IBM z16 (M/T 3931) Model A01
Hardware Overview
zExpertenforum April 2022

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IBM zSystems® Family

IBM zSystems® Generations

N-4

zEnterprise EC12
- Announced 8/28/2012
- 5.5 GHz
- Up to 101 cfg cores
- CP, IFL, ICF, zAAP, zIIP
- Up to 3 TB Memory

zEnterprise BC12
- Announced 7/23/2013
- 4.2 GHz
- Up to 13 cfg cores (6 CP)
- CP, IFL, ICF, zAAP, zIIP
- Up to 496 GB Memory

N-3

IBM z13
- Announced 1/14/2015
- 5.0 GHz
- Up to 141 cfg cores
- CP, IFL, ICF, zIIP
- Up to 10 TB Memory

IBM z13s
- Announced 2/16/2016
- 4.3 GHz
- Up to 20 cfg cores (6 CP)
- CP, IFL, ICF, zIIP
- Up to 4 TB Memory

N-2

IBM z14 (M/T 3906)
- Announced 7/17/2017
- 5.2 GHz
- Up to 170 cfg. cores
- CP, IFL, ICF, zIIP
- Up to 32 TB cfg. Memory

IBM z14 ZR1 (M/T 3907)
- Announced 4/10/2018
- 4.5 GHz
- 19" Rack
- Up to 30 cfg cores (6 CP)
- CP, IFL, ICF, zIIP
- Up to 8 TB cfg. Memory

N-1

IBM z15 T01 (M/T 8561)
- Announced 09/12/2019
- 5.2 GHz
- Up to 190 cfg. cores
- CP, IFL, ICF, zIIP
- Up to 40 TB cfg. Memory

IBM z15 T02 (M/T 8562)
Announced 04/14/2020
4.5 GHz
Up to 65 cfg. cores
CP, IFL, ICF, zIIP
Up to 16 TB cfg. Memory

N

IBM z16 Model A01 (M/T 3931)
- Announced April 5th, 2022
- 5.2 GHz
- Up to 200 cfg. cores
- CP, IFL, ICF, zIIP
- Up to 40 TB cfg. Memory

IBM z16 (M/T 3931)

- **One model – A01**
- **Five features – Max39, Max82, Max125, Max168, Max200**
  - **Up to 200 characterizable engines**
- Sub-capacity offerings for up to 39 CPs
- PU (Engine) Characterization: CP, IFL, ICF, zIIP, SAP, IFP (No zAAPs)
- **Embedded AI Inference with central low-latency accelerator**
- IBM Integrated Accelerator for zEDC (On-chip compression)
- On Demand Capabilities
  - CoD: CIU, CBU, On/Off CoD
  - System Recovery Boost Upgrade
  - Tailor Fit Pricing
  - **Flexible capacity for Cyber Resiliency**
- **Memory – up to 40 TB (four CPC Drawers)**
  - **Up to 32 TB per LPAR** (OS dependent)
  - **256 GB Fixed HSA**
  - Virtual Flash Memory (zFlash Express replacement (**0.5 TB/feature**, up to 12 features)
- Channels
  - Dual PCIe+ Gen3 16 GBps channel buses
  - Six LCSSs, up to 85 LPARs
  - Four Subchannel Sets per LCSS
  - **OSA-Express7S 1.2 (NB)**
  - OSA Express7S, 6S (CF)

In blue: new

- Channels (cont.)
  - **FICON Express32S(NB),**
  - FICON Express16SA, 16S+ (CF)
  - IBM zHyperLink Express1.1 (NB, CF)
  - IBM zHyperLink Express (CF)
  - **10 and 25 GbE RoCE Express3 (NB)**
  - 10 and 25 GbE RoCE Express2.1 (CF)
  - 10 and 25GbE RoCE Express2 (CF)
  - HiperSockets™ – up to 32
  - Shared Memory Communications – V2 (SMC-Rv2, SMC-Dv2)
- **Crypto Express8S** (7S and 6S CF)
- Parallel Sysplex clustering:
  - **Coupling Facility Control Code Level 25**
  - Support for 384 Coupling CHPIDs per CPC
  - Support for 64 Internal Coupling Links
  - **CF Resiliency enhancements**
  - ICA SR 1.1 (PCIe) Coupling (NB, CF)
  - ICA SR (PCIe) Coupling (CF)
  - **Coupling Express2 Long Reach (NB)**
- Operating Systems
  - z/OS®, z/VM®, z/VSE, z/TPF, Linux on IBM Z, KVM for IBM Z
  - **System Recovery Boost for Middleware**
  - Dynamic I/O for Standalone CF CPCs
- IBM Dynamic Partition Manager (DPM)
- IBM Secure Service Container
- IBM Z Hardware Management Appliance

Availability Dates

IBM z16 availability dates

IBM z16 Announcement – April 5th, 2022

General Availability – May 31st, 2022

IBM z16

IBM z14, z14 ZR1 withdrawal from marketing

HW withdrawal from marketing

- IBM has withdrawn the selected products
  - IBM z14 – June 30, 2021
  - IBM z14 ZR1 – September 30, 2021

LIC withdrawal from marketing

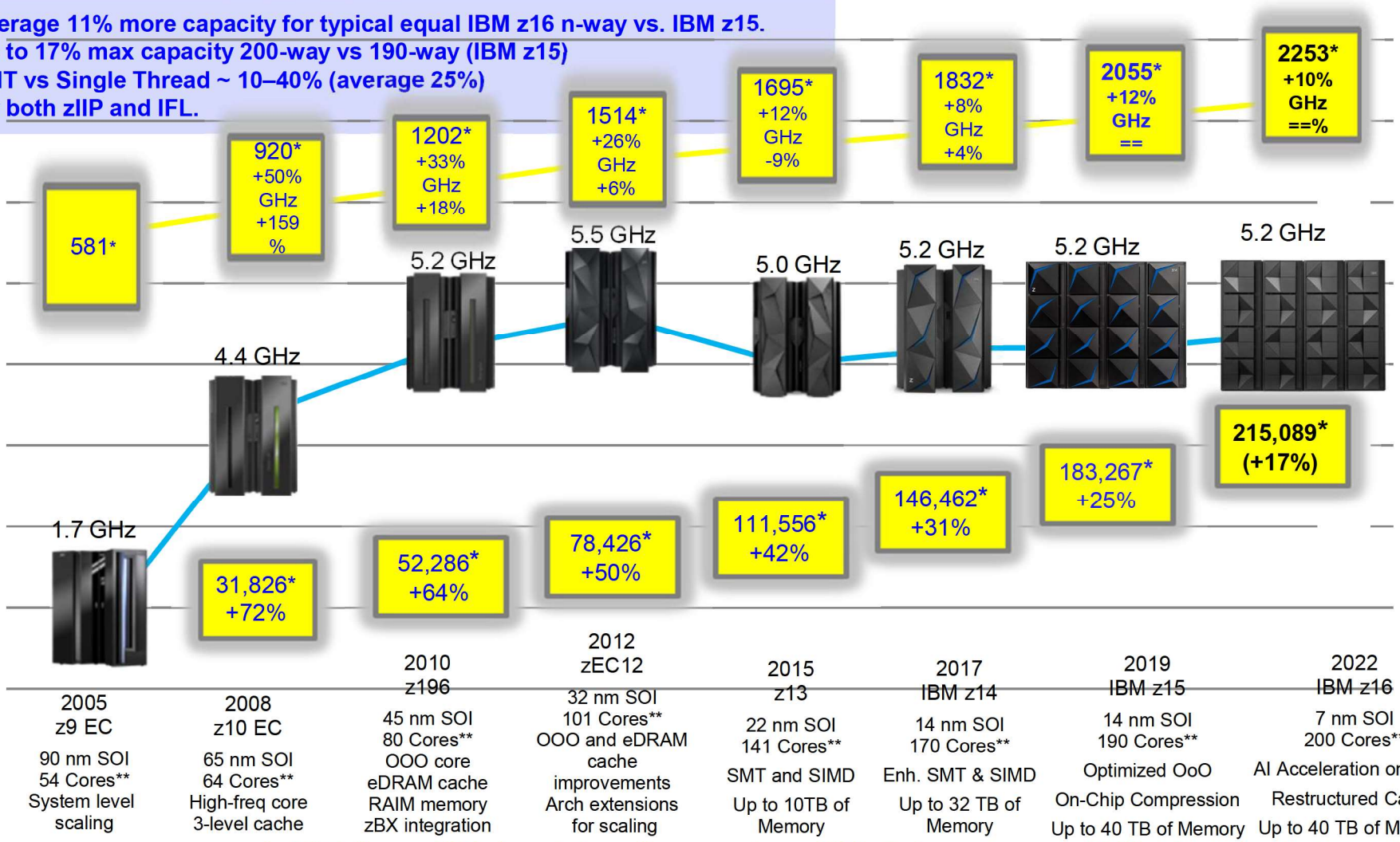
- IBM z14: Effective June 30, 2022, IBM® will withdraw from marketing the field installed features and all associated conversions that are delivered solely through a modification to the machine's Licensed Internal Code (LIC).

- IBM z14 ZR1: Effective September 30, 2022, IBM® will withdraw from marketing the field installed features and all associated conversions that are delivered solely through a modification to the machine's Licensed Internal Code (LIC).

IBM z16 (MT 3931) Overview

IBM z16 Continues the CMOS Mainframe Heritage

Average 11% more capacity for typical equal IBM z16 n-way vs. IBM z15.
Up to 17% max capacity 200-way vs 190-way (IBM z15)
SMT vs Single Thread ~ 10–40% (average 25%)
for both zIIP and IFL.

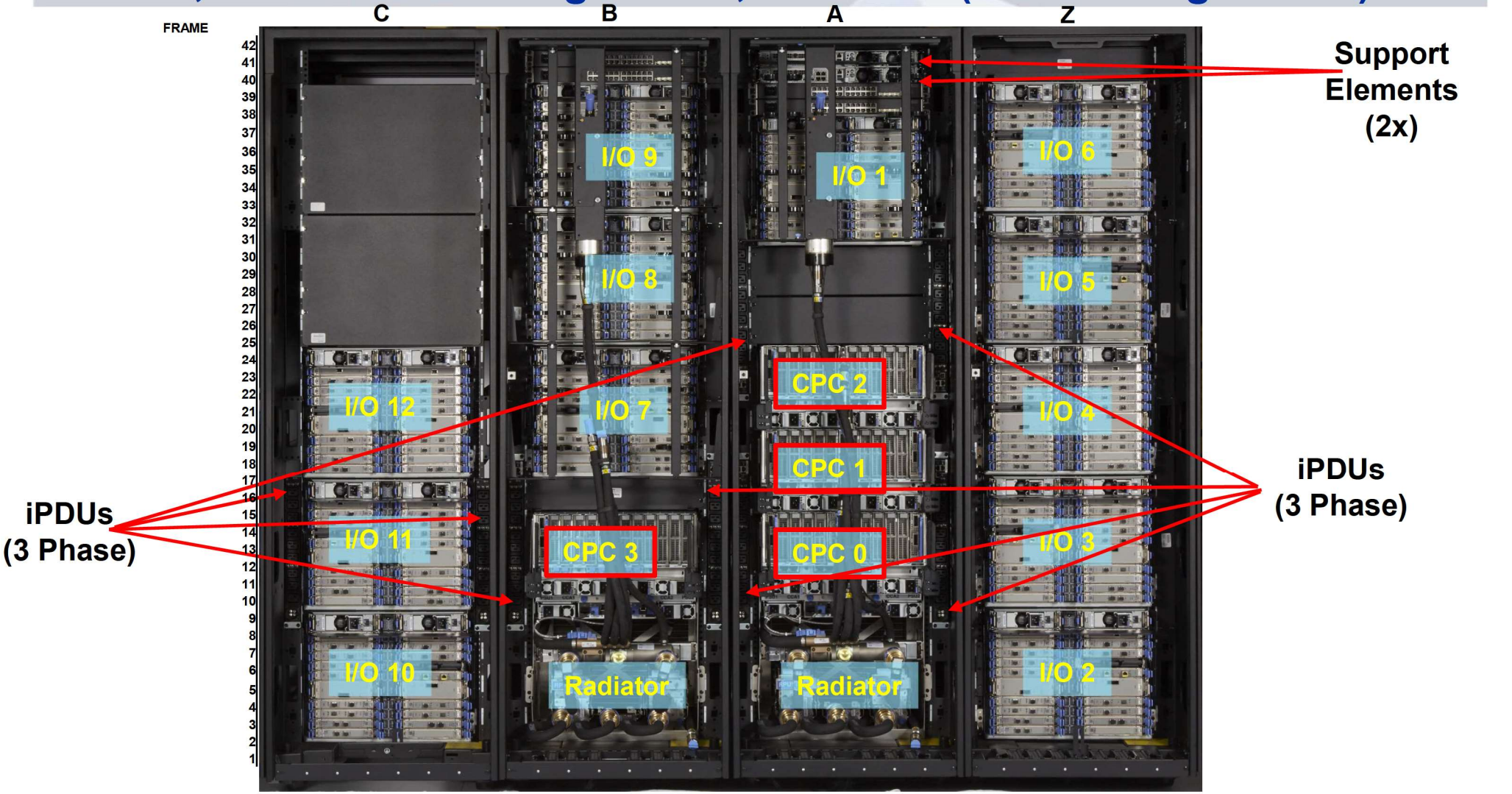


* PCI Tables are NOT adequate for making comparisons of IBM zSystems processors. Additional capacity planning required

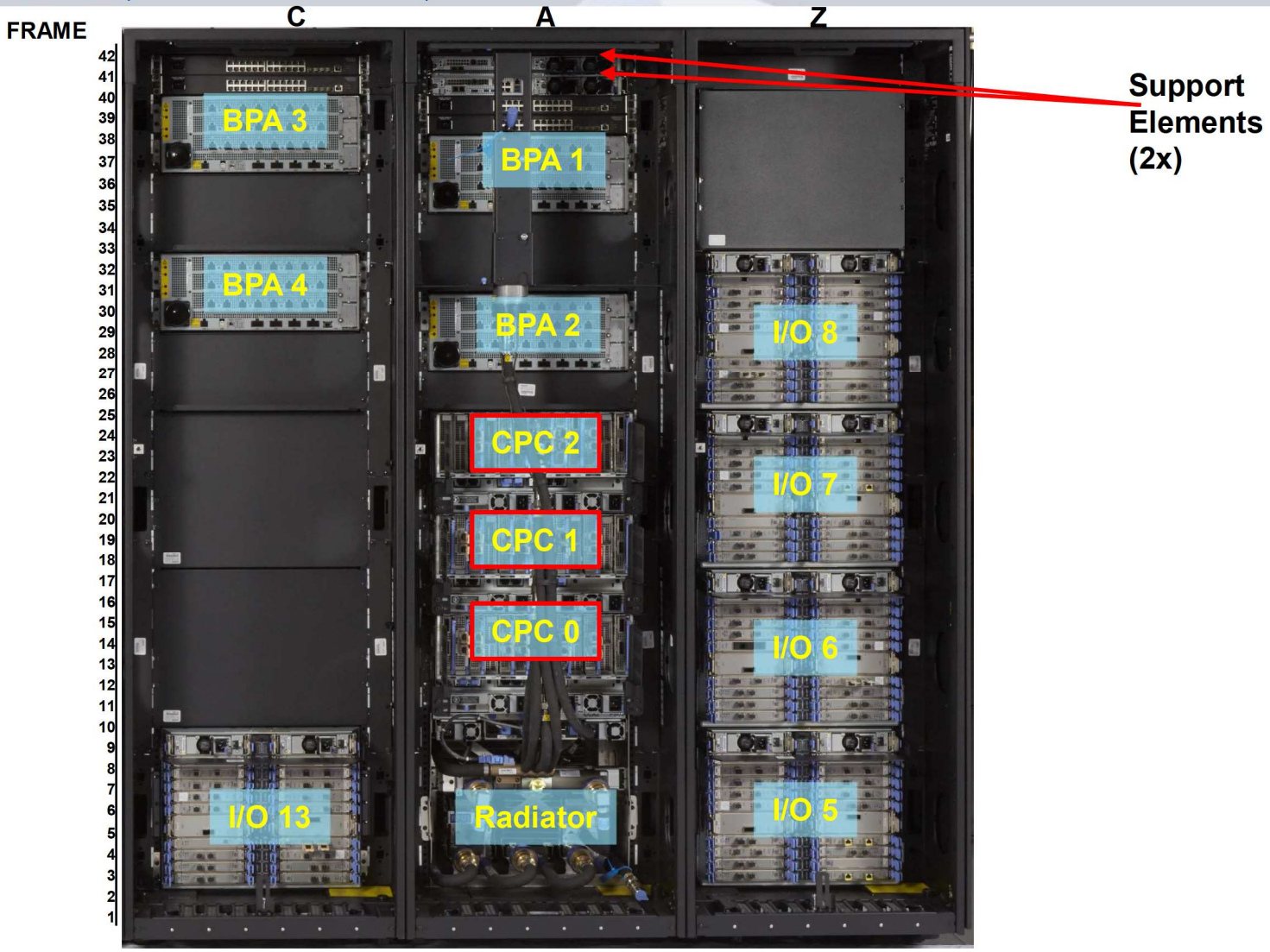
 ** Number of PU cores for customer use

IBM z16 Model A01 (MT 3931) Details

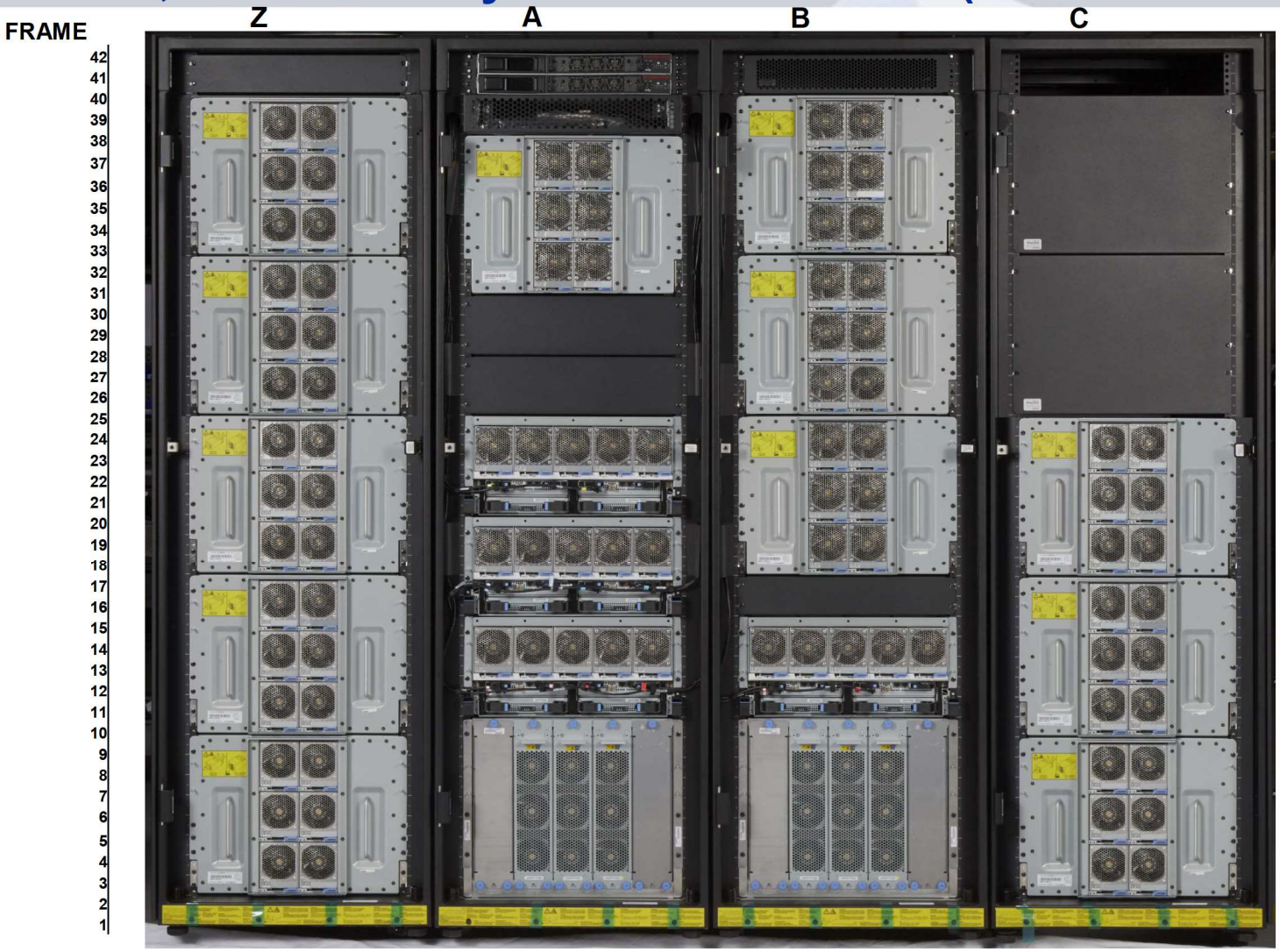
IBM z16, PDU-based configuration, rear view (max. configuration)



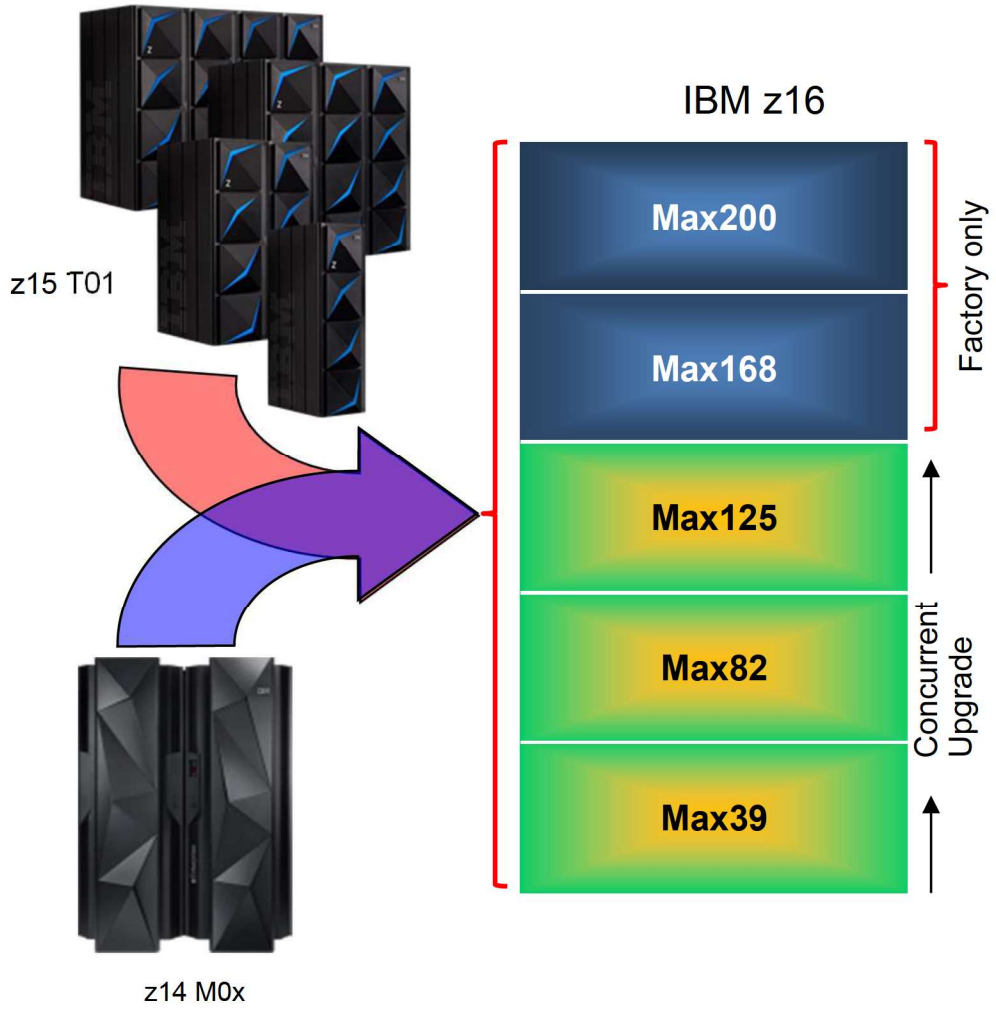
IBM z16 A01, Max125, BPA-based, rear view



IBM z16 A01, Air cooled system – Front view (doors removed)



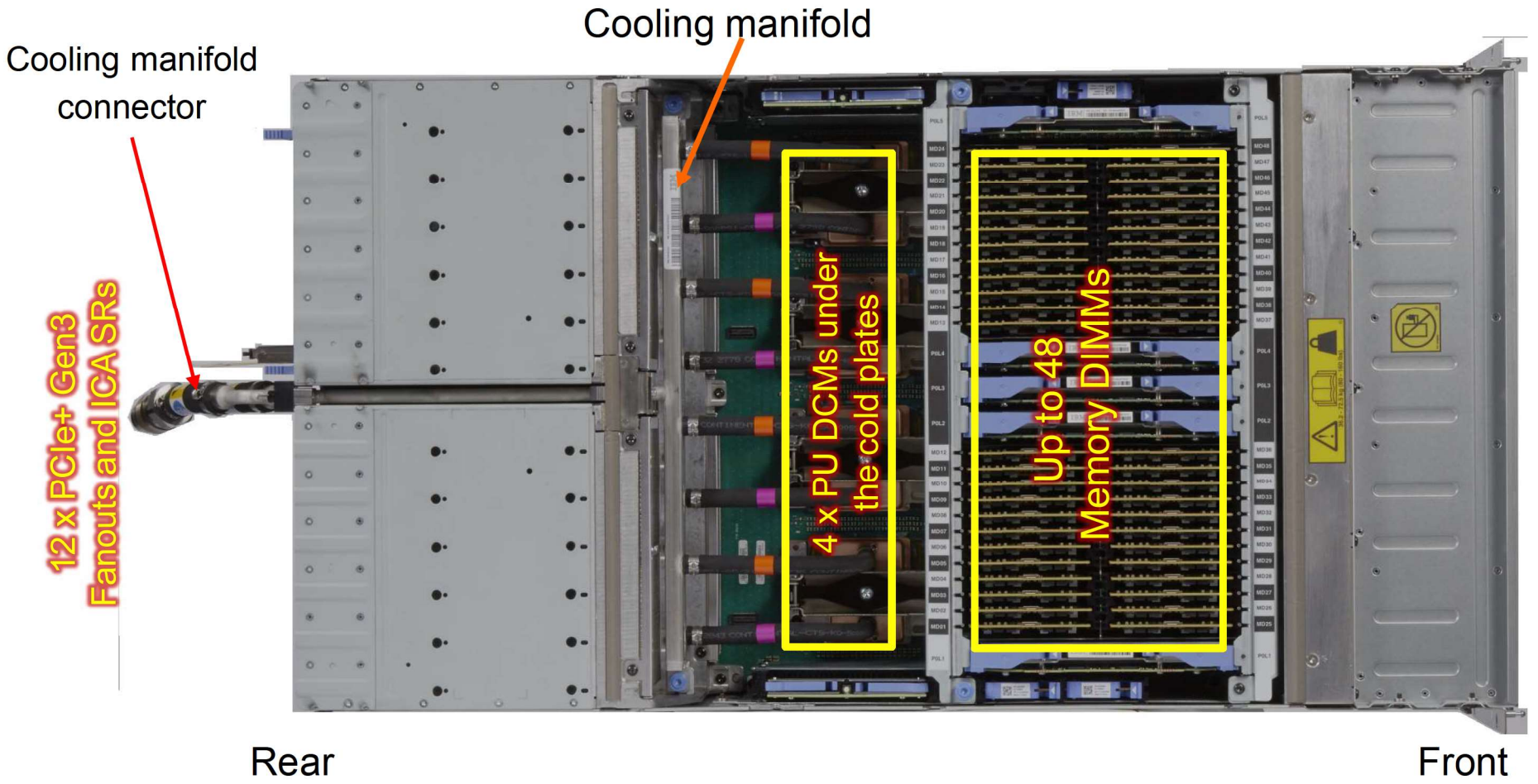
IBM z16 System Upgrades



- IBM z16 to IBM z16 model upgrades
  - IBM z16 A01 Max39 to Max82, Max125 (FC 2981 and/or 2982 must be ordered initially to allow later upgrades)
  - No field upgrade to Max168 or Max200 (these features are Factory built and shipped only).
  - ***Additional I/O Drawers can be added based on available space in current frames and/or I/O expansion frames***
- Any z14 M0x (3906, all models) to any IBM z16 (frame roll)
- Any z15 T01 (8561, all models) to any IBM z16 (frame roll)

Processor Design

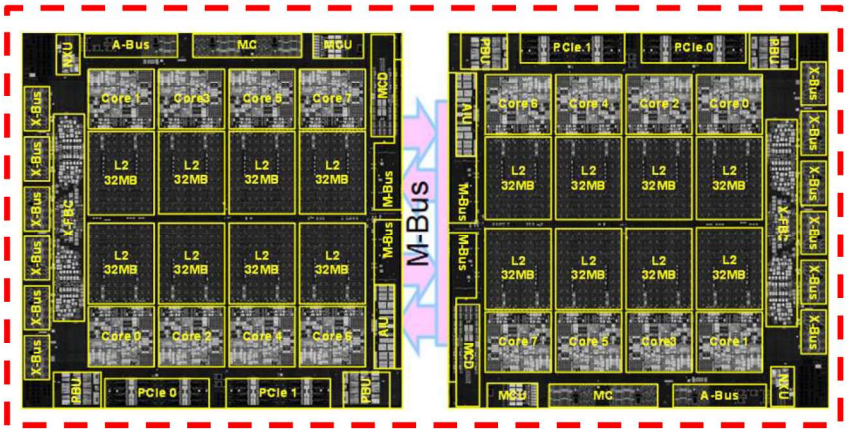
IBM z16 CPC Drawer Layout Details (top view, no covers)

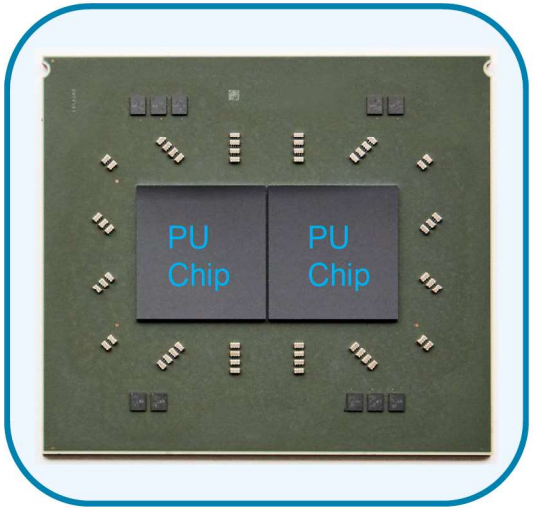


Dual Chip Module (DCM) and the M-Bus

- The **M-Bus** is a high-speed bus for intra-DCM communication
- Two chips per socket using a DCM (dual Chip Module)

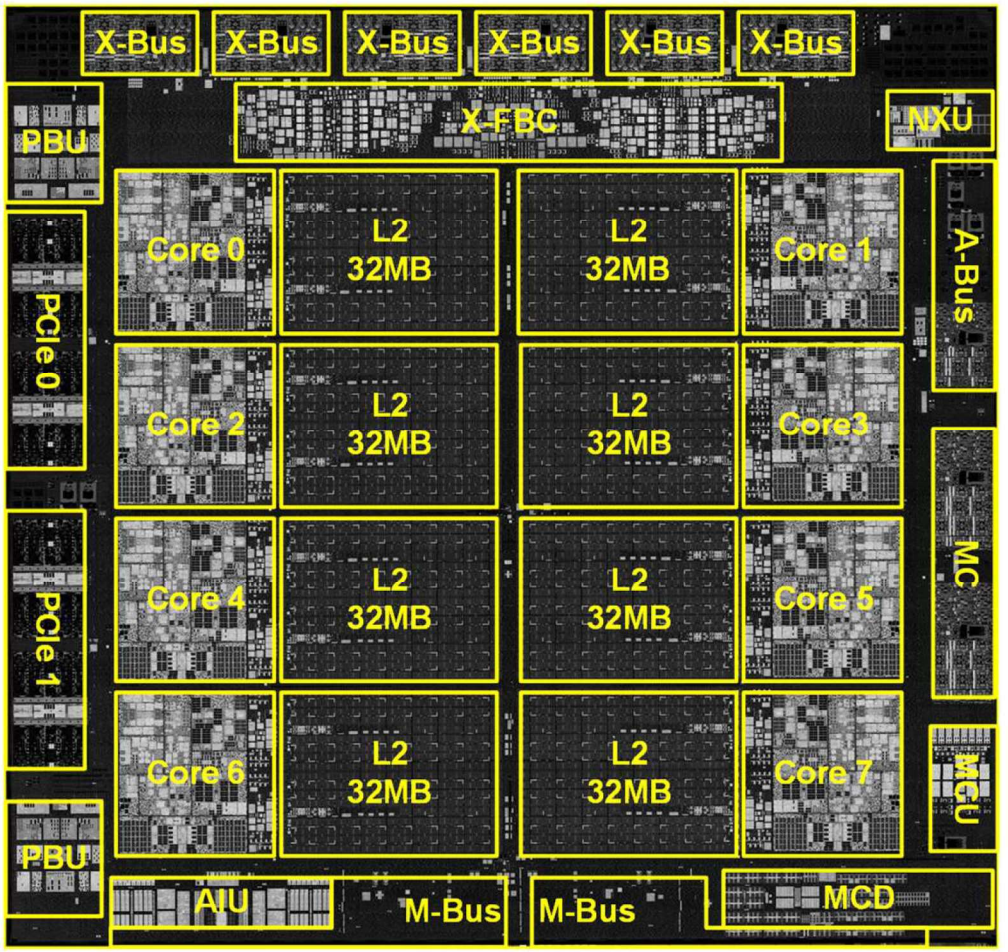
DCM





IBM z16 Processor Design Summary

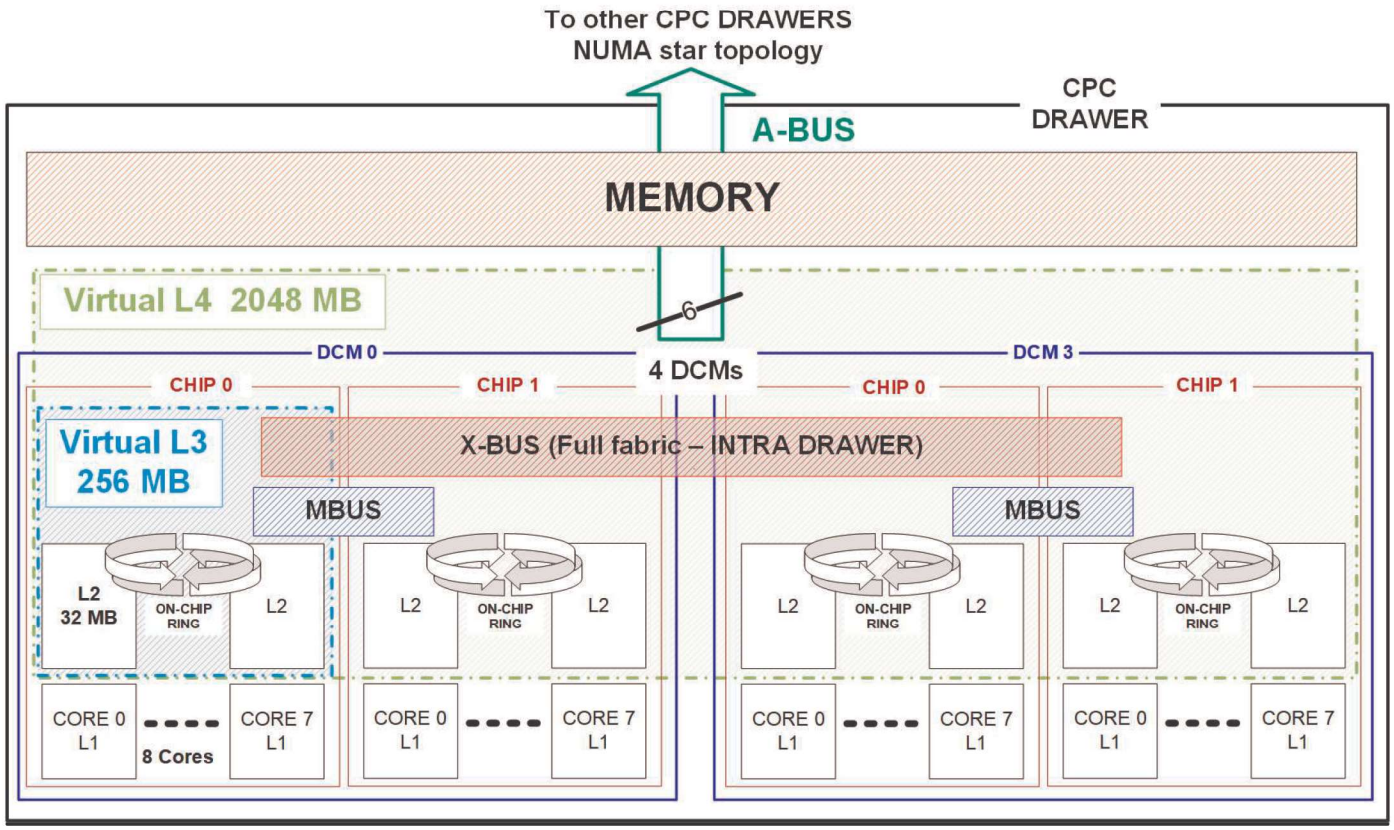
- 7nm silicon wafer technology
- 530 mm2 chip size
- 22.5 Billion transistors
- 5.2 GHz base clock frequency
- New cache structure
  - L1D(data, 128K) and L1I(instruction, 128K) cache - ON-core
  - L2 - dense SRAM - outside the core, semi-private to the core (32 MB)
  - L3 (virtual) == up to 256 MB
  - L4 (virtual) == up to 2048 MB
- Brand new branch prediction design using SRAM
- On chip AI – deep learning focus for inference

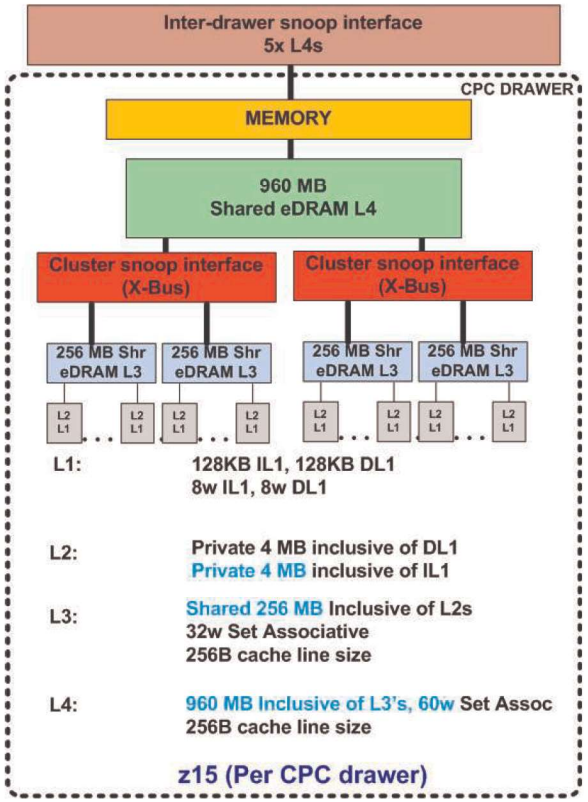


Cache topology comparison: IBM z16 vs. z15

	# of cores	L1 (per core)	L2 (per core)
z15	12	128 KB I / 128 KB D	4 MB I + 4 MB D
IBM z16 CHIP	8	128 KB I / 128 KB D	32 MB
IBM z16 DCM	16	128 KB I / 128 KB D	32 MB

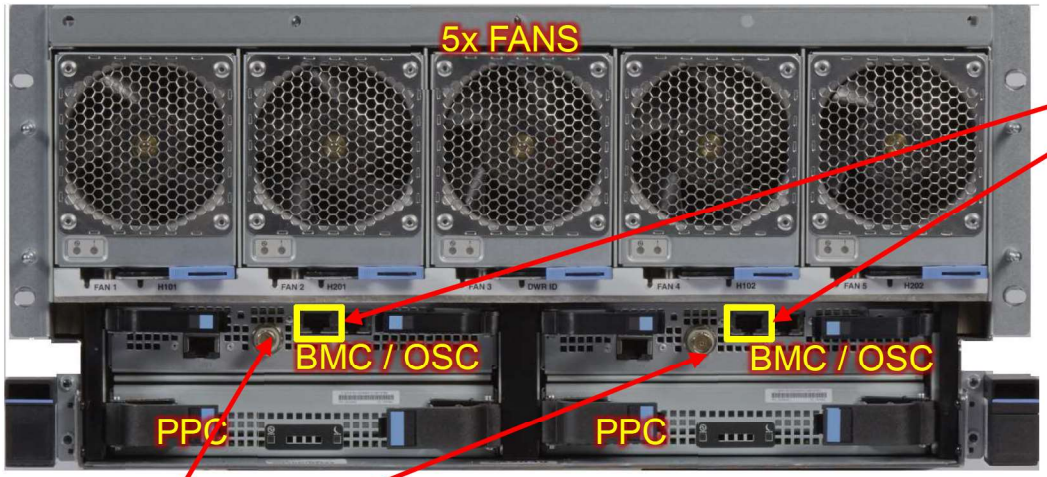
	L3 (on chip)	L4 (on drawer)
z15	256 MB	960 MB
IBM z16 Virtual	256 MB	2048 MB





IBM z16 CPC Drawer – Front and Rear Views

Front



ETS (PTP/NTP) Ports

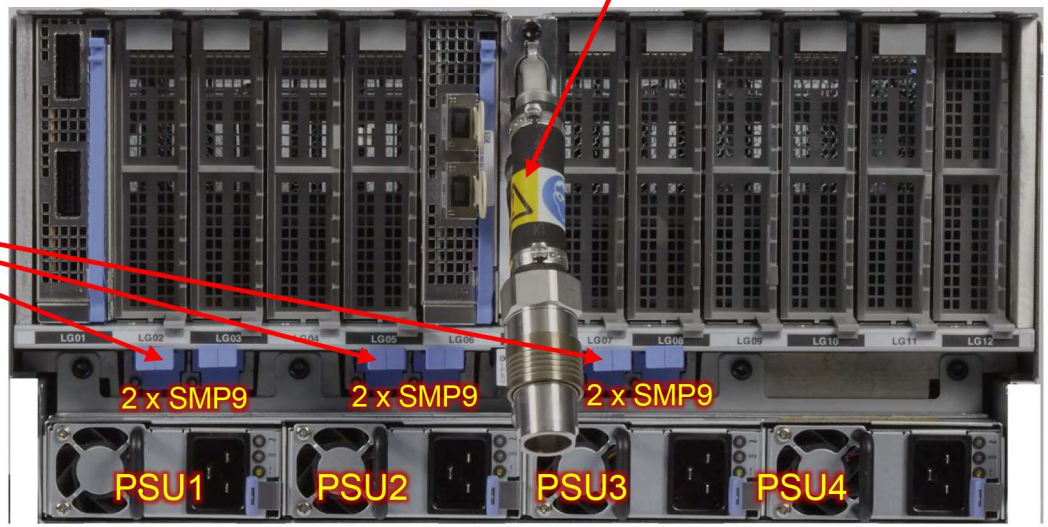
Water manifold

12x PCIe+ Gen3 fanouts and ICA SRs
(LG01, LG02 .. LG12)

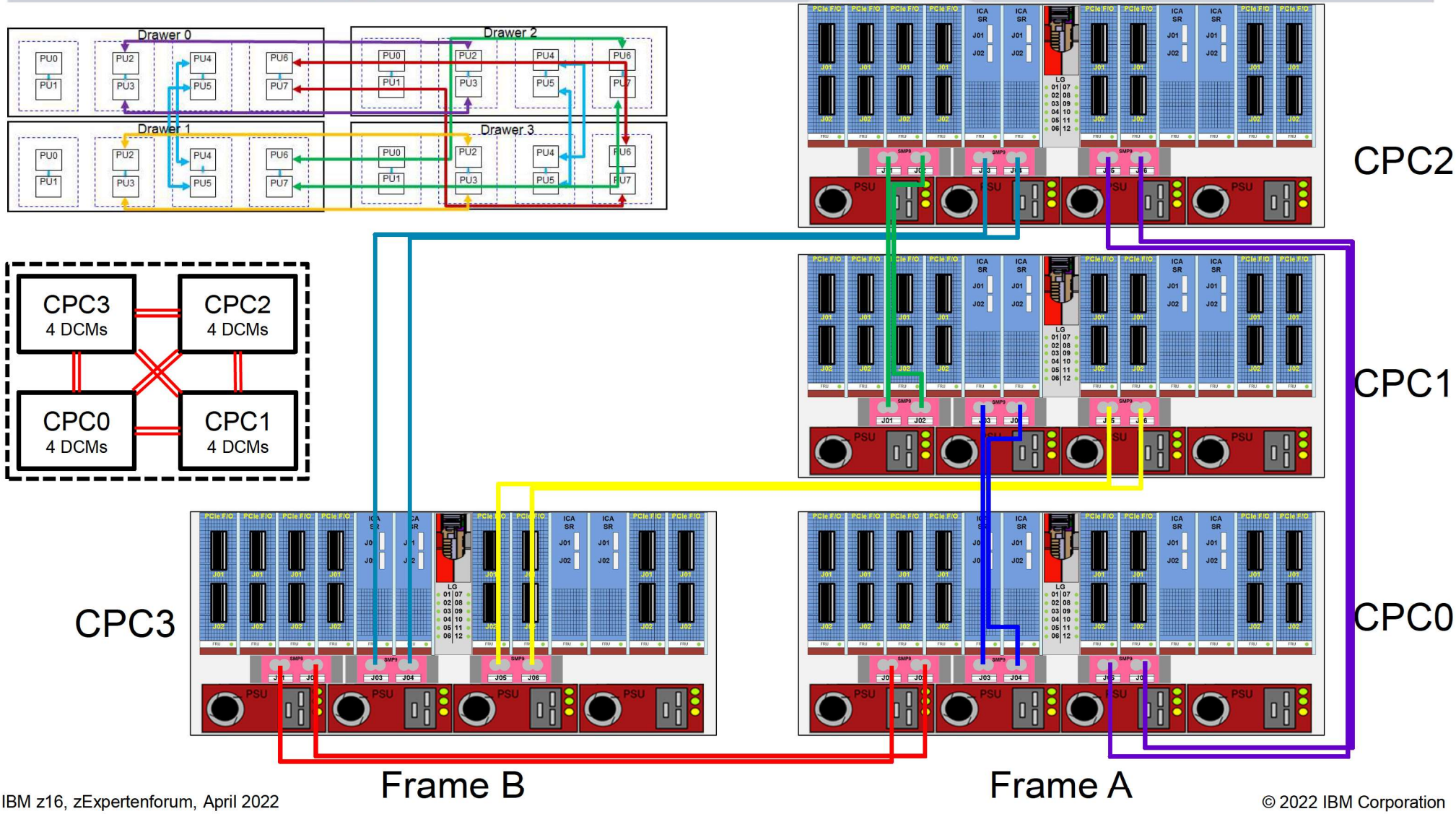
Rear

PPS Ports

SMP Connectors



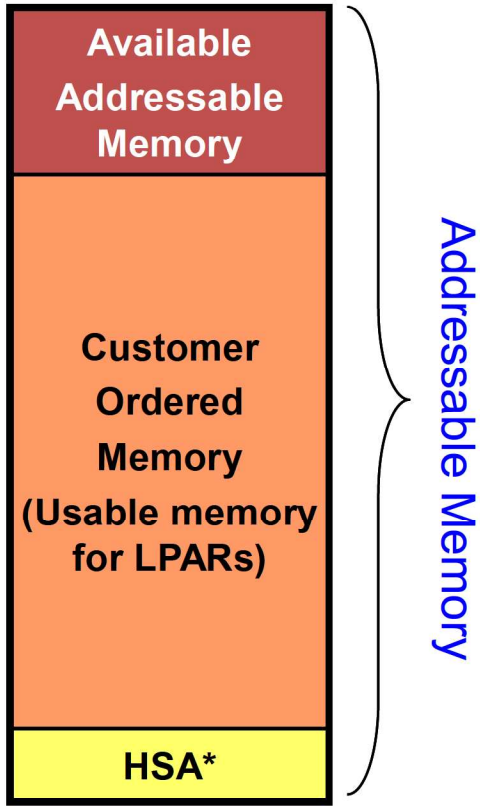
IBM z16 – Max168, Max200 - additional details – Rear View



Memory Design and Structure

IBM z16 Memory Usage and Allocation

- Installed Physical Memory (DIMM capacity) in configuration reports is addressable memory size. Memory is protected by RAIM. DIMM size includes RAIM overhead.
- Servers are configured with the most efficient configuration of memory DIMMs that can support Addressable Memory required for Customer Ordered Memory plus HSA. In some cases, there will be Available Addressable Memory that might support one or more concurrent LIC CC Customer Memory upgrades with no DIMM changes.



*HSA size is 256 GB on IBM z16

Note: DIMM changes require a disruptive POR on IBM z16 A01 Max39. They are always done without a POR on models with multiple drawers using Enhanced Drawer Availability (EDA). On those models, some or all LPARs can continue to run with one drawer out of service to have DIMMs changed or added. Probably all LPARs, if Flexible Memory is selected.

IBM z16 Purchased Memory Offering Ranges

Feature	Standard Memory GB (Min – Max)	Flexible Memory GB
Max39	512 - 9984	NA
Max82	512 - 20224	512 - 9984
Max125	512 - 30464	512 - 20224
Max168, Max200	512 - 40704	512 - 30464

- Hardware System Area – Standard 256 GB of addressable memory for system use outside customer memory
- Standard Memory – Provides minimum physical memory required to hold customer purchase memory plus 256 GB HSA
- Flexible Memory – Provides additional physical memory needed to support activation base customer memory and HSA on a multiple CPC drawer IBM z16 with one drawer out of service.
- No Plan Ahead Memory for new orders. Existing Plan Ahead memory can be carried forward during an upgrade.

System Recovery Boost Stage 3

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

Flexible Capacity for Cyber Resiliency

IBM Z Flexible Capacity for Cyber Resiliency - Use Cases

Disaster Recovery & DR Testing

Automate and test recovery procedures for unplanned outages and cyber incidents

Frictionless Compliance

Meet todays and future regulatory requirements

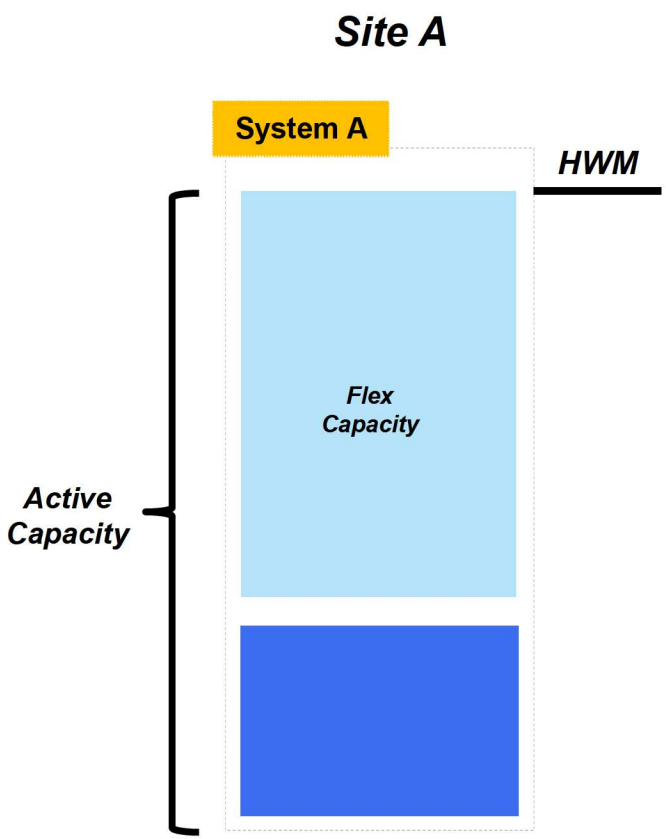
Facility Maintenance

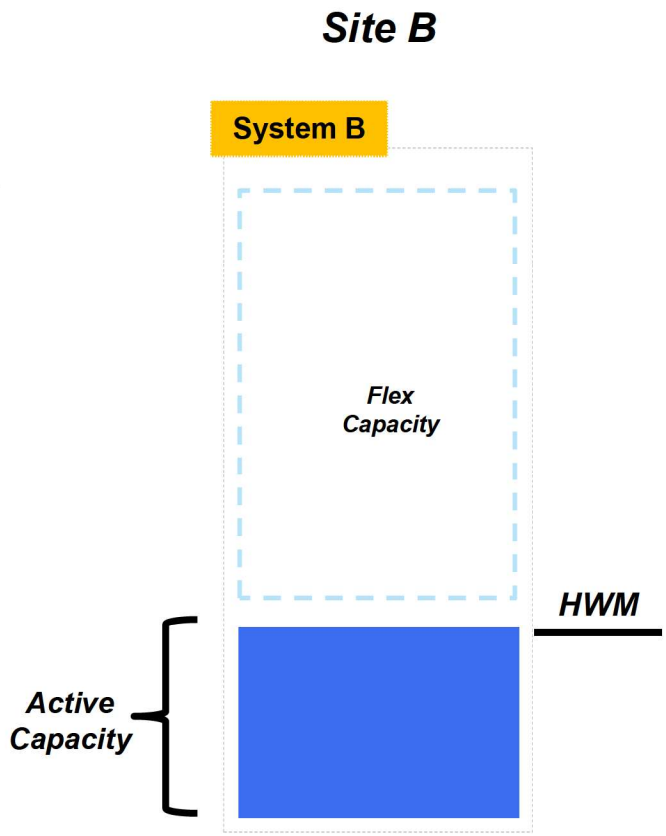
Run your production workload from an alternate site during maintenance

Pro-active Avoidance

Mitigate the risks of natural disasters and prolonged power outages

IBM z16 Flexible Capacity for Cyber Resiliency - Setup





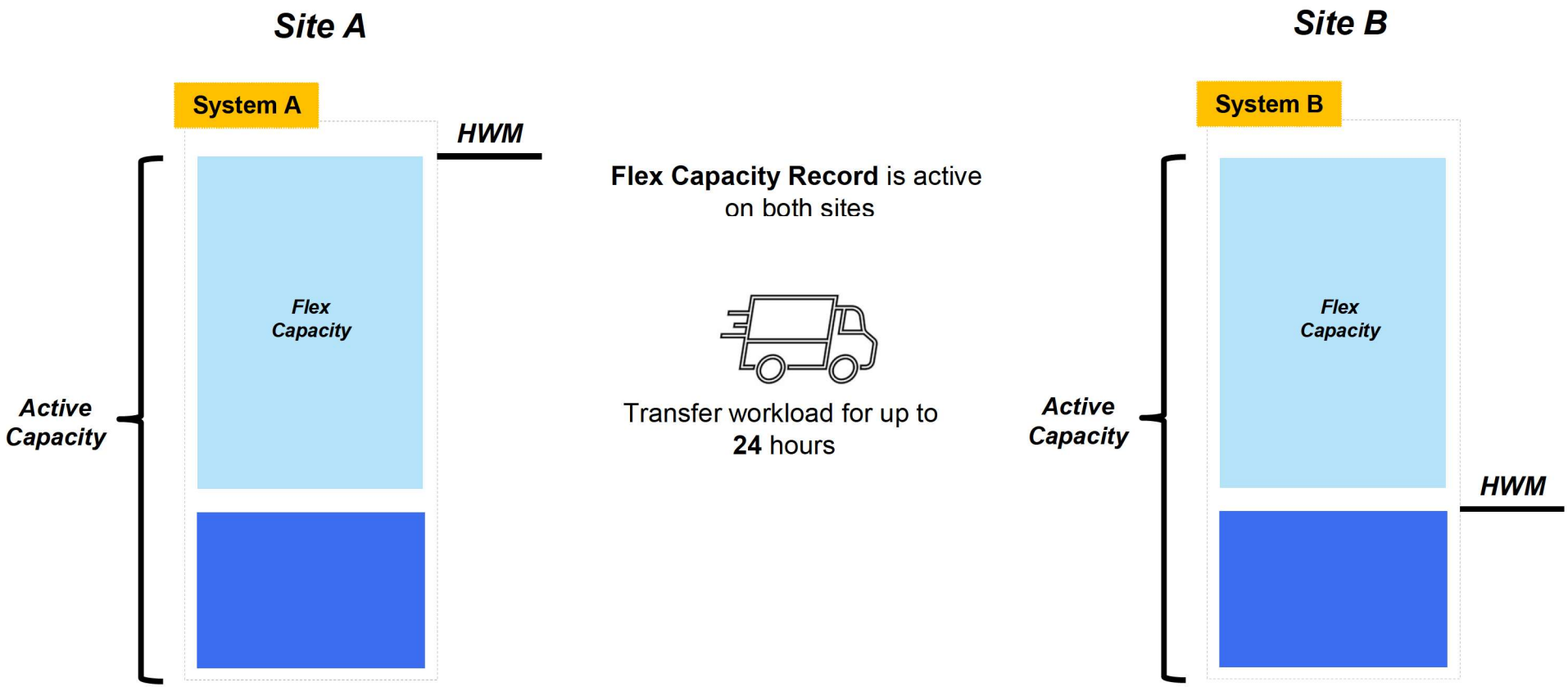
System A

- **Flex Capacity Record** active to HWM

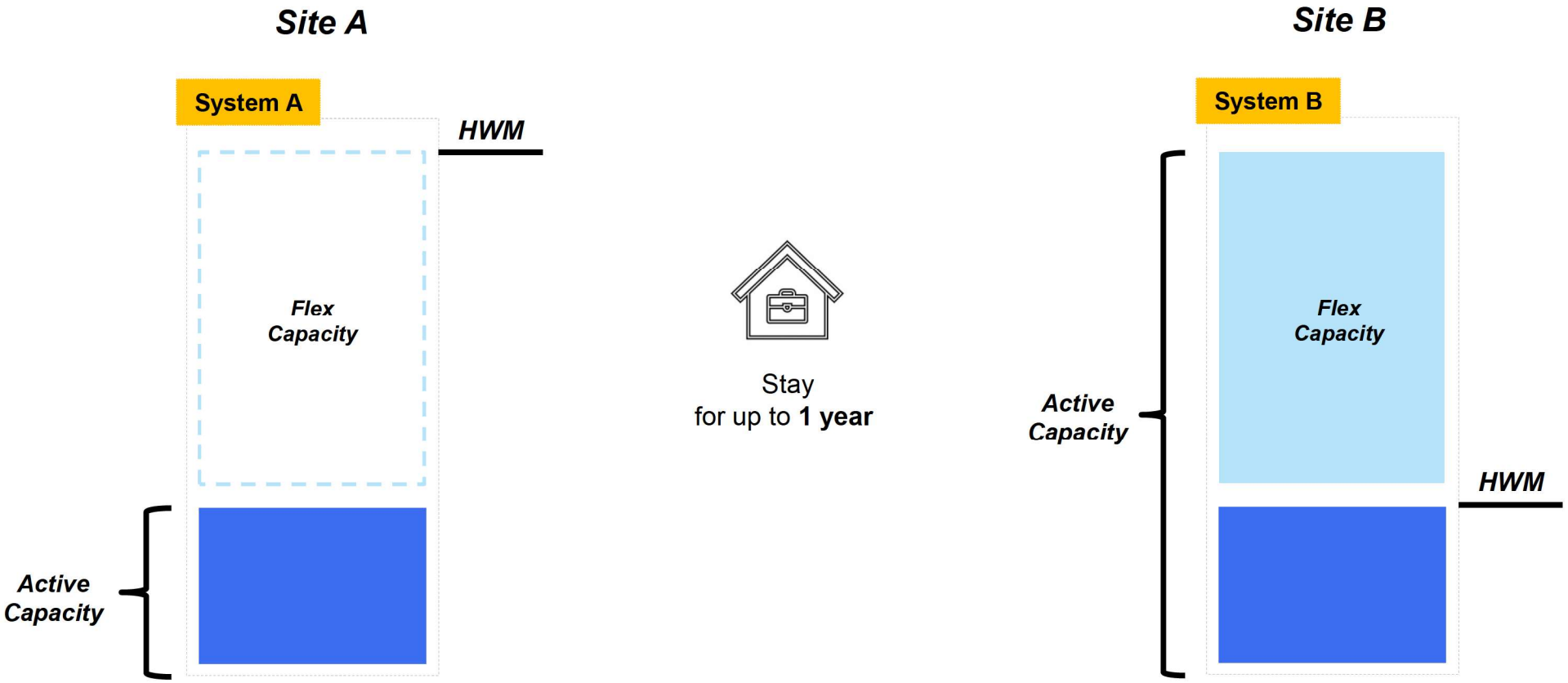
System B

- **Flex Capacity Record** installed, but not active

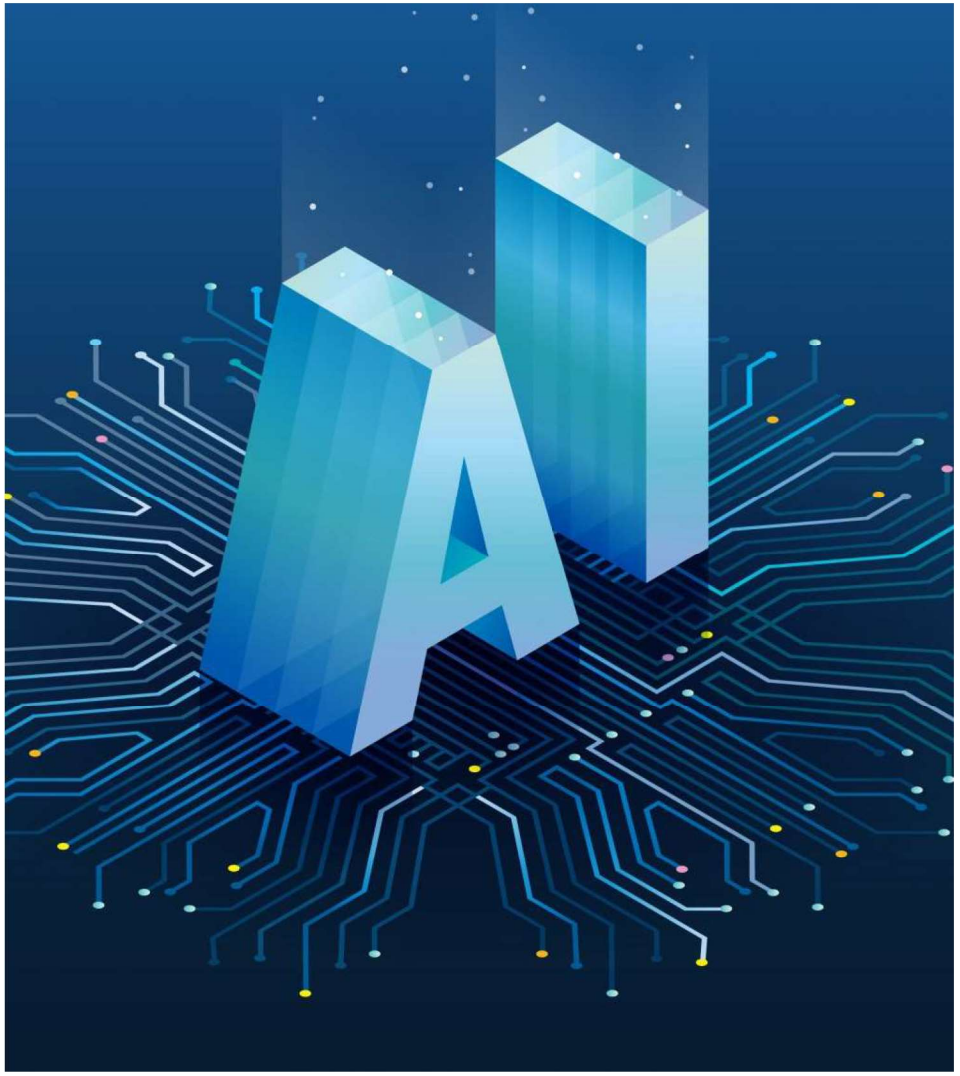
IBM z16 Flexible Capacity for Cyber Resiliency - Transfer



Swap and stay

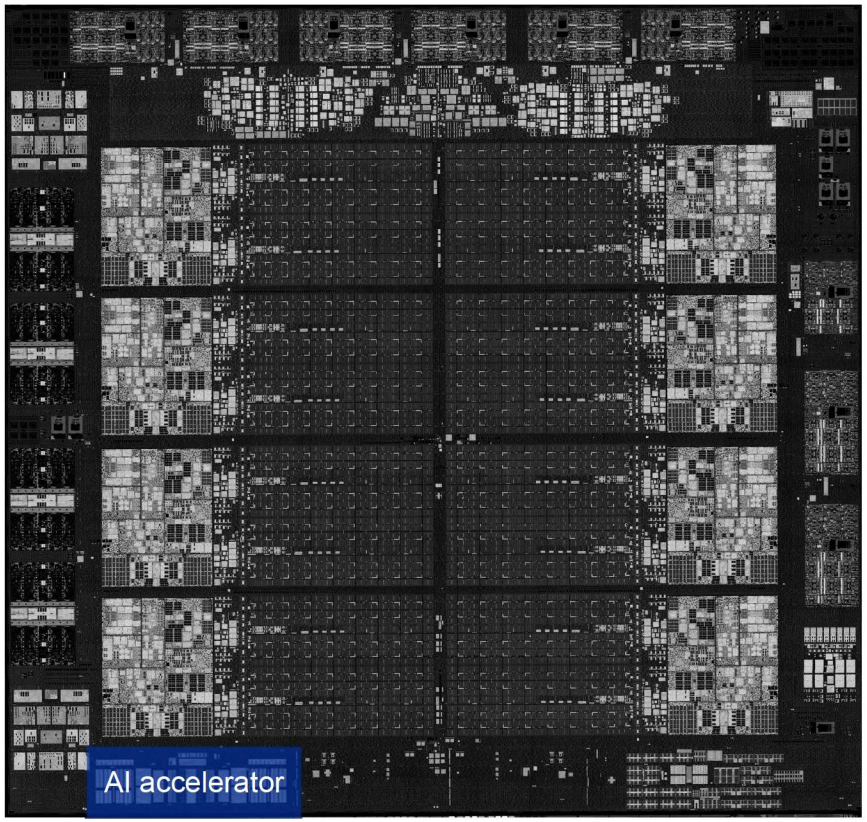


AI Exploitation with the IBM zSystem Integrated Accelerator for AI



IBM Telum Processor

https://www.youtube.com/watch?v=fUqOdu2ympk



What is AI, ML, and DL?

Artificial Intelligence (AI)

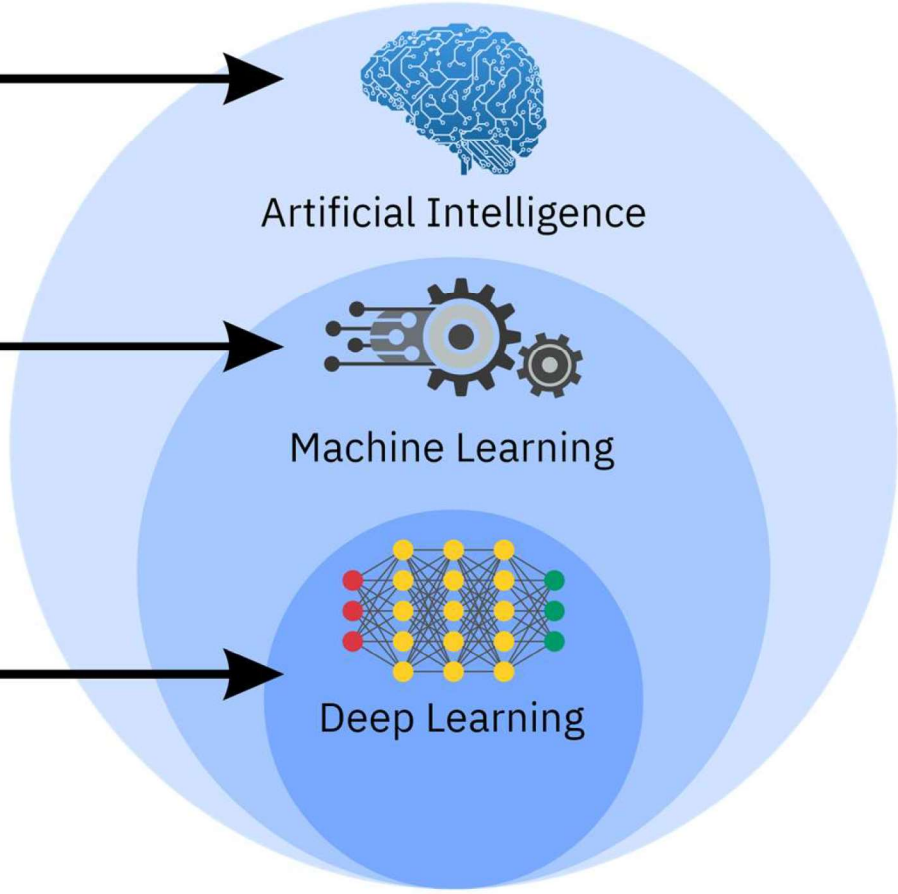
Any technique that enables computers to mimic human behavior

Machine Learning (ML)

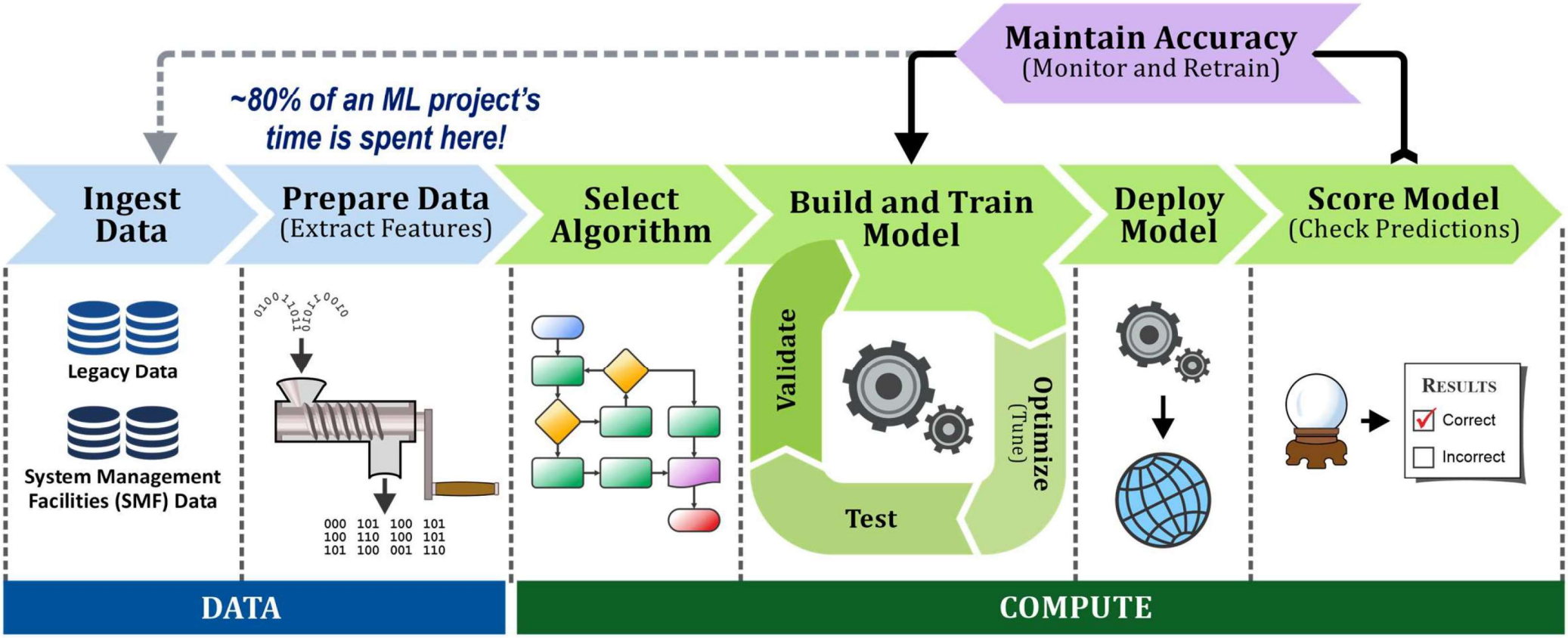
Subset of AI that uses statistical methods to enable computers to learn and improve from experience, automatically

Deep Learning (DL)

Subset of ML that makes the computation of multi-layer neural networks feasible



The ML workflow



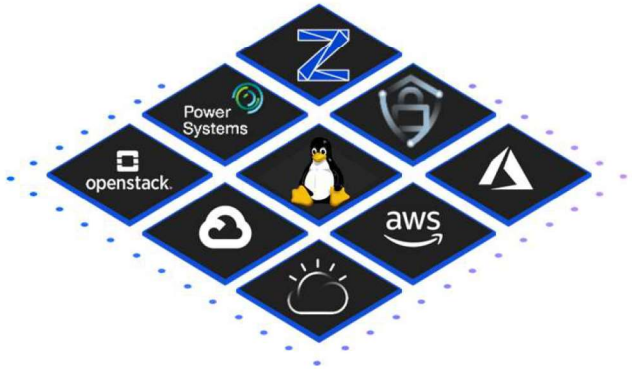
IBM Z: Fully enabled platform for business intelligence
Build and train anywhere

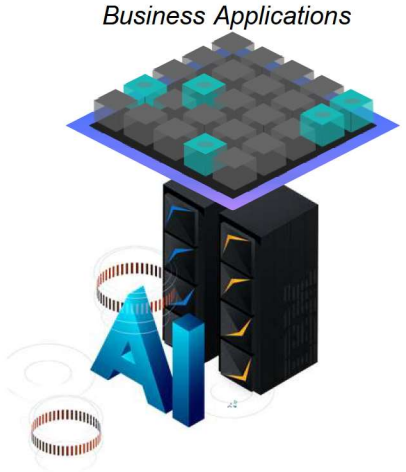
Organize Data
Import data from different applications and sources

Train anywhere
Public clouds, private clouds, on-premises, and hyperconverged systems.

Deploy on IBM Z
Deploy on IBM Z and seamlessly exploit innovations across the stack to infuse AI in every single transaction.

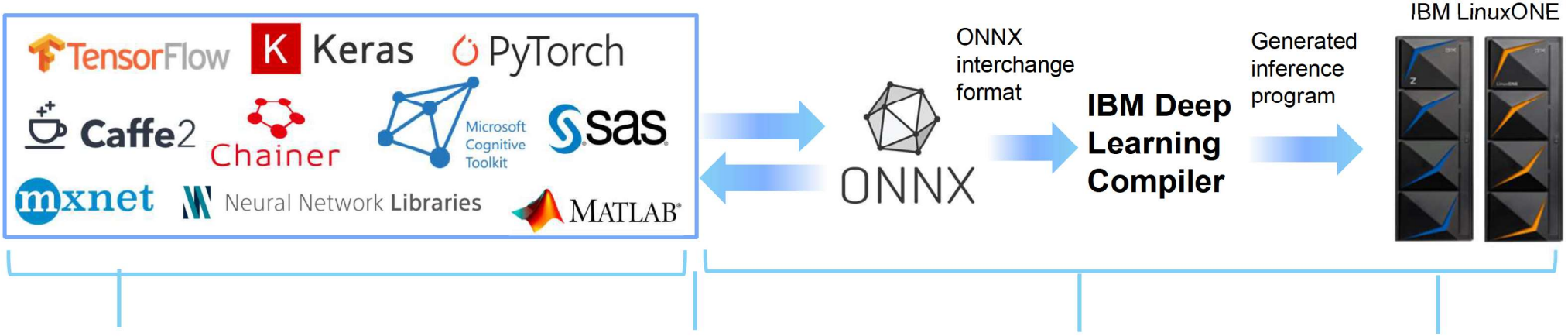
Import Data → Model & Data Prep → Model Training → Deploy → Predict





Any vendor supporting ONNX models can leverage AI accelerator on IBM zSystems

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



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

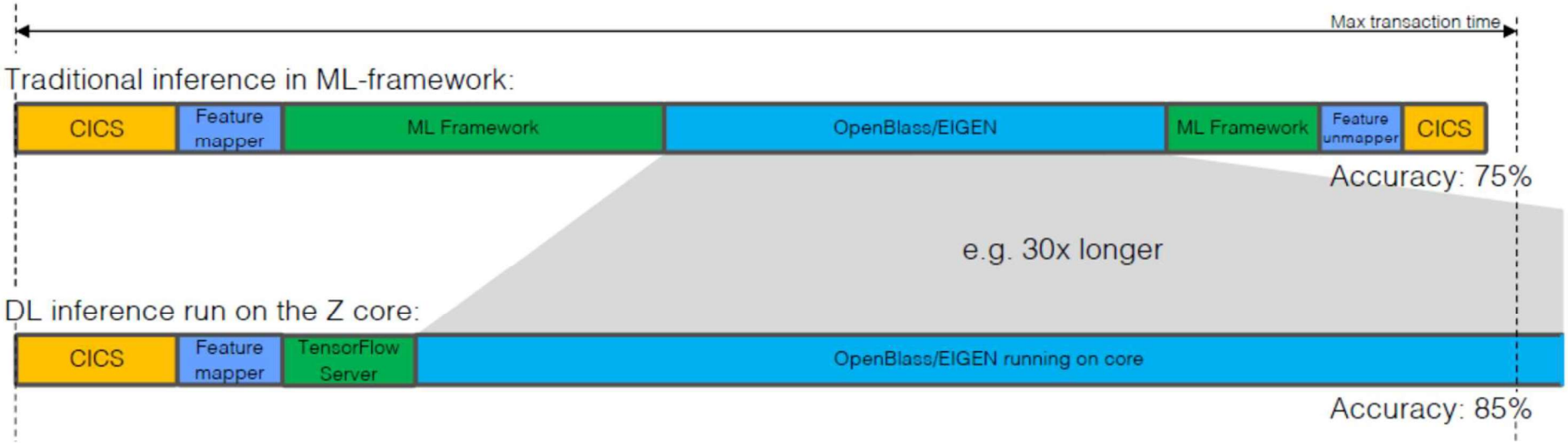
The **IBM DLC** (Deep Learning Compiler), optimized for performance and new libraries, generates a program from the model for execution on z/OS or Linux on Z

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

AI on IBM zSystems – Life of a Transaction

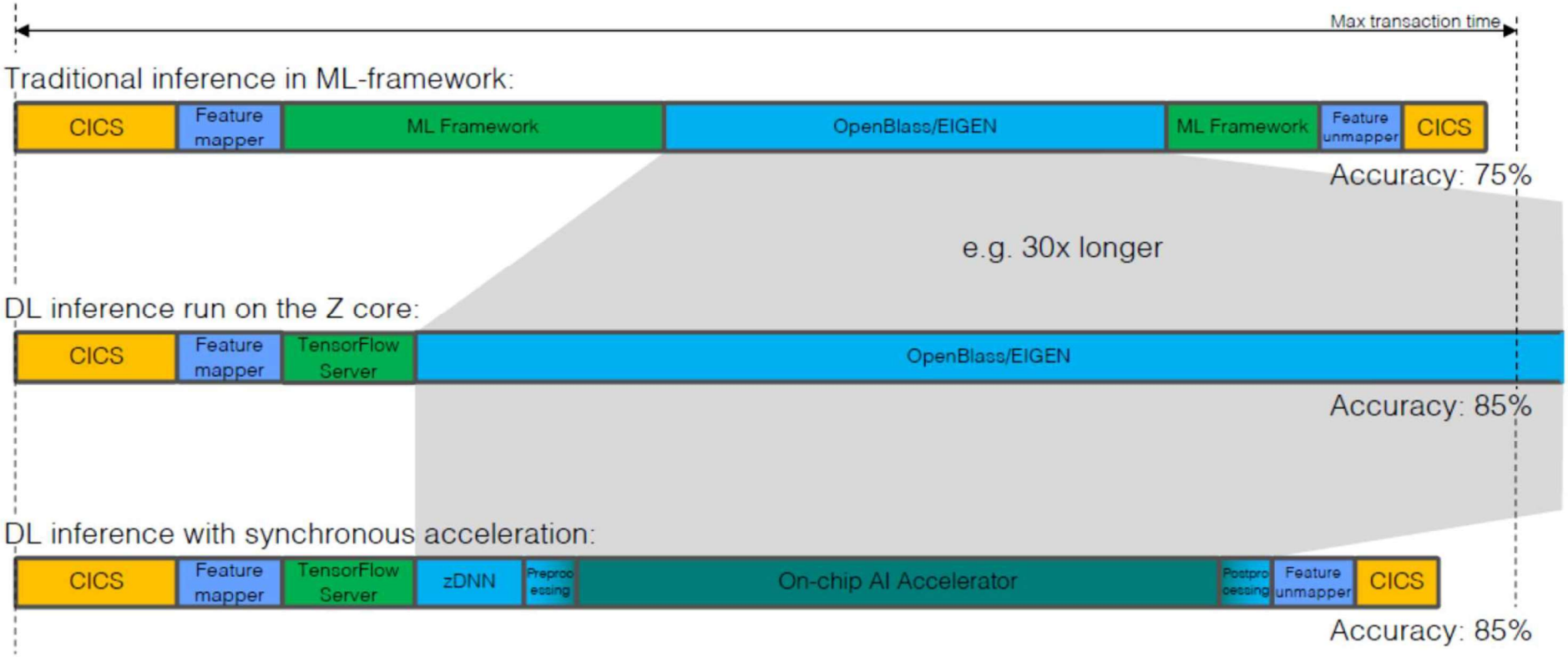
(1)

AI on IBM zSystems – Life of a Transaction (2)



AI on IBM zSystems – Life of a Transaction

(3)



AI on IBM zSystems Strategy: Designed for Business Insights and Intelligent Infrastructure

Infuse AI in real time into every business transaction

- High throughput, low latency AI, in-transaction decision making
- Detect Fraud and Mitigate risk
- Meet even the most stringent SLAs

IBM DB2

SQL Data Insights
Semantic query for discover new insights

ΓELLIGENT INFRASTRUCTURE

Improve Security, Data Privacy, IT Operations with AI

Watson AIOps (IZOA)
Deploy advanced, explainable AI across the ITOps toolchain

DB2 AI for z/OS
Optimize database performance with Machine Learning

Data Privacy for Diagnostics
Leverage Machine Learning to detect and redact PII from diagnostic dumps

Enable leading AI portfolio & ecosystem

ONNX · Apache Spark · XGBoost · Keras · PyTorch · scikit-learn · Watson Machine Learning for z/OS · ANACONDA · Cloud Pak for Data

Db2 SQL Data Insights – an industry-first database with embedded AI

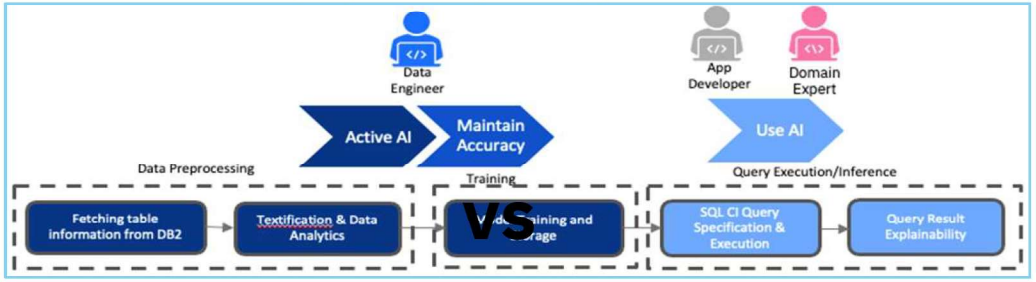
Enabling Self-service AI

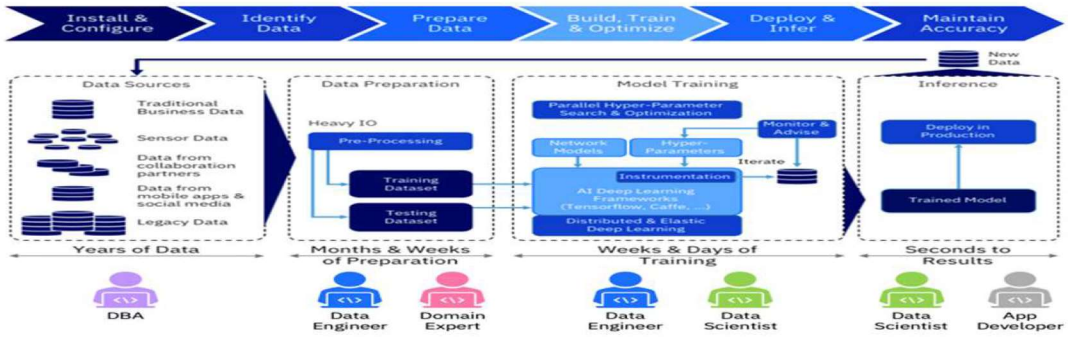
- **provides hidden relationships and inferred meaning from data in your database**
- Reduces need for deep data science skills

```
SELECT    X.accountID, X.FirstName, X.LastName,
          X.openedDate,  X.RewardPoints,
          ai_semanticCluster( X.accountID,
     '1234ABCD','4567EFGH','6789IJKL') AS RiskScore

 FROM Data_Table X

 WHERE ai_semanticCluster(
    X.accountID, '1234ADCB','4567EFGH','6789IJKL') > 0.0

 ORDER BY  RiskScore DESC
```

Auto-AI based deployment

- **Minimizes complexity of infrastructure and tooling to deploy AI for your applications**





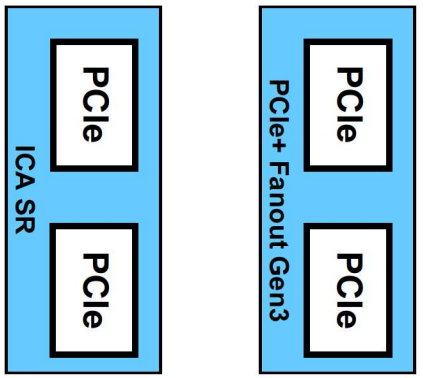
Additional Benefits

- Provides interpretability
- Operates on encrypted data
- Exploits hardware acceleration (SIMD, AIU)
- Applicable to a broad range of enterprise critical domains: Finance, Insurance, Retail, Security, HR, IT Management, Data Integration (Entity Resolution; Data Cleaning) (Entity Resolution; Data Cleaning

I/O Infrastructure

IBM z16 Processor (CPC) Drawer Connectivity

- **12 PCIe+ Gen3 fanout slots per IBM z16 CPC drawer**
  - Same as z15
- **Integrated Coupling Adapter (ICA) SR 1.1**
  - Two ports @ 8 GBps* (PCIe Gen3) for short distance coupling
  - 150m fiber optic coupling link
- **PCIe+ Gen3 Fanout**
  - Two ports @ 16GBps (PCIe Gen3)
  - Connects to the PCIe Interconnect Gen3 in the PCIe+ I/O drawers

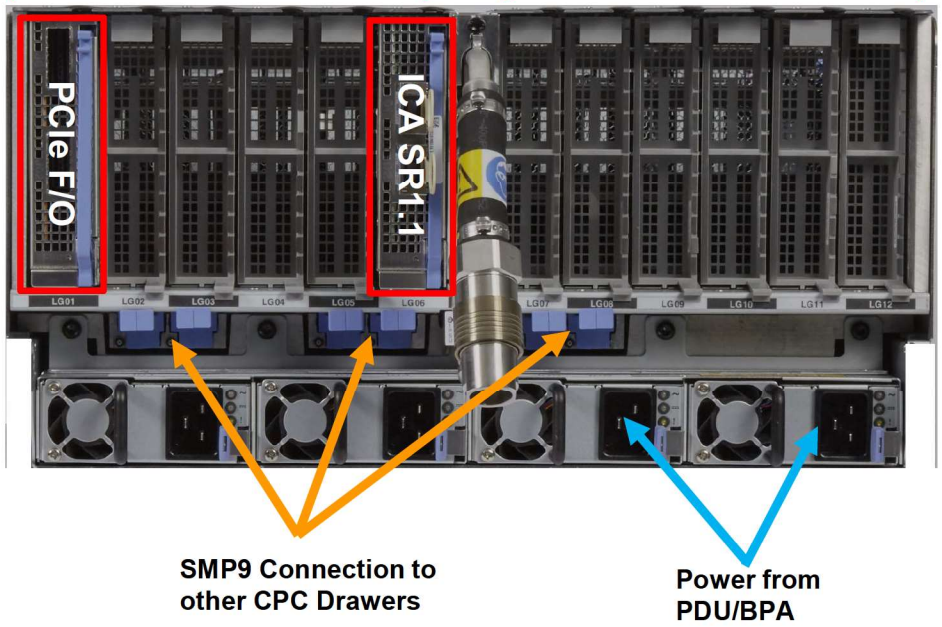


ICA Coupling Links

To PCIe+ I/O Drawers

No InfiniBand fanouts

Up to 12 PCIe Fanouts - Concurrent add/repair.
LG01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12.



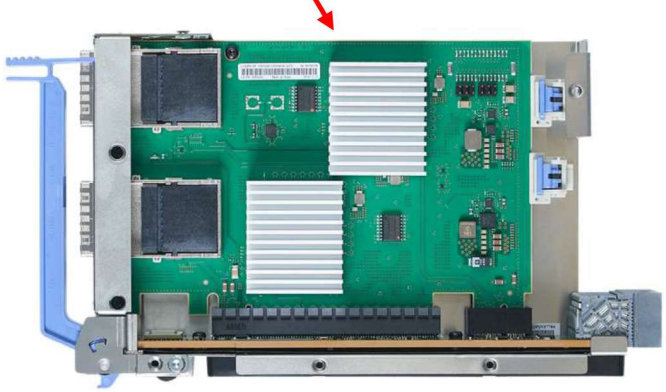
SMP9 Connection to other CPC Drawers

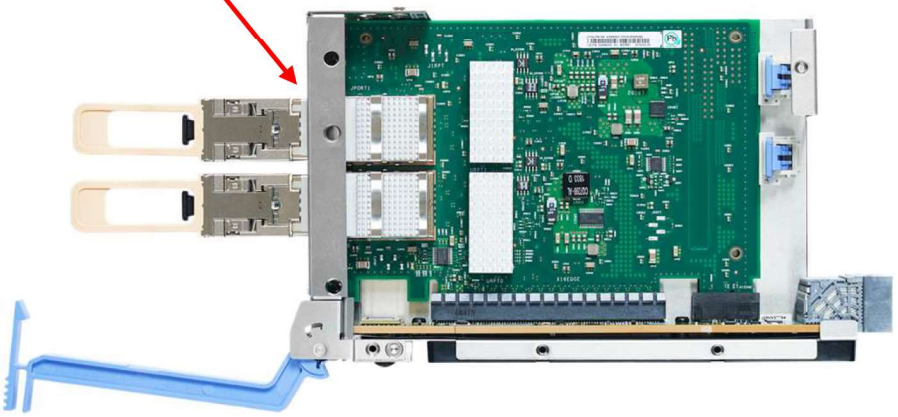
Power from PDU/BPA

* The link data rates do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.

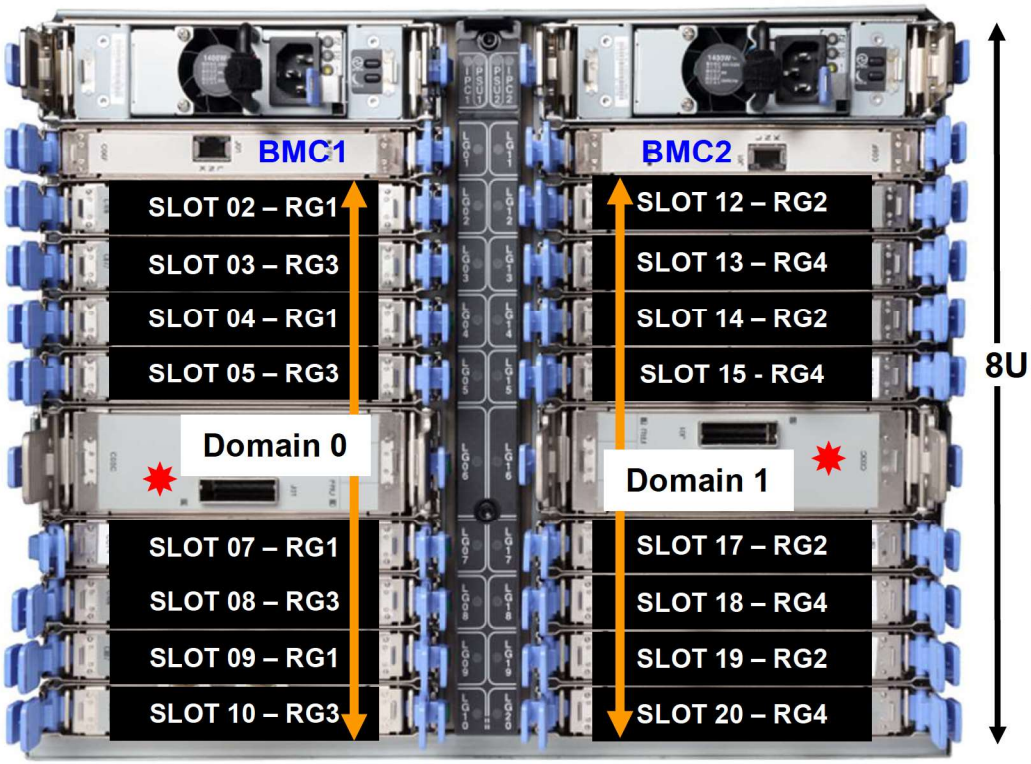
IBM z16 CPC Drawer Fanout (PCIe) Features - Summary

Description	F/C	Ports	Comments
ICA SR (CF)	0172	2	Coupling up to 150 meters (optical cable)
ICA SR1.1 (NB)	0176	2	Coupling up to 150 meters (optical cable)
PCIe+ Gen3 fanout	0175	2	To PCIe+ I/O Drawers (FC 4023)



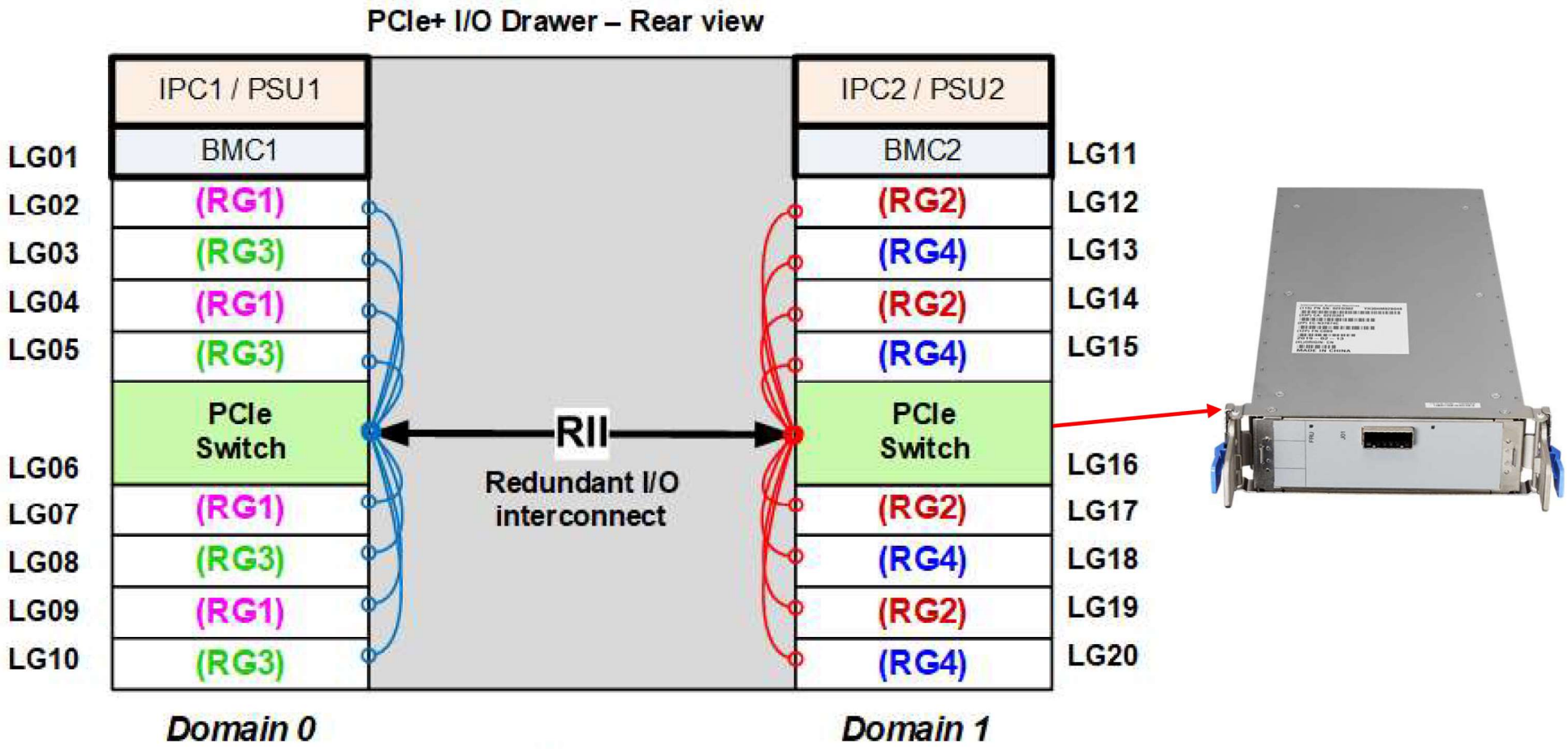


PCIe+ I/O Drawer – 16 slots



- **Supports PCIe I/O cards**
  - First introduced on the IBM z14 ZR1
  - Unlike previous machines where PCIe I/O drawers were in fixed locations, PCIe+ I/O drawers locations are dependent on power type (BPA or PDU) and CPC drawer count.
  - IBM z16 - PDU: Up to 12 drawers
  - IBM z16 – BPA: Up to 10 drawers
- **Supports 16 PCIe I/O cards, horizontal orientation, in two 8-card domains.**
- **Requires two 16 GBps PCIe Interconnect cards (✸), each connected to a 16 GBps PCIe+ Gen3 Fanout to activate both domains.**
- **To support Redundant I/O Interconnect (RII) between domain pairs 0/1 the interconnects to each pair will be from 2 different PCIe+ Gen3 Fanouts.**
- **Concurrent repair of drawer & concurrent install of all I/O features (hot plug).**
- **Requires 8 EIA Units of frame space (14 inches ≈ 355 mm)**

PCIe+ I/O Drawer Slots Numbers



Note: Resource Groups (RGs) in parentheses apply to select "native" PCIe features

Review of the Integrated Firmware Processor (IFP)

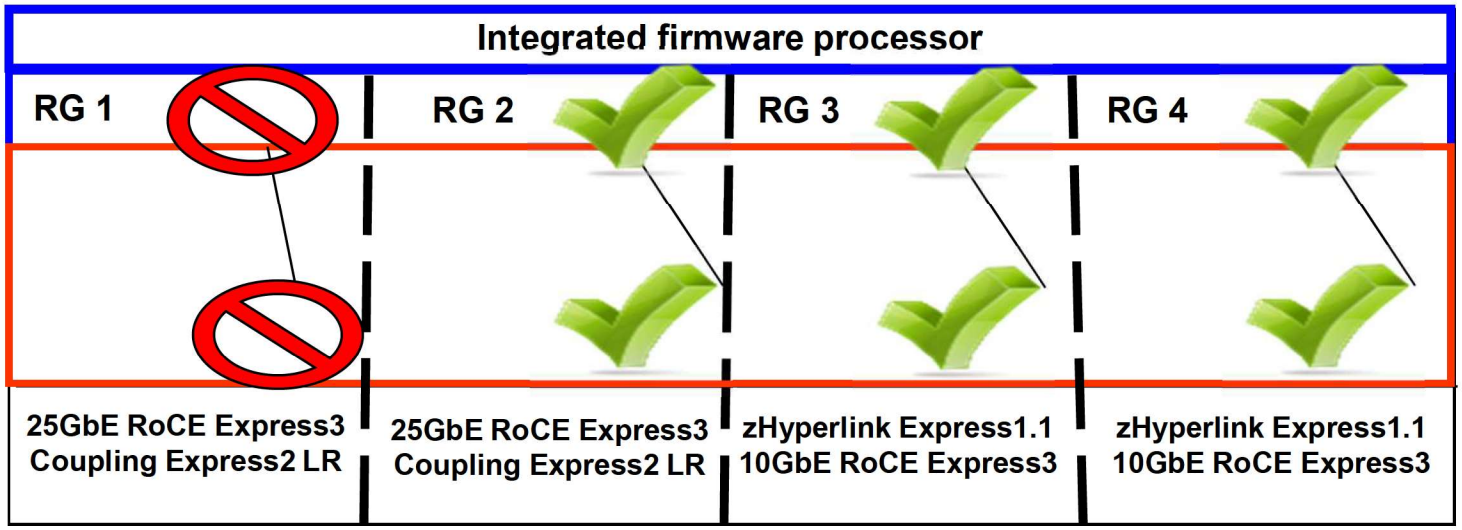
- Integrated firmware processor (IFP)
  - The IFP is allocated from the pool of non-client cores available for the whole system
    - Unlike other characterized cores, the customer doesn't pay for the IFPs
    - It's a single core dedicated solely for the purpose of supporting the native PCIe features and is initialized at POR if these features are present.
    - The IBM z16 has four Resource Groups (RGs) which have firmware for:

- **10GbE and 25GbE RoCE Express3 (LR and SR)**
- **10GbE and 25GbE RoCE Express2.1 (SR)**
- **10GbE and 25GbE RoCE Express2 (SR)**
- **zHyperLink Express 1.1**
- **Coupling Express2 LR**

* NOTE: There are two IFPs for IBM z16

IFP and Resource Groups – Basic Configuration

- **Resource Groups (RG)**
  - **Each Resource Group will handle 25% of the native PCIe features based on the plugging rules and purchases made in pairs of features**
    - During firmware updates, error conditions, etc. that affects one RG, ALL the features attached to that RG will be unavailable across all PCIe+ I/O Drawers
  - MCL update to Resource Group requires a RG outage of a few minutes



Supported I/O Features

New Build I/O Features

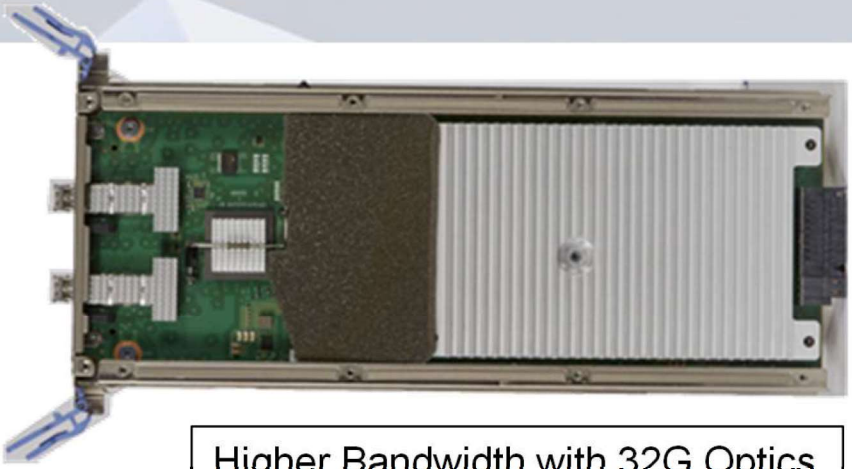
Description	Feature Code	Ports	Max Features	Comments
Coupling Express2 10G LR (new)	0434	2	32	
ICA SR 1.1	0176	2	48	Carry Forward also
10GbE RoCE Express3 SR (new)	0440	2	16	
10GbE RoCE Express3 LR (new)	0441	2	16	
25GbE RoCE Express3 SR (new)	0452	2	16	
25GbE RoCE Express3 LR (new)	0453	2	16	
zHyperLink 1.1	0451	2	16	Carry Forward also
Crypto Express8S (new)	0909	N/A	16	1 HSM
Crypto Express8S (new)	0908	N/A	30	2 HSM

New Build I/O Features (continued)

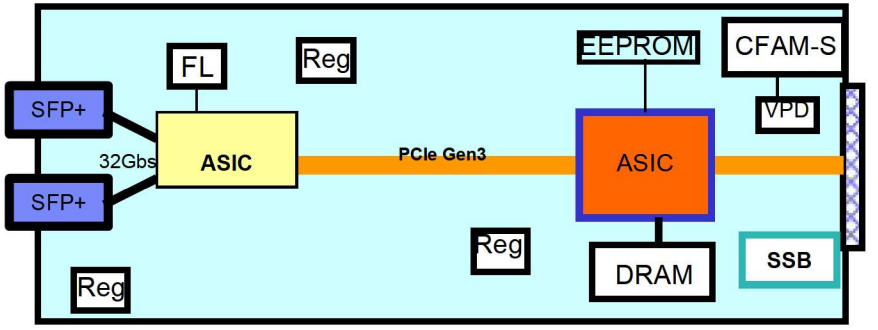
Description	Feature Code	Ports	Maximum Features	Comments
OSA Express7S 1.2 25GbE SR	0459	1	48	
OSA Express7S 1.2 25GbE LR	0460	1	48	
OSA Express7S 1.2 GbE LX	0454	2	48	
OSA Express7S 1.2 GbE SX	0455	2	48	
OSA Express7S 1.2 10GbE LR	0456	1	48	
OSA Express7S 1.2 10GbE SR	0457	1	48	
OSA Express7S 1.2 1000BASE-T	0458	2	48	
FICON Express32S LX	0461	2	192	
FICON Express32S SX	0462	2	192	

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

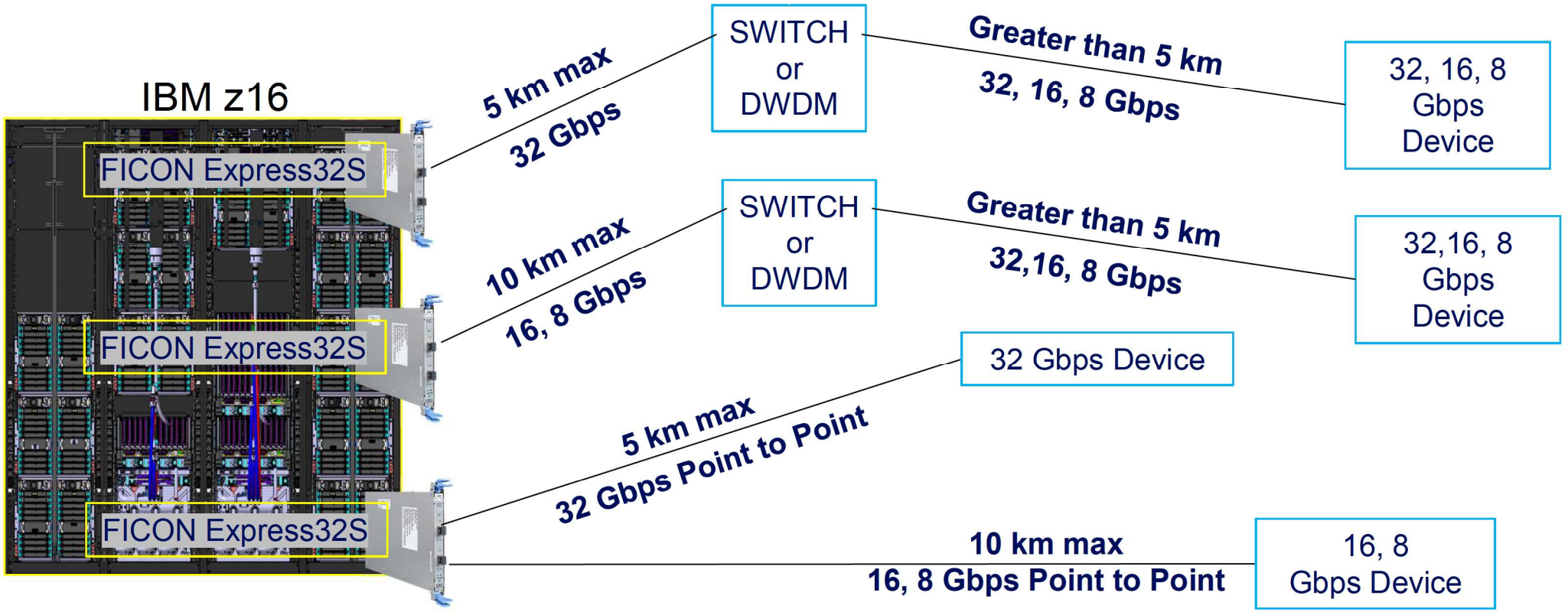


Higher Bandwidth with 32G Optics



If FICON Express32S intended to attach to a 32 Gb device…

Qualified Distance Switch or DWDM, documented on ResourceLink



FICON and IOCP Rules

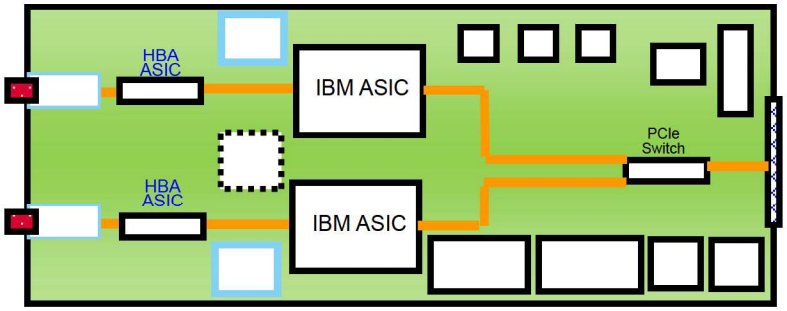
FICON Express32S, Express16SA and Express 16S+ ➔ Both ports must be FICON or FCP.

–FICON Express16S did not have this restriction.
–FICON Express16S is not available on the IBM z16.

FICON Express

FCP CHPID 108

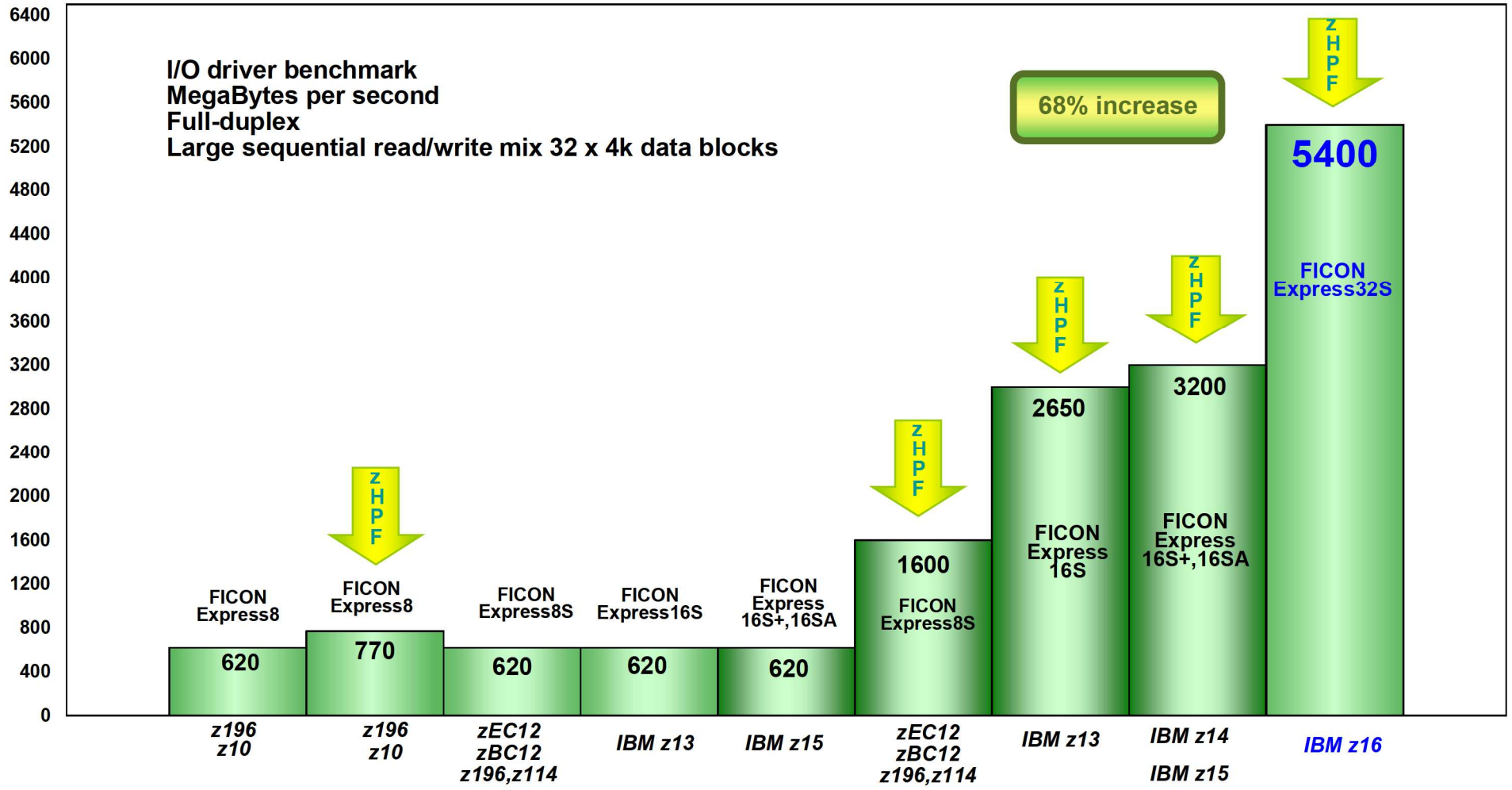
FC CHPID 109



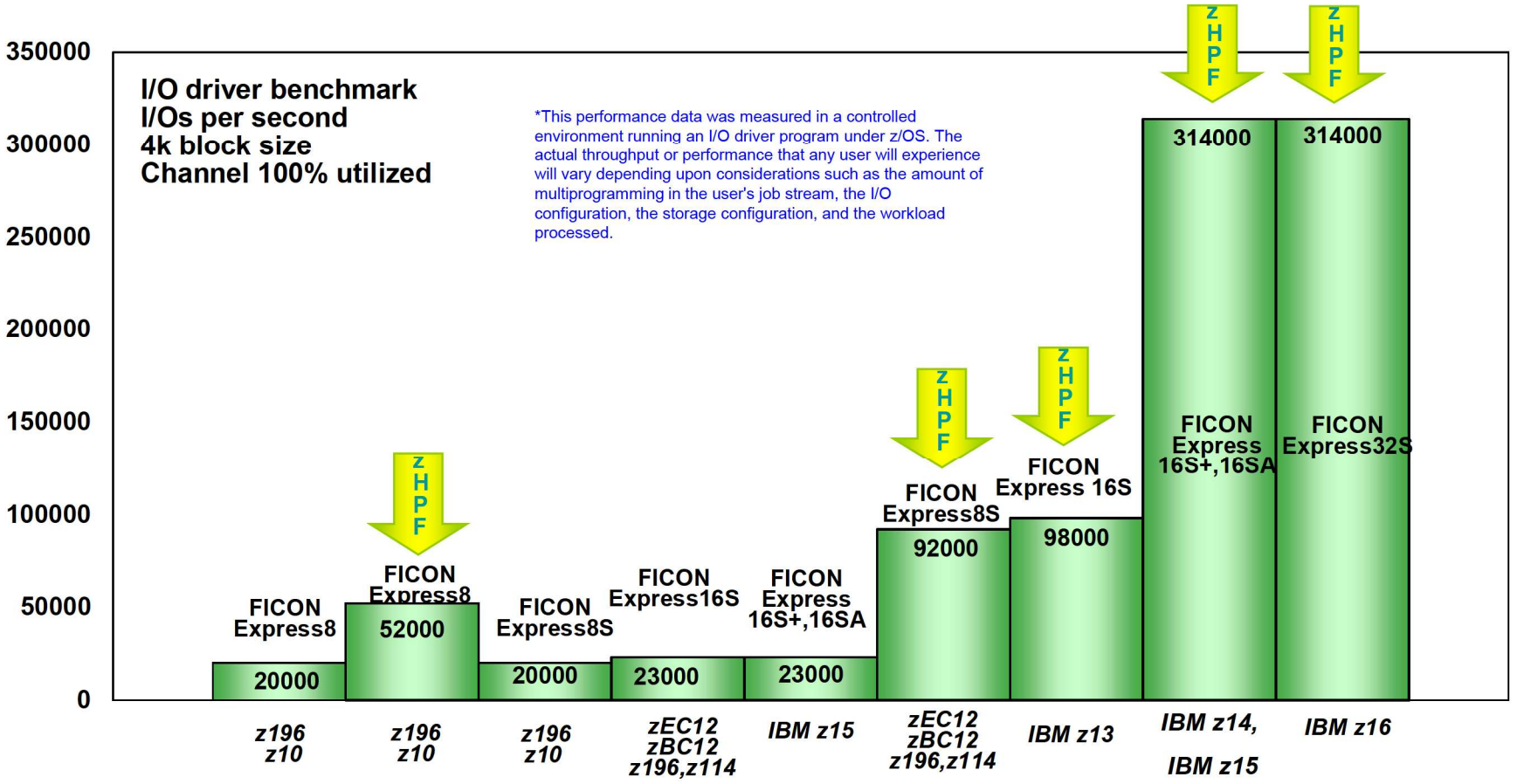
FEATURE (not available on IBM z16)	**Valid Syntax examples**
FICON EXPRESS16S	CHPID PCHID=108,PATH=(CSS(0),84),SHARED,TYPE=FCP
FICON EXPRESS16S	CHPID PCHID=109,PATH=(CSS(0),85),SHARED,TYPE=FC,**MIXTYPE**

IBM zHPF and FICON Performance (large seq. R/W)

*This performance data was measured in a controlled environment running an I/O driver program under z/OS. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.



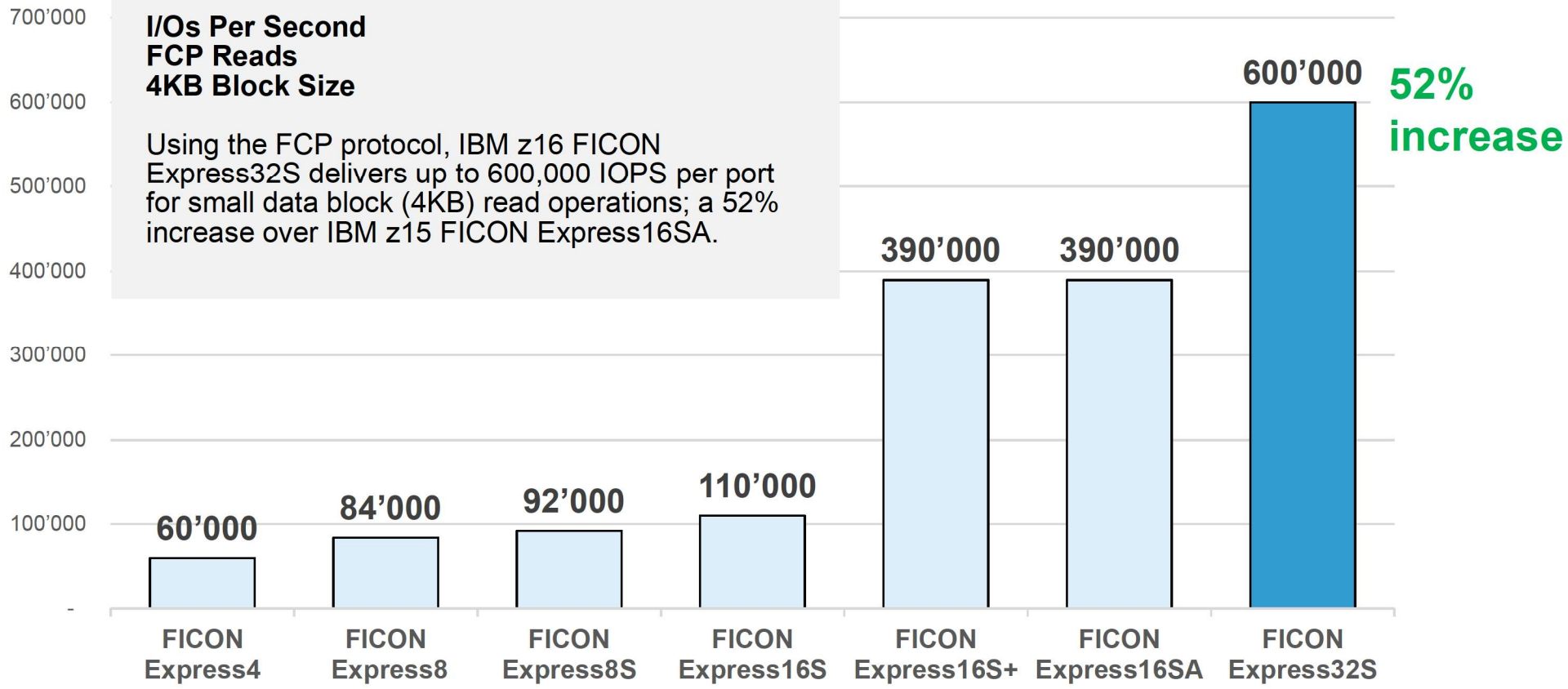
IBM zHPF and FICON performance (small block)



FICON Express32S – FCP Performance (small block)

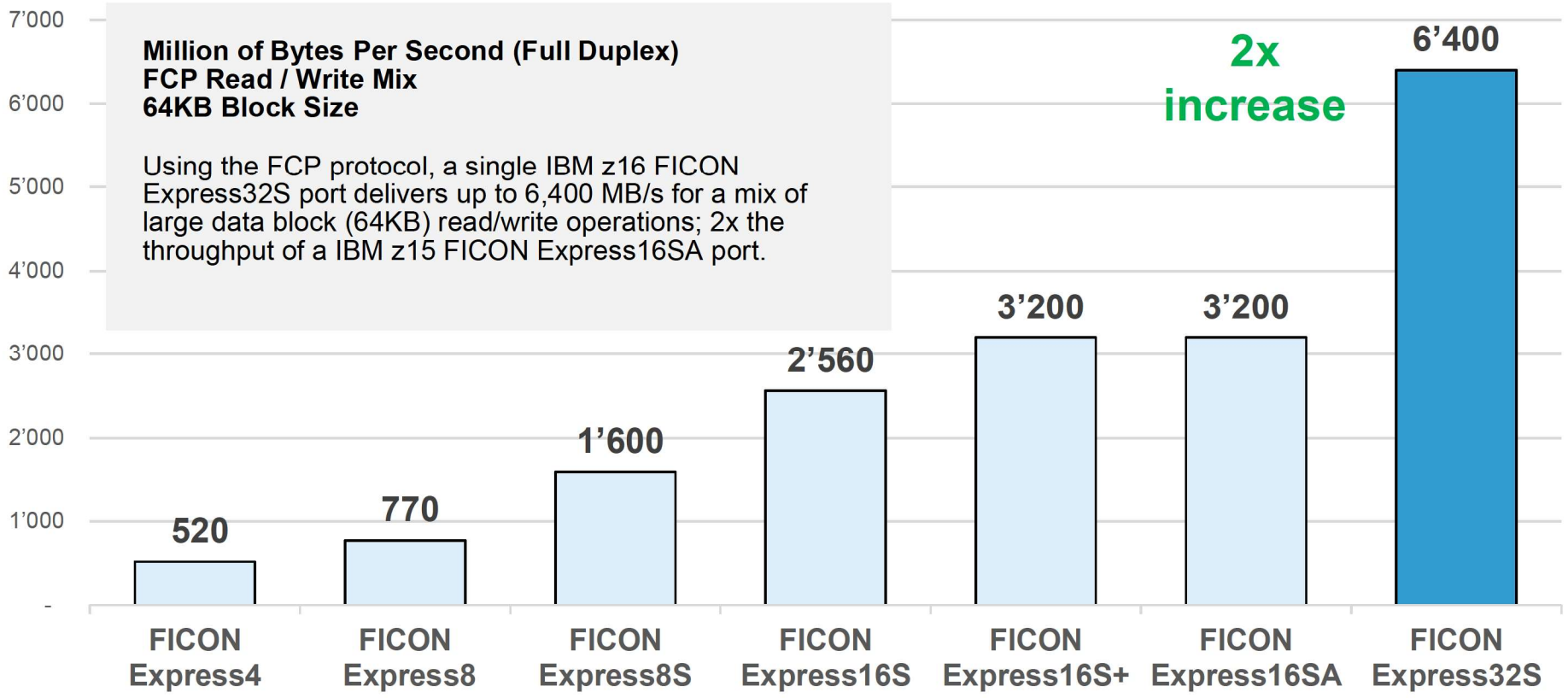
I/Os Per Second
FCP Reads
4KB Block Size

Using the FCP protocol, IBM z16 FICON Express32S delivers up to 600,000 IOPS per port for small data block (4KB) read operations; a 52% increase over IBM z15 FICON Express16SA.



DISCLAIMER: Based on laboratory measurements on IBM z16 using an internal Linux on IBM Z microbenchmark to execute FCP I/O operations on FICON Express32S. The FICON Express32S port operated at a 32Gbps link data rate. The workload consisted of 4KB read-only data transfer I/O operations. Results may vary.

FICON Express32S – FCP Performance (large block)



DISCLAIMER: Performance results are based on laboratory measurements done on IBM z16 using an internal Linux on IBM Z microbenchmark to execute FCP I/O operations on a single FICON Express32S port. The FICON Express32S port operated at a 32Gbps link data rate. The workload consisted of an even mix of 64KB read/write data transfer I/O operations. Results may vary.

OSA-Express7S 1000BASE-T 1.2

- 1000BASE-T Ethernet (1 GbE)
  - Copper Wiring
  - Two ports with RJ-45 connector
    - 1 PCHID/CHPID
  - Small form factor pluggable (SFP+) transceivers
  - Concurrent repair/replace for each SFP transceiver
- 1 Gbps (full duplex)

Connector = RJ-45

OSA-Express7S 1000BASE-T 1.2 Statement of Direction

- Statements by IBM regarding its plans, directions, and intent are subject to change or withdrawal without notice at the sole discretion of IBM. Information regarding potential future products is intended to outline general product direction and 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 IBM products remain at the sole discretion of IBM.
- **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 (#0426, #0446, and #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.

Coupling Express2 Long Reach

Overview

- Coupling Express2 LR adapter in PCIe+ IO drawer for IBM z16 – FC 0434
  - **No carry forward of Coupling Express LR (FC 0433)**
  - 32 features per system (Two ports per feature)
  - Long-distance optics/fiber.
    - Fiber is same single-mode fiber as used for ISC and PSIFB-1x (9/125 µm)
    - 10km unrepeated distance, up to 100 km with qualified DWDM, More than 100 km requires RPQ 8P2981.
    - 10 Gbps link speed*
    - Point-to-point only (no switching)
- Single PCHID identifies card/slot
- Four channels (CHPIDs) per port
  - Each channel is identified by VCHID/CSS.CHPID
  - CHPID type (CL5)

***Note: The link data rates do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.**

Integrated Coupling Adapter Short Range (ICA-SR)

Performance ICA-SR

- On IBM z16, the enhanced ICA-SR coupling link protocol provides **up to 10% improvement for read requests and lock requests**, and up to **25% for write requests and duplexed write requests**, compared to CF service times on IBM z15 systems. The improved CF service times for CF requests can translate into better Parallel Sysplex coupling efficiency and therefore, may reduce software costs for the attached z/OS images in the Parallel Sysplex.

RoCE Express3

RoCE Express 3

- IBM z16 introduces new features for 10 GbE RoCE Express3 (FC 0440, 0441) and 25GbE RoCE Express3 (FC 0452, 0453)
  - New RoCE Express3 generation hardware
  - Requires 10/25GbE optics (**LR** and SR) and Ethernet switch 10/25GbE support
- The 10 GbE and 25GbE RoCE Express3 features provide a technology update for RoCE on IBM Z.
  - The technology updates are related to internal card management.
- RoCE Express3 has the same virtualization capabilities as RoCE Express2 and RoCE Express2.1

HMC / SE / HMA Enhancements

HMC/SE Driver 51/Version 2.16.0

- **HMC support to n-2 only**
  - z13 no longer supported
  - same as SYSPLEX support

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

Note: HMC 2.16.0 code can be loaded on:
- z16 HMA (Hardware Management Appliance)
- z15 HMA
- Supported Standalone HMC hardware

HMC/SE Driver 51/Version 2.16.0

HMC Driver 51 = HMC Version 2.16.0

SE Driver 51 = SE Version 2.16.0

HMC

- HMC Features

  – Hardware Management Appliance (HMA, FC 0129) will be the only orderable HMC feature (for new build systems).

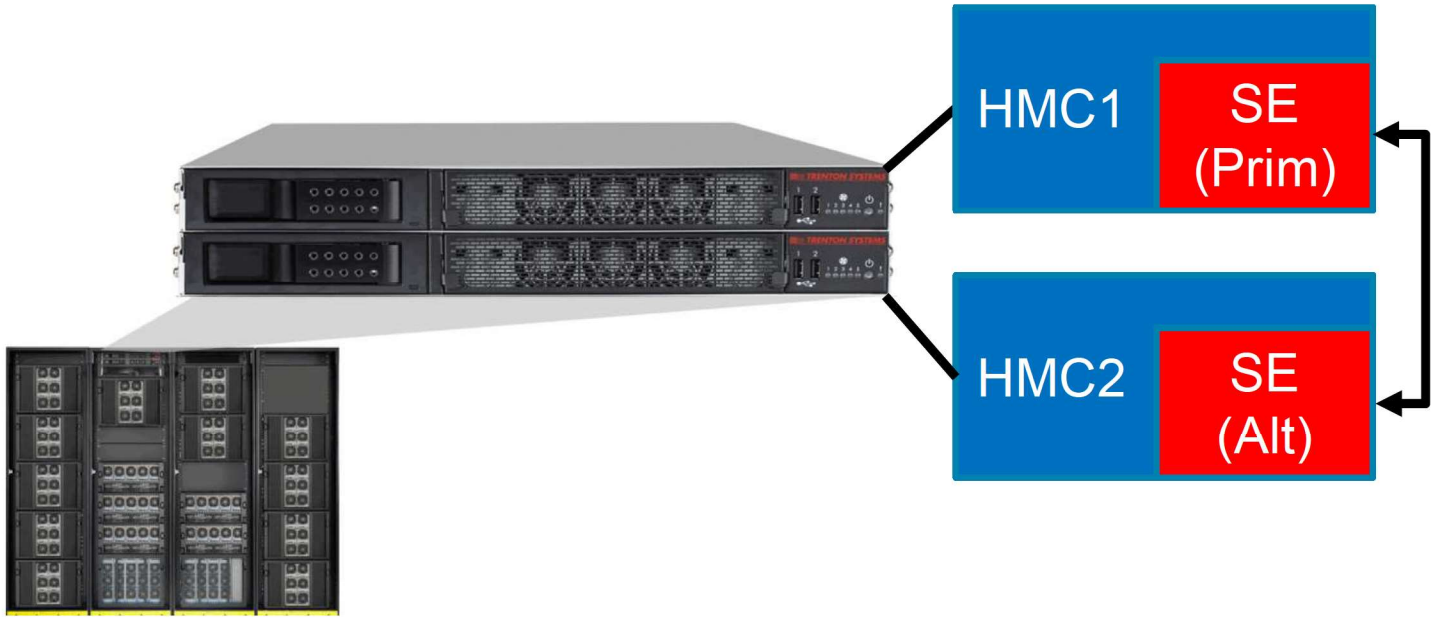
  – Most recent HMCs (FC 0062 & 0063) and one generation older HMCs (FC 0082, 0083) can be carried forward

  – NO orderable standalone Rack or Tower HMC for IBM z16

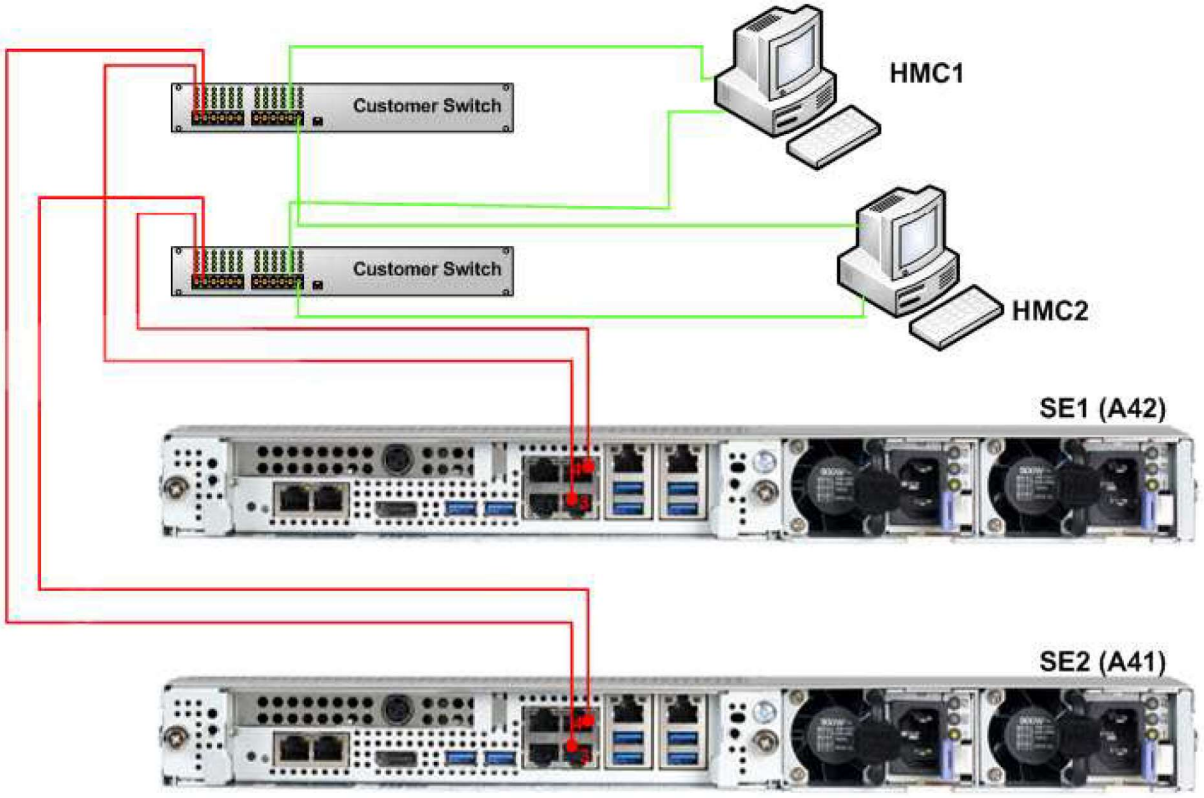
  – IBM z16 will provide the ability to order HMA feature after IBM z16 system installed (MES of Redundant SEs to HMAs)

HMA / SE / HMC

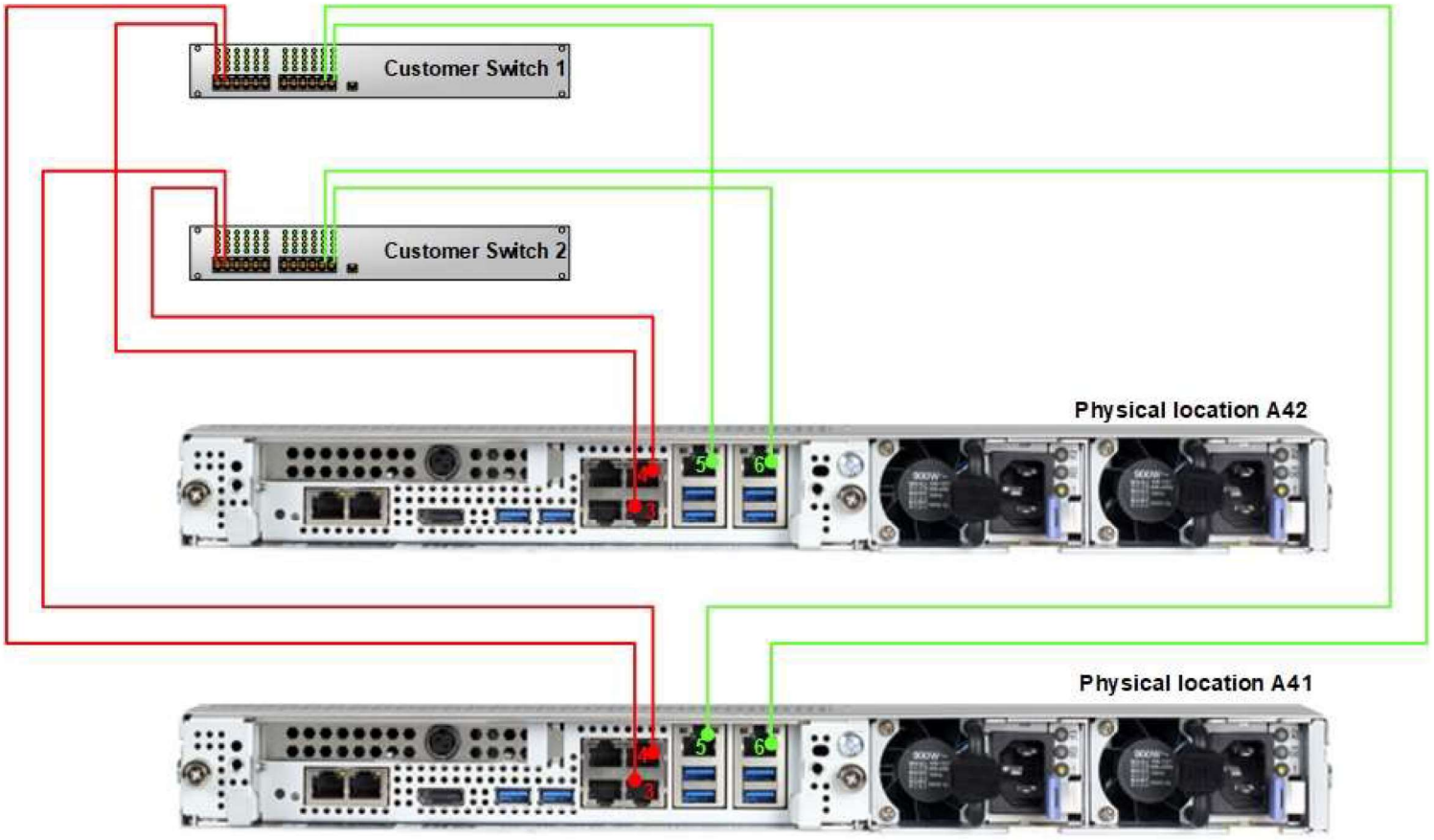
HMA (Hardware Management Appliance)
FC 0129 (2 x HMC / 2 x SE)



HMA / SE / HMC Network z14



HMA / SE / HMC Network



HMA / SE / HMC Network

If the Hardware Management Appliance feature (**FC 0129**) is ordered on the 3931, the dual 1U servers function as a Support Element (SE) and a Hardware Management Console (HMC). See Figure 25 on page 119 for network connection requirements.

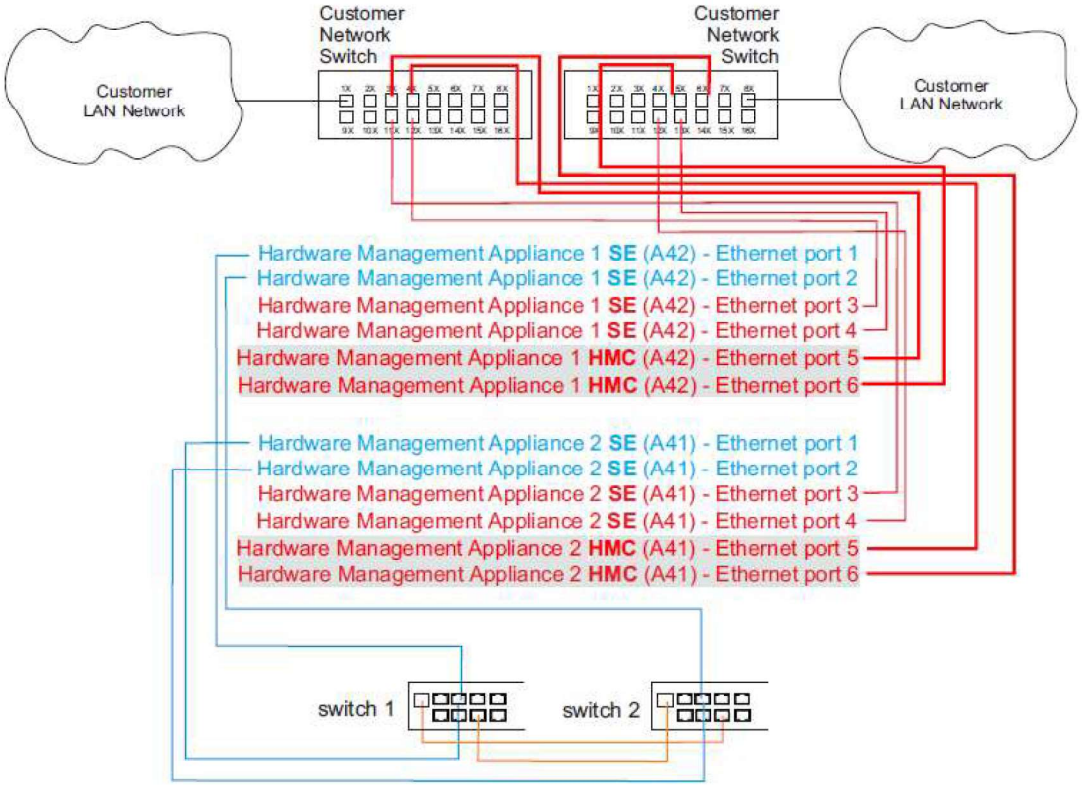


Figure 25. Two-switch configuration with Hardware Management Appliance (FC 0129)

Security Enhancements

- All Default Users Password Change

- Background
  - In 2020 California introduced "password law" that bans the use of default passwords in connected devices
    - Internet of Things password law
      -- Requires any default shipped passwords to be
        --- Changed on installation
        --- Or unique per device shipped
  - Implemented on z15 for (CA) installed systems
  - For IBM z16 will implement worldwide with expanding laws

Security Enhancements

All Default Users Password Change

- IBM z16 Implementation for HMC/SE users
  - Will limit default userids/requirement to ACSADMIN & SERVICE
    - **ADVANCED, OPERATOR, STORAGEADMIN, SYSPROG default users will no longer be shipped**
      Default user roles for ADVANCED, OPERATOR, STORAGEADMIN, and SYSPROG will be shipped, & user IDs can be created from those.
    - Any Default User IDs which are part of a previous HMC level can be carried forward to new HMC levels as part of a MES Upgrade or via the selection of
      -- *User Profile Data* for the *Save/Restore Customizable Console Data* or *Configure Data Replication* tasks
  - Will force password logon change on first user Logon
    - Clients responsible for maintaining password
  - Need to establish a plan for Service users
    - IBM SSRs (System Serviceability Reps) may be different for various visits
    - IBM SSRs may show up at any time (including middle of night) ==> **Planned** (firmware update) or **Unplanned** (Repair actions)
    - Should be ready to provide userid and password to SSR upon arrival to IBM Z system
      -- Client should maintain list of unique Service IDs and passwords
      -- Need an established process to avoid service delay

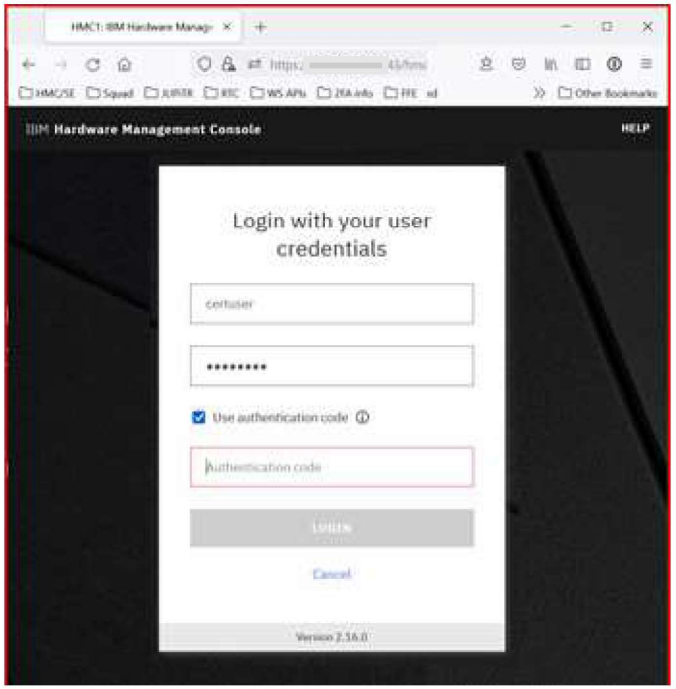
Security Enhancements

- **Additional Factor Authentication – MFA (Multi-Factor Authentication)**
  - Current Support
    - HMC – TOTP (Time Based One Time Password)
    - IBM Z Multi-Factor Authentication (z/OS) – RSA SecurID
  - Further Types to be supported
    - Certificates
      - PIV (*Personal Identity Verification*)
      - CAC (*Common Access Card*)
    - Generic RADIUS – allows for support of all various RADIUS factor types
      - RADIUS => Remote Authentication Dial-In User Service

- **Additional MFA factor types – Certificates (see next slide also).**
  - Certificate-based smart cards
    - Government/military employees and contractors
    - Personal Identify Verification (PIV) card
    - Common Access Card (CAC)
  - Certificates on USB keys
  - **Involves the IBM Z MFA out-of-band web server**

Login with certificate factor

- Enter HMC userid and password
- Check “Use authentication code”



- Insert PIV/CAC card into card reader

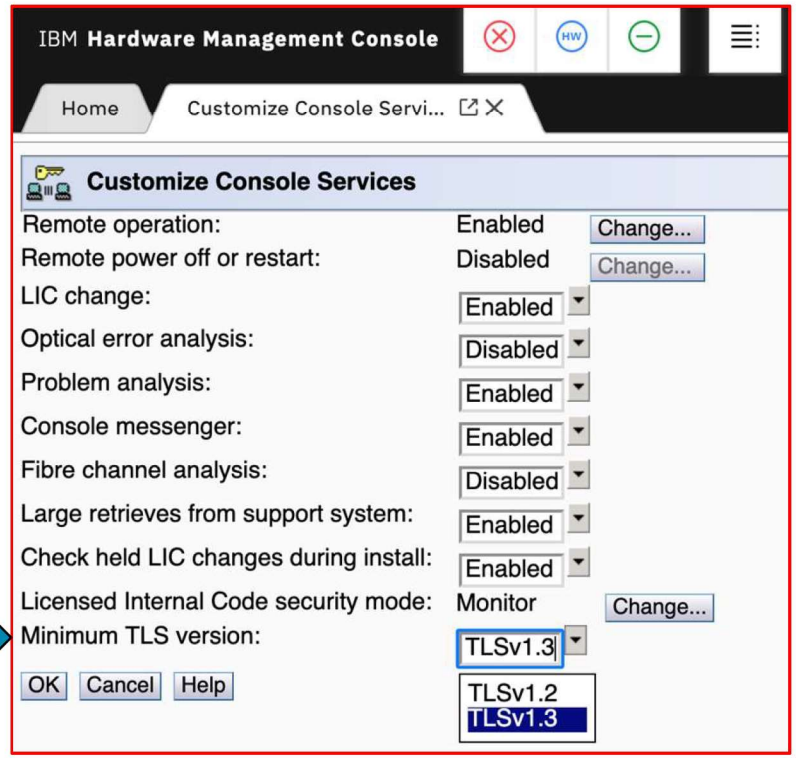
OR

- Alternatively, insert USB key with certificate into USB port…

Security Enhancements

- **HMC/SE TLS 1.3 support**
  - Provided on IBM z16 HMCs/SEs
    - Over time, expect to also provide support for z15 & z14 SEs
  - Clients should ensure that all services/servers connecting via TLS to the HMC/SE support TLS 1.3 before setting TLS 1.3
    - Remote browsing workstations
    - LDAP Authentication Servers
    - WebServices API connections
    - Fibre Channel End Point Security
    - FTPS servers
    - Single Object Operations
  - TLS 1.0 & 1.1 Support will be removed for IBM z16 HMCs/SEs
    - Must ensure all your connecting servers support TLS 1.2 or 1.3

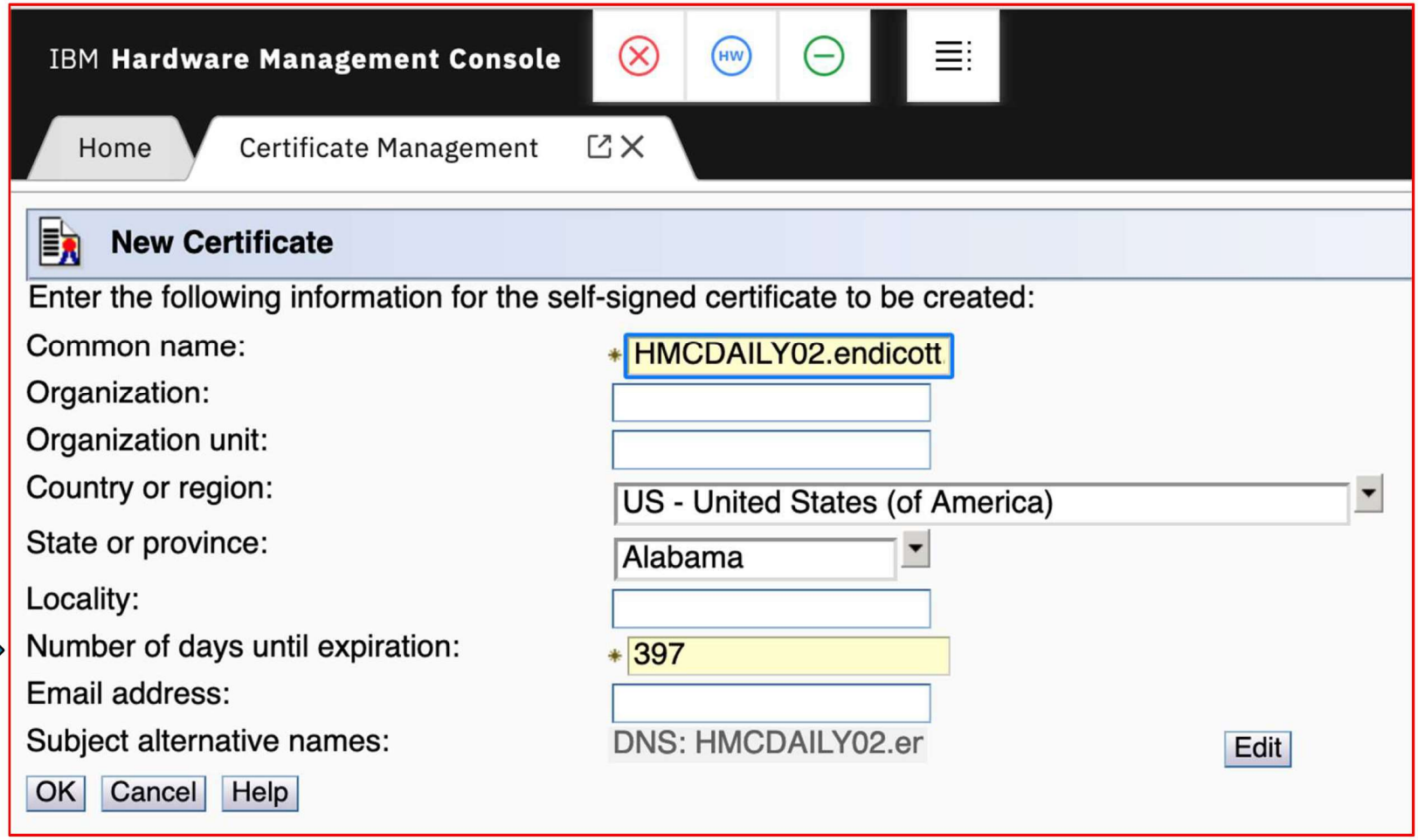
Note: If Minimum TLS level is set to 1.2, TLS 1.3 will be attempted first, then fall back to TLS 1.2 if required



Security Enhancements

- **HMC/SE Certificates Expiration Updates**
  - Newly created certificates
    - New default expiration: 398 days
      - Can be modified
      - Driven by industry shorter certificates => Apple Safari browser and iOS
  - Hardware Message for every expiration (days prior: 90, 30, 7, 1, and daily afterwards)
    - Client notification by IBM Resource Link
    - Audit Log entry
  - Type 2 problem call home to the Support Center for every expiration (days prior: 7, 1, and daily afterwards)
  - Client Responsibility to manage
    - HMC certificates used for Browser, WS APIs, HMC Mobile, Remote Syslog Server
    - Fibre Channel End Point Security, RSF (Remote Support Facility) Proxy
    - MFA (Multi-Factor Authentication)

Security Enhancements



New HMC Read Only Support

- Additional Support for
  - Change LPAR Controls
  - Change LPAR Group Controls
- New approach for selection of Read Only task versions
  - Prior to IBM z16 had 2 task selections => Task Name or Task Name (view only)
  - Starting with IBM z16 for User Management Role task selection
    - Single task name New Permissions assignment for tasks with Read Only support
      - Can assign View Only permission to that task
  - IBM z16 Tasks supporting Read Only
    - Hardware Messages
    - Operating System Messages
    - Manage Coupling Facility Port Enablement
    - OSA Advanced Facilities

Cryptographic Configuration

Cryptographic Management

Change LPAR Controls

Change LPAR Group Controls

Configure Channel Path On/Off

Advanced Facilities

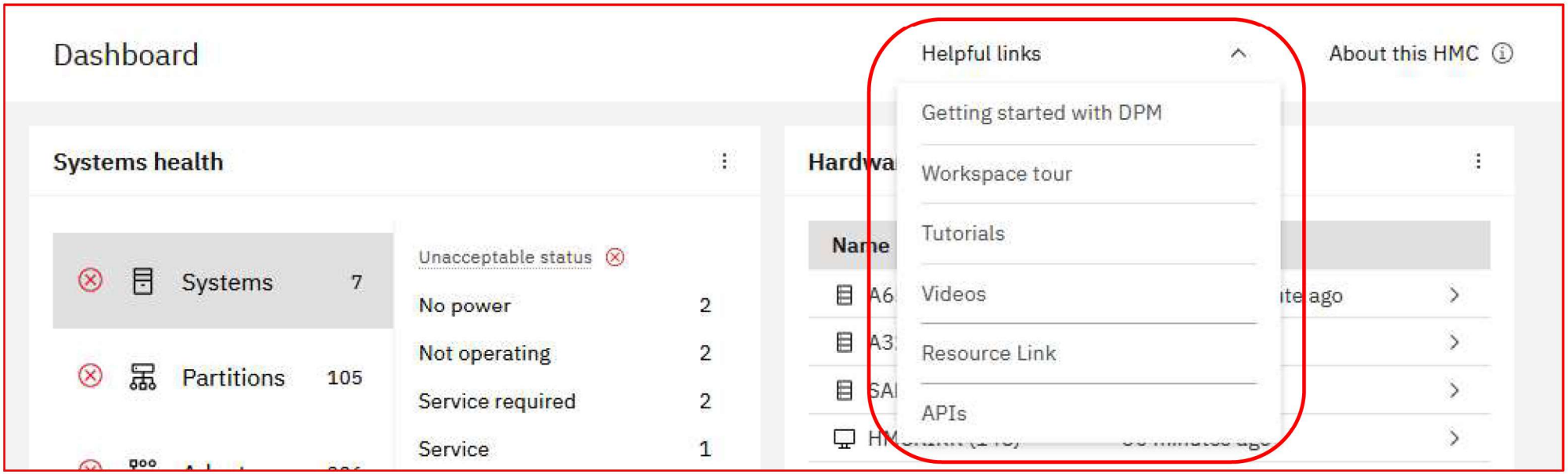
Configure On/Off

Manage System Time (subtask selection of view actions)

View Activation Profiles (separate task name)

Workspace Enhancements

- HMC Dashboard > Toolbar > **Helpful links**
  - Provides links to help resources and the workspace tour



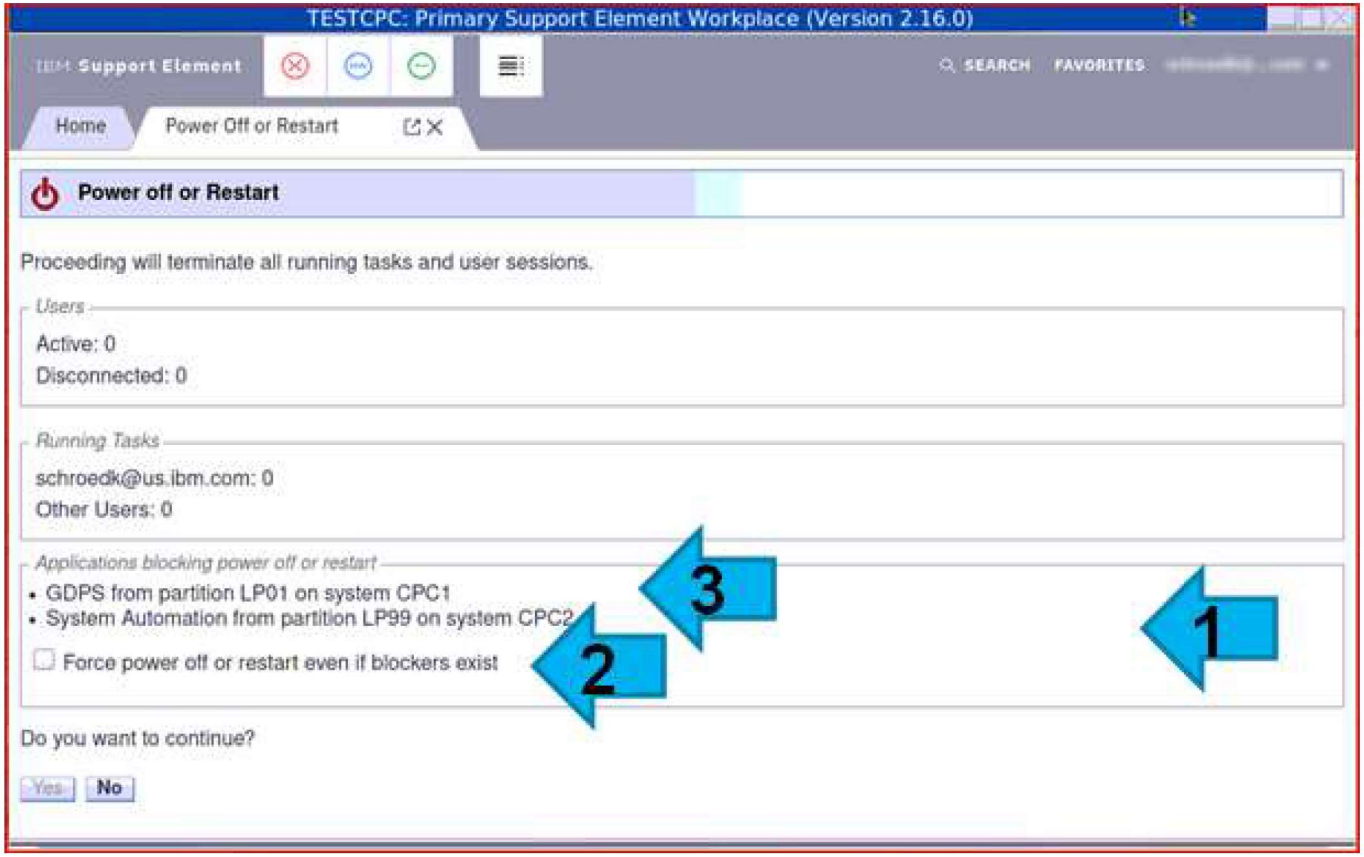
BCPii Enhancements

- **Suspend/Resume for SE Reboots**
  - Reboots due to
    - Firmware updates => most likely scenario
    - Automatic problem recovery
    - User initiated restart
    - Primary / alternate SE switch (includes automatic switch and power cycle)
    - Automation restart request
  - Ability for trusted applications (GDPS) to temporarily delay SE shutdown/restart
  - New Firmware notifications about restarts
    - Can be used by GDPS to know when restarts will be occurring and when to expect the restart to be completed
      - GDPS will generally eliminate requests to the SE while the SE is away for the restart
      - GDPS can potentially delay these restarts
    - SA Proc Ops & Client's own BCPii automation can also utilize these new notifications

BCPii Enhancements – “Power off or Restart” UI Changes

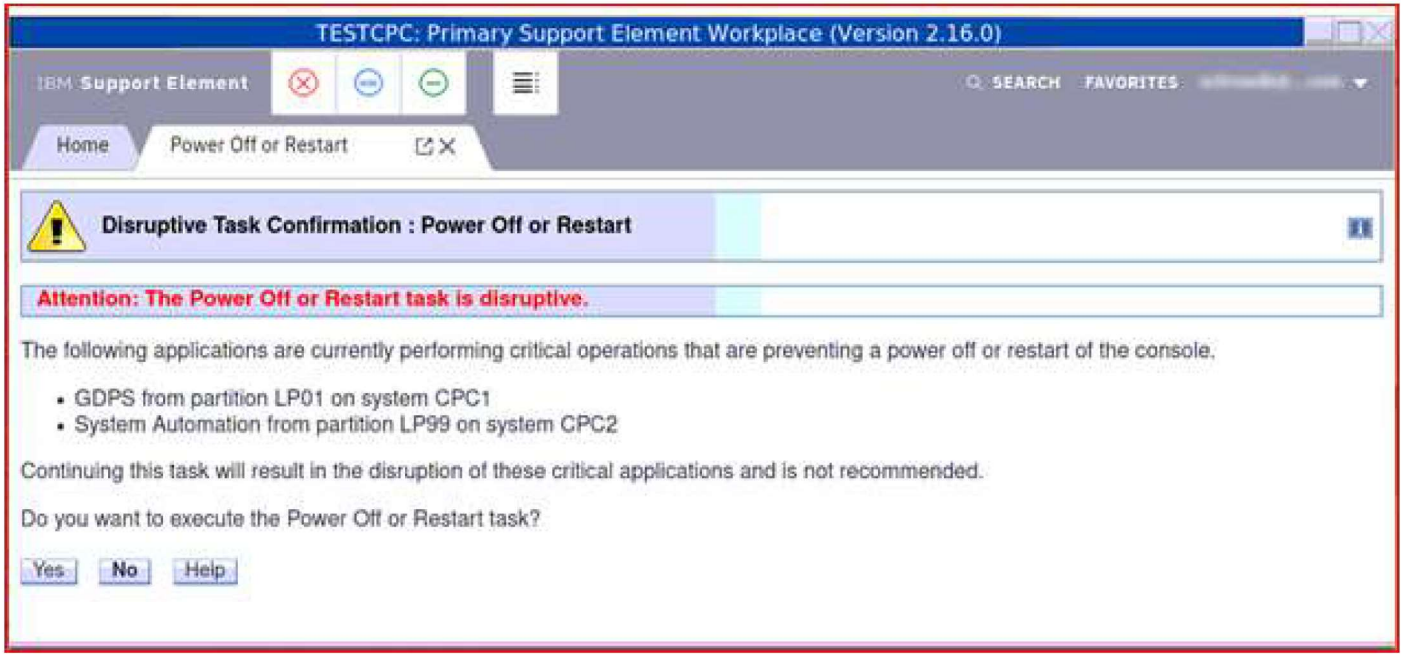
Changes to “Power off or Restart” confirmation panel:

1. New section that lists existing shutdown delayers. Is not present if there are none.
2. Ability to force shutdown regardless of whether delayers exist or not.
3. Shows the application name for each delayer.



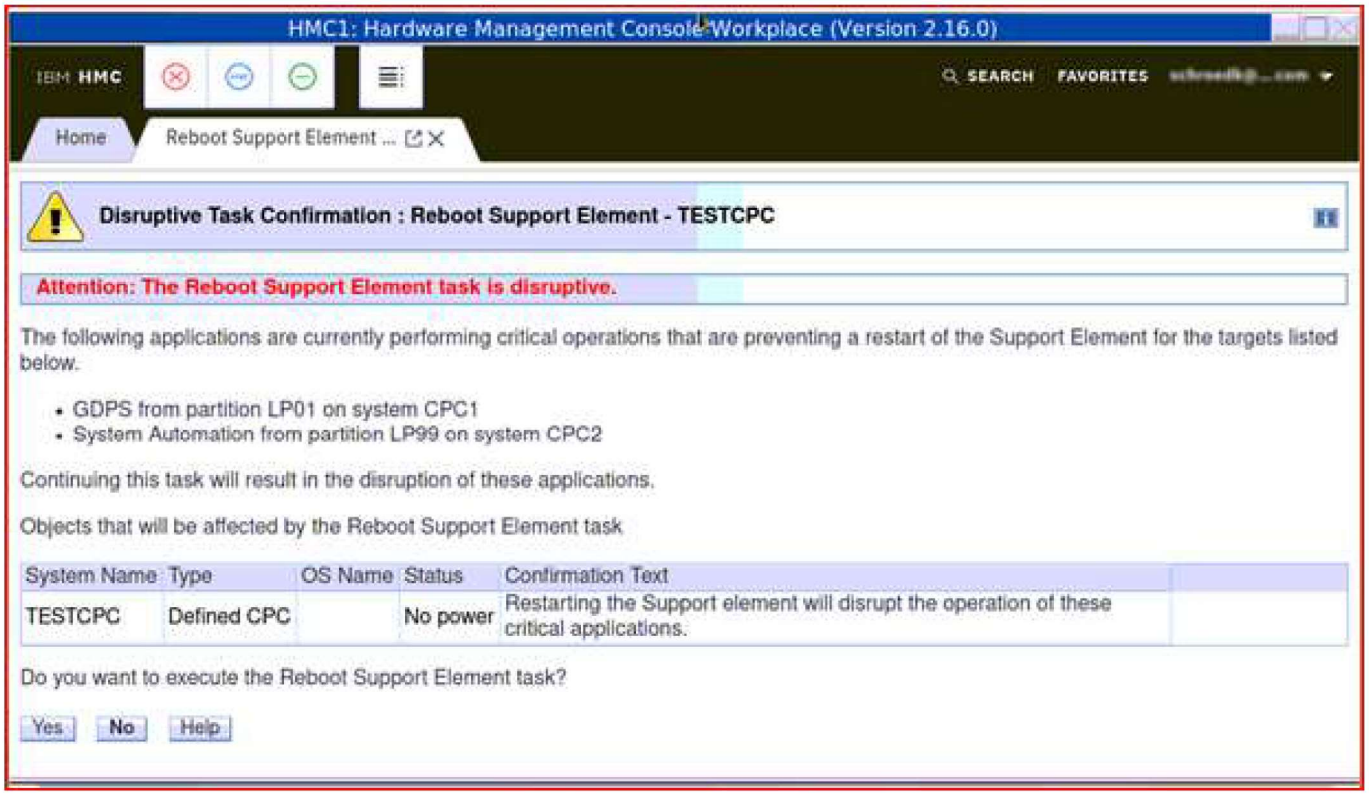
BCPii Enhancements – “Power off or Restart” UI Changes

When forcing a shutdown or restart the user is shown a disruptive confirmation panel.



BCPii Enhancements – “Reboot Support element” UI Changes

Similarly, if shutdowns or restarts are currently being prevented, then the user is shown a disruptive confirmation.



BCPii Enhancements

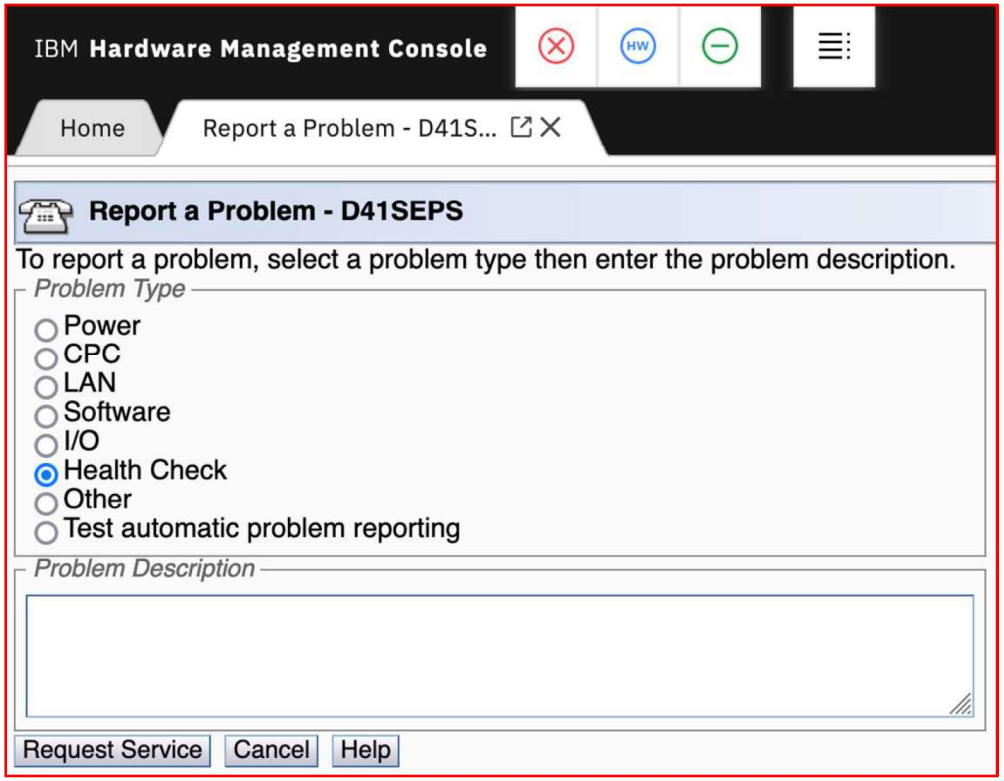
- **System Resiliency for BCPii**
  - Early Warning/Automatic Recovery for Certain Areas affecting BCPii
    - Prior to IBM z16, automatic recovery exists for critical SE services being impacted
    - Starting with IBM z16, additional conditions will be monitored for issues with automatic recovery if found
      - Some analysis of BCPii client request timeouts, certain other timeouts and deadlocks

HMC Data Replication Enhancements

- **Basics**
  - HMC task and underlying communication framework
  - Allows the exchange of configuration data between linked machines:
    - *Acceptable Status Settings*
    - *Associated Activation Profiles*
    - *Customer Information Data*
    - *Group Data*
    - *Monitor System Events Data*
    - *Object Locking Data*
    - *Outbound Connectivity Data*
    - *User Profile Data*
  - Convenient way to keep multiple HMC synchronized
  - Can be disabled to prevent this exchange
- **Roles**
  - Primary – Authoritative source of information for any attached Replica HMCs
  - Replica – HMC which can only receive data from either Primary or Peer HMCs (will never provide updates to other HMCs)
  - Peer – HMC that may be cooperating with other peer HMCs & can act as an authoritative source of information for any listening Replica HMCs

Report a Problem Update

- If IBM Z HW/FW issue observed, use *Report a Problem* task to notify IBM of issue/collect data if **no** problem was opened automatically
  - IBM z16 Enhancement **allows LPAR targets** to be used for Report a Problem task
    - Helpful if issue is in conjunction with a software issue such as BCPii
  - **Task name clarification** to ensure proper use
    - HMC: *Report a Console Problem*
    - CPC/LPAR: *Report a Problem*

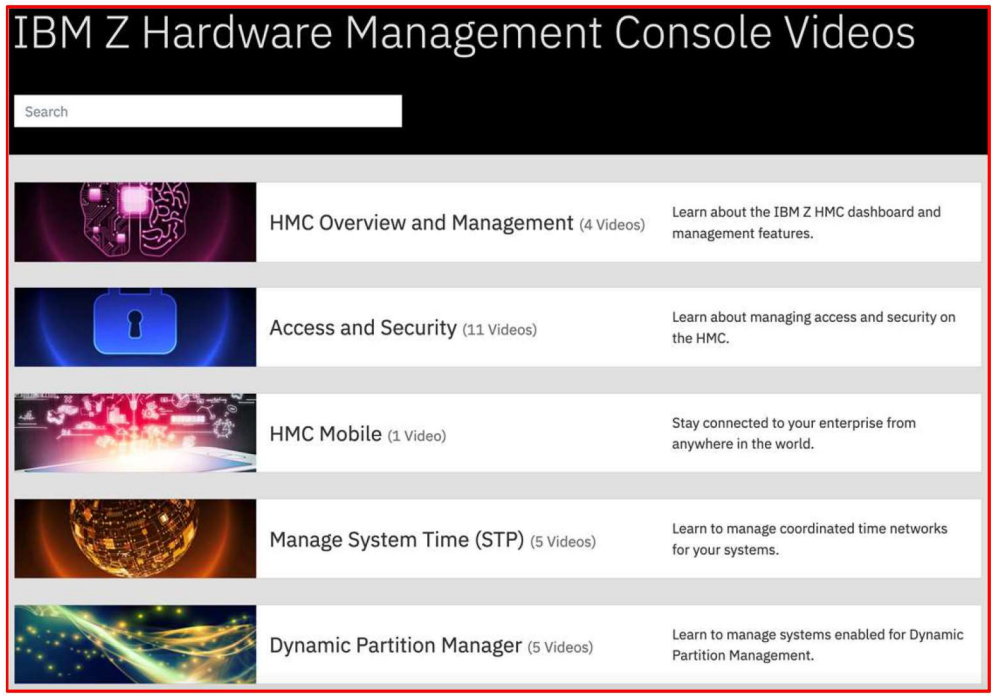


YouTube Videos for HMC Content

- Formal Release Documentation on HMC
  - Online Help and IBM Resource Link

Additional information on HMC via YouTube videos

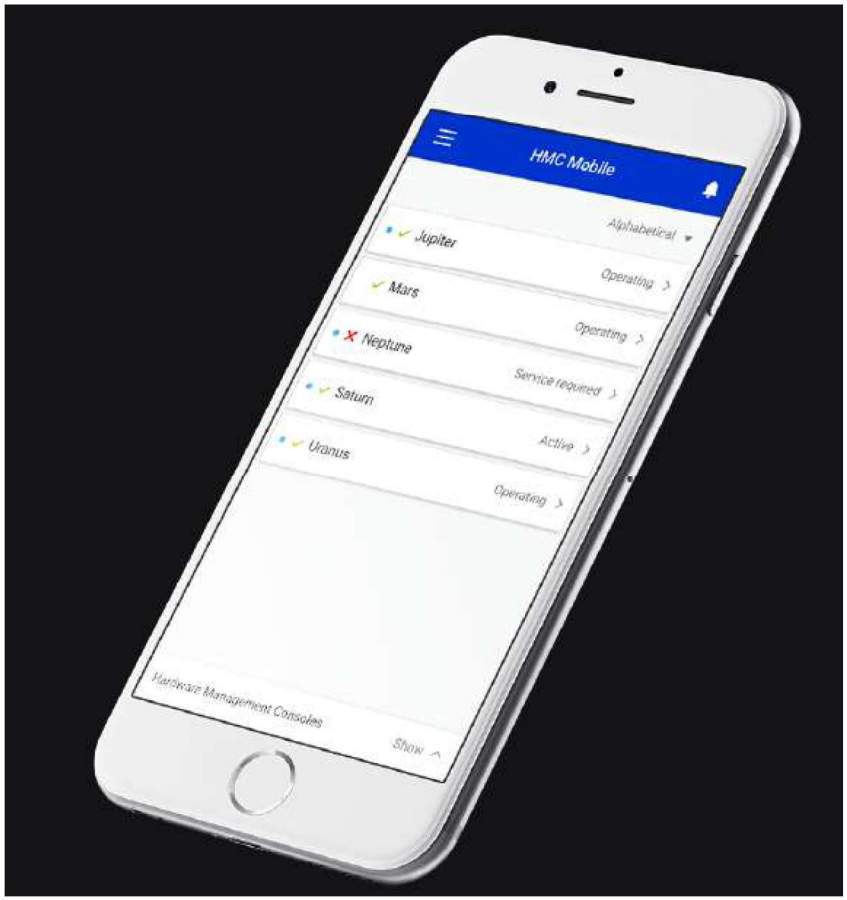
Monitor for videos being added to the IBM HMC playlist url: *https://ibm.biz/IBM-IBM Z-HMC*



IBM Z HMC Mobile – Updates

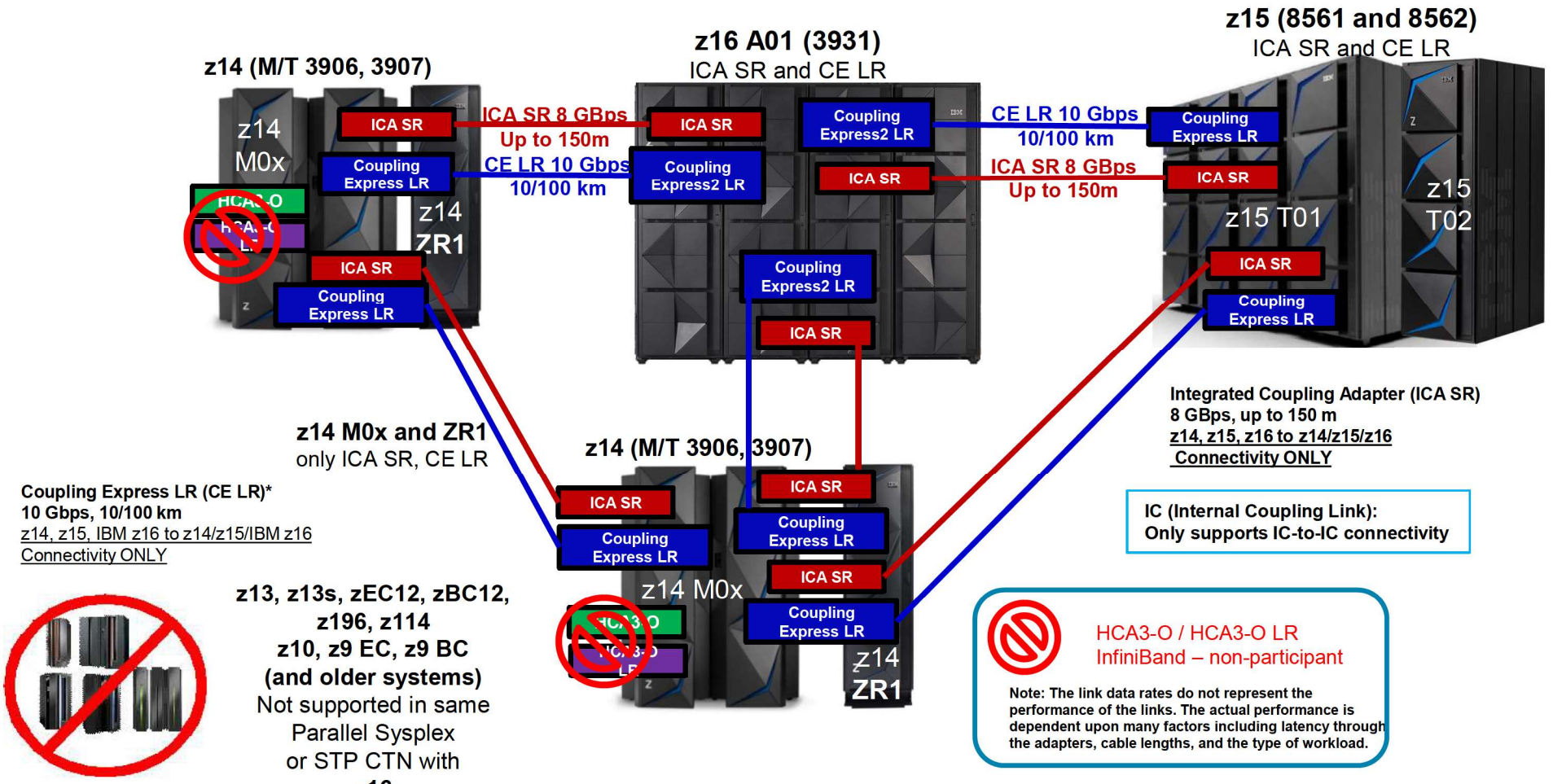
- **Release 3.1 … 3.5**
  - (3.1) IBM Z MFA with RSA SecurID
  - (3.1) Secure Boot for Linux
  - (3.1) Secure Execution for Linux
  - (3.1) Password view toggles
  - (3.2) Load OS into Partition from SCSI device
  - (3.3) Request service for hardware events
  - (3.4) Load OS from NVMe Device (LinuxONE only)
  - (3.4) Survey
  - (3.5) IBM Plex Typography (Carbon)
- **Release 4.0**
  - PCI-DSS compliance
  - Enhanced MFA support
  - Remote firmware update
  - HMC HW messages
  - HMC push notifications

https://ibm.biz/hmc-mobile



Parallel Sysplex, Coupling Links

IBM z16 Coupling Connectivity and Coexistence



Server Time Protocol

What is PTP and why it has been introduced to STP?

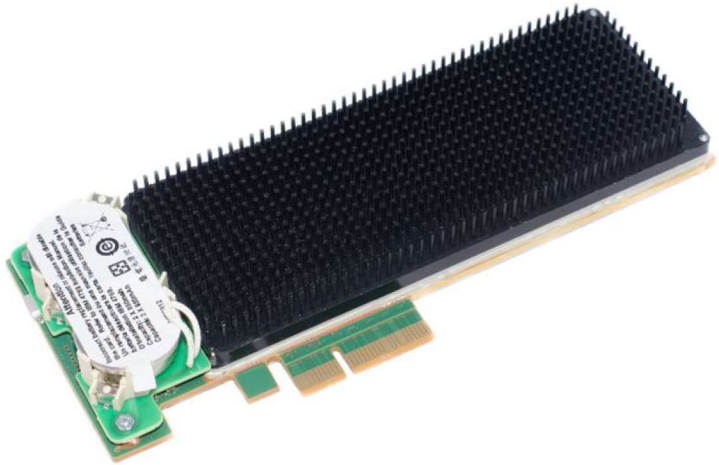
- The PTP Standard (IEEE 1588) has been originally approved in 2002, and has been updated in 2008:
  - Provides more accurate timestamps to connected devices
  - Initially used for Power Distribution Systems, Telecommunications, and Laboratories
  - **Requires Customer Network Infrastructure to be PTP-capable**
  - Accuracy comparison :
    - NTP – synchronize to within 100 milliseconds
    - NTP with Pulse Per Second – to within 10 microseconds
    - PTP – to sub-microsecond accuracy
- Regulatory requirements for time synchronization (to UTC):
  - Financial Industry Regulations
    - FINRA - 50 milliseconds
    - MiFID II - 100 microseconds
  - Payment Card Industry (PCI) Requirements and Security Assessment Procedures V3.2.1 (May 2018) requires an auditable, tightly synchronized system for credit card companies

IBM z16 Crypto Sub System

IBM z16 4770 Hardware Security Module

The 4770 IBM PCIeCC is the next generation IBM HSM with the goal for this HSM is to deliver Quantum Safe functionality and performance in support of the IBM z16 Cyber threat secure functionality and support the new FIPS 140-3 Level 4 standard.

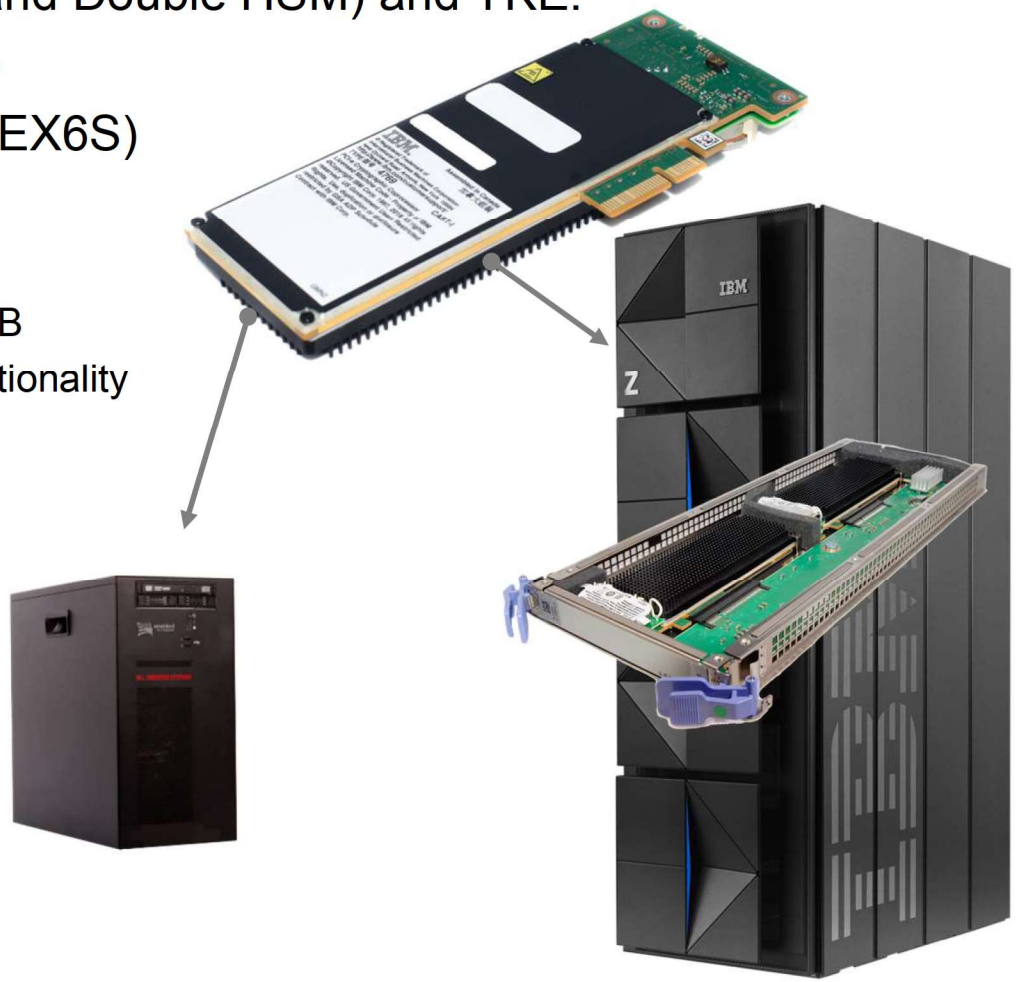
- It is built from the 4769 Hardware and it uses the 32nm ASIC and half-height/half-length PCIe express card.
- Planned Certifications: FIPS 140-3, Common Criteria EAL4+, PCI HSM, GBIC, APN
- Platforms: IBM z16, Trusted Key Entry (TKE)
- Features:
  - Follow on to 4769 Hardware with firmware upgrades
  - Increased persistence storage (2 x 256MB FLASH)
  - Concurrent Segment 1 and Segment 3 Upgrade.
  - Quantum Safe Mini-boot with Parallel Signatures using Dilithium and ECC.
  - Quantum Safe Algorithm Acceleration



IBM z16 4770 Hardware Security Module (HSM) Cont.

- Supports 4770 in IBM z16 (CEX8S Single and Double HSM) and TKE.
- Three Modes (Accelerator, CCA and EP11)
- Carry Forward: 4769 (CEX7S) and 4768 (CEX6S)
- Hardware Changes:
  - Based on IBM 4769
  - Flash Module to be changed to 512MB from 256MB
  - FPGA content upgraded to support additional functionality

- Planned Certifications:
  - FIPS 140-3
  - Common Criteria EAL4+
  - PCI HSM, GBIC, APN



What Level of TKE do I NEED?

- NOTE: The TKE does not check the IBM Z or LinuxONE processor level.
  - It is the version of the newest HSM on your 3931 that determines what level of TKE you must use. This chart shows you the level of TKE you need to manage the HSMs on your 3931:

- It is always recommended to be at the most current level of TKE because it can manage any level of HSM.

HSM	Minimum Level of TKE that can Manage the HSM
Crypto Express 8	TKE 10.0
Crypto Express 7	TKE 9.2
Crypto Express 6	TKE 9.0
Crypto Express 5	TKE 8.0

z/OS Support for IBM z16

z/OS support summary

	z10 EC z10 BC WdfM	z196 z114 WdfM	zEC12 zBC12 WdfM	z13 Z13s WdfM	z14 z14 ZR1 WdfM	z15 T01 z15 T02	IBM z16	End of Service	Extended Defect Support (1)
z/OS V2.1[1]	X	X	X	X	X	X		9/18	9/21
z/OS V2.2	X	X	X	X	X	X	X	9/20	9/23 (*)
z/OS V2.3			X	X	X	X	X	9/22 (*)	9/25 (*)
z/OS V2.4			X	X	X	X	X	9/24 (*)	9/27 (*)
z/OS V2.5				X	X	X	X	9/26 (*)	9/29 (*)

Notes:
(1) The IBM Software Support Services offering provides the ability for customers to purchase extended defect support service for those z/OS releases which are end of service.

(*) Planned. All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice.

WdfM – Server has been withdrawn from Marketing

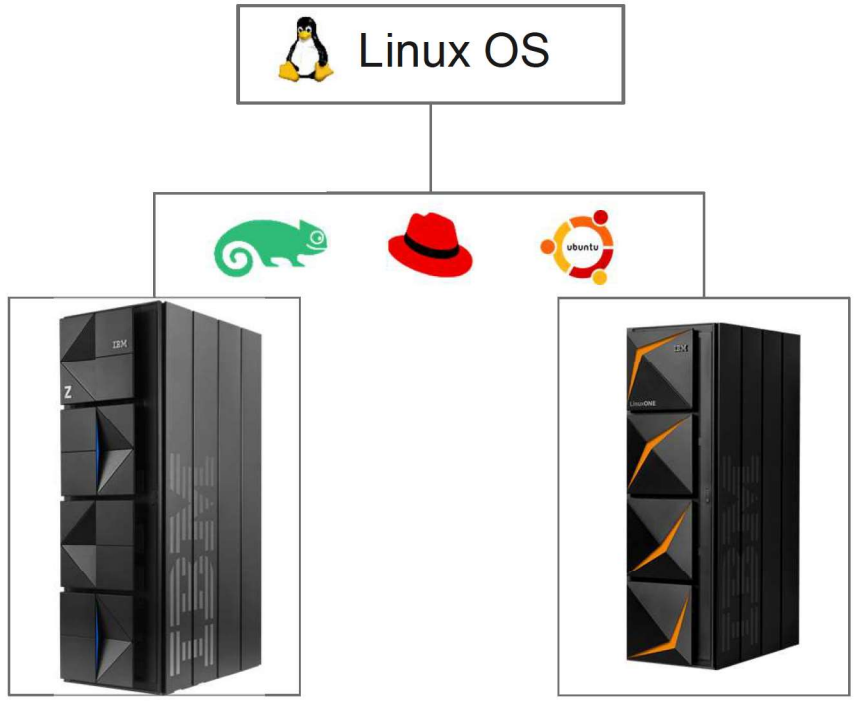
IBM Software Support Services required for z/OS support
Generally supported
Not supported

Linux and KVM IBM z16

Linux for z/Architecture serves two IBM Brands

- *IBM open source contribution for no charge ,*
- *strengthening the z/Architecture platforms,*
- *build and delivered by Linux partners,*
- *providing value to customers.*

We are committed to support the three major Enterprise distributions!



IBM z16

(Linux co-located
w z/OS, z/VSE, z/TPF, z/VM, KVM)

IBM LinuxONE

Linux on IBM Z supported distros – IBM z16

- Linux on IBM Z - IBM plans to support running the following Linux on IBM Z distributions on IBM z16:
  - SUSE Linux Enterprise Server:
    - SLES 15 SP3 with service, and
    - SLES 12 SP5 with service.
  - Red Hat Enterprise Linux:
    - RHEL 9.0 with service,
    - RHEL 8.4 with service, and
    - RHEL 7.9 with service.
  - Canonical: Ubuntu 20.04 LTS with service.
- The support statements for IBM z16 also cover the KVM hypervisor on distribution levels that have KVM support. For minimum required and recommended distribution levels refer to the IBM Z website.

NOTE: The IBM product "KVM for IBM Z" is out of service and no longer available from IBM. KVM technology is now provided as part of the distributions.

IBM z16 Redbooks

- April 5th, 2022– New and Updated Redbooks
  - IBM z16 Technical Introduction, SG24-8950
  - IBM z16 Technical Guide, SG24-8951
  - IBM Z Connectivity Handbook, SG24-5444
- April 5th, 2022– Updated Redpaper
  - IBM Z Functional Matrix, REDP-5157-06
- May 31st, 2022 – New and updated Redbook materials:
  - IBM z16 Configuration Setup, SG24-8960
  - IBM Z STP Guide, SG24-8480-01
  - IBM Z System Recovery Boost, REDP-5563

IBM z16 announcement replays

https://ibmz16day.bemyapp.com/

End of Presentation

Questions and Comments please send to:

aspa@ch.ibm.com