






IBM POWER9 Enterprise E980


Unofficial Deep Dive

MTM: 9080-M9S








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

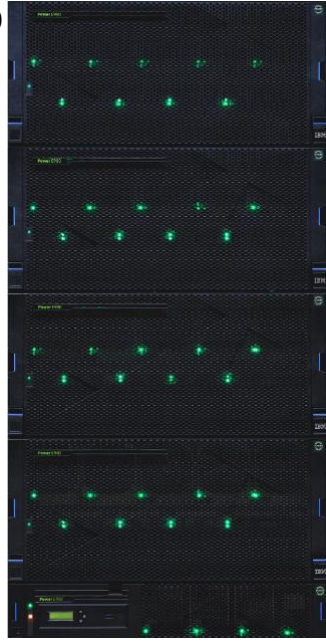


This Presentation



POWER9 Server performance:

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



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<p>Announcement Date:</p> <p>eConfig Date:</p> <p>General Availability Date:</p> <p>Upgrade from POWER8 & POWER9 2 to 4 node MES upgrades:</p>	<p>August 7th both E950 & E980</p> <p>August 8th</p> <p>August 17th E950</p> <p>Sept 21st E980 2 nodes= 96 core</p> <p>Nov 16th E980 4 nodes=192 core</p> <p>In Q4 for easy upgrades</p>
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<p>Before we start</p>	<p>PDF of todays slides & replay from http://tinyurl.com/PowerVUG</p> <ul style="list-style-type: none">- Not going to cover every point- Not covering all the slides- Not covering the market slides <p>Going to share the PowerPoint on the Power VUG website http://tinyurl.com/AIXpert</p> <p>I have ~250 slides including</p> <ul style="list-style-type: none">~ 100 picture slides of the server- Pictures are of a beta machine- GA servers might differ slightly <p>Plus loads of link to more information</p>
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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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Enterprise E980

- Require HMC software 920
- An **update** from HMC 910

POWER9 requires HMC 920 software

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

Gotchas

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



HMC News

Hardware Management Console


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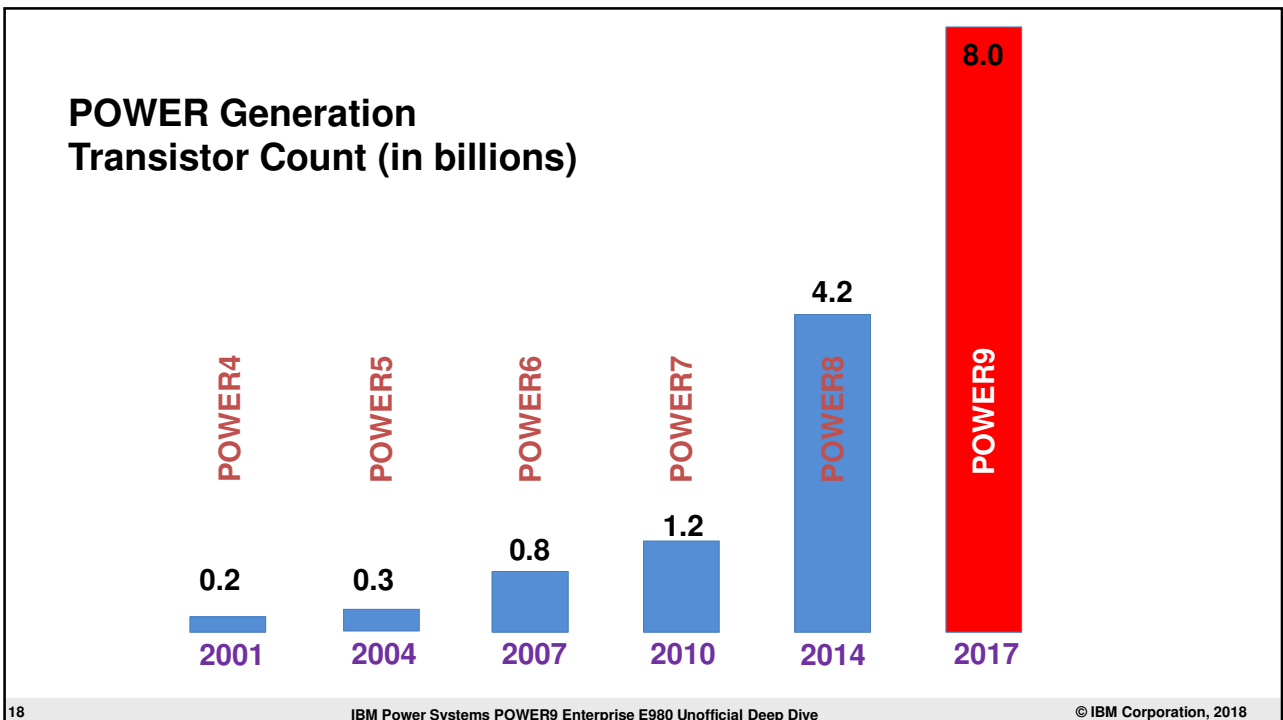
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POWER9 Processor

features that effect the Servers



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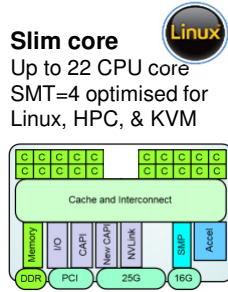


POWER9 Chip Variations

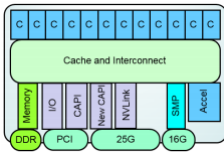


Models
AC922
LC922
LC921

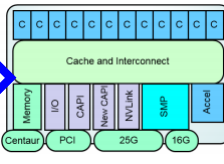
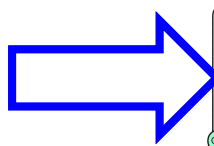
December
OpenPOWER
SMT4
Up to 22 Cores
DDR4 RAM
Linux Only



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

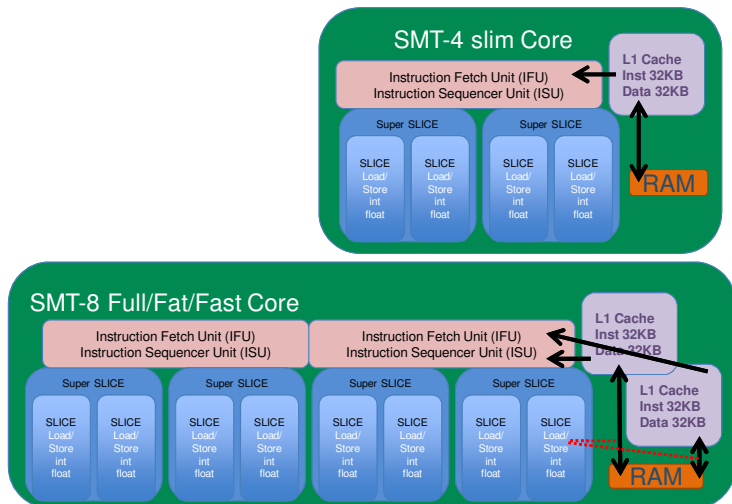


Later 2018 IBM Enterprise SMT8
Up to 12 cores
Centaur RAM
AIX + IBM i + Linux

Models
E950
E980
- 2 node
- 4 node



Wikipedia on POWER9 fast core



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

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

x4

x4

x2

x2

x2

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



POWER9 Processor Peripherals



New 19" Rack 7965-S42



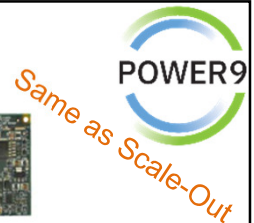
GA 4Q17
POWER8 & POWER9

	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: E980 is tight in a T42!**

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



POWER9 U.2 NVMe support for E980

E980 has four external storage bays

Independent of SAS controllers

NVMe ~price of a SAS adapter

Concurrent 8 SAS 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 DWPD



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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 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, IBM i & Linux all supported installing from USB memory key



Same as Scale-Out
 POWER9



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Nice external USB DVD "holster" in the front door

Personal opinion DVD is NOT recommended

It is time to move the USB memory keys

Select a quality USB 3+, narrow, 16GB like my favourite Sandisk



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POWER9

The Server Range



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POWER9 range in 2018



Enterprise Q3+Q4

E980

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

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 Q3

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POWER9 Model Details



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POWER9 E980

2U System Control Unit
5U 4x System Nodes

Software Stack

- HMC 920+
- PowerVM 2.2.6.30+
- AIX 6 TL9 sp12, 7.1 TL5 sp4 & 7.2 TL3 (full POWER9 support)
- Linux
 - SLES 11 sp4, 12 sp3, 15
 - RHEL 7.4, 7.5
- IBM i
 - 7.2 TR9, 7.3 TR5

	System (9080-M9S) E980
POWER9 Fast/Fused Core Processors	Four Sockets each node 32,40,44,48 CPU cores Sept 21 st 1 or 2 Node drawers Nov 16 th 1 to 4 Node drawers 8, 10, 11 or 12 CPU Cores per socket 3.9 to 4.0 GHz
Sockets	4 per node (all populated)
Memory	CDIMM sizes 32, 64,128, 256, 512 GB populated in quads 16 TB max Memory per node => 64TB in 4 node 230GB/s per module / 920GB/s total (each node!)
Media Bays	DVD via external USB DVD or USB flash key in SCU
Integrated PCIe/node	Eight PCIe Gen 4 x16 HH HL All are CAPI capable and use Blind Swap Cassettes
Internal I/O	- U.2 format 1 to 4 NVMe slots for 1 to 4 NVMe devices 2.5 inch 7 mm 800GB - USB 3.0
Max I/O Drawers	GA1 0-2 MEX PCIe Adapter drawers per node GA2 0-4 MEX PCIe Adapter drawers per node
External Storage Drawers	EXP12SX, ESP24SX & EXP24S Each requires: PCIe SAS adapter or SAS port

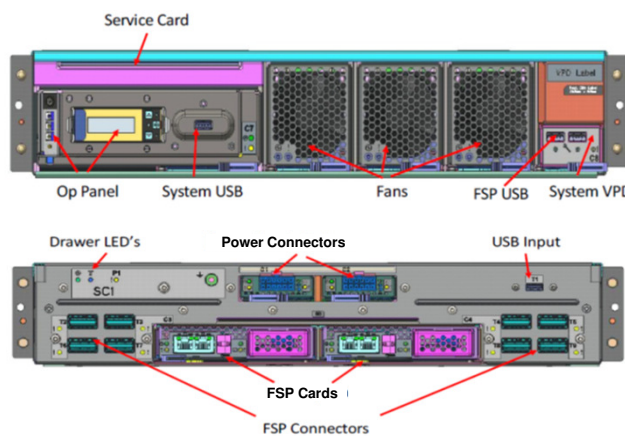
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E980 System Control Unit

- ✓ Eliminated Clock Cabling
- ✓ Provides Front Accessible USB port
- ✓ Reduced UPIC Power cabling
- ✓ External DVD

If the E980 contains only one system node, it supplies input power To the SCU using two UPIC cables.

If the E980 system contains two or more system nodes, SCU power is supplied from node one and two also using two UPIC cables.

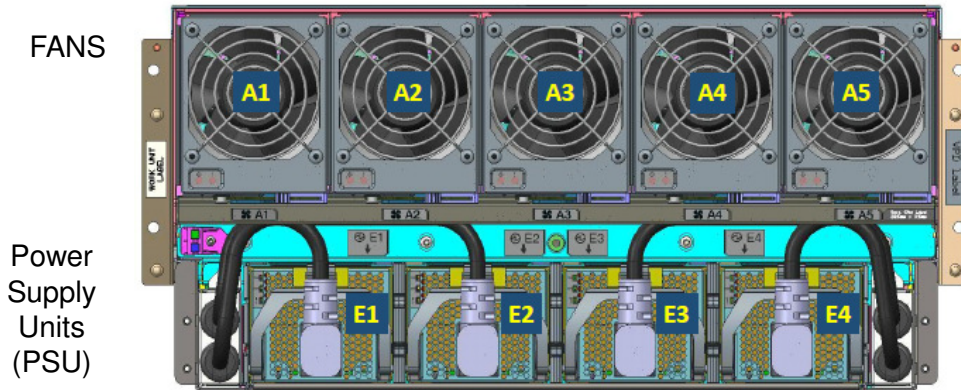


Front View

Rear View

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POWER9 Enterprise E980 node - (front view)



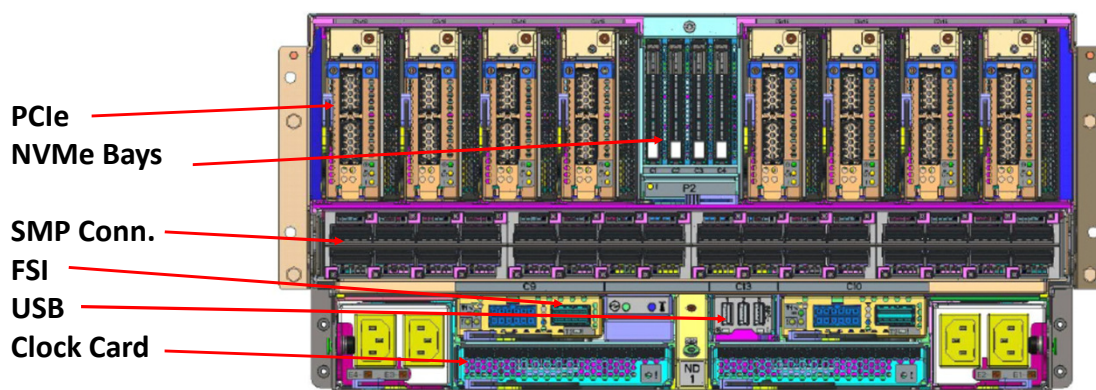
FANS and PSUs are redundant and concurrently maintainable

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POWER9 Enterprise E980 node - (rear view)



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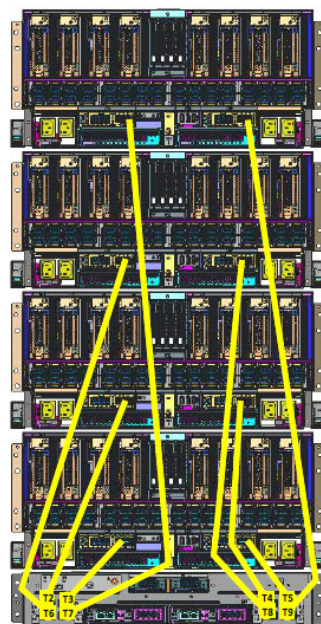
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Cabling to turn four E980 nodes + System Control Unit into one computer system

Flexible Service Processor cabling

Each system node needs to be connected to both the FSPs in the bottom System Control Unit

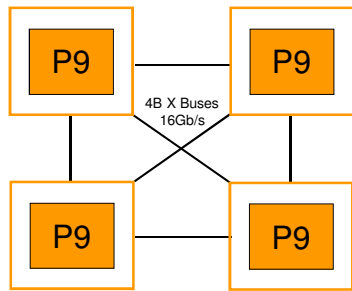
Therefore each node has 2 FSP cables as shown



FSP Cable Locations			
Drawer	Cable	From	To
1	A	SC1-P1-T3	ND1-P1-C9-T2
	B	SC1-P1-T5	ND1-P1-C10-T2
2	A	SC1-P1-T2	ND2-P1-C9-T2
	B	SC1-P1-T4	ND2-P1-C10-T2
3	A	SC1-P1-T6	ND3-P1-C9-T2
	B	SC1-P1-T8	ND3-P1-C10-T2
4	A	SC1-P1-T7	ND4-P1-C9-T2
	B	SC1-P1-T9	ND4-P1-C10-T2

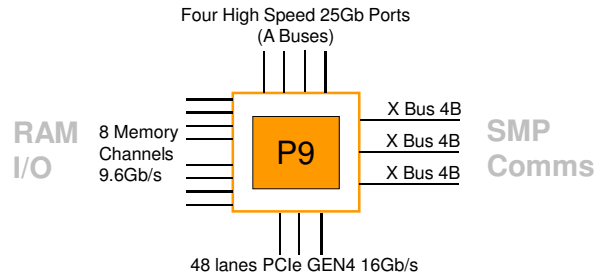
E980 Processor Architecture Highlights

Four directly connected POWER9 Processors = first hop



One hop Chip to Chip within the node (X bus)

Future GPU & CAPI & Node to Node SMP comms



Adapter I/O
Second hop Inter-node cables (A bus)

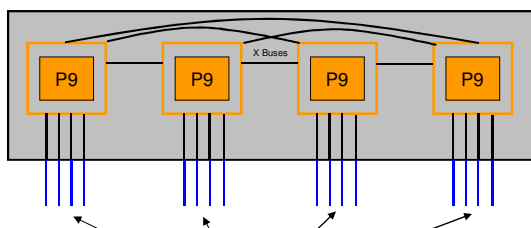
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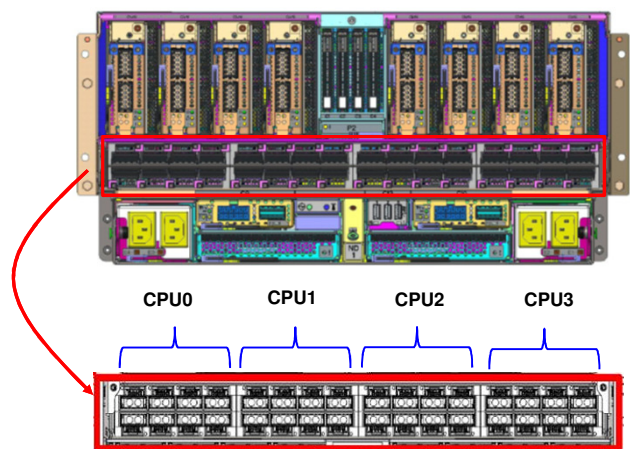
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SMP cabling

- ✓ New SMP Cables with 25Gb/s signaling (4x improvement)
- ✓ 2 Cables per bus enable degraded ½ bandwidth mode for failed cable
- ✓ 2 Cables per bus enable Concurrent Maintenance capability
- ✓ LEDs for install and repair assist



- The 4 High Speed 25Gb ports from each CPU
 - 3 SMP A Buses
 - 1 OpenCAPI bus to external accelerator (future)

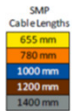
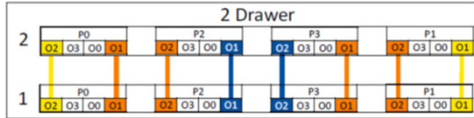


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SMP cabling



Each connection shown in the diagram represents a pair of SMP cables

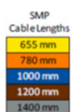
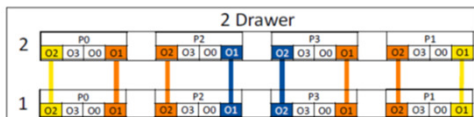


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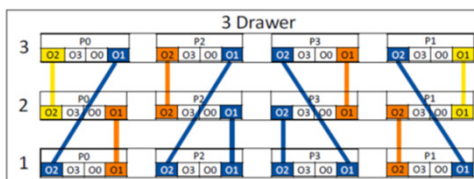
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SMP cabling



Each connection shown in the diagram represents a pair of SMP cables

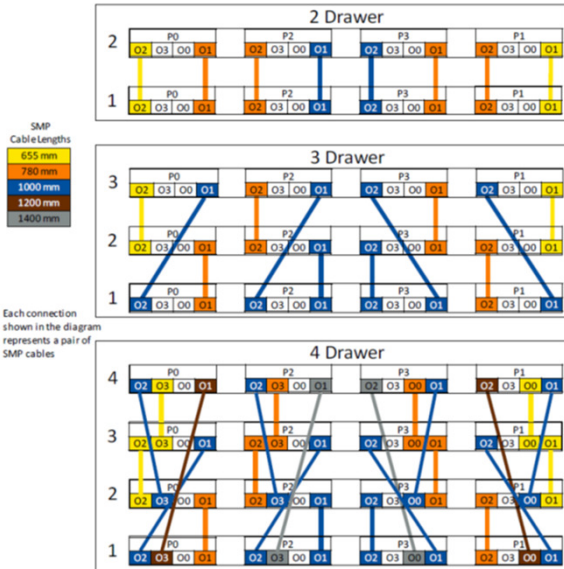


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SMP cabling



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Processors

E980 nodes always
- 4 Processors =
4 POWER9 chips

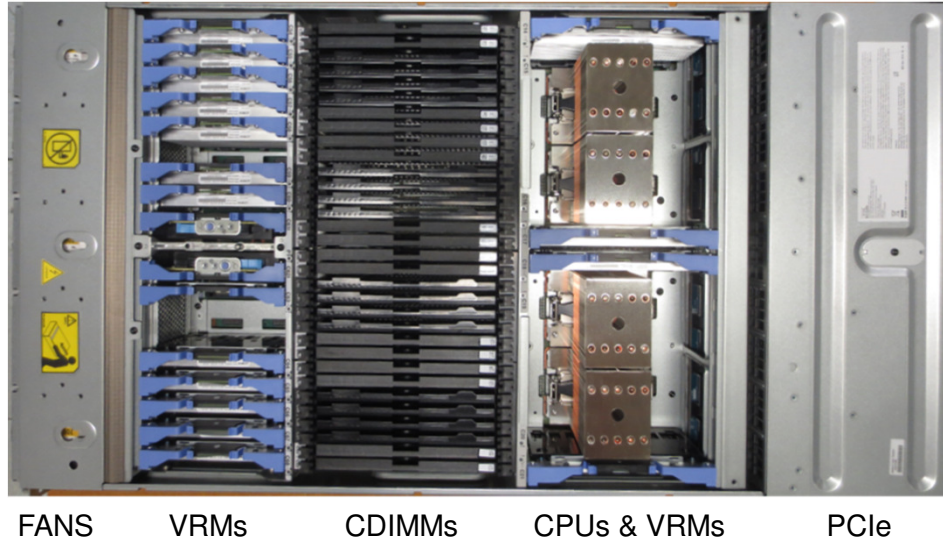
Sept 21st: 1 to 2 nodes
Nov 16th : 1 to 4 nodes

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POWER9 E980 Node – top view



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E980 Processors options

CPU cores per POWER9	CPU cores per node	Nominal GHz	No-name GHz	Max GHz
12	48	2.9	3.55	3.9
11	44	3.0	3.58	3.9
10	40	3.15	3.6	3.9
8	32	3.4	3.8	4.0

Some OS commands report Nominal GHz

Default GHz

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E980 Performance

E980
2 nodes

CPU cores per POWER9	Max GHz	CPU cores per node	CPU cores per system	rPerf	CPW
12	3.9	48	96	2,540	1,368,000
11	3.9	44	88	2,363	1,271,000
10	3.9	40	80	2,196	1,216,000
8	4.0	32	64	1,820	1,012,000

E980
4 nodes

CPU cores per POWER9	Max GHz	CPU cores per node	CPU cores per system	rPerf	CPW
12	3.9	48	192	5,081	2,743,000
11	3.9	44	176	4,762	2,549,000
10	3.9	40	160	4,392	2,439,000
8	4.0	32	128	3,640	2,030,000

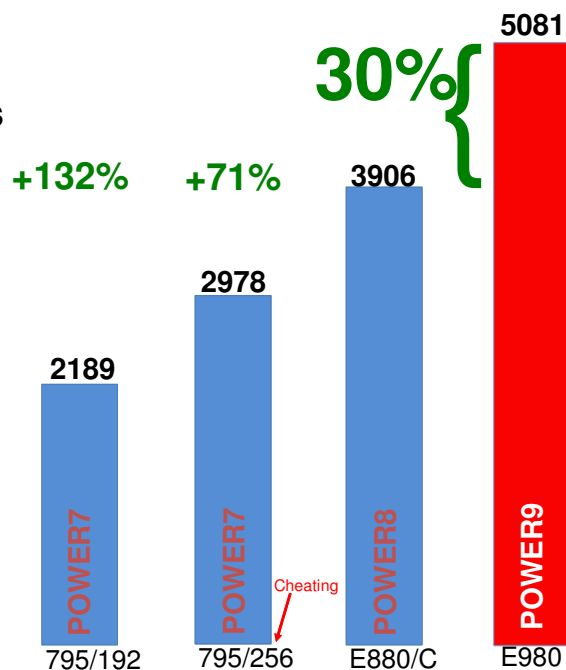
POWER9 Performance Report <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POO03017USEN&>

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Server Generation rPerf for E980 192 CPU cores



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Memory

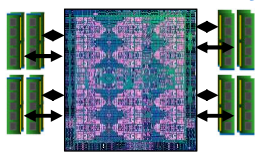
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POWER9 Processor Family Three Memory Architectures

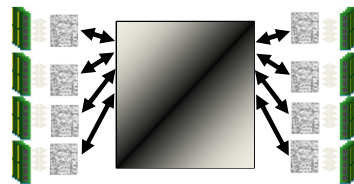
Scale Out Direct Attach Memory



8 Direct DDR4 Ports
POWER9 → DDR4

Max 2-Socket Systems

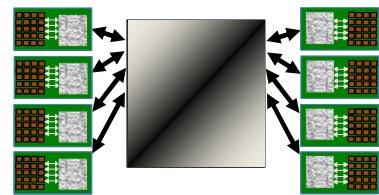
Scale Up Buffered Memory



8 Buffered Channels
POWER9 → Centaur chip → DDR4

E950 4 Socket Systems

Scale Up Buffered Memory



8 Buffered Channels
POWER9 → Centaur chip → RAM

E980 16 Socket Systems

Expect all current memory features in an E870/E880 to be migratable to an E980

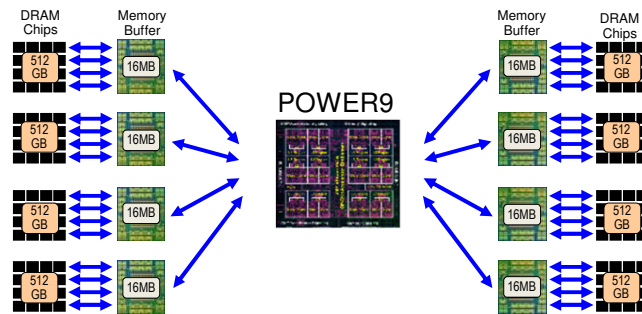
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E980 Memory Subsystem Highlights

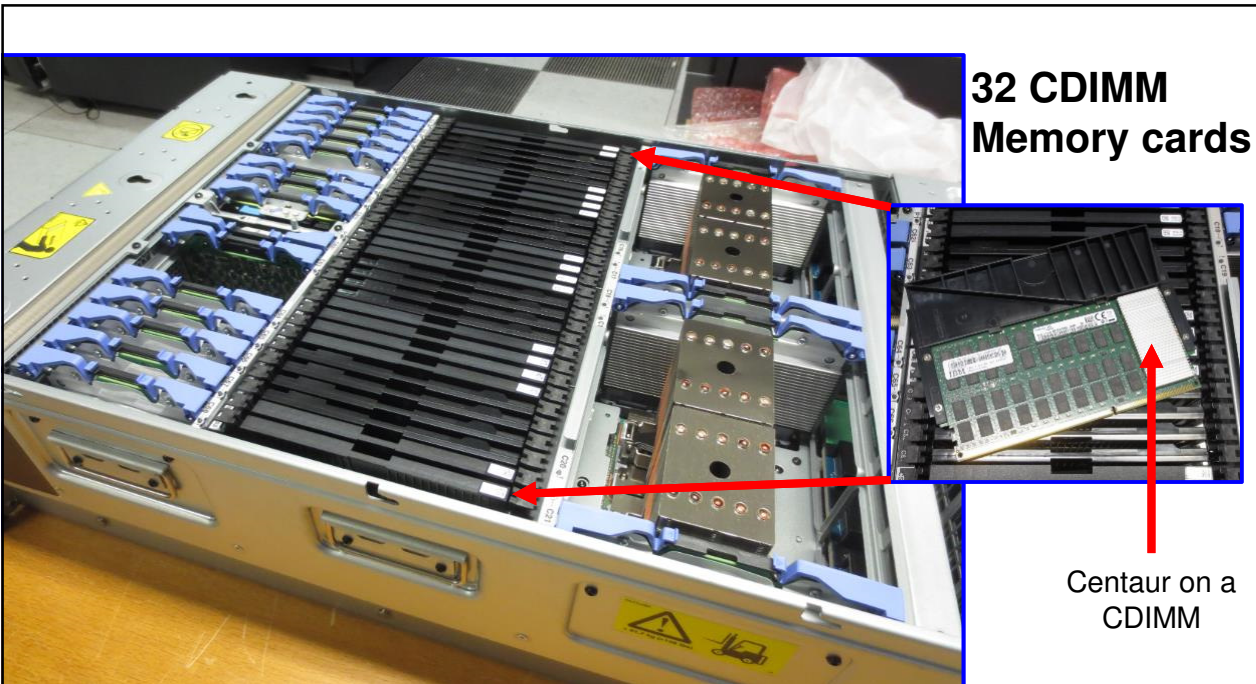
- ✓ 230 GB/s Memory Bandwidth per Node
- ✓ 960 GB/s Memory Bandwidth per Server
- ✓ 32 DIMMs per Node drawer, same CDIMM technology as POWER8
- ✓ Quad DIMM granularity with same plug rules as POWER8
- ✓ 32, 64, 128, 256, 512 GB DDR4 CDIMMs
- ✓ Support for migrating POWER8 DDR3 (16GB, 32GB, 64GB, 128GB) and DDR4 CDIMMs
 - ✓ Mixing DDR3 and DDR4 supported but drawers must be homogeneous
- ✓ Capacity on Demand support



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E980 Infrastructure

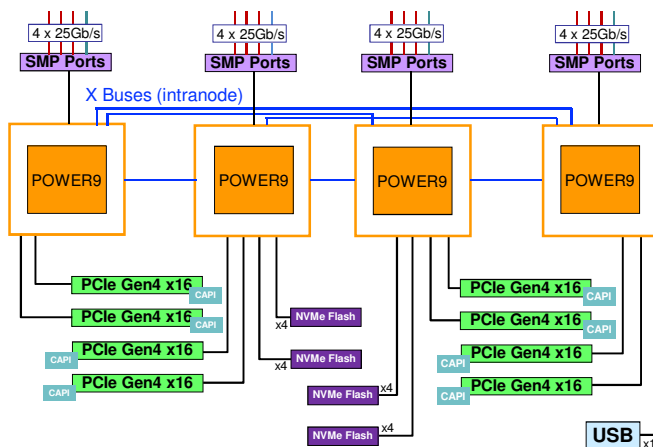
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Power E980 Processor Fabric & I/O Subsystem

3 SMP A-Buses to other Nodes plus OpenCAPI accelerator bus for the future



- ✓ Increased processor-to-processor fabric interconnect bandwidth
 - ✓ 2x 16Gb/s X-Bus fully connected fabric within node Drawer
 - ✓ 4x increase in SMP A-Bus fabric bandwidth for drawer-to-drawer connections
- ✓ Double the I/O bandwidth with
 - PCIe GEN4 Slots (8 per drawer)
 - PCIe slots are Low Profile & Blindswap

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E980 Infrastructure

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Comparison E880C vs E980 System

Features	E880C	E980
Processor	POWER8	POWER9
Sockets	4, 8, 12, 16	4, 8, 12, 16
Cores	Up to 192 cores	Up to 192 cores
Maximum Memory	32TB	64TB
Memory Bandwidth	920 GB/sec / drawer	920 GB/sec / drawer
Predecessor Memory Migration	No	Yes
PCIe slots	8 PCIe GEN3 slots / drawer	8 PCIe GEN4 slots / drawer
I/O Drawer Expansion	Yes	Yes
Acceleration Ports	Yes (CAPI 1.0)	Yes, future (CAPI 2.0 + OpenCAPI)
PCIe Hot Plug Support	Yes	Yes
IO bandwidth	315 GB/sec	630 GB/sec
Integrated I/O		USB 3.0
Internal Storage Bays		4 NVMe Bays / drawer
Drawer Fabric BW		4x higher Bandwidth
RAS		SMP Cable Concurrent Repair

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E980 follows the Enterprise Server package traditions

- **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
- **IBM Active Memory Mirroring** for Hypervisor

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

* 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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POWER9 Enterprise Frequencies & Defaults

Model	Default Mode	Feature Code	Number of Cores	Static Nominal Frequency Disable All mode	Dynamic Performance mode GHz Range	Maximum Performance mode Typical GHz Range
E980	Maximum Performance	EFB3	12cores	2.9 GHz	2.9 to 3.9 GHz (max)	3.55 to 3.9 GHz (max)
		EFB4	11 cores	3.0 GHz	3.0 to 3.9 GHz (max)	3.58 to 3.9 GHz (max)
		EFB2	10 cores	3.15 GHz	3.15 to 3.9 GHz (max)	3.7 to 3.9 GHz (max)
		EFB1	8 cores	3.4 GHz	3.4 to 4.0 GHz (max)	3.9 to 4.0 GHz (max)

Nominal GHz reported by some OS commands

POWER Performance Report new GHz Range

Notes:

1. Frequencies outlined in Red reflect the default mode (i.e. frequency range) for that particular system
2. In order to reach maximum frequency, some cores may need to be turned off

POWER9 Energy & CPU GHz Balance



Enables higher dynamic operational frequencies

Important Frequencies

- **High** – Overclocking (~20%)
- **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

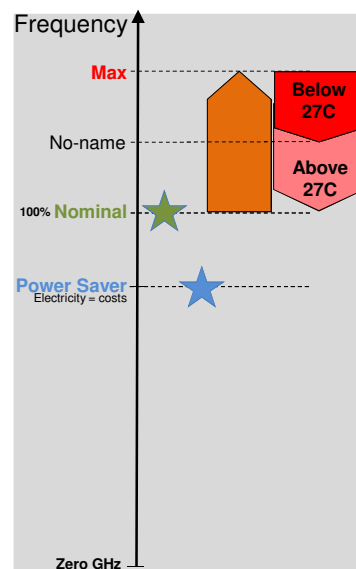
– Fixed Frequency

🏠 **Dynamic Performance Mode**

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

🔥 **Maximum Performance Mode**

– 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



On Twitter?



```
# lparstat -E 1 3
System configuration: type=Shared mode=Uncapped smt=8 lcpu=16 mem=16384MB ent=1.00
Physical Processor Utilisation:
-----Actual-----
user  sys  wait  idle  freq  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%] 1.274 0.018 0.000 0.000
1.124 0.016 0.000 0.000 3.7GHz[113%] 1.271 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
#
```

3.7 GHz = 13% Over-clocking (oops!)

3.3 billion Hz = 3.3 GHz Nominal

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

Memory

Memory Options



Feature Code	Feature Size	Made up for
EF20	128GB DIMM	4 x 32GB
EF21	256GB DIMM	4 x 64GB
EF22	512GB DIMM	4 x 128GB
EF23	1024GB DIMM	4 x 256GB
EF24	2048GB DIMM	4 x 512GB

- ✓ 32 CDIMM memory slots per system node
- ✓ DDR4 1600 MHz CDIMM technology
- ✓ 16MB eDRAM L4 cache buffer per CDIMM

- ✓ 128 CDIMM max config on 4-drawer system

Memory Rules:

- ✓ Remarkably similar to POWER8
- ✓ You can move POWER8 DDR3 based CDIMMs to POWER9 E980
- ✓ A node drawer must be all DDR3 or all DDR4

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Dual VIOS suggestions



Network

- 2 or 4 (for redundancy) Ethernet adapters

Storage

- A. 1 to **16** NVMe drives (8 VIOS with mirrored pairs)

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

- B. **No other Internal disks or SSD**

- C. 2 or 4 (for redundancy) **Fibre Channel SAN**

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

- D. **Remote Disk Drawers for Disks or SSD**

- Cost of PCIe slot+ Remote Drawer Adapters plus the disks/SSD

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NVMe storage Options



Feature Code	DIMM Size
EC5J	800 GB

Yes, just the one size



- ✓ 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



Operating Systems for Enterprise

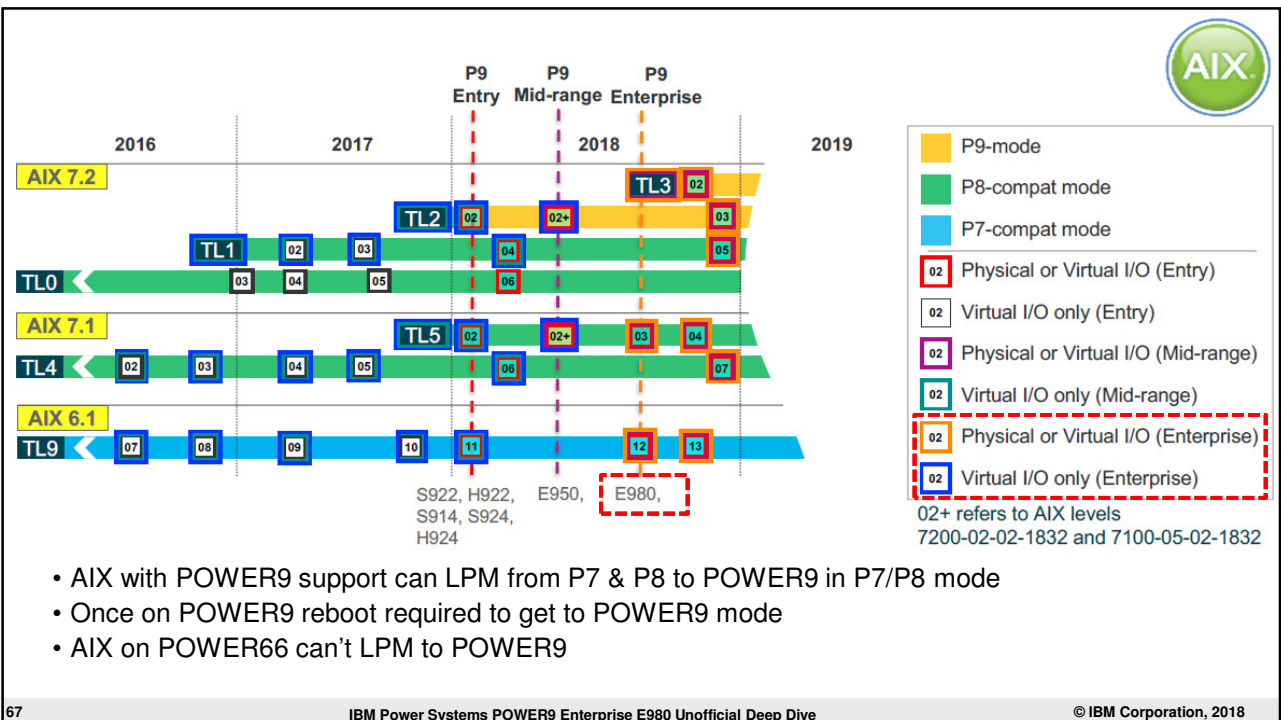
AIX



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AIX for new POWER9 Generally

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

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AIX Level Support at E980 GA

REL-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*

Same as E950

AIX with Adapters

- AIX Version 7.2 TL3 or later
- AIX 7100-05-03-1838 or later
- AIX 6100-09-12-1838*

New

Only as it is a month later

AIX with Adapters later in 2018

- AIX 7200-02-03-1837 Dec 2018
- AIX 7200-01-05-1837 Dec 2018
- AIX 7100-04-07-1837 Dec 2018

* AIX 6 service extension required

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Linux



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Linux on POWER9 E980



- SUSE SLES
- Red Hat RHEL

- Linux on E980 only available under PowerVM
- Older Linux versions 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 E980



• 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



Release Support are:

- IBM i 7.3 TR5
- IBM i 7.2 TR9

IBM i 7.3 TR5 announcement

- http://www-01.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep_ca/8/877/ENUSZP18-0438/index.html&lang=en&request_locale=en#availx
- and developerWorks technical info at
- <https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20i%20Technology%20Updates/page/IBM%20i%207.3%20-%20TR5%20Enhancements>

IBM i 7.2 TR9 announcement

- http://www-01.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep_ca/5/877/ENUSZP18-0435/index.html&lang=en&request_locale=en
- and developerWorks technical info at
- <https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20i%20Technology%20Updates/page/IBM%20i%207.2%20-%20TR9%20Enhancements>

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VIOS

2.2.6.30 or the latest on 21st September 2018

Do not use older versions due to new E980 devices like NVMe

VIOS 3.1 is coming soon (based on AIX 7.2)

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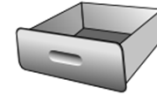
**Storage & Adapter
Remote Drawers
– similar to Scale-Out)**

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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 I/O Drawers

- At first release only per E980 node: 2 Drawers = 4 Fan-outs = 4 Server cards
- E980 node supports
 - Eight Server EMX cards (FC#EJ07)
 - Eight EMX fan-out 1/2 drawer connected to Four EMX Drawers
 - As used on POWER8
- EMX Fan-out has 6 adapters slots = EMX Drawer 12 adapters slots

E980 nodes	FC#EJ07 adapters	EMX Drawers	Fan-out 1/2 Drawers	PCIe slots in total
1	8	4	8	48
2	16	8	16	96
3	24	12	24	144
4	32	16	32	192

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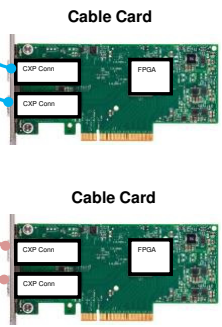
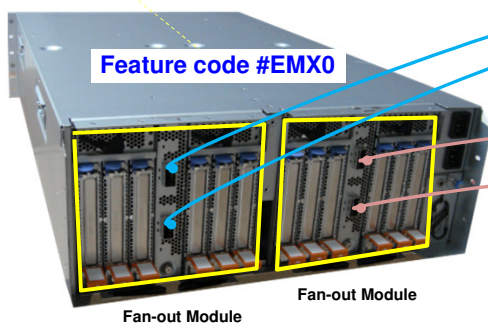
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I/O Expansion Drawer Reminder

- ✓ Modifications made to I/O Expansion drawer to enhance RAS
- ✓ Changed clock topology to eliminate EEH recoveries during FPGA resets
- ✓ New Feature codes for "Cable" card and Fanout Module
- ✓ Migration support for previous I/O Expansion drawer features
- ✓ Planned support for MES upgrade of existing I/O expansion drawers



- 6 or 12 PCIe Gen3 slots
- 4U drawer
- Full high PCIe slots
- Hot plug PCIe slots
- Modules not hot plug



E980 EMX Drawer card:
FC#EJ07 Low Profile Adapter

CPU, RAM and Adapter Support (eye test)

Power I/O currently planned* to be supported on Power E980 **FC & SAS**

FC	CCIN	Description	Max	OS support
5273	577D	PCIe LP 8Gb 2-Port Fibre Channel Adapter	32	AIX IBM i Linux
5729	5729	PCIe2 8Gb 4-port Fibre Channel Adapter	192	AIX IBM i Linux
5735	577D	8 Gigabit PCI Express Dual Port Fibre Channel Adapter	192	AIX IBM i Linux
EN0A	577F	PCIe3 16Gb 2-port Fibre Channel Adapter	192	AIX IBM i Linux
EN0B	577F	PCIe3 LP 16Gb 2-port Fibre Channel Adapter	32	AIX IBM i Linux
EN1A	578F	PCIe3 32Gb 2-port Fibre Channel Adapter	192	IBM i Linux
EN1B	578F	PCIe3 LP 32Gb 2-port Fibre Channel Adapter	32	IBM i Linux
EN1C	578E	PCIe3 16Gb 4-port Fibre Channel Adapter	192	IBM i Linux
EN1D	578E	PCIe3 LP 16Gb 4-port Fibre Channel Adapter	32	IBM i Linux
FC	CCIN	Description	Max	OS support
EJ0J	57B4	PCIe3 RAID SAS Adapter Quad-port 6Gb x8	128	AIX IBM i Linux
EJ0M	57B4	PCIe3 LP RAID SAS Adapter Quad-Port 6Gb x8	32	AIX IBM i Linux
EJ10	57B4	PCIe3 SAS Tape/DVD Adapter Quad-port 6Gb x8	192	AIX IBM i Linux
EJ11	57B4	PCIe3 LP SAS Tape/DVD Adapter Quad-port 6Gb x8	32	AIX IBM i Linux
EJ14	57B1	PCIe3 12GB Cache RAID PLUS SAS Adapter Quad-port 6Gb x8	192	AIX IBM i Linux
FC	CCIN	Description	Max	OS support
ESLL	78D1	EXP12SX SAS Storage Enclosure	168	AIX Linux
ESLS	78D1	EXP24SX SAS Storage Enclosure	168	AIX IBM i Linux

Low Profile internal
to the E980 node



Subject to Change

Power I/O currently planned* to be supported on Power E980 **SAS DISKS**

FC	CCIN	Description	Max	OS support
ES0Q	59E8	387GB SFF-2 4K SSD for AIX/Linux	2016	AIX IBM i Linux
ES0S	59C3	775GB SFF-2 4k SSD for AIX/Linux	2016	AIX IBM i Linux
ES78	5B16	387GB SFF-2 SSD 5xx eMLC4 for AIX/Linux	2016	AIX Linux
ES7E	5B17	775GB SFF-2 SSD 5xx eMLC4 for AIX/Linux	2016	AIX Linux
ES80	5B21	1.9TB Read Intensive SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX Linux
ES85	5B10	387GB SFF-2 SSD 4k eMLC4 for AIX/Linux	2016	AIX Linux
ES8C	5B11	775GB SFF-2 SSD 4k eMLC4 for AIX/Linux	2016	AIX Linux
ES8F	5B12	1.55TB SFF-2 SSD 4k eMLC4 for AIX/Linux	2016	AIX Linux
ES8Y	5B29	931GB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	
ES96	5B21	1.86TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	
ESE7	5B2D	3.72TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESG5	5B16	387GB Enterprise SAS 5xx SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESGB	5B10	387GB Enterprise SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESGF	5B17	775GB Enterprise SAS 5xx SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESGK	5B11	775GB Enterprise SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESGP	5B12	1.55TB Enterprise SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESHJ	5B29	931 GB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESHL	5B21	1.86 TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESHN	5B2F	7.44 TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	AIX IBM i Linux
ESM8	5B2D	3.72 TB Mainstream SAS 4k SFF-2 SSD for AIX/Linux	2016	

Subject to Change

Power I/O currently planned* to be supported on Power E980 Network

FC	CCIN	Description	Max	OS support
5260	576F	PCIe2 LP 4-port 1GbE Adapter	32	AIX IBM i Linux
5899	576F	PCIe2 4-port 1GbE Adapter	192	AIX IBM i Linux
EC2R	58FA	PCIe3 LP 2-Port 10Gb NIC&ROCE SR/Cu Adapter	32	IBM i
EC2S	58FA	PCIe3 2-Port 10Gb NIC&ROCE SR/Cu Adapter	64	IBM i
EC2T	58FB	PCIe3 LP 2-Port 25/10Gb NIC&ROCE SR/Cu Adapter	32	IBM i
EC2U	58FB	PCIe3 2-Port 25/10Gb NIC&ROCE SR/Cu Adapter	64	IBM i
EC67	2CF3	PCIe4 LP 2-port 100Gb ROCE EN LP adapter	32	IBM i
EN0H	2B93	PCIe3 4-port (10Gb FCoE & 1GbE) SR&RJ45	192	AIX IBM i Linux
EN0J	2B93	PCIe3 LP 4-port (10Gb FCoE & 1GbE) SR&RJ45	32	AIX IBM i Linux
EN0K	2CC1	PCIe3 4-port (10Gb FCoE & 1GbE) SFP+Copper&RJ45	192	AIX IBM i Linux
EN0L	2CC1	PCIe3 LP 4-port(10Gb FCoE & 1GbE) SFP+Copper&RJ45	32	AIX IBM i Linux
EN0S	2CC3	PCIe2 4-Port (10Gb+1GbE) SR+RJ45 Adapter	192	AIX IBM i Linux
EN0T	2CC3	PCIe2 LP 4-Port (10Gb+1GbE) SR+RJ45 Adapter	32	AIX IBM i Linux
EN0U	2CC3	PCIe2 4-port (10Gb+1GbE) Copper SFP+RJ45 Adapter	192	AIX IBM i Linux
EN0V	2CC3	PCIe2 LP 4-port (10Gb+1GbE) Copper SFP+RJ45 Adapter	32	AIX IBM i Linux
EN0W	2CC4	PCIe2 2-port 10/1GbE BaseT RJ45 Adapter	192	AIX IBM i Linux
EN0X	2CC4	PCIe2 LP 2-port 10/1GbE BaseT RJ45 Adapter	32	AIX IBM i Linux
EN15	2CE3	PCIe3 4-port 10GbE SR Adapter	192	AIX IBM i Linux
EN16	2CE3	PCIe3 LPX 4-port 10GbE SR Adapter	32	AIX IBM i Linux

Subject to Change

Power I/O currently planned* to be supported on Power E980 RAM, CPU & bits

FC	CCIN	Description	Max	OS support
EF27	31ED	128GB DDR4 Memory (4X32GB) CDIMMs for 80H	32	
EF28	31EE	256GB DDR4 Memory (4X64GB) CDIMMs for 80H	32	
EF29	31EF	512GB DDR4 Memory (4X128GB) CDIMMs for 80H	32	
EF2A	31FC	1024GB DDR4 Memory (4X256GB) CDIMMs for 80H	32	
EF2B	31FD	2048GB DDR4 Memory (4X512GB) CDIMMs for 80H	32	
EFP5	5C35	3.40 GHz 32-core (4x8) POWER9 processor	4	
EFP6	5C36	3.15 GHz 40-core (4x10) POWER9 processor	4	
EFP7	5C39	2.90 GHz 48-core (4x12) POWER9 processor	4	
EFP8	5C46	3.0 GHz 44-core (4x11) POWER9 processor		
FC	CCIN	Description	Max	OS support
5785	57D2	4 Port Async EIA-232 PCIe Adapter	32	AIX IBM i Linux
EJ33	4767	PCIe3 Crypto Coprocessor BSC-Gen3 4767	96	AIX IBM i Linux
EJ07	6B52	PCIe3 Optical Cable Adapter for PCIe3 Expansion Drawer (MEX)	32	AIX IBM i Linux

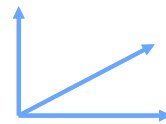
Subject to Change

Physicals

POWER9 E980

E980 node size

- Width: 445.5 mm (17.54 in.)
- Depth: 867 mm (34.13 in.) → T42 consider the 8 inch extension for rear cables
- Height: 218 mm (8.58 in.) → 5U each



E980 System Control Unit size

- Width: 445.6 mm (17.54 in.)
- Depth: 779.7 mm (30.7 in.)
- Height: 86 mm (3.39 in.) → 2U

E980 Weight:

Node: 86.2 kg (190 lb)
System Control Unit: 22.7 kg (50 lb)

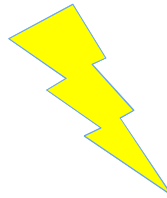




POWER9 E980

E980 Node Electrical Power

Operating voltage: 200 - 240 V AC
Operating frequency: 50 - 60 Hz +/- 3 Hz
Power consumption: 4,130 watts maximum
Power source loading: 4.2 kVA maximum



Note:

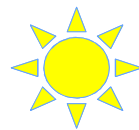
Model 9080-M9S use four power supply units
C13/C14 connectors like the E880



POWER9 E980

E980 Thermal output

14,095 Btu/hr maximum (per system node)



E980 Maximum altitude:

3,050 m (10,000 ft)



E980 Noise level

One maximally configured :
- 8.5 bels LwAm (operating/idle, 25 C, 500 m)
- 9.0 bels LwAm (heavy workload, 27 C, 500 m)



Power E980 easy understand for POWER8 E880 users

- ✓ Similar to E880
 - ✓ So it is “familiar”
 - ✓ Kept all the best things & adds more
- ✓ POWER9 gives big benefits
 - ✓ Stronger CPU cores
 - ✓ Massive memory footprint
 - ✓ Higher Bandwidth
 - ✓ Internal NVMe disks
 - ✓ Good for VIOS
 - ✓ Often no need for remote disk drawers
- ✓ Better RAS
 - ✓ Advanced clocking
 - ✓ SMP cable concurrent repair



Summary

Power E980 Specification Highlights

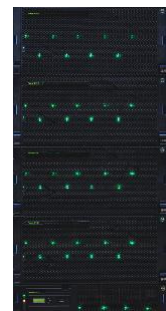
- ✓ Modular, Scalable POWER9 server
 - 1 to 4 x 5U node drawers + 2U Control Unit
- ✓ POWER9 Enterprise SMT8 processor
 - (8, 10, 11 or 12 cores per socket)
- ✓ Up to 192 cores in a single system
- ✓ Up to 64 TB DDR4 memory
 - 16 TB per node drawer
 - 920 GB/sec memory bandwidth per drawer
 - New systems use the same DDR4 CDIMMs technology introduced on POWER8
- ✓ Secure and Trusted Boot with Trusted Platform Module (TPM)
- ✓ Up to 32 PCIe Gen4 slots, Blindswap, Low Profile (8 per node)



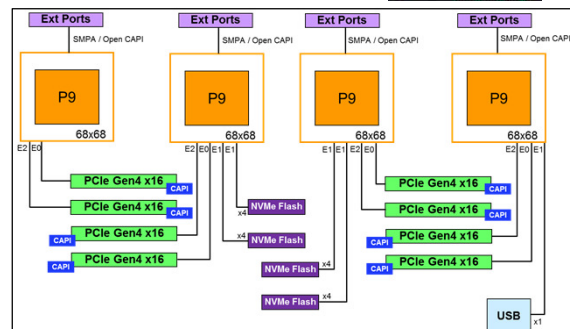
- ✓ High speed 25Gb/s ports
 - Used for SMP cabling between nodes - 4x bandwidth improvement
 - Enabled for OpenCAPI accelerators
- ✓ 4 NVMe Flash U.2 Bays per node
- ✓ Integrated USB ports
- ✓ Up to 16 PCIe I/O Expansion Drawers (4 per node drawer)
- ✓ Distributed Redundant Clocking
- ✓ 2U System Control Unit drawer
 - Redundant FSP cards
 - Front-side USB Port



POWER9 Enterprise Server (E980)



- ✓ Up to four 5U nodes + 2U Control Unit
- ✓ POWER9 Enterprise SMT8 processor (8,10, 11, 12 cores per socket)
- ✓ Up to 64TB total memory (16TB per drawer)
 - 920 GB/s total system memory bandwidth per drawer
 - Uses same DDR4 CDIMMs as POWER8
 - Planned support for migration of POWER8 DDR3 CDIMMs
- ✓ 32 PCIe Gen4 slots, Blindswap, Low Profile
- ✓ New SMP Cables with 4x bandwidth improvement
- ✓ Four 25Gb/s acceleration ports
- ✓ 4 NVMe Flash U.2 Bays (rear accessible) per drawer
- ✓ Integrated USB ports in rear
- ✓ Up to 16 I/O Expansion Drawers
- ✓ Distributed Redundant Clocking
- ✓ 2U System Control Unit Drawer
 - Redundant FSP cards
 - Front-side USB Ports



POWER9 High-end Server: Power E980

- ✓ Maximize performance, scalability, and throughput
(192 POWER9 cores, up to 64 TB memory, PCIe Gen4, 25 Gb/s SMP fabric)
- ✓ Flexible, economically efficient infrastructure
(Multi-OS: AIX, IBM i, Linux; Modular scalability, Integrated NVMe for boot, Capacity on Demand and Enterprise Pools with POWER8)
- ✓ Improve infrastructure resilience
- ✓ Enable rapid service delivery
(Cloud Management, built-in virtualization and Elastic Capacity on Demand)
- ✓ Deliver a smooth, non-disruptive transition to modernize your infrastructure



POWER9 Enterprise Server (E980) Highlights

- ✓ Modular Scalable Design – Up to **two 5U nodes + 2U Control Unit = 12U**
- ✓ Max of 96 POWER9 SMT8 with 8,10, 11 or 12 cores per socket
- ✓ Up to 32TB total memory (16TB per drawer)
 - Planned support for migration of POWER8 CDIMMs
- ✓ Max of 16 PCIe Gen4 slots, Blindswap, Low Profile
- ✓ New SMP Cables with 4x bandwidth improvement
- ✓ High Speed 25Gbps ports to attach future OpenCAPI accelerators
- ✓ Internal Storage - 4 NVMe Flash U.2 Bays (rear accessible) per node
- ✓ Integrated USB ports
- ✓ Secure and Trusted Boot with TPM module
- ✓ Up to 4 PCIe I/O Expansion Drawers (2 Drawers per node)
- ✓ 2U System Control Unit Drawer

Generally Available 3Q



POWER9 Enterprise Server (E980) Highlights

- ✓ Modular Scalable Design – Up to 4x 5U node drawers+2U Control Unit
- ✓ Max of 192 POWER9 SMT8 with 8,10, 11 or 12 cores per socket
- ✓ Up to 64TB total memory (16TB per drawer)
 - Planned support for migration of POWER8 CDIMMs
- ✓ Max of 32 PCIe Gen4 slots, Blindswap, Low Profile
- ✓ New SMP Cables with 4x bandwidth improvement
- ✓ High Speed 25Gbs ports to attach future OpenCAPI accelerators
- ✓ Internal Storage - 4 NVMe Flash U.2 Bays (rear accessible) per node
- ✓ Integrated USB ports
- ✓ Secure and Trusted Boot with TPM module
- ✓ Up to 16 PCIe I/O Expansion Drawers (4 Drawers per node)
- ✓ 2U System Control Unit Drawer
- ✓ Serial Number preserving upgrade support from POWER8
- ✓ MES Drawer Adds supported
- ✓ Earthquake certification

Generally Available 4Q

