Journée Common - Geneve Dec 2013

IBM Power Systems
Trends & Direction

Beyond Power7

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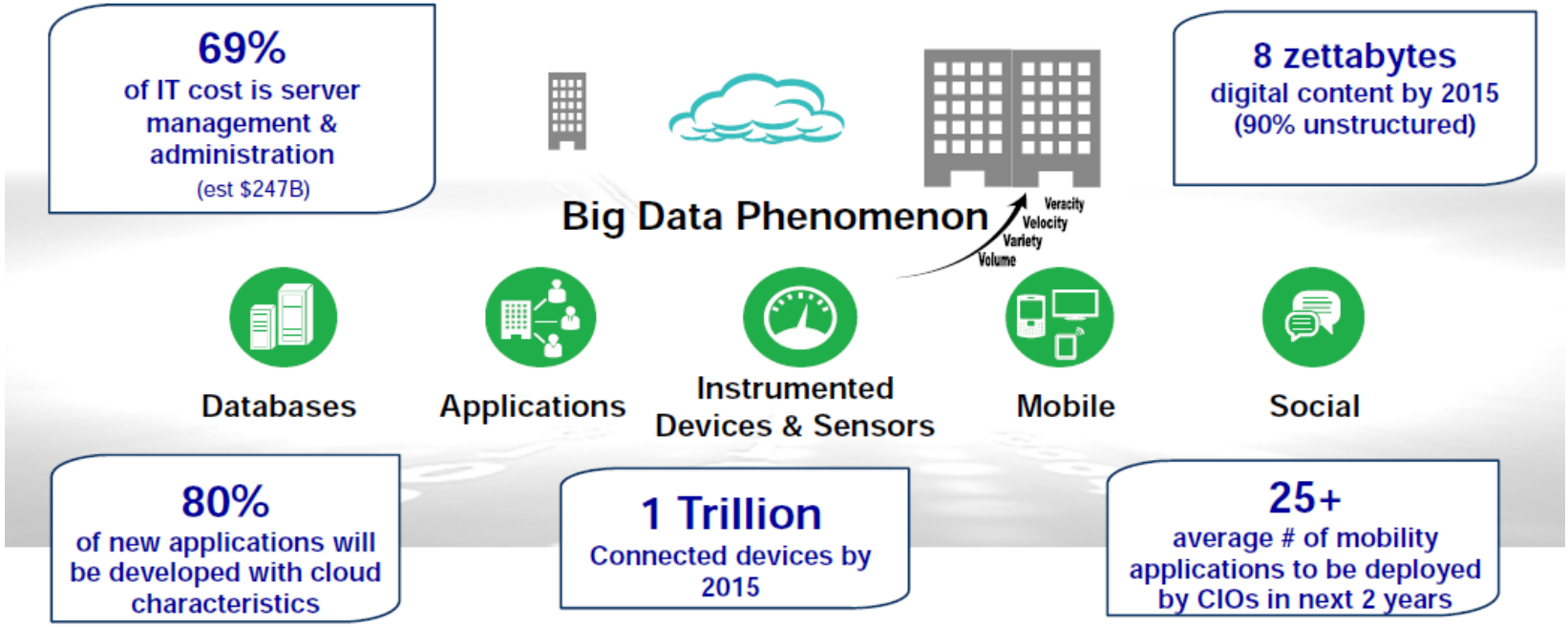
Business-needs and Workloads are Transforming

Driving infrastructure transformation



1 ZB = 1000000000000000000000bytes = 1000^7bytes = 10^{21}bytes = 1000exabytes = 1 billion terabytes

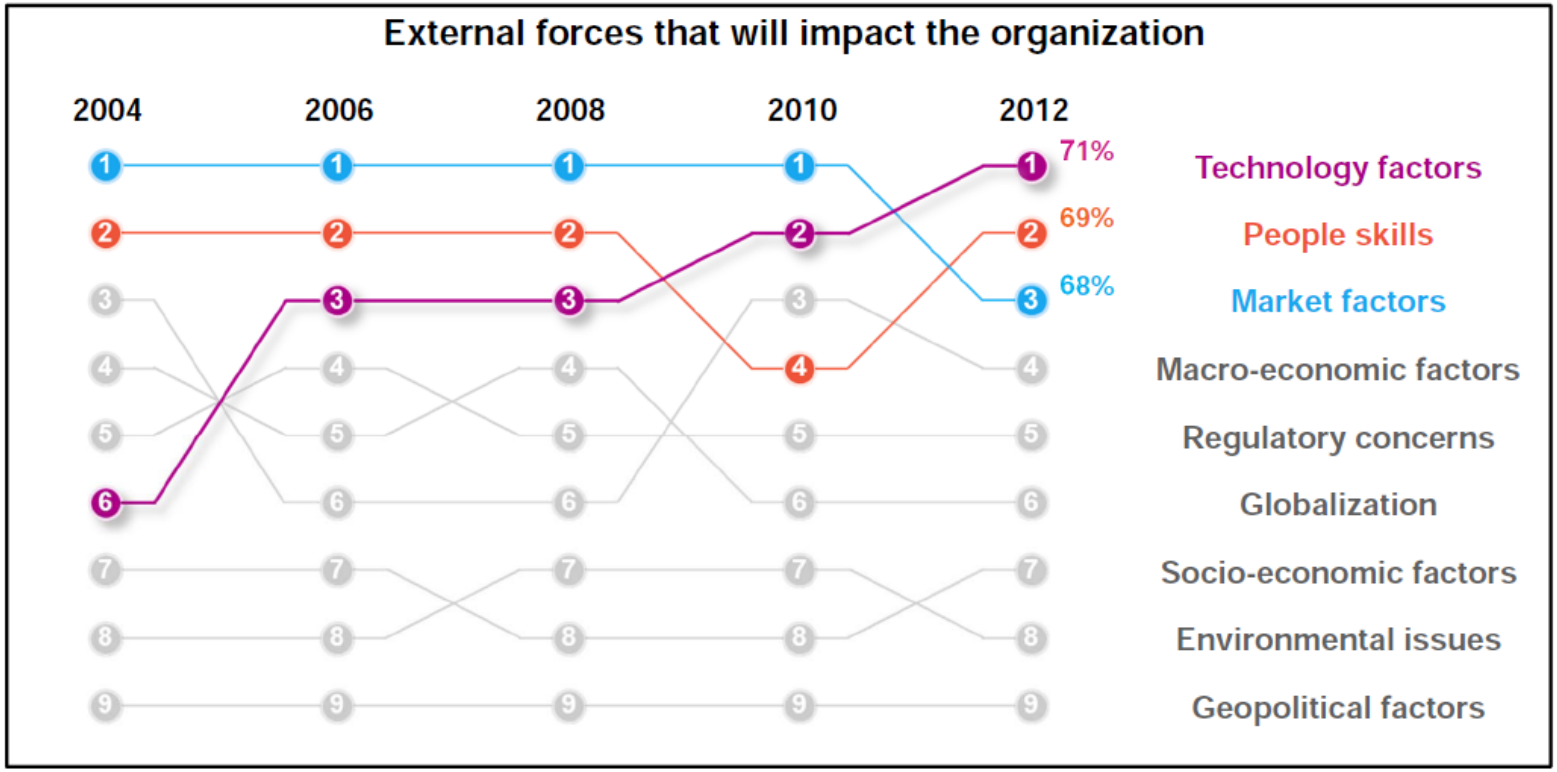
Multiples of bytes									V · T · E
Decimal				Binary					
Value		Metric		Value		JEDEC		IEC	
1000	kB	kilobyte		1024	KB	Kilobyte	KiB	kibibyte	
1000^2	MB	megabyte		1024^2	MB	Megabyte	MiB	mebibyte	
1000^3	GB	gigabyte		1024^3	GB	Gigabyte	GiB	gibibyte	
1000^4	TB	terabyte		1024^4	TB	Terabyte	TiB	tebibyte	
1000^5	PB	petabyte		1024^5			PiB	pebibyte	
1000^6	EB	exabyte		1024^6			EiB	exbibyte	
1000^7	ZB	**zettabyte**		1024^7			ZiB	zebibyte	
1000^8	YB	yottabyte		1024^8			YiB	yobibyte	

Client Business needs have evolved

- Data-driven insights
- Flexible, responsive IT environment
- Secure from external and internal threats
- Simplified end user experience
- Compelling ROI

Technology: critical to the success of the business

- **For the first time, CEOs identify technology as the most important external force impacting their organizations**

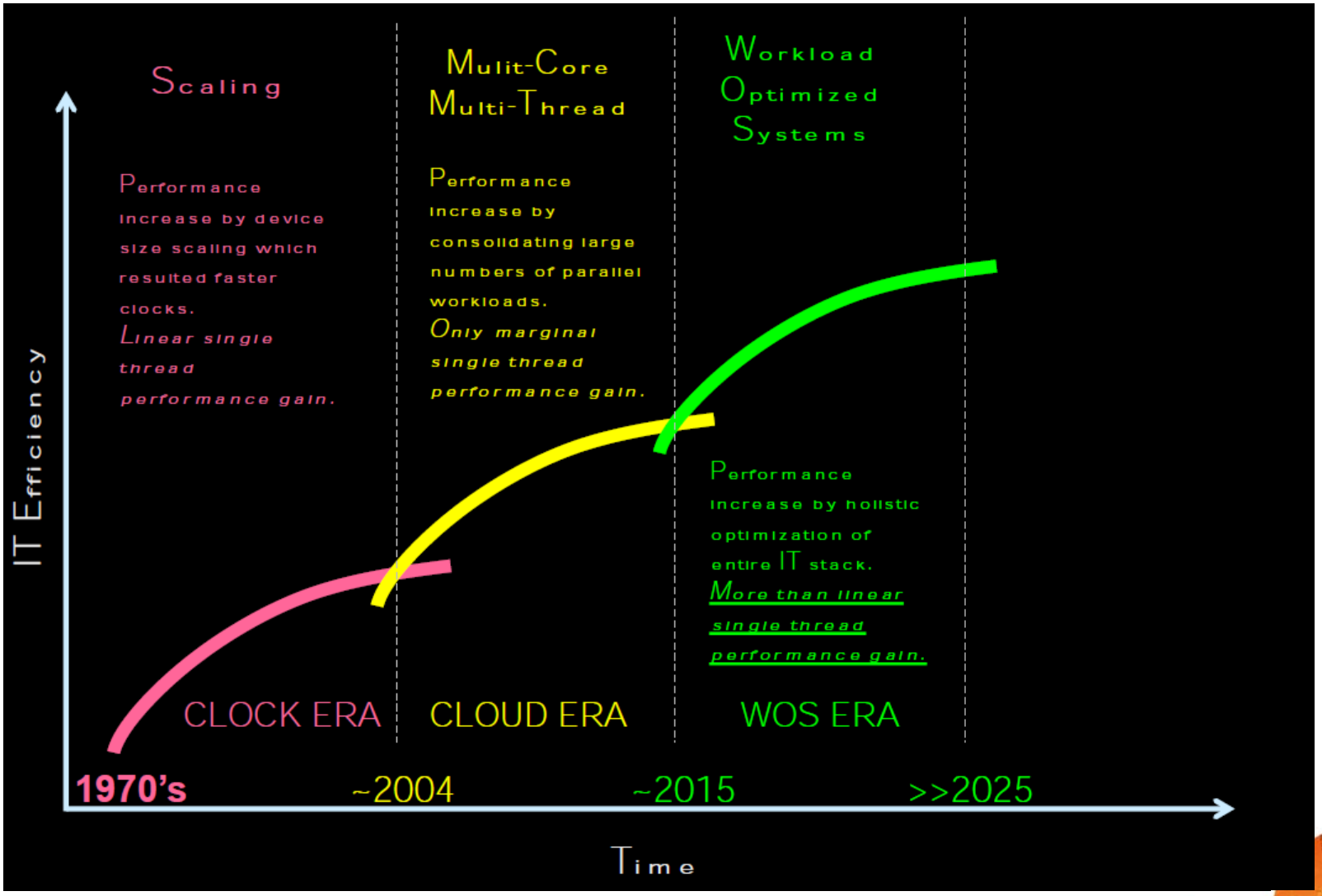


Source: Q1 IBM CEO study 2012 "What are the most important external forces that will impact your organization over the next 3 to 5 years?"

Agenda

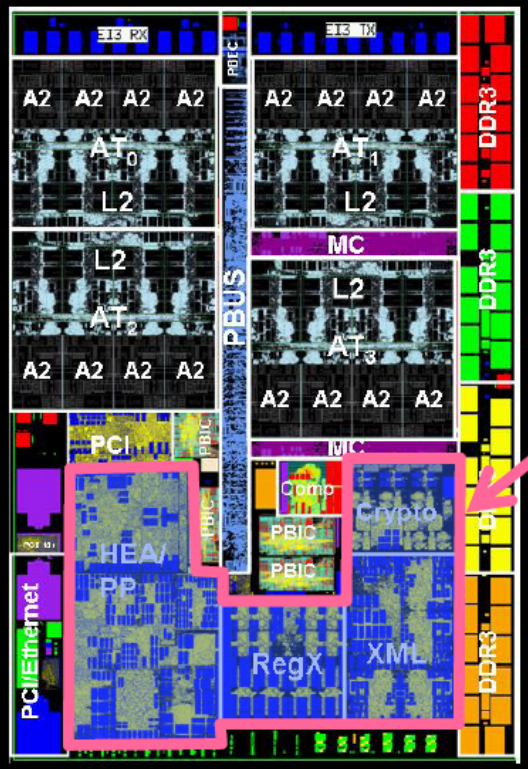
- *POWER Future Technology*
  - *Next Generation Processor*
  - *Information about HighEnd System*
  - *PowerVM Management*
- *New PowerLinux Offering*

IBM vision : To the Workload Optimized Systems ...



Workload Optimized Systems Example

Network Computing with IBM WireSpeed Power Processor



Technology	IBM 45nm SOI
Core Frequency	2.3GHz @ 0.97V (Worst Case Process)
Chip Power (4-AT node) Chip Power (1-AT node)	65W @ 2.0GHz, 0.85V Max Single Chip 20W @ 1.4GHz, 0.77V Min Single Chip
Transistor Count	1.43B
A2 Cores / Threads	16 / 64
Hardware Accelerators	Crypto, Compression, RegX, XML
Intelligent Network Interfaces	Host Ethernet Adapter/Packet Processor 2 Modes: Endpoint & Network
Memory Bandwidth	2x DDR3 controllers 4 Channels @ 800-1600MHz
System I/O Bandwidth	4x 10G Ethernet, 2x PCI Gen2
Chip-to-Chip Bandwidth	3 Links, 20GB/s per link
Chip Scaling	4 Chip SMP

Optimized nodes with specialized network-speed processors
increase performance ~100 times (10'000%) => WOS clearly has a long-term potential.

POWER7+ Processors & Architecture

Faster Performance

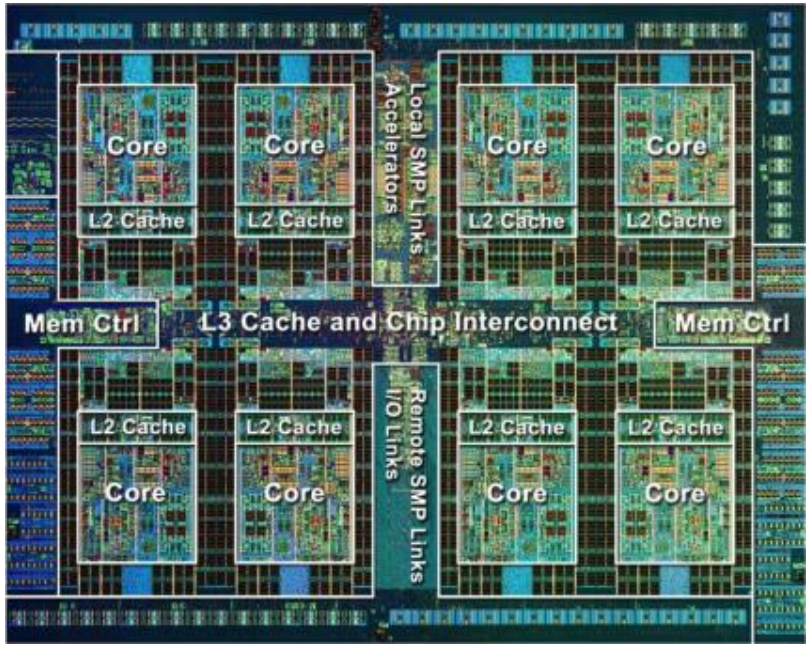
- Higher frequencies
- 80MB L3 Cache (10 MB per core)
- **HW Random number generator**
- **HW encryption accelerator (AIX)**
- Enhanced Single Precision Floating Point

Increased Efficiency and Flexibility

- **HW Memory Expansion accelerator**
- More performance per watt
- Enhanced energy / power gating
- **20 Virtual Machines per core**

Better Availability RAS

- Self-healing capability for L3 Cache functions
- Processor re-initialization

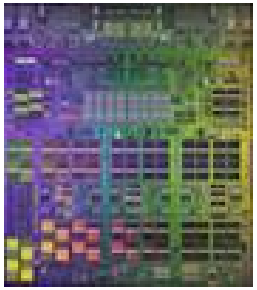


POWER7+
32 nm

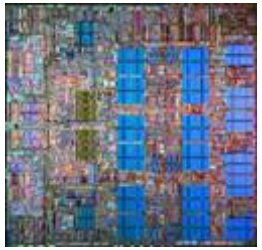
IBM POWER Processor Roadmap

~ 3 Year Revolution

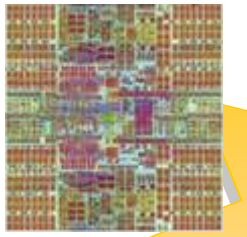
~ 18-24 month "+" Evolution



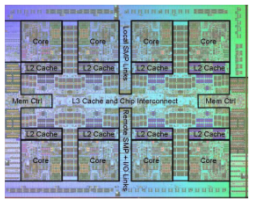
POWER4/4+



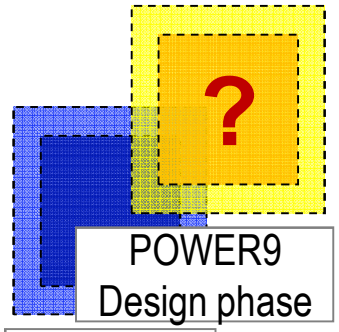
POWER5/5+



POWER6/6+



POWER7/7+



POWER8

First Dual Core in Industry

- Dual Core
- Chip Multi Processing
- Distributed Switch
- Shared L2
- Dynamic LPARs (32)
- 180nm, 130nm

2001

Hardware Virtualization for Unix & Linux

- Dual Core & Quad Core Md
- Enhanced Scaling
- 2 Thread SMT
- Distributed Switch +
- Core Parallelism +
- FP Performance +
- Memory bandwidth +
- 130nm, 90nm

2004

Fastest Processor In Industry

- Dual Core
- High Frequencies
- Virtualization +
- Memory Subsystem +
- Altivec
- Instruction Retry
- Dyn Energy Mgmt
- 2 Thread SMT +
- Protection Keys
- 65nm

2007

Most POWERful & Scalable Processor in Industry

- 4,6,8 Core
- 32MB On-Chip eDRAM
- Power Optimized Cores
- Mem Subsystem ++
- 4 Thread SMT++
- Reliability +
- VSM & VSX
- Protection Keys+
- 45nm

Power 7+ 32nm
Faster
Very large cache
Accelerators

2010

Most POWERful, Scalable and Exclusive Performance

- More Cores
- Larger Cache
- 4th Gen SMT
- Reliability ++
- Accelerators +
- more…
- 22nm

Binary Compatible & Increased Core Performance

POWER8 Processor

Technology

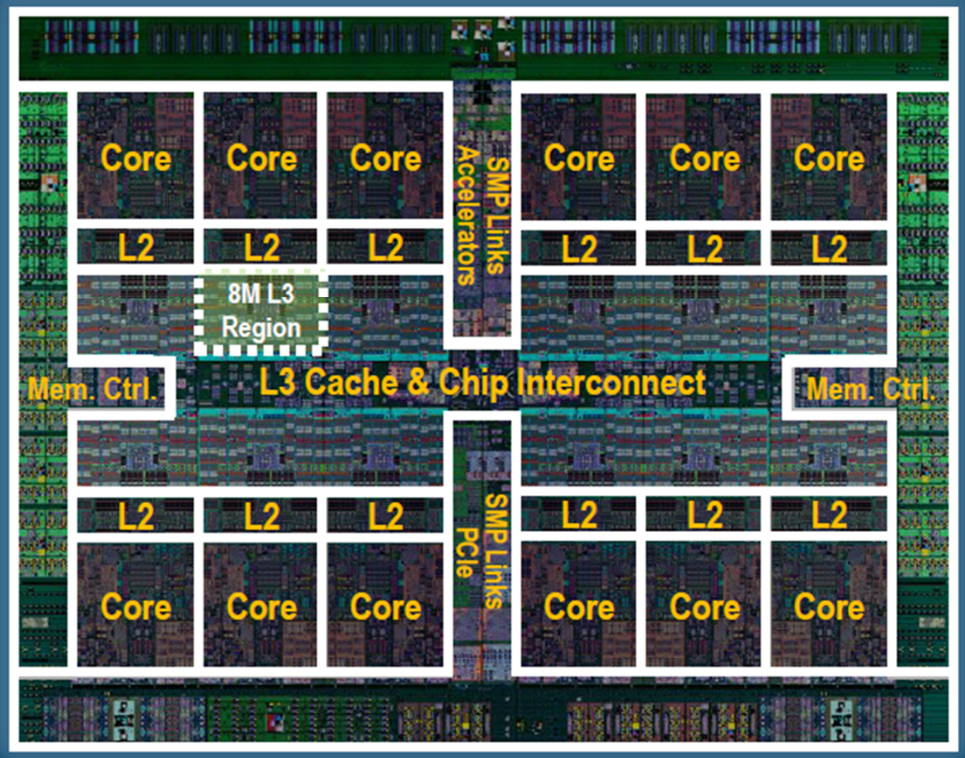
- 22nm SOI, eDRAM, 15 ML 650mm2

Cores

- 12 cores (SMT8)
- 8 dispatch, 10 issue, 16 exec pipe
- 2X internal data flows/queues
- Enhanced prefetching
- 64K data cache, 32K instruction cache

Accelerators

- Crypto & memory expansion
- Transactional Memory
- VMM assist
- Data Move / VM Mobility



Caches

- 512 KB SRAM L2 / core
- 96 MB eDRAM shared L3
- Up to 128 MB eDRAM L4 (off-chip)

Memory

- Up to 230 GB/s sustained bandwidth

Bus Interfaces

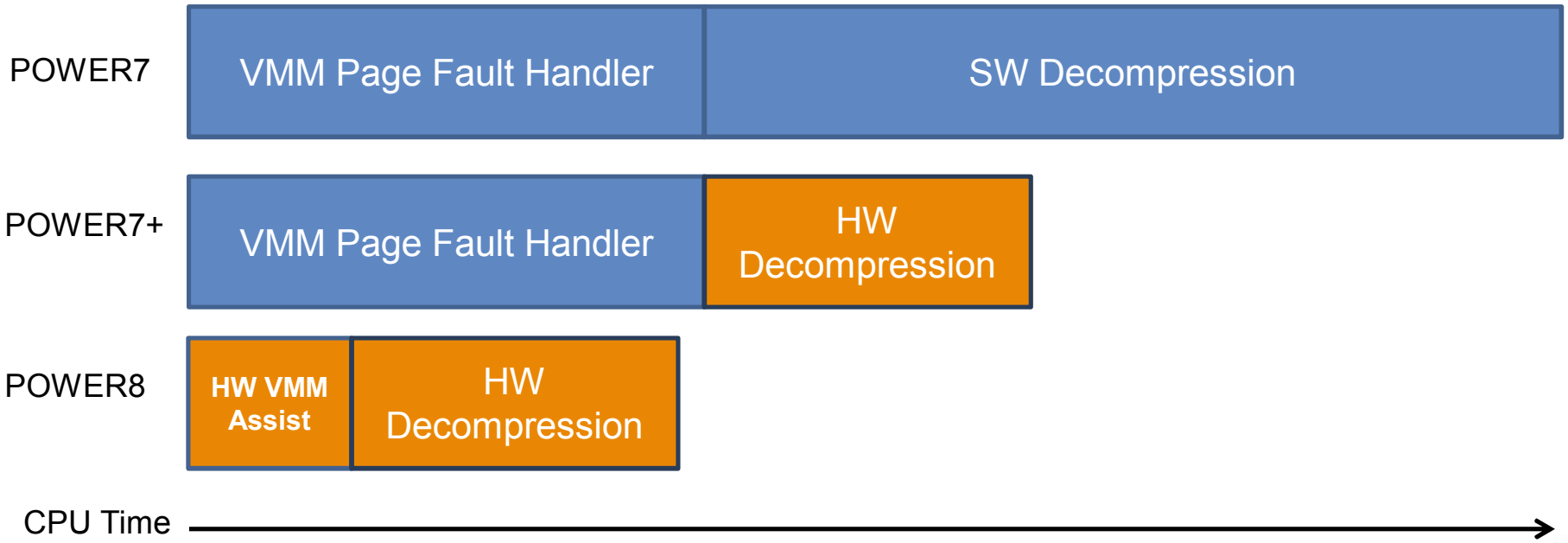
- Durable open memory attach interface
- Integrated PCIe Gen3
- SMP Interconnect
- CAPI (Coherent Accelerator Processor Interface)

Energy Management

- On-chip Power Management Micro-controller
- Integrated Per-core VRM
- Critical Path Monitors

POWER8 - AME Enhanced

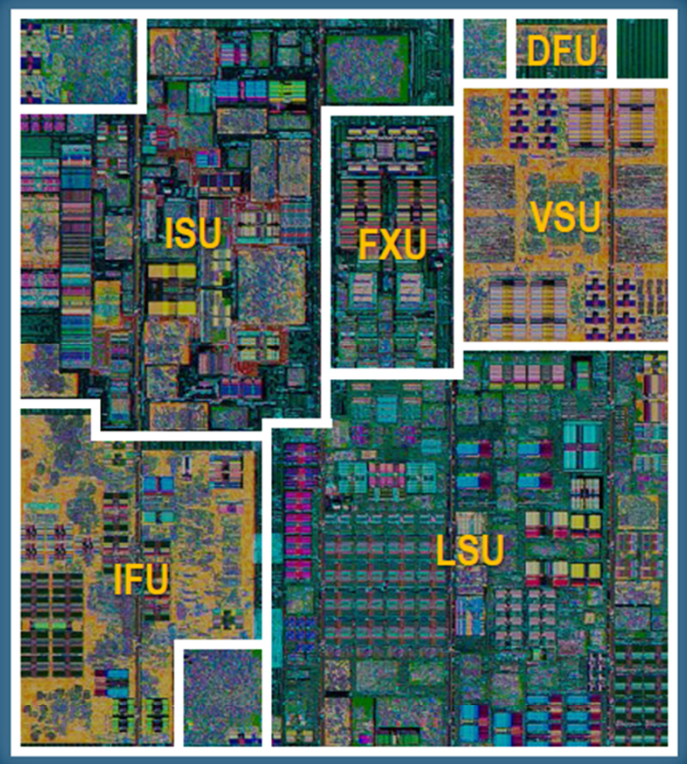
- POWER7+ embedded HW compression accelerator improves by up to 2.1x decompression time
- POWER8 will accelerate VMM with Hardware. This will improve AME and LPM performance.



POWER8 Core

Execution Improvement vs. POWER7

- SMT4 → SMT8
- 8 dispatch
- 10 issue
- 16 execution pipes:
  - 2 FXU, 2 LSU, 2 LU, 4 FPU, 2 VMX, 1 Crypto, 1 DFU, 1 CR, 1 BR
- Larger Issue queues (4 x 16-entry)
- Larger global completion, Load/Store reorder
- Improved branch prediction
- Improved unaligned storage access



Larger Caching Structures vs. POWER7

- 2x L1 data cache (64 KB)
- 2x outstanding data cache misses
- 4x translation Cache

Wider Load/Store

- 32B → 64B L2 to L1 data bus
- 2x data cache to execution dataflow

Enhanced Prefetch

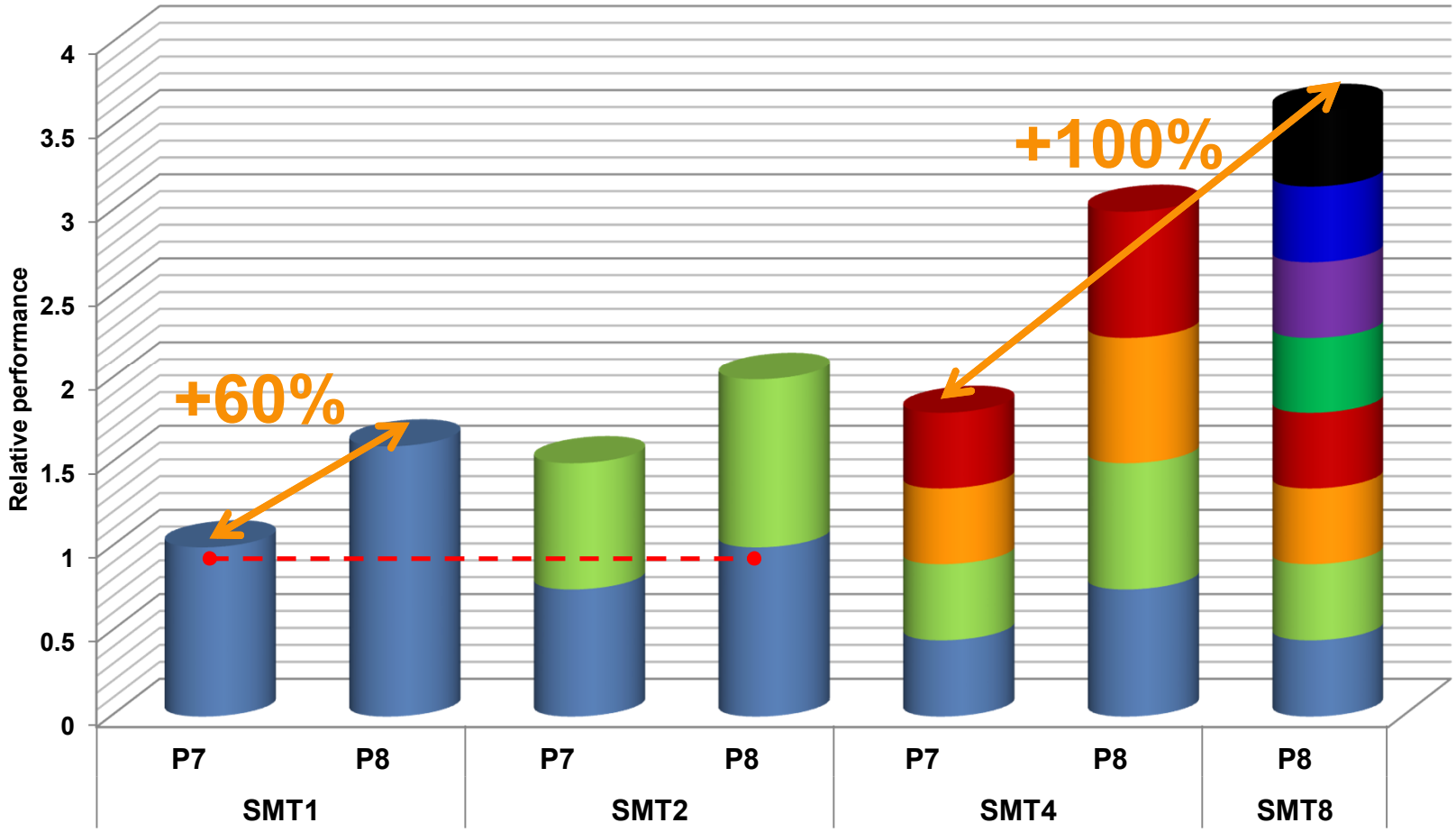
- Instruction speculation awareness
- Data prefetch depth awareness
- Adaptive bandwidth awareness
- Topology awareness

Core Performance vs. POWER7

~1.6x Single Thread

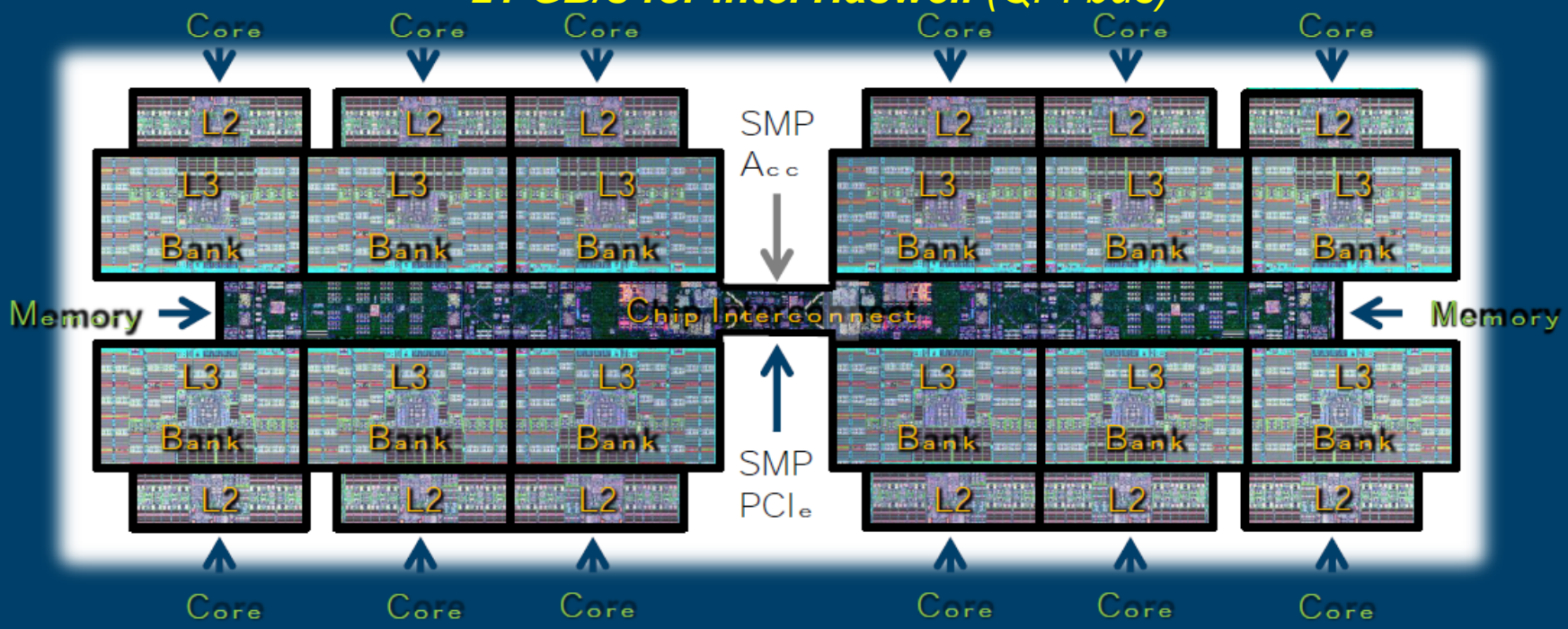
~2x Max SMT

POWER7+ vs POWER8 – SMT performance

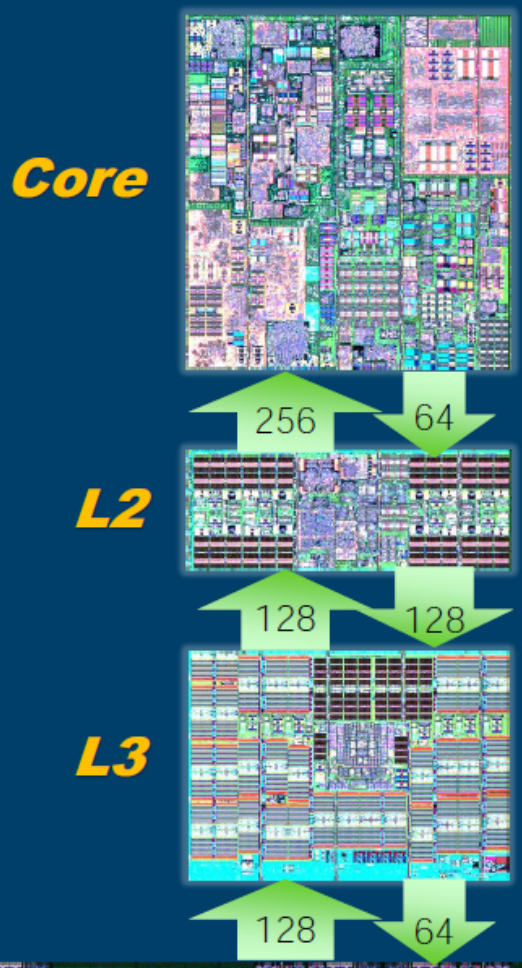


POWER8 On Chip Caches

- L2: 512 KB 8 way per core ***X2 Intel Ivy Bridge & Haswell***
- L3: 96 MB (12 x 8 MB 8 way Bank) ***8MB shared for Intel Ivy Bridge & Haswell***
- "NUCA" Cache policy (Non-Uniform Cache Architecture)
  - Scalable bandwidth and latency
  - Migrate "hot" lines to local L2, then local L3 (replicate L2 contained footprint)
- Chip Interconnect: 150 GB/sec x 12 segments per direction = 3.6 TB/sec
  ~21 GB/s for Intel Haswell *(QPI bus)*

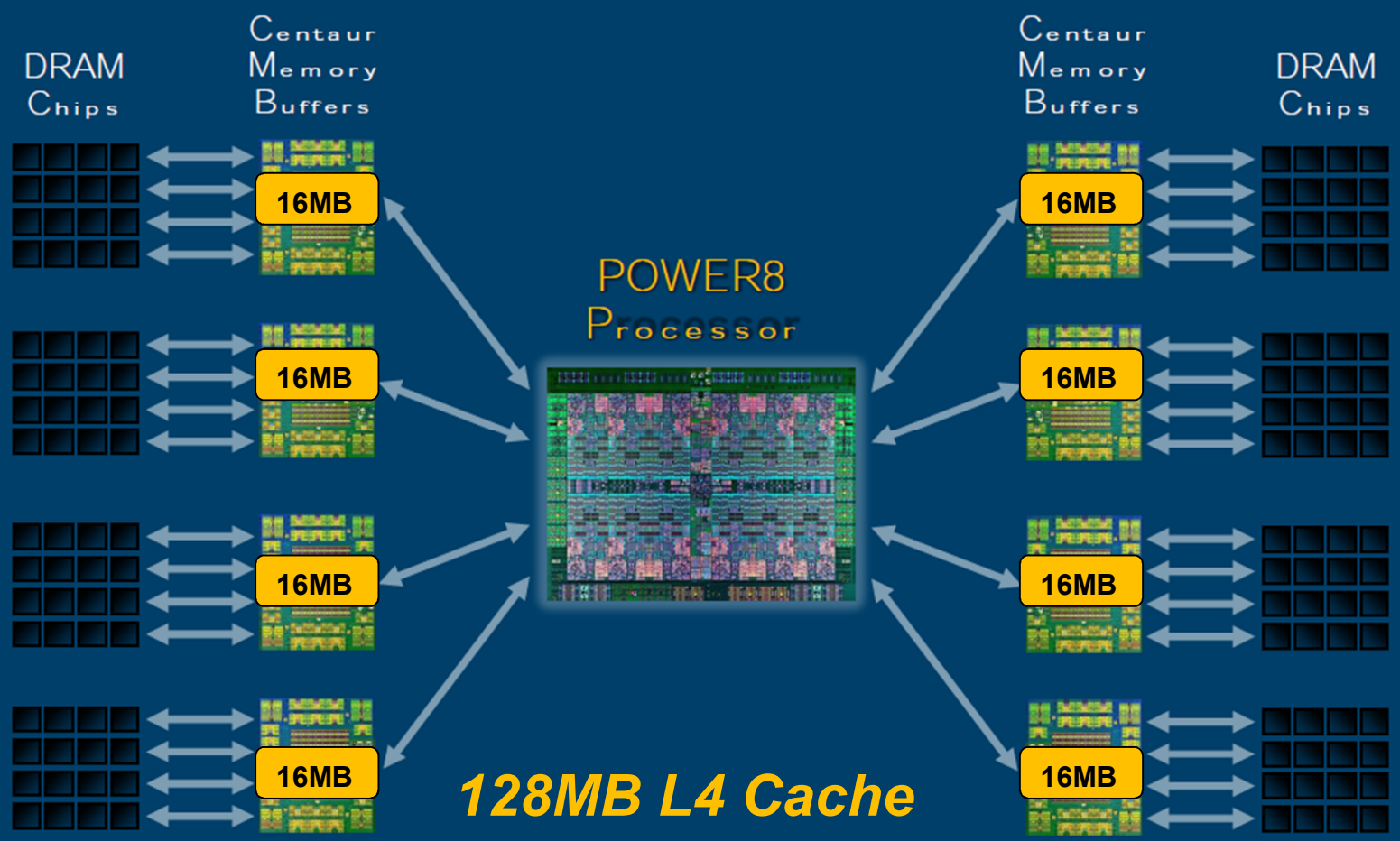


Cache Bandwidths



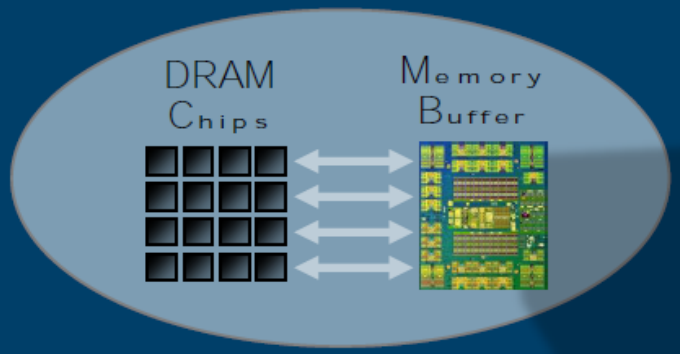
- GB/sec shown assuming 4 GHz
  - Product frequency will vary based on model type
- Across 12 core chip
  - 4 TB/sec L2 BW
  - 3 TB/sec L3 BW

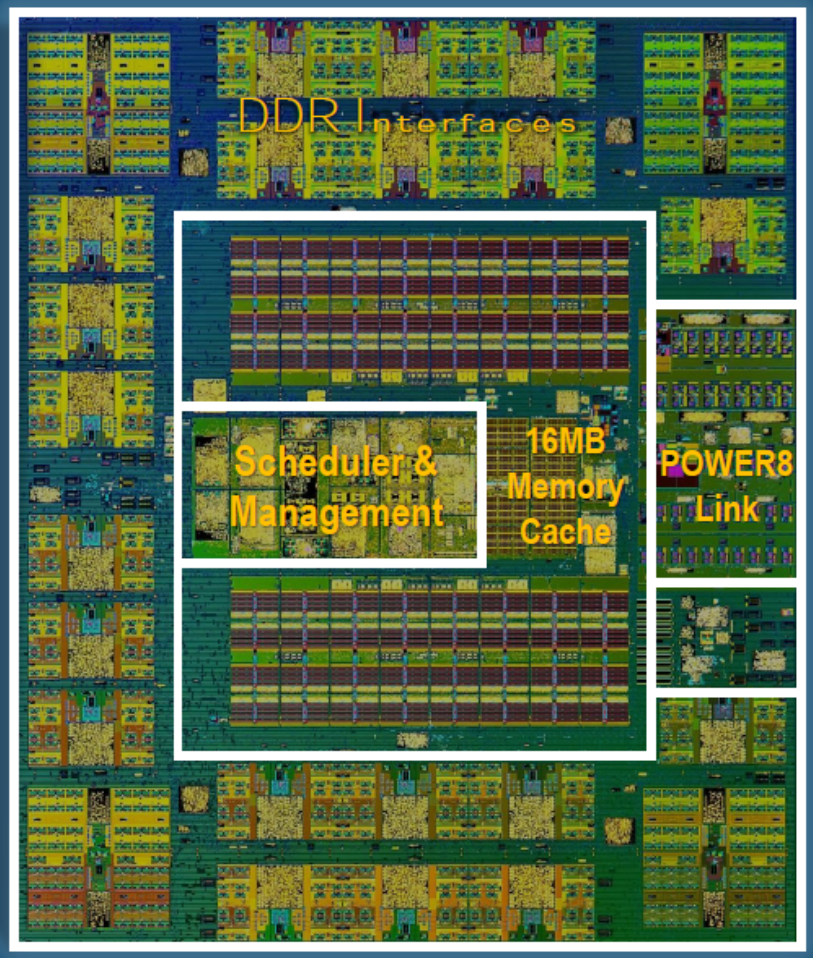
POWER8 Memory Organization



- Up to 8 high speed channels, each running up to 9.6 Gb/s for up to 230 GB/s sustained
- Up to 32 total DDR ports yielding 410 GB/s peak at the DRAM
- Up to 1 TB memory capacity per fully configured processor socket

POWER8 Memory Buffer Chip *…with 16MB of Cache…*





Intelligence Moved into Memory

- Scheduling logic, caching structures
- Energy Mgmt, RAS decision point
  - Formerly on Processor
  - Moved to Memory Buffer

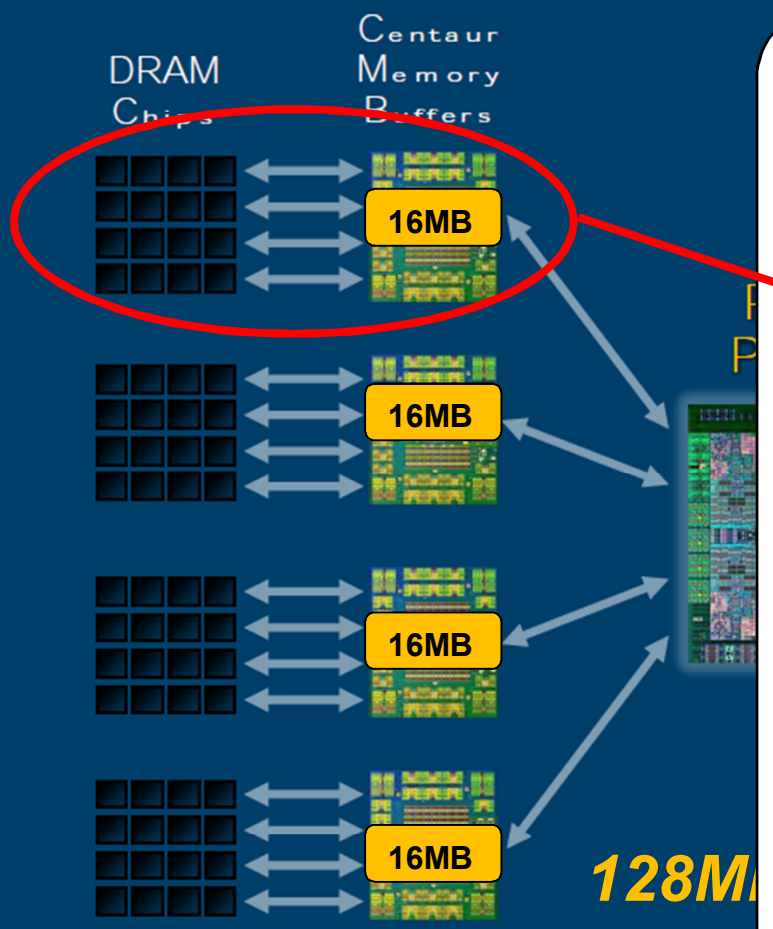
Processor Interface

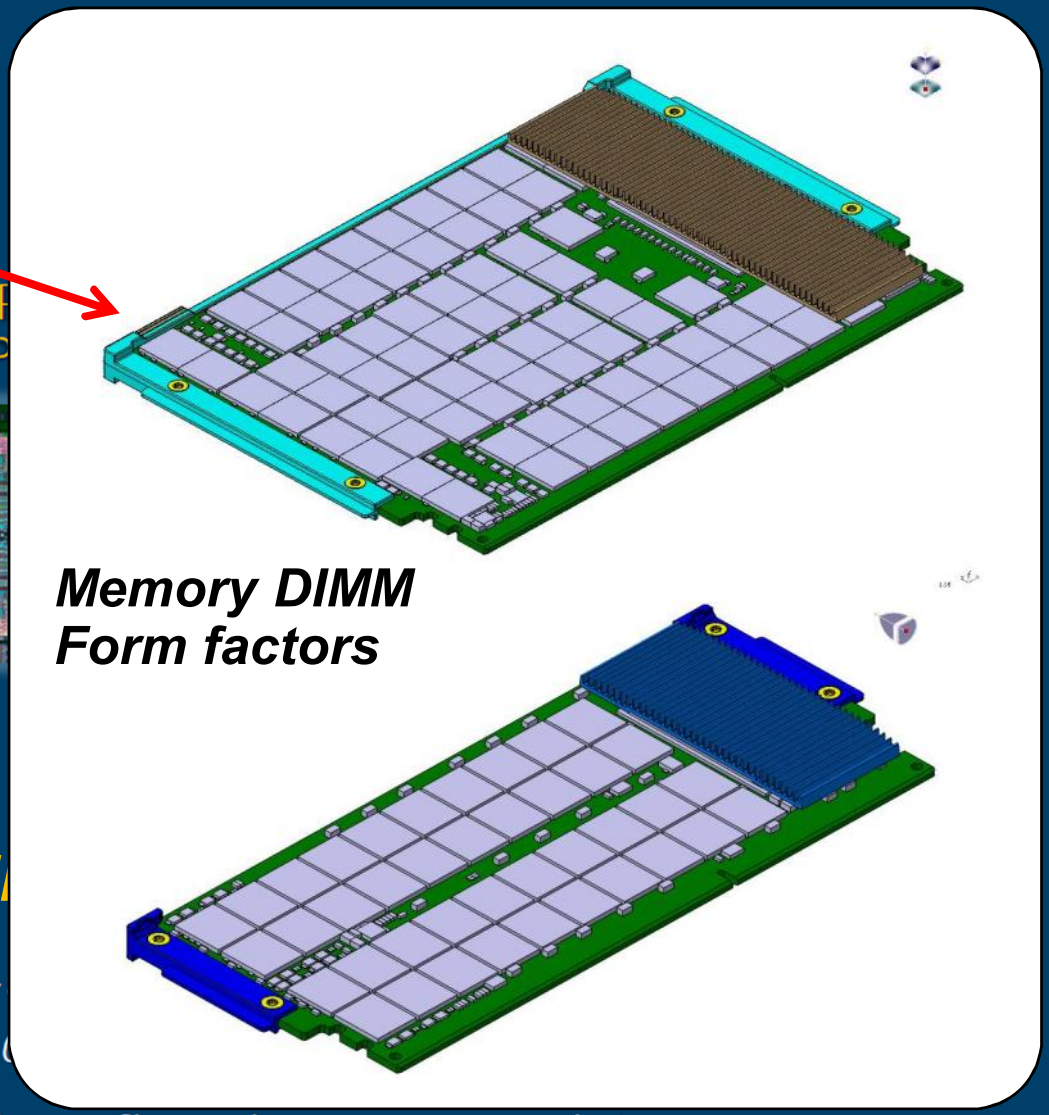
- 9.6 GB/s high speed interface
- More robust RAS
- "On-the-fly" lane isolation/repair
- Extensible for innovation build-out

Performance Value

- End-to-end fastpath and data retry (latency)
- Cache → latency/bandwidth, partial updates
- Cache → write scheduling, prefetch, energy
- 22nm SOI for optimal performance / energy
- 15 metal levels (latency, bandwidth)

POWER8 Memory Organization





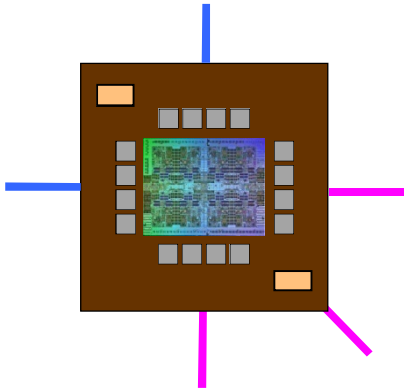
- Up to 8 high speed channels, each r
- Up to 32 total DDR ports yielding 41
- Up to 1 TB memory capacity per fully configured processor socket

POWER: Socket connection

POWER7 Chip

- 3 intra nodes connection per chip
- 2 inter nodes connection per chip
- Up to 8 nodes

=> HighEnd : Max 3 hop interconnect



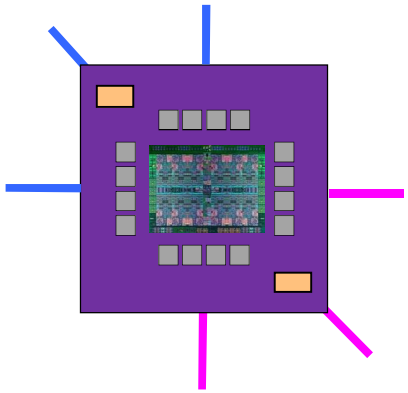
AB bus

XYZ bus

POWER8 Chip

- 3 intra nodes connection per chip
- 3 inter nodes connection per chip
- UP to 4 nodes

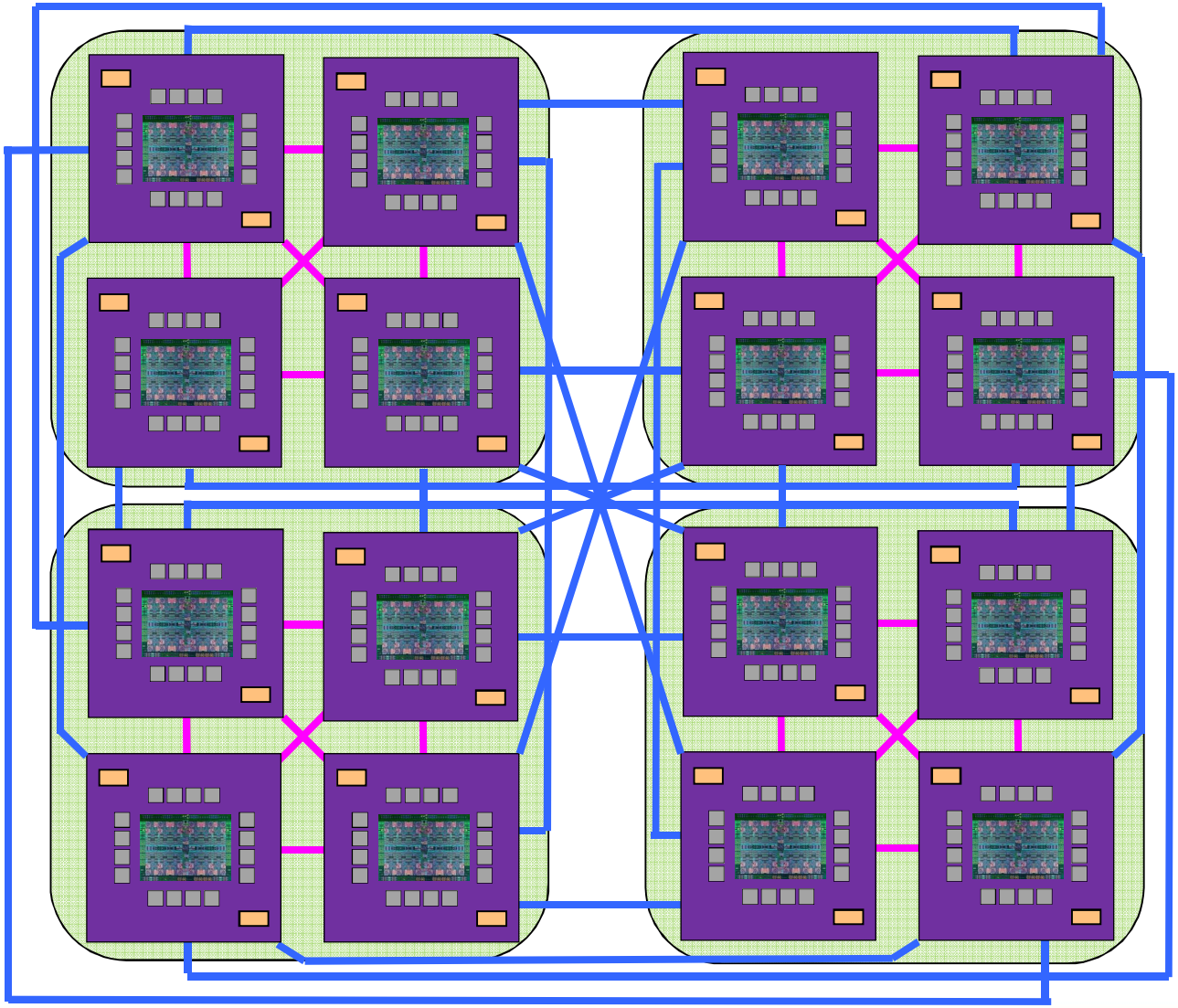
=> HighEnd : Max 2 hop interconnect



ABC bus

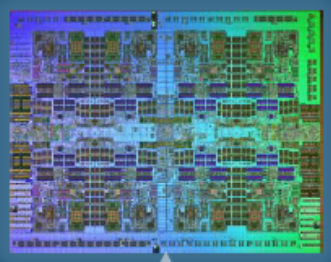
XYZ bus

POWER8 : High End socket/node connection



POWER8 Integrated PCIe Gen 3

POWER7



GX Bus

I/O Bridge

PCIe G2

PCI Device

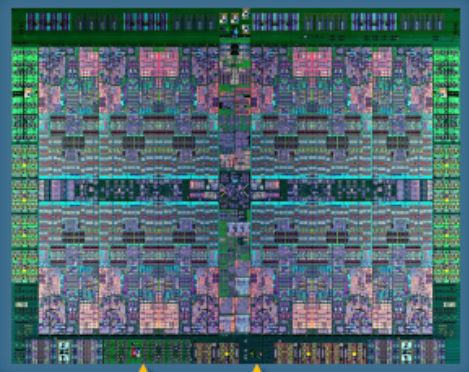
Native PCIe Gen 3 Support

- Direct processor integration
- Replaces proprietary GX/Bridge
- Low latency
- Gen3 x16 bandwidth (16 Gb/s)

Transport Layer for CAPI Protocol

- Coherently Attach Devices connect to processor via PCIe
- Protocol encapsulated in PCIe

POWER8



PCIe G3

PCI Device

POWER8 CAPI Coherent Accelerator Processor Interface

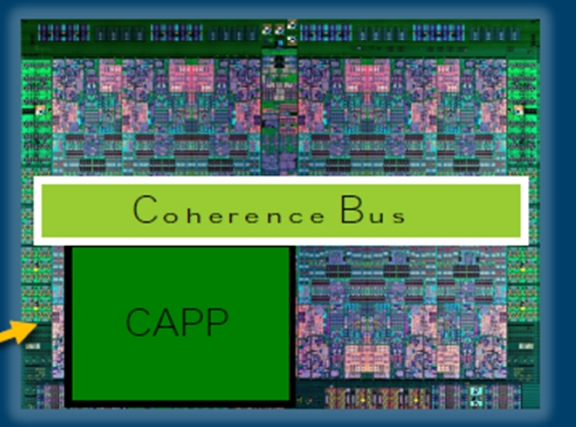
Virtual Addressing

- Accelerator can work with same memory addresses that the processors use
- Pointers de-referenced same as the host application
- Removes OS & device driver overhead

Hardware Managed Cache Coherence

- Enables the accelerator to participate in "Locks" as a normal thread Lowers Latency over IO communication model

POWER8



PCIe Gen 3

Transport for encapsulated messages

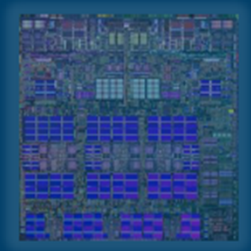
Processor Service Layer (PSL)

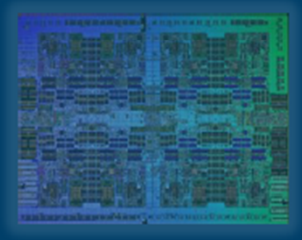
- Present robust, durable interfaces to applications
- Offload complexity / content from CAPP

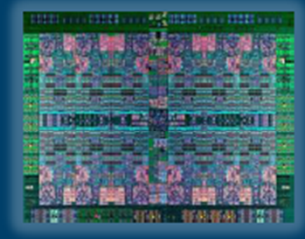
Customizable Hardware Application Accelerator

- Specific system SW, middleware, or user application
- Written to durable interface provided by PSL

POWER8 Innovation

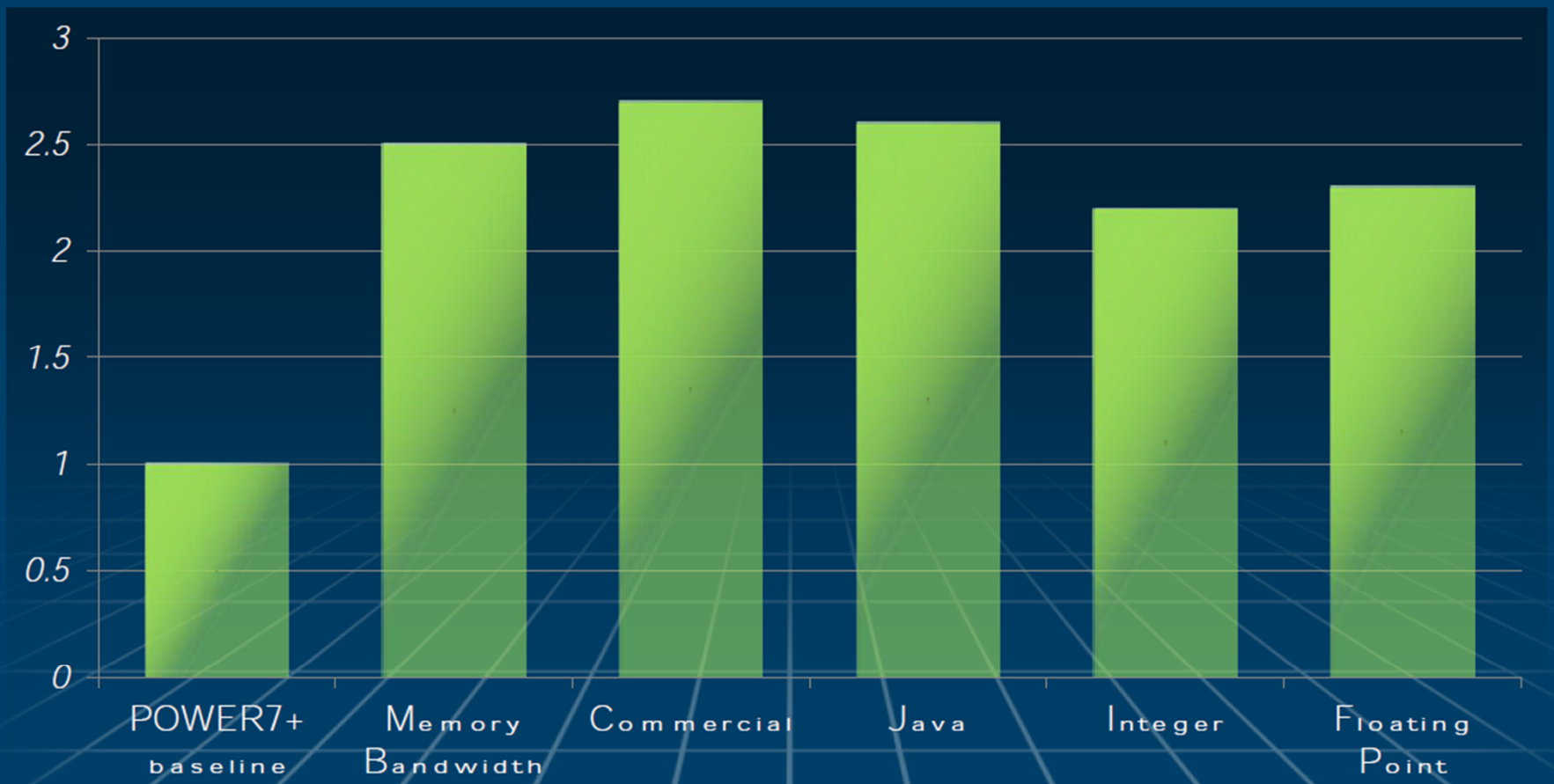






	POWER5 *2004*	POWER6 *2007*	POWER7 *2010*	POWER7+ *2012*	POWER8
Technology	130nm SOI	65nm SOI	45nm SOI eDRAM	32nm SOI eDRAM	22nm SOI eDRAM
Compute					
Cores	2	2	8	8	12
Threads	SMT2	SMT2	SMT4	SMT4	SMT8
Caching					
On-chip	1.9MB	8MB	2 + 32MB	2 + 80MB	6 + 96MB
Off-chip	36MB	32MB	None	None	128MB
Bandwidth					
Sust. Mem.	15GB/s	30GB/s	100GB/s	100GB/s	230GB/s
Peak I/O	6GB/s	20GB/s	40GB/s	40GB/s	96GB/s

Socket Performance



POWER8 Enabling: *…Big Data, Analytics, Cognitive Computing…*

POWER8 Differentiation for Analytics

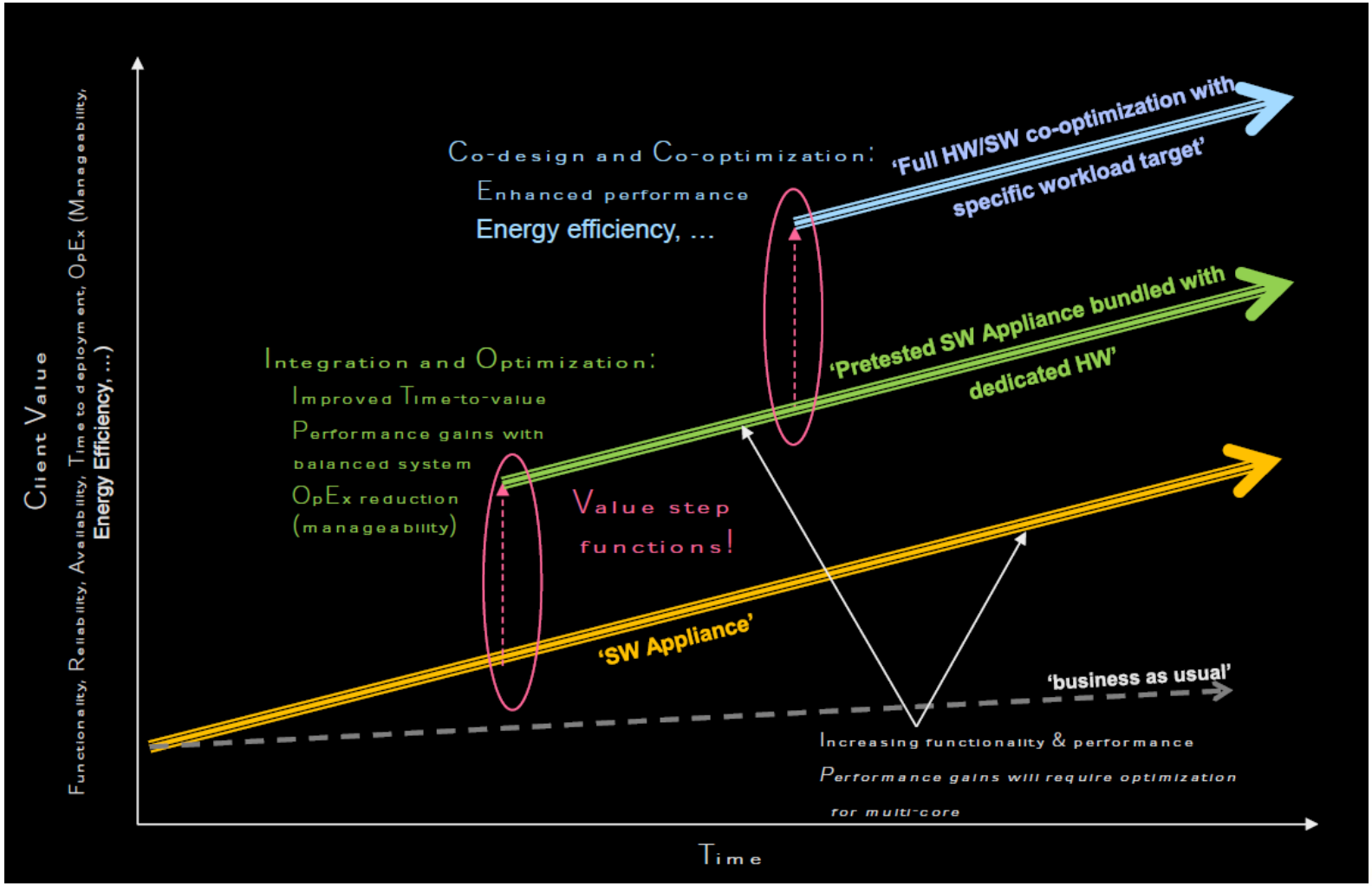
- Massive capacity and bandwidth to memory and IO
- Large caches with massive bandwidth
- Strong Single thread
- SMT8, Many threads to hide memory latency
  - Graph traversals
  - Transactional memory enables efficient thread scaling

CAPI Accelerators

- Enables heterogeneous compute (GPU, FPGA, etc.)

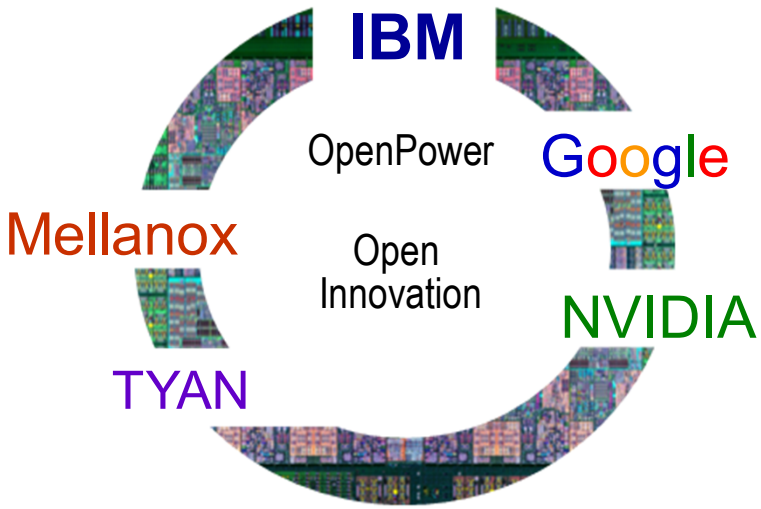
Synergy with IBM Software, Driving Optimization Across the Stack

Client Value Step Functions through Workload Optimization



POWER8… Giving ecosystem partners a license to innovate…

OpenPOWER will enable hyper-scale cloud data centers to rethink their approach to technology.

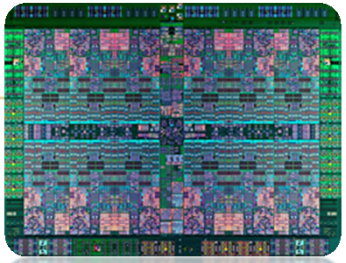


Member companies will use POWER for custom open servers and components for Linux based cloud data centers.

First time, OpenPOWER ecosystem partners can optimize the interactions of server building blocks – microprocessors, networking, I/O & other components – to tune performance.

POWER8 Highlights

PERFORMANCE



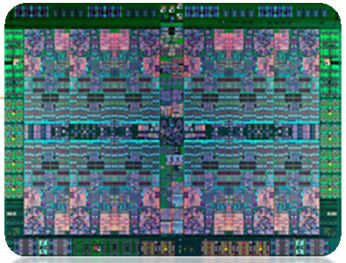
The Register: *"it most certainly does belong in a **badass** server, and Power8 is by far one of the most elegant chips that Big Blue has ever created"*

- **Huge performance improvement:**
  - **1.5X** to **1.7X** thread-level improvement*
  - **2X** core improvement*
  - **3X** socket improvement*
- **Compared with POWER7+**
  - Commercial **2.5X*** and Java **2.6X***
  - Integer **2.2X*** and Floating Point **2.3X***
- **Coherent Accelerators (CAPI) – memory-space addressable**
- **SMP scaling**
  - 16 sockets, 192 cores
  - Lower latency, high speed

* approximate

POWER8 Highlights

MEMORY and BANDWIDTH



Linley Group microprocessor report: "The Power8 specs are mind boggling. . .IBM's newest server processor will smash existing performance records, particularly for memory-intensive applications"

The Linley Group

- **Caching Structure**
  - L1 to L4 cache with Non-Uniform Cache Architecture
  - **4 TB/s** L2 bandwidth* per chip (4GHz 12core)
  - **3 TB/s** L3 bandwidth* per chip (4GHz 12core)
- **Memory Subsystem**
  - **230 GB/s** sustained* bandwidth per chip
  - **410 GB/s** bandwidth* at DRAM level per chip
  - **1 TB** memory per socket (e.g. 4sockets = 4 TB)
  - Transactional Memory

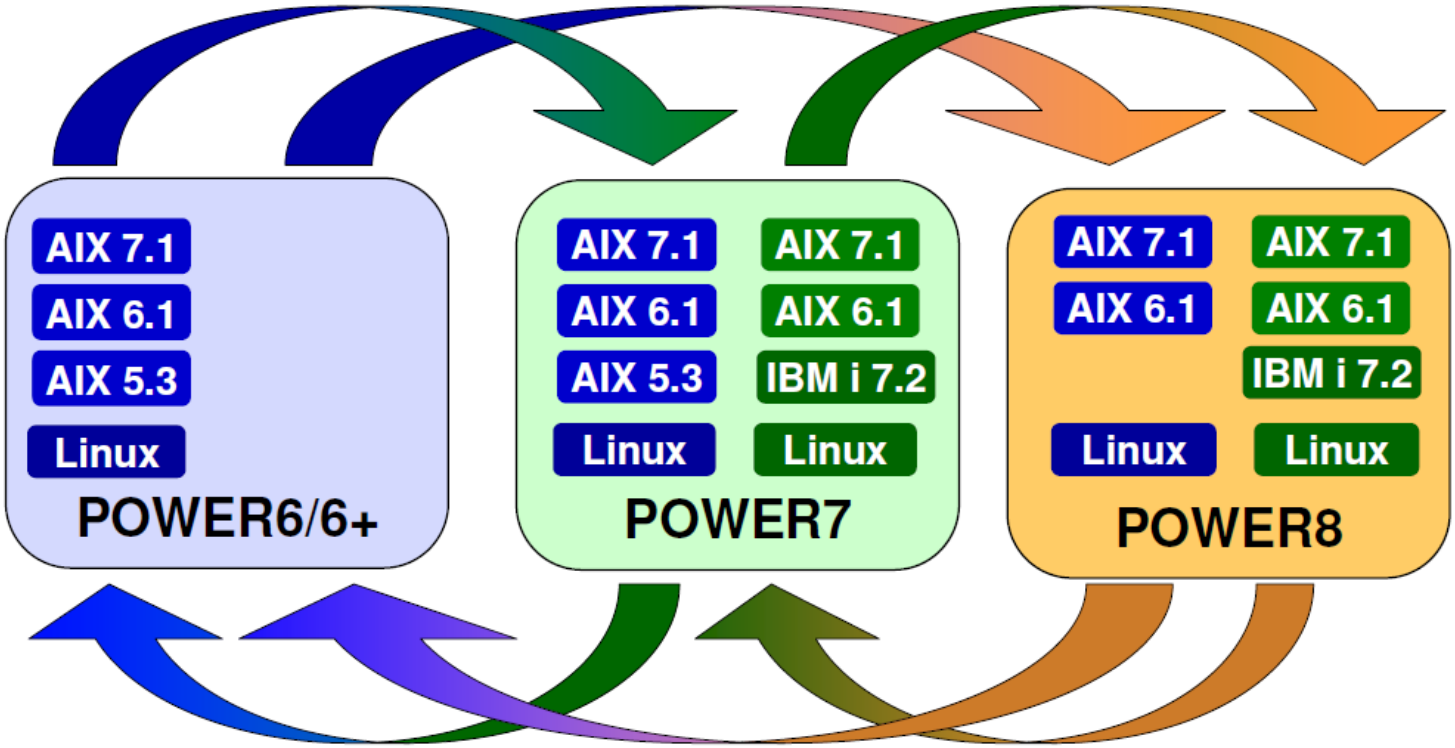
* approximate

Agenda

- *POWER Future Technology*
  - *Next Generation Processor*
  - ***<u>Information about HighEnd System</u>***
  - *PowerVM Management*

- *New PowerLinux Offering*

POWER6 / POWER7 / POWER8 Partition Mobility



Leverage POWER6 / POWER7 Compatibility Modes
LPAR Migrate between POWER6 / POWER7 / POWER8 Servers
Can not move POWER8 Mode partitions to POWER6 or POWER7 systems.

Agenda

- *POWER Future Technology*
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  <u>BONUS Break : 5min Technology</u>

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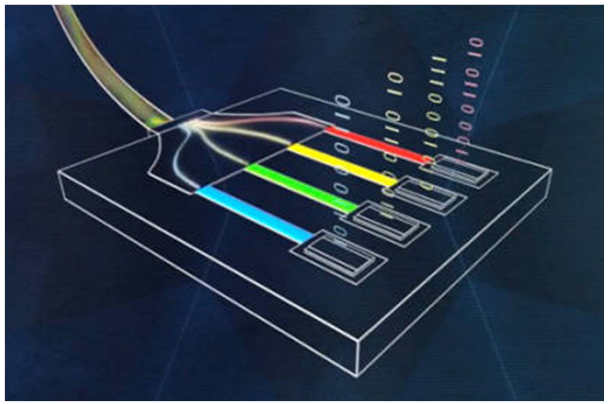
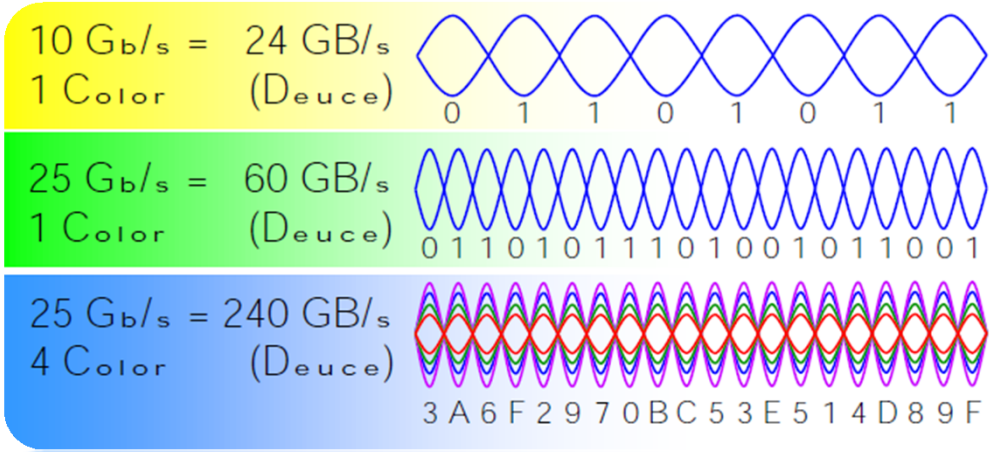
Optical Interconnects – Silicon Photonic

Disruptive Optics Evolution and Silicon Photonics

Silicon Photonics, Multi-wavelength, => 25 Gb/s Optics





POWER7 775 HPC system

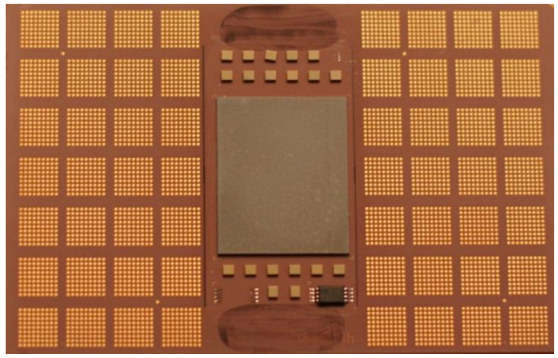
High density IO off module optical transceivers

•Physical escape density

•P7 775 HPC network chip shown below

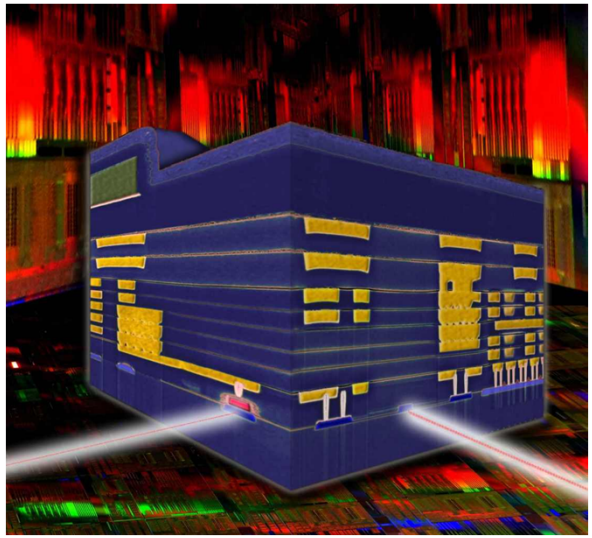
- Tx : 12 x 10Gb/s

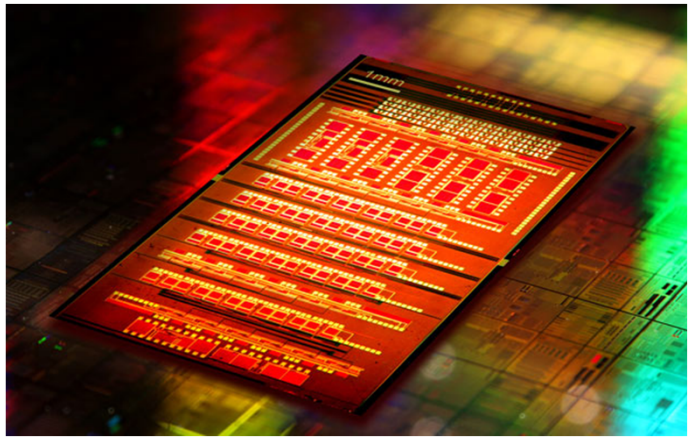
- Rx : 12 x 10Gb/s



IBM - Silicon Integrated Nanophotonics

An IBM 90nm Silicon Integrated Nanophotonics technology is capable of integrating a photodetector (red feature on the left side of the cube) and modulator (blue feature on the right side of the cube) fabricated side-by-side with silicon transistors (red sparks on the far right of the cube).
Silicon Nanophotonics circuits and silicon transistors are interconnected with nine levels of yellow metal wires.





IBM Silicon Nanophotonics technology is capable of integrating optical and electrical circuits side-by-side on the same chip.

IBM develops the **TINIEST nanophotonic switch** able to connect Tb/s network. This technology can be used for chips interconnection in next generation systems.

Sources:
http://researcher.watson.ibm.com/researcher/view_project.php?id=2757
http://news.cnet.com/8301-30685_3-20024223-264.html

3D Stacking

Today's 2D designs :

Larger structures introduce longer physical distances creating a design conflict :

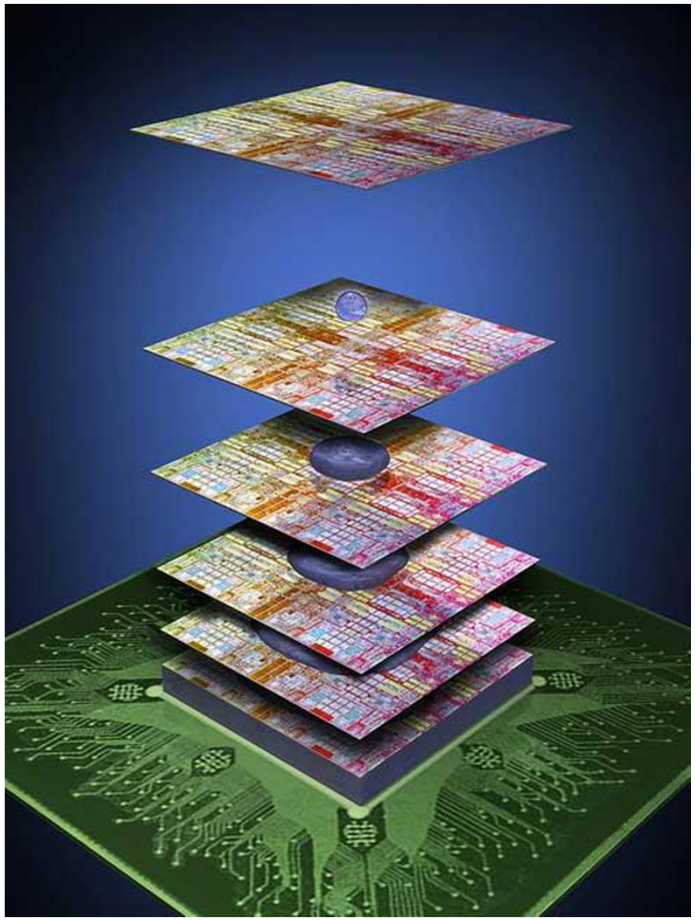
- Increase latency
- Need more power

3D designs :

Many-levels of chips with low power and latency communication

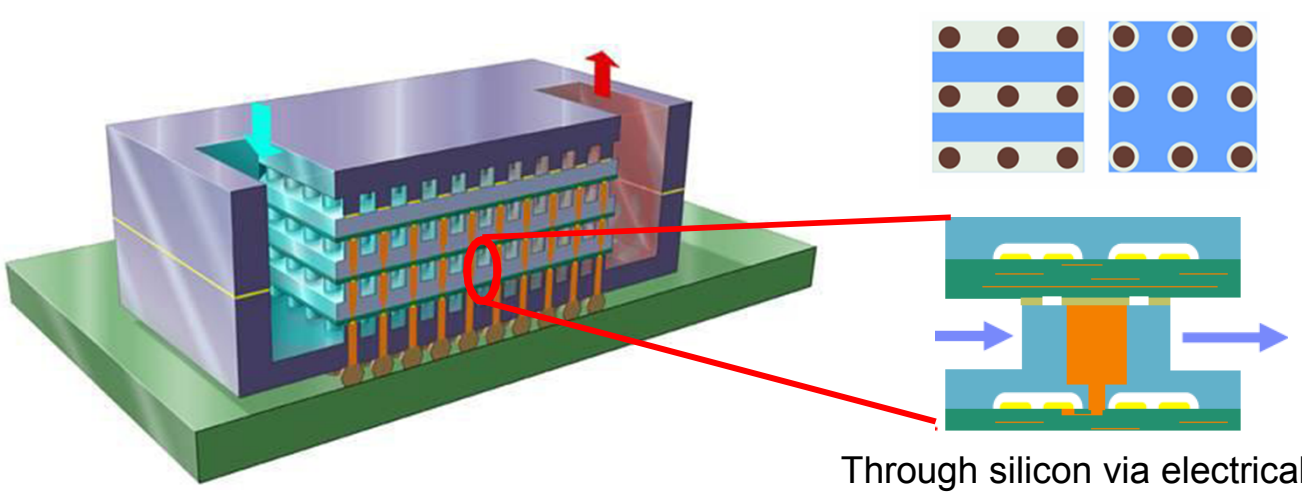
•Enables larger caches stacked below the CPU
•Enables larger chips with good yield

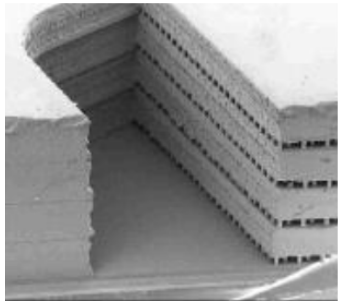
1st generation : Pull external interface logic and voltage regulation into lower layer
2nd generation : Add an L3 cache layer
3rd generation : Move L2 cache and large second level core centric structures (TLB, Predictors)
4th generation : Two layer CPU, execution units on top, L1 caches below



Scalable Heat Removal by Interlayer Cooling

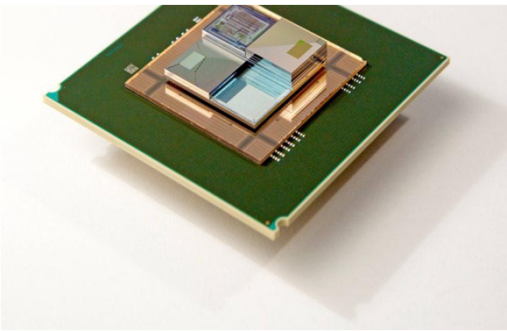
- 3D integration requires interlayer cooling for stacked logic chips
- Bonding scheme to isolate electrical interconnects from coolant

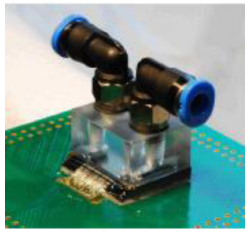




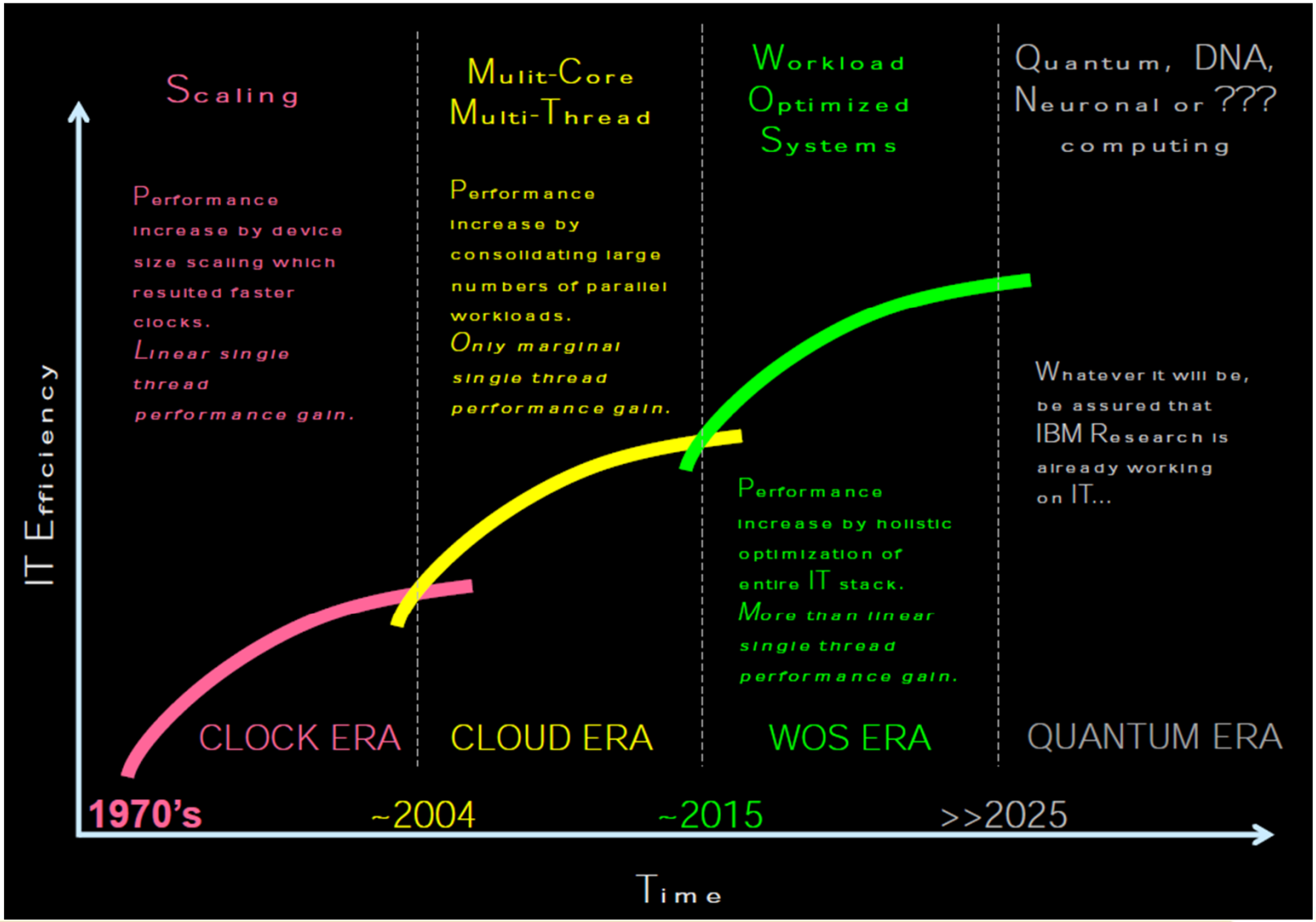
Through silicon via electrical bonding and water insulation scheme

- A large fraction of energy in computers is spent for data transport
- Shrinking computers saves energy





IT Performance Evolution: Outlook to the future



Agenda

- *POWER Future Technology*
  - *Next Generation Processor*
  - *Information about HighEnd System*
  - ***PowerVM Management***
- *New PowerLinux Offering*

Agenda

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- ***<u>New PowerLinux Offering</u>***

Power enable next gen applications & cognitive computing

Power Solutions

Industry Solutions | **Business & Predictive Analytics** | **Cognitive Computing**

Retail, Healthcare, Banking, Government, Telecom

Cognos, SPSS, DB2, WebSphere, AIX, Linux

IBM Watson, Linux

Stream Computing | ***Real-time Analytics*** | ***Natural Language Learning***

Power Systems Design

Continuous data load | Massive IO bandwidth | Parallel processing | 1,000+ Concurrent Queries | Large-scale memory processing

99.997% Availability | ***0 Incidents, Vulnerability*** | ***1.3M IOPS Scalability***

Open & flexible infrastructure - Available on premise or through the Cloud

SmartCloud, Linux, AIX

Expanding POWER into Big Data, Analytics, Cloud, Linux

POWER recognized leader for

- Business Applications – ERP, OLTP, Enterprise Web Applications
- Data Warehousing/Minig/Analitics
- Data Store
- Workload Consolidation
- Investment Protection

Expansion Focus

- Big Data & Analitics
- New Industry Solutions
- Cloud Computing
- Open Source
- Cognitive Computing / IBM Watson

AIX

Linux

High Performance	Scalability	DataCapabilities	Security
Efficiency	Reliability & Availability	Advanced Virtualization	
Industry Affiliation	Mature & Growth Market	Large Scale Adoption	

New PowerLinux Offering

L'open source est un facteur important d'innovation technologique .

Septembre 2012: IBM orchestre le lancement de la fondation OpenStack avec un investissement de 10 m$ et 5600 membres transformant la dynamique des écosystèmes de Cloud ouverts

openstack™ CLOUD SOFTWARE

150+ interconnected OSS Projects

A l'ère d'une Smarter Planet, IBM continue à s'impliquer dans les écosystèmes Opensource….

30-50 OSS Projects

A l'ère de l'e-business…

IBM tire parti de l'émergence du mouvement **open source** ...

…et **devient le leader du marché** SOA et le premier éditeur de middleware

20-30 independent OSS Projects

e-business

eclipse

Novembre 2001 – IBM fédère 150 éditeurs et une communauté de développeurs autour d'une nouvelle plateforme de développement logiciel, et contribue pour 40m$ de code ,source. Cette initiative bouleverse le marché du développement logiciel

Linux

Septembre 1999: IBM investit 60m$ annuellement sur Linux, et devient un membre actif de la communauté développant Linux

Apache

Juin 1998 – IBM signe un accord de technologie avec The Apache Group pour le développement du serveur HTTP Apache,

You know what's cool?

$1 Billion

Power Systems intends to invest a billion dollars in solutions for Linux and open source workloads, adding to prior investments by IBM during the last decade on a wide range of open initiatives.

In addition, we're expanding our Linux on Power development cloud, which will give Linux developers who want to prototype applications easy access to Power.

Finally, we're opening a new Power Systems Linux Center in Montpellier, France, joining a worldwide network of centers dedicated to the success of Linux software developers on Power.

Offering POWER to new OpenSource Workloads

BigData

Mobile

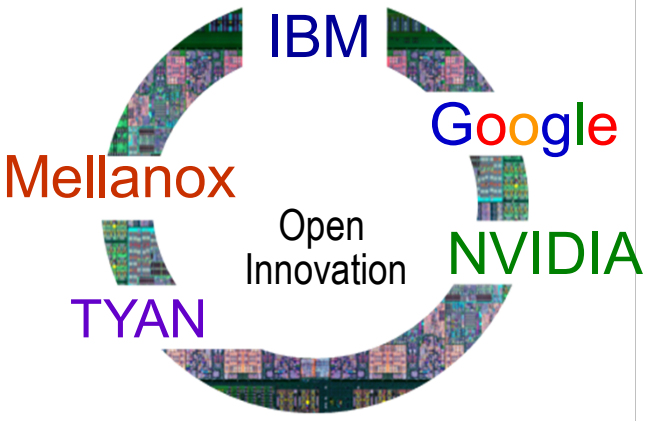
Cloud

Performance
Virtualization
Resiliency

Social

Ecosystem leadership providing client choice and flexibility

OpenPOWER Consortium



- Collaborative innovation for highly advanced systems
- Produce open hardware, software, firmware and tools
- Expand industry skills and investment for Power ecosystem
- Provide alternative architectures

Open Applications and Tools

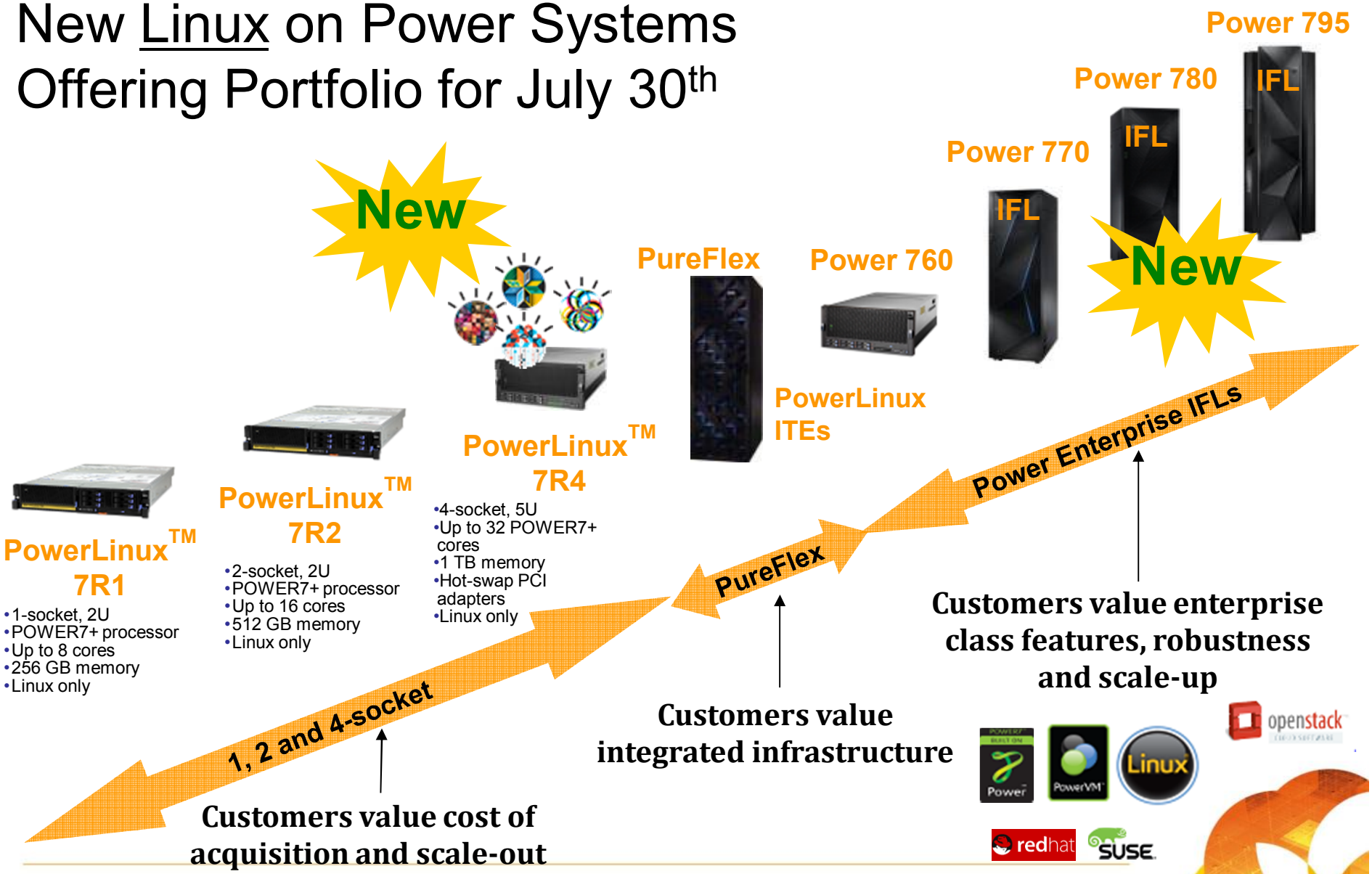
- *JavaScript*
- *OpenJDK*

- Access to industry innovation from a broad community
- Optimize scripting languages and development tools
- Contribute innovation to Linux, KVM and OpenStack

Open Management

- Simplified, consistent management
- Software-defined environments
- Deployment on premise or via cloud
- Seamless upgrades

New Linux on Power Systems Offering Portfolio for July 30th



Now Four Types of Activations

Static	**Mobile** Annc Oct 2013	**Elastic** or On/Off CoD	**Power IFL** Annc Oct 2013
Permanent activation	Permanent activation	Temporary activation	Permanent activation
AIX, IBM i, Linux	AIX, IBM i, Linux	AIX, IBM i, Linux	Linux only
PowerVM choice Standard or Enterprise across all server	PowerVM choice Standard or Enterprise across all server	PowerVM choice Standard or Enterprise across all server	PowerVM Enterprise only, PowerVM for PowerLinux for Power IFL
Supported on all Power 770/780/795	- 795 in 4Q 2013 - POWER7+ 770 / 780 Apr 2014	Supported on all Power 770/780/795	Supported on all Power 770/780/795
Many firmware levels	Newest 780 firmware	Many firmware levels	Many firmware levels
Base cost	More value	Temporary	Lowest cost

Additional temporary activations: Utility CoD and Trial Cod not shown

PowerVM for IBM PowerLinux™ vs. VMware - $ US

Superior capabilities and value – dynamically add or remove resources and save 16%

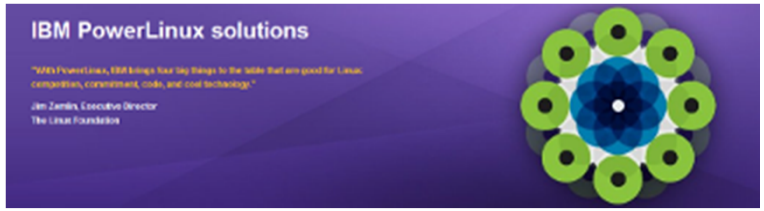
Virtualization features	**PowerVM for IBM PowerLinux[4]**	**VMware vSphere 5.0 – Enterprise[1]**
Server platforms supported	PowerLinux 7R1 or 7R2 IBM Flex System p24L	x86-64 based servers
Guest operating systems supported	Linux	Linux, Windows, Solaris and others
Memory - dynamically add or remove	Yes	Add – Yes Remove - No
Virtual CPUs - dynamically add or remove	Yes	Add – Yes Remove – No OS support
Virtual CPUs per VM	Only limited by # cores 7R1: 32 7R2/p24L: 64 795: 1,024	32 per socket (limited by Enterprise Ed. license)
Secure hypervisor (zero reported vulnerabilities)	Yes (h/w based)	No (s/w based)
License + 3 year, 9x5 SWMA 	$7,840[3] (2-sockets / 16 cores)	$9,374[2] (2-socket / 64 vCPU license)

16%

[1]VMware edition comparisons: www.vmware.com/products/datacenter-virtualization/vsphere/compare-editions.html
[2]VMware pricing: www.vmware.com/products/datacenter-virtualization/vsphere/pricing.html
[3]Based on US pricing for PowerVM for PowerLinux as of 10/05/2012
[3]PowerVM for PowerLinux is functionally equivalent to PowerVM Enterprise Edition & is only available for Linux only, PowerLinux servers.

Linux on Power Big Data Analytic Innovation

Faster +64%



- Big Data Analytics Innovation
  - IBM PowerLinux Big Data Solution for Apache Hadoop
  - New benchmark: only use 1/3 the time to sort 1TB of data vs. comparable x86 cluster
- IBM PowerLinux Advantages
  - POWER7 has 4 SMT per core vs. Intel's 2 threads per core
  - POWER7 has outstanding memory and I/O bandwidth
  - POWER7 offers highly optimized JVM
  - POWER7 servers deliver high I/O bandwidth

IBM InfoSphere BigInsights

Powered by hadoop

IBM InfoSphere Streams

PowerVM

IBM Systems Director

Linux

redhat

POWER7 BUILT ON Power

IBM PowerLinux Servers

8 min 44s

10 Power7R2+1 EXP24S

24 min

intel

one result used 10 x86 Linux nodes and another used 11 x86 Linux nodes*

*MapR used 1 master node and 10 slave nodes for its Terasort results (@Hadoop Summit 2011). Cloudera used 10 nodes (@Hadoop World 2011).

New IBM PowerLinuxTM 7R2 pricing comparison ($US)

Server list price* -3-year warranty, on-site	**$10,483**	**$11,946**	**$11,628** New Power7+
Virtualization - OTC + 3yr. 9x5 SWMA	**$9,374** VMware vSphere Enterprise 5.1	**$9,374** VMware vSphere Enterprise 5.1	**$7,840** PowerVM for IBM PowerLinux
Linux OS list price - RHEL, 2 sockets, unlimited guests, 9x5, 3 yr. sub./ supp.	**$5,697** Red Hat subscription and Red Hat support	**$5,697** Red Hat subscription and Red Hat support	**$4,489** Red Hat subscription and IBM support
Total list price: Server/Virtualization/Linux	**$25,554**	**$26,568**	**$23,957**

** Based on US pricing for PowerLinux 7R2 announced on 2/05/2013 matching configuration table below. Source: dell.com, hp.com, vmware.com: 1/15/13*

Compare prices online

Server model	Dell R720	HP Proliant DL380p G8	IBM PowerLinux 7R2
Processor / cores	**Two 2.9 GHz , E5-2690, Sandy Bridge, 8-core processors**		**Two 4.2 GHz POWER7+, 8-core**
Configuration	32 GB memory, 2 x 147GB HDD, 10 Gb two port		Same memory, HDD, NIC

TCA pricing of Power vs. Intel x86 for Linux is comparable

PowerLinux 7R1 vs. Dell R720

*(Comparable **1-socket** server w/ virtualization & Red Hat)*

Dell PowerEdge R720	IBM PowerLinux 7R1
$16,935	$15,404

PowerLinux 7R2 vs. HP DL380 G8

*(Comparable **2-socket** server w/ virtualization & Red Hat)*

HP ProLiant DL380 G8	IBM PowerLinux 7R2
$27,707	$23,957

PowerLinux 7R4 vs. HP DL580 G7

*(Comparable **4-socket** server w/ virtualization & Red Hat)*

HP ProLiant DL580 G7	IBM PowerLinux 7R4
$67,439	$67,435

Power IFLs vs. Intel x86 scale out

$16,935 — *8-cores*

$27,707 — *16-cores*

$67,439 — *32-cores*

Power IFL

$8,591* (4-cores)

$78,280 (32-cores)

Activate 4 cores per Power IFL

* Does not include Linux OS

Thank You

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Power Systems
Systems & Technology Group
IBM Client Center
Montpellier - France

...any Question ?