

IBM POWER9 Enterprise E950

MTM: 9040-MR9 Unofficial Deep Dive



This is Nigel's Personal Deck & Opinions – It is not an IBM Announcement or IBM Statement

Nigel Griffiths Power Systems: Advanced Technology Support EMEA

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Version 7 (6th August 2018)

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POWER9 Enterprise

Power Systems POWER9 Enterprise E980
 192 POWER9 CPU cores @ 4.0 GHz
 64 TB DDR4 CDIMM Memory
 16 Internal NVMe for VIOS or OS booting
 32 PCIe Gen4 adapters
 30% jump in performance from E880
 - due to whole system enhancements

Power Systems POWER9 Enterprise E950

48 POWER9 CPU cores @ 3.8 GHz

16 TB DDR4 ISDIMM Memory

4 Internal NVMe for VIOS or OS booting

10 PCIe Gen4 adapters + 1 Gen3

42% jump in performance from E850



← This Presentation

POWER9 Server performance:

- Super strength SMT threads
- CPU memory caching
- SMP bus bandwidth
- Memory sizes
- PCIe Gen4 boost



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Announcement Date:	August 7th both E950 & E980
eConfig Date:	August 8th
General Availability Date:	August 17th E950
	Sept 21st E980 2 nodes= 96 core
	Nov 16th E980 4 nodes=192 core
Upgrade from POWER8 & POWER9 2 to 4 node MES upgrades:	In Q4 for easy upgrades

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Before we start

PDF of todays slides & replay from
<http://tinyurl.com/PowerVUG>
 - Not going to cover every point
 - Not covering all the slides
 - Not covering the market slides

Going to share the PowerPoint on the Power VUG website

<http://tinyurl.com/AIXpert>

I have ~250 slides including
 ~ 100 picture slides of the server
 - Pictures are of a beta machine
 - GA servers might differ slightly
Plus loads of link to more information

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There will be typo's, mistakes and more information becoming available

Check for updates on the Power System VUG website

If you spot mistakes please report them to me Nigel Griffiths
→ nag@uk.ibm.com

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POWER9 requires HMC 920 software
(an update to HMC 910)

- Supported on CR7, CR8, CR9 or
- HMC 7063-CR1 POWER8 based
 - More CPU, RAM, Disk & slightly lower cost
 - Simple: remote start/stop with ipmitool + WebUI

Gotchas

- HMC Enhanced+ GUI (No Classic GUI)
- No POWER6 support
- HMC hardware too old
- IVM not supported
- Intel based HMC out of stock in many countries



HMC News
Hardware Management Console

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POWER9 Processor

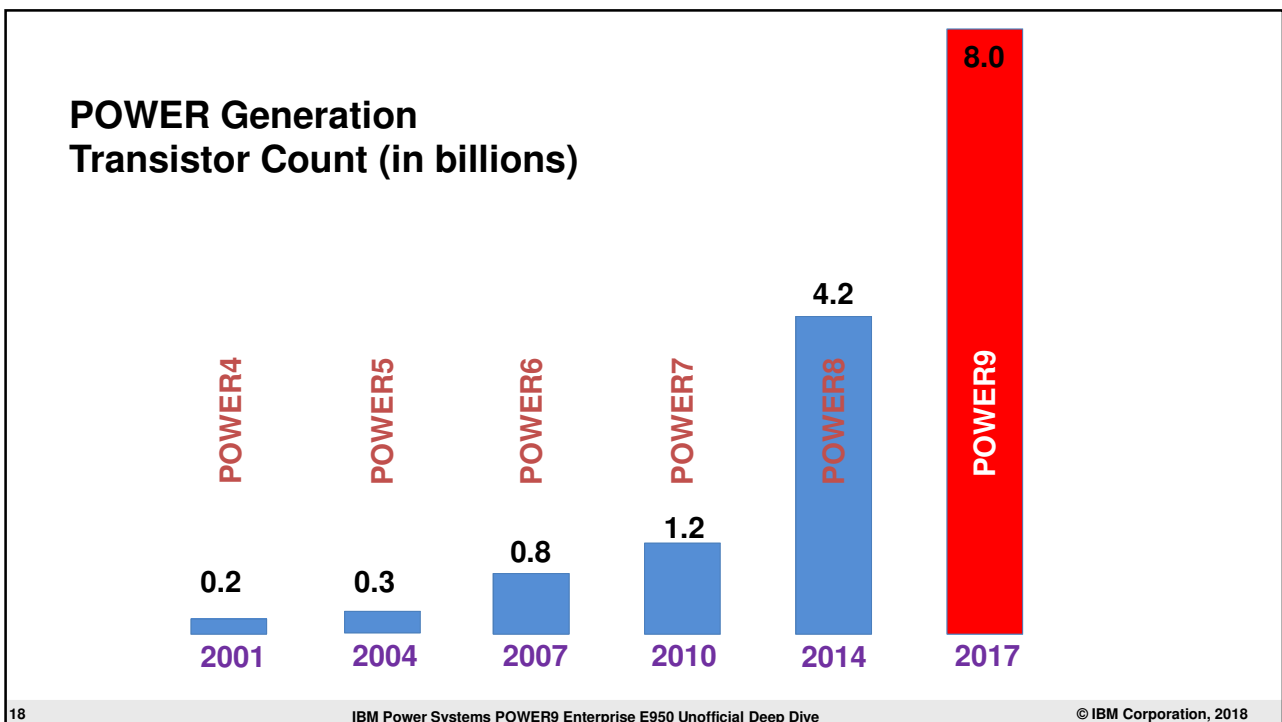
features that effect the Servers



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POWER9 Chip Variations



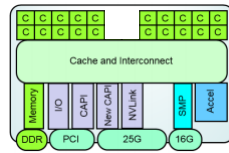
Models

AC922
LC922
LC921

December
OpenPOWER
SMT4
Up to 22 Cores
DDR4 RAM
Linux Only

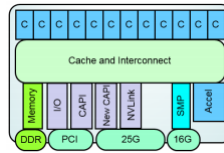
Slim core

Up to 22 CPU core
SMT=4 optimised for
Linux, HPC, & KVM



Fused core

12 CPU core
SMT=8 optimised for
PowerVM, throughput



IBM Scale-Out

SMT8
Up to 12 cores
Centaur with
DDR4 RAM
AIX + IBM i + Linux

Q3 2018

IBM Enterprise

SMT8
Up to 12 cores
Centaur RAM
AIX + IBM i + Linux

Models

E950

E980
- 2 CEC
- 4 CEC

The E950 does not support IBM i

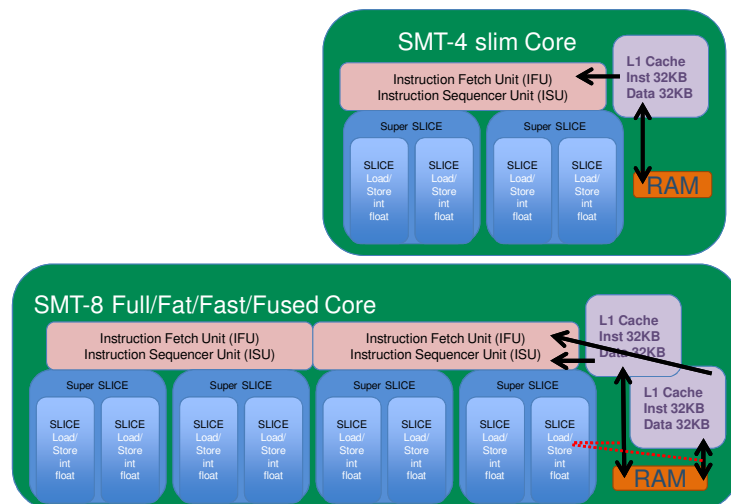


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Wikipedia on POWER9 fast core



Each of the eight CPU core threads gets at least a slice & up to 8 slices

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POWER9 Fused core STRENGTH

POWER8 SMT8 Core Resources

Issue of VSU and AGEN

- 2x load AGEN / simple-ALU
- 2x load/store AGEN
- 2x scalar-64b / vector-128b
- 2x FXU

Vector Scalar Unit (VSU) Pipes

- 2x FP (64b/128b) + Complex (128b)
- 2x ALU (128b)
- 2x Permute (128b)
- 1x Decimal FP
- 1x Cryptography

Fixed Point (FXU) Pipes

- 2x ALU (64b)
- 2x FX-MUL + Fixed Divide (64b)

Load Store Unit (LSU) Slices

- 64kB, 8-way Data Cache
- Up to 4 DW load or 2 store
- 1x Store complete

POWER9 SMT8 Core Resources

Issue of VSU and AGEN

- 8x scalar-64b / 4x vector-128b
- 8x load/store AGEN

Vector Scalar Unit (VSU) Pipes

- 8x FP + FX-MUL + Complex (64b slice)
- 8x ALU + Simple (64b slice)
- 4x Permute (128b)
- 4x Quad Fixed (128b)
- 4x Fixed Divide (64b)
- 2x Quad FP / Decimal FP
- 2x Cryptography

Load Store Unit (LSU) Slices

- 64kB, 8-way Data Cache
- Up to 8 DW load or store
- 2x Store complete



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POWER9 Processor Peripherals



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New 19" Rack 7965-S42



GA 4Q17

**POWER8 &
POWER9**

	S42	T42	94Y
42U	Yes	Yes	Yes
600mm Wide (datacenter floor tile)	Yes ★	No	Yes
Ship Loaded from Factory	Yes	Yes	No
Flat surface for mounting H2O Manifolds and Strip PDUs	Yes ★	No	Yes
1200mm Depth (rack w/ covers)	1070+130cvrs	1016+cvrs	1040 + cvrs
Rear door heat exchanger	Yes	Yes	Yes
# Vertical, 1U Pockets	4	4	6
Height Reduction – fit standard doorways	Yes	Yes	No
Back cable depth (mm)	280 ★	246	261
Earthquake certified	Yes – 45lbs / EIA	Yes – 35lbs/ EIA	No

OK. it is only a Rack! **Perhaps, it is time to retire the older T42.** **Warning: E950 is tight in a T42!**

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POWER9 Adapters

- PCIe GEN 4
 - Good timing for future proofing
 - Double the I/O rates
 - GEN 4 for next generation adapters like of 40+ Gb /sec
- Initially most adapters will be GEN 3
 - Fast enough for line speeds
 - Can use GEN2 or GEN3 in GEN4 adapters slots
- Warning: Not all adapters are supported at initial GA
 - See later lists in this deck



Same as Scale-Out
POWER9

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POWER9 U.2 NVMe support for E950

E950 has four external storage bays

Independent of SAS controllers

NVMe ~price of a SAS adapter

Concurrent 8 SAS disks and 4 NVMe drives

SAS takes 1 or 2 PCIe slots

U.2 NVMe

- A maximum of four x U.2 NVMe drives
- Higher performance than SAS SSD
- Support concurrent maintenance (unlike Scale-Out S922/S924)
- Write endurance is 2.4 drive write per day DWPD (5 years)
- Intended primarily to store and boot OS (AIX / VIOS) images
- Each NVMe device is a separate PCIe endpoint = assign to different LPARs
 - On the HMC, it looks like each has own adapter slots
- NVMe drives may be assigned to the VIOS & virtualized to client OS
- Warranty: 5 years if not worn out. A “fuel gauge” to monitor wear is provided for AIX/Linux **nvmemgr**



Different to Scale-Out
→ M.2
→ these have higher DWP

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POWER9 No internal DVD support

This should not be surprising with 22 year old Tech!

- It is old, slow, hot, unreliable = dead = get over it!

Alternative is a USB Memory Key

1. Faster: USB 3.0 reads at **90 MB/s**
2. Larger: lowest GB per buck now is 32 GB USB
3. Memory Key is €\$£ ~10

If you must go DVD:

- Use external USB DVD or USB DVD-RAM **but at your own risk**
- IBM now offered a External USB DVD (at a stiff price but supported)
 - FC#EUA5 Standalone USB DVD drive w/cable €\$£122.82
- Use the front USB sockets (provide more electricity power for mechanical DVD drive)

POWER9 OS Install:

- AIX, VIOS & Linux all supported installing from USB memory key



POWER9
Same as Scale-Out

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POWER9

The Server Range

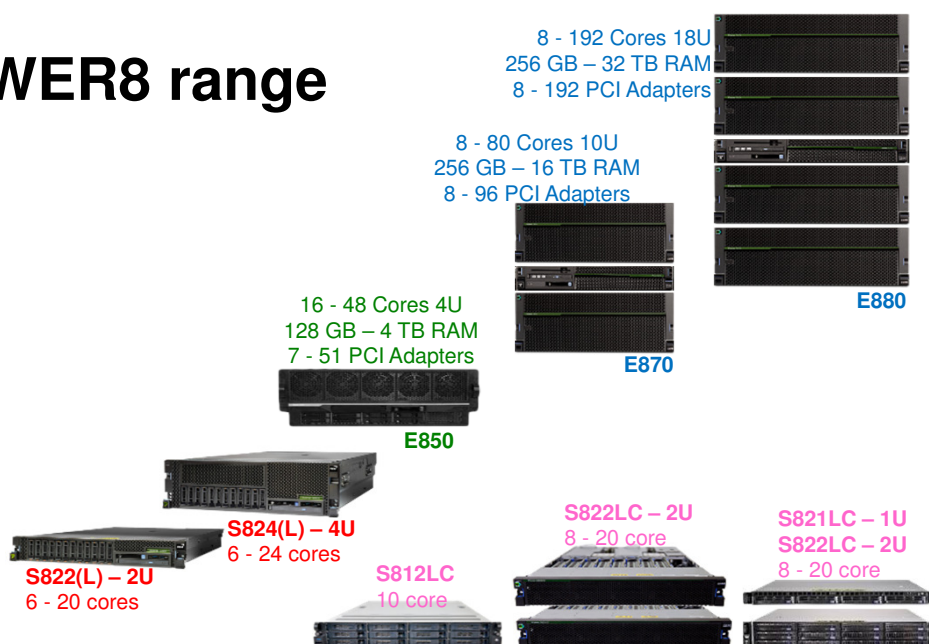


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POWER8 range



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POWER9 range in 2018



Enterprise Q3+Q4



7U to 22U
4 to 16 socket
8 to 192 cores
16TB RAM

E980

Midrange Q3

E950



4U
2 or 4 socket
16 to 48 cores
16TB RAM

Scale-Out Q2

S924



S922

2U or 4U
1 or 2 socket
4 to 24 cores
4TB RAM

AC922 Q4 2017



LC922/LC921 Q2



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POWER9 Model Details



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POWER9 E950



3 Year 24x7 Warranty

Software Stack

- HMC 920+
- PowerVM 2.2.6.23+
- AIX 6 TL9 sp12, 7.1 TL5 sp4 & 7.2 TL3 (full P9 support)
- Linux
 - SLES 11 sp4, 12 sp3, 15
 - RHEL 7.4, 7.5
- IBM i not supported

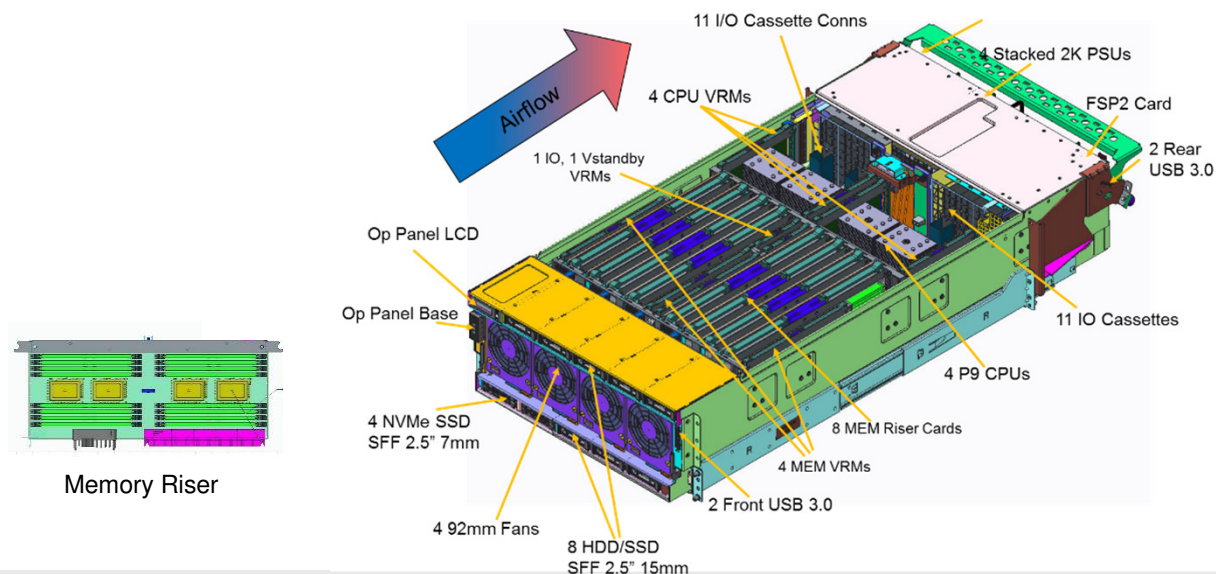
	System (9040-MR9) – 4U
POWER9 Fast/Fused Core Processors	Two or four processors → 16,20,22,24,32,40,44,48 CPU cores 8, 10, 11 or 12 CPU Cores per socket Maximum 3.8 GHz
Sockets	2 or 4 Field Upgradable
Memory	8 Riser Cards each with 16 x DDR4 ISDIMMs = 128 total DIMM sizes 8, 16, 32, 64,128 GB 16 TB max Memory (four times the E850)
Media Bays	DVD via external USB DVD or USB flash key
Integrated PCIe - Full Height	PCIe Gen 4: eight x16 + two x8 (2 processors = 4 x16) PCIe Gen 3: one x8 (default Ethernet @ 2x10Gb + 2x1Gb) PCIe slots are Full High, Half Length and Blind swap
Internal SAS Bays	- Up to 8 SAS 2.5 inch, 15mm via 1 or 2 SAS adapters (x8) Split disk capable JBOD, RAID 1,5,6 or 10 - U.2 format 1 to 4 NVMe slots for 1 to 4 NVMe devices 2.5 inch 7 mm 800GB, 1.6TB 3.2TB - USB 3.0 (2 front and 2 rear)
Max I/O Drawers	4 EMX I/O Drawer (PCIe Adapter drawer)
External Storage Drawers	EXP12SX, ESP24SX & EXP24S Each requires: PCIe SAS adapter or SAS port

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POWER9 4 Socket Server E950

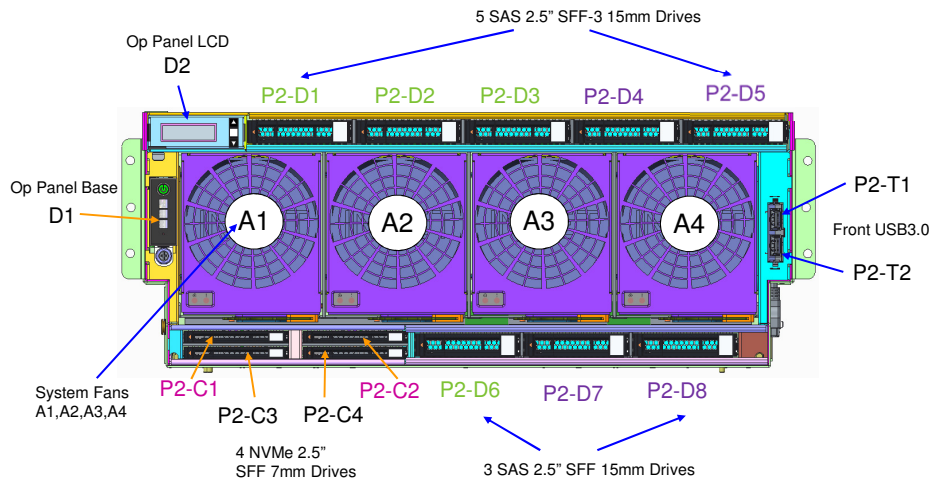


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POWER9 Enterprise E950 Server - (Front view w/o Bezel)

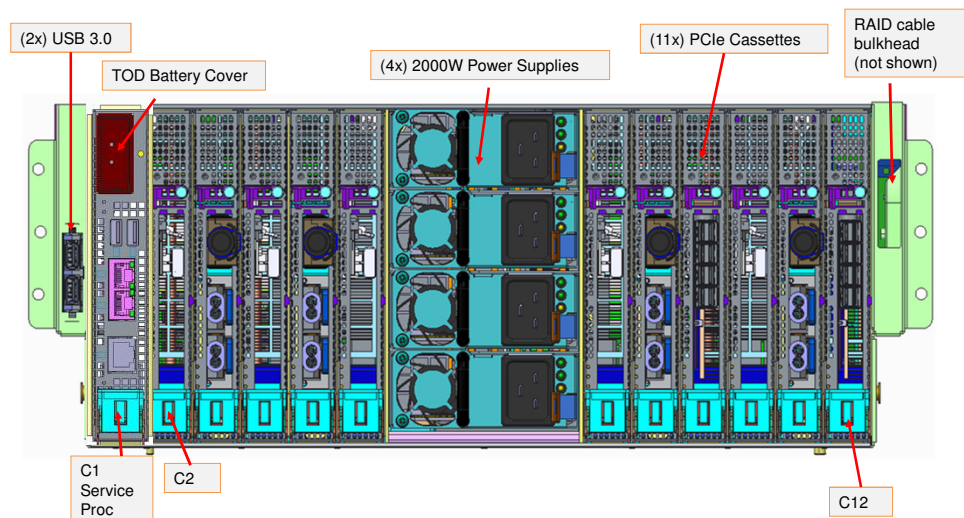


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POWER9 Enterprise E950 Server - (Rear view)



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Processors

Initially

- 2 or 4 Processors =
2 or 4 POWER9 chips
- Can 2 to 4 MES upgrade

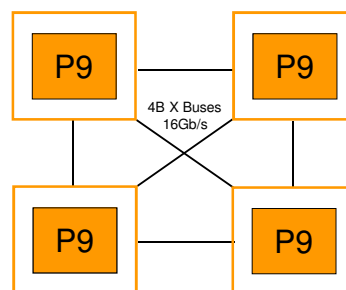
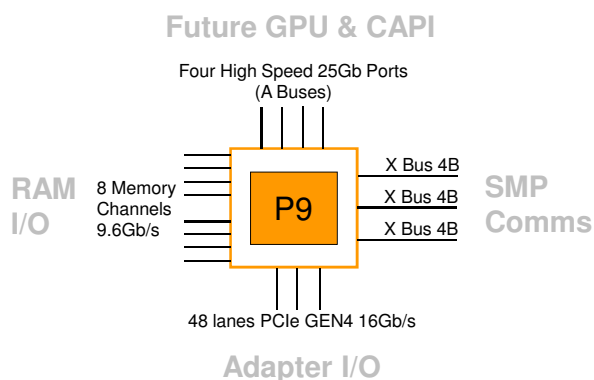
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E950 Processor Architecture Highlights

Four directly connected POWER9 Processors = 1 hop



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E950 Processor options

CPU cores per POWER9	CPU cores per 2 Proc Server	CPU cores per 4 Proc Server	Comment
12	24	48	Max throughput
11	22	44	
10	20	40	
8	16	32	Max core strength



Much higher performance
Full 16 TB memory available

These CPU cores counts are available on the S924

E950 makes sense if you:

- a) plan to upgrade later or
- b) need 8 TB memory, S924 max is 4TB

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E950 Processor options

CPU cores per POWER9	CPU cores per 2 Proc Server	CPU cores per 4 Proc Server	rPerf	rPerf / core
12	24	48	1146	23.8
11	22	44	1072	24.3
10	20	40	1034	25.9
8	16	32	870	27.2



Much higher performance
Full 16 TB memory available

These CPU cores counts are available on the S924

E950 makes sense if you:

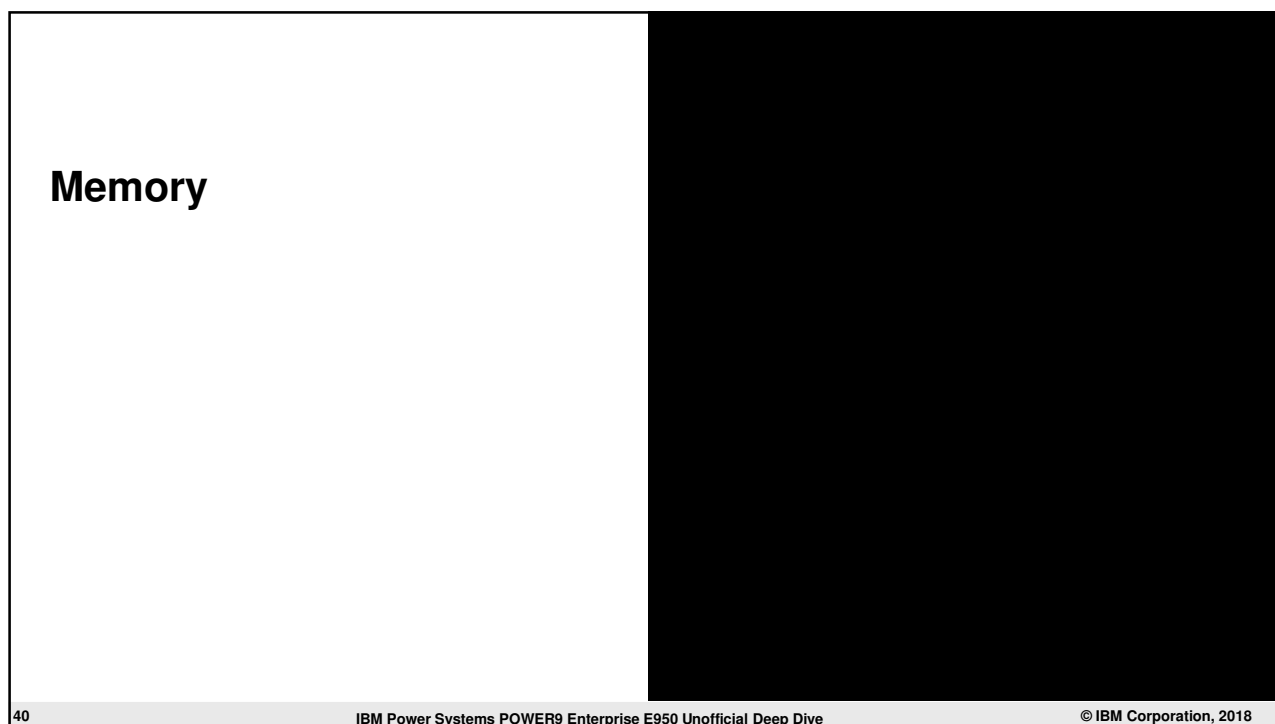
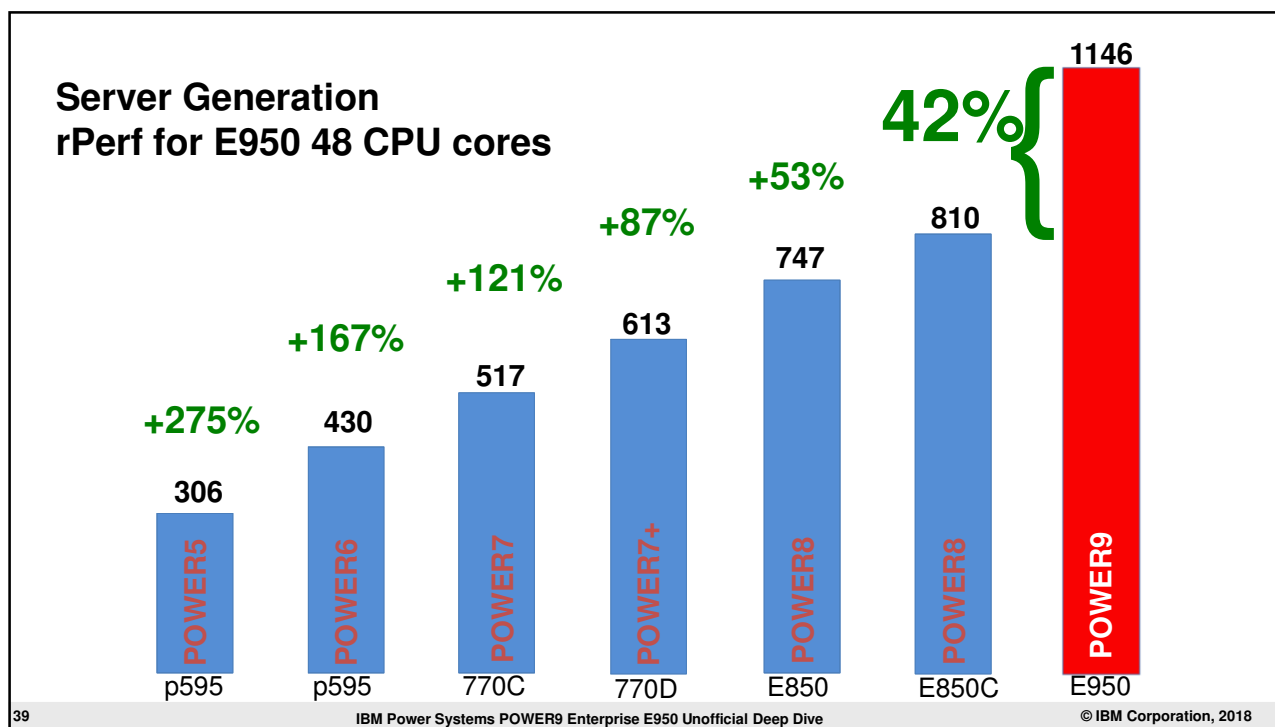
- a) plan to upgrade later or
- b) need 8 TB memory, S924 max is 4TB

POWER9 Performance Report <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POO03017USEN&>

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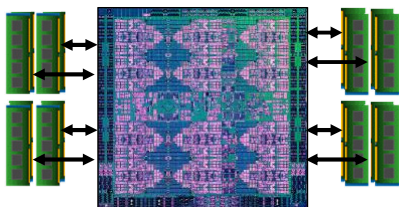


POWER9 Processor Family

~~Two~~ Memory Architectures

Three

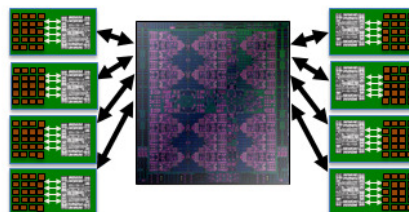
Scale Out
Direct Attach Memory



8 Direct DDR4 Ports

Max 2-Socket Systems

Scale Up
Buffered Memory



8 Buffered Channels

4 to 16 Socket Systems

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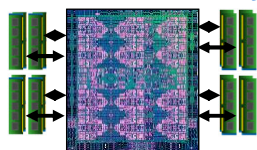
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POWER9 Processor Family

Three Memory Architectures

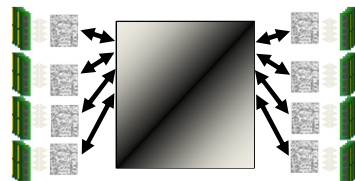
Scale Out
Direct Attach Memory



8 Direct DDR4 Ports
POWER9 → DDR4
Lower cost

Max 2-Socket Systems

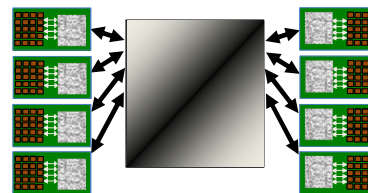
Scale Up
Buffered Memory



8 Buffered Channels
POWER9 → Centaur chip → DDR4
Best of both!

E950 4 Socket Systems

Scale Up
Buffered Memory



8 Buffered Channels
POWER9 → Centaur chip → RAM
Higher performance & higher RAS

E980 16 Socket Systems

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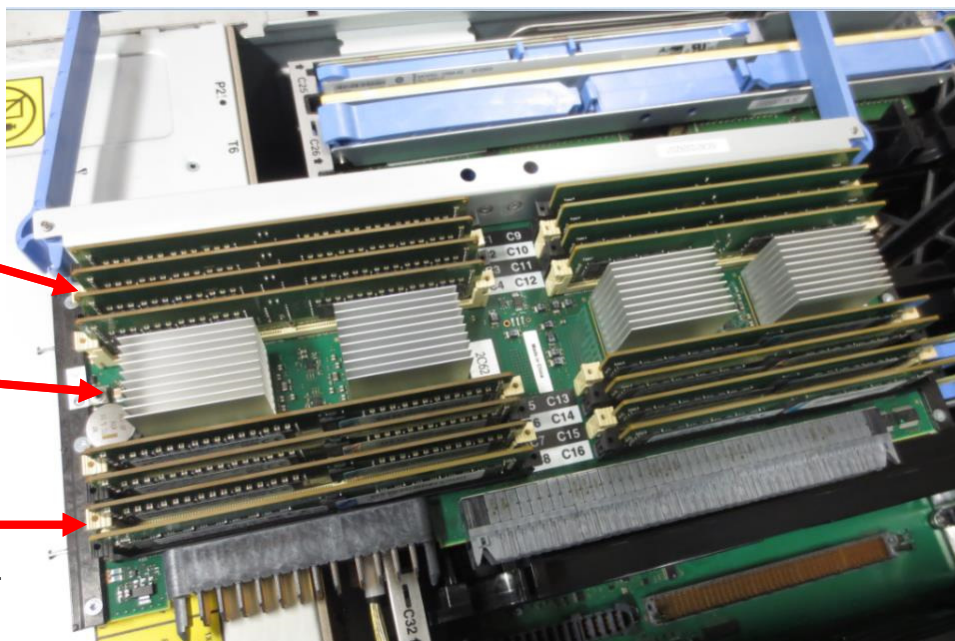
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Memory Riser Card

16 x DDR4 DIMMs

4 Centaurs
L4 Cache

8 white slots is the
minimum on a Riser



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E950 Memory Subsystem Highlights

DDR4 DIMMs sizes

✓ 8, 16, 32, 64, 128GB

Per E950 Server

✓ Max 920 GB/s Memory Bandwidth

✓ Min 2 Socket: 64 GB Memory

✓ Min 4 Socket: 128 GB Memory

✓ Max of 16TB Memory

✓ 8 Riser Cards with 128 DIMMs slots

✓ Minimum of 50% Memory Activated

Per POWER9 processor

✓ Max 230 GB/s Memory Bandwidth

✓ Up to 4TB Memory

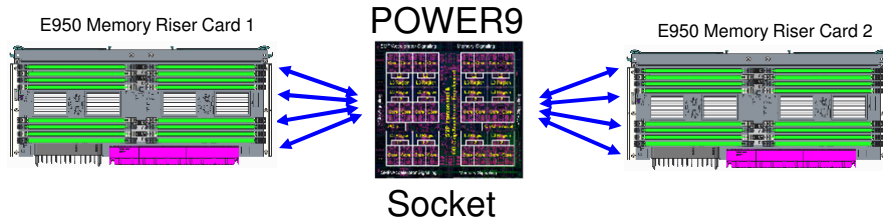
✓ 2 Memory Riser cards (like below) each with

✓ 4 Centaur chips

✓ 16 DIMM slots

Memory increment

✓ 8 DIMMs



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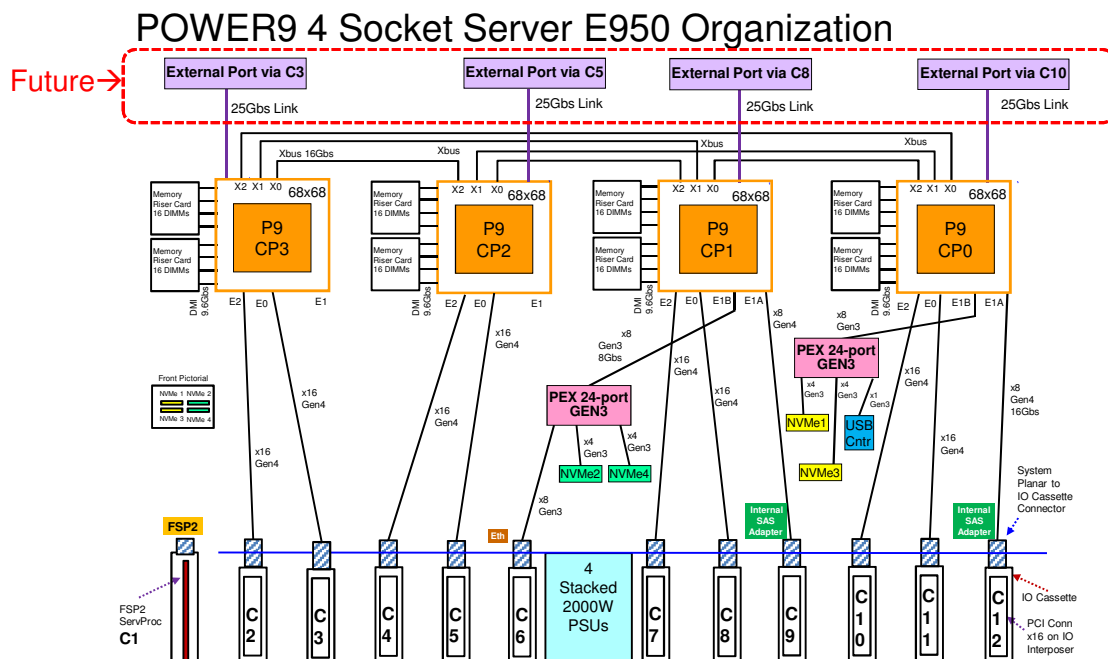
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E950 I/O Subsystem

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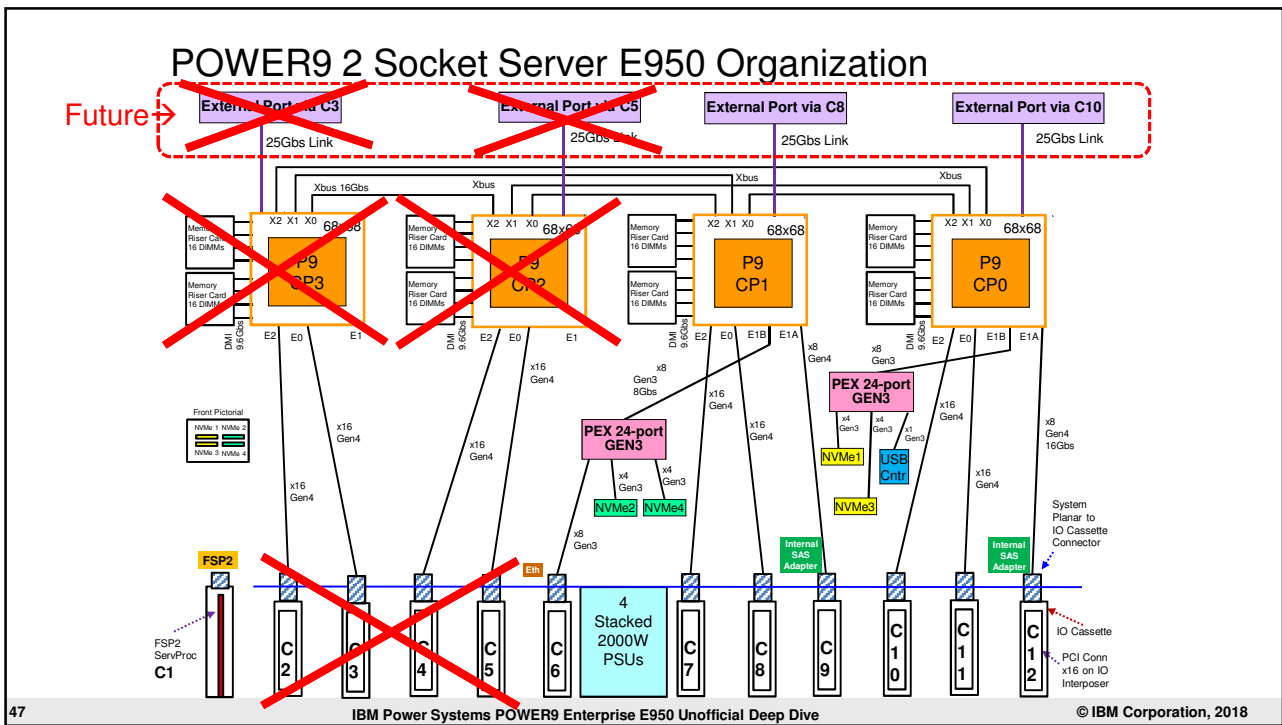
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E950 Infrastructure

Key Power E950 technical enhancements over Power E850C

Features	E850C	E950	Enhancements
Processor	P8 (DCM)	P9 (SCM)	✓ More efficient processor communication
Sockets	2 to 4	2 to 4	
Cores	32 or 40 or 48	32 or 40 or 44 or 48	✓ More processor options
Maximum Memory	4 TB	16 TB	✓ 4X Maximum Memory
DIMM Type/DIMM slots count	Up to 32 CDIMMs	Up to 128 ISDIMMs	✓ More Memory Capacity and Flexibility
Memory Bandwidth	768 GB/sec	920 GB/sec	✓ 20% more Memory Bandwidth
IO Expansion Slots	Yes	Yes	
PCIe slots	11	11	✓ 8 Gen4 x16 + 2 Gen4 x8 + 1 Gen3
Acceleration Ports	Yes (CAPI 1.0)	Yes (CAPI 2.0 + OpenCAPI)	✓ Enabled for enhanced acceleration for AI environments
PCIe Hot Plug Support	Yes	Yes + Blindswap	
IO bandwidth	315 GB/sec	630 GB/sec	✓ ~2X IO bandwidth
Ethernet ports	Quad 1 Gbt (x8 Slot)	Quad 1 Gbt (x8 Slot)	
Internal Storage Bays	12 (8 x 2.5" SAS bays + 4 x 1.8" SSD bays)	12 (8 x 2.5" SAS bays + 4 x NVMe bays)	✓ NVMe for high-bandwidth, low latency local boot
Internal Storage Controllers	Integrated	Optional & Conc Maintainable	✓ Improved cost and serviceability
RAS		Enhanced DC-DC Reg Redundancy Enhanced Fan Conc Maint	✓ More reliable power/cooling

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E950 follows the Enterprise Server package traditions

Included with the Server

- **PowerVM** at no cost*
 - Includes Hypervisor, VIOS, Firmware and HMC** support for server management, virtualization and RAS
- **PowerVC** at no cost*
- **Power to Cloud Rewards** (Education or Lab Services days)
- **Cloud Management Console** (Server status reports on you mobile/cell phone or tablet)
- **Warranty**: 3 years of 24x7 service included

Regular & popular Power Server options with a cost:

- Elastic Capacity on Demand (CoD) for both processor cores & memory
- Enterprise Pool Capacity (n-1 so the pool can be POWER8 and POWER9)
- IBM Active Memory Expansion for AIX
- IBM Active Memory Mirroring for Hypervisor

* There is a SWMA cost

** HMC is orderable separately at a cost

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POWER9

eConfig view of the Features



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E950 Processor GHz

Feature code	CPU cores per POWER9	CPU cores per Server (max)	Nominal GHz	No-name GHz	Max GHz
EPWT	12	48	2.8	3.15	3.8
EPWY	11	44	2.85	3.28	3.8
EPWS	10	40	3.0	3.4	3.8
EPWR	8	32	3.3	3.6	3.8

Number of Processor sockets filled
 1 – not allowed
 2 – minimum
 3 – possible future offering
 4 – maximum

↑
 GHz reported by
 some commands

↑
 Default and
 GHz in Practice
 AIX: lparstat -E 1 3

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POWER9 Energy & CPU GHz Balance

Enables higher dynamic operational frequencies

Important Frequencies

- **High** – Overclocking (~15%)
- **Medium** – Overclocking (~10%)
- **Nominal** – Fixed normal GHz
- **Power Saver** – Fixed reduce GHz
 - Reduces electrical power use = saves money
- **Zero GHz** – The server is powered off

 Static Power Saver Mode

- Reduced electrical use to lower costs – lower GHz

- ★ **Disabled All Mode** → “overclocking” disabled

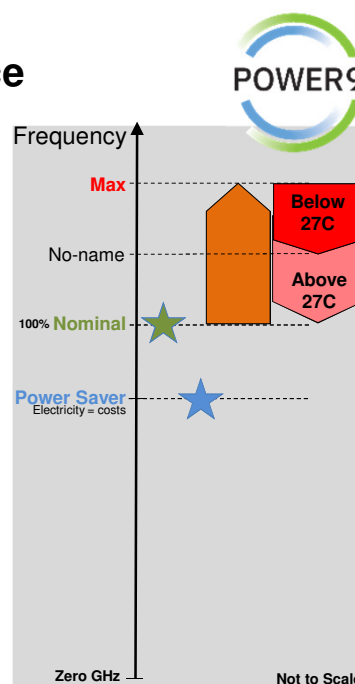
- Fixed Frequency

 Dynamic Performance Mode

- Variable Frequency (Nominal to High GHz) based in workload
- Higher the workload, the lower the GHz

Maximum Performance Mode – E950 default

- Variable Frequency (Medium to High GHz) based in workload
- If necessary, speeds up fans
- In a hot 27+C computer room, can lower GHz to Nominal GHz



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On Twitter?

@mr nmon



```
# lparstat -E 1 3

System configuration: type=Shared mode=Uncapped smt=8 lcpu=16 mem=16384MB ent=1.0

Physical Processor Utilisation:

-----Actual-----
user  sys  wait  idle      freq      user  sys  wait  idle      Normalised-----
1.126 0.016 0.000 0.000 3.7GHz[113%] 1.272 0.018 0.000 0.000
1.127 0.016 0.000 0.000 3.7GHz[113%] 1.271 0.018 0.000 0.000
1.124 0.016 0.000 0.000 3.7GHz[113%] 1.274 0.018 0.000 0.000
#
# lsattr -El proc0
frequency 3300000000 Processor Speed False
smt_enabled true Processor SMT enabled False
smt_threads 8 Processor SMT threads False
state enable Processor state False
type PowerPC_POWER9 Processor type False
#
```

P9 GHz **part 1:** [#POWER9](#) servers in practice run at (max) ~**3.7-4 GHz**, other server chips eat our dust!
I see: normal GHz+overclocking, I am told to not use the "o" word, oops!

[#EnergyScale](#) guys say run full speed but will lower GHz, if getting hot like your air-conditioning fails!

P9 GHz **part 2: #POWER9** servers **How to get too hot!** If you don't have: max CPU count+ max memory size+ max disks+ max high-speed adapter AND max server workload+ computer room is warm then your server may never get too hot and still be at that (max) GHz. I know as I tried!!!

P9 GHz **part 3:** One quirk on AIX: commands like `lparstat -E 1 9` report the varying current GHz but others report the non-overclocking (oops!) GHz value called Nominal So don't worry is you buy 3.9 GHz but `nmon` or `lsattr -El proc0` reports a lower Nominal GHz between 2.3 to 3.3 GHz

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Memory Options

Feature Code	DIMM Size
EM6A	8GB DIMM
EM6B	16GB DIMM
EM6C	32GB DIMM
EM6D	64GB DIMM
EM6E	128GB DIMM

- ✓ Up to 230 GB/s peak memory bandwidth per socket
- ✓ Up to 920 GB/s peak memory bandwidth per Server
- ✓ Memory Riser card: 16 DDR4 DIMMs & imbedded 4 Centaur L4 Cache chips
- ✓ Max Memory Riser card: 8
- ✓ Maximum 2 TB per Riser so a total of 16 TB
- ✓ Industry Standard DDR4 memory Registered DIMMs (server class)
- ✓ DDR4 ISDIMMs rated 2400MHz but running at 1600MHz behind Centaurs
- ✓ Only IBM DIMMs are supported
- ✓ Minimum config is 1 Riser Card with 8 DIMMs x 8 GB per Processor (64 GB / processor)
- ✓ DIMM plug rules are complex
 - ✓ A single Riser card recommended all memory the same size
 - ✓ A single Riser card can have 2 DIMM sizes (8 one size + 8 another size)

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Memory rules min and max for 2 or 4 procs

- All memory is DDR4 - No POWER8 E850 RAM is supported
- All memory is the same speed
- Only difference is the DIMM size
- Each Processor socket has 2 Riser cards, each with 16 DIMM slots
- 2 Processor Socket: min 64 GB* & max 8 TB Memory
- 4 Processor Socket: min 128 GB* & max 16 TB Memory
- Add DIMMs in packs of eight = half a Riser Card
- More DIMMs = more performance

* Poor performance as $\frac{3}{4}$ of the ports are not used.

- Recommend not going below 256 GB and 512GB

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NVMe storage Options



Feature Code	DIMM Size
EC5J	800 GB
EC5K	1.6TB
EC5L	3.2TB



- ✓ Three sizes of internal NVMe boot devices
- ✓ Ideal for VIOS boot or OS boot devices (two for redundancy)
- ✓ Faster than SSD - skipping SAS protocol level
- ✓ 2.4 drive write per day DWPD (5 years warranty)
 - ✓ Meaning complete Drive Writes Per Day
- ✓ “nvmmgr” command to determine drive wear
- ✓ They will issue warning messages at 100% used
 - ✓ Customer to backup and replace

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Three Backplane options



Depends on the SAS internal disk support that you need

- All have four NMVe bays

One of these SAS options must be selected:

1. Zero DASD Backplane no disks (only NMVe), so no SAS adapter
–FC#EJ0B
2. Base DASD backplane with 1 SAS PCIe adapter + selected SAS drives
–FC#EJBB - all disks connect to the 1 adapter
3. Split DASD backplane with 2 SAS PCIe adapters + selected SAS drive
–FC#EJ0J - disks are split between the two SAS adapters 4 + 4

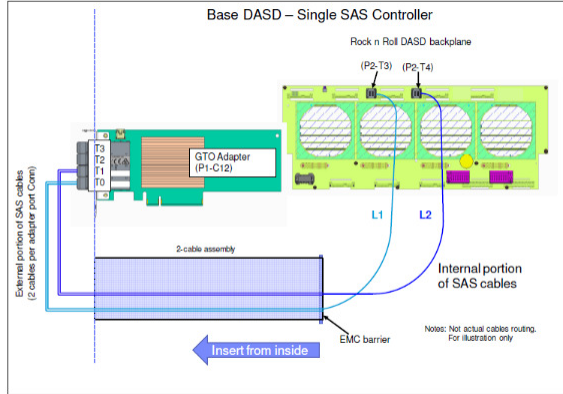
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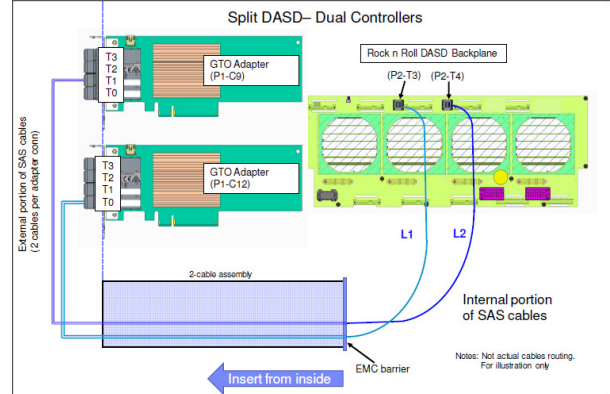
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Internal SAS cabling

All 8 disks on one SAS EJ0K adapter



Split Disk 4 + 4 with EJ0K SAS adapters



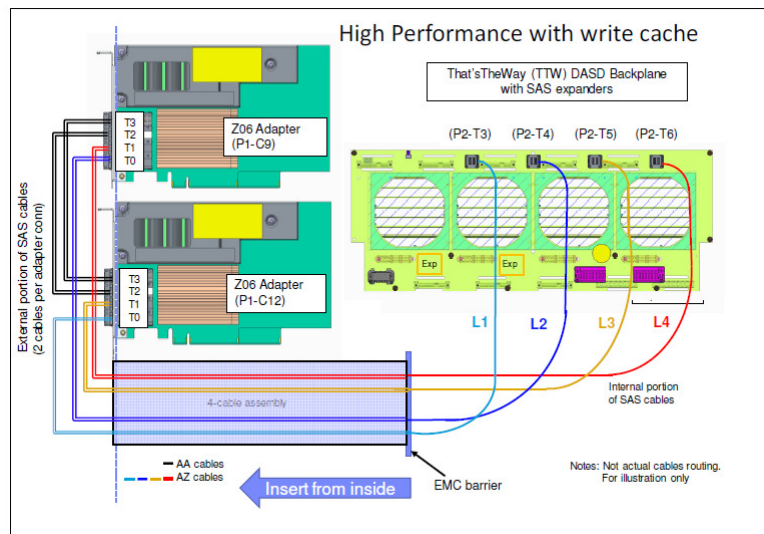
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Internal SAS cabling

High Performance with large shared adapter disk cache – 2 x EJ14 adapters



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Dual VIOS suggestions

Network

- 2 or 4 (for redundancy) Ethernet adapters

Storage

A. 1 to 4 NVMe drives

- Fast (possible AIX flash Cache use too)
- No system downtime to replace NVMe drives

B. 2 or 4 (for redundancy) Fibre Channel SAN

- SAN booting VIOS is standard these days & fast. Assumes you have a SAN

C. Internal disks or SSD via two SAS adapter (Split backplane)

- 8 disk at the front (redundancy using AIX mirroring)
- If not SSD its pretty slow I/O
- Requires 2 SAS adapters & uses 2 PCIe slots

D. Remote Disk Drawer

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Internal storage numbering

SAS disks

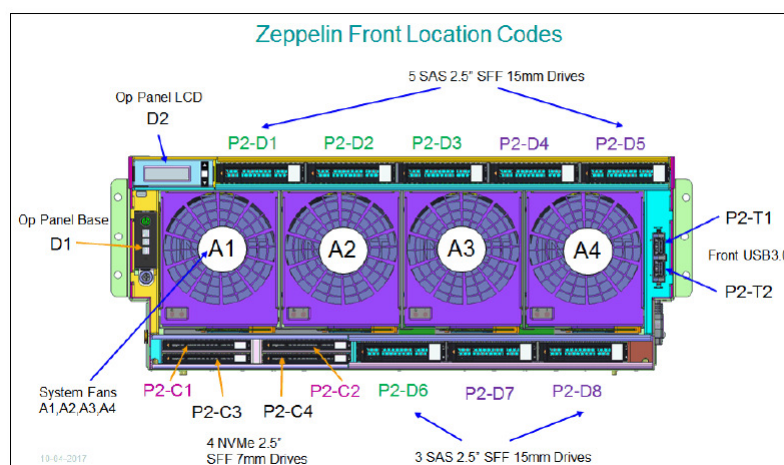
1 2 3 4 5
6 7 8

- SAS adapter 1 + 2

NVMe

1 2
3 4

- VIOA A
- VIOB B



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Operating Systems for Enterprise

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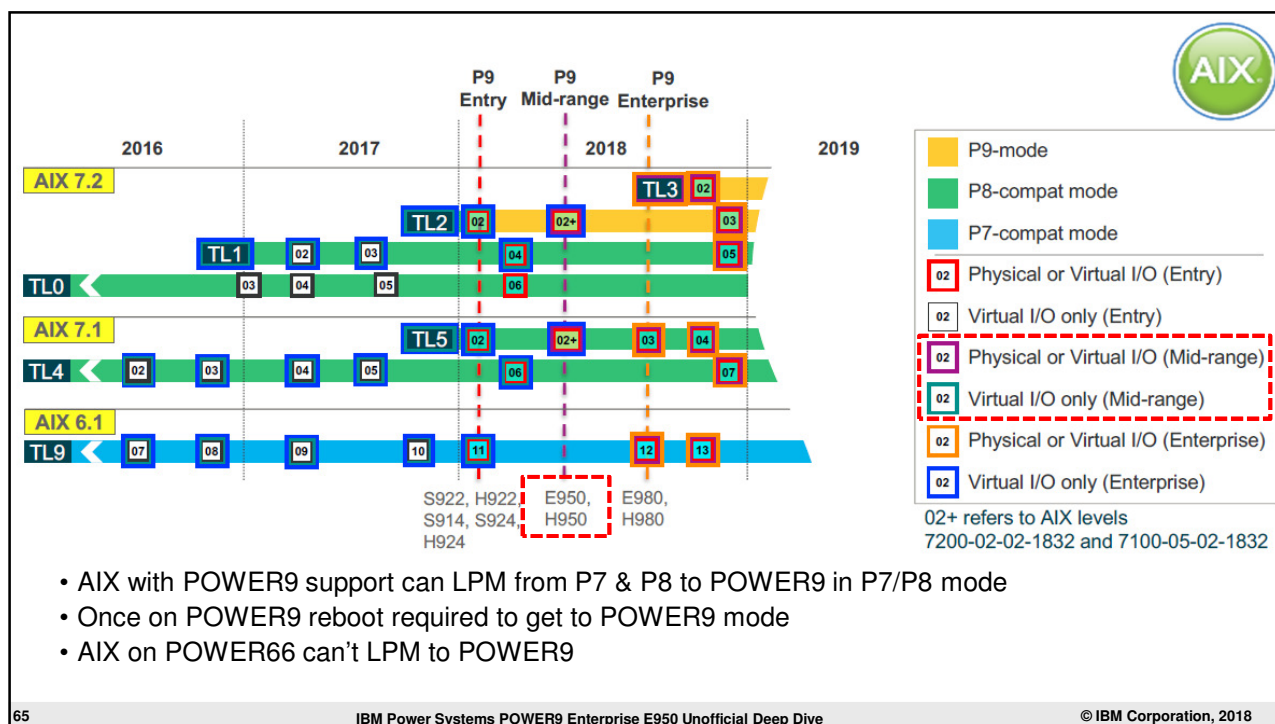
AIX



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AIX for new POWER9 Generally

Reference Chart
not E950 specific

AIX 7.2 TL2 + SP2 (Mar 2018)

- Random number generator
 - User-mode accessible
 - For application exploitation
- Power 3.0B ISA extensions
 - VSX3, string, video encode, quad floating point, pc relative addressing, 32-bit overflow, Memory Atomics
 - For application exploitation
- NVMe support

AIX 7.2 TL3 (2H 2018)

- Dynamic System Optimizer
 - Enabled for P9 systems
- 1536-thread single LPAR
 - 192-core/SMT8 single system image support
- 32 TB max RAM in an LPAR

AIX Level Support at **E950** **RELEASE-TL-SP-YYWW**

Virtualised and LPM

- AIX 7200-02-01-1732 or later
- AIX 7200-01-01-1642 or later
- AIX 7100-05-01-1731 or later
- AIX 7100-04-02-1614 or later
- AIX 6100-09-07-1614 or later*

AIX with Adapters at 17th August

- AIX 7200-02-02-1832 or later
- AIX 7100-05-02-1832 or later

AIX with Adapters later in 2018

- AIX 7200-01-05-1837 Dec 2018
- AIX 7100-04-07-1837 Dec 2018
- AIX 6100-09-12-1838 Sept 2018*

* AIX 6 service extension required

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Linux



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Linux on POWER9 E950



- SUSE SLES
- Red Hat RHEL

- Linux on E950 only available under PowerVM
- Older Linux version run fine in POWER8 mode
 - SLES 11 sp4 and 12 sp3
 - RHEL 7.4
- Refreshed releases in 2018 have some POWER9 support – ask the vendor
- For POWER9 optimisation best chance is:
 - SLES 15
 - RHEL 7.5 for POWER9 also know as the ALT version
like RHEL-ALT-7.5-20180315.0-Server-ppc64le-dvd1.iso

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Linux on POWER9 E950



- Canonical Ubuntu

- Ubuntu on PowerVM no longer being supported by IBM
 - Includes 16.04 and 18.04
 - Include POWER8 and POWER9
 - Does actually work – just no support
- If you previously purchased support **Ubuntu 16.04 in POWER8 mode on PowerVM**, then support continues and is available for 2 more years
- **Native Ubuntu** on base metal & for KVM hosting is **fully supported by IBM**
 - Native meaning “not PowerVM” environment (also known as OPAL mode)
 - For example: POWER9 Servers **AC922 & LC922** and **LC921**

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IBM i



IBM i is not supported on the E950

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VIOS

2.2.6.23 or the latest on 17th August 2018

Do not use older versions due to new E950 devices like NVMe

VIOS 3.1 is coming soon (based on AIX 7.2)

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Storage Remote Drawers Adapter Remote Drawers

Same drawers & connections as POWER9 Scale-Out Servers

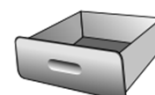
- this should all be business as usual
- also used in POWER8

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Remote Disk drawers for Disks



- SAS Disk Drawers EXP12SX | EXP24SX | EXP 24S
 - FC#ESLL | FC#ESLS | FC#5887 (slider, slider & homerun)
 - Supported via PCIe SAS adapter
 - FC#EJ0J (full height) & FC#EJ0M (low profile) (GTO)
 - As used on POWER8
 - Care needed if the old “migrating” drawer is back level

EXP12SX = 12x 3.5 inch disks

EXP24SX = 24 x 2.5 inch disks



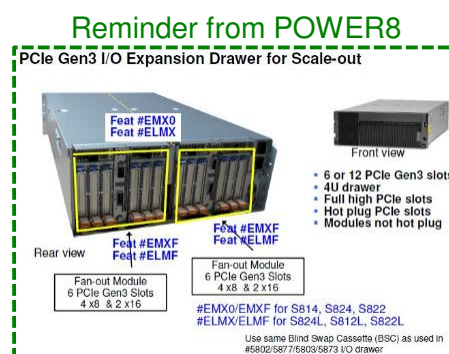
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Remote Adapter drawers - FC#EMX (know as MEX drawers)

- Four Processor E950 supports
 - 8 FC#EJ08 cards (Bear Mountain) in x16 PCIe Slots
 - 8 Fan-out drawer halves = Four #EMX Drawers
 - Each Fan-out has 6 adapters slots (12 per drawer)
- Eight Adapter slots → 48 Adapter slots plus 3 slower E950 slots = total 51 !



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I/O support for 17th August release of E950 Adapters, disks & related bits

Important for early migration & quick adoption

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POWER9 I/O currently planned for GA1 on Power E950

FC	CCIN	Description	Max	OS support
5729	5729	PCIe2 8Gb 4-port Fibre Channel Adapter	50	AIX Linux
5735	577D	8 Gigabit PCI Express Dual Port Fibre Channel Adapter	50	AIX Linux
EN0A	577F	PCIe3 16Gb 2-port Fibre Channel Adapter	50	Linux
EN12		PCIe2 8Gb 4-port Fibre Channel Adapter	50	AIX Linux
EN1A	578F	PCIe3 32Gb 2-port Fibre Channel Adapter	50	Linux
EN1C	578E	PCIe3 16Gb 4-port Fibre Channel Adapter	50	Linux

FC	CCIN	Description	Max	OS support
EJ0J	57B4	PCIe3 RAID SAS Adapter Quad-port 6Gb x8	34	AIX Linux
EJ0K	57BF	PCIe3 RAID SAS Adapter Quad-port 6Gb x8 for MR9	34	
EJ10	57B4	PCIe3 SAS Tape/DVD Adapter Quad-port 6Gb x8	34	AIX Linux
EJ14	57B1	PCIe3 12GB Cache RAID PLUS SAS Adapter Quad-port 6Gb x8	34	AIX Linux

FC	CCIN	Description	Max	OS support
ESLL	78D1	EXP12SX SAS Storage Enclosure	136	AIX Linux
ESLS	78D1	EXP24SX SAS Storage Enclosure	136	AIX Linux

E950

FC SAN

Drawer SAS

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POWER9 I/O currently planned for August 17th on Power E950

FC	CCIN	Description	Max	OS support
ES78	5B16	387GB SFF-2 SSD 5xx eMLC4 for AIX/Linux	768	AIX Linux
ES7E	5B17	775GB SFF-2 SSD 5xx eMLC4 for AIX/Linux	768	AIX Linux
ES7K	5B19	387GB SFF-3 SSD 5xx eMLC4 for AIX/Linux	8	AIX Linux
ES7P	5B1A	775GB SFF-3 SSD 5xx eMLC4 for AIX/Linux	8	AIX Linux
ES80	5B21	1.9TB Read Intensive SAS 4k SFF-2 SSD for AIX/Linux	768	AIX Linux
ES83	5B2B	931GB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	768	
ES85	5B10	387GB SFF-2 SSD 4k eMLC4 for AIX/Linux	768	AIX Linux
ES8C	5B11	775GB SFF-2 SSD 4k eMLC4 for AIX/Linux	768	AIX Linux
ES8F	5B12	1.55TB SFF-2 SSD 4k eMLC4 for AIX/Linux	768	AIX Linux
ES8J	5B20	1.9TB Read Intensive SAS 4k SFF-3 SSD for AIX/Linux	8	AIX Linux
ES8N	5B13	387GB SFF-3 SSD 4k eMLC4 for AIX/Linux	8	AIX Linux
ES8Q	5B14	775GB SFF-3 SSD 4k eMLC4 for AIX/Linux	8	AIX Linux
ES8V	5B15	1.55TB SFF-3 SSD 4k eMLC4 for AIX/Linux	8	AIX Linux
ES8Y	5B29	931GB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	
ES92	5B20	1.86TB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	8	
ES96	5B21	1.86TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	
ESE1	5B2C	3.72TB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	8	
ESE7	5B2D	3.72TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	

8 SFF-3 disk drive slots at the front of the E950



E950

Disk

Lime colour found in eConfig has "Withdrawn" could be migrated from POWER8 & supported

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POWER9 I/O currently planned for August 17th on Power E950**E950**

FC	CCIN	Description	Max	OS support
ESG5	5B16	387GB Enterprise SAS 5xx SFF-2 SSD for AIX/Linux	768	
ESG9	5B19	387GB Enterprise SAS 5xx SFF-3 SSD for AIX/Linux	8	
ESGB	5B10	387GB Enterprise SAS 4k SFF-2 SSD for AIX/Linux	768	
ESGD	5B13	387GB Enterprise SAS 4k SFF-3 SSD for AIX/Linux	8	
ESGF	5B17	775GB Enterprise SAS 5xx SFF-2 SSD for AIX/Linux	768	
ESGH	5B1A	775GB Enterprise SAS 5xx SFF-3 SSD for AIX/Linux	8	
ESGK	5B11	775GB Enterprise SAS 4k SFF-2 SSD for AIX/Linux	768	
ESGM	5B14	775GB Enterprise SAS 4k SFF-3 SSD for AIX/Linux	8	
ESGP	5B12	1.55TB Enterprise SAS 4k SFF-2 SSD for AIX/Linux	768	
ESGR	5B15	1.55TB Enterprise SAS 4k SFF-3 SSD for AIX/Linux	8	
ESHJ	5B29	931 GB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	
ESHL	5B21	1.86 TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	
ESHN	5B2F	7.44 TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	
ESHS	5B2B	931 GB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	8	
ESHU	5B20	1.86 TB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	8	
ESHW	5B2E	7.44 TB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	8	
ESM8	5B2D	3.72 TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	768	
ESMQ	5B2C	3.72 TB Mainstream SAS 4k SFF-3 SSD for AIX/Linux	8	

Disk

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POWER9 I/O currently planned for August 17th on Power E950**E950**

FC	CCIN	Description	Max	OS support
1953	19B1	300GB 15k RPM SAS SFF-2 Disk Drive (AIX/Linux)	1536	AIX Linux
1964	19B3	600GB 10k RPM SAS SFF-2 Disk Drive (AIX/Linux)	1536	AIX Linux
ES62	5B1D	3.86-4.0 TB 7200 RPM 4K SAS LFF-1 Nearline Disk Drive (AIX/Linux)	768	
ES64	5B1F	7.72-8.0 TB 7200 RPM 4K SAS LFF-1 Nearline Disk Drive (AIX/Linux)	768	
ESD5	59D0	600GB 10K RPM SAS SFF-3 Disk Drive (AIX/Linux)	8	AIX Linux
ESDB	59E0	300GB 15K RPM SAS SFF-3 Disk Drive (AIX/Linux)	8	AIX Linux
ESEV	59D2	600GB 10K RPM SAS SFF-2 Disk Drive 4K Block - 4096	1536	AIX Linux
ESEZ	59C9	300GB 15K RPM SAS SFF-2 4K Block - 4096 Disk Drive	1536	AIX Linux
ESF3	59DA	1.2TB 10K RPM SAS SFF-2 Disk Drive 4K Block - 4096	1536	AIX Linux
ESF5	59D3	600GB 10K RPM SAS SFF-3 Disk Drive 4K Block - 4096	8	AIX Linux
ESF9	59DB	1.2TB 10K RPM SAS SFF-3 Disk Drive 4K Block - 4096	8	AIX Linux
ESFB	59E1	300GB 15K RPM SAS SFF-3 4K Block - 4096 Disk Drive	8	AIX Linux
ESFF	59E5	600GB 15K RPM SAS SFF-3 4K Block - 4096 Disk Drive	8	AIX Linux
ESFP	59CC	600GB 15K RPM SAS SFF-2 4K Block - 4096 Disk Drive	1536	AIX Linux
ESFT	59DD	1.8TB 10K RPM SAS SFF-2 Disk Drive 4K Block - 4096	1536	AIX Linux
ESFV	59DE	1.8TB 10K RPM SAS SFF-3 Disk Drive 4K Block - 4096	8	AIX Linux
ESNK	5B41	300GB 15K RPM SAS SFF-3 4k Block Cached Disk Drive (AIX/Linux)	8	
ESNP	5B45	600GB 15K RPM SAS SFF-3 4k Block Cached Disk Drive (AIX/Linux)	8	

Disk

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POWER9 I/O currently planned for August 17th on Power E950**E950****Network**

FC	CCIN	Description	Max	OS support
5899	576F	PCIe2 4-port 1GbE Adapter	50	AIX Linux
EC66	2CF3	PCIe4 2-port 100Gb ROCE EN CAPI adapter	10	
EN0H	2B93	PCIe3 4-port (10Gb FCoE & 1GbE) SR&RJ45	51	AIX Linux
EN0K	2CC1	PCIe3 4-port (10Gb FCoE & 1GbE) SFP+Copper&RJ45	51	AIX Linux
EN0S	2CC3	PCIe2 4-Port (10Gb+1GbE) SR+RJ45 Adapter	51	AIX Linux
EN0U	2CC3	PCIe2 4-port (10Gb+1GbE) Copper SFP+RJ45 Adapter	51	AIX Linux
EN0W	2CC4	PCIe2 2-port 10/1GbE BaseT RJ45 Adapter	51	AIX Linux
EN15	2CE3	PCIe3 4-port 10GbE SR Adapter	51	AIX Linux

NOTE

The adapters with FCoE in the description are supported for Ethernet usage but you require an RPQ if you intend to use FCoE in POWER9

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POWER9 I/O currently planned for August 17th on Power E950**E950****CPU + RAM**

FC	CCIN	Description	Max	OS support
EM6A		8 GB DDR4 Memory (2666 MHz)	128	
EM6B		16 GB DDR4 Memory (2666 MHz)	128	
EM6C		32 GB DDR4 Memory (2666 MHz)	128	
EM6D		64 GB DDR4 Memory (2666 MHz)	128	
EM6E		128 GB DDR4 Memory (2666 MHz)	128	
EPWR		8-core 3.6 GHZ processor	32	
EPWS		10-core 3.4 GHZ processor	40	
EPWT		12-core 3.15 GHZ processor	48	
EPWX		11-core X.YZ GHZ processor	44	

FC	CCIN	Description	Max	OS support
EJ08	2CE2	PCIe3 Optical Cable Adapter for PCIe3 Expansion Drawer	8	AIX Linux
EC5J	59B4	800 GB Mainstream U.2 SSD NVMe	16	AIX/Linux
EC5K	59B5	1.6 TB Mainstream U.2 SSD NVMe	16	AIX/Linux
EC5L	59B6	3.2 TB Mainstream U.2 SSD NVMe	16	AIX/Linux

Other

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POWER9 E950 Power Supply

Concurrent maintenance & redundant power – four units

Rating

- 2000 W 200- 240 VAC
- Redundancy 2+2 → if cabled correctly

Energy Efficiency

- 80+ Platinum Power Supply Compliant
- EPA Energy Star Compliant
- Built-in Advanced Thermal & Power Management

Physicals

POWER9 E950



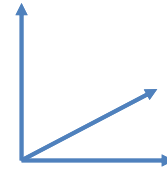
E950 size

- Width: 448 mm (17.5 in.)
- Height: 175 mm (6.9 in.)
- Depth: 902 mm (35.6 in.)

→ 4 EIA units

→ 5 inches greater than E850

→ T42 needs a 8 inch extension for rear cables



E950 Weight:

- 69 kg (152 lb)
- With weight reduction (removing parts) ~121 lb
- Four person lift recommended or better yet a lifting tool

→ Heavier than the E850



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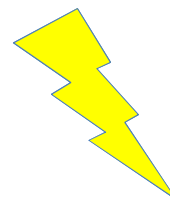
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POWER9 E950



E950 Electrical Power

- Operating voltage: 200 - 240 V AC
- Operating frequency: 50 - 60 Hz +/- 3 Hz
- Power consumption: 3,850 watts maximum
- Power source loading: 3.9 kVA maximum



Note:

- Model 9040-MR9 use four power supply units
- C19/C20 connectors for higher amps → different to the E850 C13's

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POWER9 E950



E950 Thermal output

- 14,403 Btu/hr maximum (per system node)

E950 Maximum altitude:

- 3,050 m (10,000 ft)

E950 Noise level

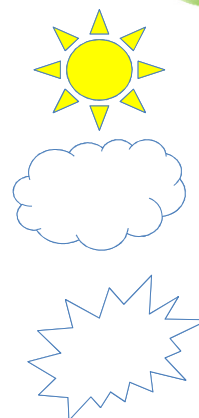
- Acoustics A-weighted Upper-Limit Sound Power Levels

One typically configured Four 8-core or 12-core, 2 TB memory:

- 7.4 bels (operating/idle: 25 C, 500 m)

One maximum configured Four 12-core, 2 TB memory:

- 8.1 bels (heavy workload, 25 C, 500 m)



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Call to Action

→ We need to make sure every one understands

Good News

1. E950 many improvement to the already good E850
2. Up to 48 CPU cores: POWER9 performance boost ~42%
3. Memory jump → 4 TB to 16 TB
4. Adapters → Easy to use rear PCIe cassette access
5. HMC – get them ready ASAP

Challenges

1. Electricity → C19/C20 connectors for higher amps, may need PDU changes
2. Size → It's a lot longer – need to check racks & doors
3. Heavy → Loading in to a rack needs extra care, use the Lifting Device
4. Noisy → May need ear protection, check the computer room policy



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Power E950 Specification Highlights



- ✓ 4U Server - 19" Rack Enclosure
- ✓ 2 or 4 POWER9 Enterprise SMT8 processors
- ✓ Processor SCMs enables efficient 1-Hop processor fabric interconnect
- ✓ Up to 16TB Total DDR4 DIMMs – up to 4TB per processor
 - 920 GB/s memory bandwidth per System
 - 230 GB/s memory bandwidth per Processor
 - 128 DIMM slots on 8 memory riser cards
 - 16 DIMM slots on each riser
- ✓ Capacity on Demand for Processor and Memory
- ✓ 10 PCIe Gen4 slots, 1 PCIe Gen3 - Blind swap, Full Height, Half Length
- ✓ Four High Speed 25Gb/s acceleration ports to attach to future accelerators



- ✓ 4 x NVMe Flash U.2 Bays (bootable)
- ✓ 8 x internal 8 SFF (2.5") SAS bays
- ✓ Storage controller adapters plug into PCIe slots
 - Single backplane for 0 or 1 SAS storage PCIe adapters
 - Split backplane for two storage SAS PCIe adapters
 - SAS PCIe adapters are concurrently maintainable
- ✓ Enhanced DC-DC Regulator Redundancy
- ✓ Full Fan Concurrent Maintenance
- ✓ I/O Expansion and Storage drawers support
- ✓ 4U Server - 19" Rack Enclosure

No Charge: PowerVM & PowerVC