IBM zSystems Tech Bytes

Presented by the Washington Systems Center

IBM z16 Technical Overview

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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

Design thinking IBM z16 co-created with clients

70+
enterprises

IBM Z Sponsor user program

IBM Z Design Council

GM Advisory Council

Cross section of users
(geos, industries, size)

1 on 1 Interviews and Surveys

Hill value validation

Prototype evaluations

1100+
interaction
hours

2x more engagements over IBM z15
from developers, architects, to execs

Driven by early engagements across
IBM Z and LinuxONE

Innovations through cross-team
alignment from product management,
design, marketing, development, sales
and support

23
user
personas

Application Architect

Application Developer

Application Owner

Auditor

Chief Data Officer

Chief Privacy Officer

Chief Sustainability Officer

Cloud Architect

CTO, CIO, CFO, CISO / CIRO

Data Architect

Dev Ops Engineer

Director of Mainframe Datacenter

Evidence Provider

Infrastructure Architect

Line of Business Owner

Security Architect

System Admin

VP of AI / Analytics

VP of Application Development

VP of Infrastructure

IBM z16 ™ is built to build

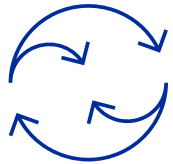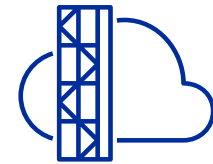We built a powerful and secure platform for business. Let's build the future of yours.

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.

z/OS
z/VM
z/VSE
z/TPF
Linux on Z
KVM on Z

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 z16 System Design Changes

- 7 nm Silicon Lithography*

- 8 Cores per PU CHIP design

- Dual Chip Module packaging

- 4 PU DCMs per Drawer, up to four CPC drawers – <u>NO SC Chip</u>

- Integrated I/O with PCIe+ Gen3

- New IBM Accelerator for Artificial Intelligence (AIU) – on chip

- New cache design

- Crypto Express8S (single/dual port)

- OSA-Express7S 1.2 (all features)

- FICON Express32S

- 25GbE and 10GbE RoCE Express3

- IBM zHyperLink Express1.1

- Integrated Coupling Adapter SR1.1

- Coupling Express2 Long Reach

CPC Drawer
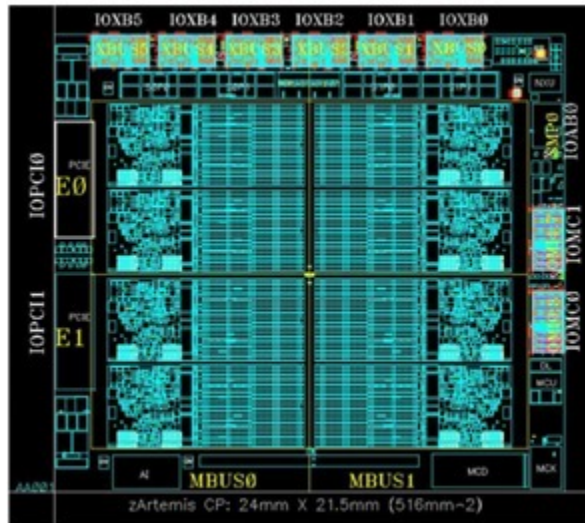
Back   Front

IBM Z – Processor Roadmap

7 nm

**IBM z16
4/2022**

14 nm

**IBM z15
9/2019**

14 nm

**IBM z14
7/2017**

22 nm

**IBM z13
1/2015**

32 nm

**IBM zEC12
8/2012**

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

Focus on power efficiency and new on-chip architectures

Improved and enlarged caches

Optimized Out-of-Order architecture

Binary Floating point enhancements
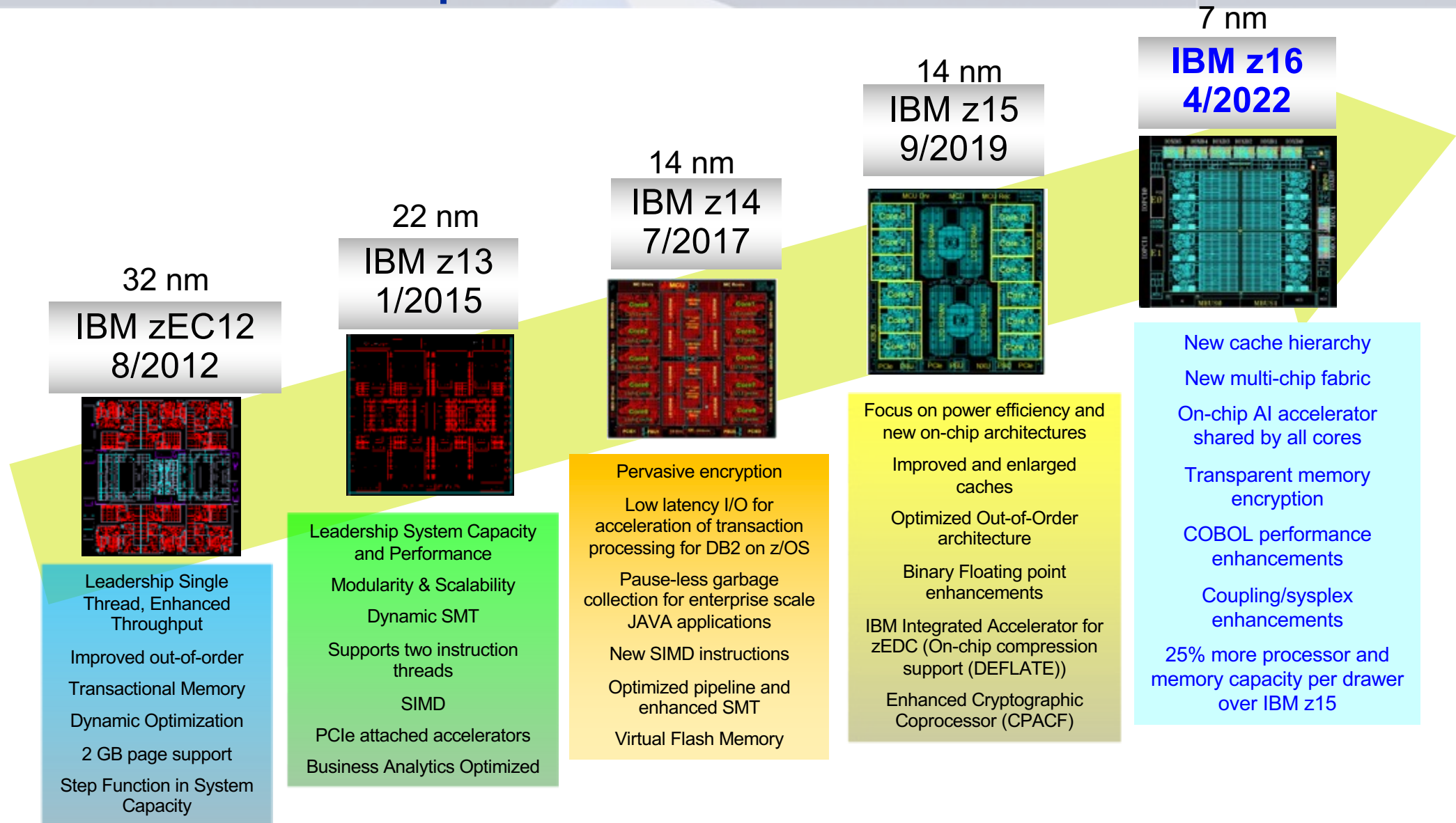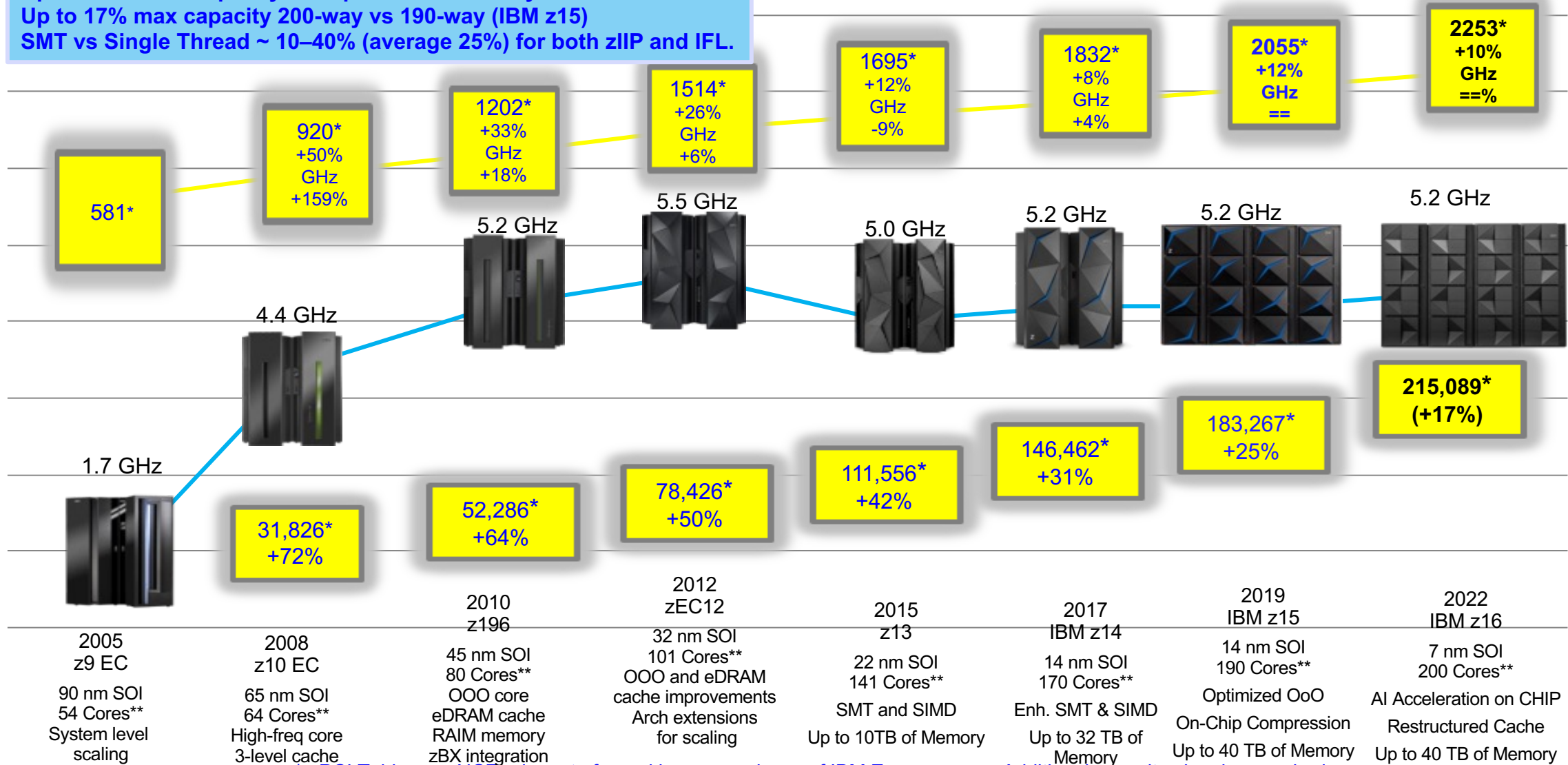
IBM Integrated Accelerator for zEDC (On-chip compression support (DEFLATE))

Enhanced Cryptographic Coprocessor (CPACF)

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

Leadership System Capacity and Performance

Modularity & Scalability

Dynamic SMT

Supports two instruction threads

SIMD

PCIe attached accelerators

Business Analytics Optimized

Leadership Single Thread, Enhanced Throughput

Improved out-of-order

Transactional Memory

Dynamic Optimization

2 GB page support

Step Function in System Capacity

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.

GHz / PCI*

581*

920*
+50%
GHz
+159%

1202*
+33%
GHz
+18%

1514*
+26%
GHz
+6%

1695*
+12%
GHz
-9%

1832*
+8%
GHz
+4%

2055*
+12%
GHz
==

2253*
+10%
GHz
==%

4.4 GHz

5.2 GHz

5.5 GHz

5.0 GHz

5.2 GHz

5.2 GHz

5.2 GHz

1.7 GHz

31,826*
+72%

52,286*
+64%

78,426*
+50%

111,556*
+42%

146,462*
+31%

183,267*
+25%

215,089*
(+17%)

2005 z9 EC	2008 z10 EC	2010 z196	2012 zEC12	2015 z13	2017 IBM z14	2019 IBM z15	2022 IBM z16
90 nm SOI 54 Cores** System level scaling	65 nm SOI 64 Cores** High-freq core 3-level cache	45 nm SOI 80 Cores** OOO core eDRAM cache RAIM memory zBX integration	32 nm SOI 101 Cores** OOO and eDRAM cache improvements Arch extensions for scaling	22 nm SOI 141 Cores** SMT and SIMD Up to 10TB of Memory	14 nm SOI 170 Cores** Enh. SMT & SIMD Up to 32 TB of Memory	14 nm SOI 190 Cores** Optimized OoO On-Chip Compression Up to 40 TB of Memory	7 nm SOI 200 Cores** AI Acceleration on CHIP Restructured Cache Up to 40 TB of Memory

* PCI Tables are NOT adequate for making comparisons of IBM Z processors. Additional capacity planning required
** Number of PU cores for customer use
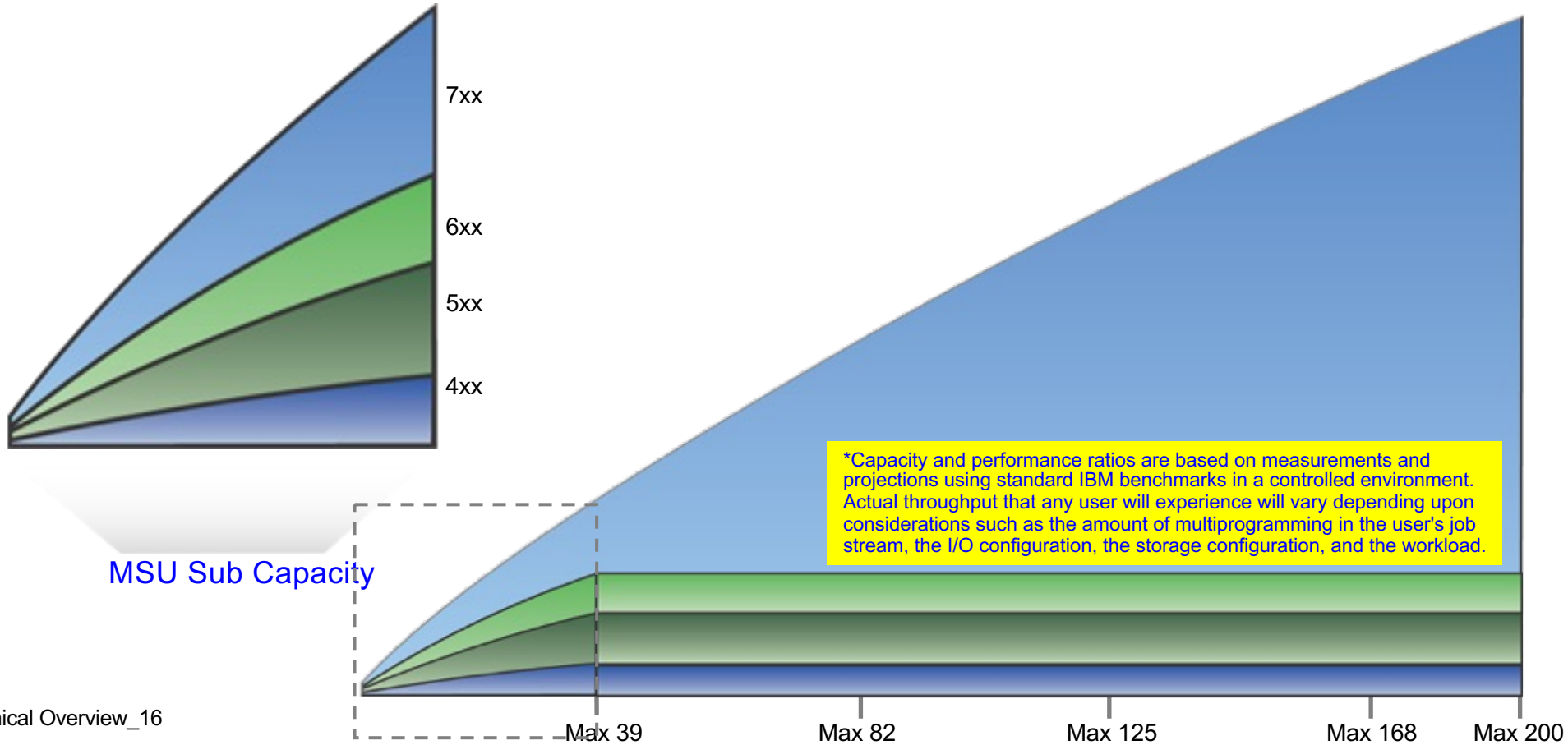
IBM z16 Technical Overview_15

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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).**

7xx

6xx

5xx

4xx

MSU Sub Capacity

*Capacity and performance ratios are based on measurements and projections using standard IBM benchmarks in a controlled environment. 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.

Max 39   Max 82   Max 125   Max 168   Max 200

Call to Action – Sizing done right – Best Practices CPU Measurement Facility

- **Ensure the CPU MF data is captured and <u>kept</u> for analysis**

- **Performance, Capacity Planning and Problem Determination**

- **Critical Migration Action for every IBM Z (z/OS and z/VM)**
  - **CPU MF Counters must be enabled on their current processor**
  - **CPU MF Counters must be enabled on their z15**

In z/OS there is a HIS started task.
This is run on each System/LPAR and writes SMF 113 records.
This should be set up and run on all partitions.

z/VM also gathers CPU MF Counters through new z/VM Monitor Records.

IBM z16 Processor Design and Structure

CPC Drawer

Fanouts

- 12 PCIe slots for both fanouts and ICA SR Coupling links

CP Layout

- 8 CPs in 4 Dual Chip Modules (DCM)
  - 48 active PUs per drawer - Max39, Max82, Max125 and Max168
  - 57 active PUs per drawer – Max200

- Built on 7 nm technology
- Up to 2 PCIe interfaces per CP
- Up to 1 memory controller per CP
- No SC Chip

Memory

- 8 4u DDR4 DDIMMs per Memory Controller
- Max 48 DIMMs per CPC Drawer

Rear

12 PCIe Fanouts

4 DCMs

Up to 48 DDIMMs
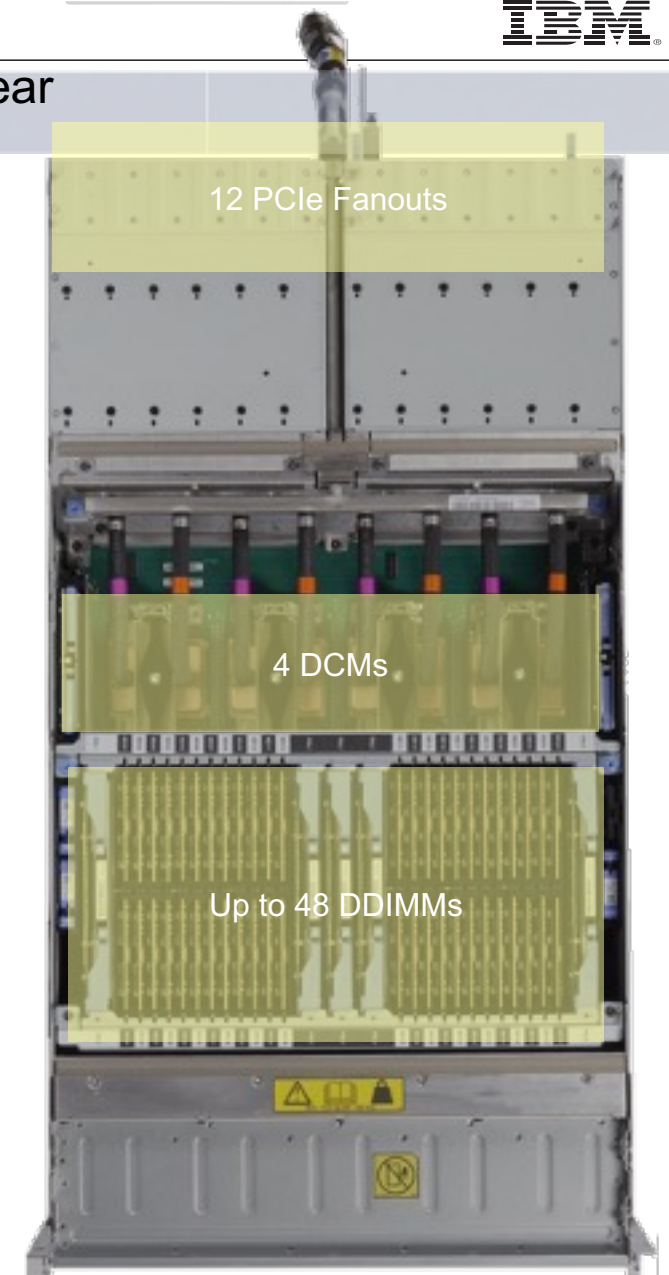
Front

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

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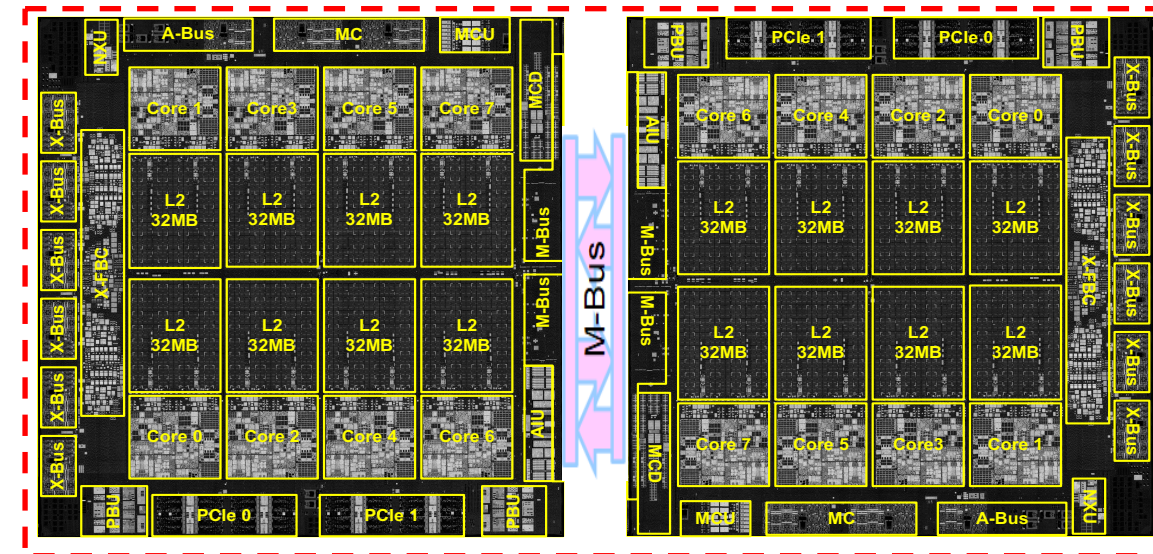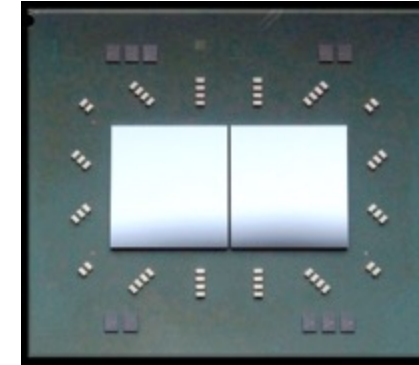
8-Core Processor Chip Detail (Telum)
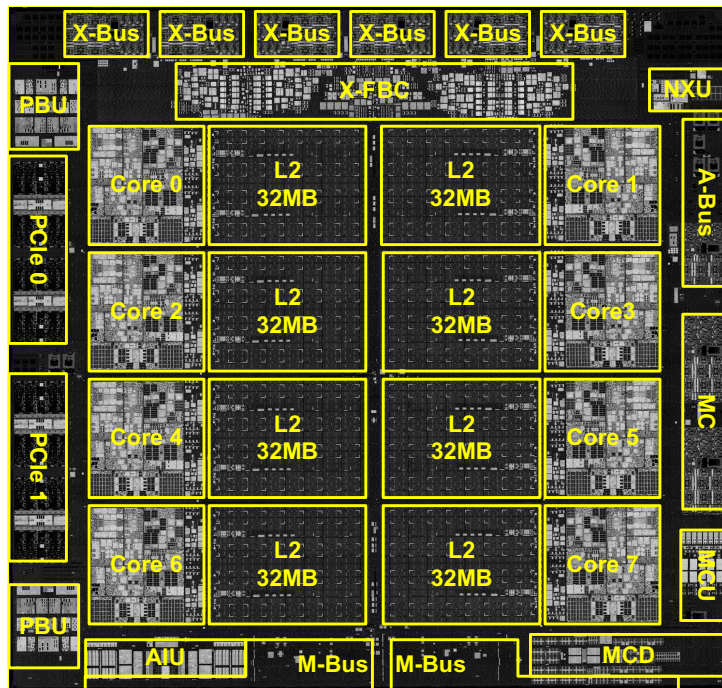
7nm FinFET Technology
- 8 cores per CP
- 18.8 miles of wire
- ~ 23mm x 22 mm
- Up to 2 PCIe buses, and 8 DDIMMS
- 22.5B transistors versus 9.2B on z15

- **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

Core-Nest Design Changes

▪ On Core L2 Cache

- Cache split into two 16 MB Segments
  - Enables half of the cache to be used as a virtual cache if the core is underutilized
- Runs at a 2:1 Cycle time
- Data evicted from a 32MB L2 can be persisted in another cache on the chip or drawer
- Other L2 caches dynamically determine based on their current state if they will accept persisted cache lines
  - No persistence across drawers
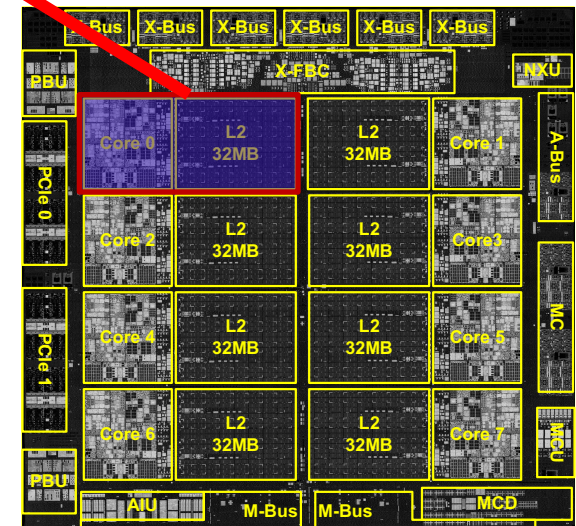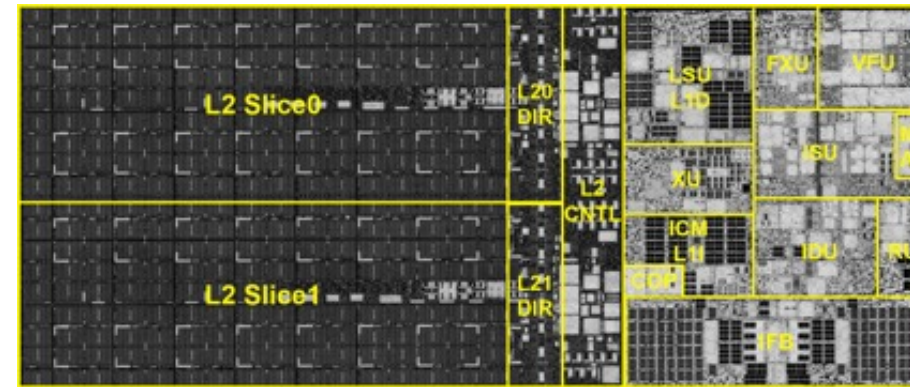
IBM z16 Cache

- **What's different from z15**
  - There is no L3 physical cache present on the cores
    - There is a new L1 Shadow Cache that will help manage syncing lines with L2
  - There is no SC chip or physical L4 Cache
    - All CPs L2 are interconnected via buses

- **How Virtual Caches work**
  - L2 Caches of unused cores or underutilized cores will be converted to be used as virtual caches
    - If the core becomes actives the cache will be returned
  - Virtual cache on the same CP will be seen as additional virtual L3 cache to the core
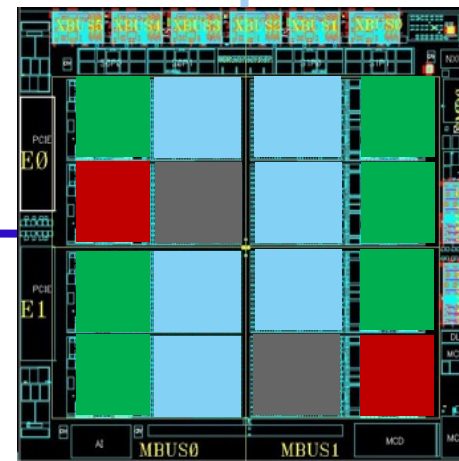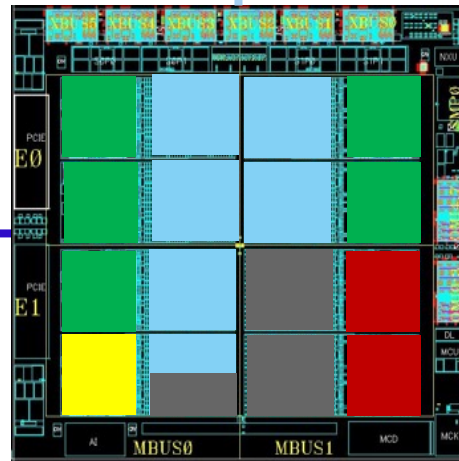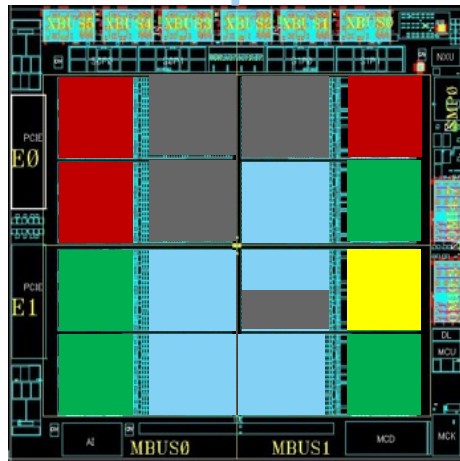 - Virtual Cache on a different CP on the same drawer will be seen as L4 Cache

Memory DIMMs
10TB/Drawer 40TB Max

Up to 1.75 GB
Shared Virtual L4 Cache

x7 7nm 8 core CP Chips

Up to 224 MB
Shared Virtual L3 Cache

16 MB Shared Virtual L3 Cache
16 MB Private L2 Cache

On Core L1 Cache
128KB L1I 128KB L1D

7nm 8 core CP Chip
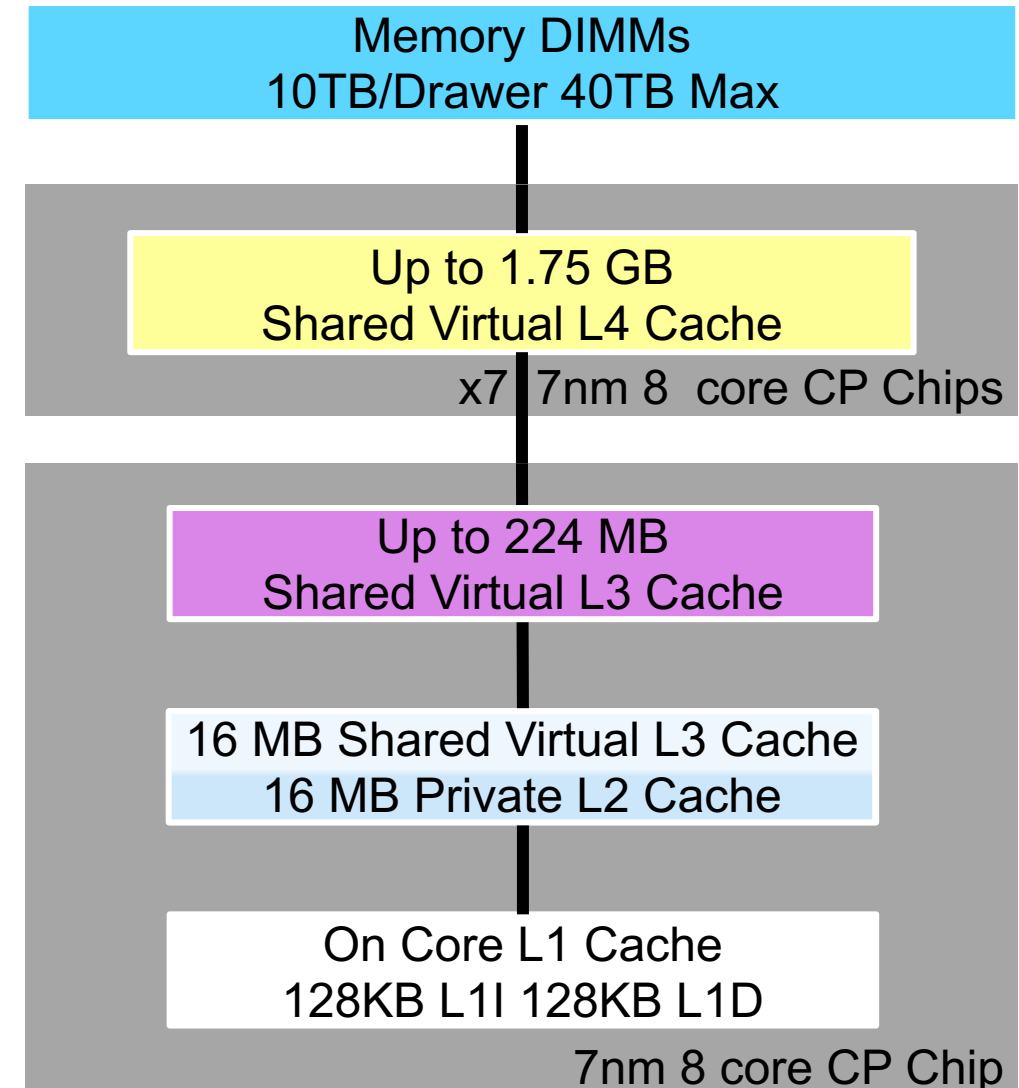
Cache Demo

Active Core

Inactive Core

Underutilized Core

You are now here

L2 Private Cache

Virtual L3 Cache

Virtual L4 Cache

You are here
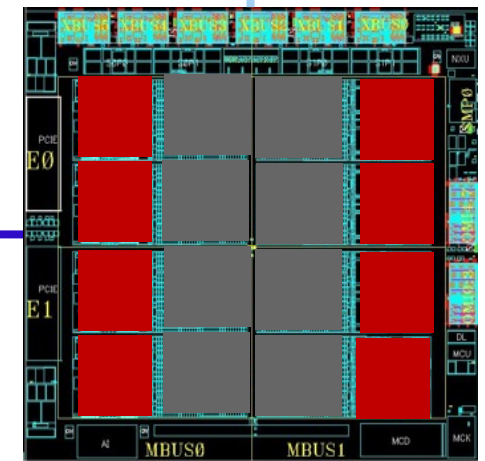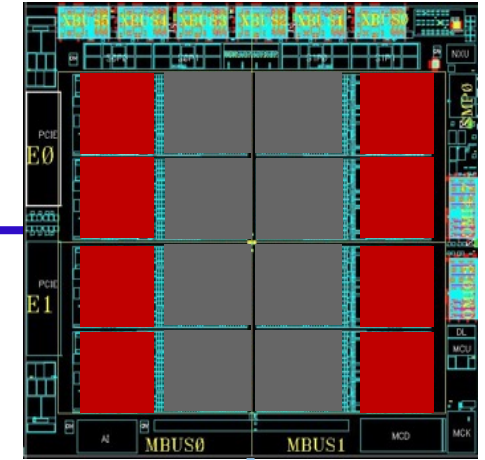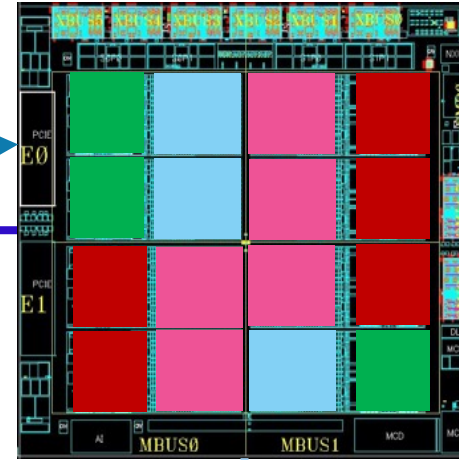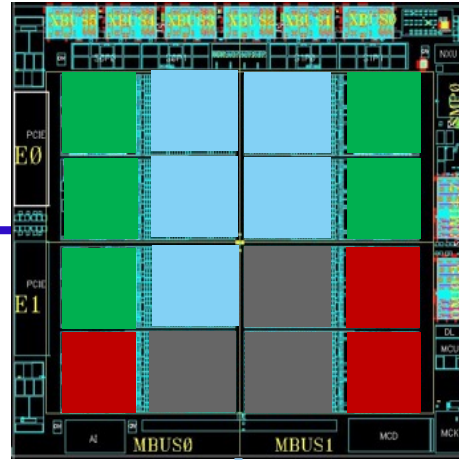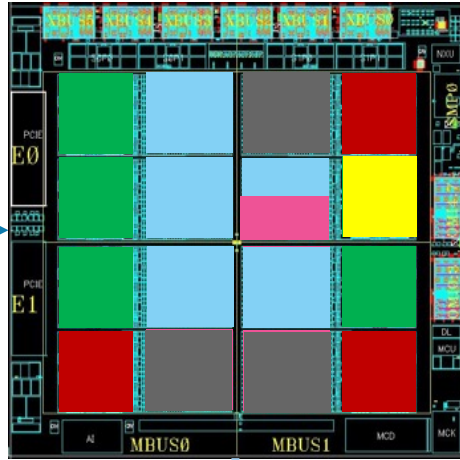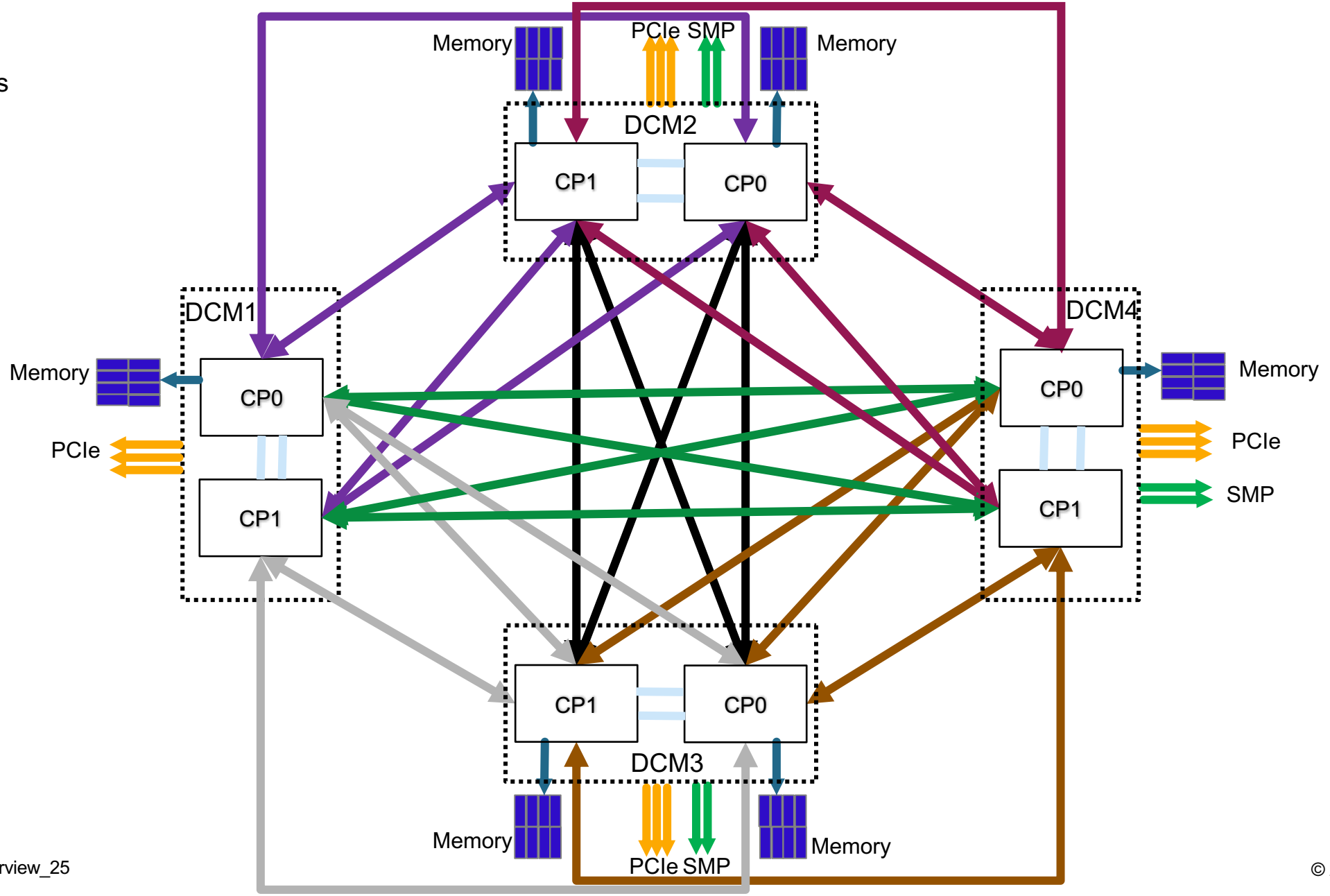
8-Core Processor Chip Design & Improvements

- **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
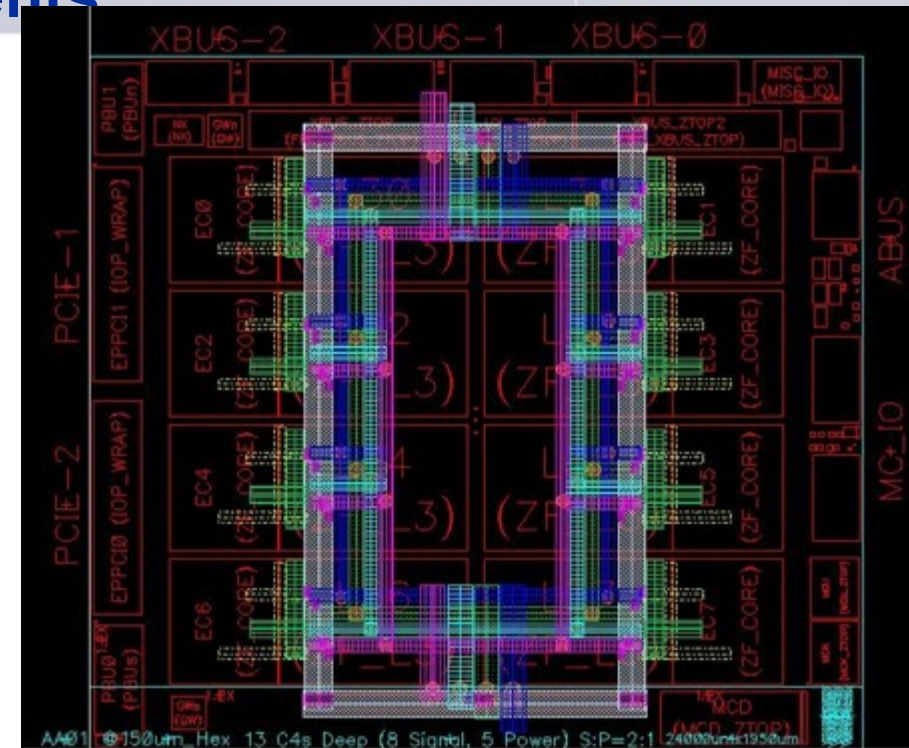
NXU – Nest Accelerator Unit

Integrated Accelerator for AI

Integrated Accelerator for AI

- Central on-chip AI accelerator shared amount all cores; similar

  concept to compression accelerator in z15

- Neural Network Processing Assist (NNPA) instruction

  - Memory-to-memory CISC instruction

  - Operates directly on tensor data in user space

- Connected to chip ring like core: 120+ GB/s read, 80+ GB/s store

- Matrix array for matrix multiplication and convolution

- Special engines for complex functions
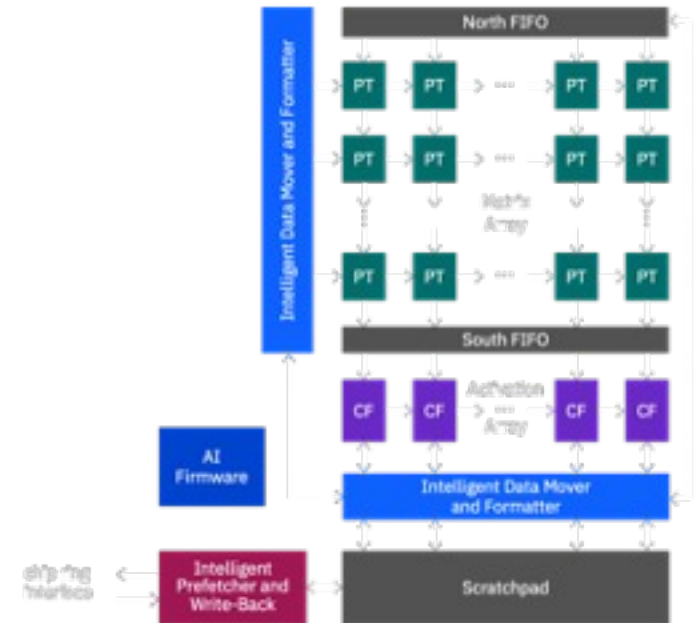
Integrated AI Accelerator – combining compute & data movers

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
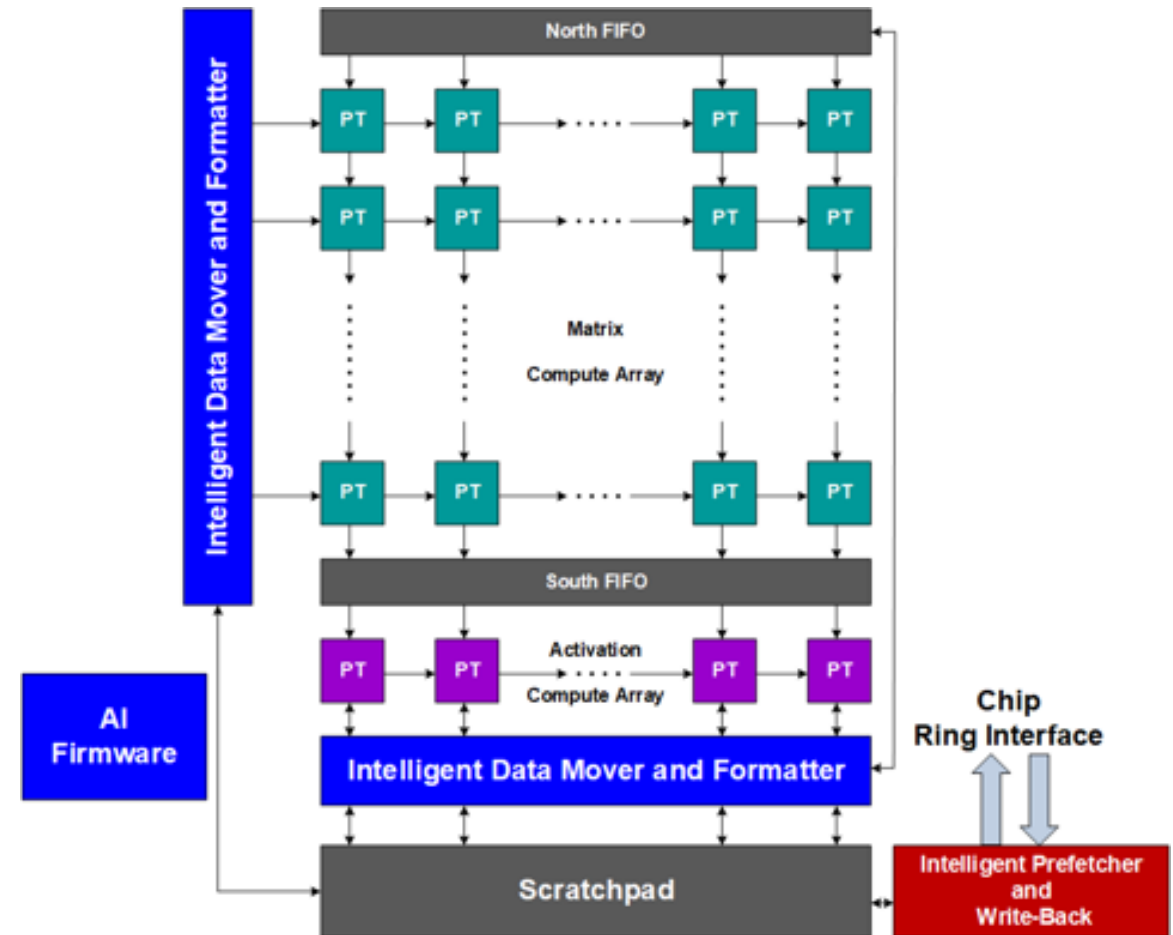
3931-A01 Processing Units

Model	Feature Code Description	Drawers / Cores	Chips/ CPs	Dual Chip Modules	IFLs/ uIFLs	zIIPs uzIIPs	ICFs uICFs	Std SAPs	Optional SAPs	Std. Spares	IFP
A01	Max39	1 / 48	8 0-39	4	0-39 0-38	0-25 0-24	0-39 0-38	5	0-8	2	2
	Max82	2 / 96	16 0-82	8	0-82 0-81	0-54 0-53	0-82 0-81	10	0-8	2	2
	Max125	3 / 144	24 0-125	12	0-125 0-124	0-82 0-81	0-125 0-124	15	0-8	2	2
	Max168	4 / 192	32 0-168	16	0-168 0-167	0-110 0-109	0-168 0-167	20	0-8	2	2
	Max200	4 / 228	32 0-200	16	0-200 0-199	0-132 0-131	0-200 0-199	24	0-8	2	2

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 cores are available (2:1). This remains true for sub-capacity CPs and for "banked" CPs.
3. "uIFL" = Unassigned IFL
4. The IFP is conceptually an additional, special purpose SAP – used by PCIe I/O features and some other functions.

IBM z16 MES Upgrades

z15

IBM z16

| Max200 |
| Max168 |

Factory Only

| Max125 |
| Max82 |
| Max39 |

Concurrent Upgrade

z14
M01-M05

- **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

Integrated system design for IBM z16

Memory

IBM z16Memory Considerations

Model	Feature	Min	Max
A01/LA1	Max39	512 GB	10 TB
A01/LA1	Max82	512 GB	20 TB
A01/LA1	Max125	512 GB	30 TB
A01/LA1	Max168	512 GB	40 TB
A01/LA1	Max200	512 GB	40 TB

- **Concurrent memory upgrades via licensed internal code (LICC) are available at several capacity levels.**

- **25% additional Memory capacity per drawer**

- **DDR4 Memory DIMMS (32, 64, 128, 256 GB)**
- **An additional 256 GB of memory is reserved above the customer purchase amount for the Hardware System Area (HSA).**
- **DIMMs now include RAIM overhead**
- **New RAIM design implemented to improve RAS**

IBM Virtual Flash Memory (VFM) Feature Code 0614

- **IBM Virtual Flash Memory**
  - Upgrades from z14 system to IBM z16will convert the VFM to half terabyte increments

- **Increment Size**
  - Up to twelve features/increments
    - **0.5 TB | 1.0 TB | 1.5 TB | 2.0 TB**
    - **2.5 TB | 3.0 TB | 3.5 TB | 4.0 TB**
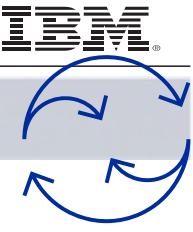   - **4.5 TB | 5.0 TB | 5.5 TB | 6.0 TB**

Use Cases

- Large Page/DB2/Java
- Market open transitions
- SVC and SA Dumps
- MQ objects stored in a Coupling Facility

← **12 TB** →

| **10 TB normal use** | **2 TB VFM** |
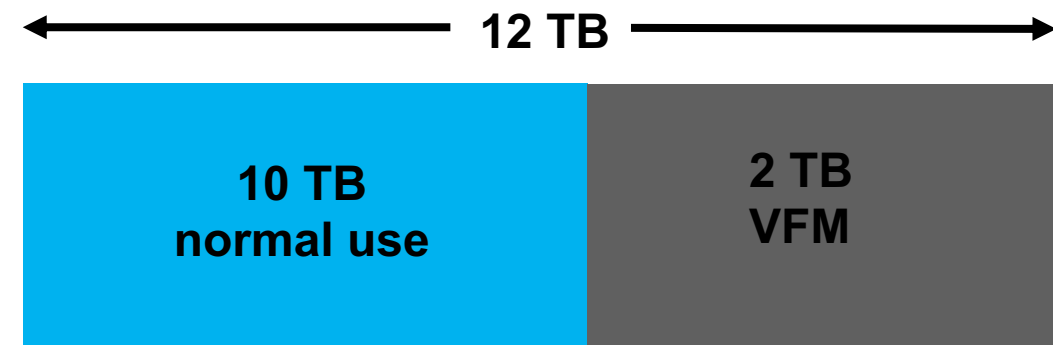
New Features and Functionality

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
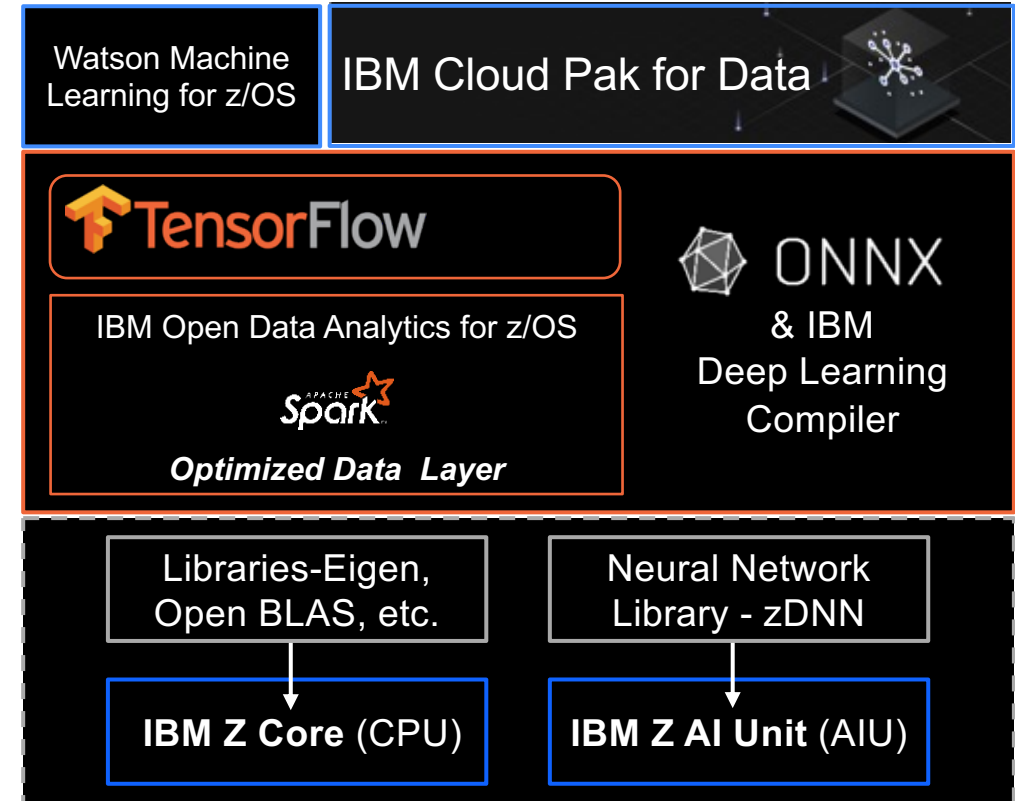- Pricing & actuarial analysis for better risk assessment

Other

Examples

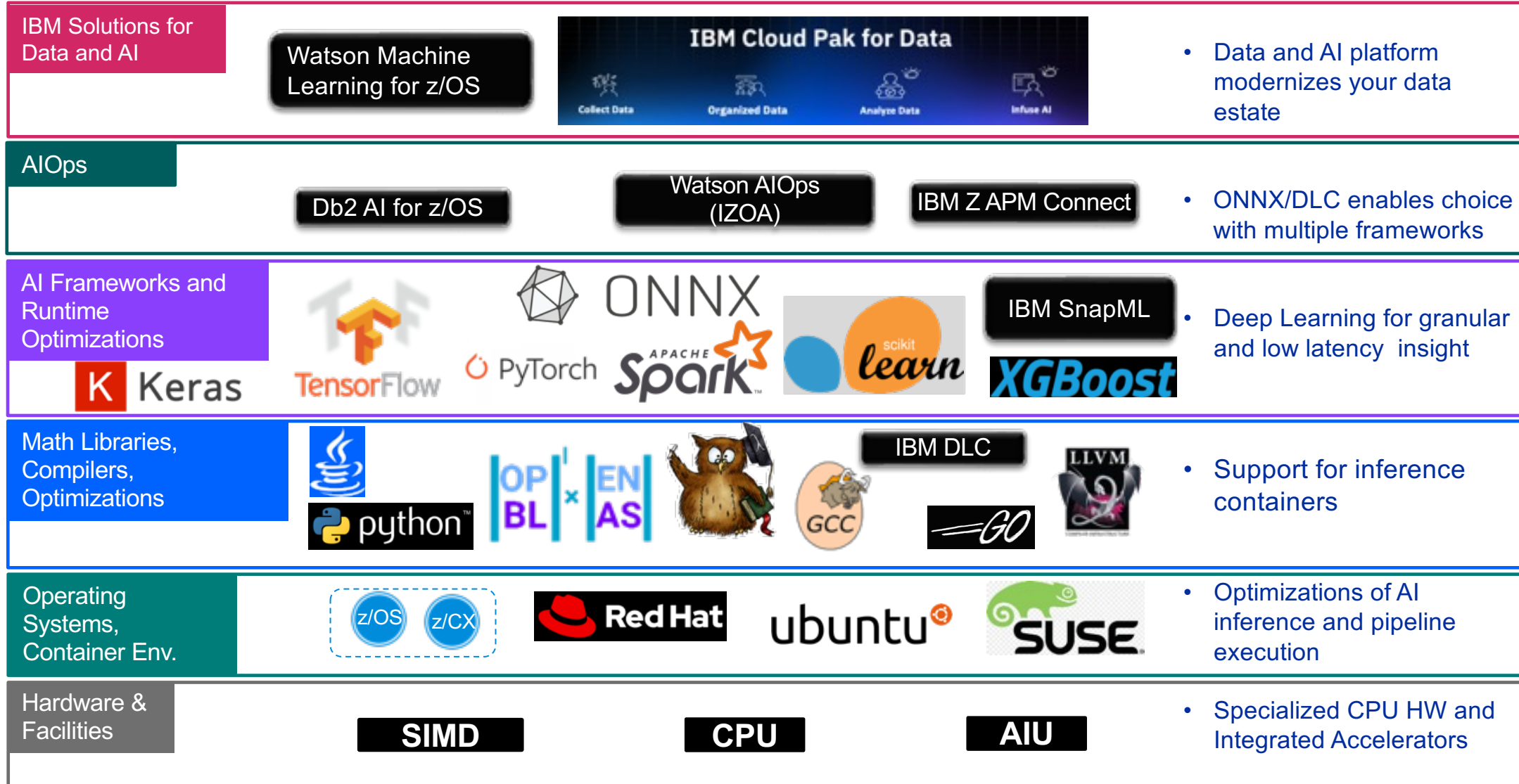- Supply Chain
- Payroll processing
- Manufacturing
- Scientific research
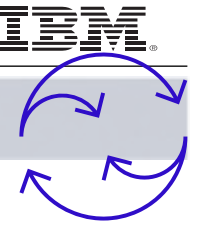- Computer design
- Biosecurity
- Mining
- Healthcare

IBM Z – An industry leader in optimized inferencing

- ## On-Chip engine for Deep Learning
  - Industry-first low latency in-transaction inferencing

- ## Software enablement for DL acceleration
  - zDNN is an AIU-accelerated library of primitives for deep neural networks.
  - ONNX/DLC enables multiple DL frameworks
  - TensorFlow enablement delivers acceleration in an industry-standard serving environment

- ## ML Performance
  - Library enhancements for ML performance
  - Optimization of AI inference and pipeline execution

Watson Machine Learning for z/OS

IBM Cloud Pak for Data

TensorFlow

ONNX & IBM Deep Learning Compiler

IBM Open Data Analytics for z/OS

APACHE Spark

Optimized Data Layer

Libraries-Eigen, Open BLAS, etc.

Neural Network Library - zDNN

IBM Z Core (CPU)

IBM Z AI Unit (AIU)

A comprehensive technology stack designed for AI

IBM Solutions for Data and AI

Watson Machine Learning for z/OS

IBM Cloud Pak for Data

Collect Data · Organized Data · Analyze Data · Infuse AI

- Data and AI platform modernizes your data estate

AIOps

Db2 AI for z/OS · Watson AIOps (IZOA) · IBM Z APM Connect

- ONNX/DLC enables choice with multiple frameworks

AI Frameworks and Runtime Optimizations

Keras · TensorFlow · ONNX · PyTorch · Apache Spark · scikit learn · IBM SnapML · XGBoost

- Deep Learning for granular and low latency insight

Math Libraries, Compilers, Optimizations

Java · python · OPEN BLAS · IBM DLC · GCC · GO · LLVM

- Support for inference containers

Operating Systems, Container Env.

z/OS · z/CX · Red Hat · ubuntu · SUSE

- Optimizations of AI inference and pipeline execution

Hardware & Facilities

SIMD · CPU · AIU

- Specialized CPU HW and Integrated Accelerators

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

Generated inference program

ONNX interchange format

IBM Deep Learning Compiler

Deploy on IBM z16 and IBM LinuxONE

Build and train model in any popular framework on any platform of your choice

Use ONNX, an opensource tool for framework interoperability
Models are converted to the ONNX interchange format
Leverage zCX and run on zIIP engines

The IBM DLC (Deep Learning Compiler), optimized for performance and new libraries, generates a program from the model for execution on z/OS or Linux® on IBM z16

Deploy on IBM z16 and IBM LinuxONE and infuse model into workload application

We are entering a new cryptographic era

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

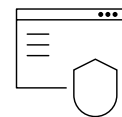Your data and security is already at risk for quantum-attacks

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.	New Crypto Express8S HSM with quantum-safe APIs to enable you to start now to future proof your applications and data.	Discover where and what crypto is used in applications to aid in developing a crypto inventory for migration and modernization planning.
Helps protect IBM z16 firmware from quantum attacks through a built-in dual signature scheme with no changes required.	Modernize existing and build new applications leveraging quantum-safe cryptography along with classical cryptography for a dual scheme approach as recommended by NIST.	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 <u>before</u> 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: **00**
ICF: **40**
IFL: **40**
ACP: 401
UzIIP: 10
UICF: 4
UIFL: 4

zIIP

IFL
ICF
720

710

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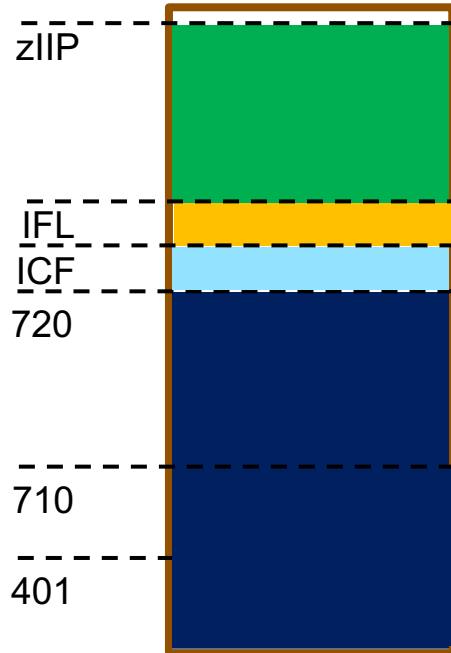
Configuration
CP: 401
zIIPs: 0
ICF: 0
IFL: 0

zIIP

IFL
ICF
720

710

401
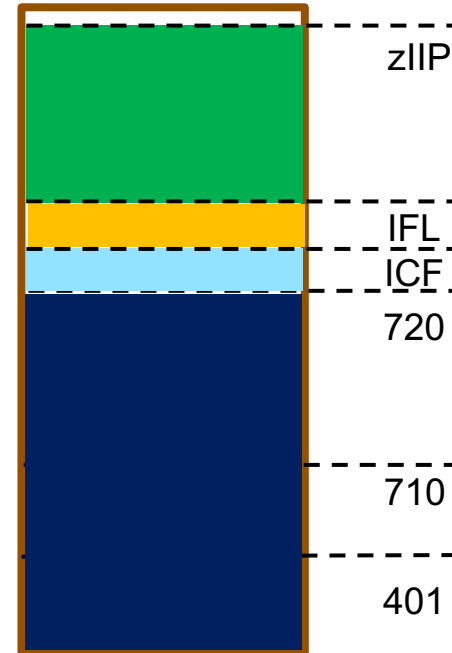
Flex Record
CP: 20
IFL: 4
ICF: 4
zIIPS: 10
Capacity indicator: 7

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

Site B

Site A

System A1

Flex Capacity

System A2

Flex Capacity

System A3

Flex Capacity

System B1

Flex Capacity

System B2

Flex Capacity
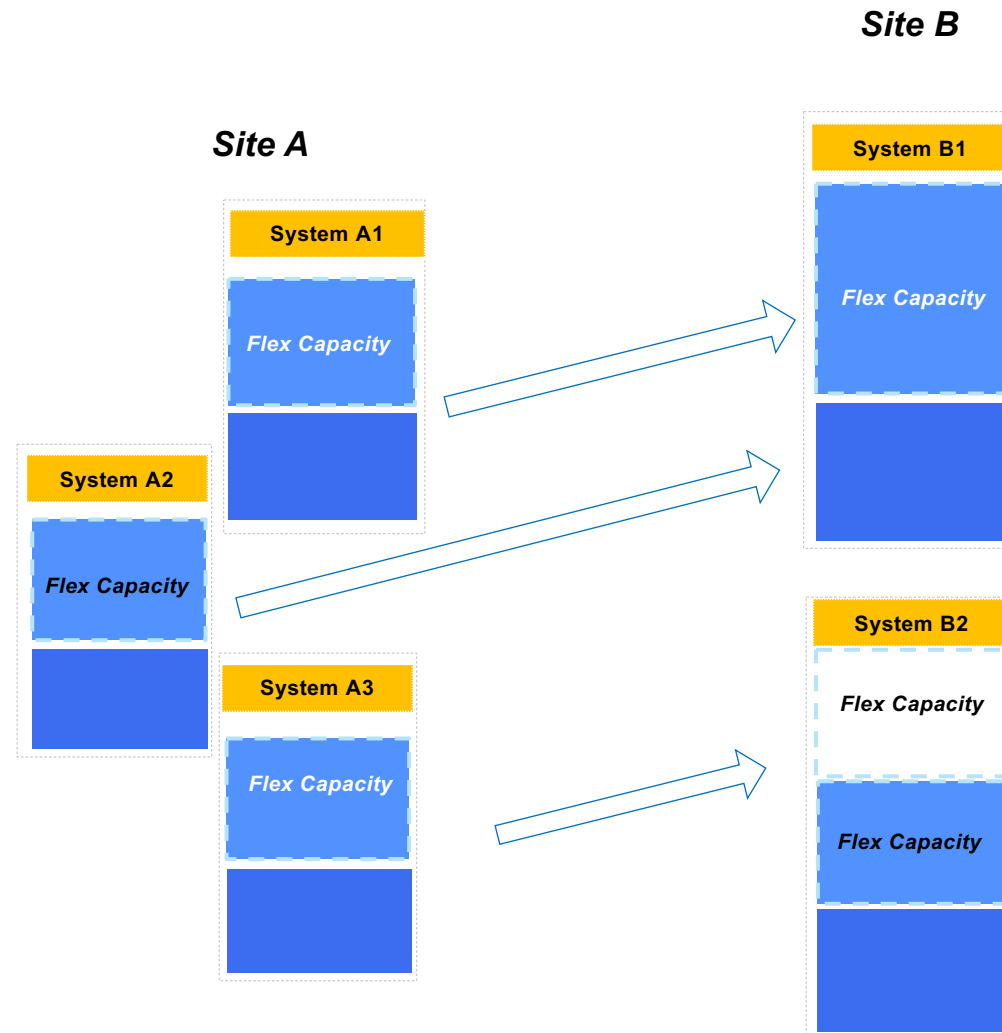
Flex Capacity

Flexible Capacity vs. CBU

	IBM Z Flexible Capacity for Cyber Resiliency	Capacity Back Up (CBU)

Primary Purpose & Benefits	1. All CBU benefits at alternate site, plus …..
	
	2. Run mainframe workload in alternate site for up to 1 year
	   • Demonstrate ability to migrate entire mainframe workload to alternate site (ex, regulatory requirements).
	   • Run entire workload in alternate site for extended period (ex, facilities requirements).
	   • Proactively swap production to alternate out-of-region site before a (natural) disaster hits.
		1. Run full mainframe workload if D/R event is declared
		
		2. **Ability to test D/R readiness up to 10 days**
		   • Validate with non-production workload (up to 10 days per CBU Test)
		   • Validate with production workload (up to 10 days per CBU Test)
		   Requires primary site capacity to be disabled

Limitations	• Alternate site can be used for maximum of 1 year • Allows up to 24 hrs overlap period, where full capacity is active on both sites for transferring workload • Allows 12 swaps between sites per year (one direction)	• Each CBU test is limited to a maximum of 10 days
Contracts & Features	• LIC is licensed only to one particular serial numbered machine, and its transfer to another machine is not permitted • Offering requires TFP for software, CMP will get grandfathered in. • The LIC license is expired 5 years past WFM. An invalid LIC license resumes if the System z machine gets upgraded or replaced to a System IBM Z machine not older than N-2	• Capacity Back Up Agreement • CBU capacity provided in annual increments • CBU tests provided in individual increments

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	New with IBM z16

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.

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

System Recovery Boost Stage 3 - Overview

- New IBM z16-only use cases for System Recovery Boost that significantly reduce the impact of these disruptions by boosting a set of recovery processes that create significant pain points for our users today. These recovery processes include:
  - SVC Dump boost
  - Middleware shutdown/restart/recycle boost
  - Hyperswap configuration load boost
  - With System Recovery Boost Stage 3, we will further enable our clients to maximize service availability by using tailored short-duration boosts to mitigate the impact of these recovery processes.

- New support for monitoring and display for recovery process boost usage information
  - Ability to display usage information for recovery process boost time against the 30 minute allotment per day
  - Ability to track "potential" usage of recovery process boosts and display that information
  - New SMF information that records daily and cumulative usage in SMF records
  - HMC/SE displays of recovery process boost usage information
  - HMC/SE logging of boost usage with call-home (including boost class information)

- Ability to enable/disable all recovery process boosts for a system
  - S IEASRB,[CLASS=RP,]REQ=DISABLE|D to dynamically disable recovery process boosts
  - S IEASRB,[CLASS=RP,]REQ=ENABLE|E to dynamically enable recovery process boosts

IBM Z Security and Compliance Center

A modern application specifically designed for progressing towards a state of continuous compliance readiness with over 300 pre-built goal validations and customizability.

Optimize Resources	Assess Compliance Posture	Identify Compliance Drift
Automates the collection and validation of facts against goals to help increase visibility into potential compliance oversights and reduce manual errors.	Interactive dashboard provides a view of current compliance posture for PCI-DSS and NIST SP800-53 regulations to help simplify audit preparations and improve continuous compliance operations.	Track compliance drift over time with dashboard style visualizations which display historical compliance scores, to help clients better understand their compliance posture

Reduce number of skilled resources needed for audit preparation functions by over 40%[1]

Reduce audit preparation time from one month to one week[2]

1,2 See claims in notes

IBM Z Security and Compliance Center dashboard

IBM z16: Modernize for hybrid cloud
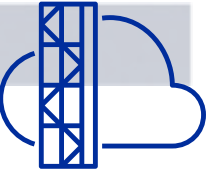
Enable all developers to develop applications using familiar tools and existing skill sets

Get to market faster for new and modernized services and integrate applications and data across the hybrid cloud

Gain efficiencies and tie cost to value by optimizing deployment on best fit resources across the hybrid cloud

Remote Code Load Option for Firmware

- Current process to upgrade the firmware on an IBM Z machine requires an IBM Z SSR (Systems Services Rep) to travel to the customer site and process the code load.

- Customers do not want any extra personnel in their data center for safety and security reasons.

- The Remote Code Load for IBM Z Firmware functionality will allow IBM to upgrade a machine remotely.
  - IBM will work with the customer to schedule the date and time of the code load and then monitor the process to ensure the process is successful.

– Remote Update Controls for Setup and Monitoring without connection into HMC

– Utilizes existing zRSF Call Out Connection

– Requires Opt In Security Configuration by Customer
  - Verbal communication from Customer to SSR on execution direction & security token
  - Customer has ability to
    – Confirm what FW Updates are scheduled
    – Can easily cancel any scheduled FW Update

– 96 % Success Rate => If exception issue encountered, IBM SSR to be dispatched
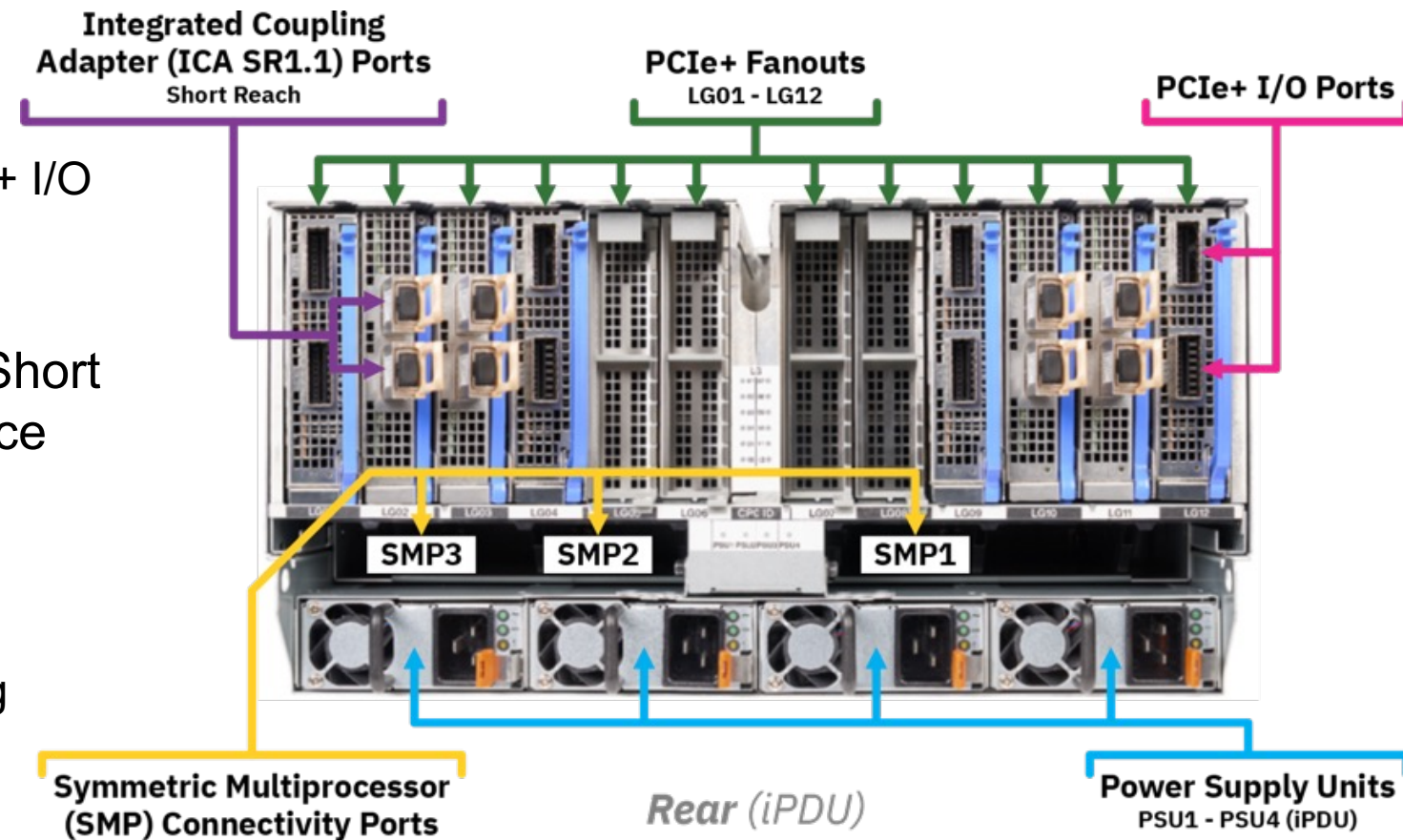
IBM z16 I/O Infrastructure

What is not offered on the 3931?

- **FCP Express32S**

- **FICON Express8S**

- **FICON Express16S**

- **OSA Express5S**

- **Crypto Express5S**

- **OSA CHPID type OSN**
  - **formerly used for 3745 EP**

- **OSA CHPID type OSX**
  - **formerly used for zBX**

- **OSA CHPID type OSM**
  - **Formerly used for zBX**
  - **Formerly used for Dynamic Partition Manager (DPM)**
    - **Ethernet now defined and cabled between the CPC Drawer and Support Elements by the IBM factory.**
      - **No client definition required!**

- **HCA3-O 12x Infiniband Short reach**
  - **Infiniband Retired**

- **HCA3-O LR 1x Infiniband Long reach**
  - **Infiniband Retired**

- **zEDC (z14) or FLASH Express (z13)**

IBM z16 CPC drawer connectivity

- Up to **12** PCIe+ fanout slots (numbered *LG01* to *LG12*) per CPC drawer

- Fanouts that may be installed include:

  – Dual port PCIe+ Gen3 fanouts for PCIe+ I/O drawer connectivity
    - **16 GBps** per port

  – Integrated Coupling Adapter (ICA) Short Reach (SR) fanouts for short distance coupling
    - **~ 8 GBps** per port
    - 150m fibre optic coupling link

  – Filler plates to assist with airflow cooling

Integrated Coupling Adapter (ICA SR1.1) Ports Short Reach

PCIe+ Fanouts LG01 - LG12

PCIe+ I/O Ports

SMP3   SMP2   SMP1

Symmetric Multiprocessor (SMP) Connectivity Ports

Rear (iPDU)

Power Supply Units PSU1 - PSU4 (iPDU)

PCIe+ I/O drawer connectivity

- Requires two 16 GBps PCIe+ Interconnect adapters, each connected to a 16 GBps PCIe+ Gen3 fanout in a CPC drawer

- Supports 16 I/O adapters, in two 8-adapter domains:
  - Each domain has a redundant PCIe+ I/O interconnect
  - Two connections to a PCIe+ Gen3 fanout are required to activate both domains
  - To support Redundant I/O Interconnect (RII) between domain pairs, interconnects to each domain must come from different PCIe+ Gen3 fanout adapters

- All Interconnect adapters and I/O adapters are hot pluggable
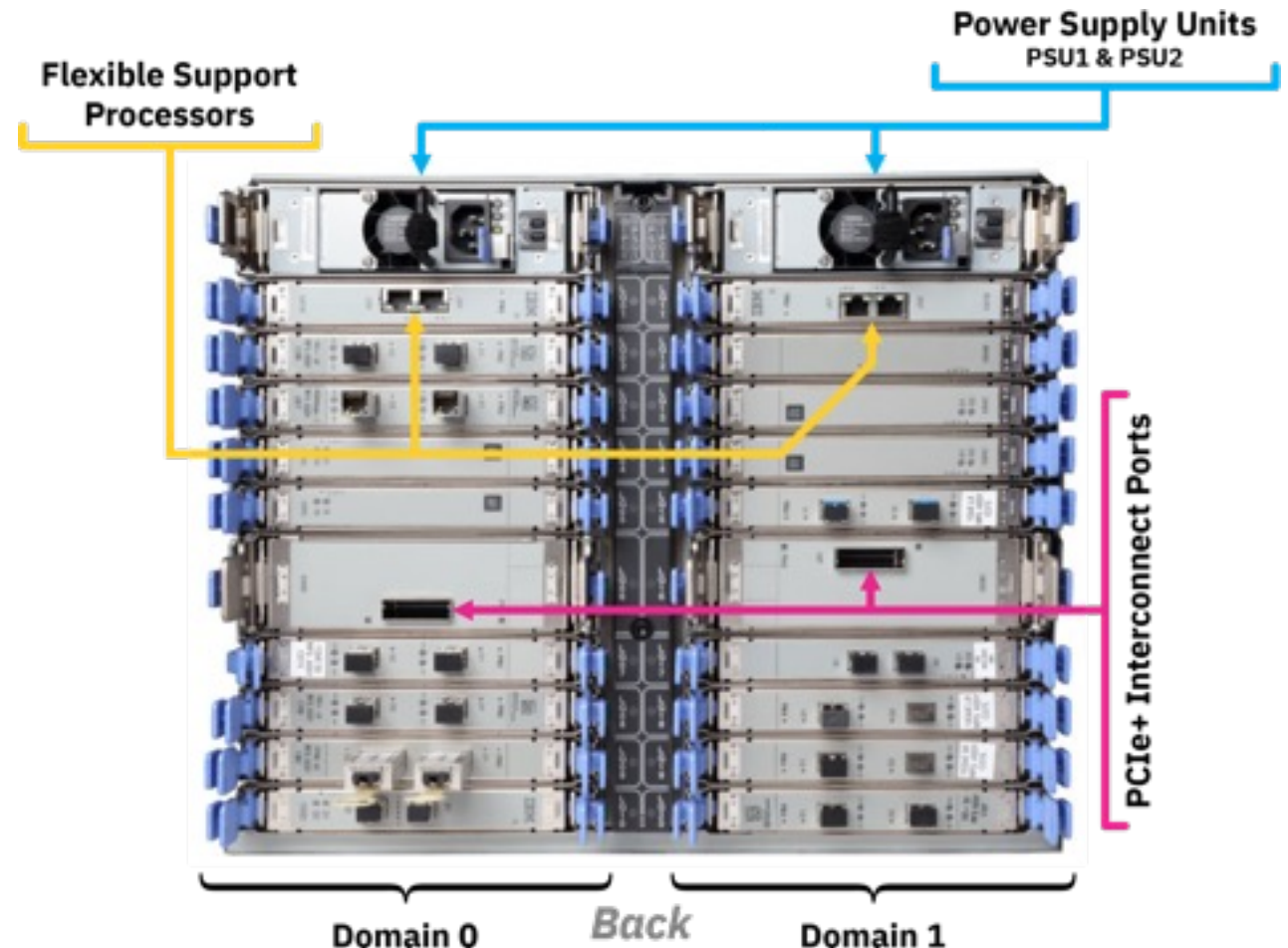
IBM z16 CPC & PCIe+ I/O drawer structure and interconnect

- Maximum I/O drawer count power dependent
  - iPDU: 12 (192 PCIe I/O adapters, max)
  - BPA: 10 (160 PCIe I/O adapters, max)
- PCIe+ I/O drawer locations are configuration dependent
  - Placement starts above CPCs in the A Frame and expands to the Z Frame, followed by the C Frame
  - B Frame is "Factory build only" and used with Max168 or Max200
- Internal I/O paths spread across different CPC drawer nodes or multiple CPC drawers
- BPA components are located at the top of the CPC drawer frames

Rear (fully configured iPDU)
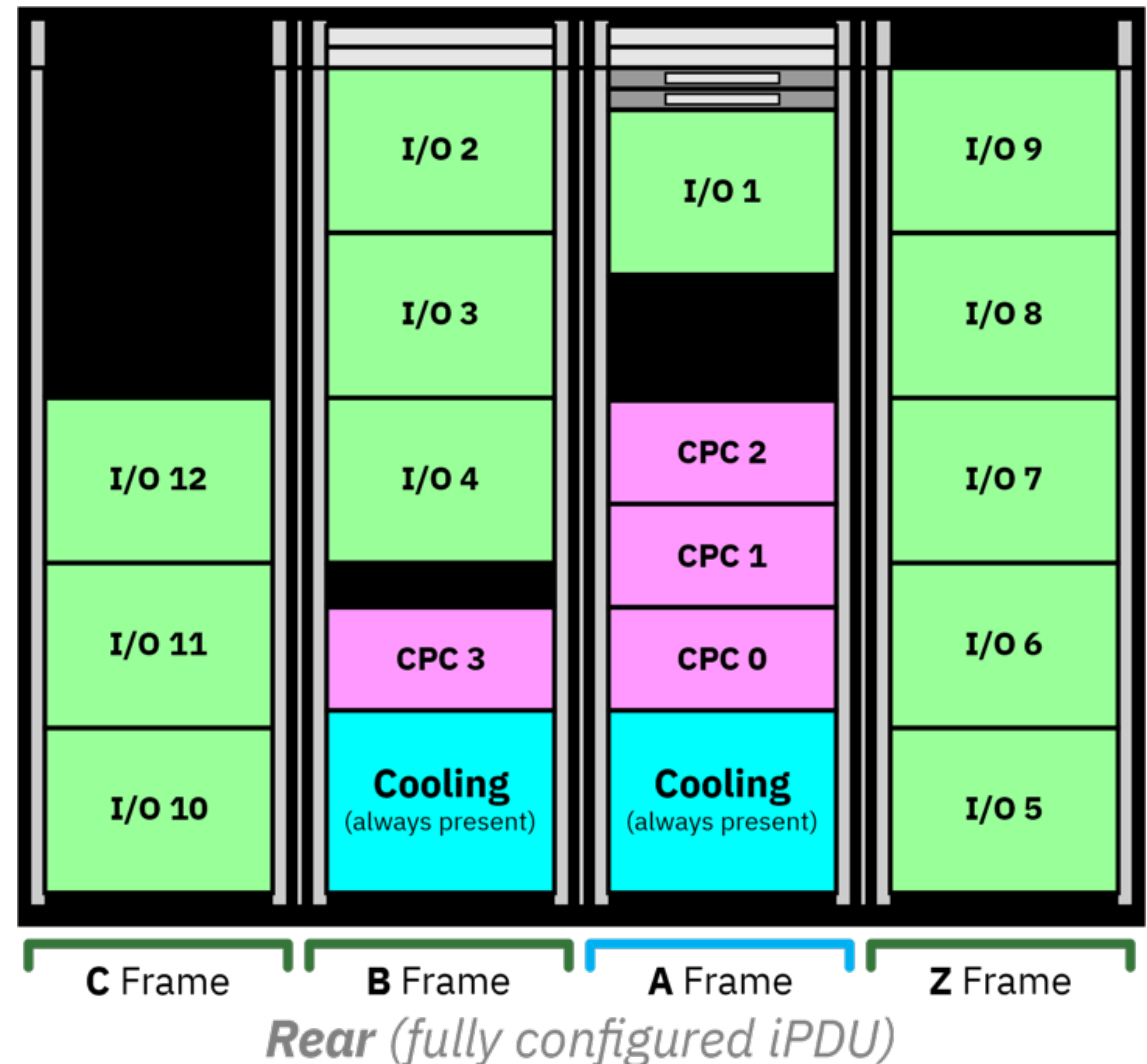
Supported I/O Features
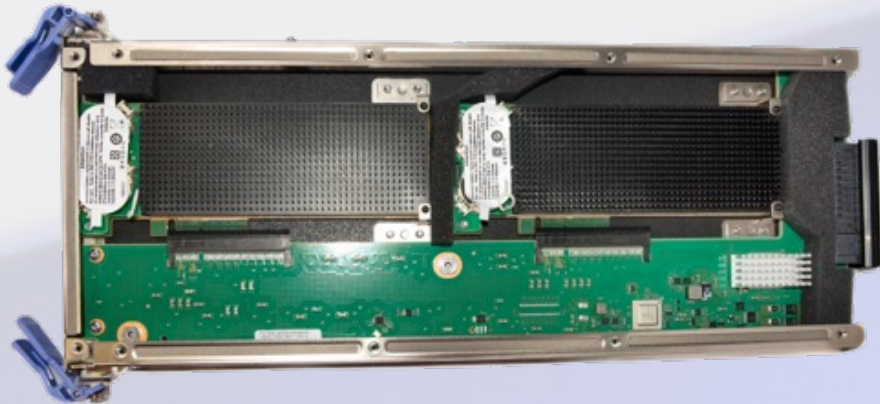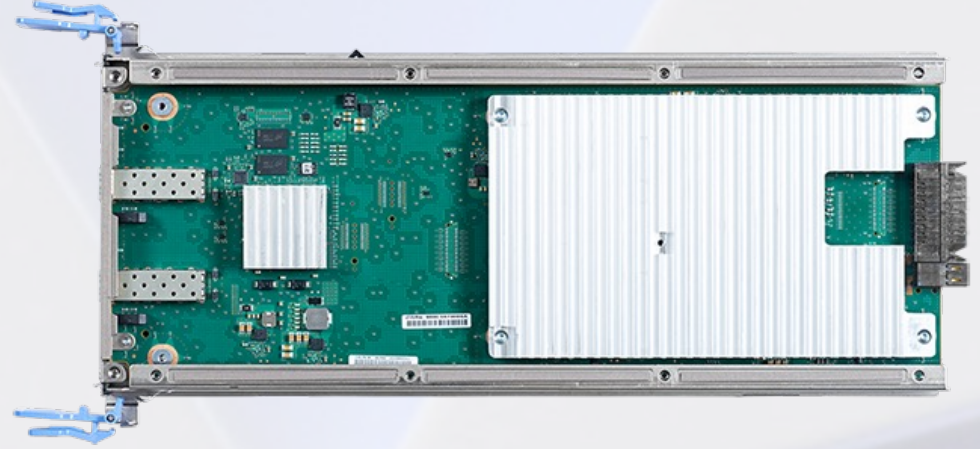
Storage connectivity

| 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**

FICON Express32S

- For FICON, zHPF, and FCP
  - FC 0461 (LX) and FC 0462 (SX)
  - CHPID types supported: FC and FCP
    - Two PCHIDs/CHPIDs
    - NO mixed CHPIDs for same card – only FC or FCP
    - Supports EDiF – FC 1146 must be ordered

- Auto-negotiates to 8, 16, or 32 Gbps
  - Negotiation to 4 Gbps NOT supported
  - 2 and 4 Gbps supported through a switch with 8 or 16 Gbps optics

- Max. 192 features per system

- Concurrent repair/replace of small form factor pluggable (SFP) optics
  - Port components can be replaced instead of the entire adapter.
  - 10KM LX - 9 micron single mode fiber
    - Unrepeated distance - 10 kilometers (6.2 miles) – See next page
    - Receiving device must also be LX
  - SX - 50 or 62.5 micron multimode fiber
    - Distance variable with link data rate and fiber type
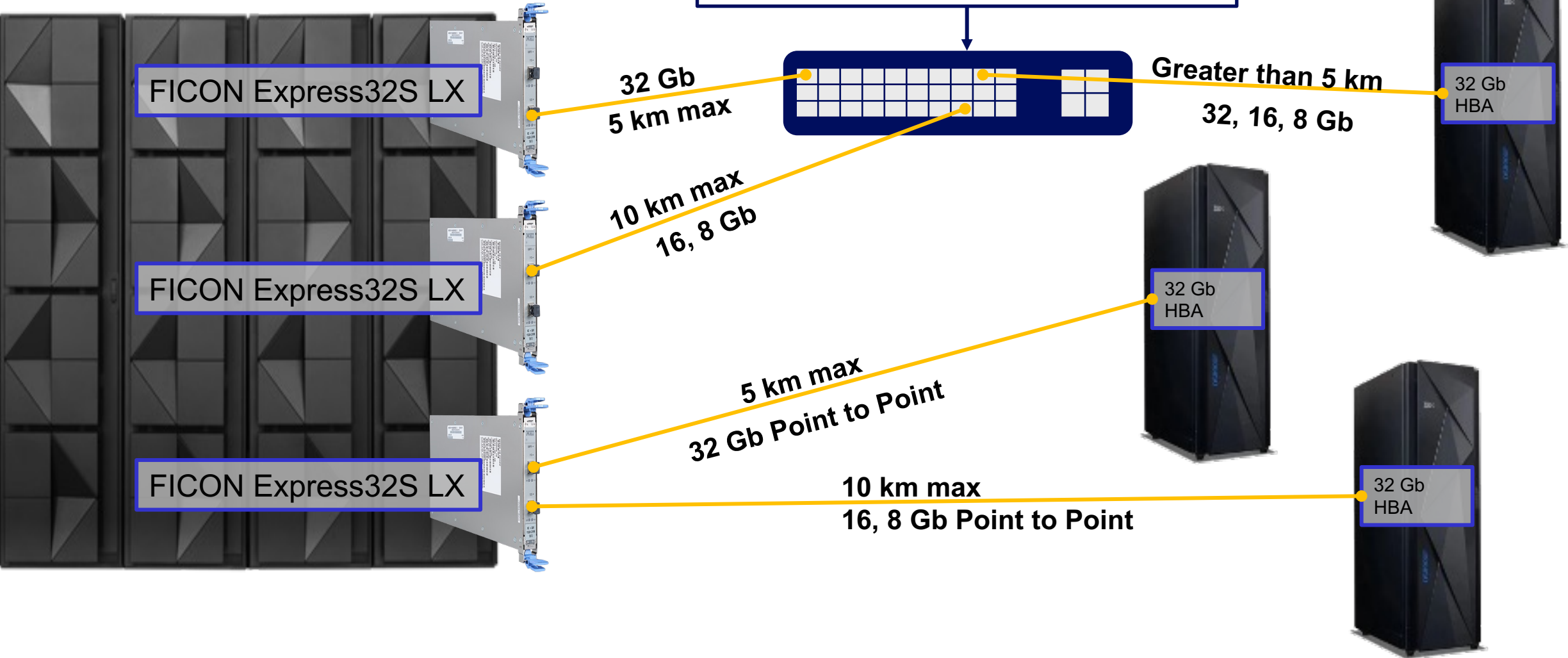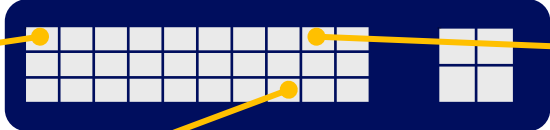   - Receiving device must also be SX
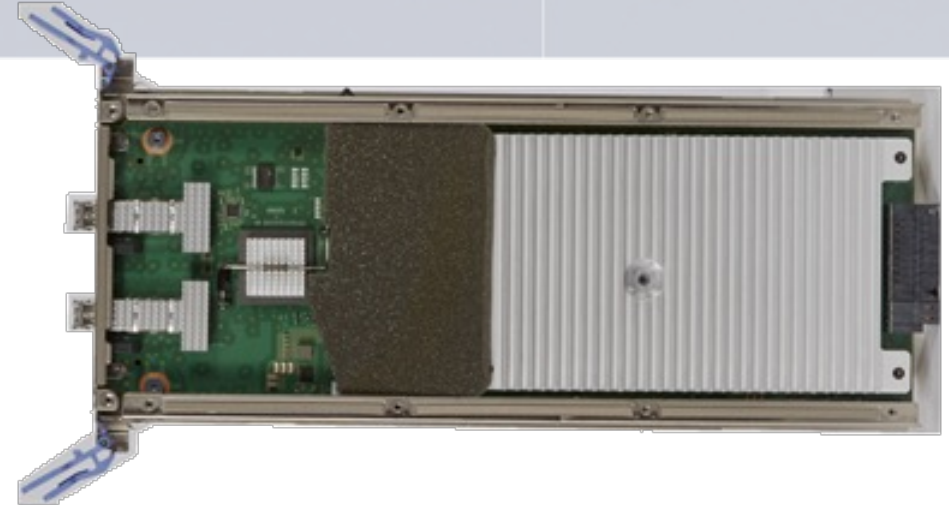
Higher Bandwidth with 32G Optics

© 2022 IBM Corporation
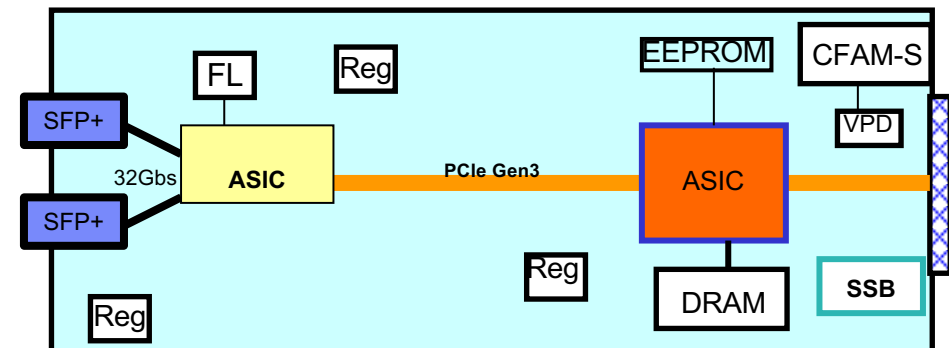
FICON Express32S LX distance guidelines

Qualified Distance Switch or DWDM, documented in ResourceLink

FICON Express32S LX

FICON Express32S LX

FICON Express32S LX

32 Gb
5 km max

10 km max
16, 8 Gb

5 km max
32 Gb Point to Point

10 km max
16, 8 Gb Point to Point

Greater than 5 km
32, 16, 8 Gb

32 Gb HBA

32 Gb HBA

32 Gb HBA

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.

IBM Fibre Channel Endpoint Security enables FICON® or Fibre Channel Protocol (FCP) Links from the IBM z16 to the IBM DS8900F storage family to be encrypted and protected

| Challenges	Customer Value
• Encrypt all data in-flight by corporate directive • Protect the integrity and • confidentiality of data in-flight	• Gain confidence that all data flowing within and across data centers is traveling between trusted entities • **Ensure ability to provide auditable information**[1] verifying that customer data is only accessed by trusted IBM Z and storage devices • Use on all IBM Z operating systems z/OS z/VM z/VSE z/TPF KVM Linux • Reduce and eliminate insider threats of unauthorized access to data in-flight • The FICON Express16SA and the FICON Express32S channel with Fibre Channel Endpoint Security protects your data in flight, offloading encryption processing to the channel hardware **with less than 2% impact** on maximum High Performance FICON® for IBM z Systems® (zHPF) throughput[2]

FICON/FCP IBM Endpoint Security

- **Requirements**
  - **FICON Express32S LX/SX (FC0461/FC0462)**
    - Up to 192 Features / Up to 384 Ports, CHPID Type FC or FCP

  - **FICON Express16SA LX/SX (FC0436/0437)**
    - Up to 192 Features / Up to 384 Ports, CHPID Type FC or FCP

  - **Minimum, DS8910, DS8890 (Power 9 based)**
    - 32GFC (encryption) Host Bus Adapter
    - 16GFC (authentication-only) Host Bus Adapter

  - **IBM z16 Endpoint Security Enablement: FC 1146**

- **ISKLM V3.0.1 (minimum)**
  - IBM Security Guardium Key Lifecycle Manager 4.1 (most current, adds container support)
- **CPACF Required**
- **No OS changes required to enable functionality**
- **Audit capability (SMF)**

zHyperlink Express1.1

- A direct connect, short distance I/O feature designed to reduce I/O response time without requiring application changes.

- Feature code: **0451** (**0431** carry forward)

- Two ports per feature

- Maximum of **16** features (32 ports)

- Up to **127** Virtual Functions (VFs) per port (254 per feature)

- Point-to-point connection using PCIe+ Gen3

- Maximum distance: **150 meters (492 feet)**

- Supports DS8880 and DS8900F models

IBM z16

Storage
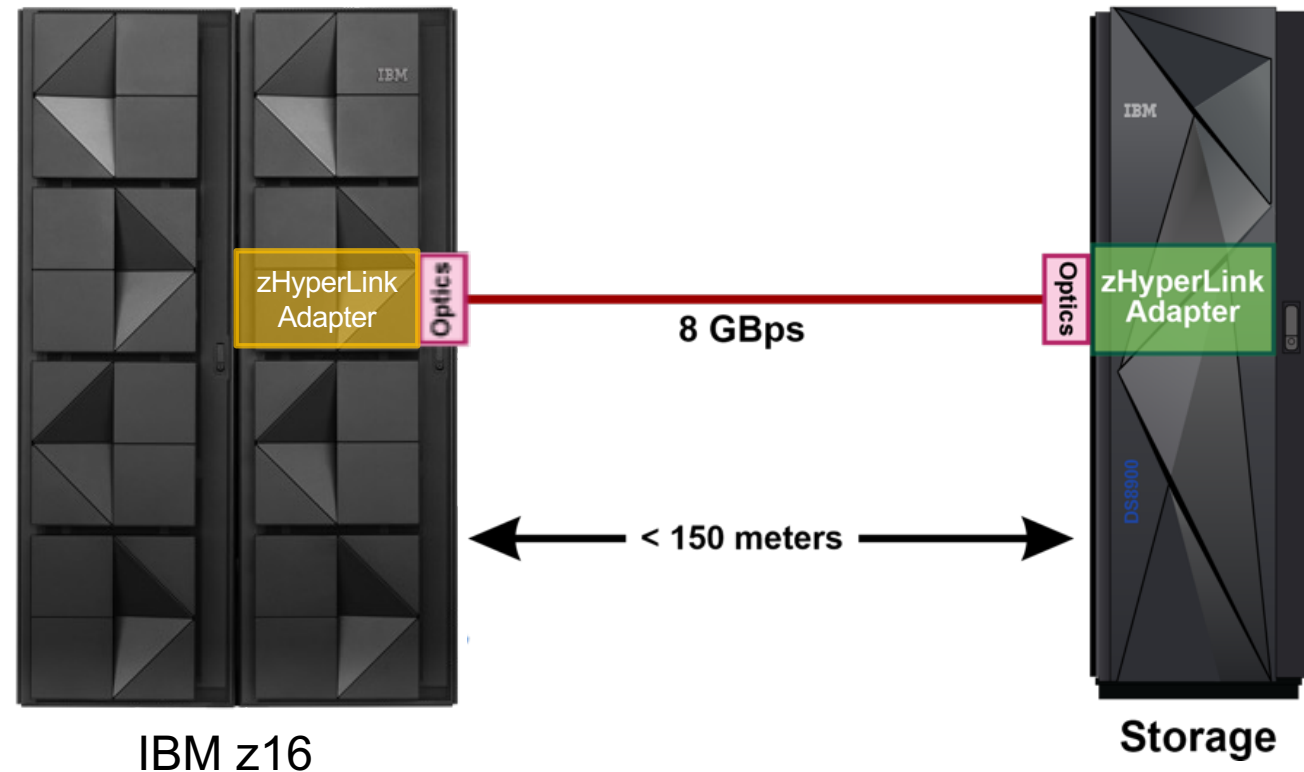
Network connectivity: OSA

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)

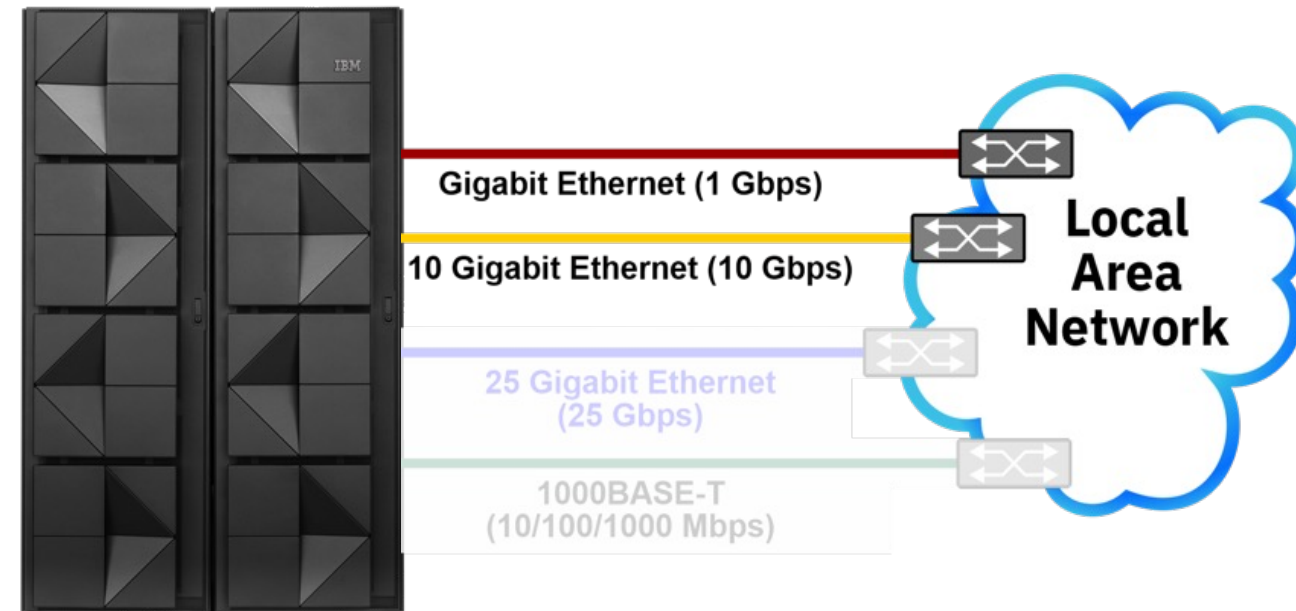| Description	Feature Code	New Build / Carry Forward	Ports	Maximum Feature Quantity
OSA Express7S 1.2 GbE LX	0454	New Build	2	48
OSA Express7S 1.2 GbE SX	0455	New Build	2	48
OSA Express7S 1.2 10GbE LR	0456	New Build	1	48
OSA Express7S 1.2 10GbE SR	0457	New Build	1	48
OSA Express7S 1.2 1000BASE-T	0458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

OSA-Express7S 1.2 Fiber Optic Features

- **Gigabit Ethernet (GbE)**

  - CHPID types: OSD, **OSC**
  - LX (FC **0454**) or SX (FC **0455**): 2 ports each
    - One PCHID/CHPID
  - Single mode (LX) or multimode (SX) cables
  - SFP transceivers
  - **Does NOT auto-negotiate to a lower speed**

- **10 Gigabit Ethernet (10 GbE)**

  - CHPID type: OSD
  - LR (FC **0456**) or SR (FC **0457**): 1 port each
    - One PCHID/CHPID
  - Single mode (LR) or multimode (SR) cables
  - SFP+ transceiver
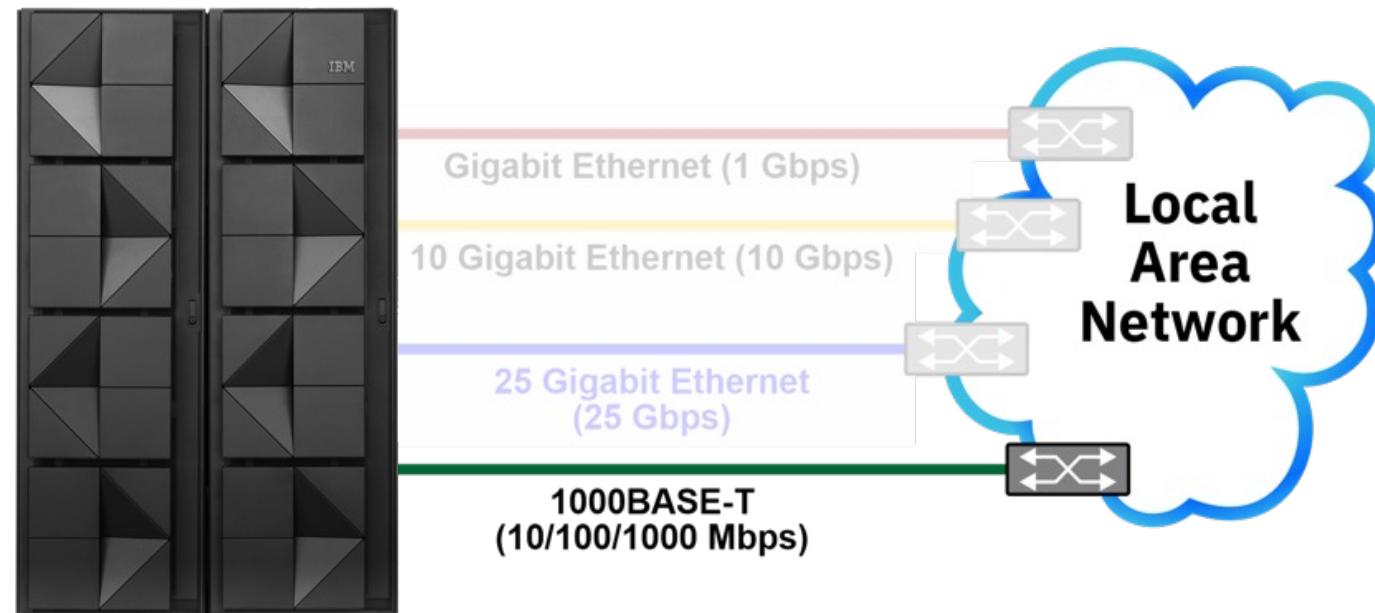 - **Does NOT auto-negotiate to a lower speed**

Gigabit Ethernet (1 Gbps)

10 Gigabit Ethernet (10 Gbps)

25 Gigabit Ethernet (25 Gbps)

1000BASE-T (10/100/1000 Mbps)

Local Area Network

OSA-Express7S 25 GbE SR1.2 & LR1.2

- Provides improved network bandwidth and the framework for possible OSA consolidation

  - CHPID type: OSD
  - One SR (**FC 0459**) or LR (**FC 0460**) port
    - One PCHID/CHPID
  - SFP+ transceiver
  - LC duplex connector
  - **Does NOT auto-negotiate to a slower speed**
  - Supports RS-FEC; **does NOT support FC-FEC**
    - Customer must ensure their switch port is manually set to RS-FEC

Gigabit Ethernet (1 Gbps)

Gigabit Ethernet (10 Gbps)

25 Gigabit Ethernet (25 Gbps)

1000BASE-T (10/100/1000 Mbps)

Local Area Network
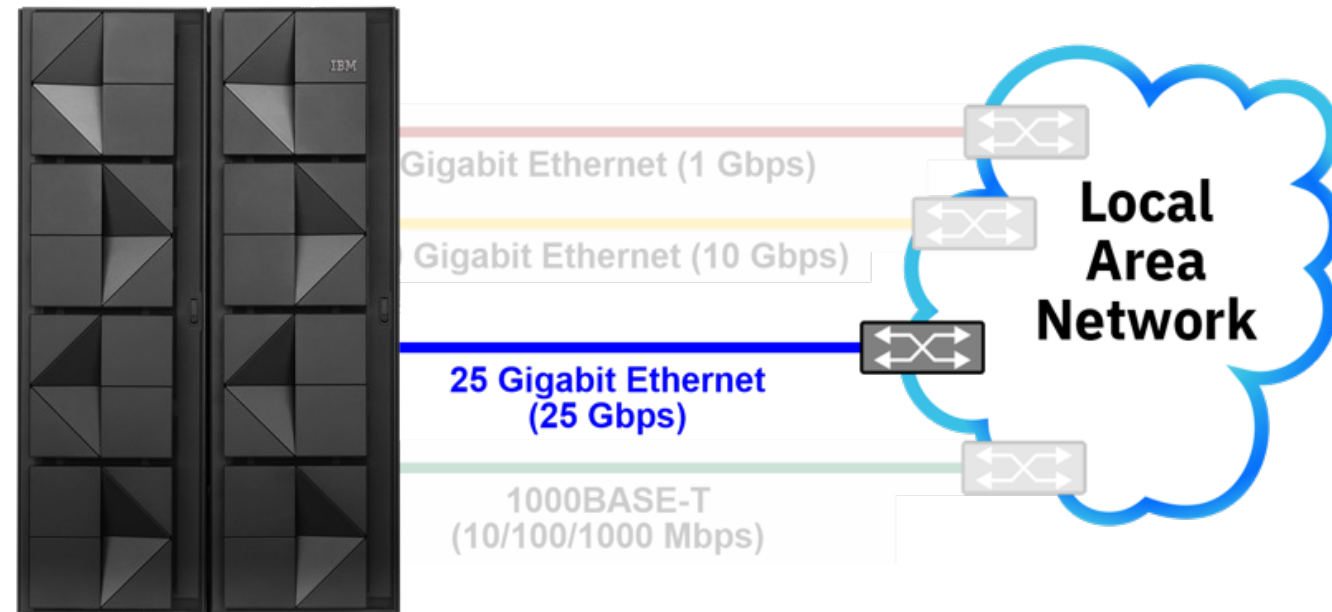
OSA-Express7S 1.2 1000BASE-T

- FC **0458**; CHPID types: OSC, OSD, **OSE**

- Two ports with RJ-45 connectors
  - One PCHID/CHPID

- Copper Wiring

- SFP transceivers – concurrent repair/replace

- TPF customers using OSC mode to support 3215 connections can migrate operations to GbE OSA cards post-GA in a IBM z16 timeframe

- **Statement of Direction**: The IBM z16 will be the last IBM Z server to support OSA Express 1000Base-T hardware adapters.

Gigabit Ethernet (1 Gbps)

10 Gigabit Ethernet (10 Gbps)

25 Gigabit Ethernet (25 Gbps)

1000BASE-T (10/100/1000 Mbps)

Local Area Network

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**

10 GbE and 25 GbE RoCE Express3

- Provides a high-speed, low-latency networking fabric for fast memory-to-memory communications between two IBM Z platforms

- SMC-R protocol

- **63** Virtual Functions (VFs) per port; **126** VFs per feature (adapter)

- 10 GbE and 25 GbE adapters available, each with Short Reach (SR) and Long Reach (LR) options

Statement of Direction: The IBM z16 will be the last IBM Z server to offer Linux support for direct OSA access.

- Will not affect z/VM Virtual Switch users

- Guidance: Linux on Z clients should adopt RoCE Express adapters for network connectivity

Model	Maximum Number of Features Supported	Ports per Feature	Maximum VFs per Feature	Maximum VFs per Machine
A01	16	2	126	126 X 16 = 2016

Integrated Firmware Processor (IFP)

- The IBM z16 IFPs have four Resource Groups (RGs) that can provide firmware for:

  10 GbE RoCE Express

  10 GbE and 25 GbE RoCE Express2

  10 GbE and 25 GbE RoCE Express2.1

  10 GbE and 25 GbE RoCE Express3

  Coupling Express2 Long Reach

- Each RG will handle **25%** of native PCIe+ I/O features, based on plugging rules and purchases made (in feature pairs)

- The IBM z16 Integrated Firmware Processors (IFPs) support:

- Native PCIe I/O features

- IBM Fibre Channel Endpoint Security (Local Key Manager)

- Dynamic I/O for Stand Alone Coupling Facilities

- Dynamic Partition Manager (DPM)

- The 2 IFPs are allocated from the pool of non-client PUs available (*customers do not pay for the IFPs*)
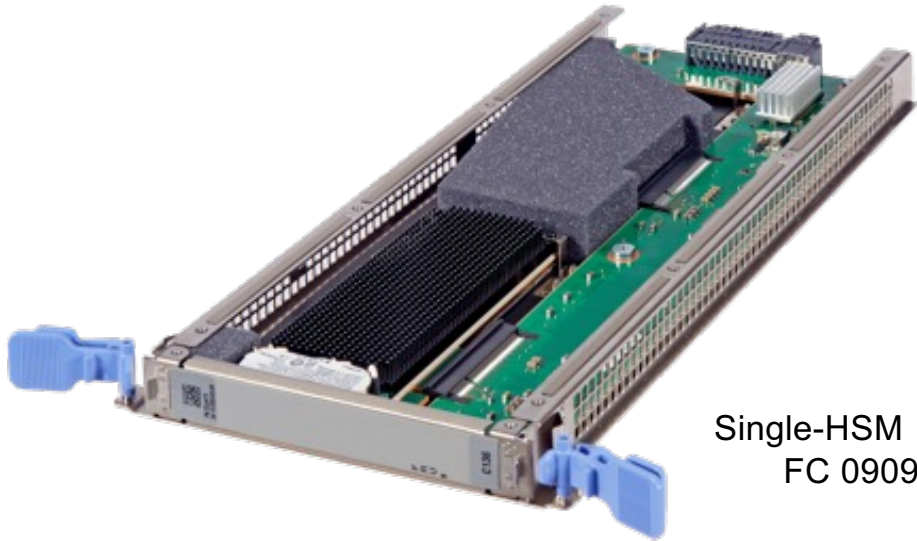
Crypto Express8S

- 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
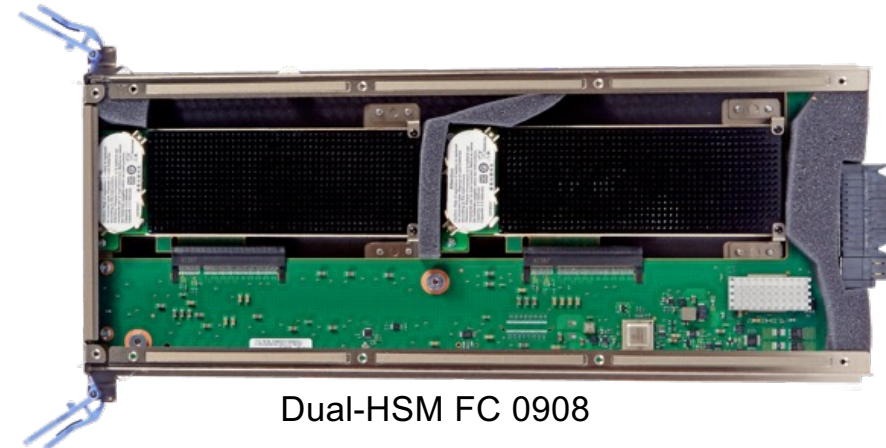
Dual-HSM FC 0908

Crypto Express8S HSM *(IBM 4770 Cryptographic Hardware Security Module)*

- Three configuration modes

  - Only one mode can be used at any given time

  - Switching between modes can cause all adapter card secrets to be erased

Single-HSM
FC 0909

- Preprocessing and functionality offloaded from the main processor unit

- Provides hardware acceleration of Dilithium and Kyber algorithms for **Quantum-Safe** support

- Supports Hybrid cryptographic schemes leveraging classical and Quantum-Safe cryptographic algorithms

- Designed to be **FIPS 140-2 Level 4** compliant

- EP11 can run with Protected Keys

Trusted Key Entry (TKE)

- Workstation allowing hardware-based key management for CCA and EP11

- TKE 10.0 LIC (FC **0882**) is required to manage Crypto Express8S adapters

  - IBM z16 TKE leverages Quantum-Safe crypto

  - When managing Crypto Express8S, secrets protected in-flight between TKE and IBM Z

- Crypto Express modules with Quantum-Safe capabilities **may not** be in a domain group with modules without Quantum-Safe capabilities

Description	FC	Comments
TKE 10.0 LIC	**0882**	Crypto Express6S Crypto Express7S Crypto Express8S - **NEW**
Workstation Rack	**0057**	**New**. Includes 4770 crypto HSM
Workstation Tower	**0058**	**New**. Includes 4770 crypto HSM
4770 TKE Crypto Adapter	0851	Loose piece adapter to convert older TKE workstations. 0851 added automatically for Carry Forward.
Smart Card Reader	0885 **0891**	Carry Forward **New Build** & Carry Forward
Additional smart cards	0892 **0900**	Carry Forward **New Build** & Carry Forward
Client keyboard	**0189**	**New Build** & Carry Forward
Client KMM	**0190**	**New Build** & Carry Forward
Tower KB	**0155**	**New Build** & Carry Forward
Rack KB & Mouse	**0156**	**New Build** & Carry Forward
Table top KMM	**0157**	**New Build** & Carry Forward

IBM z16 Coupling

Coupling connectivity

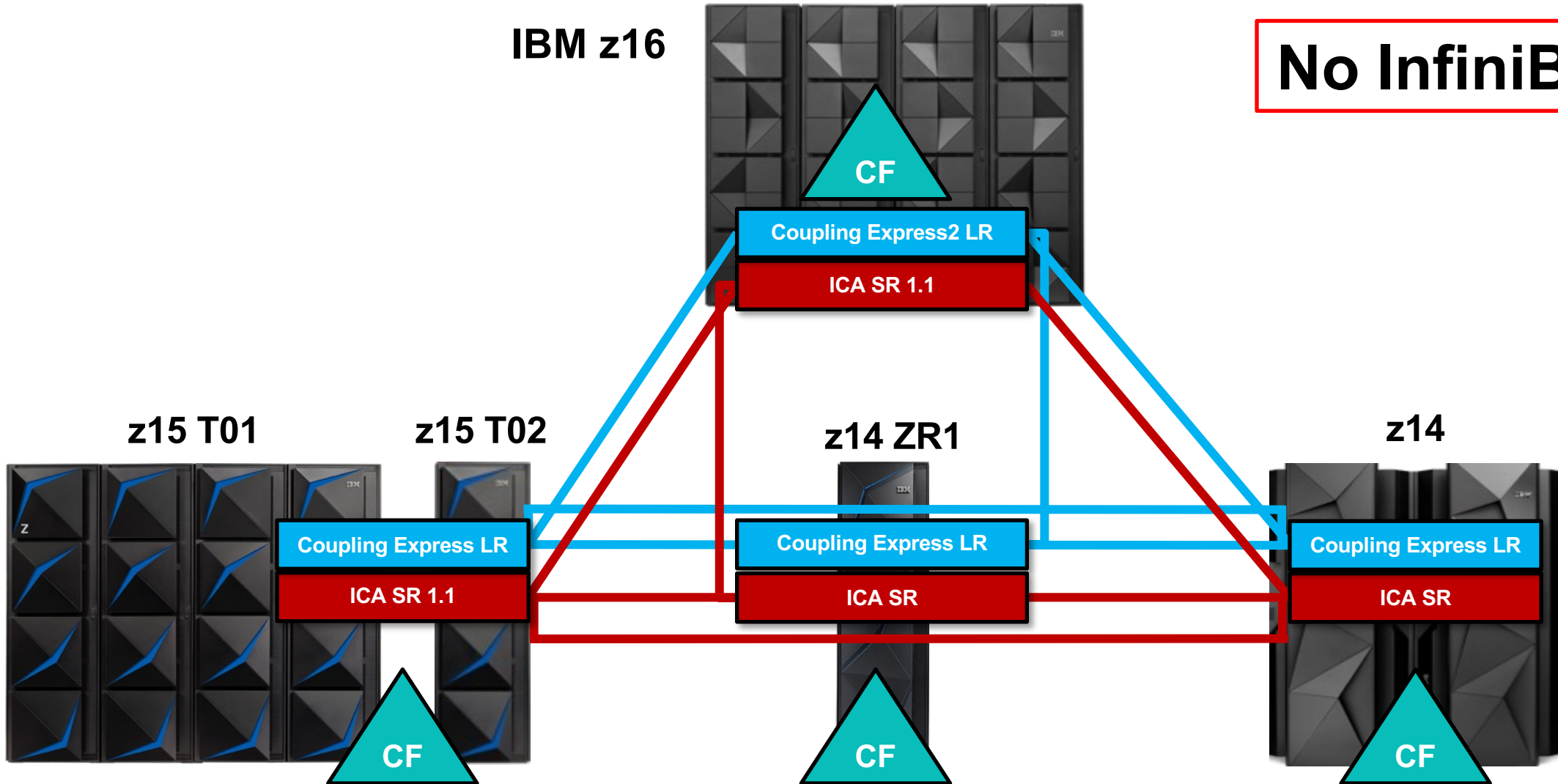| Description	Feature Code	New Build _____ Carry Forward	Ports	Maximum Feature Quantity
Integrated Coupling Adapter Short Reach (ICA SR)	0172	Carry Forward	2	48
Integrated Coupling Adapter Short Reach 1.1 (ICA SR1.1)	**0176**	**New Build /** Carry Forward	**2**	**48**
Coupling Express2 LR	**0434**	**New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

IBM z16 coupling links

- **Coupling Express2 LR (CE LR)**

  - Interconnect compatible with previous generation's links

  - CHPID: **CL5**

  - Installed in a PCIe+ I/O drawer

  - Same adapter as 10GbE RoCE Express but with Coupling optics and firmware

  - Up to **10** Gbps

  - Up to **4** CHPIDs per port; **32** subchannels (buffers) per CHPID

  - Maximum distance: **10 KM unrepeated**; up to **100 KM** with qualified DWDM

- **IBM Integrated Coupling Adapter SR1.1 (ICA SR1.1)**

  - IBM z16 enhanced protocol designed to lower latency and improve Coupling Facility service times

  - CHPID: **CS5**

  - PCIe+ Gen3

  - Installed in a fanout in a CPC drawer

  - 2 ports per feature

  - Up to **8** GBps

  - Maximum distance: **150 meters (492 feet)**

IBM z16 coupling connectivity

IBM z16

CF

Coupling Express2 LR

ICA SR 1.1

No InfiniBand

z15 T01 **z15 T02**

Coupling Express LR

ICA SR 1.1

CF

z14 ZR1

Coupling Express LR

ICA SR

CF

z14

Coupling Express LR

ICA SR

CF

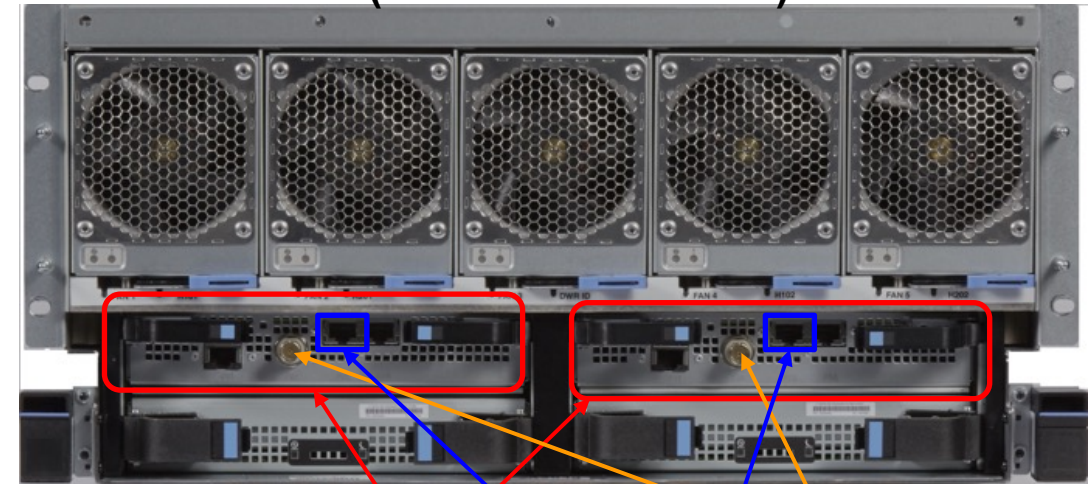# Server Time Protocol
Precision Time Protocol

Oscillator cards changes

- IBM z16 configurations can have one to four drawers

- Each CPC drawer has two combined BMC/OSC cards, each with one PPS port and one ETS port (RJ45 Ethernet, for both PTP and NTP)

- For timing signal redundancy, two links must be used
  - For a single CPC drawer system, both ports must be connected and configured for timing and/or PPS.
  - For a system with two or more CPC drawers, only the first ports in the first and second CPC drawer can be used, and only two ports (one in CPC 0 and one in CPC 1)
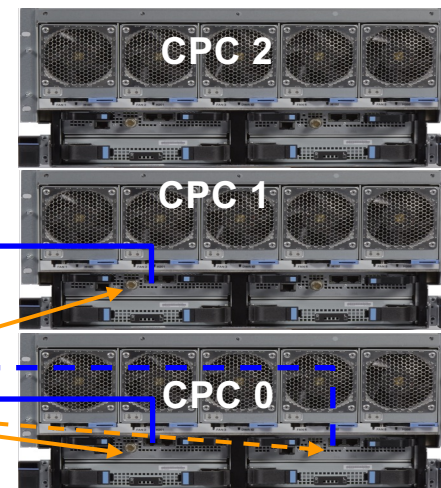
CPC Drawer, Front view
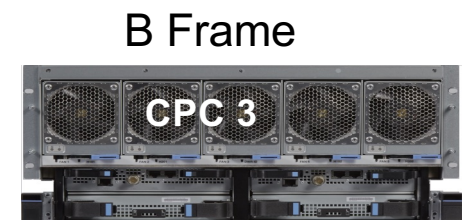**(Bezel not installed)**

BMC/OSC Cards

PPS Ports

PTP/NTP Ethernet Ports

A Frame

To customer network*
(PTP or NTP connectivity)

Used PPS ports

CPC 2

CPC 1

CPC 0

B Frame

CPC 3

Precision Time Protocol (PTP) - IEEE 1588

- **The Precision Time Protocol (PTP) is a protocol used to synchronize clocks throughout a computer network. Other vendor platforms may also exploit PTP.**

  - PTP is designed for local systems requiring accuracies beyond those attainable using NTP. [Wikipedia]
  - The first IBM Z implementation provides the use of an external time source (ETS) capable of supporting PTP.
    - Accuracy today with
      - NTP – within about **100ms**
      - NTP with PPS – within about **10μs**
      - PTP with PPS – within about **10μs (z15)**
      - PTP without PPS – **100ns** or less (IBM z16)

- **IBM z16 provides a stepping stone to further PTP support.**
  - Sets the stage for exciting future enhancements

- **PTP ETS exploitation is optional. No feature code required.**

N-Mode Power Sensing
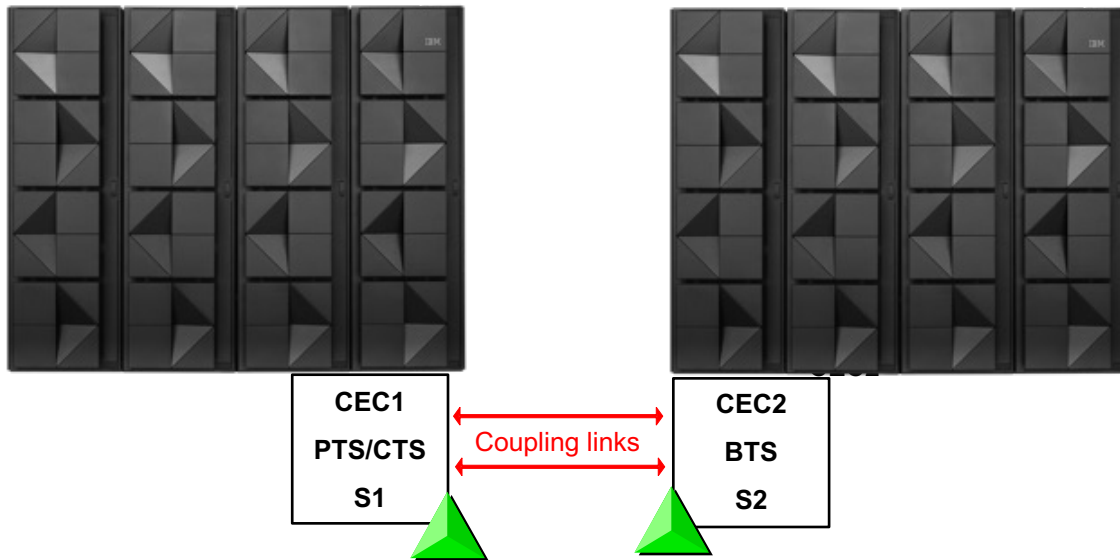
– **CEC1 power outage, quickly sends** *Imminent Disruption Signal*

• *"N-Mode Power Sensing"*

• *One-time setup step on the HMA within "Manage System Time" task*

– **If within 30 seconds CEC2 does not receive a signal that power is back to fully redundant on CEC1, CEC2 takes over as CTS.**

– **Once normal power is restored to CEC1, CEC1 will automatically return to the CTS role.**

CEC1
PTS/CTS
S1

Coupling links

CEC2
BTS
S2

N-Mode Power Sensing requires UPS power on at least half of the machine connected redundantly.

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

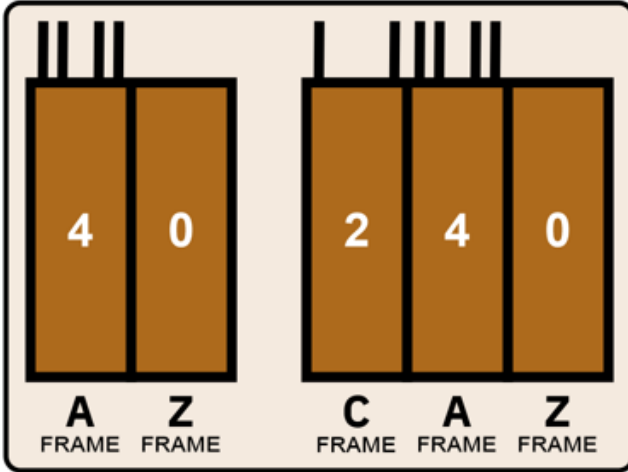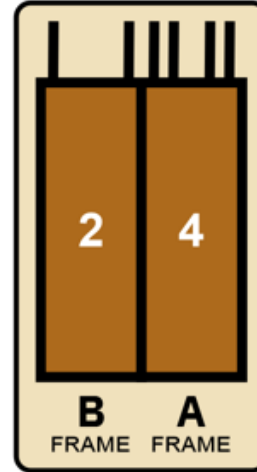| Feature	iPDU	BPA
Number of line cords	2, 4, 6, or 8	2 or 4
Max. PCIe+ I/O drawers	12	10
200-240 VAC (4 wire), 60A	Yes	Yes
380-415 VAC (5 wire), 30/32A	Yes	Yes
480 VAC (5 wire Wye)	No	Yes
Phase loss immunity	No	Yes
Internal Battery Feature	No	No
Water Cooling Unit	No	No
Balanced Power	No	Yes

Power line cords (rear view)

iPDU Power

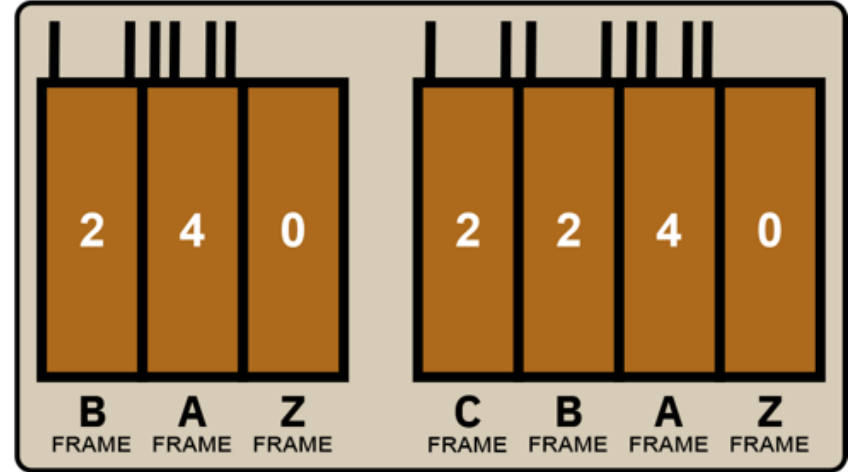*4 line cords are required in the A Frame if more than 1 CPC drawer*

A FRAME
2 or 4

I/O Expansion

A FRAME	Z FRAME
4	0

C FRAME	A FRAME	Z FRAME
2	4	0

CPC Expansion *Factory Build Only*

B FRAME	A FRAME
2	4

CPC and I/O Expansion *Factory Build Only*

B FRAME	A FRAME	Z FRAME
2	4	0

C FRAME	B FRAME	A FRAME	Z FRAME
2	2	4	0

BPA Power

A FRAME
2

I/O Expansion

A FRAME	Z FRAME
2	0

C FRAME	A FRAME	Z FRAME
2	2	0

C FRAME	B FRAME	A FRAME	Z FRAME
0	2*	2	0

CPC Expansion *Factory Build Only*

B FRAME	A FRAME
2	2

CPC and I/O Expansion *Factory Build Only*

B FRAME	A FRAME	Z FRAME
2	2	0

C FRAME	B FRAME	A FRAME	Z FRAME
0	2	2	0
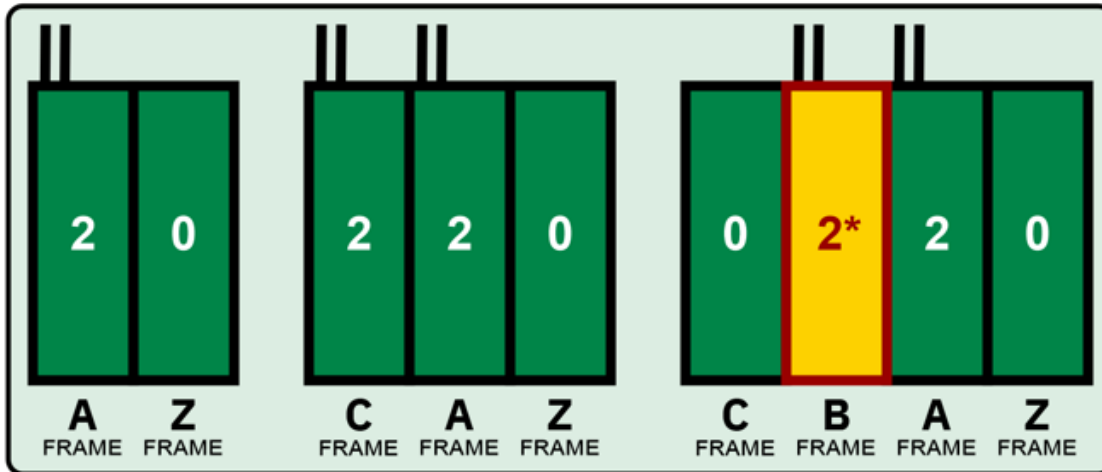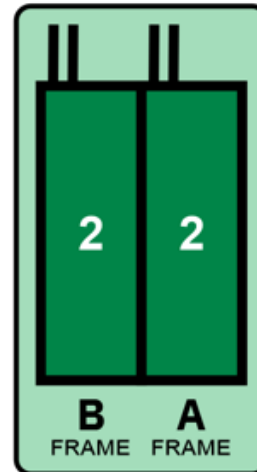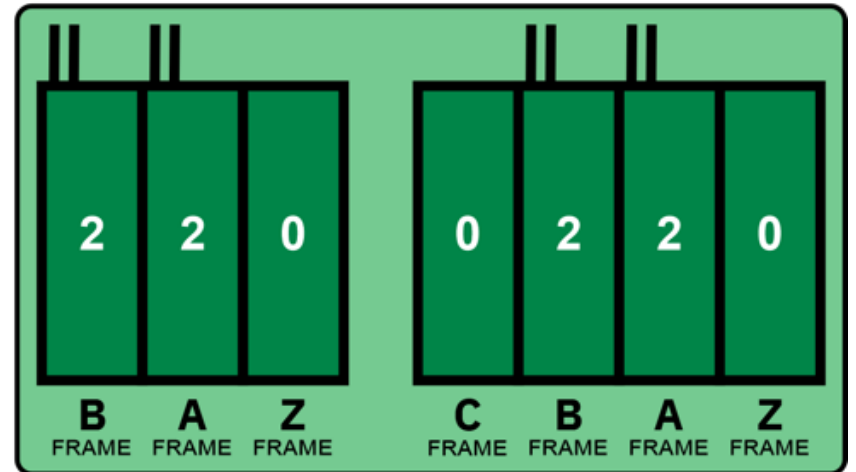
* Special BPA B Frame plan-ahead - contains no CPC drawers or cooling

Environmental classes – Same ASHRAE Rating as z14

ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) is an organization devoted to the advancement of indoor-environment-control technology in the heating, ventilation, and air conditioning (HVAC) industry.

System z ASHRAE Ratings

z13

A2
Chiller Required

- Temp range 10C (50F) to 35C (95F)
- RH range 20% to 80%
- Max dew point 21C (69.8F) (note 1)
- Alt 10,000 ft.

z14, z15, z16

A3
Chiller Required

- Temp range 5C (41F) to 40C (104F)
- RH range 8% to 85%
- Max dew point 24C (75.2F) (note 1)
- Alt 10,000 ft.
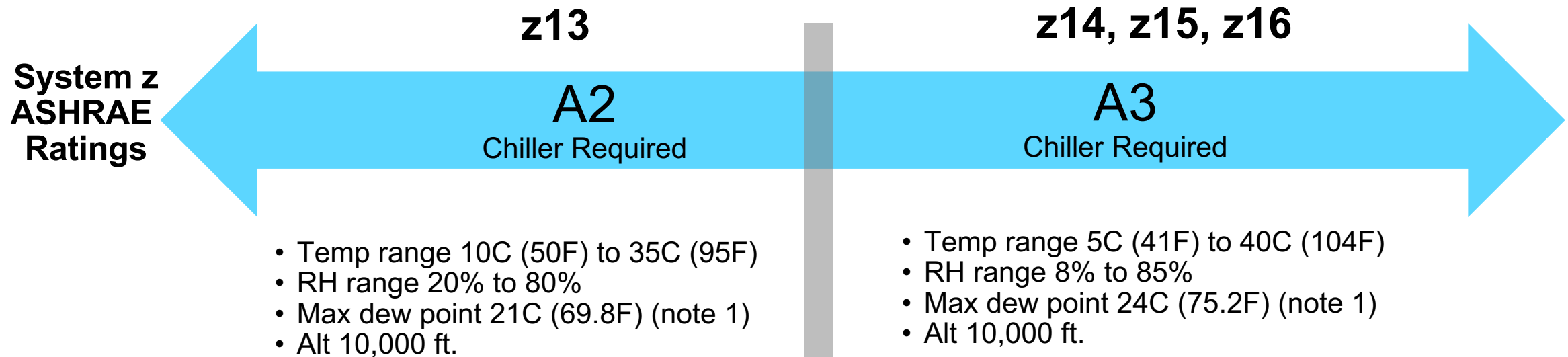
**IBM recommended Temp range 18C (64.4F) to 27C (80.6F)
RH range 5.5C (41.9F) min dew point; up to 60%, Max dew point 15C (59F) (note 1)**

Note 1: Actual inlet air moisture content range (grams moisture/Kg dry air)   A1: 2 – 12   A2: 1.5 – 16   A3: 1.5 – 19, Recommended: 6.2 - <10

Hot and cold aisle cooling containment

- Partitions used in the aisle cooling containment solution should be self-supporting and not attach to the frame for structural integrity.

- Service clearances must be maintained when the system is installed in the cooling containment solution.

- Airflow requirements of the IBM z16 must meet the intended and abnormal operating conditions to assure sufficient airflow can be provided, particularly in cold aisle cooling containment systems.

- Ensure racks across the aisle will not negatively impact the IBM z16 operation or the IBM z16 impacts other racks.
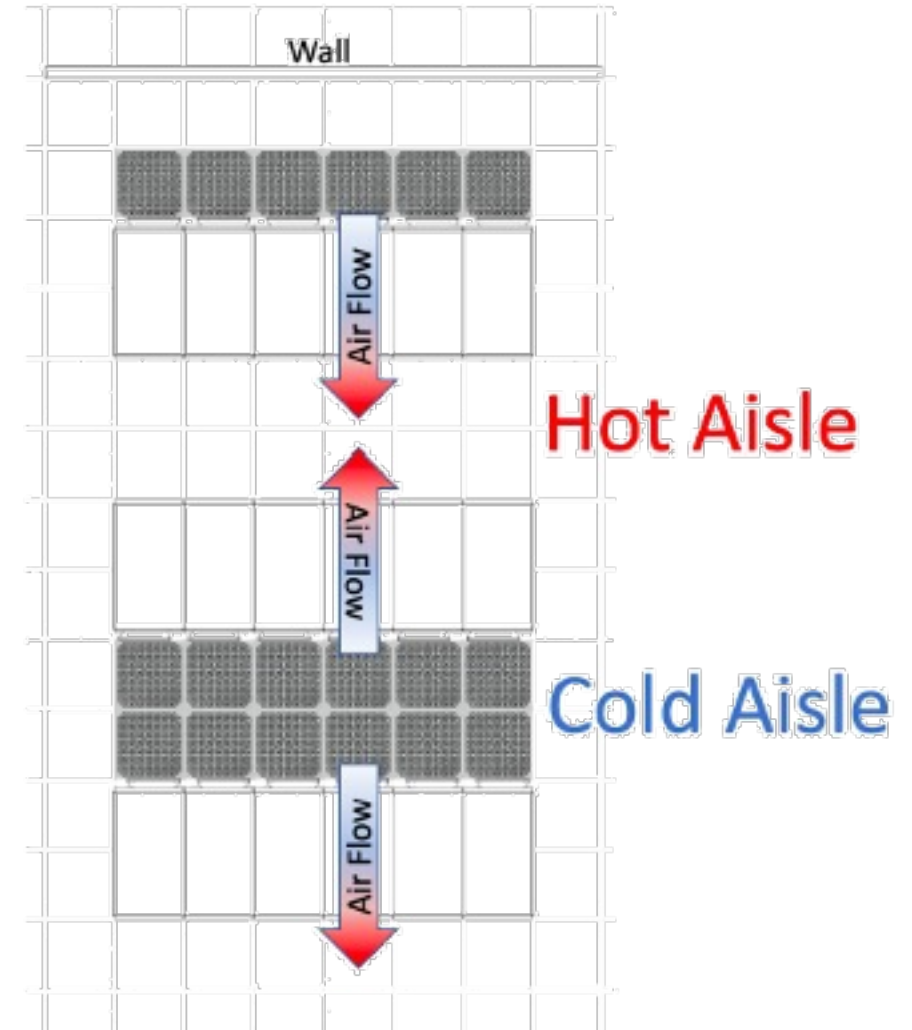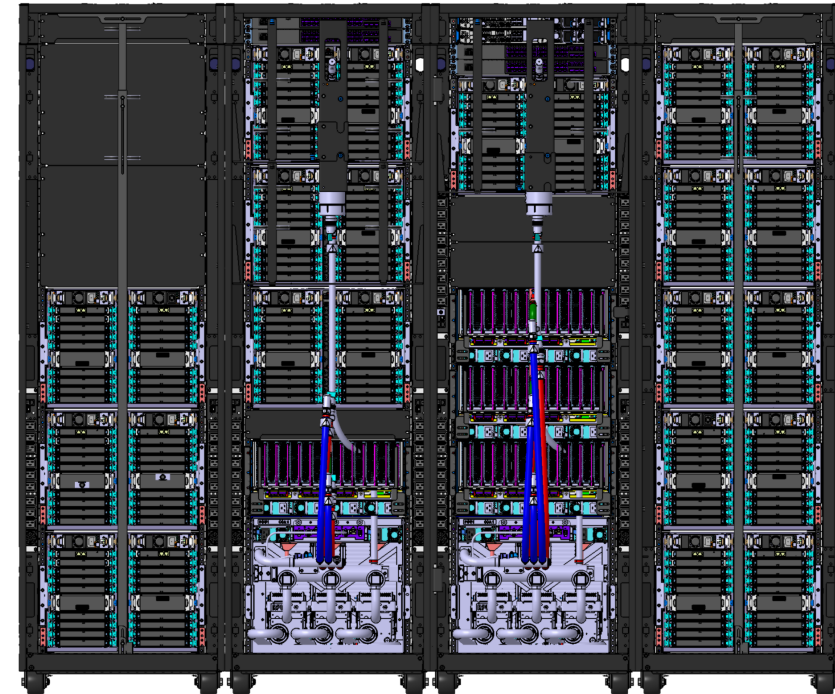
IBM z16 (3931-A01)

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
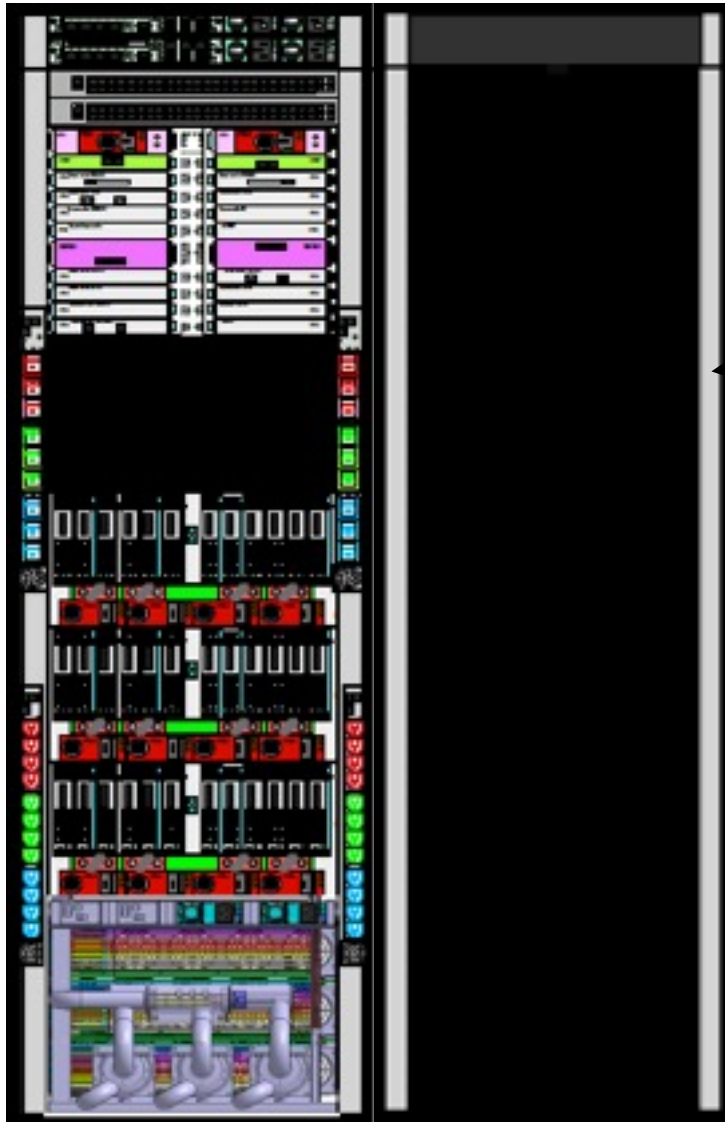- Up to 3 I/O Drawers (48 I/O Cards) without CPC Reserve FCs 2981 and 2982

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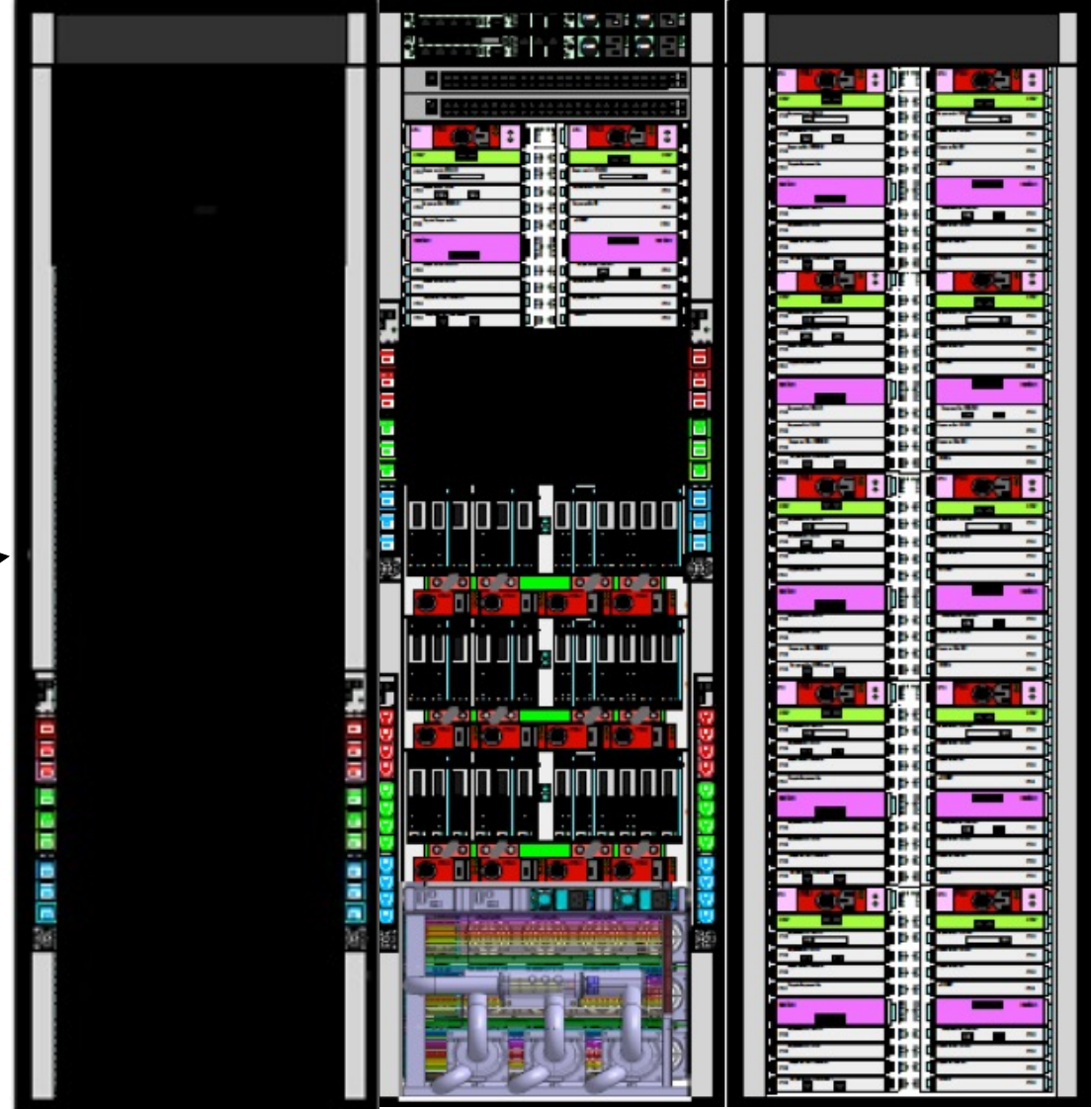- From 39 to 125 CPs
- 2-7 I/O Drawers (112 I/O Cards Max)

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

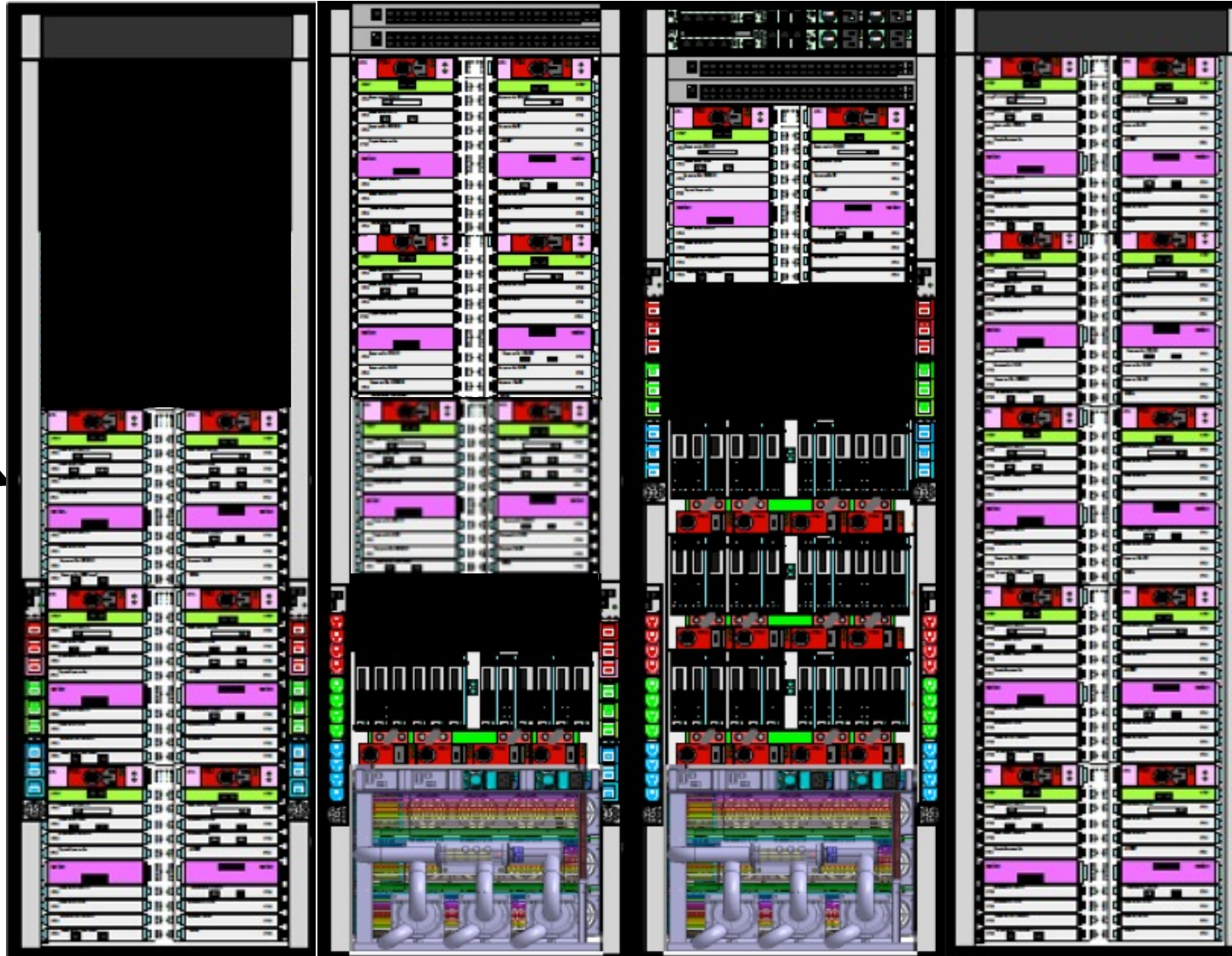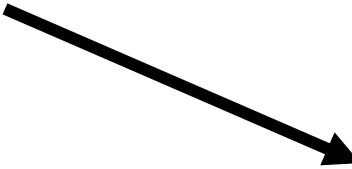# IBM z16 Configuration: PDU based CP Expansion Rear View

Max 168/200

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

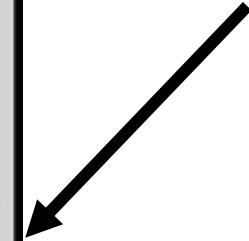# IBM z16 Configuration: PDU base I/O and CP Expansion

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)

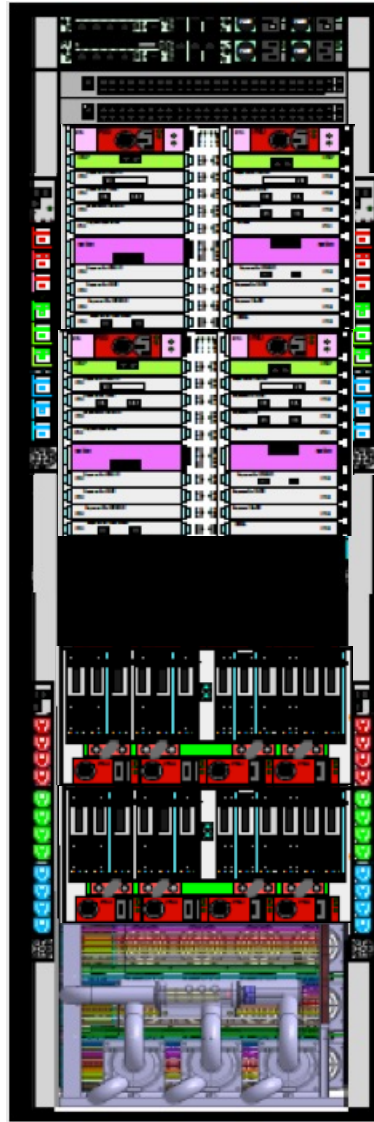# IBM z16 Configuration: PDU based single frame Rear View

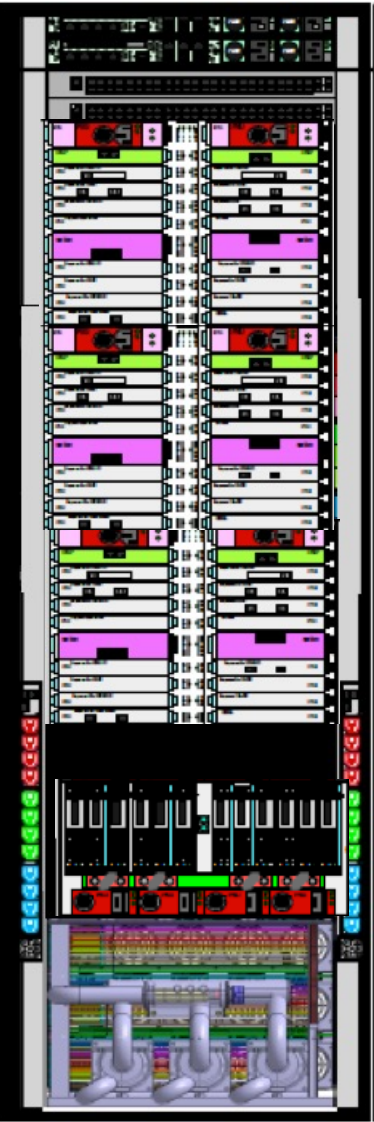**Max 39**

- 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
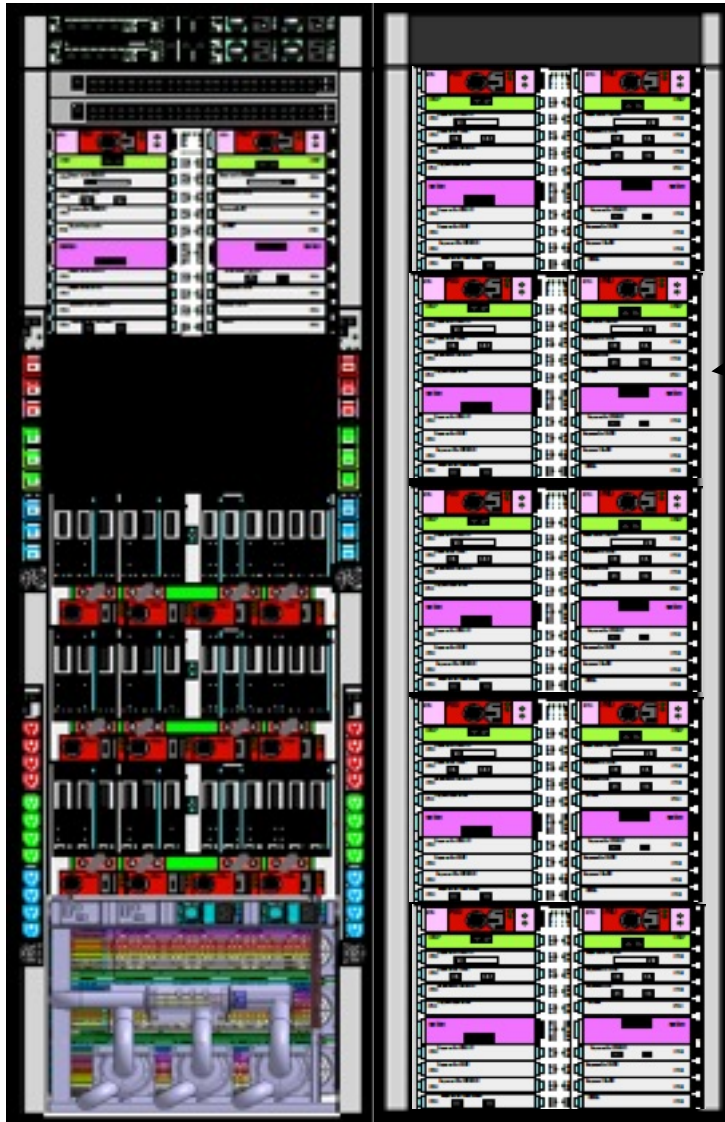
Max 82

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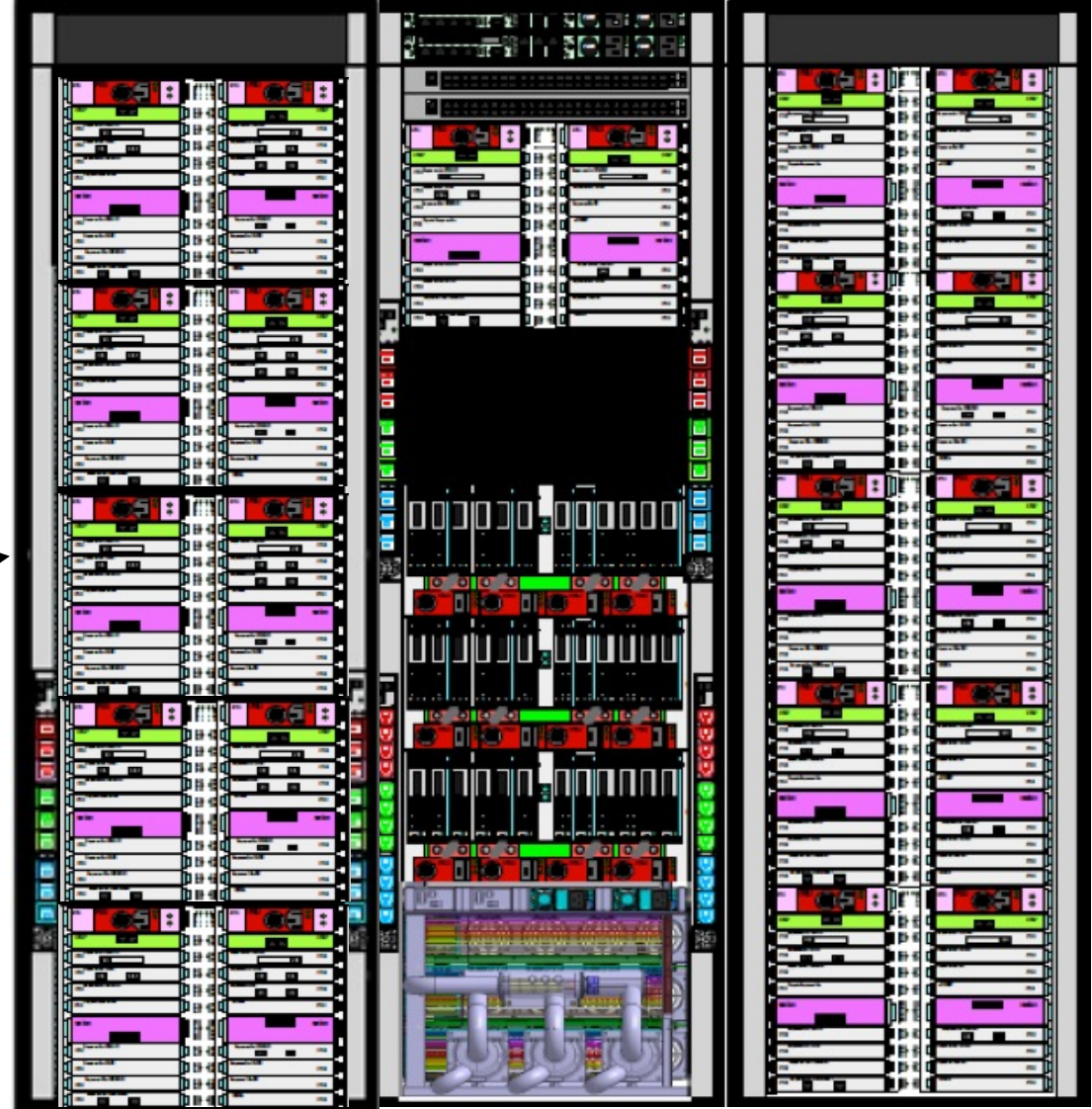
- 6 line cords required
- Up to 125 CPs
- 7-12 I/O Drawers (192 I/O Cards Max)

Max39 can only plug 6 I/O drawers

IBM z16 Configuration: PDU based CP Expansion Rear View

Max 168

- 6 line cords required
- 168 CPs (**Factory Build Only**)
- 0-4 I/O Drawers (64 I/O Cards Max)
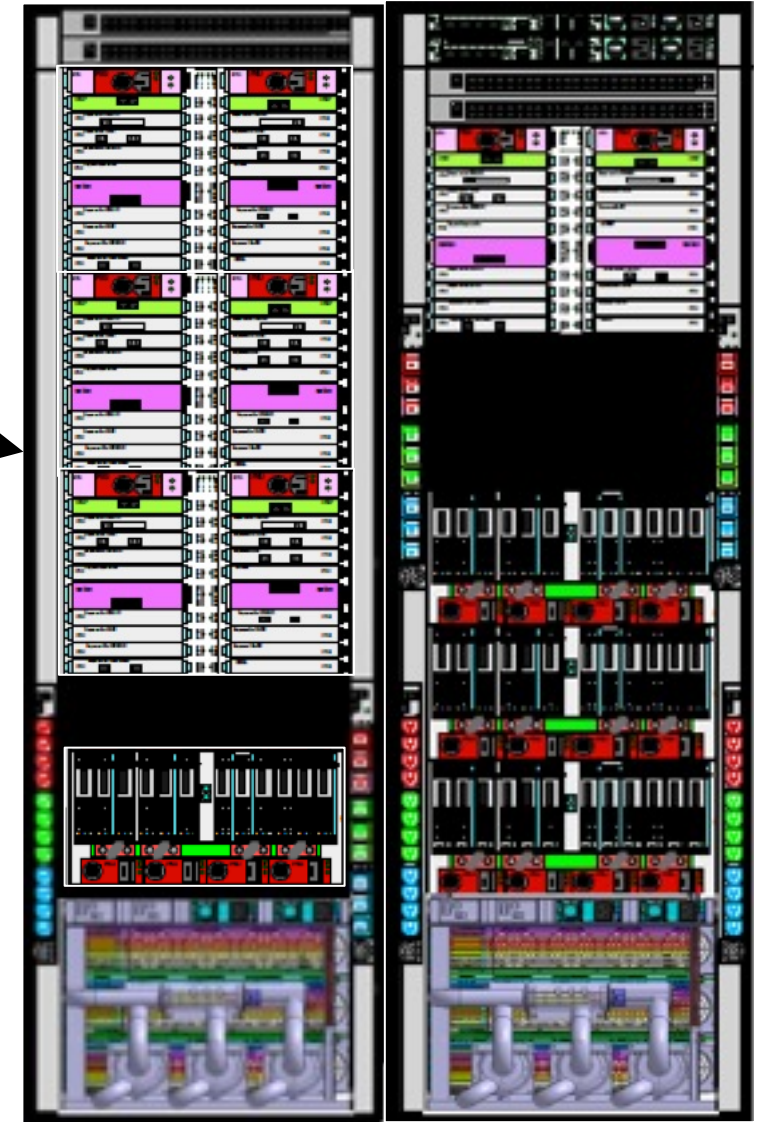
Max 200

- 6 line cords required
- 200 CPs (**Factory Build Only**)
- 0-4 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)
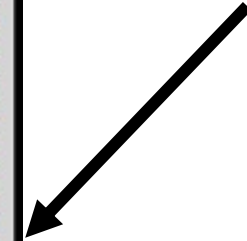
Guide For Raised Floor Preparation

- **Things to consider:**

  - Number of frames are configuration dependent and can change based on future MESs

    - Plan your IBM z16 floor placement for future growth

  - Rear exit I/O, coupling, and power cabling **only**, for bottom and top exit cabling

  - New floor cutouts may be necessary depending on placement

  - Raised floor stanchions locations may need to be reevaluated

  - As with previous systems, the IBM z16 should be placed with adequate service clearance areas on both the front and back of the system
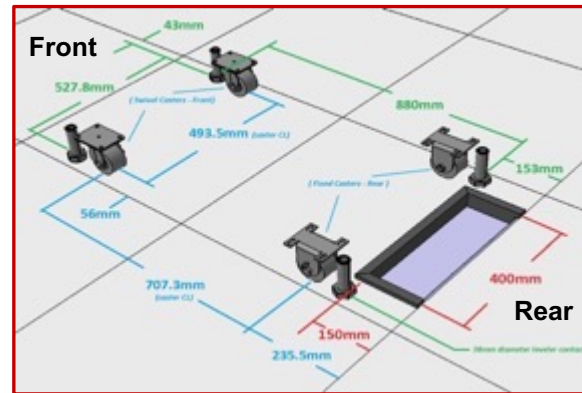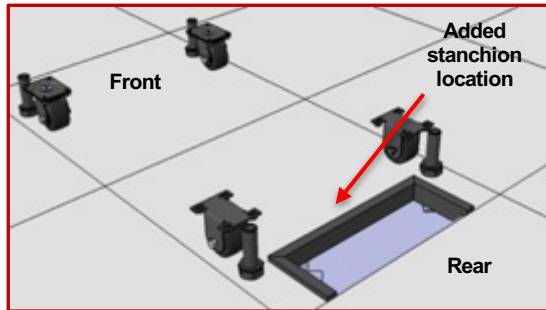
Frame Entry/Exit	Approx. Max. Cut-out Dims.	
	Metric Tile	English Tile
Rear	150 mm D x 450 mm W	6.0" D x 18" W

Typical Floor Tile Cut-out

Service Clearance Area
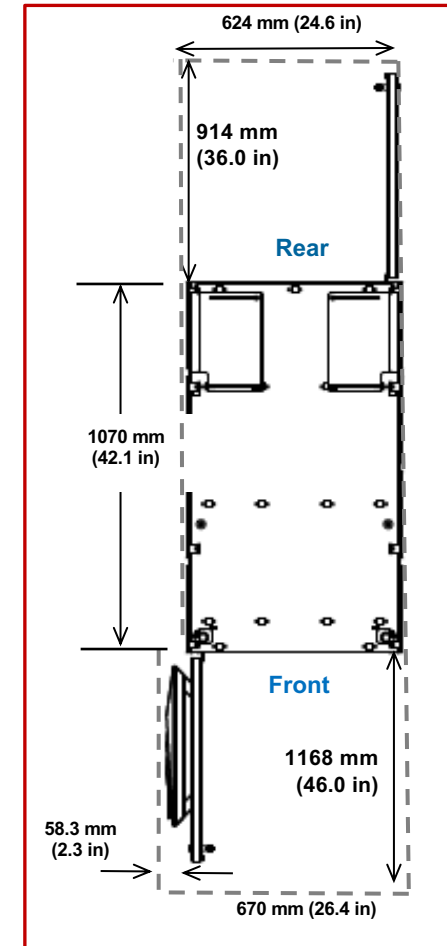
Recommended Stanchion Locations

Consult the IBM z16 IMPP for additional information IMPP GC28-7015

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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

Cabling spine

- Vertical cable management guide that:

- Assists with the management of fiber, copper, and coupling cables

- Minimizes interference with the iPDUs that are mounted on the sides of a frame

- Allows cables from CPC and PCIe+ I/O drawers to be routed to the middle of the frame
    - Cables can be routed for bottom exit or top exit
    - Cable retention clips (provided) can be relocated for best usage

- Is installed automatically with all systems with I/O frames (Z or C frame) regardless of PCIe+ I/O drawer count

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
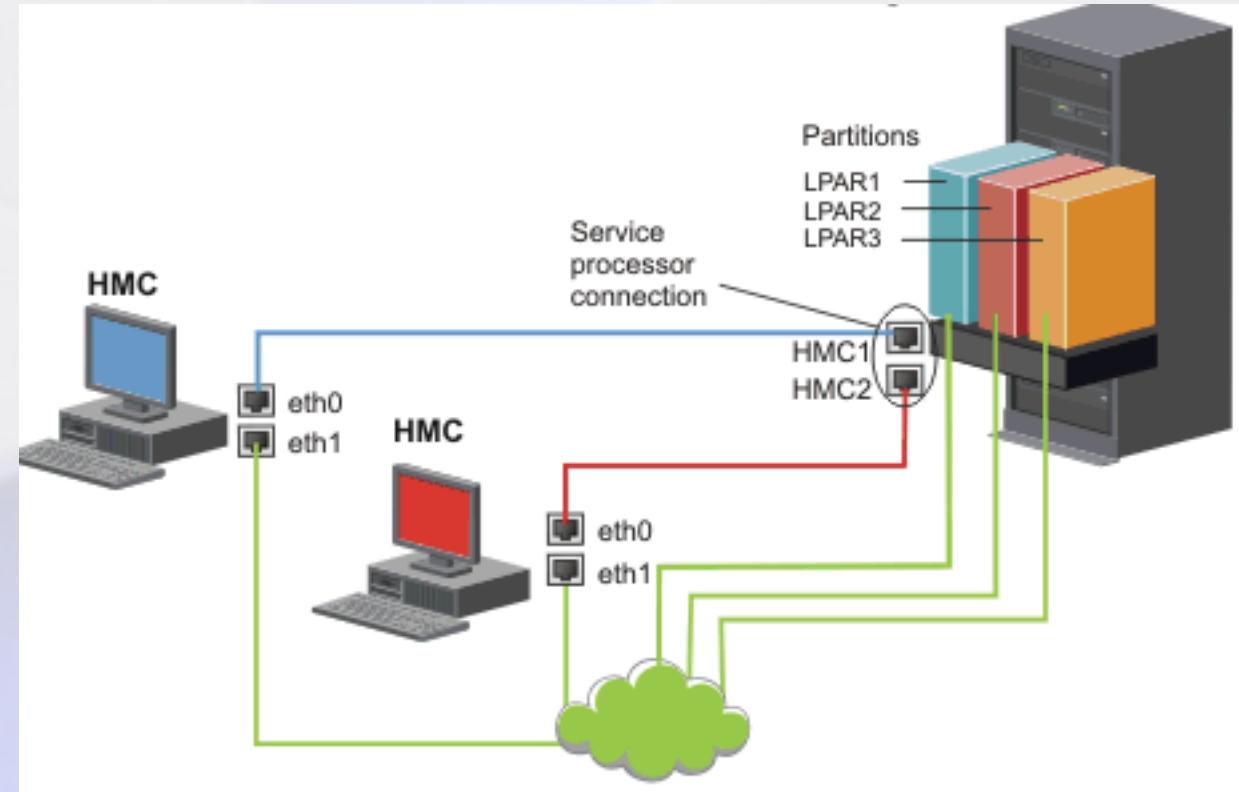
HMC/SE Changes

- **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**

z15 — SE / SE

z15 — HMA / HMA

z14 — SE / SE

z14 — SE / SE

IBM z16 — HMA / HMA — HMC/SE / HMC/SE

Switch   Switch

HMC's are peers and support data replication. SE's are primary/alt
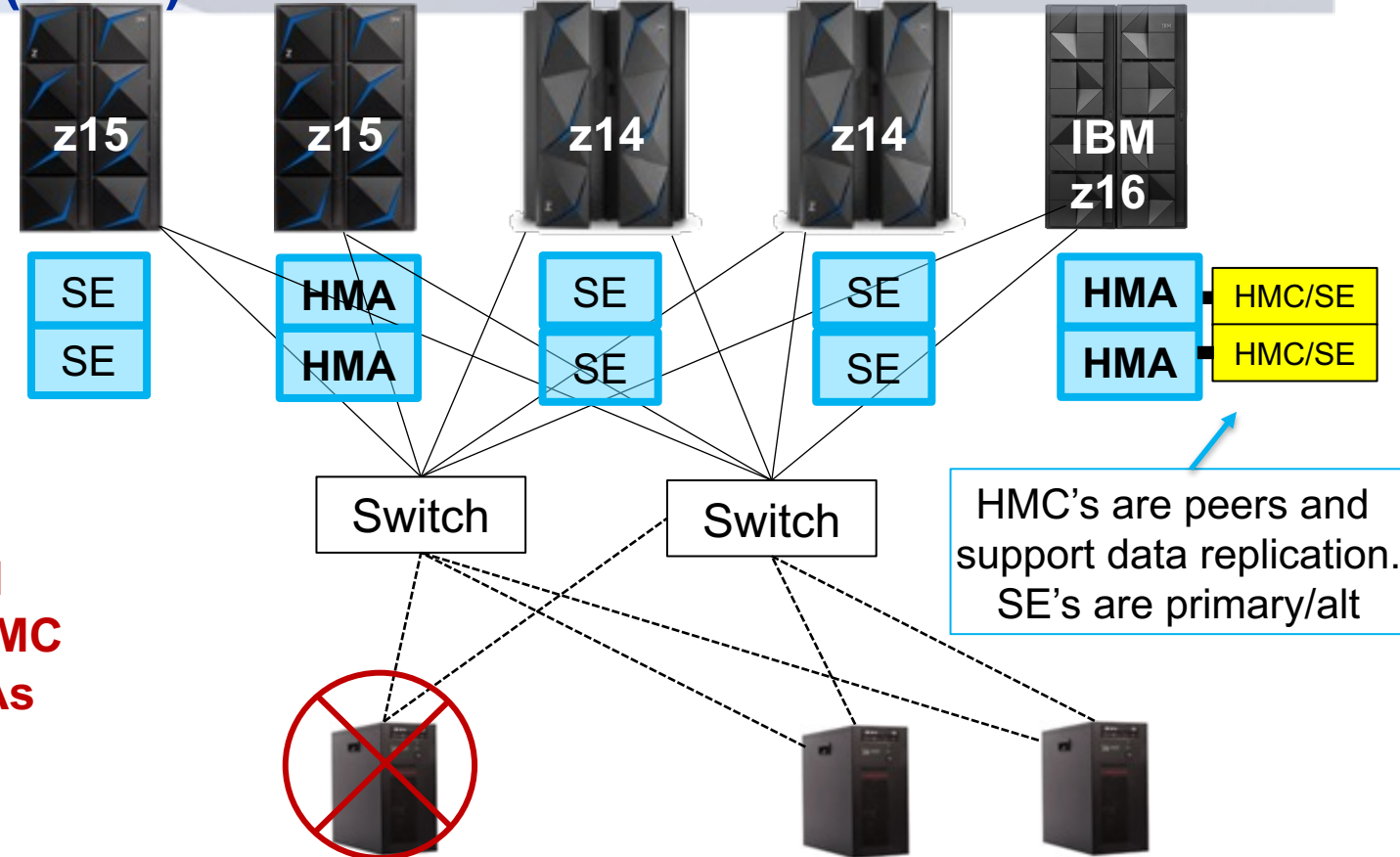
Add V2.16.0 code to existing HMCs.
No charge.
Obtain from the SSR at GA.

IBM z16 Hardware Management Console

- **Available HMCs to manage IBM z16 (can be upgraded to code level 2.16.0):**

| Feature Code	Description
0062	HMC Tower
0063	HMC Rack Mount
0082	HMC Tower
0083	HMC Rack Mount
0100	HMA (z15)
0129	HMA

- **HMC Support**
  - Seamless hard drive encryption
  - Will only support n-2 Systems

Machine Family	Machine Type	Firmware Driver	SE Version
IBM z16	3931	51	2.16.0
z15 T02	8562	41	2.15.0
z15 T01	8561	41	2.15.0
z14 M0x	3906	36	2.14.1
z14 ZR1	3907	36	2.14.1

Site Tools

IBM z16 Fill and Drain Tool (FDT) Comparison

zEC12 / z13 / z14

(0.58 m)
23"

(0.79 m)
31"

32"
(0.81 m)

z15 / z16 (FC 3393)

(0.74 m)
29"

(0.53 m)
21"

35"
(0.89 m)
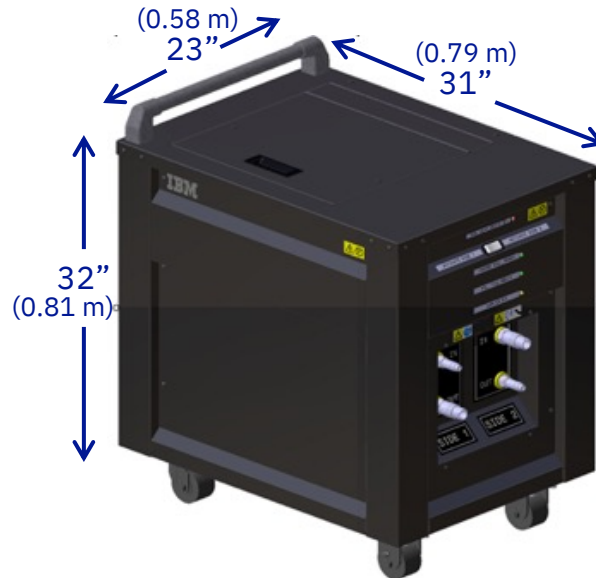
- 350V DC from BPA
- 10 gallon internal reservoir
- 2 pumps, 1 solenoid valve, 1 check valve
- Switch, relays, float switches, leak sensors for control
- Different system connection scheme for fill/drain
- Tool prep and system drain are more time consuming
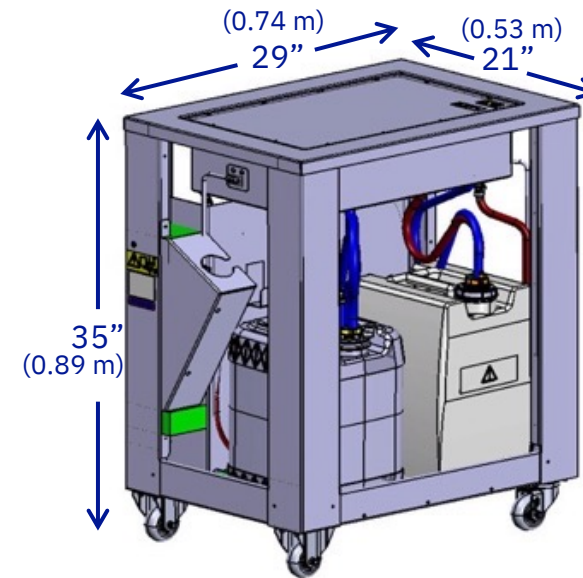
- 12V and 3V DC from CCA (card in radiator or WCU)
- 5 gal blue jug (new, clean water), 6 gal drain jug, normally stored in tool
- 1 pump, 1 compressor, 2 solenoid valves, 1 check valve, 1 pressure sensor
- Control via RCU/WCU control card with 3 soft switches
- Tool always connects to the system the same way
- Faster fill and drain, more effective drain, automatic pressure checking

Lift Tool and Extension Ladder

- **Lift Tool FC 3100**
  - Same as the z15 & z14 ZR1
  - 5 separate components that attach to the front of the system
  - Each site requires at least one for all z15 and z14 ZR1 systems

- **Extension Ladder FC 3101**
  - Same as the z15 & z14 ZR1
  - Each data center requires at least one for all IBM z16, z15 and ZR1 Systems

Table installation

integrated gearbox / table assembly

Hand tool and fastener storage

Upper mounting rails

Lower mounting rails
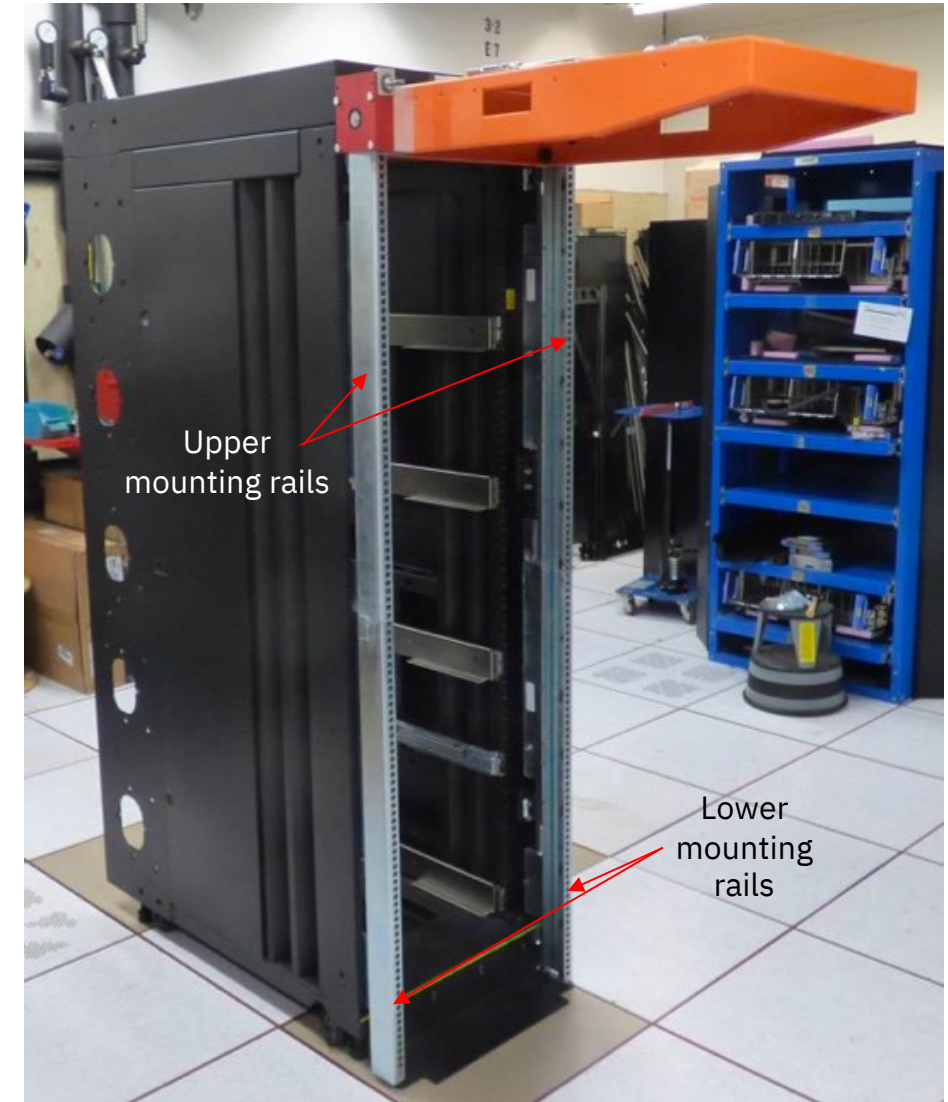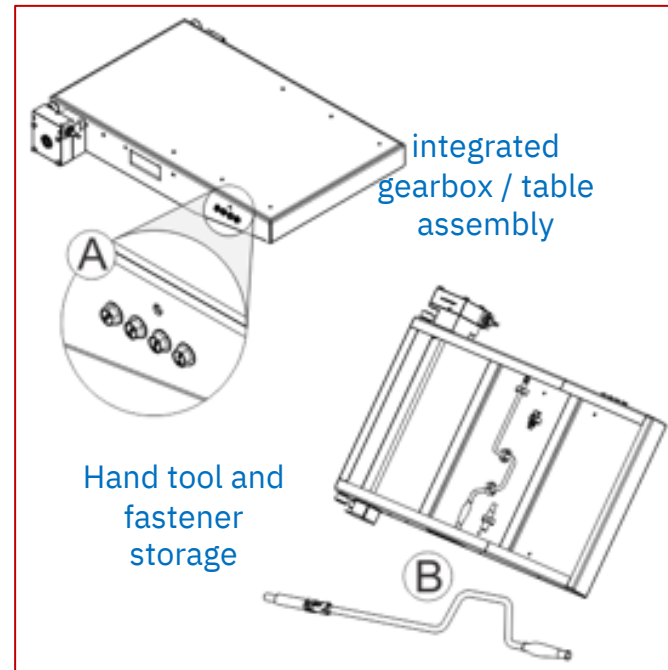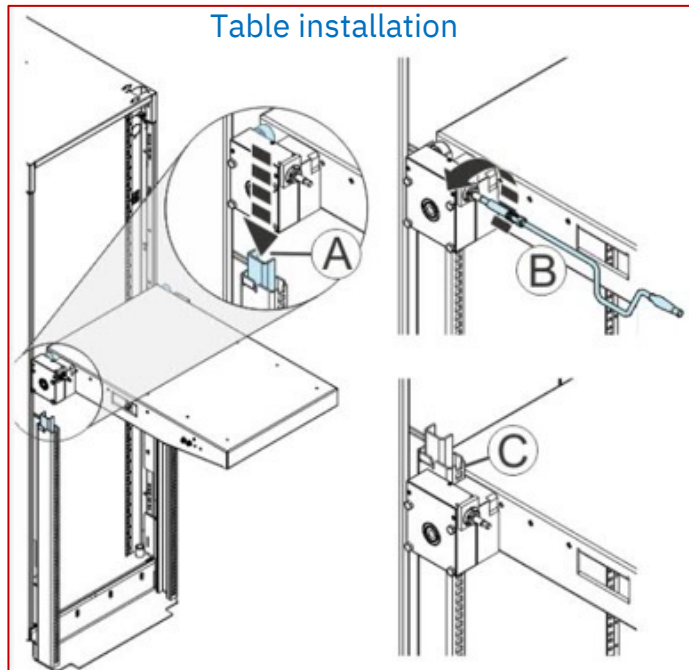
IBM z16
Operating Systems
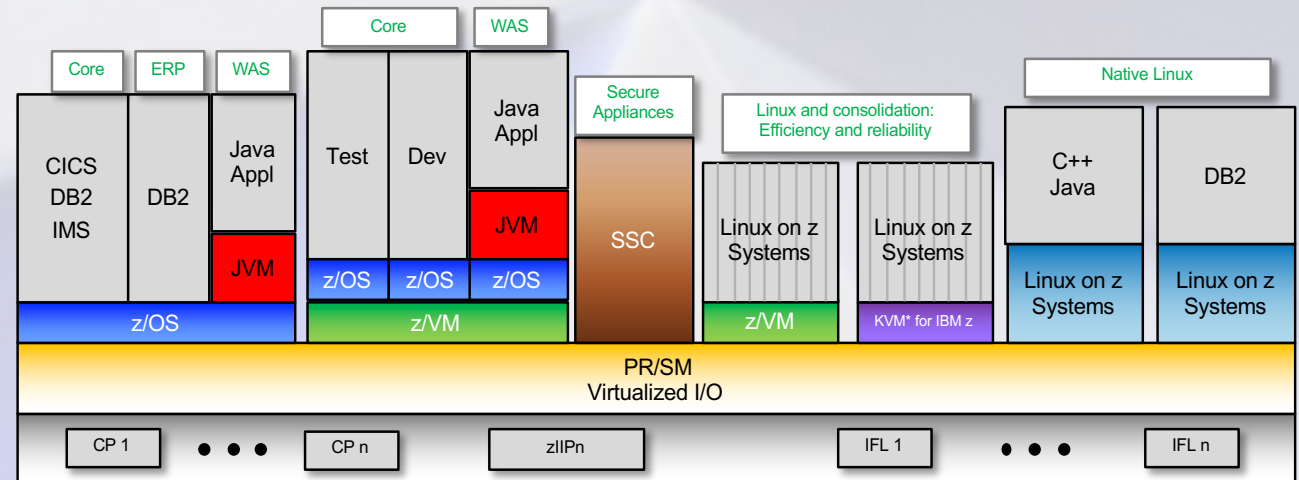
IBM z16 operating system support

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**
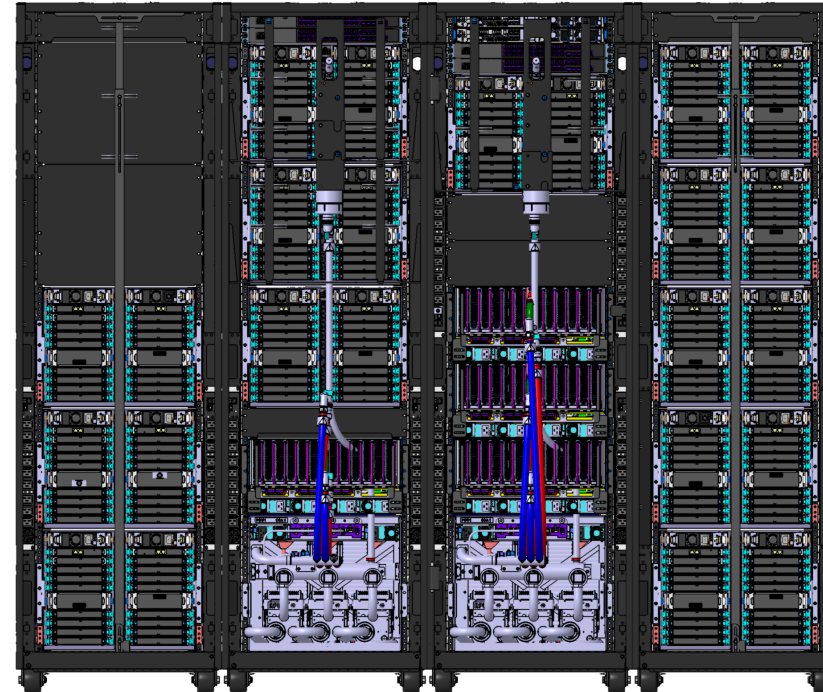
z/TPF
- **z/TPF 1.1 with PTFs**

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.

- Session Evaluation link is provided in the Chat for this session.
- Please fill out a session evaluation as it does help us greatly!

https://ibm.biz/ztechbytes-03-z16