNIX applications. These capabilities are designed to support architecture-independent standards and new containerized deployment options. The intention is to empower agile development teams to incorporate z/OS applications into a Kubernetes-based orchestration model utilizing industry standard operations. Future z/OS container use cases are planned to promote application modernization, new application development, and API creation with tight integration to core z/OS applications.

Statements of General Direction

- **Removal of support for Bulk Power Assembly (BPA):** IBM z16 is planned to be the last generation of IBM Z server to support BPA.

- **IBM LinuxONE Next release:** In addition to the Linux on IBM Z functionality described in this RFA, which will be available on IBM z16, IBM plans to announce and release a new generation of LinuxONE systems in the second half of 2022, designed to help enterprises in their hybrid cloud and AI journey.