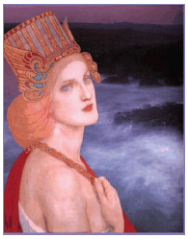
International Technical Support Organization

IBM System z9 - Technical Details



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Redbooks Workshop

IBM ITSO - International Technical Support Organization

Notices

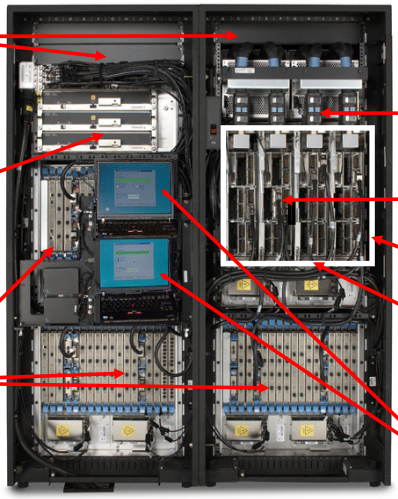
Agenda

- Positioning
- Technical Details
- I/O and Network Enhancements
- I/O growth solutions
- Availability Enhancements
- HMC/SE changes
- LPAR Management
- Cryptography

Technical details

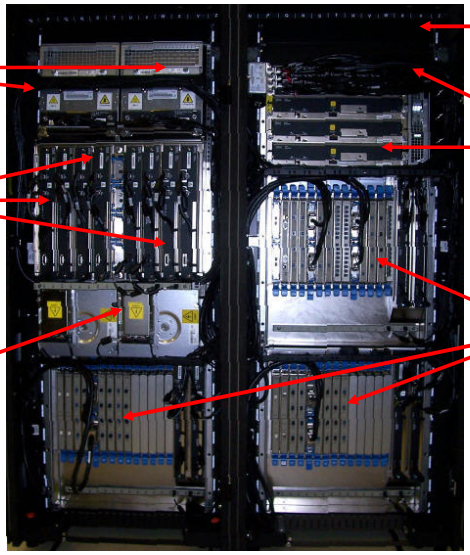
- Frame & Models
- Processor Book Design/Components
- Memory
- STI & I/O Connectivity
- I/O Features
- Channel Subsystems
- New HMC Introduction
- Environmental
- Software Support

z9-109 Under the covers



Front View

Z9-109 Under the covers



Back View

IBM System z9 Overview

- **Machine Type**
  - 2094
- **5 Models**
  - S08, S18, S28, S38 and S54
- **Processor Units (PUs)**
  - 12 PUs (16 for Model S54) per book
  - 2 SAPs per book, standard
  - 2 spares per server
  - 8, 18, 28, 38 or 54 PUs available
    - CPs, IFLs, ICFs, zAAPs, optional SAPs
- **Memory**
  - Minimum of 16 GB
  - Up to 128 GB per book
    - 16 GB increments
  - Up to 512 GB z9-109 System total
- **Bandwidth for I/O cage**
  - Up to 16 STIs per book
    - 2.7 GB/s for each I/O and 2.0 GB/s for ICBs
  - Total system I/O bandwidth capability of 172.8 GB

z9-109 Model Overview

Model	S08	S18	S28	S38	S54
Books	1	2	3	4	4
Processor Units (PUs)	12	24	36	48	64
Spare PUs	2	2	2	2	2
Standard SAPs	2	4	6	8	8
Characterizable PUs (Standard)	8	18	28	38	54
Characterizable PUs (Enhanced Availability)	NA	8	18	28	40
GB Memory (Standard)	16 - 128	16 - 256	16 - 384	16 - 512	16 - 512
GB Memory (Flexible)	NA	32 - 128	32 - 256	32 - 384	32 - 384
Maximum Channels	960	1024	1024	1024	1024

Notes: Shaded boxes represent improvements compared to z990.
"Enhanced Availability" and "Flexible" configurations best exploit **Enhanced Book Availability**, the capability to run with one book removed from the configuration.
Channel maximums vary by type. "Maximum Channels" assumes all ESCON.

z9-109 Performance Comparison

Number of z9-109 CPs	Base	Ratio
1 CP	z990 301	1.35
8 CPs	z990 308	1.34
18 CPs	z990 318	1.34
28 CPs	z990 328	1.32
38 CPs	z990 332	1.51
54 CPs	z990 332	1.95

* CI = Capacity Indicator and refers to number of installed CPs. Reported by STSI instruction. Model 700 does not have any CPs.

Note: For MSU values, refer to: www-1.ibm.com/servers/eserver/zseries/library/swpriceinfo/
For ITRs refer to: www-1.ibm.com/servers/eserver/zseries/lspr/zSerieszOS.html

S/W MSU: 81 158 229 298 363 422 479 532 584 640 690 742 795 843 893 938 985 1032 1077 1127 1177 1226 1274 1314 1353 1400 1436 1481 1524 1567 1609 1650 1691 1732 1772 1811 1850 1889 2409

** Proposals to customers for zSeries processors must NEVER quote capacity expectation on the basis of any MIPS chart.

z9-109 – Enhanced Availability Configurations

- **Concept: Configure enough physical memory and limit PUs configured so that all active purchased PUs and memory remain available with one book removed from the configuration with Enhanced Book Availability**
  - **Book removed concurrently for physical memory upgrade or repair**
  - **Restart with a fenced book following the rare event of a book failure**
- **How?**
  - **Select an S18, S28, S38, or S54 Model**
    - Configure no more than the following number of PUs
      - 8 active PUs on the S18
      - 18 active PUs on the S28
      - 28 active PUs on the S38
      - 40 active PUs on the S54
    - Requires no special feature codes for PU/model configuration.
  - **Select Flexible Memory configuration features**

Configurable PUs (Standard)	8	18	28	38	54
Configurable PUs (Enhanced Availability)	NA	8	18	28	40
GB Memory (Standard)	16 - 128	16 - 256	16 - 384	16 - 512	16 - 512
GB Memory (Flexible)	NA	32 - 128	32 - 256	32 - 384	32 - 384

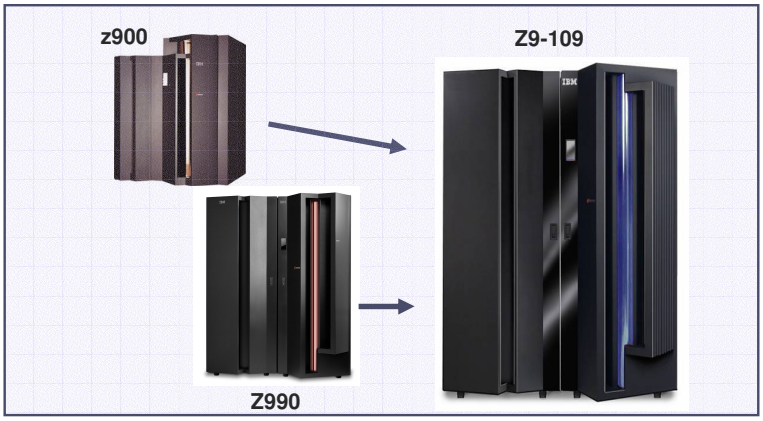
IBM System z9 109 Model S54

- **2094 Model S54**
  - Four books standard
- **Processor Units (PUs)**
  - 16 PUs in each of four books
  - 2 SAPs per book, standard
  - 2 spares per server
  - 1 - 54 PUs available
    - CPs, IFLs, ICFs, zAAPs, optional SAPs
- **Memory**
  - Minimum of 16 GB
  - Up to 512 GB
    - 16 GB increments at 128 GB per book
- **Bandwidth for I/O cage**
  - Up to 16 STIs per book
    - 2.7 GB/s for each I/O and 2.0 GB/s for ICBs
  - Total system I/O bandwidth capability of 172.8 GB
- **Upgradeability**
  - Disruptive upgrade from zSeries and from other z9-109 models

Flexible upgrades

Protecting Your Investment in zSeries Technology

- **Full upgrades within the z9-109 ***
- **Any to any upgrade from IBM eServer zSeries 990 (z990)**
- **Any to any upgrade from IBM eServer zSeries 900 (z900), except Model 100**



* Upgrading to an S54 (planned availability Nov. 2005) from other z9-109 models will require a planned outage

Technical details

Frame & Models

Processor Book Design/Components

Memory

STI & I/O Connectivity

I/O Features

Channel Subsystems

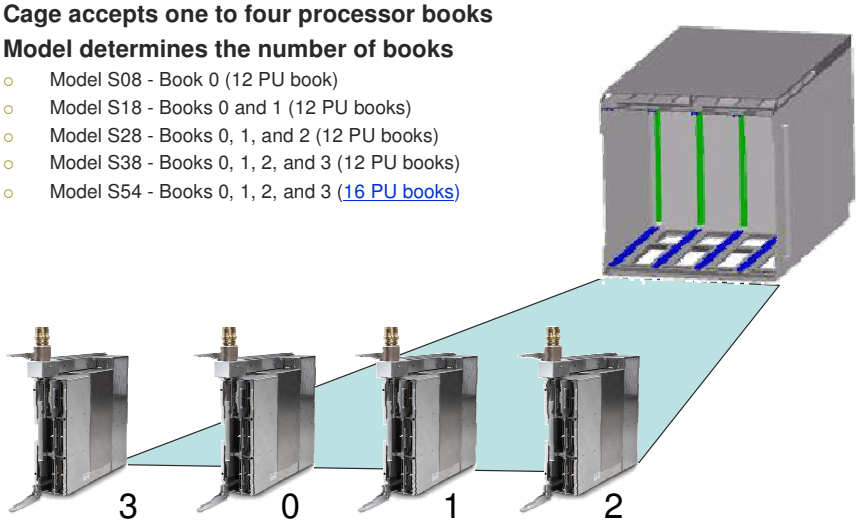
New HMC Introduction

Environmental

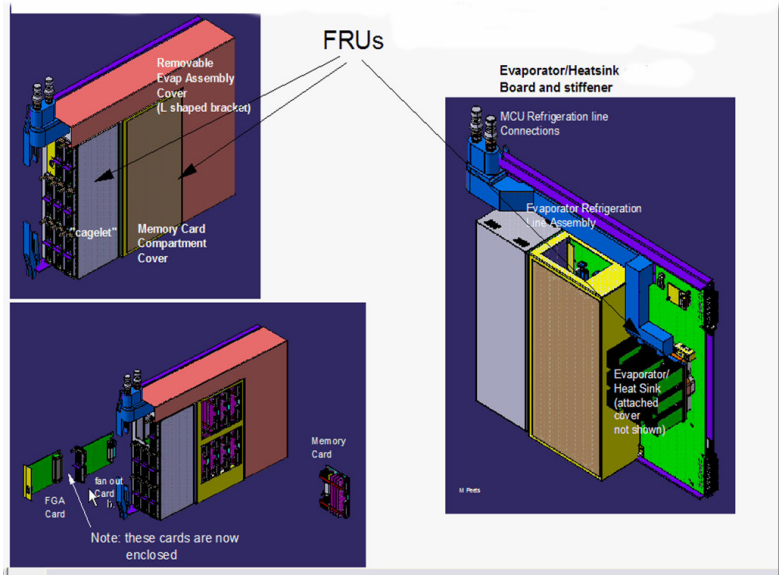
Software Support

z9-109 Books and CEC Cage

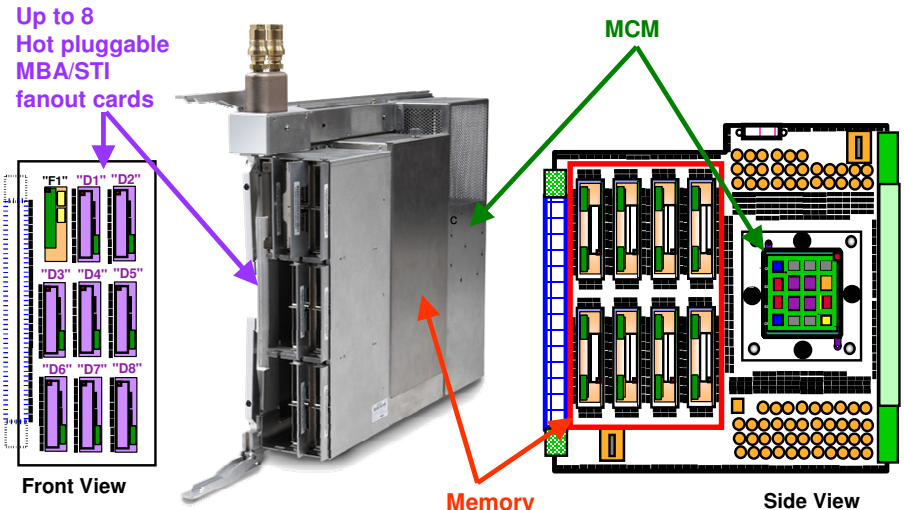
- Cage accepts one to four processor books
- Model determines the number of books
  - Model S08 - Book 0 (12 PU book)
  - Model S18 - Books 0 and 1 (12 PU books)
  - Model S28 - Books 0, 1, and 2 (12 PU books)
  - Model S38 - Books 0, 1, 2, and 3 (12 PU books)
  - Model S54 - Books 0, 1, 2, and 3 (16 PU books)



z9-109 Book Components

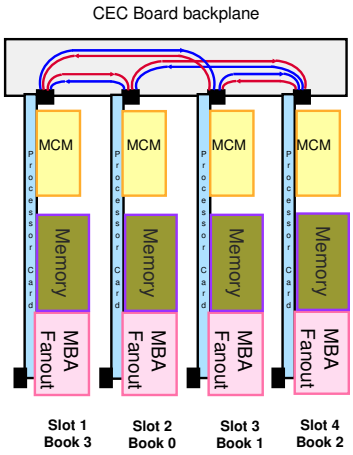


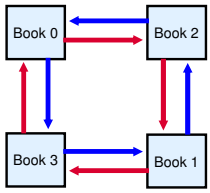
z9-109 Book Layout



Notes: 1. Concept Illustration only - not to scale
2. 4 or 8 pluggable Memory Cards
3. Each MBA fanout card is hot-pluggable and has 2 STIs

z9-109 Communication Ring Structure

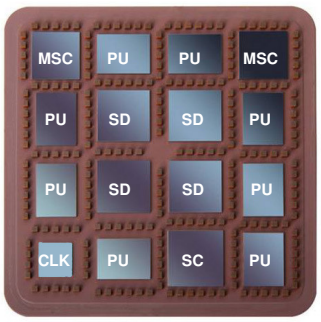




- **The ring structure consists of two rings (one running clockwise, the other counterclockwise)**
- **In a two or three Book configuration, jumper Book(s) (installed in the CEC cage) complete the ring**
  - Jumper Books are not needed for a single-Book configuration
- **Books can be inserted into or removed from the ring nondisruptively**
  - **Concurrent book add** for model upgrade
  - **Enhanced book availability** to return a book after removal for upgrade or repair

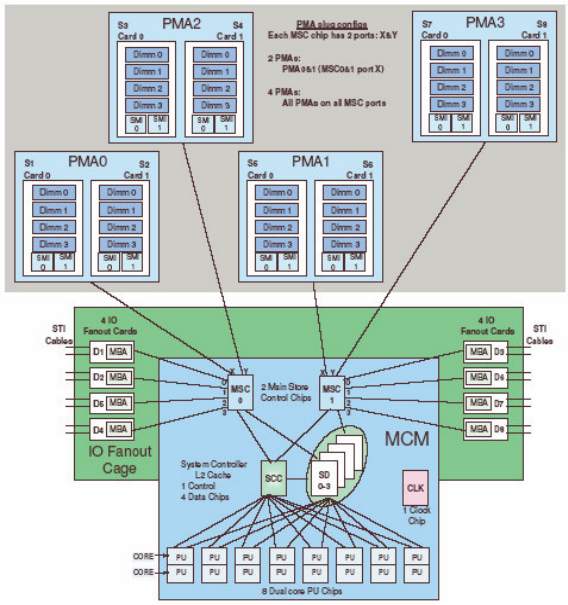
z9-109 multi-chip module (MCM)

- **Advanced 95mm x 95mm MCM**
  - 102 Glass Ceramic layers
  - 16 chip sites, 217 capacitors
  - 0.545 km of internal wire
  - 5,184 input/output pads (2,966 signal pads)



- **CMOS 10K chip Technology**
  - PU, SC, SD and MSC chips
  - Copper interconnections, 10 copper layers
  - 8 PU chips/MCM
    - 15.78 mm x 11.84 mm
    - 121 million transistors/chip
    - L1 cache/PU
      - 256 KB I-cache
      - 256 KB D-cache
    - 0.58 ns Cycle Time
  - 4 System Data (SD) cache chips/MCM
    - 15.66 mm x 15.40mm
    - 660 million transistors/chip
    - L2 cache per Book: 40 MB
  - One Storage Control (SC) chip
    - 16.41mm x 16.41mm
    - 162 million transistors
    - L2 cache crosspoint switch
    - L2 access rings to/from other MCMs
  - Two Memory Storage Control (MSC) chips
    - 14.31 mm x 14.31 mm
    - 24 million transistors/chip
    - Memory cards (L3) interface to L2
    - L2 access to/from MBAs (off MCM)
- **One Clock (CLK) chip - CMOS 8S**
  - Clock and ETR Receiver

z9-109 MCM Data Flow



z9-109 PU Types and Characterization Features

- **Central Processor (CP7) – Feature 7810**
  - Provides processing capacity for z/Architecture and ESA/390 instruction sets
  - Can support **ANY** operating system, z/VM guest, or Coupling Facility
  - Z9-109 has **Capacity Marker** features NOT **Unassigned CP** features
- **IBM eServer zSeries Application Assist Processor (zAAP)** - **Feature 7814**
  - Under z/OS only and only the Java Virtual Machine (JVM)
  - Requires z/OS 1.6 and later
- **Integrated Facility for Linux (IFL) and Unassigned IFL – Features 7811 and 7831**
  - Provides additional processing capacity exclusively for Linux workloads
  - Runs Linux or Linux under z/VM Version 4 or Version 5
- **Internal Coupling Facility (ICF) – Feature 7812**
  - Provides additional processing capacity exclusively for the execution of the Coupling Facility Control Code (CFCC) in a CF LPAR
- **Optional System Assist Processors (SAPs) – Feature 7813**
  - Standard and Optional SAPs do I/O processing in the channel subsystem
  - Two standard SAPs are provided per book
  - Optional SAPs are typically NOT needed except, sometimes for TPF
- **Spare PUs – Not orderable**
  - Two standard spares per z9-109 and available (unassigned) PUs

Technical details

Frame & Models

Processor Book Design/Components

Memory

STI & I/O Connectivity

I/O Features

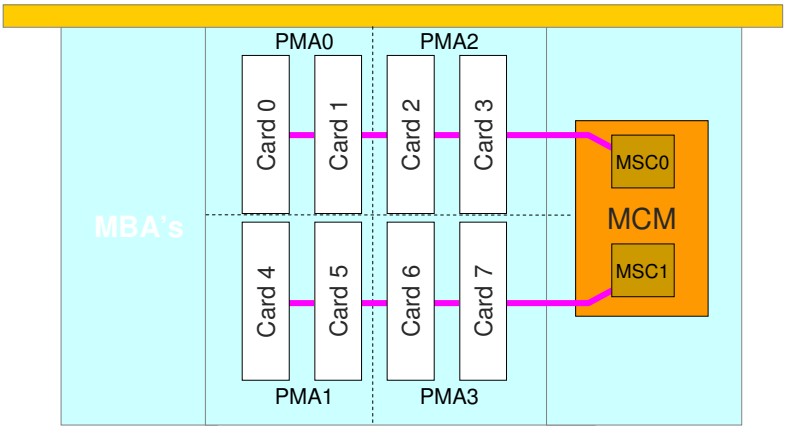
Channel Subsystems

New HMC Introduction

Environmental

Software Support

Memory Cards in a Book



z9-109 Memory Configurations

- Standard – Least cost: **split memory as equally as possible among books, use smallest possible cards for purchased memory**
- Flexible – **Supports** Enhanced Book Availability**: split memory as equally as possible among books, use large enough cards to** ensure purchased memory remains available if any one book is removed
- Memory Purchase Increment – 16 GB **standard or flexible**

Purchased	Model	S08	S18	S28	S38, S54
Standard Configuration	Minimum	16 GB	16 GB	16 GB	16 GB
	Maximum	128 GB	256 GB	384 GB	512 GB
Flexible Configuration	Minimum	NA	32 GB	32 GB	32 GB
	Maximum	NA	128 GB	256 GB	384 GB

Physical memory In a book	16 GB	32 GB	48GB	64 GB	80 GB	96 GB	112 GB	128 GB
Memory Card Configuration	4 x 4	4 x 8	8 x 8	8 x 8	8 x 16	8 x 16	8 x 16	8 x 16

z9-109 Concurrent Memory Upgrades

- **LIC enable additional memory to the physical limit of the installed cards and memory configuration**
  - Designed to be possible and concurrent in many but not all configurations
- **Add a book with additional memory**
  - Designed to be possible except for Models S38 and S54
- **Exploit Enhanced Book Availability to change memory card configuration in existing books**
  - Not possible on Model S08
  - Exploits capability for concurrent book remove, upgrade and return
  - Designed to be possible with flexible memory and PU configurations
  - May be possible with standard memory and PU configurations depending on LPAR configuration

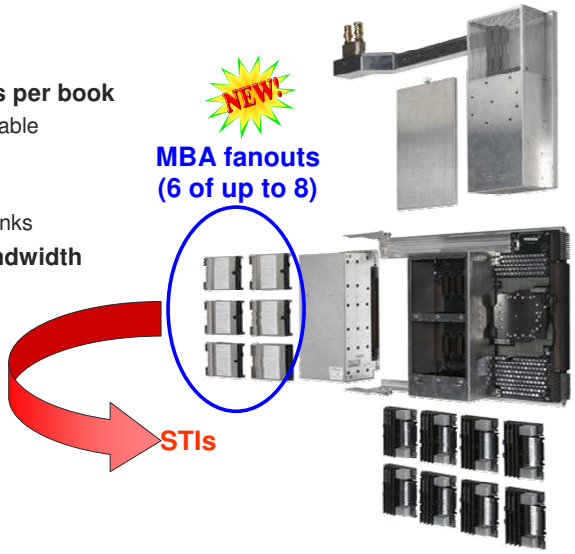
Note: Concurrent memory upgrades above are designed not to require CEC activation (POR). z/OS with "reserved memory" configured in the LPAR profile can add memory to a running partition. Otherwise adding memory to a partition requires deactivation, profile change and activation of the partition, which is designed to be disruptive to that partition only.

Technical details

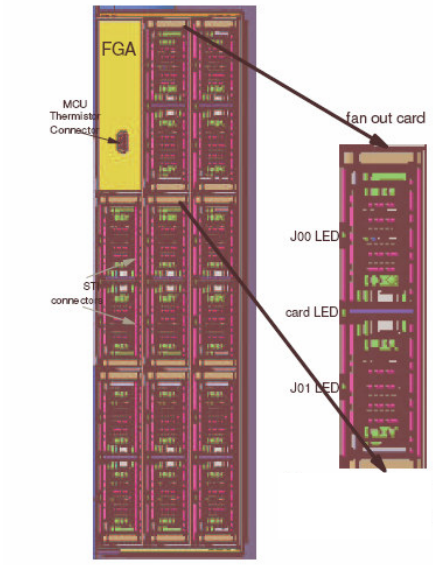
- Frame & Models
- Processor Book Design/Components
- Memory
- STI & I/O Connectivity
- I/O Features
- Channel Subsystems
- New HMC Introduction
- Environmental
- Software Support

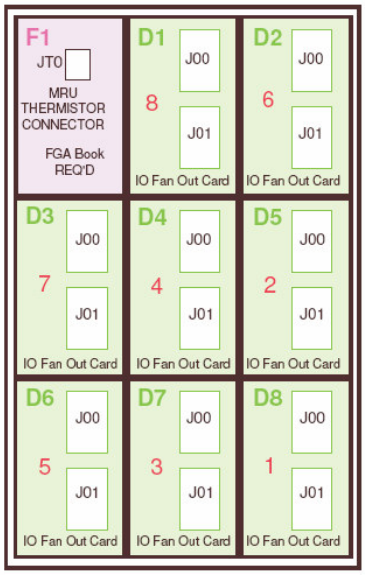
z9-109 MBA Fanouts and STIs

- **Up to 8 MBA fanout cards per book**
  - Hot pluggable and maintainable
- **Two STIs per fanout**
  - 2.7 GB/sec for I/O domains
  - 2 GB/sec for ICB coupling links
- **Up to 80% greater I/O bandwidth per book than z990**



STIs

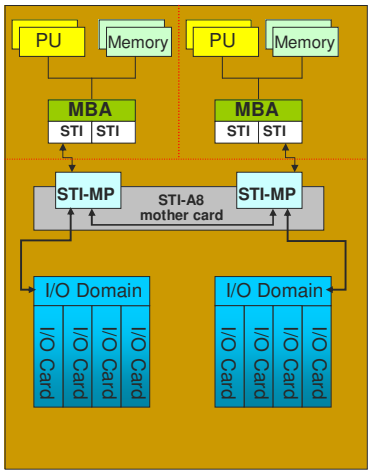




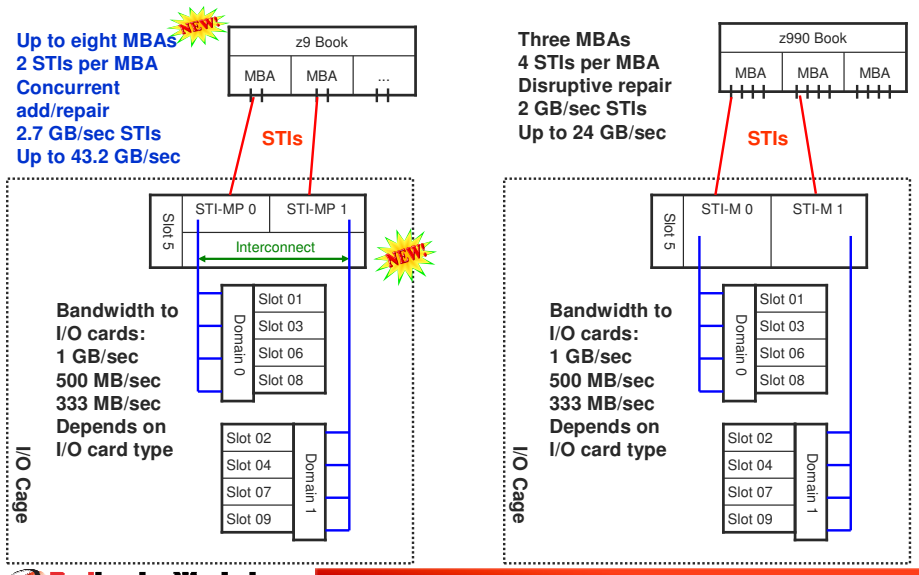
z9-109 Dynamic I/O Bus

- **Primary Requirement:**
  - Support the dynamic book maintenance with minimal system impact (requires planning)
- **I/O Adapter Characteristics**
  - On a multi-book machine, I/O Adapters are distributed across books
  - I/O Adapters have no intrinsic BOOK AFFINITY
  - All Books/PU's can access all adapters via Shared Memory, Book Busses
  - Book Removal must not cause loss of I/O in use by other Books
  - Significant loss of connectivity if violated (up to 64 CHPIDs / STI, 16 STI's)
- **Approach:**
  - Provide Dual STI Attachment for each STI-MP, each with unique book connectivity
  - Provide a means to "Swap" the traffic to the other path when required.
  - Controlled Swap for Maintenance Scenarios

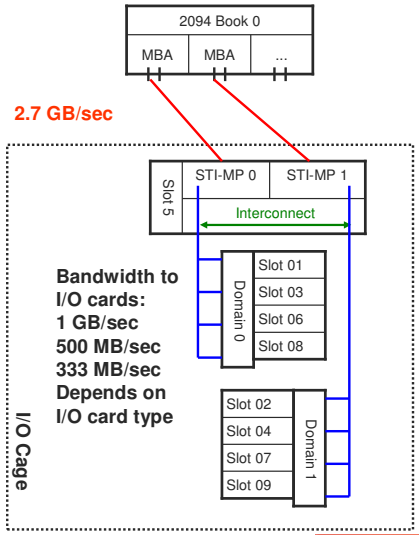
z9-109



z9-109 I/O structure compared to z990 (per book)



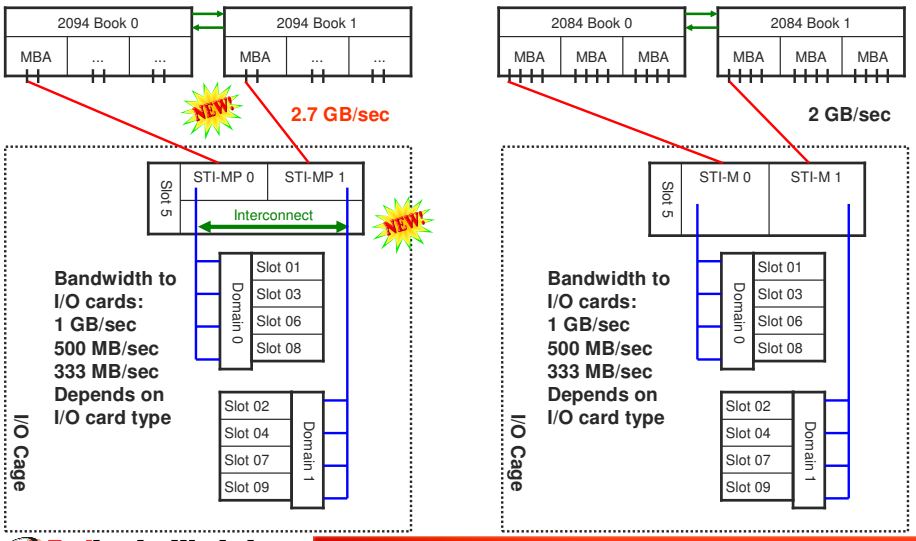
z9-109 Redundant I/O Interconnect – single book



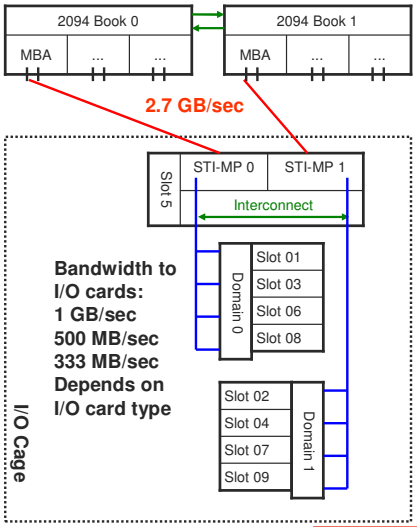
- **Normal Operation**
  - STI-MP 0 STI supports only Domain 0
  - STI-MP 1 STI supports only Domain 1
  - STIs from different MBAs
- **Redundant operation – one book**
  - Using the interconnect STI-MP 0 STI **OR** STI-MP 1 STI supports **both** domains
  - New function on z9-109:
    - **Concurrent MBA repair**
    - **Concurrent STI cable repair**

NEW!

z9-109 I/O structure compared to z990 (two books)



z9-109 Redundant I/O Interconnect - multiple book

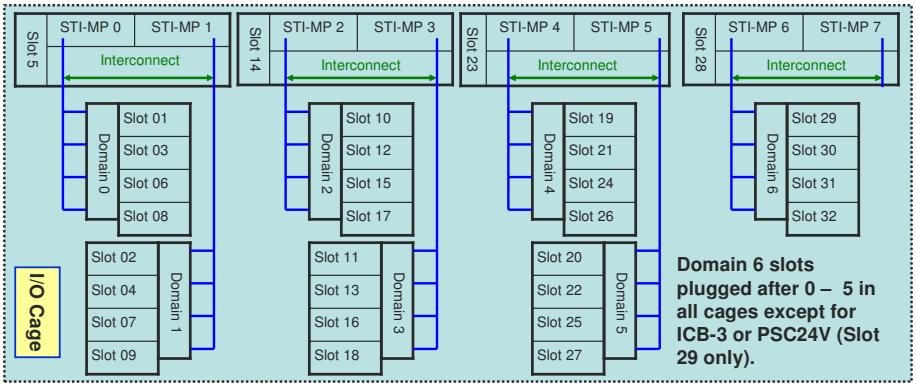


- **Normal Operation**
  - STI-MP 0 STI supports only Domain 0
  - STI-MP 1 STI supports only Domain 1
  - MBAs from different books
- **Redundant operation – multi-book**
  - Using the interconnect STI-MP 0 STI **OR** STI-MP 1 STI supports both domains
  - New function: STI/MBA repair and
    - Concurrent MBA/STI reconfiguration for **Concurrent Book Add**
    - **Enhanced Book Availability** Concurrent book shutdown without loss of I/O (except ICB) and Restart with fenced book

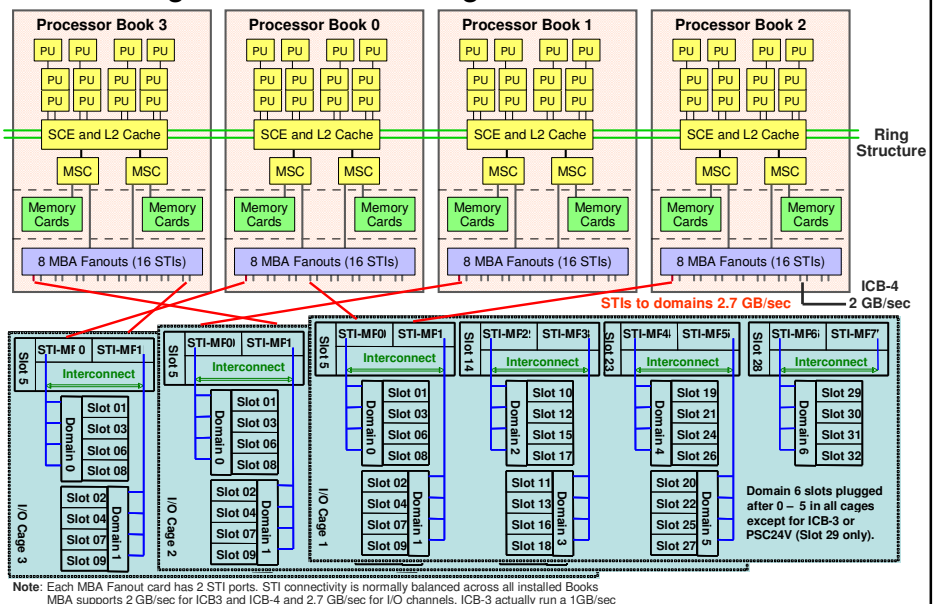
NEW!

z9-109 I/O cage

- **Increased power capacity – Adequate cage for any combination of 28 I/O cards**
- **New STI multiplexers with Redundant I/O Interconnect**
  - Up to four pairs supporting Domains 0/1, 2/3, 4/5, and 6
  - Up to 1 GB/sec bandwidth per I/O card in each domain
  - Hot pluggable (Airflow cards used if domains not populated)
- **Disruptive MES add – Use "Plan Ahead" to avoid disruption**



z9-109 Logical Channel Configuration



Note: Each MBA Fanout card has 2 STI ports. STI connectivity is normally balanced across all installed Books
MBA supports 2 GB/sec for ICB3 and ICB-4 and 2.7 GB/sec for I/O channels. ICB-3 actually run a 1GB/sec

Technical details

Frame & Models

Processor Book Design/Components

Memory

STI & I/O Connectivity

I/O Features

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z9-109 Channel and Cryptographic Feature Overview

- **FICON**
  - FC and FCP:
    - FICON Express2
      - 64 Open Exchanges
    - FICON Express*
  - FCV: FICON Express
- **Networking**
  - OSA-Express2
    - Gigabit Ethernet LX and SX
    - 10 Gigabit Ethernet LR
    - 1000BASE-T Ethernet
  - OSA-Express*
    - Gigabit Ethernet LX and SX
    - 1000BASE-T Ethernet
    - Fast Ethernet
  - HiperSockets
- **Coupling Links**
  - ISC-3 (Peer mode only)
  - ICB-3, ICB-4
  - IC (Peer mode only)
- **ESCON**

- **Crypto**
  - Crypto Express2
    - Secure Coprocessor
    - Accelerator
- **Channel types not supported:**
  - OSA-Express Token-Ring (SOD Oct 2004)
  - ICB-2 (SOD 2003)
  - ISC-3 Links in Compatibility Mode (SOD April 2004)
  - Older crypto is not supported

* Available only when carried forward on an upgrade.

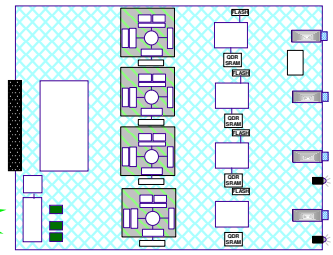
Note: Only ICB cables orderable. All other cables have to be sourced separately.

z9-109 I/O connectivity overview

- **FICON Express2, FICON Express**
  - Up to 84 features
  - Up to 336 channels (256 on Model S08) if all FICON Express2
  - FICON Express required for FCV support (RPQ 8P2295)
- **OSA-Express2, OSA-Express**
  - Up to 24 features, 48 ports
  - Gigabit Ethernet, 10 Gigabit Ethernet, 1000BASE-T Ethernet, Fast Ethernet
- **HiperSockets internal LANs, up to 16**
- **Coupling Links, up to 64 total**
  - IC (up to 32), ICB-3 (up to 16), ICB-4 (up to 16), ISC-3 (up to 48 links)
- **ESCON Channels, 16-port cards**
  - Up to 1024 channels, 69 cards (960 channels, 64 cards on Model S08)
- **Crypto Express2**
  - Up to 8 features, 16 coprocessors
  - Default Secure Coprocessor or configurable as “Public key” Accelerator

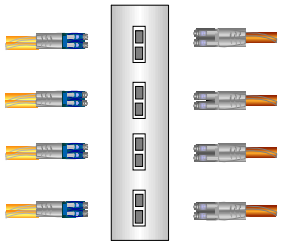
z9 FICON Express2

- **Four channels per feature of LX or SX**
  - Carry forward and new build
- **Connectivity options for each channel**
  - 1 or 2 Gbps, auto-negotiated
  - Can be shared among LPARs, and defined as spanned
- **Two operating modes (no FCV support)**
  - Defined on a port basis
  - FC (Fibre Channel): Native FICON and FICON CTC
    - Up to 64 Open Exchanges
    - Point to point or two director cascade
  - FCP (Fibre Channel Protocol)
    - SCSI LUN access for Linux environments
    - Point to point or multiple director fabric
- **Connector - LC Duplex**
- **LX - 9 micron single mode fiber**
  - Unrepeated distance – up to 10 kilometers (6.2 miles)
  - Receiving device must also be LX
- **SX - 50 or 62.5 micron multimode fiber**
  - Variable distance with speed and fiber type
  - Receiving device must also be SX
- **Supported connectivity devices**
  - Refer to: www.ibm.com/servers/eserver/zseries/connectivity



NEW!

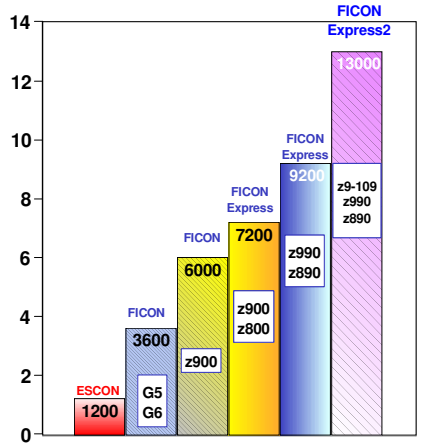
4th Generation



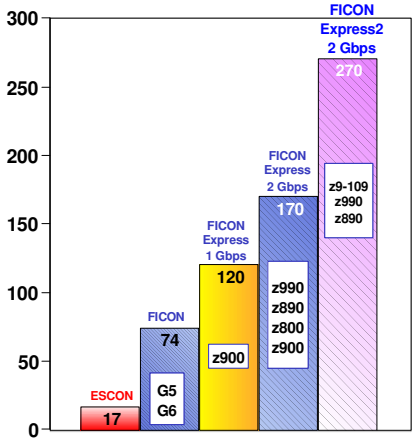
LX = FC3319 or SX = FC3320

FICON Express2 Performance (FC channel)

I/Os per second*
4k block size, Channel 100% utilized



MB/sec throughput (Full Duplex)*
Large Sequential R/W mix

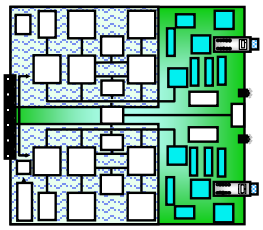


*This performance data was measured in a controlled environment on a z990 running an I/O driver program under z/OS 1.6. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.

z9-109 FICON Express – for FCV Support

- **Modes of Operation: defined on a port basis**
  - **FCV (FICON Bridge Converted) LX feature only**
  - FC (Fibre Channel): Native FICON and FICON CTC
    - Up to 32 Open Exchanges
  - FCP (Fibre Channel Protocol): SCSI devices in Linux environments
- **Replaced by FICON Express Express2**
  - Still fully supported on z9-109
  - Carried forward in upgrades to z9-109
  - **Not orderable by feature code**
  - **Orderable by RPQ 8P2295 if required to add additional FCV channels ONLY (as available)**
    Note: IBM 9032-5 ESCON Director FICON Bridge cards were withdrawn as of December 31, 2004
- **Bandwidth**
  - 1 or 2 Gbps link data rate- Auto-negotiated
- **Connector - LC Duplex**
- **LX - 9 micron single mode fiber**
  - Unrepeated distance – up to 10 kilometers (6.2 miles)
  - Receiving device must also be LX
- **SX - 50 or 62.5 micron multimode fiber**
  - Variable distance with speed and fiber type
  - Receiving device must also be SX

FICON Express
3rd Generation

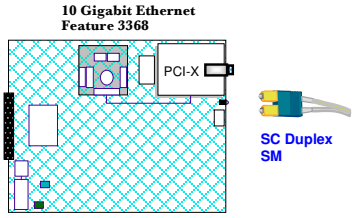


FC 2319 (LX), 2320 (SX)

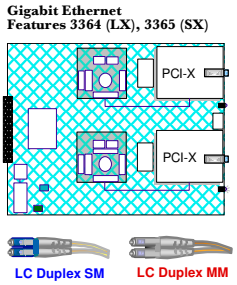
LC Duplex Connectors

OSA-Express2 GbE, 10 GbE

- **10 Gigabit Ethernet LR (long reach)**
  - One port per feature
  - CHPID type OSD (QDIO)
  - 9 micron single mode fiber, SC Duplex connector



- **Gigabit Ethernet features, 2 ports per feature**
  - **CHPID types OSD (QDIO), OSN (OSA for NCP)**
  - **Designed to achieve line speed - 1 Gbps in each direction**
  - Gigabit Ethernet LX (Long wavelength)
    - 9 micron single mode fiber, LC Duplex connector
  - Gigabit Ethernet SX (Short wavelength)
    - 50 or 62.5 micron multimode fiber, LC Duplex connector



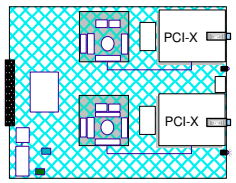
- **OSA-Express2 GbE and 10 GbE support**
  - **Layer 2 support -** protocol-independent packet forwarding
  - **Large send -** offloading TCP segmentation
  - **640 TCP/IP stacks -** improved virtualization
  - **Concurrent LIC update** to minimize network traffic disruption
  - **Queued Direct Input/Output** (QDIO), CHPID type OSD

z9-109 OSA-Express2 1000BASE-T Ethernet

- **New to OSA-Express2 family**
- **Supports auto-negotiation to 10, 100, 1000 Mbps over Category 5 copper**
- **Capable of achieving line speed**
  - Actual throughput is dependent upon environment
- **Supports:**
  - **Large send -** offloading TCP segmentation
  - **Concurrent LIC update** to minimize network traffic disruption
  - **640 TCP/IP stacks -** improved virtualization
  - **Layer 2 support -** protocol-independent packet switching

Mode	CHPID	Description
OSA-ICC	OSC	3270 data streams
QDIO	OSD	TCP/IP traffic when Layer 3 Protocol-independent when Layer 2
Non-QDIO	OSE	TCP/IP and/or SNA/APPN/HPR traffic
OSA NCP	OSN	Channel Data Link Control for Linux NCP

1000BASE-T Ethernet #3366



I/O connectivity summary

Maximum of 1024 CHPIDs, three I/O cages, 84 I/O slots (28 I/O slots per I/O cage)

Features	Minimum # of features	Maximum # of features	Maximum connections	Increments per feature	Purchase increments
16-port ESCON	0 (1)	69	1024 channels	16 channels 1 reserved as a spare	4 channels
FICON Express2 *	0 (1)	84	336 channels	4 channels	4 channels
FICON Express *	0 (1)	60	120 channels	2 channels	2 channels
STI-3 (2) IBC-3 link	0 0 (1)	8 N/A	N/A 16 links (3)	2 outputs N/A	N/A 1 link
ICB-4	0 (1)	N/A	16 links (3) (4)	N/A	1 link
ISC-3	0 (1)	12	48 links (3)	4 links	1 link
OSA-Express2	0	24	48 ports	2 or 1 (10 GbE has 1)	2 ports/1 port
OSA-Express *	0	24	48 ports	2 ports	2 ports
Crypto Express2	0	8	16 PCI-X adapters	2 PCI-X adapters	2 PCI-X adapters (5)

1. Minimum of one I/O feature (ESCON, FICON) or one Coupling Link (ICB , ISC-3) required.
2. Each STI-3 distribution card occupies one I/O slot (supports ICB-3s).
3. Maximum number of Coupling Links combined (ICs, ICB-3s, ICB-4s, and active ISC-3 links) cannot exceed 64 per server.
4. ICB-4s are not included in the maximum feature count for I/O slots but are included in the CHPID count.
5. Initial order of Crypto Express2 is 4 PCI-X adapters (two features). Each PCI-X adapter can be configured as a coprocessor or an accelerator.

* Available only when carried forward on an upgrade.

Note: There is a maximum of 64 ESCON features/960 active channels and a maximum of 64 FICON features/256 channels Model z08.

Connectors and fiber optic cabling

Feature #	Feature name	Connector	Cable type
0219	**ISC-3**	**LC Duplex**	**9 u SM**
6155	**External Time Reference (ETR)**	**MT-RJ**	**62.5 u MM**
2324	**ESCON channel**	**MT-RJ**	**62.5 u MM**
2319	**FICON Express LX**	**LC Duplex**	**9 u SM**
2320	**FICON Express SX**	**LC Duplex**	**50, 62.5 u MM**
3319	**FICON Express2 LX**	**LC Duplex**	**9 u SM**
3320	**FICON Express2 SX**	**LC Duplex**	**50, 62.5 u MM**
2364	**OSA-Express GbE LX**	**SC Duplex**	**9 u SM**
2364	**OSA-Express GbE LX**	**SC Duplex**	**9 u SM**
2365	**OSA-Express GbE SX**	**SC Duplex**	**50, 62.5 u MM**
2366	**OSA-Express Fast Ethernet**	**RJ-45**	**Category 5 UTP**
1364	**OSA-Express GbE LX**	**LC Duplex**	**9 u SM**
1365	**OSA-Express GbE SX**	**LC Duplex**	**50, 62.5 u MM**
1366	**OSA-Express 1000BASE-T Ethernet**	**RJ-45**	**Category 5 UTP**
3364	**OSA-Express2 GbE LX**	**LC Duplex**	**9 u SM**
3365	**OSA-Express2 GbE SX**	**LC Duplex**	**50, 62.5 u MM**
3366	**OSA-Express2 1000BASE-T Ethernet**	**RJ-45**	**Category 5 UPT**
3368	**OSA-Express2 10 GbE LR**	**SC Duplex**	**9 u SM**

NEW!

U = micron SM = Single mode fiber, MM = Multimode fiber, LX = Long wavelength transceiver, SX = Short wavelength transceiver, UTP = Unshielded Twisted Pair, STP = Shielded Twisted Pair, LR = Long Reach transceiver

Z9-109 Cards and Connectors

Description	Feature Code	CCIN	Connector	Picture
ETR	6154	QZ8E	MM MT-RJ	
ISC-3 2Gb	0219	QZ2B	SM LC-Duplex	
ESCON-16 Port	2323	QZ26	MM MT-RJ	
eSTI-3 for ICB-3	3993	QZ83	STI	
ICB-4 Enablement	3393	n/a	STI	
PSC-24V	6501	QZ20	DB15	

Z9-109 Cards and Connectors…

Hydra 1.5 Family	Feature Code	CCIN	Connector	Picture
OSA Express Fast Ethernet	2366	QD2F	RJ-45	
Hydra\Ficon 1.75 Family	**Feature Code**	**CCIN**	**Connector**	**Picture**
OSA Express GbE LX	2364	QD2L	SM SC-Duplex	
OSA Express GbE SX	2365	QD2G	MM SC-Duplex	
OSA Express GbE (Goliad-LX)	1364	QD8Y	SM LC-Duplex	
OSA Express GbE SX (Goliad-SX)	1365	QD8S	MM LC-Duplex	
OSA Express Fast Ethernet 10/100/1000	1366	QD8Z	RJ-45	
FICON Express LX	2319	QD2V	SM LC-Duplex	
FICON Express SX	2320	QD2X	MM LC-Duplex	

Z9-109 Cards and Connectors…

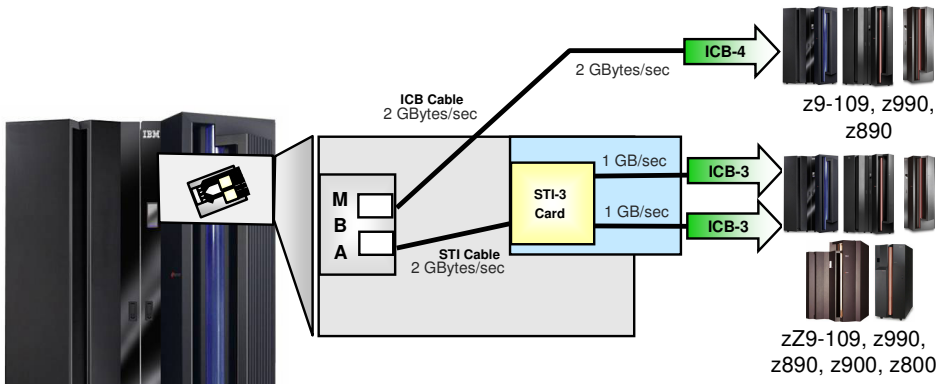
Hydra\Ficon 3.00 Family	Feature Code	CCIN	Connector	Picture
PCIXCC 3.0 Crypto Express 2	0863	QD8C	-	-
OSA Express2 GbE LX	3364	QD8E	SM LC-Duplex	
OSA Express2 GbE SX	3365	QD8G	MM LC-Duplex	
OSA Express2 Fast Ethernet 10/100/1000	3366	QD8F	RJ-45	
OSA Express2 10 GbE Long Reach	3368	QD8O	SM SC-Duplex	
FICON Express2 1/2Gb LX 4-port	3319	QD8L	SM LC-Duplex	
FICON Express2 1/2Gb SX 4-port	3320	QD8A	MM LC-Duplex	

zSeries OSA-Express features over time

Feature	Feature Name	z900	z800	z990	z890	z9	CHPIDs
3364	OSA-E2 GbE LX	N / A	N / A	01/05	01/05	Yes, C	OSD, OSN (09/05)
3365	OSA-E2 GbE SX	N / A	N / A	01/05	01/05	Yes, C	OSD, OSN (09/05)
3366	OSA-E2 1000BASE-T Ethernet	N / A	N / A	N / A	N / A	Yes	OSC, OSD, OSE, OSN
3368	OSA-E2 10 GbE LR	N / A	N / A	01/05	01/05	Yes, C	OSD
1364	OSA-E GbE LX	09/04	09/04	WD, C	WD, C	C	OSD
1365	OSA-E GbE SX	09/04	09/04	WD, C	WD, C	C	OSD
1366	OSA-E 1000BASE-T Ethernet	N / A	N / A	Yes	Yes	C	OSC, OSD, OSE
2362	OSA-E 155 ATM SM	Yes	Yes	RPQ	N / A	N / A	OSD, OSE
2363	OSA-E 155 ATM MM	Yes	Yes	RPQ	N / A	N / A	OSD, OSE
2364	OSA-E GbE LX	WD	WD	C	C	C	OSD
2365	OSA-E GbE SX	WD	WD	C	C	C	OSD
2366	OSA-E Fast Ethernet	Yes	Yes	C	C	C	OSD, OSE
2367	OSA-E Token-Ring	Yes	Yes	Yes	Yes	N / A	OSD, OSE

LX = Long wavelength transceiver, SX = Short wavelength transceiver, LR - Long Reach transceiver
C = Carry forward on an upgrade. Replacements available.
WD = Formerly available, now withdrawn. Replacements available
Yes = Currently orderable.

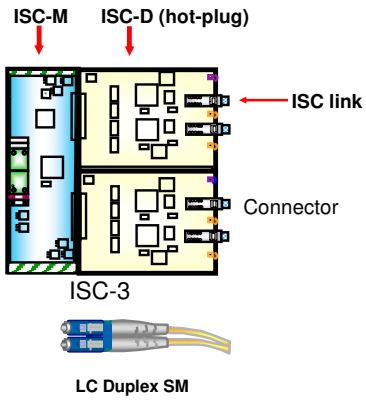
z9-109 and ICB Coupling Links



- **STI multiplexor cards take I/O card slots**
- **No I/O slot needed for ICB-4 on z9-109**
- **ICB Cables – different types for ICB-3 and ICB-4**
  - 10 meter copper wire cables

z9-109 Fiber Optic Coupling Links

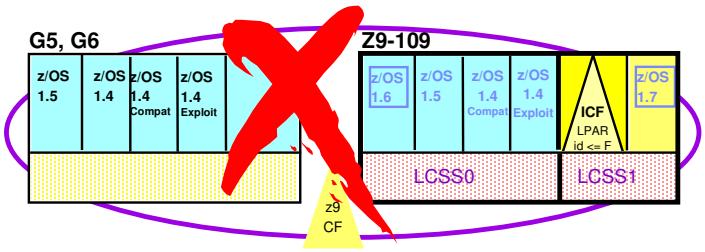
- **InterSystem Channel-3**
  - 3rd generation Coupling Link
  - ISC-3 links ordered in increments of one
  - Activated links balanced across features
- **Peer mode only**
  - Peer Mode (2 Gigabits per second - Gbps)
  - Connects to System z9 and zSeries
  - **No connectivity to any 9672 or 9674**
- **ISC-3 FCs: 0217(ISC-M), 0218 (ISC-D / ISC link)**
  - Activate link - FC 0219
  - Four ports per ISC-M (two ports per ISC-D)
  - Supports 9 micron single mode fiber
- **Up to 48 links**



z9-109 CF Links - Connectivity to G5/G6

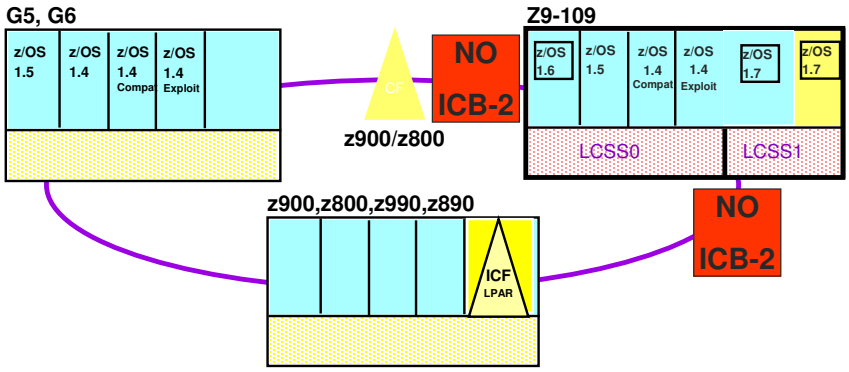
- **z9-109 CF image**
  - Cannot connect to any G5/G6 z/OS senders (or duplex to a G5/G6)
- **G5/G6 CF image**
  - Cannot connect to any z9-109 z/OS senders (or duplex to a z9-109 CF).
- **G5/G6 and z9-109 images**
  - Can coexist in the same sysplex if CFs are on z990/z890/z900/z800
    - These CFs can connect to both G5/G6 and the z9-109, so they can provide a "bridge" that allows them to coexist in a sysplex.
- **Links only supported in Peer Mode**
  - No support for compatibility mode (CFS/CFR, etc)
- **No support for ICB-2 Links**
  - Which could only run in compatibility mode (i.e. CBS/CBR)

Parallel Sysplex coexistence with a z9-109 CF



- Connecting a z9-109 CF image to any G5/G6 z/OS senders is **NOT** supported

Sysplex coexistence with a G5/G6 and z9-109 Senders



G5/G6 z/OS senders CAN be in the same Sysplex with z9-109 senders if they connect with CFs on z990, z890, z900 or z800 servers!

- These CFs can connect to both the old (G5/G6) and the z9-109
- They can provide a "bridge" that allows them to coexist in a Sysplex

z9-109 CF Link Connectivity

Connectivity Options	Z9-109 ISC-3	Z9-109 ICB-3	Z9-109 ICB-4
z800/z900 ISC-3	**2 Gbps Peer Mode**	**N/A**	**N/A**
z890/z990/z9-109 ISC-3	**2 Gbps Peer Mode**	**N/A**	**N/A**
z800/z900 ICB-3	**N/A**	**1 GBps Peer Mode**	**N/A**
z890/z990/z9-109 ICB-3	**N/A**	**1 GBps Peer Mode Recommendation: Use ICB-4**	**N/A**
z890/z990/z9-109 ICB-4	**N/A**	**N/A**	**2 GBps Peer Mode**

RPQ - 20Km for 1Gbps.
Coupling Connectivity to 9672's and any System with ICB-2 is not supported
Compatibility mode (sender/receiver) ISC-3 not supported

CF Levels

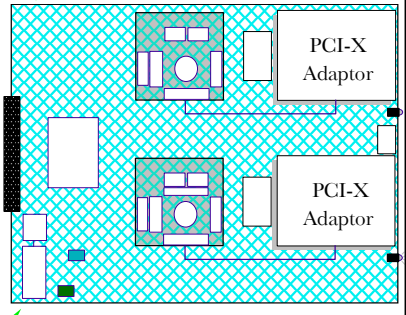
Release	G5/G6	Z800/Z900	Z990	z890	z9-109
Level 11		**NA**	**NA**	**NA**	**NA**
Level 12	**NA**	EC J11207 Driver 3G MCL 016	EC J12555 Driver 52 MCL 007	**NA**	**NA**
Level 13	**NA**	EC J11207 Driver 3G MCL 022	EC J13481 Driver 55K MCL 003	EC J13481 Driver 55K MCL 003	**NA**
Level 14	**NA**	**NA**	EC J13481 Driver 55K MCL 004	EC J13481 Driver 55K MCL 004	EC J99670 Driver 63 MCL ---

- www.ibm.com/servers/eserver/zseries/cfsizer/
  - No storage/structure increases if already on CF Level 14
- **Dedicated ICF's recommended**

z9-109 Crypto Express2 Feature

- **Dual Integrated Cryptographic Coprocessors**
  - Individually configurable as:
    - **Secure Coprocessor** (default), which provides both "Secure key" and "Public key" functionality
    - **Accelerator**, which provides only "Public key" functionality with enhanced performance
  - Current applications expected to run without change
- **Secure Coprocessor mode is fully programmable and supports User Defined Extensions (UDX)**
- **Scalable (no CP affinity)**
  - Supported Crypto Express2 configurations: 0, 2, 3, 4, 5, 6, 7, or 8 features
  - Plugs into an I/O card slot (no external cables)
  - Up to 8 Crypto Express2 features can plug into a single I/O cage
- **Designed for FIPS 140-2 Level 4 Certification**
- **Trusted Key Entry (TKE) support (optional)**
  - If configured, TKE 5 required on z9-109
  - Updated user interface compared to TKE 4.x
  - Secure operational and master key loading
  - Smart Card Reader support

NEW!



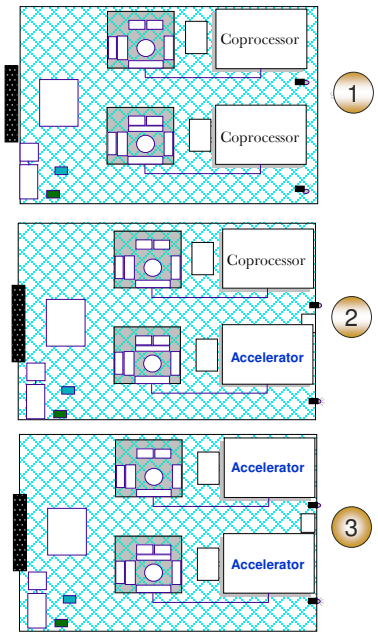
NEW!

z9-109 Crypto Express2 Configuration

- **Secure Coprocessor (default)**
  - Provides both Secure key" and "Public key" functionality and performance equivalent to Crypto Express2 features on z990
  - "Secure key" improved performance compared to PCIXCC on z990 (requires multitasking)
  - "Public key" equivalent performance to PCICA on z990
  - No action required

NEW!

- **Accelerator**
  - Provides only "Public key" functionality with enhanced performance
  - Must be configured using the HMC



z9-109 I/O connectivity summary

Maximum of 1024 CHPIDs, three I/O cages, 84 I/O slots (28 I/O slots per I/O cage)

Features	Minimum # of features	Maximum # of features	Maximum connections	Increments per feature	Purchase increments
16-port ESCON	0 (1)	69 64 (S08)	1024 channels 960 (S08)	16 channels 1 reserved as a spare	4 channels
FICON Express2	0 (1)	84 64 (S08)	336 channels 256 (S08)	4 channels	4 channels
FICON Express *	0 (1)	60	120 channels	2 channels	2 channels
STI-3 (2) ICB-3 link	0 0 (1)	8 N/A	N/A 16 links (3)	2 outputs N/A	N/A 1 link
ICB-4	0 (1)	N/A	16 links (3) (4)	N/A	1 link
ISC-3	0 (1)	12	48 links (3)	4 links	1 link
OSA-Express2	0	24	48 ports	2 or 1 (10 GbE has 1)	2 ports/1 port
OSA-Express *	0	24	48 ports	2 ports	2 ports
Crypto Express2	0	8	16 PCI-X Adapters	2 PCI-X Adapters	2 PCI-X Adapters (5)

1. Minimum of one I/O feature (ESCON, FICON) or one Coupling Link (ICB, ISC-3) required.
2. Each STI-3 distribution card occupies one I/O slot (supports ICB-3s).
3. Maximum number of Coupling Links combined (ICs, ICB-3s, ICB-4s, and active ISC-3 links) cannot exceed 64 per server.
4. ICB-4s are not included in the maximum feature count for I/O slots but are included in the CHPID count.
5. Initial order of Crypto Express2 is two features (4 PCI-X adapters). Each PCI-X adapter can be configured as a coprocessor (default) or an accelerator.

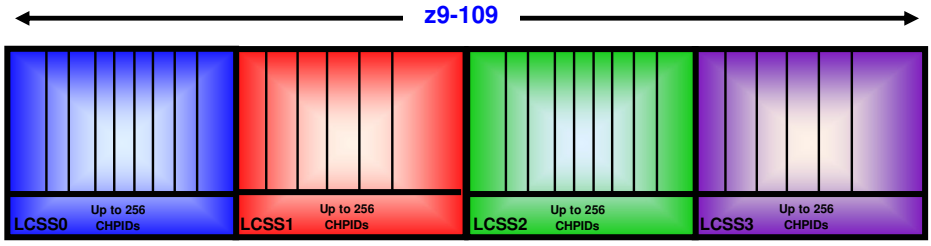
* Available only when carried forward on an upgrade or, for FICON Express, by RPQ 8P2295 for FCV support.

Note: There is a maximum of 64 ESCON features/960 active channels and a maximum of 64 FICON features/256 channels Model s08.

Technical details

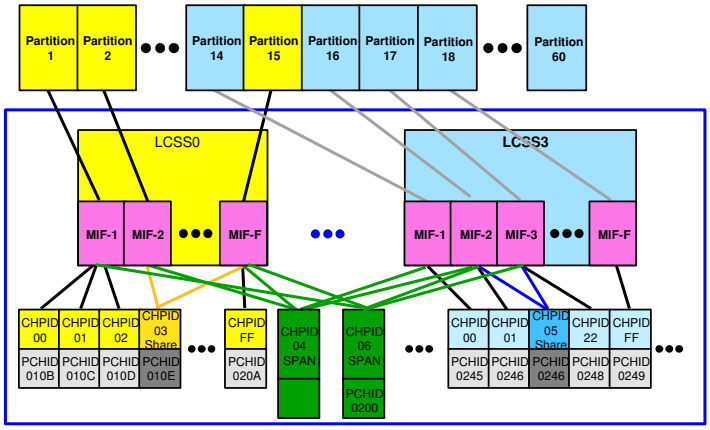
- Frame & Models
- Processor Book Design/Components
- Memory
- STI & I/O Connectivity
- I/O Features
- Channel Subsystems
- New HMC Introduction
- Environmental
- Software Support

z9-109 Logical Channel Subsystems (LCSSs)



- Up to four Logical Channel SubSystems (LCSSs) on z9-109
  - Up to 15 LPARs per LCSS
  - Up to 256 channels per LCSS
- Multiple Subchannel Sets (MSS) Enable
  - Up to 2 Subchannel sets (0 and 1) to increase IBM System z9 I/O addressability
- Multiple LCSSes Enable
  - **Up to 60 Logical Partitions per CEC (Requires four LCSSes on z9-109)**
  - Up to 1024 external channels on z9-109
- An LPAR can access channels ONLY in its assigned LCSS
- Some channels may be assigned to multiple LCSSs - "**Spanned Channels**"
  - ICP, IQD, FC, FCP, OSE, OSD, OSC, **OSN**, CBP, CBS, CFP, CFS
  - But not ESCON, FICON Conversion

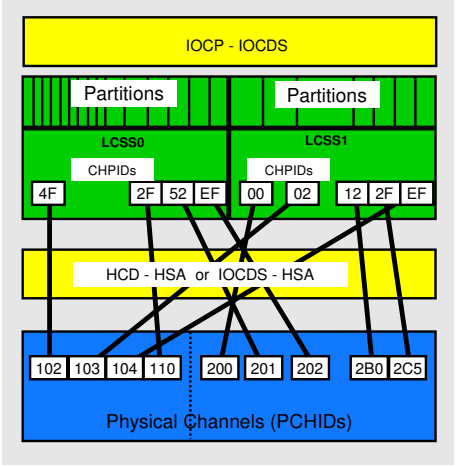
z9-109 Four LCSSs and External Spanned Channels



- **CHPID 04 Spanned Internal HiperSockets (IQD) or Internal Coupling Link (ICP)**
- **CHPID 06 Spanned external channel (FICON, OSA, or External Coupling Link)**
  Supported: FC, FCP, OSE, OSD, OSC, OSN, CBP, CFP
- **Not supported: ESCON, FICON Conversion**

z9-109 Physical Channel IDs (PCHIDs)

- **CHPID numbers are no longer pre-assigned**
  - i.e. there are NO default CHPID numbers
- **Customer MUST assign CHPIDs to channels**
  - HCD/IOCP manual process, and/or
  - CHPID Mapping Tool
- **CHPID assignment**
  - Define the channel to an LCSS(s)
  - Associate the CHPID number to a physical channel port location (PCHID)
  - CHPID numbers are still 00 - FF and must be unique within an LCSS
- **Physical channel location, known as the PCHID, is assigned by manufacturing and reported by eConfig in the PCHID report**
- **Except for ESCON sparing, a PCHID relates directly to a jack location on a channel card in a specific I/O slot, in a specific I/O cage**
  - Other exception
    - IC and HiperSockets - no PCHID
    - ICB-4 - assigned to CEC cage



zSeries CHPID Mapping Tool (CMT)

- **The latest level of the CHPID Mapping Tool is REQUIRED to map z9-109**
- **Why do you need a CHPID Mapping tool?**
  - **z9-109/z990/z890** - Aid **REQUIRED** mapping of Physical Channels (PCHIDs) to CHPIDs in IOCDS
  - **z900/z800** - Enable **OPTIONAL** reassignment of default CHPIDs on the CEC.
- **Changes to the Mapping Tool for z9-109, z990 and z890**
  - Three digit Physical Channel Identifiers (PCHIDs) rather than two direct (CHPIDs)
  - A LCSS prefix qualifier is defined in the form LCSS.cc (1.A0 for LCSS 1. CHPID A0)
  - Logical CHPID numbers with their owning LCSS are associated with physical Channels in IOCDS
  - Full support for channels added to previously mapped for z9-109, z990 and z890
- **Inputs Required**
  - Valid IOCP without PCHIDs from an HCD "Validated Work IODF"
  - Hardware Configuration (HWC) file from IBM or CFReport File from the IBM configurator
  - **Knowledge of the physical channel cabling infrastructure to be connected to channel ports**
- **Using the CHPID Mapping Tool:**
  - Two functions: Manual and Availability Mapping
  - Matches available channel ports/PCHIDs to IOCDS CHPID type
  - Offers an "availability" option designed to optimize the Channel assignments for RAS
  - Output:
    - **z900/z800**: Mapping diskette for CE
    - **z9-109/z990/z890**: Provides updated IOCP statements with PCHIDs entered for each CHPID
    - All: **Configuration Reports to support installation activities**

Technical details

Hardware Management Console

- **Closed Desktop**
  - No user applications allowed
    - 9037 Console, 9032 Console
- **Look and feel different from current application**
  - Functionally, same as current HMC for the most part
  - Beauty is in the eye of the beholder, but it is a good look and feel
  - Will require some operator and systems training prior to an installation
- **The z9-109 HMC does NOT support**
  - 9672 G1, G2, G3 or G4
- **Systems supported, upgraded to a proper AROM level**
  - z990 & z890 (Driver 55)
  - z900 & z800 (Driver 3G)
  - G5 & G6 (Driver 26)
- **The minimum HMC for the z9-109 is the HMC FC0075 or FC0076 with 1 GB of memory.**

HMC Transitioning

- **Existing HMC Feature Codes 0075,0076,0077,0078**
  - Will require additional memory to be added
    - 512MB to 1GB
  - Field EC to install new driver to existing HMCs
    - New driver does not support all earlier HMCs
    - Existing CECs will need to have MCLs applied to communicate with the new HMC driver
- **All HMC orders are shipped with the new driver level**
  - Even on z990 or z890 orders
    - As above, these new HMCs will not be able to support all of the earlier machines
    - Existing CECs will need to have MCLs applied to communicate with the new HMC driver

Technical details

Frame & Models

Processor Book Design/Components

Memory

STI & I/O Connectivity

I/O Features

Channel Subsystems

New HMC Introduction

Environmental

Software Support

z9-109 Physical planning - Include z900s.

- **Compared to z990**
  - Same footprint
  - Same service clearance
  - Same channel cabling
- **Power / Cooling**
  - Same power service as z990
  - Increased power consumption
  - Increased cooling requirements

z9-109 Environmental

Model*	One I/O Cage	Two I/O Cages	Three I/O Cages
s08	6.3 kW	9.2 kW	12.1 kW
s18	8.8 kW	11.8 kW	14.7 kW
s28	10.9 kW	13.9 kW	16.9 kW
s38	12.8 kW	15.7 kW	18.3 kW
s54	12.8 kW	15.7 kW	18.3 kW

Model*	One I/O Cage	Two I/O Cages	Three I/O Cages
s08	21.5 kBTU/hr	31.4 kBTU/hr	41.3 kBTU/hr
s18	30.0 kBTU/hr	40.2kBTU/hr	50.1 kBTU/hr
s28	37.2 kBTU/hr	47.4 kBTU/hr	57.6 kBTU/hr
s38	43.6 kBTU/hr	53.5 kBTU/hr	62.4 kBTU/hr
s54	43.6 kBTU/hr	53.5 kBTU/hr	62.4 kBTU/hr

* Assumes maximum supported configuration (maximum I/O adpters installed)

z9-109 Power Consumption Comparison

# Cages	One	Two	Three	One	Two	Three
A08	5.3	7.8	10.3			
B16	7.3	9.8	12.3			
C24	9.1	11.6	13.9			
D32	10.8	13.3	15.8			
s08	6.3	9.2	12.1	+18.9%	+17.9%	+17.5%
s18	8.8	11.8	14.7	+20.5%	+20.4%	+19.5%
s28	10.9	13.9	16.9	+19.8%	+19.8%	+21.6%
s38	12.8	15.7	18.3	+18.5%	+18.0%	+15.8%
s54	12.8	15.7	18.3	+18.5%	+18.0%	+15.8%

z9-109 Cooling Comparison

# Cages	One	Two	Three	One	Two	Three
A08	18.1	26.6	35.1			
B16	24.9	33.4	41.9			
C24	31.0	39.6	47.4			
D32	36.8	45.4	53.9			
s08	21.5	31.4	41.3	+18.8%	+18.0%	+17.7%
s18	30.0	40.2	50.1	+20.5%	+20.4%	+19.6%
s28	37.2	47.4	57.6	+20.0%	+19.7%	+21.5%
s38	43.6	53.5	62.4	+18.5%	+17.8%	+15.8%
s54	43.6	53.5	62.4	+18.5%	+17.8%	+15.8%

Technical details

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z9-109 Operating System Software

Operating System	ESA/390 (31-bit)	z/Arch (64-bit)
z/OS Version 1 Release 4, 5, 6, 7	No	Yes
Linux, 64-bit distribution	No	Yes
z/VM Version 5 Release 1, 2	No	Yes
z/VM Version 4 Release 4	Yes	Yes
z/VSE™* 3.1, VSE/ESA™ 2.6, 2.7	Yes	No
z/TPF Version 1	No	Yes
TPF Version 4 Release 1 (ESA mode only)	Yes	No

*z/VSE can execute in 31-bit mode only. It does not implement z/Architecture™ and specifically does not implement 64-bit mode capabilities. z/VSE is designed to exploit select features of IBM zSystem and eServer zSeries hardware.
Note: Please refer to the latest PSP bucket for latest PTFs for new functions/features.

z9-109 Operating System Software for new Function

	z/OS	z/VM	Linux on zSystem	z/VSE VSE/ESA*	z/TPF TPF/ESA**
Basic z9-109 support	1.4	4.4	SUSE SLES 8 Red Hat RHEL 3	3.1 2.6*	4.1** 1.1
60 Logical Partitions	1.4	4.4	SUSE SLES 8 Red Hat RHEL 3	3.1	4.1** 1.1
63.75K Subchannels	1.4	4.4	SUSE SLES 8 Red Hat RHEL 3		4.1** 1.1
OSA-Express2 1000BASE-T Ethernet	1.4	4.4	SUSE SLES 8 Red Hat RHEL 3	3.1 2.6*	4.1 PUT 13** 1.1
MIDAW Facility	1.6	Not supported	N/A		
CPACF Enhancements	1.6	4.4	IBM work with LDPs***		
Crypto Express2	1.6	5.1	SUSE SLES 9	3.1 2.7*	
HiperSockets IPv6	1.7	SOD for 5.2	IBM work with LDPs***		
OSA-Express2 CDLC support	1.4	5.1	IBM work with LDPs*		
Multiple Subchannel Sets (MSS)	1.7	Not supported	IBM work with LDPs***	3.1	4.1** 1.1
FICON Link Incident Report	1.7	4.4	IBM work with LDPs***		
Single System Image	1.6 up to 32	5.1 up to 24	SLES 8 up to 16 SLES 9 up to 32 RHEL 4 up to 32	?	1.1 up to 32
Enhanced Perf Assists for z/VM Guests	N/A	5.2	IBM work with LDPs***		
N_Port ID Virtualization	N/A	4.4	IBM work with LDPs***		
FCP Program Directed re-IPL	N/A	Not supported	IBM work with LDPs***		

***IBM is working with its Linux Distribution Partners (LDPs) so that this function will be provided in future Linux on System z9 distribution releases/service updates

- THANKS