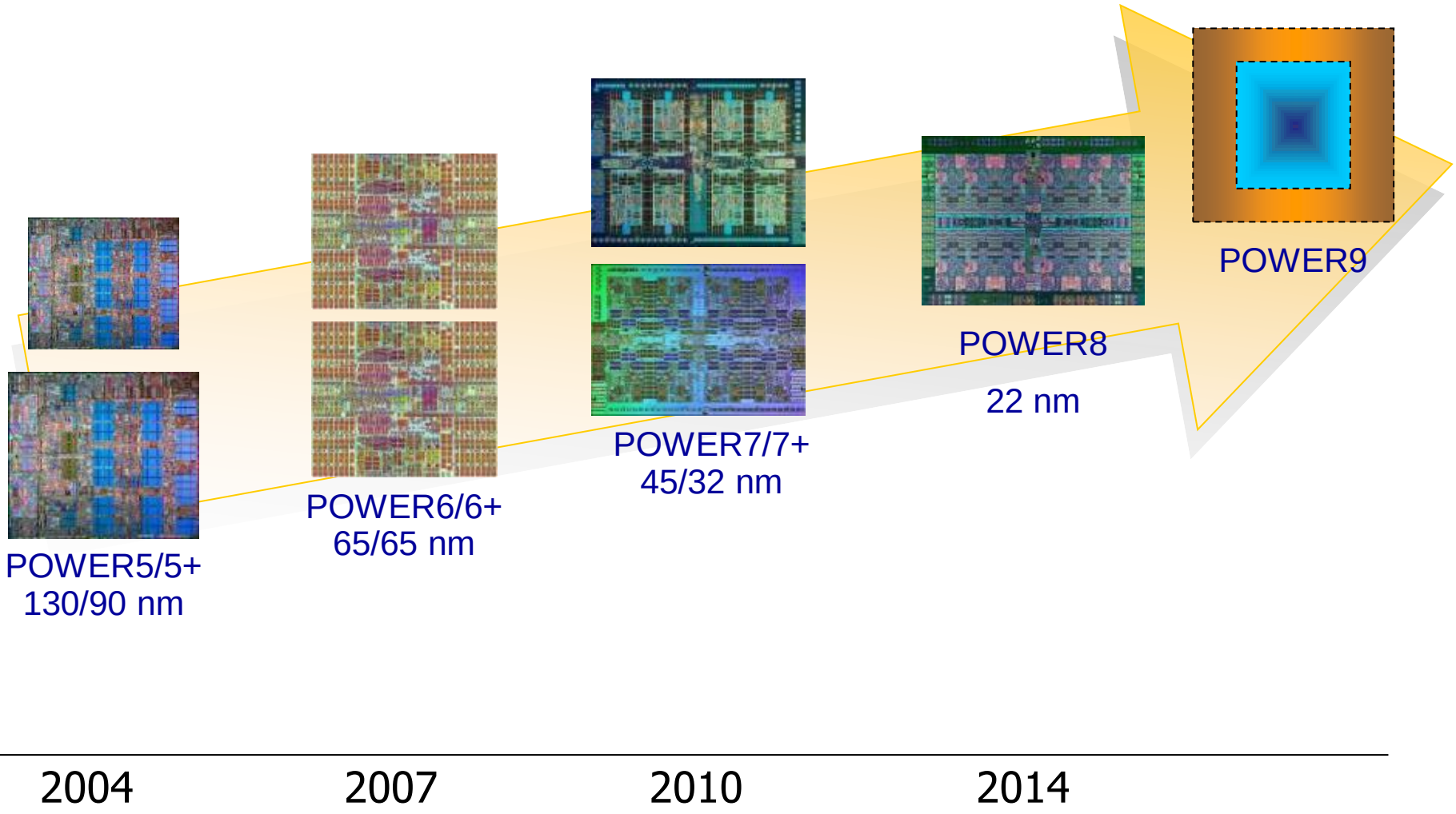
Power Systems

IBM

Scale-out Power8 Systems Introduction

Dale Perkins
dperkins@midrange.ca

Power Processor Technology Roadmap



Driving value for Big Data & Analytics, Cloud and Mobile applications with Power Systems Software

Simplified Virtualization and Cloud Management

Expanded choice and enhanced value for the industry's most scalable & flexible virtualization infrastructure for UNIX, Linux and IBM i

PowerKVM (New)	PowerVM	PowerVP	PowerVC	openstack
Open Virtualization for scale-out Linux Systems	Virtualization without Limits	Virtualization Performance	Virtualization Center: Increase IT productivity and agility	SmartCloud Entry for Power Systems*

** Will announce in May*

Delivering Innovation for IBM i 7.2 with POWER8

Systems of Engagement & Systems of Record

- Easier integration on a single system and single architecture
- IBM i 7.2 locks down business data and improves performance
- Minimize risk as you extend business systems to customers through mobile and cloud

Key Capabilities

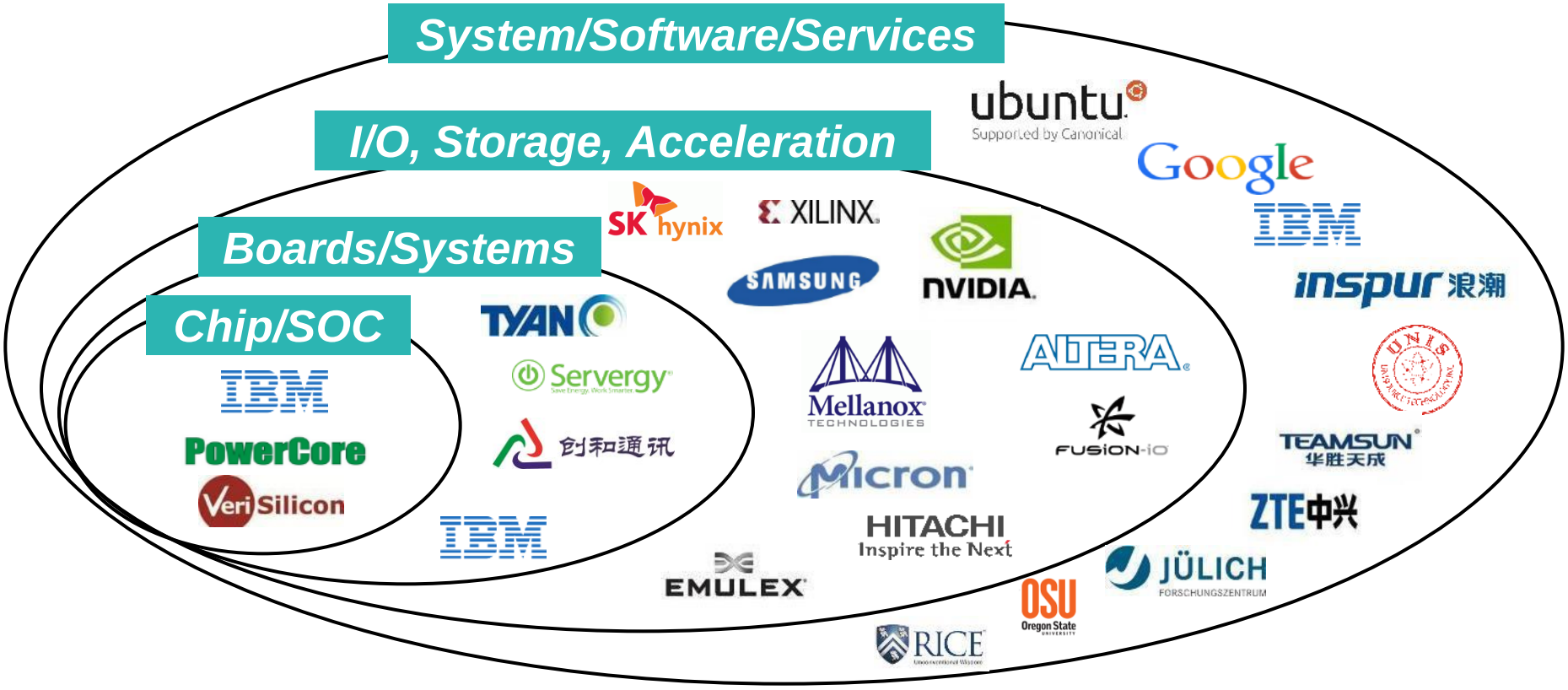
- Powerful **new features of DB2® for I**
- **IBM Navigator for i**
- **Integrated Security** SSO application suite
- **PowerHA SystemMirror for i Express Edition**
- **Analytics: combined value** of DB2 WebQuery and Cognos on Linux on Power
- Free Format RPG

PowerHA

Cognos. software

The OpenPOWER Foundation: Open & Collaborative Innovation Growing Fast

OpenPOWER™



OpenPOWER: Architecture to unleash innovation

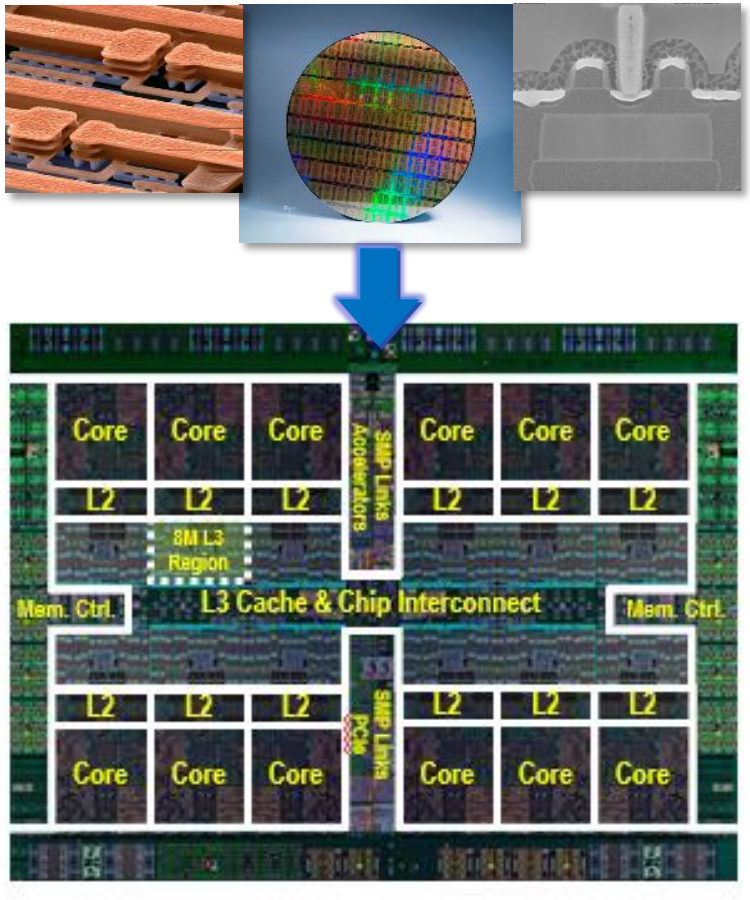
COMPUTE	MEMORY	IO NETWORK	STORAGE
Differentiating DB2 database on Power/Linux using GPU acceleration	Cost optimized “in memory like” noSQL infrastructure with CAPI + IBM FlashSystem	Distributed store accelerated by RDMA	Next-gen big data architecture leveraging GPFS/GSS, Platform, & FPGA based compression acceleration

NVIDIA, IBM DB2, XILINX, mongoDB, redislabs, Mellanox TECHNOLOGIES, redislabs, Platform Computing, IBM GPFS

POWER8: The First Processor Designed for Big Data

IBM 22nm Technology

- Silicon-on-Insulator
- 15 metal layers
- Deep trench eDRAM



POWER8 Processor

Compute

- 12 cores (thread strength optimized)
- SMT8, 16-wide execution
- 2X internal data flows
- Transactional Memory

Cache

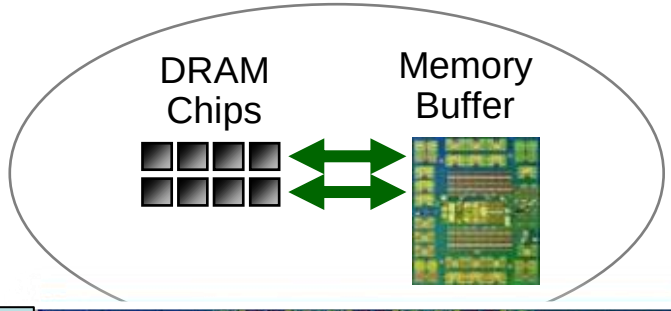
- 64KB L1 + 512KB L2 / core
- 96MB L3 + up to 128MB L4 / socket
- 2X bandwidths

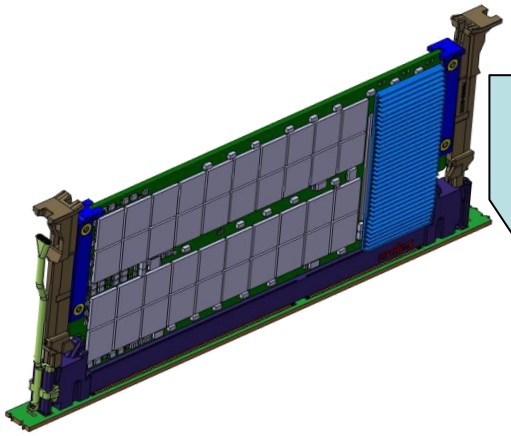
System Interfaces

- 230 GB/s memory bandwidth / socket
- Up to 48x Integrated PCI gen 3 / socket
- CAPI (over PCI gen 3)
- Robust, Large SMP Interconnect
- On chip Energy Mgmt, VRM / core

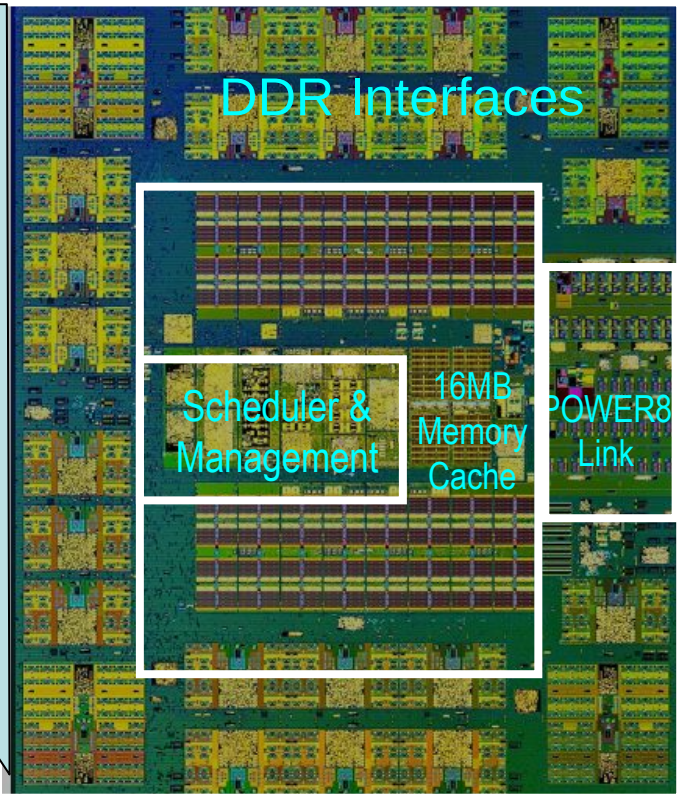
POWER8

POWER8 Memory Buffer Chip





"L4 cache"



Intelligence Moved into Memory

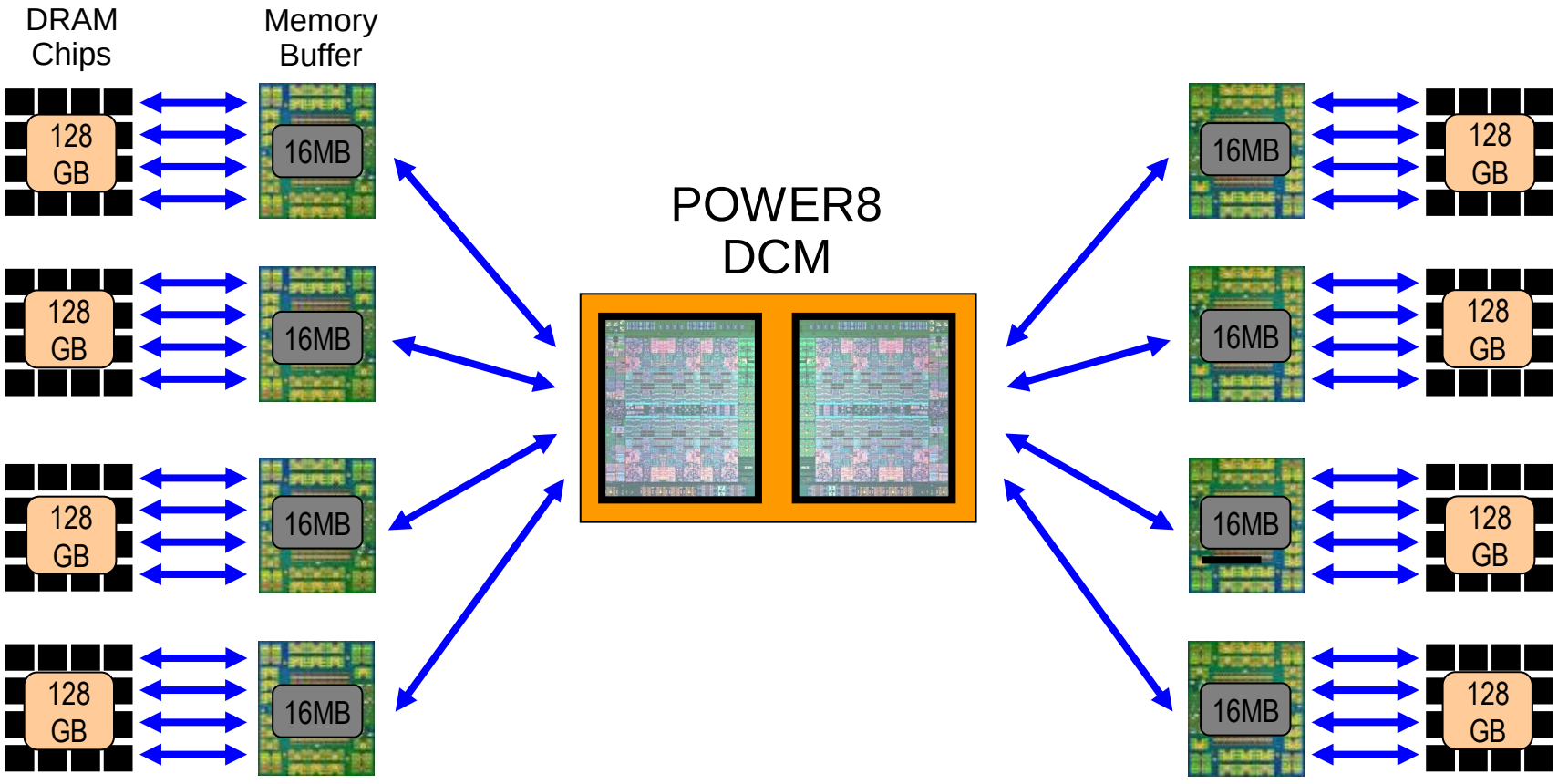
- Previously on POWER7+ chip onto buffer

Processor Interface

- High speed interface

Performance Value

POWER8 Memory Organization



- Architecturally: Up to 1 TB / Socket
- First POWER8 Systems: 512 GB / Socket announced

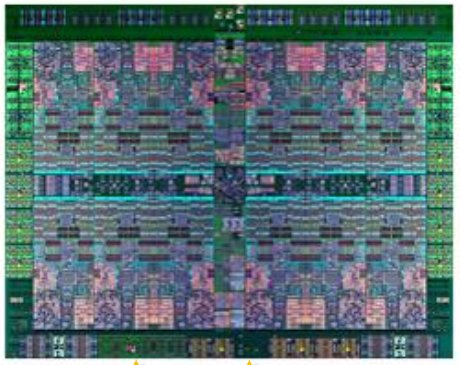
(Max Config shown)

Power Systems

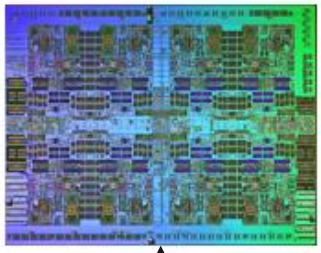
IBM

POWER8 Integrated PCI Gen 3

POWER8



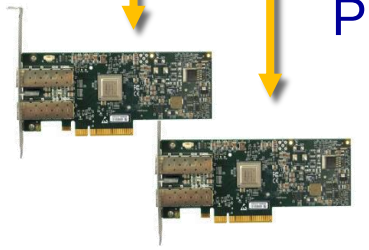
POWER7



GX Bus

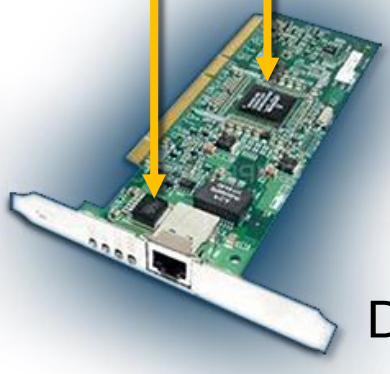
I/O Bridge

PCIe Gen2



PCI Devices

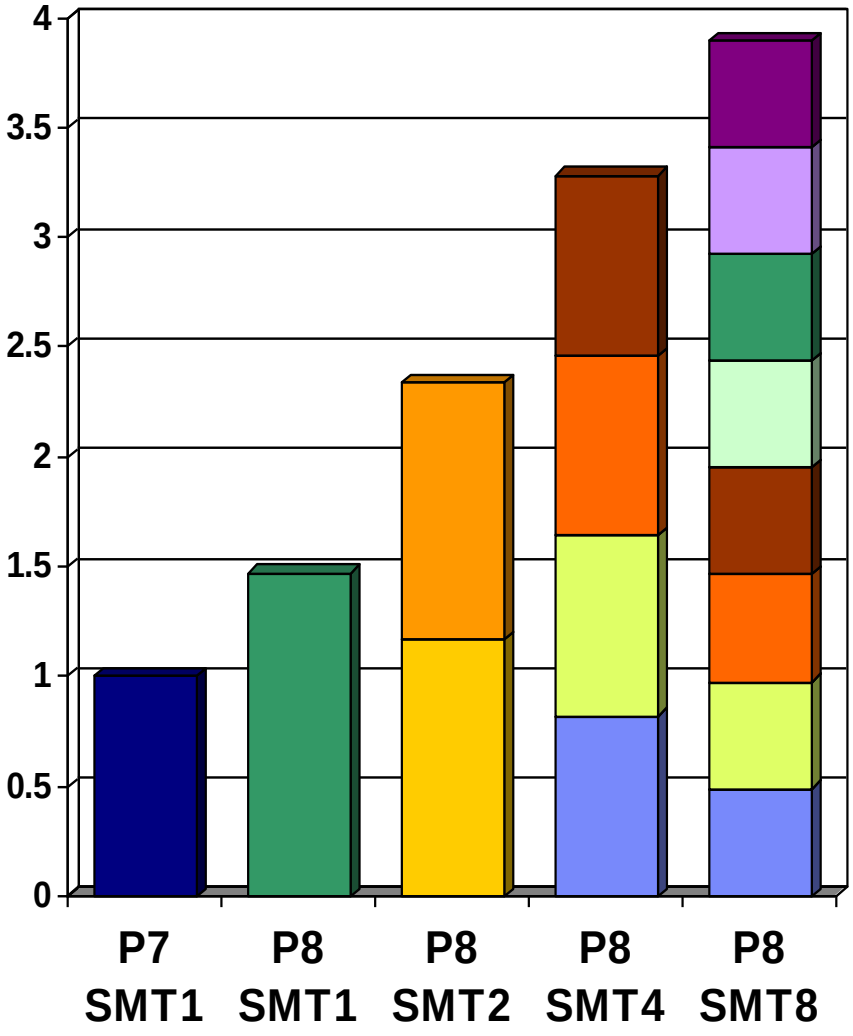
PCIe Gen3



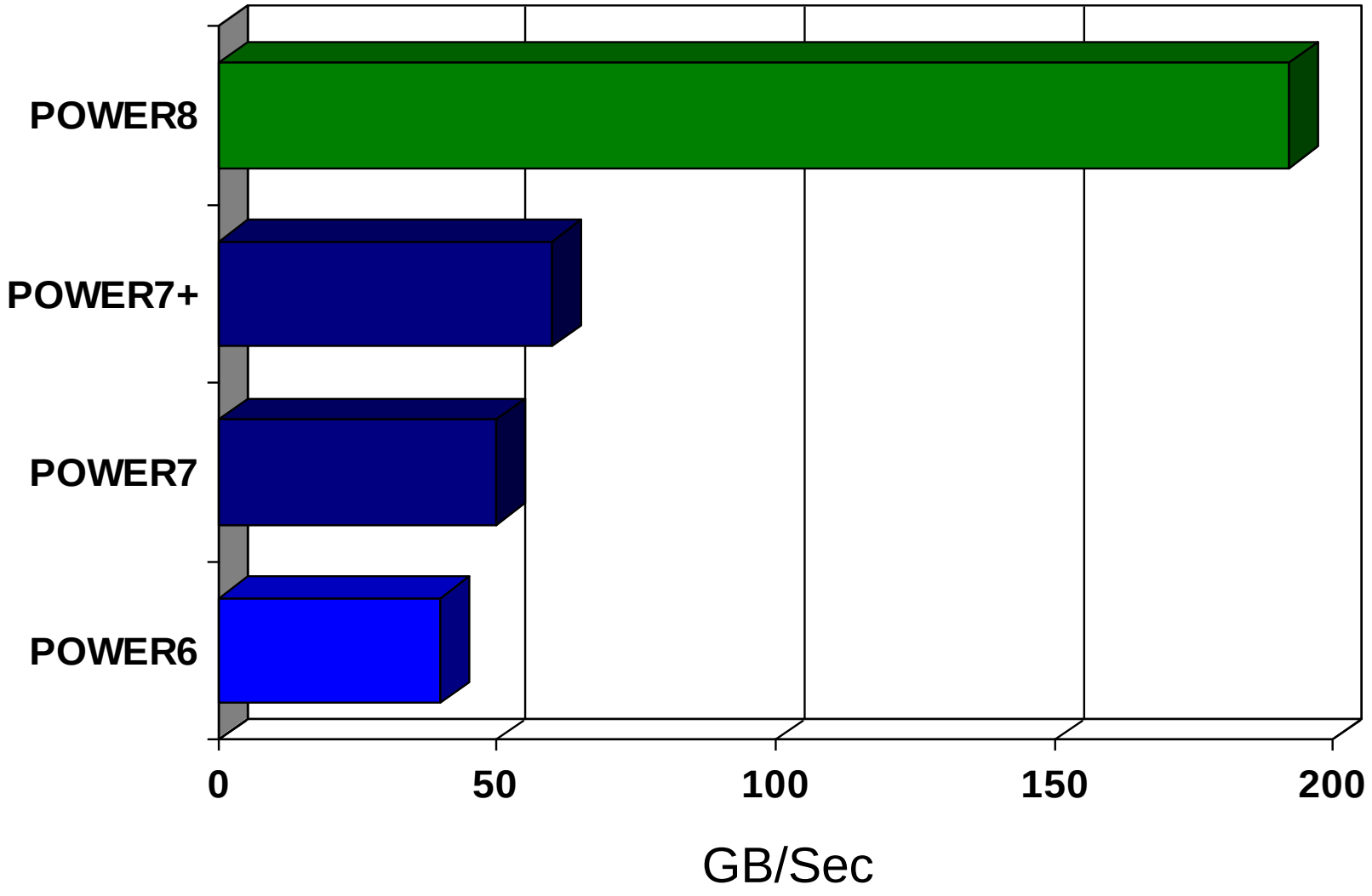
PCI Device

POWER8 Multi-threading Options

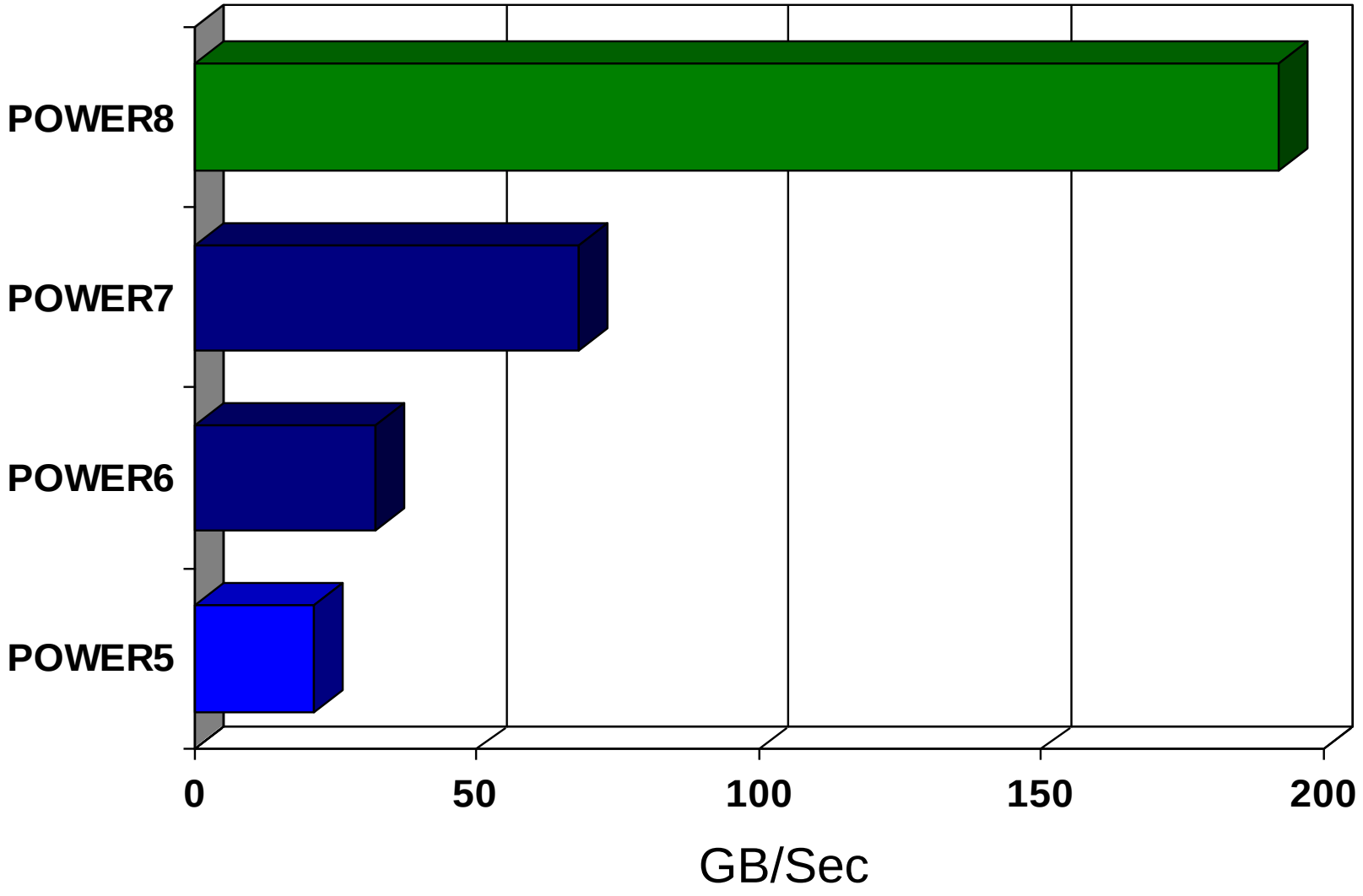
- **SMT1:** Largest unit of execution work
- **SMT2:** Smaller unit of work, but provides greater amount of execution work per cycle
- **SMT4:** Smaller unit of work, but provides greater amount of execution work per cycle
- **SMT8:** Smallest unit of work, but provides the maximum amount of execution work per cycle
- Can dynamical shift between modes as required: SMT1 / SMT2 / SMT4 / SMT8
- Mixed SMT modes supported within same LPAR
  - Requires use of “Resource Groups”



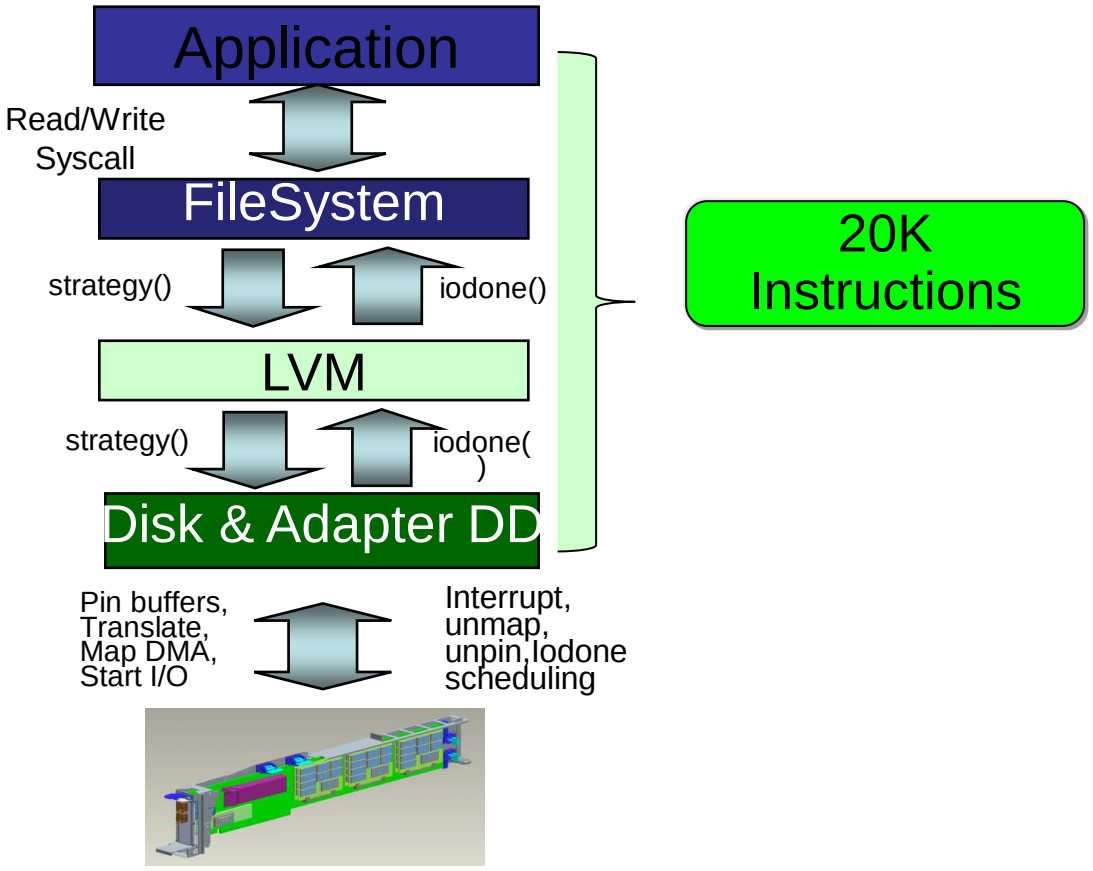
IO Bandwidth



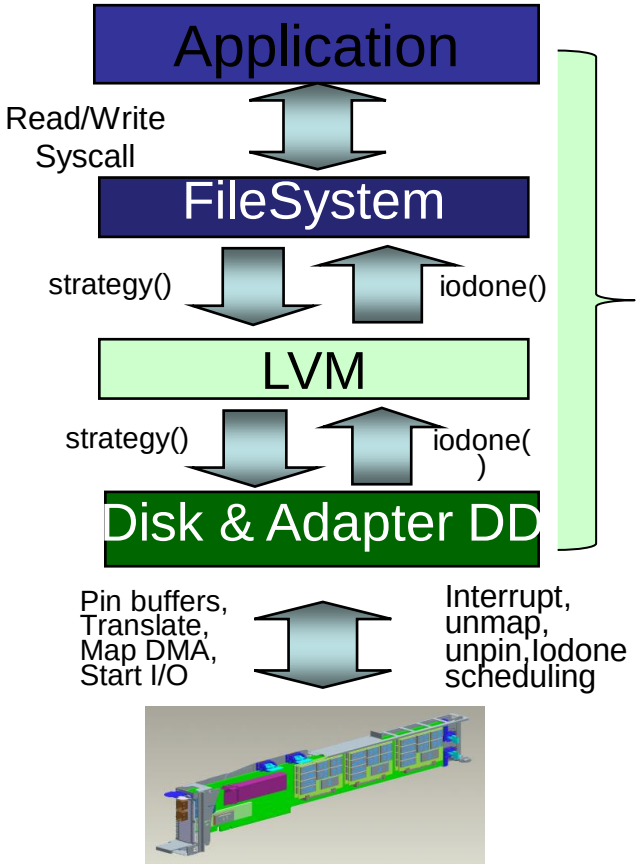
Memory Bandwidth per Socket



Possible Example: CAPI Attached Flash Optimization



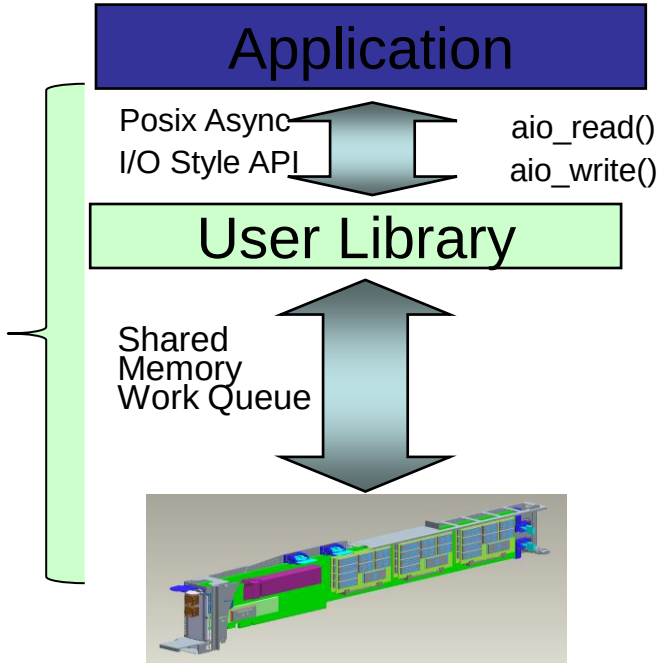
Possible Example: CAPI Attached Flash Optimization



20K Instructions

< 500 Instructions

Attach flash memory to POWER8 via CAPI coherent Attach



- **Issues Read/Write Commands from applications to eliminate 97% of instruction path length** **CAPI Flash controller Operates in User Space**
- **Saves 10 Cores per 1M IOPs**

Power System Portfolio 1Q 2014

Extending the portfolio to reach new clients and drive new workloads

Power Systems

IBM

POWER8 Scale-out Systems

POWER8

- POWER8 roll-out is leading with scale-out (1-2S) systems
- Expanded Linux focus: Ubuntu, KVM, and Open Stack
- Scale-up POWER8 (>2S) systems will be rolled out over time
- PCI Gen3 right out of POWER8 processor
- OpenPOWER Innovations

1 & 2 Socket Power Systems

S812L	S822L	S822	S814	S824L	S824
• 1-socket, 2U • POWER8 processor • Linux only • CAPI support (1) • 2H14	• 2-socket, 2U • POWER8 processor • Up to 24 cores • 1 TB memory • 9 PCI Gen3 slot • Linux only • CAPI support (2) • PowerVM & PowerKVM	• 2-socket, 2U • Up to 20 cores • 1 TB memory • 9 PCIe Gen 3 • AIX & Linux • CAPI support (2) • PowerVM	• 1-socket, 4U • Up to 8 cores • 512 GB memory • 7 PCIe Gen 3 • AIX, IBM i, Linux • CAPI support (1) • PowerVM	• 2-socket, 4U • Up to 24 cores • Linux • NVIDIA GPU • 2H14	• 2-socket, 4U • Up to 24 cores • 1 TB memory • 11 PCIe Gen 3 • AIX, IBM i, Linux • CAPI support (2) • PowerVM

openstack CLOUD SOFTWARE

AIX for Business Linux

PowerSC PowerVC
PowerHA PowerVM

Linux

PowerKVM

ubuntu Supported by Canonical

SUSE

redhat

Scale-out Systems - DCMs and POWER8 Chips

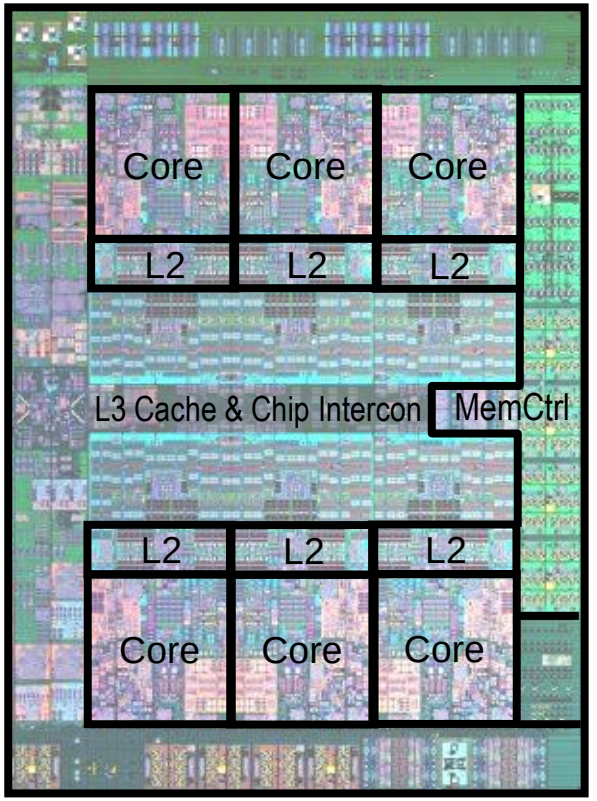
1S & 2S servers use DCM (Dual Chip Module)

- § 1 DCM fills 1 socket .... Similar to POWER7+ 750 / 760
- § 1 DCM has two Scale-out POWER8 chips
- § 1 DCM can provide 6-core, 8-core, 10-core or 12-core sockets

6-core Processor Chip
- two 3-cores for 6-core DCM
- two 4-cores for 8-core DCM
- two 5-cores for 10-core DCM
- two 6-ocres for 12-core DCM

Max 8 Threads per Core

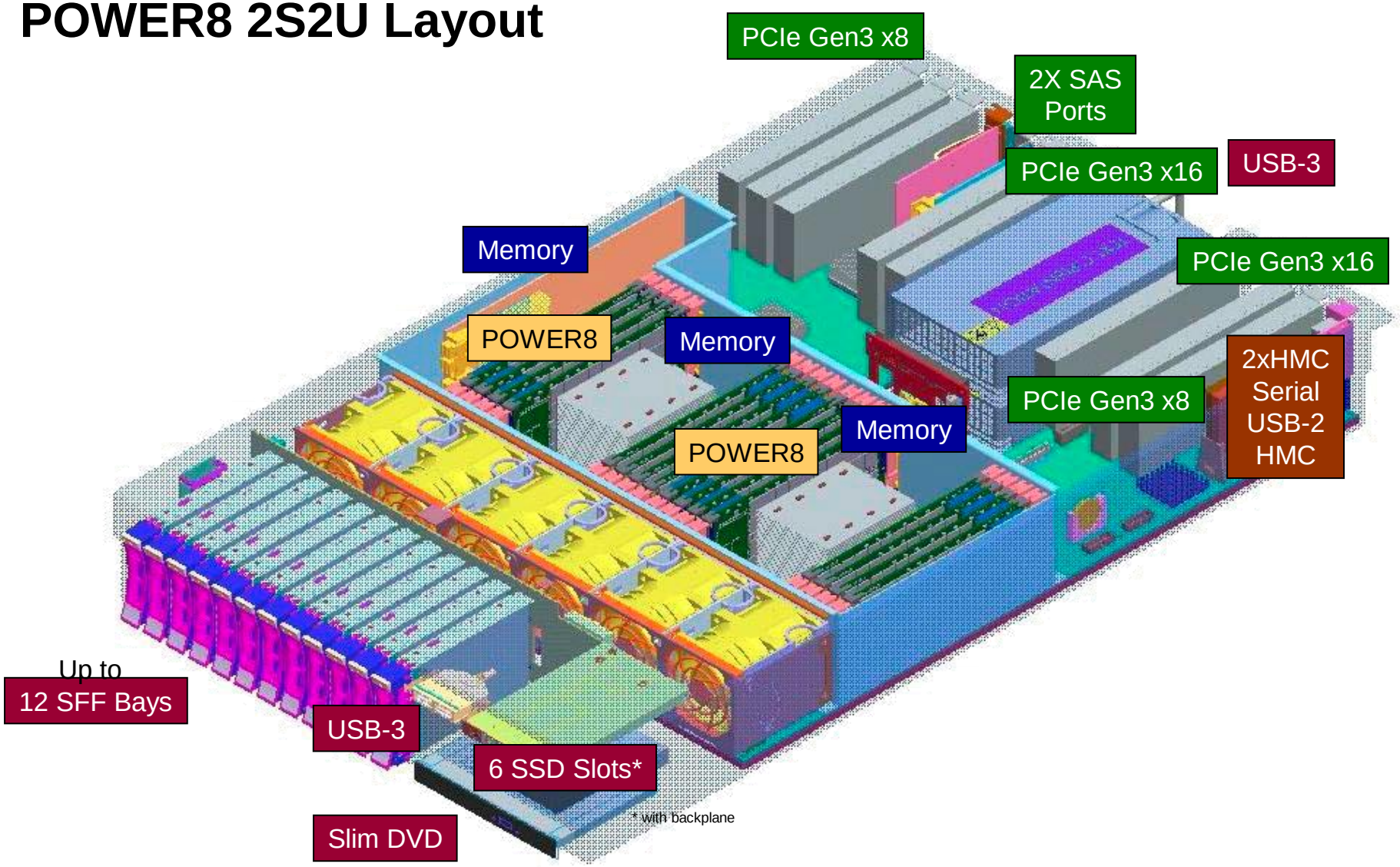
Excellent I/O bandwidth per socket



Power Systems

IBM

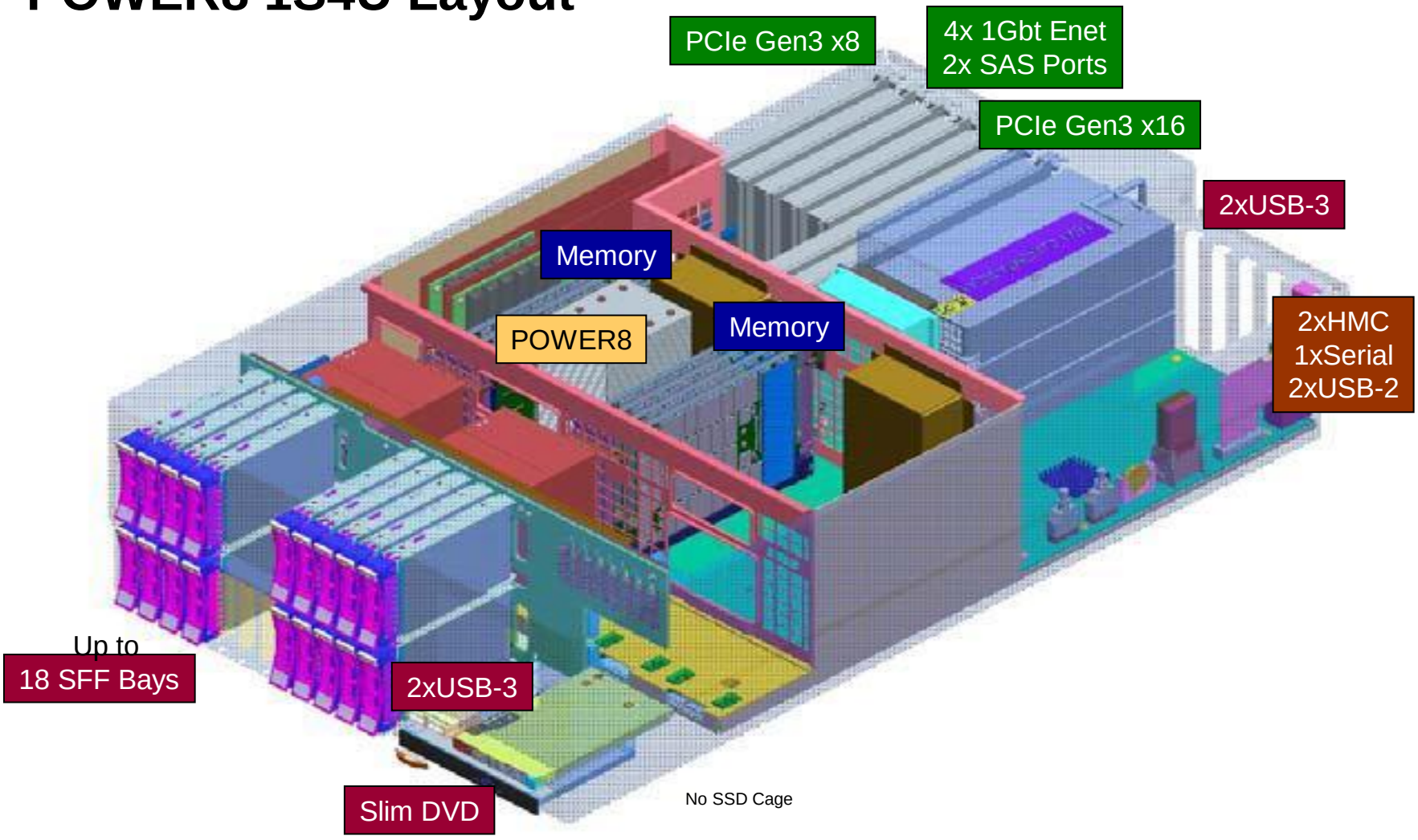
POWER8 2S2U Layout



Power Systems

IBM

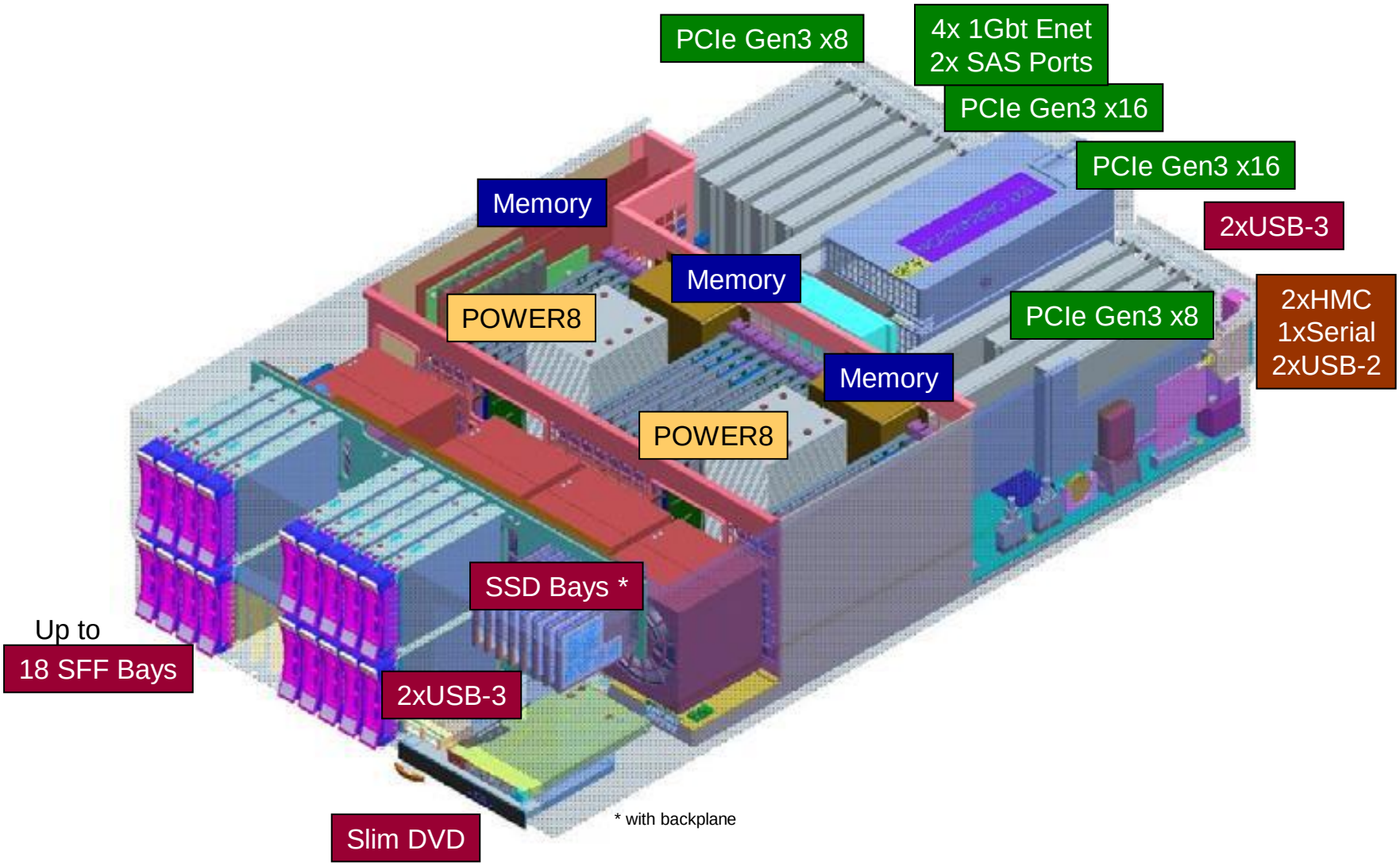
POWER8 1S4U Layout



Power Systems

IBM

POWER8 2S4U Layout



POWER8 1S4U Scale-out System

Power S814

- Form Factor: 4U or Tower
- Single Socket
  - Cores: 6 (3.0 GHz) or 8 (3.7 GHz)
  - Memory: Up to 512 GB
  - Slots: 7 PCIe Gen3 Full-high (Hotplug)

- Ethernet: Quad 1 Gbt in PCIe slot
- Integrated ports: USB (4/5), Serial (1), HMC (2)
- Internal Storage
  - DVD
  - 12 SFF Bays -- Split Backplane: 6 + 6
  - or 18 SFF Bays with Easy Tier with 7GB write cache

- Hypervisor: PowerVM
- ***OS: AIX, IBM i (P10 software tier), Linux***

3 Yr Warranty

Power Systems

IBM

POWER8 2S4U Scale-out System

Power S824

- Single Socket populated
  - Cores: 6 (3.8 GHz) or 8 (4.1 GHz)
  - Memory: Up to 512 GB
  - Slots: 7 PCIe Gen3 full-high (Hotplug)
- Both Sockets populated
  - Cores: 12 (3.8 GHz), 16 (4.1 GHz), or 24 (3.5 GHz)
- Memory: Up to 1 TB
  - Slots: 11 PCIe Gen3 full-high (Hotplug)

3 Yr Warranty

- Ethernet: Quad 1 Gbt in PCIe slot
- Integrated ports: USB (4/5), Serial (1), HMC (2)
- Internal Storage
  - DVD
  - 12 SFF Bays -- Split Backplane: 6 + 6
  - or 18 SFF bays & 8 SSD bays with Easy Tier with 7GB write cache
- Hypervisor: PowerVM
- ***OS: AIX, IBM i (P20 software tier), Linux***

POWER8 4U Scale-out Comparison – S814

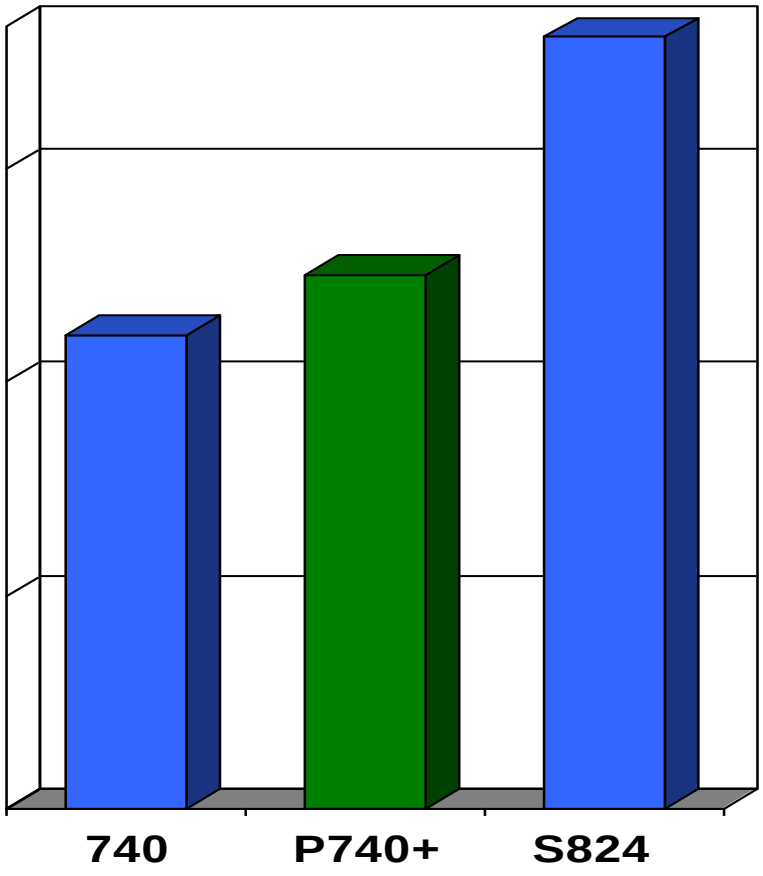
	Power 720	Power System S814
Processor	POWER7+	**POWER8**
Sockets	1	**1**
Cores	4 / 6 / 8	**6 / 8**
Maximum Memory	512 @ 1066 MHz	**512 GB @ 1600 MHz**
Memory Cache	No	**Yes**
Memory Bandwidth	136 GB/sec	**192 GB/sec**
Memory DRAM Spare	No	**Yes**
System unit PCIe slots	6 PCIe Gen2 FH Opt 4 PCIe Gen2 LP	**7 PCIe Gen3 FH**
CAPI (Capable slots)	N / A	**One**
PCIe Hot Plug Support	No	**Yes**
IO bandwidth	40 GB/sec	**96 GB/sec**
Ethernet ports	Quad 1 Gbt (x4 slot)	**Quad 1 Gbt (x8 Slot)**
SAS bays in system unit	6 or 8 SFF-1 bays	**12 SFF-3 bays Or 18 SFF-3 bays**
Integrated write cache	Optional 175 MB	**Optional effectively 7GB**
Easy Tier Support	No	**Yes**
Integrated split backplane	Yes (3 + 3)	**Yes (6 + 6)**
Service Processor	Generation 1	**Generation 2**

POWER8 4U Scale-out Comparison – S824

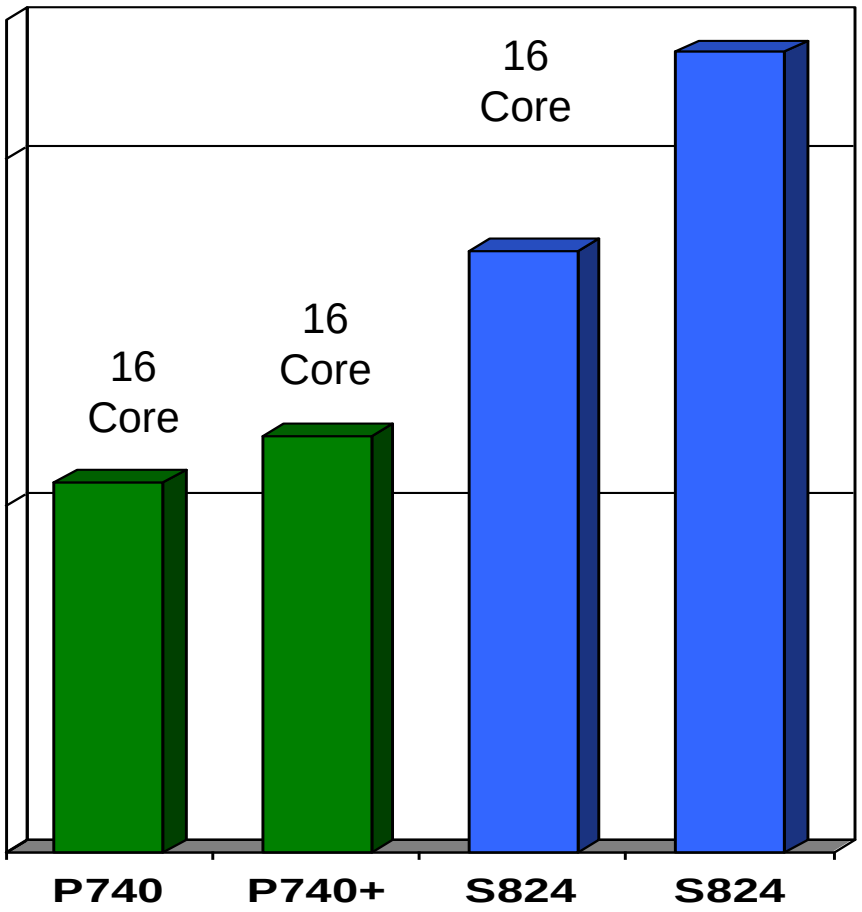
	Power 740	Power System S824
Processor	POWER7+	**POWER8**
Sockets	1 (upgradeable) / 2	**1 (upgradeable) / 2**
Max Cores	8 / 16	**8 / 24**
Maximum Memory	512GB / 1TB @ 1066 MHz	**512GB / 1TB @ 1600 MHz**
Memory Cache	No	**Yes**
Memory Bandwidth	136 GB/sec	**384 GB/sec**
Memory DRAM Spare	No	**Yes**
System unit PCIe slots	6 PCIe Gen2 FH Opt 4 PCIe Gen2 LP	**7 / 11 PCIe Gen3 FH**
CAPI (Capable slots)	N / A	**Two**
PCIe Hot Plug Support	No	**Yes**
IO bandwidth	60 GB/sec	**192 GB/sec**
Ethernet ports	Quad 1 Gbt (x4 slot)	**Quad 1 Gbt (x8 Slot)**
SAS bays in system unit	6 or 8 SFF-1	**12 SFF-3 bays Or 18 SFF-3 + 8 SSD bays**
Integrated write cache	Optional 175 MB	**Optional effectively 7GB**
Easy Tier Support	No	**Yes**
Integrated split backplane	Yes (3 + 3)	**Yes (6 + 6)**
Service Processor	Generation 1	**Generation 2**

Power 740 / POWER8 S824 CPW Compares

Performance per Core



Performance Dual Socket



CPW

S814 (1 socket)

6-core	3.0 GHz	59,500
8-core	3.7 GHz	85,500

S824 (1 or 2 socket)

6-core	3.8 GHz	72,000
12-core	3.8 GHz	130,000
8-core	4.1 GHz	94,500
16-core	4.1 GHz	173,500
12-core	1-socket not offered	
24-core	3.5 GHz	230,500

Measured using SMT8

SMT4 would be somewhat lower

Power Systems

IBM

CPW Comparison

720 POWER7+ (1 socket)

4-core	3.6 GHz	28,400
6-core	3.6 GHz	42,400
8-core	3.6 GHz	56,300

S814 (1 socket)

6-core	3.0 GHz	59,500
8-core	3.7 GHz	85,500

740 POWER7+ (1 or 2 socket)

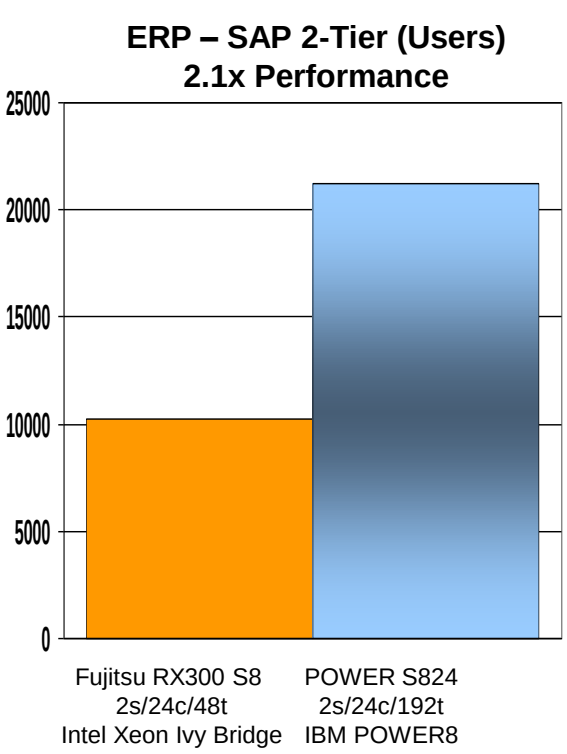
6-core	4.2 GHz	49,000
12-core	4.2 GHz	91,700
8-core	3.6 GHz	56,300
16-core	3.6 GHz	106,500
8-core	4.2 GHz	64,500
16-core	4.2 GHz	120,000

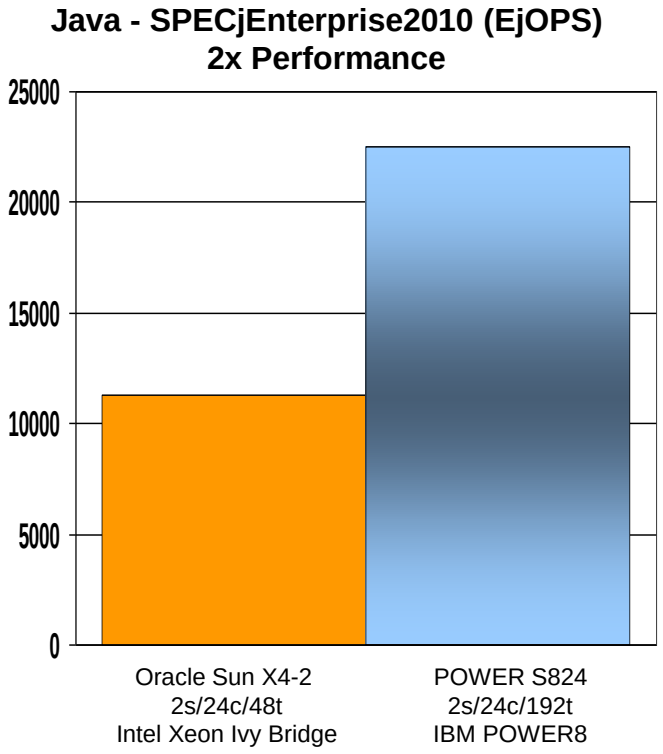
S824 (1 or 2 socket)

6-core	3.8 GHz	72,000
12-core	3.8 GHz	130,000
8-core	4.1 GHz	94,500
16-core	4.1 GHz	173,500
12-core	1-socket not offered	
24-core	3.5 GHz	230,500

POWER8 Delivers up to TWICE the performance across key workloads

POWER8





1) Results are based on best published results on Xeon E5-2697 v2 from the top 5 Intel system vendors.
2) SAP results are based on the two-tier SAP SD standard application benchmark running SAP enhancement package 5 for the SAP ERP 6.0 application. Results valid as of April 28, 2014. Source: http://www.sap.com/benchmark
3) SPECjEnterprise2010 results are valid as of 4/22/2014. For more information go to http://www.specbench.org/jEnterprise2010/results/
4) SPECcpu2006 results are submitted as of 4/22/2014. For more information go to http://www.specbench.org/cpu2006/results/

Power Systems

● Standard
◙ Optional
– Not Available

IBM

RAS Feature Overview

RAS Item	POWER7+ 710 / 730	POWER7+ 720 / 740	POWER8 models
Redundant / Hot Swap Fans & Blowers	•	•	•
Hot Swap DASD & Media	•	•	•
Hot Swap PCI Adapters	–	–	•
Concurrent Firmware Update	•	•	•
Redundant / Hot Swap Power Supplies	•	•	•
Dual disk controllers (split backplane)	–	◙	◙
Processor Instruction Retry	•	•	•
Alternate Processor Recovery	•	•	•
Storage Keys	•	•	•
PowerVM™/Live Part. Mobility/Live App Mobility	◙	◙	◙
Dynamic Processor Sparing	–	–	–
Redundant Service Processors	–	–	–
Redundant System Clocks	–	–	–
Hot GX Adapter Add and Cold Repair	–	–	N/A
Dynamic Service Processor &System Clock Failover	–	–	–
Enterprise Memory (Memory Sparing)	–	–	•
Integrated TPMD Function	–	–	•
Hot GX Adapter Repair	–	–	N / A
Active Memory Mirroring for Hypervisor	–	–	–
Power Pools	–	–	–
Dynamic Processor Sparing	–	–	–

IBM i Support for Scale-out Servers

	IBM i 7.1 TR8
POWER8	Supported – adds SMT8, more threads

	IBM i 7.2
POWER8	Supported -- adds SMT8, more cores/partition, more threads

New I/O Announced with Scale-out Servers

- SOD for PCIe3 expansion drawers
  - SOD states will have PCIe Gen3 drawer in future
  - Important planning consideration for clients with lots of I/O.
    - Emphasize multi-port adapters available to virtualize
    - Emphasize bandwidth of Gen3 PCIe slots to virtualize
- Disk/HDD
  - New capacity - 600GB 15k rpm
  - New 4k block drives
- SSD
  - New 1.8-inch 387GB for POWER8 servers SSD cage

Prices are USA list prices for a Power S822 and are subject to change. Reseller prices may vary.

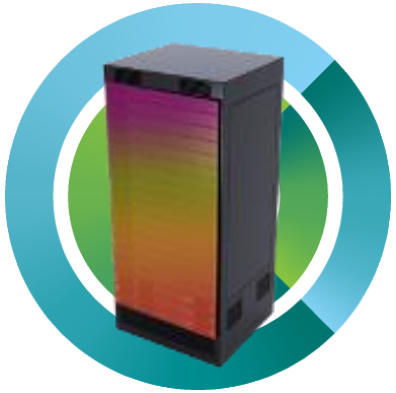
Power Enterprise Systems built on POWER8

Announcing Enterprise Pools on Power 770 & 780 and Statement of Direction for POWER8 support

IBM plans to…

- **Bring POWER8 capability to the full Power Systems portfolio**
  - Deliver the most scalable, highest performing enterprise-class Power System with an advanced version of the POWER8 processor.
- **Provide upgrade paths**
  - From the current POWER7+ Power 770 and 780 servers to enterprise-class POWER8 processor-based servers.
- **Preserve client investment in Power Systems**
  - Enable POWER8 processor-based Power systems to interoperate and share Mobile Capacity on Demand (COD) resources with POWER7/7+ processor-based Power systems in a single Power Enterprise Pool.

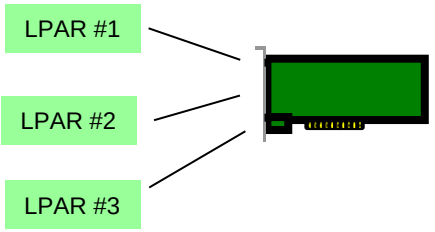
POWER8 Enterprise Systems



- **Architectural strengths of Power 795**
- **Modularity & efficiencies of Power 770/780**
- **Performance and innovation of POWER8**
- **Greater Scalability & Reliability**
- **Increased Efficiency (Space, Energy)**

SR-IOV

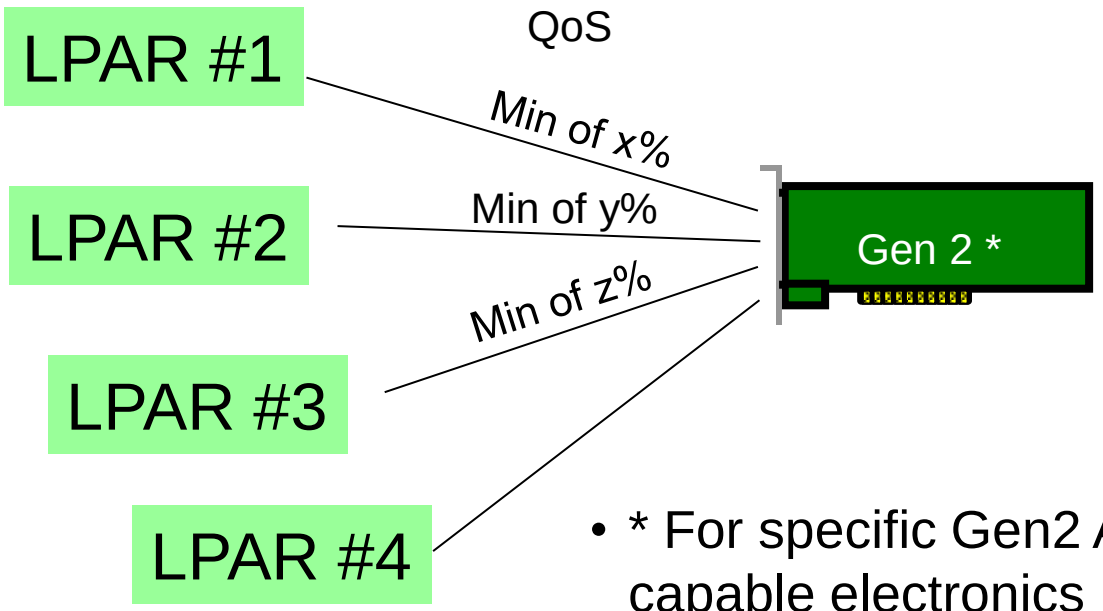
SR-IOV …. A Technology of Interest



- Single Root I/O Virtualization
- Runs “closer to the silicon” potentially offering some performance efficiencies
- Doesn’t require VIOS as a pre-req and thus can do simple virtualization under PowerVM without VIOS …. **BUT** …. VIOS continues to offer many additional advanced functions
- Architecturally can virtualize a resource like an Ethenet adapter and allocate/provide a user-defined minimum level of bandwidth to a partition … Quality of Service (QoS)
- Ethernet NIC announced. FCoE and FC not announced.
- **Can use VIOS & SR-IOV together**

SR-IOV (Single Root I/O Virtualization) for Ethernet NIC

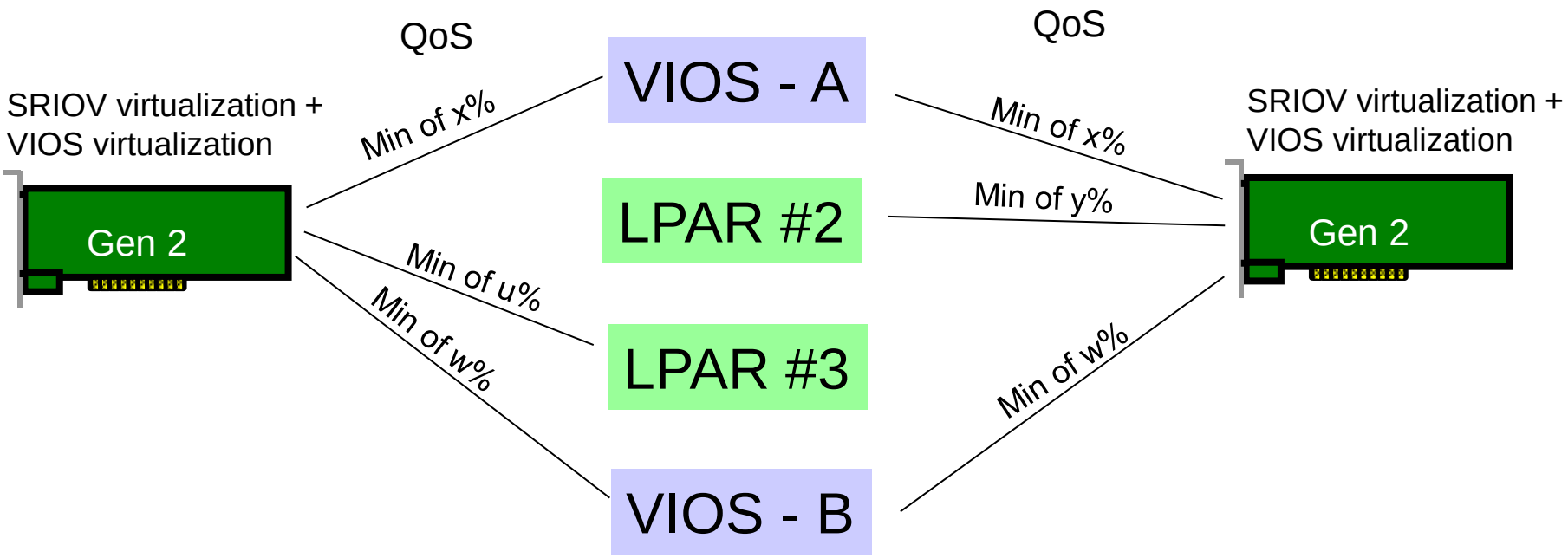
- Simple virtualization without VIOS
- With quality of service controls



- * For specific Gen2 Adapters with SR-IOV capable electronics In PCIe Gen2 (or later) slot
- For specific Integrated Multifunction Cards with SR-IOV capable electronics
- Under latest 7.8 firmware
- With recent OS level software

SR-IOV (Single Root I/O Virtualization) Dual VIOS

- Redundant VIOS with redundant hardware resource
- Minimum amount of bandwidth for Quality of Service (QoS)



SR-IOV and POWER8 Servers

- No announcement or SOD was issued for SR-IOV function in April 2014

- However, this capability is being worked on by IBM development. No architectural problems are known. The only known challenge is working it into busy test schedules and ensuring things are tuned properly on the POWER8 PCIe Gen3 slots

- Note that SR-IOV requires an HMC

A New Generation of IBM Power Systems

Designed for Big Data

Superior Cloud Economics

Open Innovation Platform

Call your IBM representative and visit a local briefing center

Watch the Webcast "Open Innovation to Put Data to Work"

Contact your IBM Business Partner and tap into IBM's ecosystem resources

Learn more at ibm.com/power

Q & A

Power Systems

Open innovation to put data to work

Special notices

This document was developed for IBM offerings in the United States as of the date of publication. IBM may not make these offerings available in other countries, and the information is subject to change without notice. Consult your local IBM business contact for information on the IBM offerings available in your area.

Information in this document concerning non-IBM products was obtained from the suppliers of these products or other public sources. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

IBM may have patents or pending patent applications covering subject matter in this document. The furnishing of this document does not give you any license to these patents. Send license inquires, in writing, to IBM Director of Licensing, IBM Corporation, New Castle Drive, Armonk, NY 10504-1785 USA.

All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

The information contained in this document has not been submitted to any formal IBM test and is provided "AS IS" with no warranties or guarantees either expressed or implied.

All examples cited or described in this document are presented as illustrations of the manner in which some IBM products can be used and the results that may be achieved. Actual environmental costs and performance characteristics will vary depending on individual client configurations and conditions.

IBM Global Financing offerings are provided through IBM Credit Corporation in the United States and other IBM subsidiaries and divisions worldwide to qualified commercial and government clients. Rates are based on a client's credit rating, financing terms, offering type, equipment type and options, and may vary by country. Other restrictions may apply. Rates and offerings are subject to change, extension or withdrawal without notice.

IBM is not responsible for printing errors in this document that result in pricing or information inaccuracies.

All prices shown are IBM's United States suggested list prices and are subject to change without notice; reseller prices may vary.

IBM hardware products are manufactured from new parts, or new and serviceable used parts. Regardless, our warranty terms apply.

Any performance data contained in this document was determined in a controlled environment. Actual results may vary significantly and are dependent on many factors including system hardware configuration and software design and configuration. Some measurements quoted in this document may have been made on development-level systems. There is no guarantee these measurements will be the same on generally-available systems. Some measurements quoted in this document may have been estimated through extrapolation. Users of this document should verify the applicable data for their specific environment.

Special notices (cont.)

Notes on benchmarks and values

The IBM benchmarks results shown herein were derived using particular, well configured, development-level and generally-available computer systems. Buyers should consult other sources of information to evaluate the performance of systems they are considering buying and should consider conducting application oriented testing. For additional information about the benchmarks, values and systems tested, contact your local IBM office or IBM authorized reseller or access the Web site of the benchmark consortium or benchmark vendor.

IBM benchmark results can be found in the IBM Power Systems Performance Report at http://www.ibm.com/systems/p/hardware/system_perf.html.

All performance measurements were made with AIX or AIX 5L operating systems unless otherwise indicated to have used Linux. For new and upgraded systems, AIX Version 4.3, AIX 5L or AIX 6 were used. All other systems used previous versions of AIX. The SPEC CPU2006, SPEC2000, LINPACK, and Technical Computing benchmarks were compiled using IBM's high performance C, C++, and FORTRAN compilers for AIX 5L and Linux. For new and upgraded systems, the latest versions of these compilers were used: XL C Enterprise Edition V7.0 for AIX, XL C/C++ Enterprise Edition V7.0 for AIX, XL FORTRAN Enterprise Edition V9.1 for AIX, XL C/C++ Advanced Edition V7.0 for Linux, and XL FORTRAN Advanced Edition V9.1 for Linux. The SPEC CPU95 (retired in 2000) tests used preprocessors, KAP 3.2 for FORTRAN and KAP/C 1.4.2 from Kuck & Associates and VAST-2 v4.01X8 from Pacific-Sierra Research. The preprocessors were purchased separately from these vendors. Other software packages like IBM ESSL for AIX, MASS for AIX and Kazushige Goto's BLAS Library for Linux were also used in some benchmarks.

For a definition/explanation of each benchmark and the full list of detailed results, visit the Web site of the benchmark consortium or benchmark vendor.

TPC	http://www.tpc.org
SPEC	http://www.spec.org
LINPACK	http://www.netlib.org/benchmark/performance.pdf
Pro/E	http://www.proe.com
GPC	http://www.spec.org/gpc
NotesBench	http://www.notesbench.org
VolanoMark	http://www.volano.com
STREAM	http://www.cs.virginia.edu/stream/
SAP	http://www.sap.com/benchmark/
Oracle Applications	http://www.oracle.com/apps_benchmark/
PeopleSoft - To get information on PeopleSoft benchmarks, contact PeopleSoft directly	
Siebel	http://www.siebel.com/crm/performance_benchmark/index.shtm
Baan	http://www.ssaglobal.com
Microsoft Exchange	http://www.microsoft.com/exchange/evaluation/performance/default.asp
Veritest	http://www.veritest.com/clients/reports
Fluent	http://www.fluent.com/software/fluent/index.htm
TOP500 Supercomputers	http://www.top500.org/
Ideas International	http://www.ideasinternational.com/benchmark/bench.html
Storage Performance Council	http://www.storageperformance.org/results

Revised January 15, 2008

Notes on HPC benchmarks and values

The IBM benchmarks results shown herein were derived using particular, well configured, development-level and generally-available computer systems. Buyers should consult other sources of information to evaluate the performance of systems they are considering buying and should consider conducting application oriented testing. For additional information about the benchmarks, values and systems tested, contact your local IBM office or IBM authorized reseller or access the Web site of the benchmark consortium or benchmark vendor.

IBM benchmark results can be found in the IBM Power Systems Performance Report at http://www.ibm.com/systems/p/hardware/system_perf.html.

All performance measurements were made with AIX or AIX 5L operating systems unless otherwise indicated to have used Linux. For new and upgraded systems, AIX Version 4.3 or AIX 5L were used. All other systems used previous versions of AIX. The SPEC CPU2000, LINPACK, and Technical Computing benchmarks were compiled using IBM's high performance C, C++, and FORTRAN compilers for AIX 5L and Linux. For new and upgraded systems, the latest versions of these compilers were used: XL C Enterprise Edition V7.0 for AIX, XL C/C++ Enterprise Edition V7.0 for AIX, XL FORTRAN Enterprise Edition V9.1 for AIX, XL C/C++ Advanced Edition V7.0 for Linux, and XL FORTRAN Advanced Edition V9.1 for Linux. The SPEC CPU95 (retired in 2000) tests used preprocessors, KAP 3.2 for FORTRAN and KAP/C 1.4.2 from Kuck & Associates and VAST-2 v4.01X8 from Pacific-Sierra Research. The preprocessors were purchased separately from these vendors. Other software packages like IBM ESSL for AIX, MASS for AIX and Kazushige Goto's BLAS Library for Linux were also used in some benchmarks.

For a definition/explanation of each benchmark and the full list of detailed results, visit the Web site of the benchmark consortium or benchmark vendor.

SPEC	http://www.spec.org
LINPACK	http://www.netlib.org/benchmark/performance.pdf
Pro/E	http://www.proe.com
GPC	http://www.spec.org/gpc
STREAM	http://www.cs.virginia.edu/stream/
Veritest	http://www.veritest.com/clients/reports
Fluent	http://www.fluent.com/software/fluent/index.htm
TOP500 Supercomputers	http://www.top500.org/
AMBER	http://amber.scripps.edu/
FLUENT	http://www.fluent.com/software/fluent/fl5bench/index.htm
GAMESS	http://www.msg.chem.iastate.edu/gamess
GAUSSIAN	http://www.gaussian.com
ABAQUS	http://www.abaqus.com/support/sup_tech_notes64.html select Abaqus v6.4 Performance Data
ANSYS	http://www.ansys.com/services/hardware_support/index.htm select "Hardware Support Database", then benchmarks.
ECLIPSE	http://www.sis.slb.com/content/software/simulation/index.asp?seg=geoquest&
MM5	http://www.mmm.ucar.edu/mm5/
MSC.NASTRAN	http://www.mscsoftware.com/support/prod%5Fsupport/nastran/performance/v04_sngl.cfm
STAR-CD	www.cd-adapco.com/products/STAR-CD/performance/320/index/html
NAMD	http://www.ks.uiuc.edu/Research/namd
HMMER	http://hmmer.janelia.org/ http://powerdev.osuosl.org/project/hmmerAltivecGen2mod

Revised January 15, 2008

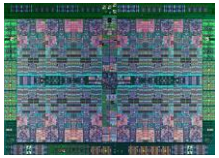
Notes on performance estimates

- **rPerf for AIX**
- **rPerf (Relative Performance) is an estimate of commercial processing performance relative to other IBM UNIX systems. It is derived from an IBM analytical model which uses characteristics from IBM internal workloads, TPC and SPEC benchmarks. The rPerf model is not intended to represent any specific public benchmark results and should not be reasonably used in that way. The model simulates some of the system operations such as CPU, cache and memory. However, the model does not simulate disk or network I/O operations.**
- **rPerf estimates are calculated based on systems with the latest levels of AIX and other pertinent software at the time of system announcement. Actual performance will vary based on application and configuration specifics. The IBM eServer pSeries 640 is the baseline reference system and has a value of 1.0. Although rPerf may be used to approximate relative IBM UNIX commercial processing performance, actual system performance may vary and is dependent upon many factors including system hardware configuration and software design and configuration. Variations in incremental system performance may be observed in commercial workloads due to changes in the underlying system architecture.**
- **All performance estimates are provided "AS IS" and no warranties or guarantees are expressed or implied by IBM. Buyers should consult other sources of information, including system benchmarks, and application sizing guides to evaluate the performance of a system they are considering buying. For additional information about rPerf, contact your local IBM office or IBM authorized reseller.**
- **==========**
- **CPW for IBM i**
- **Commercial Processing Workload (CPW) is a relative measure of performance of processors running the IBM i operating system. Performance in customer environments may vary. The value is based on maximum configurations. More performance information is available in the Performance Capabilities Reference at: www.ibm.com/systems/i/solutions/perfmgmt/resource.html**

Revised April 2, 2007

POWER8 – A signature moment in the industry

- **POWER8 is a transformational technology**
  - Designed for data and analytics, delivering significantly more performance than x86
  - Delivering cloud efficiencies
  - Open innovation
- **Launching the first POWER8 systems: the best Scale-out systems in the industry**
  - Linux on Power – a new approach
- **System Software: Delivering the intelligent IT infrastructure to support Cloud, Big Data, Analytics & Mobile**
  - Opening up the world of Linux
  - New value in System Software stack
- **Solutions – Open innovation that matters**
  - Can your infrastructure do this? (50x, 25x, ….)
  - Expanded portfolio of applications
  - Optimized solutions for CAMS
  - Data, Analytics, Java, a client's Linux solution
- **Enterprise Pools – transforming Enterprise IT for the Cloud**



* Claims are being validated prior to launch

47