IBM POWER9 Enterprise E980
Unofficial Deep Dive

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

POWER9 Server performance:
- Super strength SMT threads
- CPU memory caching
- SMP bus bandwidth
- Memory sizes
- PCIe Gen4 boost

This Presentation
Announcement Date: August 7\textsuperscript{th} both E950 & E980  
eConfig Date: August 8\textsuperscript{th}  
General Availability Date:  
August 17\textsuperscript{th} E950  
Sept 21\textsuperscript{st} E980 2 nodes= 96 core  
Nov 16\textsuperscript{th} E980 4 nodes= 192 core  
In Q4 for easy upgrades

Before we start

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

Going to share the PowerPoint on the Power VUG website  
http://tinyurl.com/AIXpert  
I have ~250 slides including  
~ 100 picture slides of the server  
- Pictures are of a beta machine  
- GA servers might differ slightly  
Plus loads of link to more information
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

HMC News

Hardware Management Console

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
POWER9 Processor features that effect the Servers

POWER Generation
Transistor Count (in billions)

- POWER4: 0.2 (2001)
- POWER5: 0.3 (2004)
- POWER6: 0.8 (2007)
- POWER7: 1.2 (2010)
- POWER8: 4.2 (2014)
- POWER9: 8.0 (2017)
POWER9 Chip Variations

**Slim core**
- Up to 22 CPU cores
- SMT=4 optimised for Linux, HPC, & KVM
- December OpenPOWER
- 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
- AC922
- LC922
- LC921

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

<table>
<thead>
<tr>
<th>Issue of VSU and AGEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2x load AGEN / simple-ALU</td>
</tr>
<tr>
<td>• 2x load/store AGEN</td>
</tr>
<tr>
<td>• 2x scalar-64b / vector-128b</td>
</tr>
<tr>
<td>• 2x FXU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vector Scalar Unit (VSU) Pipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2x FP (64b/128b) + Complex (128b)</td>
</tr>
<tr>
<td>• 2x ALU (128b)</td>
</tr>
<tr>
<td>• 2x Permute (128b)</td>
</tr>
<tr>
<td>• 1x Decimal FP</td>
</tr>
<tr>
<td>• 1x Cryptography</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixed Point (FXU) Pipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2x ALU (64b)</td>
</tr>
<tr>
<td>• 2x FX-MUL + Fixed Divide (64b)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load Store Unit (LSU) Slices</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 64kB, 8-way Data Cache</td>
</tr>
<tr>
<td>• Up to 4 DW load or 2 store</td>
</tr>
<tr>
<td>• 1x Store complete</td>
</tr>
</tbody>
</table>

### POWER9 SMT8 Core Resources

<table>
<thead>
<tr>
<th>Issue of VSU and AGEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 8x scalar-64b / 4x vector-128b</td>
</tr>
<tr>
<td>• 8x load/store AGEN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vector Scalar Unit (VSU) Pipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 8x FP + FX-MUL + Complex (64b slice)</td>
</tr>
<tr>
<td>• 8x ALU + Simple (64b slice)</td>
</tr>
<tr>
<td>• 4x Permute (128b)</td>
</tr>
<tr>
<td>• 4x Quad Fixed (128b)</td>
</tr>
<tr>
<td>• 4x Fixed Divide (64b)</td>
</tr>
<tr>
<td>• 2x Quad FP / Decimal FP</td>
</tr>
<tr>
<td>• 2x Cryptography</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load Store Unit (LSU) Slices</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 64kB, 8-way Data Cache</td>
</tr>
<tr>
<td>• Up to 8 DW load or store</td>
</tr>
<tr>
<td>• 2x Store complete</td>
</tr>
</tbody>
</table>

---

## POWER9 Processor Peripherals
New 19” Rack  7965-S42

<table>
<thead>
<tr>
<th>Feature</th>
<th>S42</th>
<th>T42</th>
<th>94Y</th>
</tr>
</thead>
<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 HDD 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+130cvs</td>
<td>1061+ cvs</td>
<td>1040 + cvs</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>
</tr>
<tr>
<td>Earthquake certified</td>
<td>Yes – 45lbs / EIA</td>
<td>Yes – 35lbs/ EIA</td>
<td>No</td>
</tr>
</tbody>
</table>

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 inGEN4 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 warn out. A “fuel gauge” to monitor wear is provided for AIX/Linux nvmemgr

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
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

POWER9
The Server Range
POWER9 range in 2018

- **Enterprise Q3+Q4**
  - 7U to 22U
  - 4 to 16 socket
  - 8 to 192 cores
  - 16TB RAM

- **Midrange Q3**
  - E950
  - 1U
  - 16 to 48 cores
  - 16TB RAM

- **Scale-Out Q2**
  - S924, S922
  - 4U
  - 2 or 4 socket
  - 16 to 48 cores
  - 16TB RAM

- **AC922 Q4 2017**
  - 4U
  - 1 or 2 socket
  - 4 to 24 cores
  - 4TB RAM

- **LC922/LC921 Q3**
  - 7U to 22U
  - 4 to 16 socket
  - 8 to 192 cores
  - 16TB RAM

POWER9 Model Details
**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

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POWER9</strong></td>
<td>Four Sockets each node 32,40,44,48 CPU cores</td>
</tr>
<tr>
<td>Fast/Fused Core Processors</td>
<td>Sept 21st 1 or 2 Node drawers</td>
</tr>
<tr>
<td></td>
<td>Nov 16th 1 to 4 Node drawers</td>
</tr>
<tr>
<td></td>
<td>8, 10, 11 or 12 CPU Cores per socket</td>
</tr>
<tr>
<td></td>
<td>3.9 to 4.0 GHz</td>
</tr>
<tr>
<td>Sockets</td>
<td>4 per node (all populated)</td>
</tr>
<tr>
<td>Memory</td>
<td>CDIMM sizes 32, 64,128, 256, 512 GB populated in quads</td>
</tr>
<tr>
<td></td>
<td>16 TB max Memory per node =&gt; 64TB in 4 node</td>
</tr>
<tr>
<td></td>
<td>230GB/s per module / 920GB/s total (each node!)</td>
</tr>
<tr>
<td>Media Bays</td>
<td>DVD via external USB DVD or USB flash key in SCU</td>
</tr>
<tr>
<td>Integrated PCIe/node</td>
<td>Eight PCIe Gen 4 x16 HH HL</td>
</tr>
<tr>
<td></td>
<td>All are CAPI capable and use Blind Swap Cassettes</td>
</tr>
<tr>
<td>Internal I/O</td>
<td>- U2 format 1 to 4 NVMe slots for 1 to 4 NVMe devices</td>
</tr>
<tr>
<td></td>
<td>- 2.5 inch 7 mm 800GB</td>
</tr>
<tr>
<td></td>
<td>- USB 3.0</td>
</tr>
<tr>
<td>Max I/O Drawers</td>
<td>GA1 0-2 MEX PCIe Adapter drawers per node</td>
</tr>
<tr>
<td></td>
<td>GA2 0-4 MEX PCIe Adapter drawers per node</td>
</tr>
<tr>
<td>External Storage Drawers</td>
<td>EXP12SX, ESP24SX &amp; EXP24S</td>
</tr>
<tr>
<td></td>
<td>Each requires: PCIe SAS adapter or SAS port</td>
</tr>
</tbody>
</table>

### 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**
POWER9 Enterprise E980 node - (front view)

FANS and PSUs are redundant and concurrently maintainable

POWER9 Enterprise E980 node - (rear view)

PCle, NVMe Bays, SMP Conn., FSI, USB, Clock Card
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

<table>
<thead>
<tr>
<th>Drawer</th>
<th>Cable</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A SC1-P1-T3</td>
<td>ND1-P1-C9-T2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B SC1-P1-T5</td>
<td>N01-P1-C10-T2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A SC1-P1-T2</td>
<td>ND2-P1-C9-T2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B SC1-P1-T4</td>
<td>N02-P1-C10-T2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A SC1-P1-T6</td>
<td>ND3-P1-C9-T2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B SC1-P1-T8</td>
<td>N03-P1-C10-T2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A SC1-P1-T7</td>
<td>ND4-P1-C9-T2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B SC1-P1-T9</td>
<td>N04-P1-C10-T2</td>
<td></td>
</tr>
</tbody>
</table>
E980 Processor Architecture Highlights
Four directly connected POWER9 Processors = first hop

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

Second hop Inter-node cables (A bus)

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)
SMP cabling

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

IBM Power Systems POWER9 Enterprise E980 Unofficial Deep Dive
© IBM Corporation, 2018
SMP cabling

Processors

E980 nodes always
- 4 Processors =
  4 POWER9 chips

Sept 21st: 1 to 2 nodes
Nov 16th: 1 to 4 nodes
POWER9 E980 Node – top view

E980 Processors options

<table>
<thead>
<tr>
<th>CPU cores per POWER9</th>
<th>CPU cores per node</th>
<th>Nominal GHz</th>
<th>No-name GHz</th>
<th>Max GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>48</td>
<td>2.9</td>
<td>3.55</td>
<td>3.9</td>
</tr>
<tr>
<td>11</td>
<td>44</td>
<td>3.0</td>
<td>3.58</td>
<td>3.9</td>
</tr>
<tr>
<td>10</td>
<td>40</td>
<td>3.15</td>
<td>3.6</td>
<td>3.9</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>3.4</td>
<td>3.8</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Some OS commands report Nominal GHz

Default GHz
## E980 Performance

### E980 2 nodes

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

### E980 4 nodes

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


---

### Server Generation

**rPerf for E980 192 CPU cores**

- **POWER7**: 2189
- **POWER8**: 2978
- **POWER9**: 3906
- **E980/C**: 5081

**Cheating**

- **795/192**: 3080
- **795/256**: 795
- **E880/C**: 192

**30%**
Memory

POWER9 Processor Family
Three Memory Architectures

Scale Out
Direct Attach Memory
8 Direct DDR4 Ports
POWER9 \(\rightarrow\) DDR4
Max 2-Socket Systems

Scale Up
Buffered Memory
8 Buffered Channels
POWER9 \(\rightarrow\) Centaur chip \(\rightarrow\) DDR4
E950 4 Socket Systems

Scale Up
Buffered Memory
8 Buffered Channels
POWER9 \(\rightarrow\) Centaur chip \(\rightarrow\) RAM
E980 16 Socket Systems

Expect all current memory features in an E870/E880 to be migratable to an E980
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
Power E980 Processor Fabric & I/O Subsystem

- 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

X Buses (intranode)
### Comparison E880C vs E980 System

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

---

**POWER9**

eConfig view of the Features
### POWER9 Enterprise Frequencies & Defaults

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

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

#### Nominal GHz reported by some OS commands
- **POWER Performance Report new GHz Range**

### 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

---

© IBM Corporation, 2018
On Twitter?

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 -E proc0 reports a lower Nominal GHz between 2.3 to 3.3 GHz
Memory Options

<table>
<thead>
<tr>
<th>Feature Code</th>
<th>Feature Size</th>
<th>Made up for</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF20</td>
<td>128GB DIMM</td>
<td>4 x 32GB</td>
</tr>
<tr>
<td>EF21</td>
<td>256GB DIMM</td>
<td>4 x 64GB</td>
</tr>
<tr>
<td>EF22</td>
<td>512GB DIMM</td>
<td>4 x 128GB</td>
</tr>
<tr>
<td>EF23</td>
<td>1024GB DIMM</td>
<td>4 x 256GB</td>
</tr>
<tr>
<td>EF24</td>
<td>2048GB DIMM</td>
<td>4 x 512GB</td>
</tr>
</tbody>
</table>

- 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

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
NVMe storage Options

<table>
<thead>
<tr>
<th>Feature Code</th>
<th>DIMM Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC5J</td>
<td>800 GB</td>
</tr>
</tbody>
</table>

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
- “nvmemgr” command to determine drive wear
- They will issue warning messages at 100% used
  - Customer to backup and replace

Operating Systems for Enterprise
AIX

- AIX with POWER9 support can LPM from P7 & P8 to POWER9 in P7/P8 mode
- Once on POWER9 reboot required to get to POWER9 mode
- AIX on POWER66 can’t LPM to POWER9
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

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*

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

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
Linux on POWER9 E980

• 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

• SUSE SLES
• Red Hat RHEL
Linux on POWER9 E980

• 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

IBM i

Release Support are:
• IBM i 7.3 TR5
• IBM i 7.2 TR9

IBM i 7.3 TR5 announcement
  and developerWorks technical info at

IBM i 7.2 TR9 announcement
  and developerWorks technical info at
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)

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

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 ½ drawer connected to Four EMX Drawers
  – As used on POWER8
• EMX Fan-out has 6 adapters slots = EMX Drawer 12 adapters slots

<table>
<thead>
<tr>
<th>E980 nodes</th>
<th>FC#EJ07 adapters</th>
<th>EMX Drawers</th>
<th>Fan-out ½ Drawers</th>
<th>PCIe slots in total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>8</td>
<td>16</td>
<td>96</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>12</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>16</td>
<td>32</td>
<td>192</td>
</tr>
</tbody>
</table>
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

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

<table>
<thead>
<tr>
<th>FC</th>
<th>CCIN</th>
<th>Description</th>
<th>Max</th>
<th>OS support</th>
</tr>
</thead>
<tbody>
<tr>
<td>5273</td>
<td>577D</td>
<td>PCIe LP 8Gb 2-Port Fibre Channel Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>5729</td>
<td>577D</td>
<td>PCIe2 8Gb 4-port Fibre Channel Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>5735</td>
<td>577D</td>
<td>8 Gigabit PCI Express Dual Port Fibre Channel Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0A</td>
<td>577F</td>
<td>PCIe3 16Gb 2-port Fibre Channel Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0B</td>
<td>577F</td>
<td>PCIe3 LP 16Gb 2-port Fibre Channel Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN1A</td>
<td>578F</td>
<td>PCIe3 32Gb 2-port Fibre Channel Adapter</td>
<td>192</td>
<td>IBM i Linux</td>
</tr>
<tr>
<td>EN1B</td>
<td>578F</td>
<td>PCIe3 LP 32Gb 2-port Fibre Channel Adapter</td>
<td>32</td>
<td>IBM i Linux</td>
</tr>
<tr>
<td>EN1C</td>
<td>578E</td>
<td>PCIe3 16Gb 4-port Fibre Channel Adapter</td>
<td>192</td>
<td>IBM i Linux</td>
</tr>
<tr>
<td>EN1D</td>
<td>578E</td>
<td>PCIe3 LP 16Gb 4-port Fibre Channel Adapter</td>
<td>32</td>
<td>IBM i Linux</td>
</tr>
</tbody>
</table>

**Low Profile internal to the E980 node**

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

<table>
<thead>
<tr>
<th>FC</th>
<th>CCIN</th>
<th>Description</th>
<th>Max</th>
<th>OS support</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES0Q</td>
<td>59E8</td>
<td>387GB SFF-2 4K SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ES0S</td>
<td>59C3</td>
<td>775GB SFF-2 4K SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ES78</td>
<td>5816</td>
<td>387GB SFF-2 SSD Sxx eMLC4 for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ES7E</td>
<td>5817</td>
<td>775GB SFF-2 SSD Sxx eMLC4 for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ES80</td>
<td>5821</td>
<td>1.9TB Read Intensive SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ES8J</td>
<td>5810</td>
<td>387GB SFF-2 4K eMLC4 for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>E91</td>
<td>5811</td>
<td>775GB SFF-2 4K eMLC4 for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ESF8</td>
<td>5812</td>
<td>1.55TB SFF-2 4K eMLC4 for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ESY8</td>
<td>5829</td>
<td>931GB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ES96</td>
<td>5821</td>
<td>1.86TB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX Linux</td>
</tr>
<tr>
<td>ESE7</td>
<td>582D</td>
<td>3.72TB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESG5</td>
<td>5816</td>
<td>387GB Enterprise SAS Sxx SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESGB</td>
<td>5810</td>
<td>387GB Enterprise SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESGF</td>
<td>5817</td>
<td>775GB Enterprise SAS Sxx SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESGK</td>
<td>5811</td>
<td>775GB Enterprise SAS SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESGP</td>
<td>5812</td>
<td>1.55TB Enterprise SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESH1</td>
<td>5829</td>
<td>931 GB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESHL</td>
<td>5821</td>
<td>1.86 TB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESHN</td>
<td>582F</td>
<td>7.44 TB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>ESM8</td>
<td>582D</td>
<td>3.72 TB Mainstream SAS 4K SFF-2 SSD for AIX/Linux</td>
<td>2016</td>
<td>AIX IBM i Linux</td>
</tr>
</tbody>
</table>
### Power I/O currently planned* to be supported on Power E980 Network

<table>
<thead>
<tr>
<th>FC</th>
<th>CCIN</th>
<th>Description</th>
<th>Max</th>
<th>OS support</th>
</tr>
</thead>
<tbody>
<tr>
<td>5260</td>
<td>576F</td>
<td>PCIe2 LP 4-port 1GbE Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>5899</td>
<td>576F</td>
<td>PCIe2 4-port 1GbE Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EC2R</td>
<td>58FA</td>
<td>PCIe3 LP 2-Port 10Gb NIC&amp;ROCE SR/Cu Adapter</td>
<td>32</td>
<td>IBM i</td>
</tr>
<tr>
<td>EC2S</td>
<td>58FA</td>
<td>PCIe3 2-Port 10Gb NIC&amp;ROCE SR/Cu Adapter</td>
<td>64</td>
<td>IBM i</td>
</tr>
<tr>
<td>EC2T</td>
<td>58FB</td>
<td>PCIe3 LP 2-Port 25/10Gb NIC&amp;ROCE SR/Cu Adapter</td>
<td>32</td>
<td>IBM i</td>
</tr>
<tr>
<td>EC2U</td>
<td>58FB</td>
<td>PCIe3 2-Port 25/10Gb NIC&amp;ROCE SR/Cu Adapter</td>
<td>64</td>
<td>IBM i</td>
</tr>
<tr>
<td>EC67</td>
<td>2CF3</td>
<td>PCIe4 LP 2-port 100Gb ROCE EN LP adapter</td>
<td>32</td>
<td>IBM i</td>
</tr>
<tr>
<td>EN0H</td>
<td>2B93</td>
<td>PCIe4 4-port (10Gb FCoe &amp; 1GbE) SR&amp;RI45</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0J</td>
<td>2B93</td>
<td>PCIe4 4-port (10Gb FCoe &amp; 1GbE) SR&amp;RI45</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0K</td>
<td>2CC1</td>
<td>PCIe4 4-port (10Gb FCoe &amp; 1GbE) SR&amp;RI45</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0L</td>
<td>2CC1</td>
<td>PCIe4 4-port (10Gb FCoe &amp; 1GbE) SR&amp;RI45</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0S</td>
<td>2CC3</td>
<td>PCIe2 4-Port (10Gb+1GbE) SR+RI45 Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0T</td>
<td>2CC3</td>
<td>PCIe2 4-Port (10Gb+1GbE) SR+RI45 Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0U</td>
<td>2CC3</td>
<td>PCIe2 4-Port (10Gb+1GbE) Copper SR+RI45 Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0V</td>
<td>2CC3</td>
<td>PCIe2 4-Port (10Gb+1GbE) Copper SR+RI45 Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0W</td>
<td>2CC4</td>
<td>PCIe2 2-port 10/1GbE BaseT RJ45 Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN0X</td>
<td>2CC4</td>
<td>PCIe2 2-port 10/1GbE BaseT RJ45 Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN15</td>
<td>2CE3</td>
<td>PCIe3 4-port 10GbE SR Adapter</td>
<td>192</td>
<td>AIX IBM i Linux</td>
</tr>
<tr>
<td>EN16</td>
<td>2CE3</td>
<td>PCIe3 LPX 4-port 10GbE SR Adapter</td>
<td>32</td>
<td>AIX IBM i Linux</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>FC</th>
<th>CCIN</th>
<th>Description</th>
<th>Max</th>
<th>OS support</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF27</td>
<td>31ED</td>
<td>128GB DDR4 Memory (4X32GB) CDIMMs for 80H</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>EF28</td>
<td>31EE</td>
<td>256GB DDR4 Memory (4X64GB) CDIMMs for 80H</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>EF29</td>
<td>31EF</td>
<td>512GB DDR4 Memory (4X128GB) CDIMMs for 80H</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>EF2A</td>
<td>31FC</td>
<td>1024GB DDR4 Memory (4X256GB) CDIMMs for 80H</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>EF2B</td>
<td>31FD</td>
<td>2048GB DDR4 Memory (4X512GB) CDIMMs for 80H</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>EFP5</td>
<td>5C35</td>
<td>3.40 GHz 32-core (4x8) POWER9 processor</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EFP6</td>
<td>5C36</td>
<td>3.15 GHz 40-core (4x10) POWER9 processor</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EFP7</td>
<td>5C39</td>
<td>2.90 GHz 48-core (4x12) POWER9 processor</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EFP8</td>
<td>5C46</td>
<td>3.0 GHz 44-core (4x11) POWER9 processor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Subject to Change
Physicals

POWER9 E980

E980 node size
• Width: 445.5 mm (17.54 in.)
• Depth: 867 mm (34.13 in.)
• Height: 218 mm (8.58 in.)
→ T42 consider the 8 inch extension for rear cables
→ 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

---

**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/second 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 64 TB total memory (16 TB 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 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 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