IBM POWER9 Family

When data-intensive workloads are the bottom line

Joe Armstrong (jdarmstr@us.ibm.com)
POWER9 Processor Family

Core Count / Size

SMP scalability / Memory subsystem

**Scale-Out – 2 Socket Optimized**

Robust 2 socket SMP system

Direct Memory Attach
- Up to 8 DDR4 ports
- Commodity packaging form factor

**Scale-Up – Multi-Socket Optimized**

Scalable System Topology / Capacity
- Large multi-socket

Buffered Memory Attach
- 8 Buffered channels

**SMT4 Core**

- 24 SMT4 Cores / Chip
- Linux Ecosystem Optimized

**SMT8 Core**

- 12 SMT8 Cores / Chip
- PowerVM Ecosystem Continuity
POWER9 Memory Subsystems

Two Memory Architectures

Scale Out
Direct Attach Memory

- 8 Direct DDR4 Ports
  - Up to 170 GB/s of peak bandwidth
  - Low latency access
  - Commodity packaging form factor
  - Adaptive 64B / 128B reads
  - Simplified Design Point

Max 2-Socket Systems

Scale Up
Buffered Memory

- 8 Buffered Channels
  - Up to 230 GB/s of memory bandwidth
  - Extreme capacity – up to 8TB / socket
  - Superior RAS with chip kill and lane sparing
  - Compatible with POWER8 system memory
  - Agnostic interface for alternate memory innovations

4 to 16 Socket Systems
**POWER9 PCIe GEN4**

**POWER7/7+**
- Proprietary GX Attach
- Utilizes Bridge Chip

**POWER8**
- Directly Integrates PCI
- Improves latency/bandwidth
- CAPI 1.0 Support

**POWER9**
- Directly Integrates PCI
- Leadership Lane Count
- Full Cache Integration
- Very Early Adoption
- CAPI 2.0 Support

**I/O Bridge**
- GX Bus

**PCI Device**
- PCIe G2

**PCIe G3**

**PCIe G4**

- 40 GB/s Peak Bandwidth
- 96 GB/s Peak Bandwidth
- 192 GB/s Peak Bandwidth
IBM POWER9 Family

When data-intensive workloads are the bottom line

- S922/S914/S924
- H922/H924/L922
- E950/H950
- E980/H980
- LC922/LC921
- AC922
IBM POWER9 Systems Roadmap

- More performance and scale
- More memory capacity for in-memory DBs
- Reduced latency and improved throughput with enhanced I/O
  - PCIe Gen4
  - Integrated NVMe Flash (bootable OS)
- High-bandwidth (25Gb/s) links for GPU/OpenCAPI acceleration

Blue = PowerVM
  FSP based

Green = KVM or
  Bare metal
*Unless noted
  BMC based

2017

- 4Q
- 1Q
- 2Q

POWER9

HPC & AI

- S924 / S914
- S922
- L922

Scale out

- P9 (SMT8)
- Scale Out

- S922LC
- S921LC

- AC922 - NVLink 2.0
  Nvidia GPUs GA1

- AC922 – GA2
  Nvidia GPUs

- New air and water cooled models

Scale up - Enterprise

- E980
- E950

2018

- 3Q
- 4Q
IBM POWER SYSTEMS for AI

AC922

An Acceleration Superhighway
Unleash state of the art IO and accelerated computing potential in the post “CPU-only” era

Designed for the AI Era
Architected for the modern analytics and AI workloads that fuel insights

Delivering Enterprise-Class AI
Flatten the time to AI value curve by accelerating the journey to build, train, and infer deep neural networks
POWER9 Extreme Acceleration

CPU Accelerator Bandwidth

POWER8 PCIe Gen3 x16
POWER9 PCIe Gen4 x16
POWER8NV with NVLink 1.0
POWER9 with 25Gbps NVLink 2.0, Open CAPI

Seamless CPU/Accelerator Interaction
- Coherent memory sharing
- Enhanced virtual address translation
- Data interaction with reduced SW & HW overhead

Broader Application of Heterogeneous Compute
- Designed for efficient programming models
- Accelerate complex analytic / cognitive applications

Increased Performance / Features / Acceleration Opportunity
Acceleration Super Highway

5.6x more data throughput vs. PCIe Gen3
with NVIDIA NVLink optimization to the core

2x bandwidth
with PCIe Gen4 vs. PCIe Gen3

Access up to 2TB of system memory
delivered with coherence … only on POWER!

Superior data transfer to multiple devices
25G Links to OpenCAPI GPU devices

GPU ↔ CPU and GPU ↔ GPU speed-up
not just GPU ↔ GPU
Large AI Models Train 4 Times Faster

POWER9 vs Intel x86

Data Scientists Run 100s of AI Trainings

Speedup = Faster Time to Insight
Power AC922 HPC Server

**MTM 8335-GTG (Dec 22, 2017)**
- 2U server - 19” Rack enclosure
- 2 POWER9 Scale Out SMT4 Processors (Up to 22-cores* per socket)
- 4 and 6 NVidia “Volta” GPU processors (NVLink 2.0 attached)
- Up to 2TB* Total DDR4 Industry Standard memory RDIMMs
  - 306 GB/s total system memory bandwidth
- 4 PCIe Gen4 Low Profile slots
- 2 SFF (2.5”) SATA bays (HDD or SSD)
- Linux only platform with BMC service processor

**MTM 8335-GTH (2Q 2018)**
- An upgrade from 8335-GTG to 8335-GTH is available as a no charge MES
- It is an optional upgrade for all 8335-GTG systems to get expanded OS and I/O
- Optional upgrade is available through end of 4Q 2018
- 2 TB Memory

**MTM 8335-GTX (2Q 2018)**
- water cooled option with up to 6 GPUs
AC922 Server w/ GPU Acceleration

https://www.ibm.com/power/news
The world’s fastest supercomputer is back in America

- **Summit** is made up of:
  - 4,608 compute nodes
- Each node is made up of:
  - Two 22-core IBM POWER9 CPUs
  - 6 NVIDIA Tesla V100 accelerators
- Total Compute:
  - 9,216 IBM POWER9 CPUs
  - 202,752 POWER9 cores
  - 27,648 NVIDIA Volta GPUs
  - 10 petabytes of Memory
  - 250 petabytes of Storage

https://www.energy.gov/articles/summit-supercomputer-ranked-fastest-computer-world
## POWER9 Scale Out family

<table>
<thead>
<tr>
<th>Model</th>
<th>9008-22L</th>
<th>9009-22A</th>
<th>9009-41A</th>
<th>9009-42A</th>
<th>9223-22H</th>
<th>9223-42H</th>
</tr>
</thead>
<tbody>
<tr>
<td>L922</td>
<td>1,2,socket, 2U</td>
<td>1,2/socket, 2U</td>
<td>1/socket, 4U &amp; Tower</td>
<td>2/socket, 4U</td>
<td>1,2/socket, 2U</td>
<td>2/socket, 4U</td>
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<tr>
<td>S922</td>
<td>8,10,12 cores/ socket</td>
<td>4, 8,10 cores/ socket</td>
<td>4,6,8 cores/ socket</td>
<td>8,10,12 cores/ socket</td>
<td>8,10,12 cores/ socket</td>
<td>8,10,12 cores/ socket</td>
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<tr>
<td>S914</td>
<td>32 IS RDIMM slots</td>
<td>32 IS RDIMM slots</td>
<td>16 IS RDIMM slots</td>
<td>32 IS RDIMM slots</td>
<td>32 IS RDIMM slots</td>
<td>32 IS RDIMM slots</td>
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<tr>
<td>S924</td>
<td>4TB memory</td>
<td>1TB memory</td>
<td>2 CAPI 2.0 Slots</td>
<td>4TB memory</td>
<td>4TB memory</td>
<td>4TB memory</td>
</tr>
<tr>
<td>H922</td>
<td>4 CAPI 2.0 Slots</td>
<td>Internal RDX Media</td>
<td>Internal RDX Media</td>
<td>4 CAPI 2.0 slots</td>
<td>4 CAPI 2.0 slots</td>
<td>Internal RDX Media</td>
</tr>
<tr>
<td>H924</td>
<td>Internal RDX Media</td>
<td>AIX, IBM i, Linux</td>
<td>AIX, IBM i, Linux</td>
<td>AIX, IBM i, Linux</td>
<td>AIX, IBM i, Linux</td>
<td>AIX, IBM i, Linux</td>
</tr>
</tbody>
</table>

### Technology Leadership

- Cloud enabled - Embedded virtualization capabilities with PowerVM
- Up to 4TB in 2 socket - DDR4 Industry Standard memory RDIMMs
- High Speed 25Gb/s external ports – one per socket
- 2 Internal NVMe Flash boot adapters
- Embedded Analytics and Algorithms on the chip help run POWER9 at an always optimized frequency
POWER9 4U Scale Out Server
S924 9009-42A, H924 9223-42H
✓ 4U server - 19” Rack enclosure
✓ POWER9 Scale-Out SMT8 processor (12-core, 10-core, 8-core offerings)
✓ Up to 4TB Total DDR4 Industry Standard memory RDIMMs
  ▪ Up to 340 GB/s total system memory bandwidth
  ▪ 32 IS RDIMM slots (no risers)
✓ 11 PCIe Gen3/Gen4 slots, Full Height, Half Length (2-sockets populated)
  ▪ Five PCIe GEN4 slots (4 CAPI 2.0 enabled)
  ▪ Six PCIe GEN3 slots (1 reserved for Ethernet adapter)
✓ 2 High Speed 25Gb/s ports for OpenCAPI / GPU Acceleration
✓ 12 or 18 SFF (2.5”) bay options
✓ Two internal storage controller slots
  ▪ Single or Split backplane or Dual RAID write cache support
  ▪ 2 Internal NVMe Flash boot adapters (two M.2 devices per card)
✓ Internal RDX Media Bay
✓ I/O Expansion Drawer support
✓ H924 supports up to 25% IBM i / AIX cores
✓ No internal DVD
POWER9 4U Scale Out Server
S924 9009-42A, H924 9223-42H

- 5 PCIe Gen4 slots
- 6 PCIe Gen3 slots
- 2 Processor modules
- 2 Internal Storage slots (SAS or NVMe)
- 16 DDR4 RDIMM’s per processor
- 32 DDR4 RDIMM’s total
- 2 Internal Storage slots (SAS or NVMe)
- 6 Blowers
- LCD Display
- USB 3.0
- Media backplane
  - 12 SFF bays & 1 RDX bay, or
  - 18 SFF bays
- RDX drive

POWER9 4U Scale Out Server
S924 9009-42A, H924 9223-42H
## Internal Storage Options

<table>
<thead>
<tr>
<th>FC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC59</td>
<td>NVMe Card with two M.2 connectors</td>
</tr>
<tr>
<td>EJ1C</td>
<td>Single RAID 0,10,5,6 12 SFF bays (Gen3-Carrier), 1 RDX bay</td>
</tr>
<tr>
<td>EJ1E</td>
<td>Split Backplane RAID 0,10,5,6 6+6 SFF bays (Gen3-Carrier), 1 RDX bay</td>
</tr>
<tr>
<td>EJ1M</td>
<td>Dual Write Cache RAID 0,10,5,6,5T2,6T2 12 SFF bays (Gen3-Carrier), 1 RDX bay</td>
</tr>
<tr>
<td>EJ1D</td>
<td>Dual Write Cache RAID 0,10,5,6,5T2,6T2 18 SFF bays (Gen3-Carrier)</td>
</tr>
<tr>
<td>EU00</td>
<td>RDX Docking Station</td>
</tr>
</tbody>
</table>

### Supported Media Overview

- **NVMe M.2 Flash devices**
  - 400GB 1.5 DWPD (ES14)
- **SFF HDDs**
  - 600GB, 1200GB, 1800GB - 10K RPM
  - 300GB, 600GB – 15K RPM
- **SFF SSDs**
  - 387GB, 775GB, 1551GB – 10 DWPD
  - 931GB, 1860GB, 3720GB – 1 DWPD
- **RDX Disk Cartridge**
  - 1TB Disk Cartridge (EU01)
  - 2TB Disk Cartridge (EU2T)

### Internal NVMe Card

![M.2 NVMe Device](image)

- 12 SFF bays, 1 RDX bay
- 18 SFF bays
POWER9 OpenPOWER family

LC921
✓ 1U server - 19” Rack enclosure
✓ POWER9 Scale-Out SMT4 processor
  ✓ (16-core and 20-core offerings)
✓ Up to 2TB Total DDR4 Industry Standard memory RDIMMs
✓ 4 PCIe Gen4 slots
✓ 4 LFF (3.5”) SATA bays (4 Bays NVMe enabled)
✓ 2 SATA DOMs for OS or read intensive applications
✓ Integrated 1Gb Ethernet port
✓ Redundant Power Supplies
✓ Linux Only platform with BMC service processor

LC922
✓ 2U server - 19” Rack enclosure
✓ POWER9 Scale-Out SMT4 processor
  ✓ (16-core and 20-core offerings)
✓ Up to 2TB Total DDR4 Industry Standard memory RDIMMs
✓ 6 PCIe Gen4 slots
✓ 12 LFF (3.5”) SATA bays (4 Bays NVMe enabled)
✓ 2 SATA DOMs for OS or read intensive applications
✓ Integrated 1Gb Ethernet port
✓ Redundant Power Supplies
✓ Linux Only platform with BMC service processor
Eliminate Big Data Bottlenecks
IBM Power Systems LC922 & LC921

The Big Data Crushers!

The IBM Power Systems LC922 enhances the LC product line’s open heritage while delivering superior performance in a cost optimized design needed in today’s AI Era.

**2x**
Price performance advantage for data intensive applications such as MongoDB

**59%**
Improved Spark price-performance for efficiency across the AI data leveraging the P9 thread density for large amounts of concurrent Spark queries

**2X**
more data scientists on a single server at FASTER RESPONSE TIMES with Data Science Experience (DSX)
4 x POWER9 LC922

$43,948
1.59x better price performance
30% more performance

4 x Intel Xeon SP Gold 6140

$53,548
18% lower price
22.6 QpH

Details on benchmarks in speaker notes.
POWER9 LC922

Intel Xeon SP Gold 6150

mongoDB

$21,878

$30,587

2x better price performance

28% lower price

472,927 Ops/sec

322,738 Ops/sec

47% more performance

Details on benchmarks in speaker notes.
Delivered Secure IBM Power Systems have security built in at all layers, from Chip to the OS, and IBM tests all permutations of entire stack to deliver end to end security.

Scales Performance Affordably IBM POWER9 drives the worlds largest super computers and is ready to accelerate your enterprise.

Proven Reliability IBM Power Systems ranks #1 in every major reliability category by ITIC and is an industry leader of Mid Range and High End Servers.

Simplified Enterprise Cloud Instantly cloud enable any workload with IBM POWER9 based Power Systems and build a cloud designed for the most data intensive workloads.

Delivered Secure IBM Power Systems have security built in at all layers, from Chip to the OS, and IBM tests all permutations of entire stack to deliver end to end security.
Power Enterprise Server 2H18 Roadmap*

Power E950/E980 Announce: August 7th*

Power E980 1-4N GA: Nov 16th

POWER9 enterprise-class processor
- Large-scale multi-socket SMP
- Buffered memory attach

More performance and scale via enterprise-class POWER9 processors

2-4X Memory capacity for in-memory DB

Reduce latency and improve throughput with enhanced I/O support
- PCIe Gen4
- Integrated NVMe Flash

High-bandwidth (25Gb/s) links for improved SMP throughput between nodes

*IBM’s statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM’s sole discretion.
Power E950

✓ Redesigned 4-socket 4U system
✓ Increased bandwidth and efficiency
✓ Built-in PowerVM virtualization
✓ Active Memory Mirroring for Hypervisor (option)
✓ OpenStack based cloud management
✓ Seamless growth with Capacity on Demand
✓ Power to Cloud Rewards
✓ Cloud Management Console
✓ Small Software Tier
✓ 3 years of 24x7 service included*

* Standard One-year warranty, 9 AM – 5 PM. Nine hours per day, Monday through Friday (excluding holidays), next business day. Warranty service upgrade is 24x7 (varies by country) and two additional years of maintenance services included at no additional charge (varies by country)

✓ 2 or 4 POWER9 processors
✓ 8-, 10-, 11 or 12-cores/processor
✓ Up to 16TB of DDR4 memory
✓ Capacity on Demand
✓ 1st socket, 128GB minimum active
✓ 11 PCIe adapter slots
✓ 4 NVMe slots
✓ Up to 4 PCIe I/O drawers
POWER9 4 Socket Server (E950)

✓ 4U server - 19” Rack enclosure
✓ POWER9 Enterprise SMT8 processor (8, 10, 11 or 12 cores per socket)
✓ Up to 16TB Total DDR4 Industry Standard memory RDIMMs
  ▪ 920 GB/s total system memory bandwidth
  ▪ 8 Memory Riser cards (2 risers per socket)
  ▪ Each riser contains 4 Centaur memory buffers & 16 IS RDIMM slots
✓ 10 PCIe Gen4 slots, Blindswap, Full Height, Half Length
✓ 1 PCIe Gen3 slot (reserved for Ethernet adapter)
✓ Four High Speed 25Gb/s external ports
✓ 8 SFF (2.5”) bay option + 4 NVMe Flash U.2 Bays
✓ Storage controller adapters use standard PCIe Slots
  ▪ Concurrently Maintainable
  ▪ Single or Split backplane or Dual RAID write cache support
  ▪ Future support for 12Gb IBM storage controller cards
✓ External DVD
✓ I/O Expansion

NDA, all statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only
E950 Scale Up System View

- 8 MEM Riser Cards
- 8 HDDs/SSDs
- SFF 2.5" 15mm
- 4 P9 Processors
- 11 I/O Cassette Conns (*)
- 4 92mm Fans
- 4 CPU VRMs
- Standby VRMs
- I/O VRMs
- Op panel LCD
- Op panel Base
- 4 NVMe SSDs
- SFF 2.5" 7mm
- 4 92mm Fans
- 2 Front USB 3.0
- 4 MEM VRMs
- 8 HDDs/SSDs
- SFF 2.5" 15mm
- 4 Stacked 2KW PSUs
- FSP2 Serv Proc Card
- 2 Rear USB 3.0
- 4 Stacked 2KW PSUs
- 11 I/O Cassette Conns (*)
- 11 I/O Adapters (*)
- 11 I/O Cassettes (*)
- 11 I/O Cassette is for the Service Processor
- 11 I/O Adapters (*)
- I/O VRMs
- 11 I/O Cassettes (*)
- (*) 12th I/O Cassette is for the Service Processor
E950 Processor Highlights

✓ SCM Single Chip Design
✓ Four processor Offerings available (SMT8 cores)
  ▪ 12-core processor (maximum throughput)
  ▪ 11-core processor
  ▪ 10-core processor
  ▪ 8-core processor (maximum core performance)
✓ Processor frequencies dynamic by default – set to maximum performance mode
✓ Increased processor to processor fabric interconnect
  ▪ X-Bus fully connected fabric within CEC Drawer
  ▪ 25Gbps link for future OpenCAPI accelerators
✓ Min config is 2 CPUs installed
✓ 3 CPU config supported at future date
✓ Min # of cores that must be activated is one socket’s worth
  ▪ See table in upper right corner

<table>
<thead>
<tr>
<th>Feature Code</th>
<th>Processor SMT8 Cores</th>
<th>Typical Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPWT EPWX</td>
<td>12 cores 1way Activation</td>
<td>3.15 to 3.8Ghz (max) Min 12 cores activated</td>
</tr>
<tr>
<td>EPWY EPN3</td>
<td>11 cores 1way Activation</td>
<td>3.20 to 3.8Ghz (max) Min 11 cores activated</td>
</tr>
<tr>
<td>EPWS EPWW</td>
<td>10 cores 1way Activation</td>
<td>3.40 to 3.8Ghz (max) Min 10 cores activated</td>
</tr>
<tr>
<td>EPWR EPWV</td>
<td>8 cores 1way Activation</td>
<td>3.60 to 3.8Ghz (max) Min 8 cores activated</td>
</tr>
</tbody>
</table>
**POWER9 Power Management Modes**

- **Static Power Save Mode**
  - Idle Power Saver (IPS) can be on or off

- **Static Nominal Mode**
  - Idle Power Saver (IPS) can be on or off

- **Dynamic Performance Mode**
  - Workloads run at highest frequency possible
  - Max Workload/Max Cores runs >= nominal in all environments
  - CPU managed to Nominal power draw
  - Idle Power Saver (IPS) can be on or off

- **Maximum Performance Mode**
  - Workloads run at highest frequency possible
  - Max Workload/Max Cores runs >= turbo in favorable environments
  - CPU managed to Turbo power draw level – Higher acoustics
  - Idle Power Saver (IPS) can be on or off
E950 Memory Subsystem Highlights

✓ Max of 230 GB/s per socket Memory Bandwidth (920 GB/s system)
✓ Max of 16TB memory capacity (4TB per processor socket)
✓ 8 Memory Riser cards, 16 DIMM slots per Riser Card, 128 DIMMs slots total
✓ 8, 16, 32, 64, 128GB DDR4 DIMM sizes
✓ Min config – 1 riser card / CPU with 8 DIMMs installed
✓ 50% of installed memory must be activated (min of 128GB activated)
✓ Memory Plug Rules (in backup charts)
Elastic Capacity on Demand

US$5 per day

buys one core of POWER9 performance - a processor core & 16GB of memory - on an IBM Power E950 using Elastic Capacity on Demand.

Activate an additional 2 processors for daily peak demands with additional capacity at around $50 for a M-F business week.

**ECOD Pricing (includes activation and system software):**
- E850C/E950 Processor core $3/day
- 8 GB Memory $1/day
### Internal PCIe Slot Summary

<table>
<thead>
<tr>
<th>Slot</th>
<th>Attributes</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>C12</td>
<td>PCIe Gen4 x8 (SAS adapter)</td>
<td></td>
</tr>
<tr>
<td>C11</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Power9 socket</td>
</tr>
<tr>
<td>C10</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
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</tr>
<tr>
<td>C9</td>
<td>PCIe Gen4 x8 (SAS adapter)</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Power9 socket</td>
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<tr>
<td>C8</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
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</tr>
<tr>
<td>C7</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
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<tr>
<td>C6</td>
<td>PCIe Gen3 x8 (rsrv for base Eth)</td>
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<tr>
<td>C5</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Power9 socket</td>
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<td>C4</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
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<tr>
<td>C3</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
<td>4&lt;sup&gt;th&lt;/sup&gt; Power9 socket</td>
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<tr>
<td>C2</td>
<td>PCIe Gen4 x16 (EJ08 slot)</td>
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<tr>
<td>C1</td>
<td>Service Processor Card</td>
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</table>

**EJ08 – I/O Expansion Adapter**

- PCIe Slots are Concurrently Maintainable from rear via IO Cassette
- Full Height, Half Length PCIe form factor

### 1<sup>st</sup> GA External PCIe Expansion Summary

<table>
<thead>
<tr>
<th>Num of CPUs</th>
<th>Max Drawers (EMX0)</th>
<th>Max Fanout Modules (EMXF, 6 slots each)</th>
<th>Total PCIe Slots Internal and External</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>27</td>
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<tr>
<td>4</td>
<td>2</td>
<td>4</td>
<td>31</td>
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</tbody>
</table>

### Next GA External PCIe Expansion Summary

<table>
<thead>
<tr>
<th>Num of CPUs</th>
<th>Max Drawers (EMX0)</th>
<th>Max Fanout Modules (EMXF, 6 slots each)</th>
<th>Total PCIe Slots Internal and External</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>8</td>
<td>51</td>
</tr>
</tbody>
</table>
## E950 Internal Storage Options

### Supported Media Overview

- **✓ NVMe u.2 Flash devices**
  - 800GB, 1.6TB, 3.2TB 2.2dwpd
- **✓ SFF HDDs**
  - 600GB, 1200GB, 1800GB - 10K RPM
  - 300GB, 600GB – 15K RPM
- **✓ SFF SSDs**
  - 387GB, 775GB, 1551GB – 10 DWPD
  - 931GB, 1860GB, 3720GB – 1 DWPD
- **✓ RDX Disk Cartridge**
  - 500GB Disk Cartridge (1107)
  - 1TB Disk Cartridge (EU01)
  - 2TB Disk Cartridge (EU2T)

### Internal Storage Options

<table>
<thead>
<tr>
<th>FC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EJ0B Zero SAS</td>
<td>No Internal SAS</td>
</tr>
<tr>
<td>backplane</td>
<td></td>
</tr>
<tr>
<td>EJBB</td>
<td>Single SAS RAID 0,10,5,6</td>
</tr>
<tr>
<td></td>
<td>8 SFF bays (Gen3-Carrier)</td>
</tr>
<tr>
<td>EJSB</td>
<td>Split Backplane RAID 0,10,5,6</td>
</tr>
<tr>
<td></td>
<td>4 + 4 SFF bays (Gen3-Carrier)</td>
</tr>
<tr>
<td>EJ0C (Future</td>
<td>Dual Write Cache RAID 0,10,5,6,5T2,6T2</td>
</tr>
<tr>
<td>Release)</td>
<td>8 SFF bays (Gen3-Carrier)</td>
</tr>
<tr>
<td>EC5J, EC5K,</td>
<td>NVMe U.2 Drives x4, 800GB, 1.6TB, 3.2TB Independent of the Internal SAS</td>
</tr>
<tr>
<td>EC5L</td>
<td>options</td>
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</tbody>
</table>

### Diagram

- **Op Panel LCD**
- **Op Panel Base**
- **4 NVMe Bays**
- **5 SFF SAS Bays**
- **2x USB 3.0**
- **3 SFF SAS Bays**
# E950 External Storage Options

<table>
<thead>
<tr>
<th>FC / MTM</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESLL</td>
<td>19&quot; Disk Expansion Drawer 12 LFF Gen2-Carrier Bays (Slider12)</td>
</tr>
<tr>
<td>ESLS</td>
<td>19&quot; Disk Expansion Drawer 24 SFF Gen2-Carrier Bays (Slider24)</td>
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<tr>
<td>5887</td>
<td>19&quot; Disk Expansion Drawer 24 SFF Gen2-Carrier Bays (EXP24S) Migrate. Future Support</td>
</tr>
<tr>
<td>EUA5</td>
<td>USB DVD w/ Cable</td>
</tr>
<tr>
<td>7226-1U3</td>
<td>19&quot; Media Drawer with 2 bays</td>
</tr>
</tbody>
</table>
E950 System Topology

NVMe bays in front of system

25Gbs Port

External Port via C3
Deferred

External Port via C5
Deferred

External Port via C8
Deferred

External Port via C10
Deferred

PCIe Gen4 x16
C2
PCIe Gen4 x16
C3
PCIe Gen4 x16
C4
PCIe Gen4 x16
C5
PCIe Gen3 x8 x16 conn
C6
PCIe Gen4 x16
C7
PCIe Gen4 x16
C8
PCIe Gen4 x16
C9
PCIe Gen4 x16
C10
PCIe Gen4 x8 x16 conn
C11
PCIe Gen4 x16
C12

NVMe 1
NVMe 2
NVMe 3
NVMe 4

PEX 24-port GEN3

USB Cntr

PEX 24-port GEN3

x8 Gen3

x4 Gen3

x4 Gen3

x1 Gen3

NVMe1

NVMe3
Power E950 planned I/O*

* As of January 2018. IBM’s statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM’s sole discretion. The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code or functionality.

### At GA 2H18

<table>
<thead>
<tr>
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<th>Feature Code</th>
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<tbody>
<tr>
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<td>5899</td>
<td>PCIe2 4-port 1GbE Adapter</td>
</tr>
<tr>
<td>LAN</td>
<td>EN05</td>
<td>PCIe2 4-Port (10Gb+1GbE) SR+RJ45 Adapter</td>
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<tr>
<td>LAN</td>
<td>EN0U</td>
<td>PCIe2 4-port (10Gb+1GbE) Copper SFP+RJ45 Adapter</td>
</tr>
<tr>
<td>LAN</td>
<td>EN0W</td>
<td>PCIe2 2-port 10/1GbE BaseT RJ45 Adapter</td>
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<tr>
<td>LAN</td>
<td>EN15</td>
<td>PCIe3 4-port 10GbE SR Adapter</td>
</tr>
<tr>
<td>CNA</td>
<td>EN0H</td>
<td>PCIe3 4-port (10Gb FCoE &amp; 1GbE) SR&amp;RJ45 Adapter</td>
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<tr>
<td>CNA</td>
<td>EN0K</td>
<td>PCIe3 4-port (10Gb FCoE &amp; 1GbE) SFP+Copper&amp;RJ45</td>
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<tr>
<td>Fibre Channel</td>
<td>5735</td>
<td>8 Gigabit PCI Express Dual Port Fibre Channel Adapter</td>
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<tr>
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<td>5729</td>
<td>PCIe2 8Gb 4-port Fibre Channel Adapter</td>
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<tr>
<td>Fibre Channel</td>
<td>EN12</td>
<td>PCIe2 8Gb 4-port Fibre Channel Adapter</td>
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<td>Fibre Channel</td>
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<td>PCIe3 16Gb 2-port Fibre Channel Adapter</td>
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<td>SAS</td>
<td>EJ14</td>
<td>PCIe3 12GB Cache RAID PLUS SAS Adapter Quad-port 6Gb x8</td>
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<tr>
<td>SAS</td>
<td>EJOI</td>
<td>PCIe3 RAID SAS Adapter Quad-port 6Gb x8</td>
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<td>SAS</td>
<td>EJ10</td>
<td>PCIe3 SAS Tape/DVD Adapter Quad-port 6Gb x8</td>
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<td>Encryption</td>
<td>EJ33</td>
<td>PCIe3 Crypto Coprocessor BSC-Gen3 4767 (Supported in EMX0 Only)</td>
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<td>Bus Expansion</td>
<td>EJO8</td>
<td>PCIe X16 TO CXP CONVERTER CARD, SUPPORTS OPTICAL OR COPPER</td>
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<tr>
<td>Drawer</td>
<td>EMX0</td>
<td>PCIe Gen3 I/O Expansion Drawer</td>
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<td>Drawer</td>
<td>EMXF</td>
<td>PCIe3 6-Slot Fanout Module for PCIe3 Expansion Drawer</td>
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<td>Drawer</td>
<td>ESSL</td>
<td>EXP12SX SAS Storage Enclosure</td>
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<td>ELLL</td>
<td>EXP12SX SAS Storage Enclosure</td>
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### FW Update 1H19

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<tr>
<td>ROCE</td>
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<td>PCIe3 2-Port 40GbE NIC RoCE QSFP+ Adapter</td>
</tr>
<tr>
<td>ROCE</td>
<td>EC38</td>
<td>PCIe3 2-port 10GbE NIC&amp;RoCE SFP+ Copper Adapter</td>
</tr>
<tr>
<td>ROCE</td>
<td>EC2N</td>
<td>PCIe3 2-port 10GbE NIC&amp;RoCE SR Adapter</td>
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<tr>
<td>ROCE</td>
<td>EC3M</td>
<td>PCIe3 2-port 100GbE (NIC&amp;RoCE) QSFP28 Adapter x16</td>
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<tr>
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<td>PCIe3 4-port 10GbE SFP+ Copper Adapter</td>
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<td>CNA</td>
<td>EN0M</td>
<td>PCIe3 4-port (10Gb FCoE &amp; 1GbE) LR&amp;RJ45 Adapter</td>
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<td>Fibre Channel</td>
<td>EN0G</td>
<td>PCIe2 8Gb 2-port Fibre Channel Adapter</td>
</tr>
<tr>
<td>SAS</td>
<td>EJ0L</td>
<td>PCIe3 12GB Cache RAID SAS Adapter Quad-port 6Gb x8</td>
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<td>WAN</td>
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<td>4 Port Async EIA-232 PCIe Adapter</td>
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<td>EC46</td>
<td>PCIe2 4-Port USB 3.0 Adapter</td>
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<td>EJ28</td>
<td>PCIe Crypto Coprocessor Gen3 BSC 4765-001</td>
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<td>Graphics</td>
<td>S748</td>
<td>POWER GTX145 PCI Express Graphics Accelerator</td>
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<tr>
<td>Graphics</td>
<td>EC42</td>
<td>PCIe2 3D Graphics Adapter x1</td>
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<tr>
<td>Drawer</td>
<td>S887</td>
<td>EXP24S SFF Gen2-bay Drawer</td>
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</table>

For latest list check e-config or with your IBM rep.
# Power E950 rPerf (AIX)

*Preliminary projections for POWER9 rPerf - these projections are subject to change without notice until Announcement*

<table>
<thead>
<tr>
<th>Frequency (E950)</th>
<th>Processor</th>
<th># Sockets</th>
<th># Cores</th>
<th>rPerf (SMT8)</th>
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<tbody>
<tr>
<td>3.15 to 3.8 GHz (max)</td>
<td>12 core</td>
<td>4</td>
<td>48</td>
<td>1,146</td>
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<tr>
<td>3.20 to 3.8 GHz (max)</td>
<td>11 core</td>
<td>4</td>
<td>44</td>
<td>1,072</td>
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<tr>
<td>3.40 to 3.8 GHz (max)</td>
<td>10 core</td>
<td>4</td>
<td>40</td>
<td>1,034</td>
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<tr>
<td>3.60 to 3.8 GHz (max)</td>
<td>8 core</td>
<td>4</td>
<td>32</td>
<td>870</td>
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</tbody>
</table>

*Up to 50% more performance when compared to POWER8 predecessor in default ship mode.*

<table>
<thead>
<tr>
<th>Frequency (E850C)</th>
<th>Processor</th>
<th># Sockets</th>
<th># Cores</th>
<th>rPerf (SMT4)</th>
<th>rPerf (SMT8)</th>
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<tbody>
<tr>
<td>3.65 GHz</td>
<td>12 core</td>
<td>4</td>
<td>48</td>
<td>757</td>
<td>810</td>
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<tr>
<td>3.95 GHz</td>
<td>10 core</td>
<td>4</td>
<td>40</td>
<td>675</td>
<td>722</td>
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<tr>
<td>4.22 GHz</td>
<td>8 core</td>
<td>4</td>
<td>32</td>
<td>575</td>
<td>615</td>
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</table>

41% more performance
43% more performance
41% more performance

*Power Systems Performance Report*
## Power E950 rPerf

<table>
<thead>
<tr>
<th>Power Model-Type</th>
<th>Nickname</th>
<th>Sockets</th>
<th>Cores per Socket</th>
<th>Total Cores</th>
<th>GHz</th>
<th>CPW</th>
<th>SMT1 rPerf</th>
<th>SMT2 rPerf</th>
<th>SMT4 rPerf</th>
<th>SMT8 rPerf</th>
<th>rPerf p/core</th>
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</thead>
<tbody>
<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>2</td>
<td>8</td>
<td>16</td>
<td>3.6 – 3.8</td>
<td>N/A</td>
<td>151.0</td>
<td>256.7</td>
<td>354.2</td>
<td>446.3</td>
<td>27.9</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>2</td>
<td>10</td>
<td>20</td>
<td>3.4 – 3.8</td>
<td>N/A</td>
<td>179.4</td>
<td>304.9</td>
<td>420.8</td>
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<td>26.5</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>2</td>
<td>11</td>
<td>22</td>
<td>3.2 – 3.8</td>
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<td>316.1</td>
<td>436.2</td>
<td>549.6</td>
<td>25.0</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>2</td>
<td>12</td>
<td>24</td>
<td>3.15 – 3.8</td>
<td>N/A</td>
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<td>338.1</td>
<td>466.5</td>
<td>587.8</td>
<td>24.5</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>3.6 – 3.8</td>
<td>N/A</td>
<td>294.4</td>
<td>500.6</td>
<td>690.8</td>
<td>870.4</td>
<td>27.2</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>4</td>
<td>10</td>
<td>40</td>
<td>3.4 – 3.8</td>
<td>N/A</td>
<td>349.8</td>
<td>594.7</td>
<td>820.7</td>
<td>1,034.1</td>
<td>25.9</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>4</td>
<td>11</td>
<td>44</td>
<td>3.2 – 3.8</td>
<td>N/A</td>
<td>362.6</td>
<td>616.4</td>
<td>850.7</td>
<td>1,071.9</td>
<td>24.4</td>
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<tr>
<td>9040-MR9</td>
<td>E950</td>
<td>4</td>
<td>12</td>
<td>48</td>
<td>3.15 – 3.8</td>
<td>N/A</td>
<td>387.8</td>
<td>659.3</td>
<td>909.9</td>
<td>1,146.4</td>
<td>23.9</td>
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</tbody>
</table>
Midrange system capacity increases with POWER9

...POWER9 offers over 2X more per-core capacity than POWER7+
E950 Software Stack Support

✓ **OS Support**
  - AIX Technology Level 7100-05
  - AIX Technology Level 7200-02
  - AIX Technology Level 7200-01
  - AIX Technology Level 7200-03 (September 2018)
  - AIX Technology Level 6100-09
  - VIOS 2.2.6.23
  - SLES 11 SP4 BE - for SAP HANA (p8compat mode)
  - SLES 12 SP3 LE (limited p9 mode)
  - SLES 15 LE (p9 mode)
  - RHEL 7.5 LE for P8 (p8compat mode)

✓ **FW Support**
  - FW920 / HMC920
E950 power supply AC connector is C20 header. The IEC 60320 C19 / 20 connectors are rated for 16 amps and a female connector end (C19) and a male connector end (C20).

The AC cable is the C20/C19 cable coupler that connects the power supply to the power distribution unit (PDU).
Power E980

✓ Modular performance and scale
✓ Enterprise RAS
✓ Built-in PowerVM virtualization
✓ Active Memory Mirroring for Hypervisor
✓ OpenStack based Cloud management
✓ Seamless growth with Capacity on Demand
✓ Share resources in a Power Enterprise Pool
✓ Power to Cloud Rewards
✓ Cloud Management Console
✓ Medium Software tier
✓ 1 year, 24x7 Warranty
POWER9 Enterprise Server - E980 3Q GA Highlights

✓ Modular Scalable Design – Up to two 5U CEC drawers + 2U Control Unit
✓ Max of 96 POWER9 SMT8 processor cores (8, 10, 11 or 12 cores per socket)
✓ Up to 32TB total memory (16TB per drawer)
  ▪ Planned support for migration of POWER8 CDIMMs
  ▪ 920 GB/s total system memory bandwidth per drawer
✓ Max of 16 PCIe Gen4 slots, Blindswap, Low Profile
✓ New SMP Cables with 4x bandwidth improvement
✓ High Speed 25Gbs ports available to attach future OpenCAPI accelerators
✓ Internal Storage - 4 NVMe Flash U.2 Bays (rear accessible) per drawer
✓ Integrated USB ports
✓ Secure and Trusted Boot with TPM module
✓ Up to 4 I/O Expansion Drawers (2 Drawers per CEC drawer)
✓ Distributed Redundant Clocking
✓ 2U System Control Unit Drawer
  ▪ Redundant FSP cards
  ▪ USB Ports
POWER9 Enterprise Server - E980 4Q GA Highlights

✓ Modular Scalable Design – Up to four 5U CEC drawers + 2U Control Unit
✓ Max of 192 POWER9 SMT8 processor cores (8, 10, 11 or 12 cores per socket)
✓ Up to 64TB total memory (16TB per system node)
  ▪ 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 available to attach future OpenCAPI accelerators
✓ Internal Storage - 4 NVMe Flash U.2 Bays (rear accessible) per system node
✓ Integrated USB ports
✓ Secure and Trusted Boot with TPM module
✓ Up to 16 I/O Expansion Drawers (4 Drawers per system node)
✓ 2U System Control Unit Drawer
✓ Serial Number preserving upgrade support from POWER8
✓ MES Drawer Adds supported
✓ Earthquake certification
E980 Enterprise Server

- 8 PCIe Gen4 slots
- 4 NVMe bays
- 4 Processor modules
- 8 DDR4 CDIMM’s per processor
- 32 DDR4 CDIMM’s total
- Memory and Misc Voltage Regulation modules
- 4 Power Supplies
- 5 Fans
- Processor Voltage Regulation modules

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POWER9 Enterprise Server - CEC Drawer (Rear view)

- PCIe
- NVMe Bays
- SMP Conn.
- FSI
- USB
- Dual Clock
- Card

- 4x NVMe 4K 800GB 4K NVMe U.2 SSD IN 7MM
- Hot Plug Concurrent Maintenance

Dual Clock Card

NVMe Bays
System Control Unit Drawer

- Redundant FSP cards (Service Processor)
- Eliminated Clock Cabling – Clocks local to CEC drawer (redundant)
- Provides Front Accessible USB port
- Reduced UPIC Power cabling
- External DVD

Front View

Rear View
E980 Processor Options

- Four processor Offerings available (SMT8 cores)
  - 12-core, (maximum throughput)
  - 11-core processor
  - 10-core processor
  - 8-core processor (maximum core performance)

- Processor frequencies dynamic (default) for maximum performance
- Capacity on Demand support
- Increased processor to processor fabric interconnect
  - 16Gb/s X-Bus Fully connected fabric within CEC Drawer
  - 4x increase in O-Bus fabric for Drawer to Drawer interconnect or Accelerator
**E980 Memory Subsystem**

**64 Terabytes**
Maximum DDR4 capacity on a Power E980
4 TB per socket

**230 GB/sec**
Maximum memory bandwidth/socket

*Support for larger in-memory database applications*
*Deliver insights faster for competitive advantage*

<table>
<thead>
<tr>
<th>Feature Size</th>
<th>DIMM Size</th>
<th>Feature</th>
<th>Memory Speed</th>
<th>E980 Per-Node Maximum</th>
<th>E980 System Maximum</th>
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<tbody>
<tr>
<td>0 / 128 GB</td>
<td>32GB</td>
<td>#EF20</td>
<td>1,600 MHz</td>
<td>1 TB</td>
<td>4 TB</td>
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<tr>
<td>0 / 256 GB</td>
<td>64 GB</td>
<td>#EF21</td>
<td>1,600 MHz</td>
<td>2 TB</td>
<td>8 TB</td>
</tr>
<tr>
<td>0 / 512 GB</td>
<td>128 GB</td>
<td>#EF22</td>
<td>1,600 MHz</td>
<td>4 TB</td>
<td>16 TB</td>
</tr>
<tr>
<td>0 / 1,024 GB</td>
<td>256 GB</td>
<td>#EF23</td>
<td>1,600 MHz</td>
<td>8 TB</td>
<td>32 TB</td>
</tr>
<tr>
<td>0 / 2,048 GB</td>
<td>512 GB</td>
<td>#EF24</td>
<td>1,600 MHz</td>
<td>16 TB</td>
<td>64 TB</td>
</tr>
</tbody>
</table>

- 16MB eDRAM L4 cache buffer per CDIMM
- 8 CDIMM slots/socket, 32 slots/drawer
- 128 CDIMM max config on 4-drawer system
- Support for POWER8 DDR3/DDR4 CDIMM (carry-over on MES Model Upgrade)
- Mixing DDR3 and DDR4 supported but drawers must be homogeneous
- 16 GB DIMMs migratable
- Capacity on Demand support (50% of installed memory must be activated)
- Plug Rules (same as POWER8):
  - Populate in Quad (group of 4)
  - Minimum of 1 Quad per socket
buys one core of POWER9 performance & 32GB of memory - on an IBM Power E980 using *Elastic Capacity on Demand*.

Activate a Power E980 processor and memory for additional temporary capacity at around $75 for a M-F business week.
E980 Internal Storage Option

- 4 NVMe bays per CEC Drawer
- Read intensive Drives (2.2 drive writes per day)

<table>
<thead>
<tr>
<th>Feature Code E980</th>
<th>Storage Device</th>
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<tbody>
<tr>
<td>EC5J</td>
<td>NVMe 4K 800GB U.2 SSD IN 7MM CARRIER</td>
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E980 External Storage Options

<table>
<thead>
<tr>
<th>FC / MTM</th>
<th>Description</th>
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<tbody>
<tr>
<td>ESLL</td>
<td>19” Disk Expansion Drawer 12 LFF Gen2-Carrier Bays (Slider12)</td>
</tr>
<tr>
<td>ESLS</td>
<td>19” Disk Expansion Drawer 24 SFF Gen2-Carrier Bays (Slider24)</td>
</tr>
<tr>
<td>5887</td>
<td>19” Disk Expansion Drawer 24 SFF Gen2-Carrier Bays (EXP24S) Migrate</td>
</tr>
<tr>
<td>EUA5</td>
<td>USB DVD w/ Cable</td>
</tr>
<tr>
<td>7226-1U3</td>
<td>19” Media Drawer with 2 bays</td>
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**E980 PCIe Slots**

### Internal PCIe Slot Summary

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<th>Attributes</th>
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<tr>
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<td>PCIe Gen4 x16</td>
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<td>C2</td>
<td>PCIe Gen4 x16</td>
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<tr>
<td>C3</td>
<td>PCIe Gen4 x16</td>
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<td>C4</td>
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<td>C5</td>
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<td>C6</td>
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<td>C7</td>
<td>PCIe Gen4 x16</td>
</tr>
<tr>
<td>C8</td>
<td>PCIe Gen4 x16</td>
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Note: All slots support I/O Expansion Adapter

### External PCIe Expansion Summary – 4Q GA

<table>
<thead>
<tr>
<th>Num of Drawers</th>
<th>Max num of I/O Exp Drawers (EMX0)</th>
<th>Total PCIe Slots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>48</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>96</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>144</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>192</td>
</tr>
</tbody>
</table>

PCIe Slots are Concurrently Maintainable
Half Height, Half Length PCIe form factor

### External PCIe Expansion Summary – 3Q GA

<table>
<thead>
<tr>
<th>Num of Drawers</th>
<th>Max num of I/O Exp Drawers (EMX0)</th>
<th>Total PCIe Slots</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>4+24</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>8+48</td>
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</table>
**Power I/O planned** to be supported on Power E980

At GA 2H18

---

**For latest list check e-config or with your IBM rep**

---

<table>
<thead>
<tr>
<th>Category</th>
<th>FC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN</td>
<td>5899</td>
<td>PCIe2 4-port 1GbE Adapter (Supported in EMX0 Only)</td>
</tr>
<tr>
<td>LAN</td>
<td>5260</td>
<td>PCIe2 LP 4-port 1GbE Adapter</td>
</tr>
<tr>
<td>LAN</td>
<td>EN05</td>
<td>PCIe2 4-Port (10Gb+1GbE) SR+RAR4 Adapter (Supported in EMX0 Only)</td>
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<tr>
<td>LAN</td>
<td>EN07</td>
<td>PCIe2 LP 4-Port (10Gb+1GbE) SR+RAR4 Adapter</td>
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<tr>
<td>LAN</td>
<td>EN0U</td>
<td>PCIe2 4-port (10Gb+1GbE) Copper SFP+RAR4 Adapter (Supported in EMX0 Only)</td>
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<tr>
<td>LAN</td>
<td>EN0V</td>
<td>PCIe2 LP 4-port (10Gb+1GbE) Copper SFP+RAR4 Adapter</td>
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<tr>
<td>LAN</td>
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<td>PCIe2 2-port 10/1GbE BaseT RAR4 Adapter (Supported in EMX0 Only)</td>
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<tr>
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<td>PCIe2 LP 2-port 10/1GbE BaseT RAR4/10G Adapter</td>
</tr>
<tr>
<td>LAN</td>
<td>EN15</td>
<td>PCIe G3 x8 4x10 4-Port Ethernet SR Optical HP (Supported in EMX0 Only)</td>
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<tr>
<td>LAN</td>
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<td>EN0H</td>
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<td>EN0K</td>
<td>PCIe2 4-port (10Gb FCoE &amp; 1GbE) SFP+Copper&amp;RJ4 (Supported in EMX0 Only)</td>
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<td>EN0L</td>
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**Fibre Channel**

<table>
<thead>
<tr>
<th>FC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5735</td>
<td>8 Gigabit PCI Express Dual Port Fibre Channel Adapter (Supported in EMX0 Only)</td>
</tr>
<tr>
<td>5273</td>
<td>PCIe 1P 8Gb 2-Port Fibre Channel Adapter</td>
</tr>
<tr>
<td>5729</td>
<td>PCIe 8Gb 4-port Fibre Channel Adapter (Supported in EMX0 Only)</td>
</tr>
<tr>
<td>EN0A</td>
<td>PCIe 16Gb 2-port Fibre Channel Adapter (Supported in EMX0 Only)</td>
</tr>
<tr>
<td>EN0B</td>
<td>PCIe 16Gb 2-port Fibre Channel Adapter</td>
</tr>
<tr>
<td>SAS</td>
<td>EJ14</td>
</tr>
<tr>
<td>SAS</td>
<td>EJ0M</td>
</tr>
<tr>
<td>SAS</td>
<td>EJ0I</td>
</tr>
<tr>
<td>SAS</td>
<td>EJ11</td>
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<td>SAS</td>
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<td>WAN</td>
<td>5785</td>
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<td>WAN</td>
<td>EN13</td>
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</table>

**Encryption**

<table>
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<tbody>
<tr>
<td>EJ33</td>
<td>PCIe3 Crypto Coprocessor BSC-Gen3 4767 (Supported in EMX0 Only)</td>
</tr>
</tbody>
</table>

**Bus Expansion**

<table>
<thead>
<tr>
<th>FC</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>EJ07</td>
<td>PCIe X16 TO CPX CONVERTER CARD, SUPPORTS OPTICAL OR COPPER CABLES</td>
</tr>
<tr>
<td>EJ08</td>
<td>EXP24S SFF Gen2-bay Drawer (19&quot; SAS 6Gbs 24 GEN2-S DISK BAYS)</td>
</tr>
<tr>
<td>Drawer</td>
<td>EMXD</td>
</tr>
<tr>
<td>Drawer</td>
<td>EMXF</td>
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<tr>
<td>Drawer</td>
<td>ESSL</td>
</tr>
<tr>
<td>Drawer</td>
<td>ELLQ</td>
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<tr>
<td>Drawer</td>
<td>ESSL</td>
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<tr>
<td>Drawer</td>
<td>ELLQ</td>
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</table>

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*As of January 2018. IBM’s statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM’s sole discretion. The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code or functionality.*
Power E980 Processor Fabric & I/O Subsystem

- **Increased processor-to-processor fabric interconnect bandwidth**
  - 16Gb/s X-Bus fully connected fabric within CEC Drawer (intranode)
  - 4x increase in SMP A-Bus fabric bandwidth for drawer-to-drawer (internode) connections

- **Double the I/O bandwidth with PCIe GEN4 Slots (8 per drawer)**
  - PCIe slots are Low Profile and Blindswap capable

- **Integrated Storage – 4 NVMe U.2 Flash bays per drawer**

- **Integrated USB 3.0 function**

- **PCIe I/O Expansion drawer support**
### Power E980 rPerf & CPW

<table>
<thead>
<tr>
<th>Power Model-Type</th>
<th>Nickname</th>
<th>Sockets</th>
<th>Cores per Socket</th>
<th>Total Cores</th>
<th>GHz</th>
<th>CPW</th>
<th>SMT1 rPerf</th>
<th>SMT2 rPerf</th>
<th>SMT4 rPerf</th>
<th>SMT8 rPerf</th>
<th>rPerf p/core</th>
</tr>
</thead>
<tbody>
<tr>
<td>9080-M9S</td>
<td>E980</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>3.9 – 4</td>
<td>508,900</td>
<td>307.8</td>
<td>523.3</td>
<td>722.2</td>
<td>910.0</td>
<td>28.4</td>
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<td>8</td>
<td>64</td>
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<td>615.7</td>
<td>1,046.7</td>
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<td>8</td>
<td>96</td>
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<td>10</td>
<td>40</td>
<td>3.7 – 3.9</td>
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<td>871.5</td>
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<td>120</td>
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<td>679.5</td>
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<td>2,813.0</td>
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<tr>
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<td>11</td>
<td>176</td>
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<tr>
<td>9080-M9S</td>
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<td>12</td>
<td>96</td>
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<tr>
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<td>E980</td>
<td>12</td>
<td>12</td>
<td>144</td>
<td>3.55 – 3.9</td>
<td>2,055,600</td>
<td>1,289.1</td>
<td>2,191.5</td>
<td>3,024.2</td>
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<tr>
<td>9080-M9S</td>
<td>E980</td>
<td>16</td>
<td>12</td>
<td>192</td>
<td>3.55 – 3.9</td>
<td>2,743,000</td>
<td>1,718.8</td>
<td>2,922.0</td>
<td>4,032.3</td>
<td>5,080.7</td>
<td>26.5</td>
</tr>
</tbody>
</table>

**P7+ 780 = 1380**

**795 = 2978**

**E880C = 3678**
Midrange system capacity increases with POWER9

...POWER9 offers over 2X more per-core capacity than POWER7+
Don’t wait…. innovate!

Migrate to POWER9 and save over 50% within 3 years

### POWER7 770
- 64 cores
- 1 TB Memory
- rPerf = 579
- rPerf/core = 9.2

**Configuration includes**
- 2 x PCIe3 16Gb 2-port Fibre Adapters
- 2 x PCIe3 4-port 10Gb FCOE Ethernet Adapters
- 16 x 64GB DIMMs
- SAN Boot

### Power E950
- 24/32 cores
- 1 TB Memory
- rPerf = 656
- rPerf/core = 27.3

**Configuration includes**
- AIX Enterprise Edition
- PowerVM Enterprise Edition

---

<table>
<thead>
<tr>
<th>Hardware List</th>
<th>$US List</th>
<th>$182K</th>
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<tbody>
<tr>
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<tr>
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<tr>
<td>SW Maint. List (3yr 24x7 Medium)</td>
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<tr>
<td><strong>Total List Price</strong></td>
<td><strong>$420K</strong></td>
<td><strong>$209K</strong></td>
</tr>
</tbody>
</table>

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**Prices are preliminary, for illustration only, are subject to change without notice and will vary based upon client-specific configuration of cores, memory & I/O installed & purchased.**

✓ Nearly 3X performance/core
✓ Over 12% additional capacity with 60% reduction in cores to save on future SW license/maint
✓ Room to grow or handle unexpected spikes - 8 cores available for CUoD or Elastic COD
✓ Deliver innovation for private cloud deployment

...while saving 50% of what you might spend to maintain your aging POWER7 system
Don’t wait…. innovate!

Migrate to a Power E980 and save 40% within 3 years

**Move to POWER9 and SAVE**

Power E980
- 32 cores
- 3.9-4.0 (Max) GHz
- 1.5 TB Memory
- rPerf = 886
- rPerf/core = 27.3

<table>
<thead>
<tr>
<th></th>
<th>$US List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware List</td>
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<tr>
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<td>HW Maint. (3yr 24x7)</td>
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<td>SW Maint. List (3yr 24x7 Large)</td>
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<tr>
<td><strong>Total Net Price (‡ 20% Discount)</strong></td>
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†AIX Enterprise Edition, PowerVM Enterprise Edition

<table>
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<tr>
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</tr>
<tr>
<td><strong>Total Net Price (‡ 25% Discount)</strong></td>
<td><strong>$452K</strong></td>
</tr>
</tbody>
</table>

✓ Save on SW licensing & maintenance by delivering equivalent performance with 1/3 of the cores and a lower tier
✓ Provide innovation for private cloud deployment
✓ Reduce energy consumption

......and still save ~$300K

Preliminary pricing

Prices are preliminary, for illustration only, are subject to change without notice and will vary based upon client-specific configuration of cores, memory & I/O installed & purchased.

† Configuration includes 3 x PCIe3 16Gb 2-port Fibre Adapters, 3 x PCIe3 4-port 10Gb FCOE Ethernet Adapters, 12 x 128GB CDIMMs, SAN Boot
### POWER9 RAS Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>POWER9 1s and 2s Systems S914, S922, S924 H922, H924</th>
<th>POWER9 IBM Power System E950</th>
<th>POWER9 IBM Power System E980</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base POWER9™ Processor RAS features including</strong></td>
<td>Yes*</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>• First Failure Data Capture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Processor Instruction Retry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• L2/L3 Cache ECC protection with cache line-delete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Power/cooling monitor function integrated into processors’ on chip controller</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• CRC checked processor fabric bus retry with spare data lane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POWER9 Enterprise RAS Features</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>• Extended L2/L3 cache line delete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Core Contained Checkstops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POWER9 Multi-node Enterprise RAS</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>• Across node ½ bandwidth capability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Asynchronous clocking across nodes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCIe hot-plug with processor integrated PCIe controller</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Memory DIMM support with ECC checking supporting x4 Chipkill</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IBM memory buffer support and Spare DRAM module capability with x4 DIMMS</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>X8 DIMMs with chipkill correction</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Custom DIMM support with additional spare DRAMs</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Active Memory Mirroring for the Hypervisor</td>
<td>No</td>
<td>Yes - Feature</td>
<td>Yes – Base</td>
</tr>
<tr>
<td>Redundant/spare voltage phases on voltage converters for levels feeding processor and memory DIMMs or Risers</td>
<td>No</td>
<td>Redundant</td>
<td>Both redundant and spare</td>
</tr>
<tr>
<td>Redundant global processor clocks with concurrent failover</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Redundant service processor with concurrent failover</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi-node support</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Ranked Number 1 in every major reliability category by ITIC

"IBM POWER8-based processor systems and the latest POWER9 servers provide several key feature/function advantages that advance reliability and enable customers to lower Total Cost of Ownership (TCO) and achieve near-immediate ROI."
## IBM Operating System Plans for POWER9

<table>
<thead>
<tr>
<th>Power Systems</th>
<th>Linux</th>
<th>SUSE</th>
<th>AIX 5.3</th>
<th>AIX 6.1</th>
<th>AIX 7.1</th>
<th>AIX 7.2</th>
<th>IBM i 7.1</th>
<th>IBM i 7.2</th>
<th>IBM i 7.3</th>
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</thead>
<tbody>
<tr>
<td>POWER9</td>
<td>✓</td>
<td>✓</td>
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</table>
E980 Software Stack Support

✓ Firmware level FW920.10 (3Q) / FW920.20 (4Q)
✓ HMC code level V9R1.920
✓ VIOS 2.2.6.31 (3Q) / VIOS 2.2.6.32 & 3.1.0 (4Q)
✓ AIX 7.2 TL2
✓ AIX 7.2 TL1 (P8 Compatibility Mode)
✓ AIX 7.1 TL4, TL5 (P8 Compatibility Mode)
✓ AIX 6.1 TL9 (P7 Compatibility Mode)
✓ IBM i 7.3 TR5
✓ IBM i 7.2 TR9
✓ RedHat RHEL 7.5 LE (P8 Compatibility Mode)
✓ RedHat RHEL 7.6 LE (4Q)
✓ SuSE SLES 11 SP4 (P8 Compatibility Mode)
✓ SuSE SLES 12 SP3
✓ SuSE SLES 15
HMC Requirements

HMC code level V9R1.920

CR7  7042-CR7
CR8  7042-CR8
CR9  7042-CR9
CR1  7063-CR1

vHMC on x86 or Power System

No longer sold
Power to Cloud Reward Program

Power to Cloud Rewards Points are included with each Power E950 & E980 system

– New #SVPC feature code released representing 5K points
– Added to each Power E950 & E980 system configuration at no additional charge
  • Power E950 : 1x #SVPC = 5K points awarded
  • Power E980 : 2x #SVPC = 10K points awarded
– Points redeemable for Lab Services engagements beginning at 10K points
Power Enterprise Pools and Elastic Capacity can help enable a seamless transition to POWER9

Interoperability between POWER8 & POWER9 (SOD*)
Elastic, On Premises cloud consumption model with IBM Marketplace for POWER8 and POWER9

* Statement of Direction, July 5, 2017. IBM's statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM's sole discretion.

1 Elastic Capacity from IBM Marketplace/ESS will be available in select countries across EMEA, AP and NA.
**MES Model Upgrades (same S/N) are available from POWER8 (N-1)**  
*9119-MME/MHE, 9080-MME/MHE*

<table>
<thead>
<tr>
<th>Model</th>
<th>Cores</th>
<th>Frequency</th>
<th>Nodes</th>
<th>Sockets</th>
<th>Memory (Max)</th>
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**Power E980**  
*9080-M9S*

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**Same S/N**

**GA : Nov 16th**

**Power E980**  
*9080-M9S*

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## New 19” Rack 7965-S42

### GA 4Q17
- **POWER8 & POWER9**

### Specifications

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<tr>
<th>Feature</th>
<th>S42</th>
<th>T42</th>
<th>94Y</th>
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<tbody>
<tr>
<td>42U</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>600mm Wide (datacenter floor tile)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ship Loaded from Factory</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Flat surface for mounting H2O Manifolds and Strip PDUs</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>1200mm Depth (rack w/ covers)</td>
<td>1070+130cvrs</td>
<td>1016+cvrs</td>
<td>1040+cvrs</td>
</tr>
<tr>
<td>Rear door heat exchanger</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td># Vertical, 1U Pockets</td>
<td>4</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Height Reduction – fit standard doorways</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Back cable depth (mm)</td>
<td>280</td>
<td>246</td>
<td>261</td>
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<tr>
<td>Earthquake certified</td>
<td>Yes – 45lbs / EIA</td>
<td>Yes – 35 lbs/ EIA</td>
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</tr>
</tbody>
</table>
E980 Rack Considerations

7965-S42 (no space required for cable egress)

Default Rack Extension for both S42 and T42

7014-T42 (requires 2U cable egress)
POWER9 Scale-Up: A Cloud-Everywhere Solution
Optimized for private, public, hybrid and multi-clouds

Built-in **PowerVM**, so every E950/E980 workload is virtualized with accelerated secure mobility

**Cloud PowerVC Manager** included in orders, for resource optimization and private cloud portal

**Cloud Management Console (CMC)** entitlement for consolidated monitoring over multiple locations

Consistent enterprise-wide multi-cloud management with **VMware vRealize Suite** integration

Create new Power cloud-native solutions with **IBM Cloud Private** suite of DevOps tools and app store

Dynamic resource management across multiple Power cloud servers with **Enterprise Pools**

**Additional POWER9 Cloud benefits**
- Simplified transfer of VMs between private and public clouds enables hybrid use cases
- Cloud-ready Power software images facilitate rapid workload provisioning
- Broader availability of term licenses and SaaS pricing for Power software and tools
Modernization To Private Cloud with IBM Cloud Private and Power Systems

Simplifies Cloud Application Deployment

Over **50% faster** to deploy applications versus traditional infrastructure \(^1\)

And is **27% less** expensive than the public cloud to run a typical workload mix \(^2\)

With **88% more** containers per core supported on Power versus x86 \(^3\)
Enterprise cloud-ready

Power Systems easily integrate into your organization’s private or hybrid cloud strategy to handle flexible consumption models and changing customer needs.

Number 1 in reliability

Ranked #1 in every major reliability category by ITIC, IBM Power Systems deliver the most reliable on-premises infrastructure to meet around-the-clock customer demands.

Industry-leading value and performance

With Power Systems, clients can take advantage of superior core performance and memory bandwidth to deliver both performance and price-performance advantages.

When data intensive workloads are the bottom line

Built-in PowerVM virtualization, IBM POWER9-based Power Systems are cloud-ready, enabling you to deploy the right cloud environment to meet your needs.
Backup Materials
IBM AIX Plans for E950 – 2nd half 2018 systems (from Sales Manual)

If installing the AIX operating system **LPAR with any I/O configuration** (one of these):

- AIX Version 7.2 with the 7200-02 Technology Level and Service Pack 7200-02-02-1832 or later
- AIX Version 7.1 with the 7100-05 Technology Level and Service Pack 7100-05-02-1832 or later
- AIX Version 7.2 with the 7200-03 Technology Level or later (planned availability September 14, 2018)
- AIX Version 6.1 with the 6100-09 Technology Level and Service Pack 6100-09-12-1838 or later (planned availability September 14, 2018) (AIX 6.1 service extension required)
- AIX Version 7.2 with the 7200-01 Technology Level and Service Pack 7200-01-05-1845 or later (planned availability January 31, 2019)
- AIX Version 7.1 with the 7100-04 Technology Level and Service Pack 7100-04-07-1845 or later (planned availability January 31, 2019)

If installing the AIX operating system **Virtual I/O only LPAR** (one of these):

- AIX Version 7.2 with the 7200-03 Technology Level or later (planned availability September 14, 2018)
- AIX Version 7.2 with the 7200-02 Technology Level and Service Pack 7200-02-01-1732, or later
- AIX Version 7.2 with the 7200-01 Technology Level and Service Pack 7200-01-01-1642, or later
- AIX Version 7.1 with the 7100-05 Technology Level and Service Pack 7100-05-01-1731, or later
- AIX Version 7.1 with the 7100-04 Technology Level and Service Pack 7100-04-02-1614, or later
- AIX Version 6.1 with the 6100-09 Technology Level and Service Pack 6100-09-07-1614, or later (AIX 6.1 service extension required)

https://www.ibm.com/support/home/
https://www14.software.ibm.com/support/customercare/iprt/home
IBM AIX Plans for E980 – 2nd half 2018 systems (from Sales Manual)

If installing the AIX operating system **LPAR with any I/O configuration** (one of these):

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- AIX Version 7.2 with the 7200-01 Technology Level and Service Pack 7200-01-01-1642, or later
- AIX Version 7.2 with the 7200-00 Technology Level and Service Pack 7200-00-02-1614, or later
- AIX Version 7.1 with the 7100-04 Technology Level and Service Pack 7100-04-02-1614, or later
- AIX Version 6.1 with the 6100-09 Technology Level and Service Pack 6100-09-07-1614, or later (AIX 6.1 service extension required)

https://www.ibm.com/support/home/
https://www14.software.ibm.com/support/customercare/iprt/home
IBM i / Linux / VIOS Support

IBM i 7.2 TR9 or later
IBM i 7.3 TR5 or later

Red Hat Enterprise Linux 7.5 for Power LE (p8compat), or later
Red Hat Enterprise Linux for SAP with Red Hat Enterprise Linux 7 for Power LE version 7.5, or later
SUSE Linux Enterprise Server 12 Service Pack 3, or later
SUSE Linux Enterprise Server for SAP with SUSE Linux Enterprise Server 12 Service Pack 3, or later
SUSE Linux Enterprise Server for SAP with SUSE Linux Enterprise Server 11 Service Pack 4, or later
SUSE Linux Enterprise Server 15, or later

Linux Download information

VIOS 2.2.6.31, or later
E950 VRM and Fan Redundancy

✓ Enhanced DC-DC Regulator Redundancy
  ▪ All voltage domains are N+1 phase redundant
  ▪ CPU, Memory, IO and Standby VRMs are FRUs
  ▪ System alerts for scheduled maintenance when 1 phase fails
  ▪ Processor and Memory VRMs are only installed as needed per 2S, 3S (1H2019), 4S configurations
    o 2S: 2 Memory VRMs, 2 Processor VRMs
    o 3S: 4 Memory VRMs, 3 Processor VRMs
    o 4S: 4 Memory VRMs, 4 Processor VRMs

✓ Full Fan Concurrent Maintenance
  ▪ N+1 Rotor redundancy
  ▪ System alerts for scheduled maintenance to replace fan when 1 rotor fails
Part migration from E850, E850C to E950

E950 is a roll in – roll out replacement from E850, E850C. However, there are several components class that can be moved.

- Power Supplies: Yes from E850C only
- P8 IO adapters: Yes for legacy adapters that E950 supports
- IBM SAS adapter: Yes for F/C EJ0K level in all PCIe slots; F/C EJ0J in all PCIe slots excepts C9 and C12
- SAS HDD/SSD: Yes for the models that E950 supports
- IO Drawer: Yes
- DASD Drawers: Yes
**E980 Memory**

- 230 GB/s Memory Bandwidth and up to 4TB per socket
- 8 DIMM slots per socket, 32 DIMMs per drawer, same CDIMM technology as POWER8
- 32, 64, 128, 256, 512 GB DDR4 CDIMMs (16GB DDR4 CDIMM migrate support)
- 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 (50% of installed memory must be activated)
- Plug Rules (same as POWER8):
  - Populate in Quad (group of 4)
  - Minimum of 1 Quad per socket

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<th>Feature Code</th>
<th>CDIMM Size</th>
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<tbody>
<tr>
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<tr>
<td>EF20</td>
<td>4 x DDR4 32GB</td>
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<td>EF21</td>
<td>4 x DDR4 64GB</td>
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<tr>
<td>EF22</td>
<td>4 x DDR4 128GB</td>
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<tr>
<td>EF23</td>
<td>4 x DDR4 256GB</td>
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<td>EF24</td>
<td>4 x DDR4 512GB</td>
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<table>
<thead>
<tr>
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<td>E980</td>
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<tr>
<td>EM8J</td>
<td>4 x DDR3 16GB</td>
</tr>
<tr>
<td>EM8K</td>
<td>4 x DDR3 32GB</td>
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<td>EM8M</td>
<td>4 x DDR3 128GB</td>
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<td>4 x DDR4 128GB</td>
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<tr>
<td>EM8Y</td>
<td>4 x DDR4 256GB</td>
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</tbody>
</table>
E950 Memory Plug Rules Overview

✓ Same DIMMs on each memory riser card.

✓ Memory increment is 8 DIMMs

✓ Start with minimum of 1 memory riser card per processor with minimum of 8 DIMMs installed in the white DIMM connectors. For consistency, install the ‘even’ riser card first for each processor.

✓ Next increment of 8 DIMMs populated in order, CPU0, CPU1, CPU2, CPU3 conforming to rule of same type and size of DIMMs on each riser card. The processor order is preferred to have system configuration consistency and is not a requirement.

✓ After all 1st (even) riser cards of the processors are filled up, add second memory riser card to CPU0 with 8 IS DIMMs. Second riser of each processor can have different IS DIMM capacity from that on first riser but it is recommended that the 2nd riser card has the same type and size DIMMs as the 1st riser card

✓ Fill up 2nd riser card with the next 8 IS DIMMS conforming to rule of same type and size of DIMMs on each riser card

✓ Repeat steps 5, 6 with CPU1, then CPU2, then CPU3 until all 2nd riser cards are filled up.
POWER9 Adapters

Watch out for Full height/Low Profile combinations
- Assuming fully populated POWER9 sockets

Midrange

- 11 PCIe adapters
  Full height

Scale-Out Q2

S924
- 11 PCIe Full height adapters

S922
- 9 PCIe Low Profile adapters
  look for “LP”

Enterprise Q3+Q4

Each CEC
- 8 x PCIe Low Profile adapters look for “LP”
Total
- 32 x PCIe LP adapters

Adapter to #EMX0
FC#EJ08 Full height
FC#EJ07 Low Profile “LP”

FC#EMX0 (MEX) adapter drawer
- 6 or 12 PCIe Full height adapters
POWER9 Storage

Watch out for LFF-1, SFF-2 & SFF-3 combinations
LFF = 3.5 inch
SFF-2 = 2.5 inch
SFF-3 = slim 2.5 inch

Enterprise Q3+Q4

Each CEC node
- no internal disks
- For NVMe see next chart

Midrange Q3

- 8 x SFF-3 disk/SSD

Scale-Out Q2

S924
- 12 or 18 SFF-3 disk/SSD
S922
- 6+2 SFF-3 disk/SSD

EXP12SX = 12 x 3.5 inch disks LFF-1
EXP24SX = 24 x 2.5 inch disks SFF-2

SAS Adapter
FC#EJ0J Full height
FC#EJ0M Low Profile “LP”
POWER9 NVMe

Watch out for M.2 & U.2 format + sizes plus different “disk writes per day” for 5 years

Midrange

- Q3
  - E95
    - 4 x U.2 NVMe disks
    - Good for 2 VIOS

Scale-Out Q2

- S924
  - 4 x M.2 NVMe disks
- S922
  - 4 x M.2 NVMe disks
  - Good for 2 VIOS

Enterprise Q3+Q4

- Each CEC node
  - 4 x U.2 NVMe disks
- Four CEC Total
  - 16 x U.2 NVMe disks
  - Good to 8 VIOS

Scale-Out

- U.2 NVMe
  - SSD like but not a SAS connector
  - 3 to 5 DWPD for 5 years

- M.2 NVMe
  - DIMM like but end connector
  - 1 DWPD for 5 years
POWER9 Enterprise models E950/E980: The case for NVMe

NVMe works like a SSD disk but skips the SAS protocol layer for fast access
Each device separately allocated to LPAR/VIOS (on the HMC)
In the E950 / E980, NVMe is hot pluggable for no downtime replacement
Using LIST price in deliberately vague currency €$£ (Euro Dollar Pound)
Assuming Dual Virtual I/O Servers with mirrored disks = 2 VIOS with 2 disks each

POWER9 E950
1. NVMe x 4 €$10.4K Very fast I/O & simple
2. Internal Disk €$10.6K Slow I/O & the SAS adapters take 2 PCIe slots
3. Internal SSD €$19.0K Fast I/O but costs more & SAS takes 2 PCIe slots
4. Disk drawers €$~40K Assuming 2 remote disk drawers. Add €$~8K for SSD

High price unless 2 SAS disk drawers already justified

QED: NVMe is faster & lower cost

POWER9 E980
Similar story but no internal disk option i.e. no option 2 or 3)
E980 has a max of 16 NVMe = 8 VIOS (per node: 4 NVMe = 2 VIOS)

Alternative is booting VIOS over a Fibre Channel SAN:
More complex install but is popular as its fast & removes all internal disks