

October 9, 2014

Power Systems Strategy - Linux

Open Innovation to Put Data to Work

Franz Bourlet

Power Systems Technical Sales
IBM Belgium & Luxembourg



- Introduction to Linux and open source (optional)
- Linux at IBM
- The OpenPOWER Foundation
- Linux and on IBM Power
- Linux on Power inhibitors
- Linux on Power benefits
- Installation & deployment
- Useful resources

Flashback

Starting in 2001 IBM invested \$1 billion in Linux



Our leadership in Linux and the Open Community has made Linux an ongoing competitive choice for our clients

IBM



Watson

Enabling IBM products

2005–2006 Application and data serving

Mainstream for IBM

2010... Next-generation workloads

Making Linux better

1999–2004 Edge and web infrastructure

Core to the IBM business

2007–2009 Business-critical workloads

Who Has Contributed to Linux?
(2005 – 2013)

Company Name	Number of Changes	Percent of Total
None	46,982	17.9%
Red Hat	31,261	11.9%
Novell	16,738	6.4%
Intel	16,219	6.2%
IBM	16,073	6.1%
Unknown	13,342	5.1%
Consultant	7,986	3.0%
Oracle	5,542	2.1%
Academia	3,421	1.3%
Nokia	3,272	1.2%
Fujitsu	3,156	1.2%
Texas Instruments	2,982	1.1%
Broadcom	2,916	1.1%
Linux Foundation	2,890	1.1%
Google	2,620	1.0%
Analog Devices	2,595	1.0%
SGI	2,578	1.0%
AMD	2,510	1.0%
Parallels	2,419	0.9%
Freescale	2,265	0.9%
Cisco	2,259	0.9%
HP	2,158	0.8%
Renesas Technology	2,092	0.8%
MontaVista	2,019	0.8%
Atheros Communications	1,960	0.7%
Wolfson Microelectronics	1,952	0.7%
Marvell	1,752	0.7%
NetApp	1,746	0.7%
Linutronix	1,656	0.6%
Samsung	1,650	0.6%

IBM provides complete Linux solutions : top-to-bottom, end-to-end

- Implementation Support services
- Subscriptions

- Enterprise-ready Common across platforms

- Manage complex environments
- Simplification

- Tier 1 Linux support for all IBM Systems
- Match workload needs to platform capabilities
- OS management skills common across platforms
- Increase flexibility
- Petabyte-scale storage solutions

IBM Global Services

Information mgt

WebSphere®

Tivoli®

Lotus®

Rational®

IBM Systems Software

IBM
Global
Financing



IBM System x



IBM Power Systems



IBM System z

IBM Systems Storage

Linux provides common benefits across all IBM platforms

Security

- Policy-based security
- Common criteria certification
- Very rapid time to fix if vulnerabilities are discovered

Supported platforms

- Wristwatches to mainframes
- Broadest range of supported virtualization environments
- Can optimize by workload

Scalability

- Ongoing innovation in both scale out and scale up
- Platform support provides flexibility in consolidation

Skills

- Linux skills widespread
- OS management skills applicable across platforms

IBM Systems positioning

PureSystem



Integrated system
Focus on efficiency, simplicity, agility, control

System z



For massive number of Linux images
(Consolidation ratio 1:8 to 1:30)
Linux applications with strong zOS affinity
Linux applications with high IO

Power System



PowerLinux for scale out
IFL for scale up
Power RAS features
For resource granularity and low virtualisation overhead
For CPU intensive Linux applications
For applications that don't scale horizontally
KVM available since April

System x



Linux X86 as general purpose linux platform,
proxy,dns,dhcp

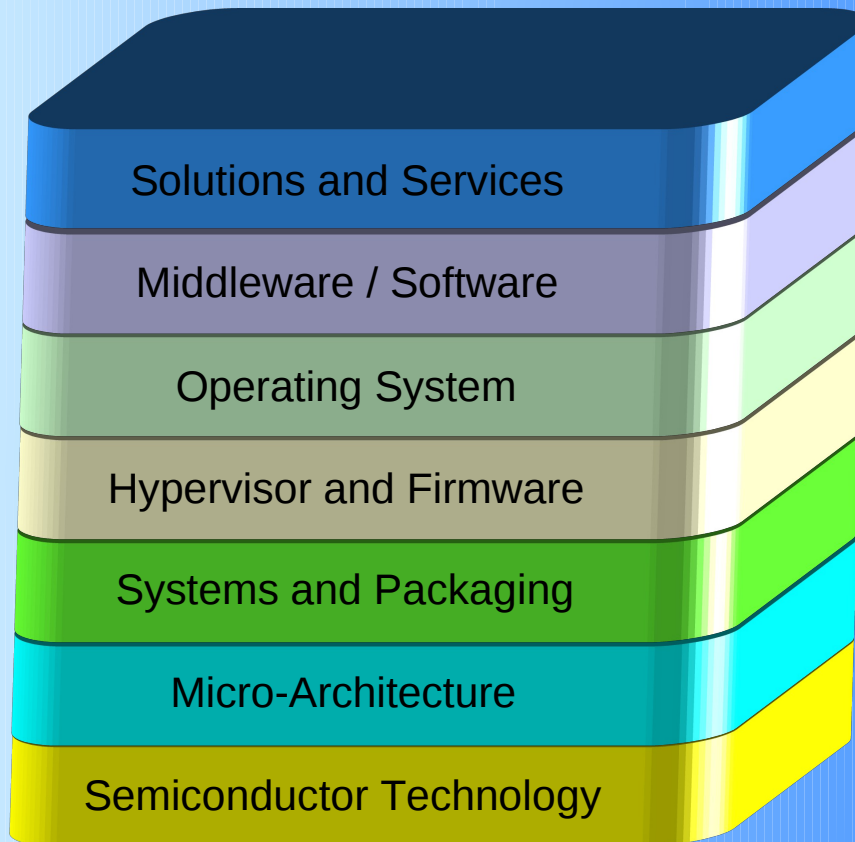
Ever heard about ARM Ltd ?

- Founded in November 1990 – www.arm.com
 - Spun out of Acorn Computers
- Runs 95% of mobile phones and tabs
- Arm designs a range of RISC processor cores but does not fabricate silicon itself
- Licenses ARM core designs to semiconductor partners who fabricate and sell to their customers
 - Examples include Apple, Samsung, Nvidia, Qualcomm,...
- Also develops technologies to assist with the design-in of the ARM architecture
 - Software tools, boards, debug hardware, application software, bus architectures, peripherals, etc



POWER wants to be the ARM of the datacenter

IBM Research: Innovation Strengthens the Stack



IBM is Unique in the World

- No other company plays in all the layers. IBM is world-class in all layers
- Those that play in multiple layers are world-class only in few.

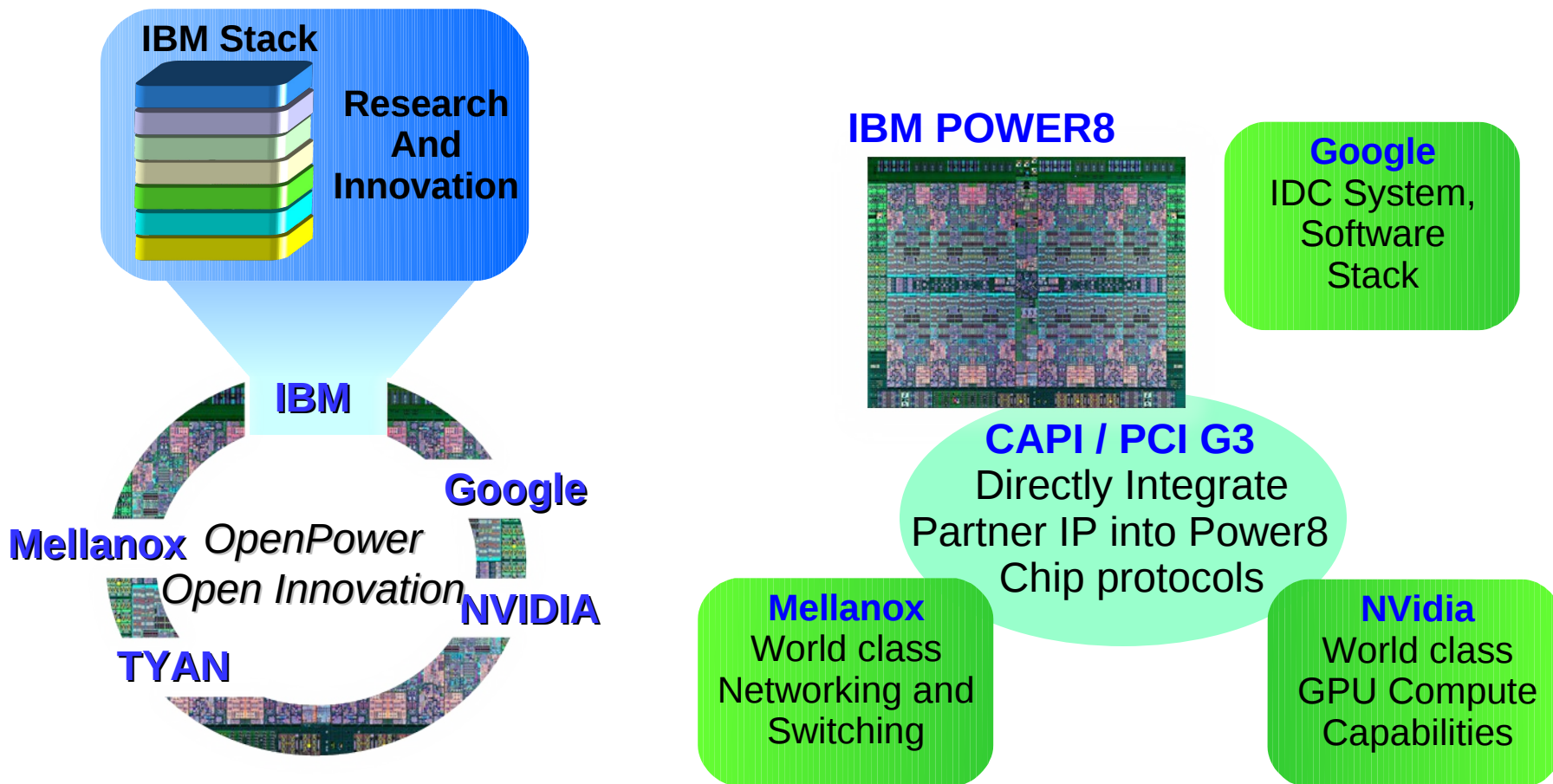
IBM R&D investment

- \$6 Billion annually
- Human capital and culture
- 3000+ Researchers
- 6478 U.S. patents in 2012
- Patent leader past 20 years

As CMOS scaling slows, Value comes from Innovating across the Stack

OpenPOWER and Innovation

OpenPOWER: Bringing Partner Innovation to Power Systems



Industry shifts drive next wave of technology innovation and consumption

Broader technology consumption models

- Design your own systems (Google, Microsoft, Facebook, Rackspace, Huawei, Inspur, etc)
- Rely on commodity white box providers in Taiwan (Tyan, Wistron, Quanta)
- Pay as you go Cloud

Growing workload demands

- Rapid growth in Big Data and Analytics solutions
- Tuning hardware and software for specific performance, energy consumption, and other goals

Proliferation of Open Software and Systems

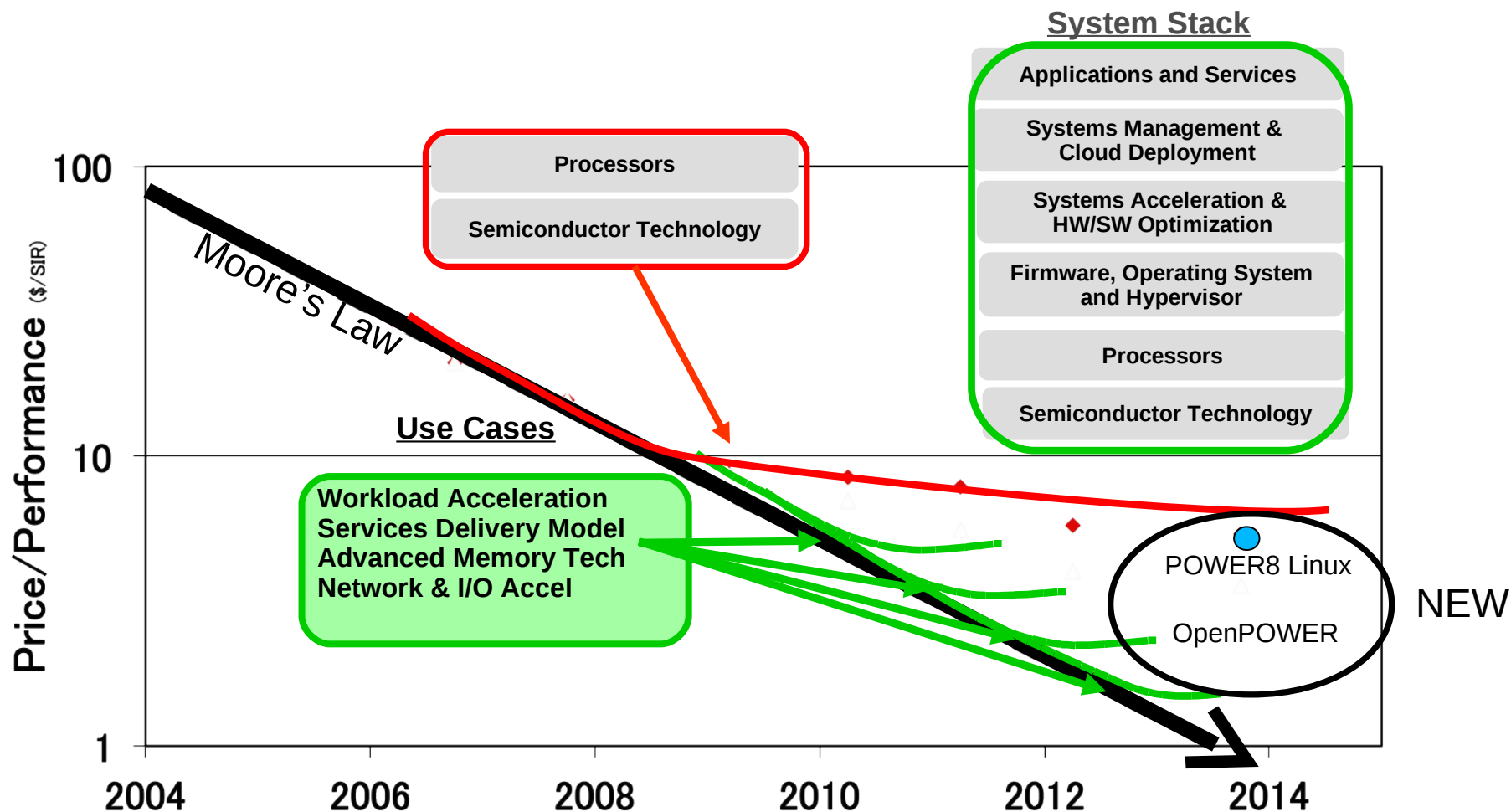
- Mature ecosystem of Open Software options
- Resistance to proprietary or closed innovation models

Price/performance improvement requires multiple innovations

- Microprocessors alone no longer drive sufficient Cost/Performance improvements

Industry trends drive innovation beyond the chip

Microprocessors alone no longer drive sufficient Cost/Performance improvements



System stack innovations are required to drive Cost/Performance

Driving industry innovation

OpenPOWER is an **Open** development Community

- Built on the premise of Open Source Software and Hardware
- Opening the entire stack for innovation, from chip to software
- Removes proprietary boundaries
- Little Endian Linux simplifies software migration to POWER



OpenPOWER fosters **Collaboration** across multiple stakeholders

- Collaboration of multiple thought leaders on multiple projects in parallel
- Building an ecosystem to provide choice and flexibility in systems
- Delivering set of compelling, shared building blocks
- Engage directly with end users



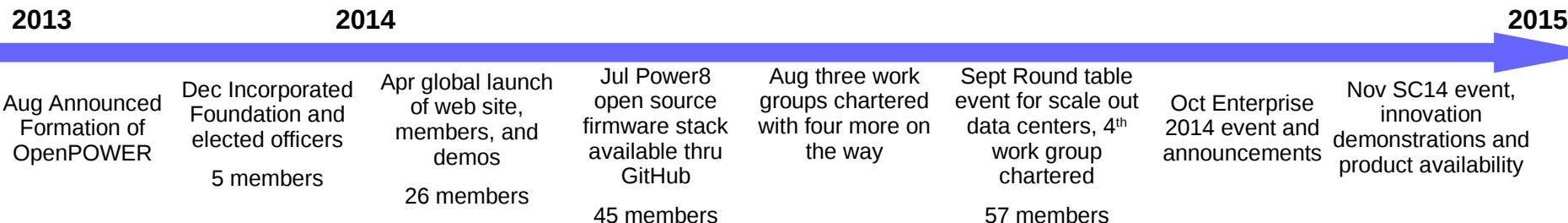
OpenPOWER leverages the **Performance** of leading POWER architecture

- Built for demands of big data and analytics
- Incredible innovation and differentiation options
- Includes SOC design, Bus Specifications, Reference Designs, FW OS and Open Source Hypervisor



The goal of the OpenPOWER Foundation is to create an open ecosystem, using the POWER Architecture to share expertise, investment, and server-class intellectual property to serve the evolving needs of customers.

Giving ecosystem partners a license to innovate



2015 will host the first OpenPOWER Foundation Summit, see numerous innovations come to light, and welcome an increasing diversity of stakeholders including software providers and end users.

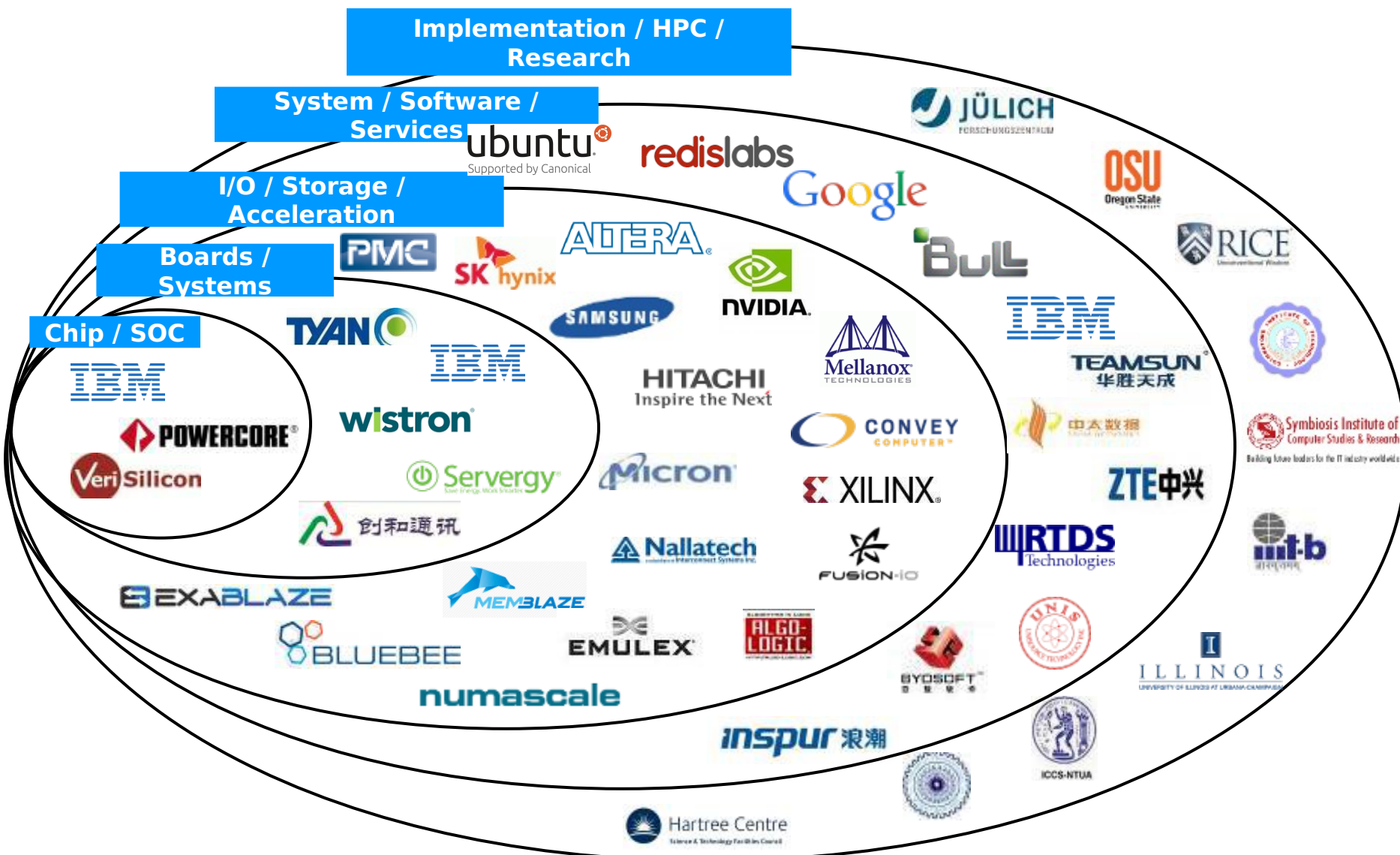
What does the OpenPOWER Foundation mean to the industry?

- OpenPOWER creates greater choice for customers
- Open and collaborative development model on the Power platform accelerates and enables innovation
- New innovation broaden the capability and value of the Power platform
Game changer on the competitive landscape of the server industry

Platinum Members

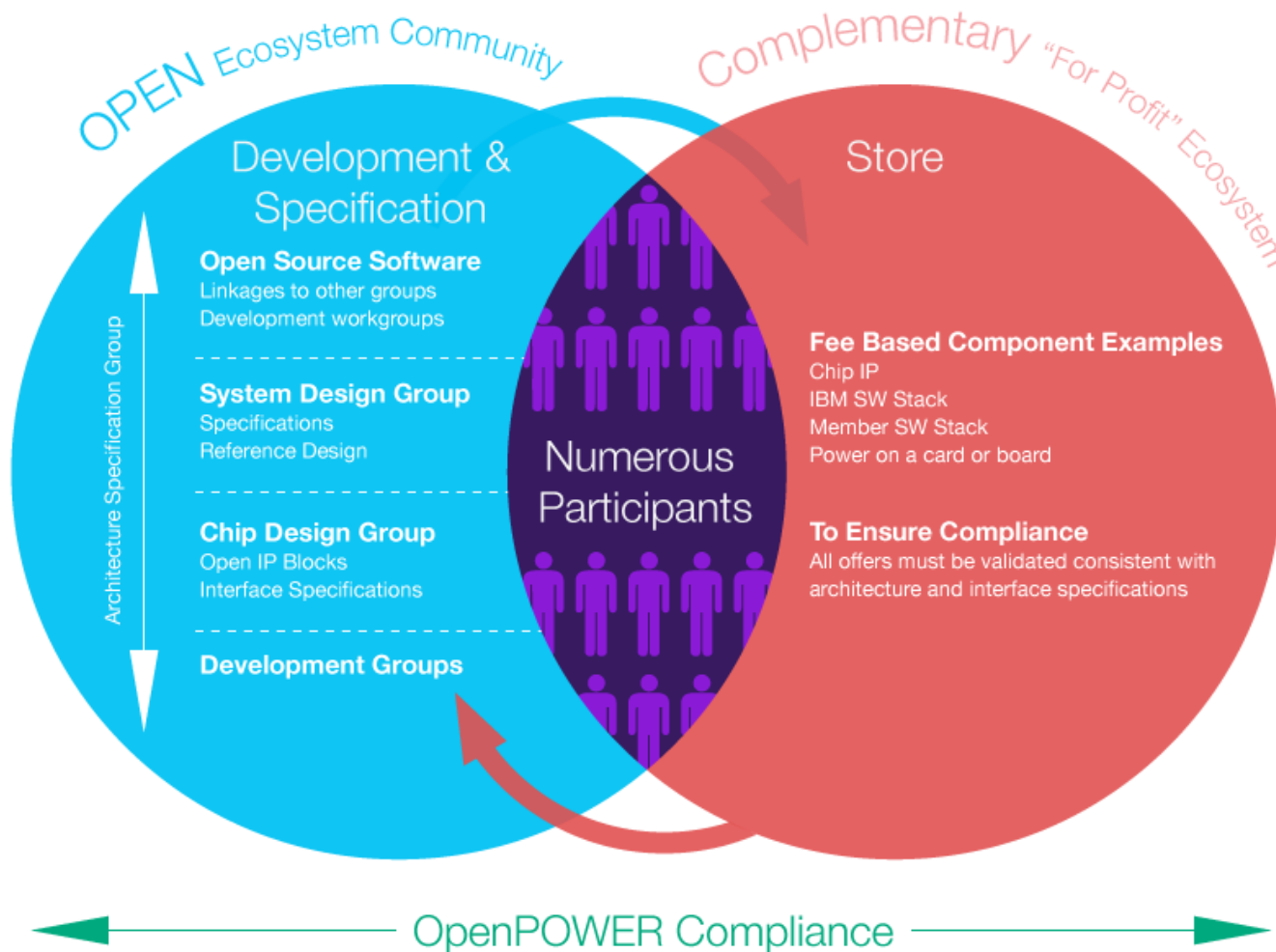


Building collaboration and innovation at all levels



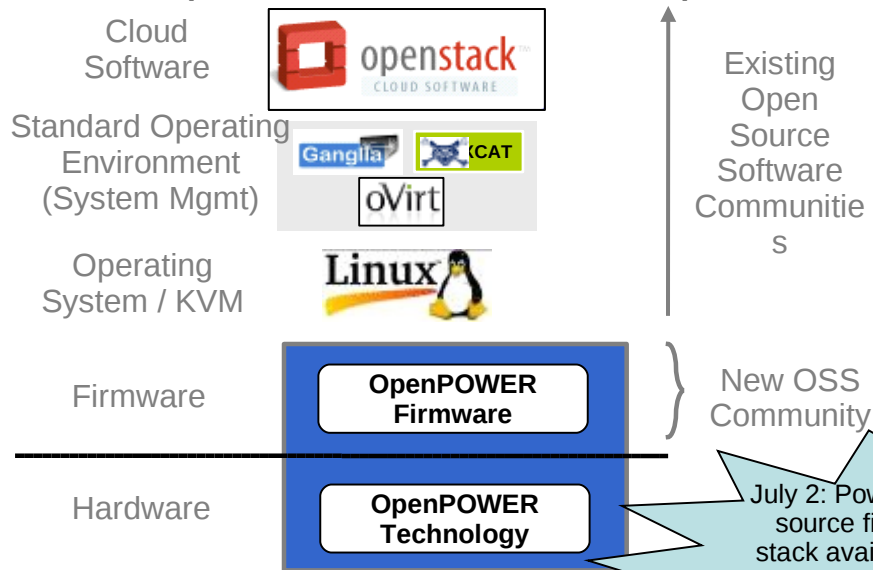
OpenPOWER Foundation Structure

OpenPOWER is an industry foundation based on the POWER architecture, enabling an Open community for development and opportunity for member differentiation and growth



Ecosystem Enablement

Power Open Source Software Stack Components



System Operating Environment Software Stack

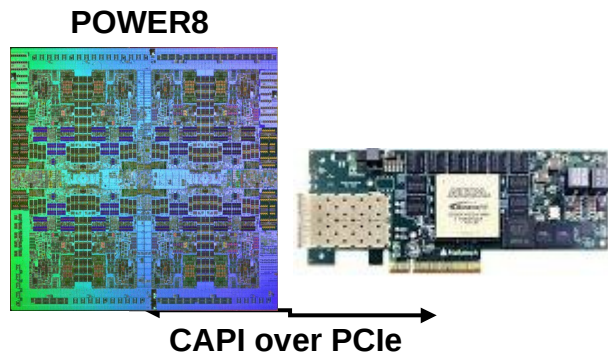
A modern development environment is emerging based on tools and services



July 2: Power8 open source firmware stack available thru GitHub

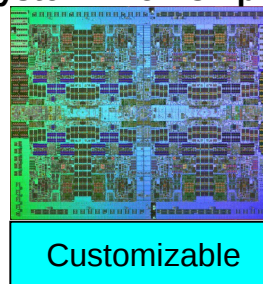
Multiple Options to Design with POWER Technology Within OpenPOWER

Hardware



“Standard POWER Products” – 2014

Framework to Integrate System IP on Chip



“Custom POWER SoC” – Future

Industry IP License Model



Demonstrations of OpenPOWER innovation



NoSQL KVS Acceleration with CAPI Flash (Sure Lock)

- IBM POWER8 Linux Server
- TMS Flash - CAPI attached

NoSQL based solution with IBM Flash and CAPI. Attaching large flash arrays to the processor, without overhead, to drive down costs of large NoSQL deployments.



Financial Risk Modeling with CAPI Accelerator (Monte Carlo)

featuring Altera technology

- IBM POWER8 Linux Server
- Altera FPGA Computing Card

Monte Carlo financial simulations run on an Altera FPGA accelerator via CAPI compared to published non-CAPI best case performance for dedicated workload acceleration.



KVS Acceleration with RDMA (Gun Hi)

featuring Mellanox technology

- IBM POWER8 Linux Server
- Mellanox RDMA interface
- IBM Research HydraDB software

POWER8 network acceleration for Big Data utilities high speed RDMA networking with acceleration technology to reduce latency by 10x when working with big data, reducing infrastructure requirements.



Big Data and Java Workload Acceleration (Espresso)

featuring NVIDIA technology

- IBM POWER8 Linux Server
- Apache Hadoop/Mahout
- NVIDIA GPU / CUDA
- IBM Java with new GPU Framework

Exploit GPUs for customized acceleration directly from Java. Ideal for Big Data and Analytic Java workloads. Demo uses GPU exploitation for 8x acceleration of a machine learning algorithm for Big Data segmentation.



KVS Acceleration with CAPI FPGA

featuring Xilinx technology

- IBM POWER8 Linux Server
- Xilinx FPGA Computing Card

Compare performance of Key Value Store on a normal configuration, to an acceleration using a Xilinx CAPI attached FPGA accelerator.



Watson on Power in SoftLayer (Tornado)

- IBM POWER8 Linux Server
- Watson Engagement Advisor
- Watson ISV (MD Buyline) Smart Advisor

SoftLayer is now providing Watson as a service on a Power System, and Tornado demonstrates that service with an application.



POWER8 Evaluation System is single socket ATX form factor, BMC based evaluation board. Designed and fulfilled by Tyan Corporation, accepting inquiries and orders for development.

OpenPOWER Work Groups and Projects

Work Group	Projects	Participants
System Software (Open Source)	<ul style="list-style-type: none">▪ Linux LE▪ KVM▪ Firmware<ul style="list-style-type: none">– OpenPOWER FW interface	Public Public Public
	<ul style="list-style-type: none">▪ POWER LE ABI	Public
Application Software* (Open Source)	<ul style="list-style-type: none">▪ System Operating Environment<ul style="list-style-type: none">– OpenPOWER Software ecosystem enablement	Public
	<ul style="list-style-type: none">▪ Toolchain	Public
OpenPOWER Development Platform	<ul style="list-style-type: none">▪ Power 8 Developer Board	Member
	<ul style="list-style-type: none">▪ POWER 8 Reference Design	Member
Accelerators	<ul style="list-style-type: none">▪ Acceleration interface and enablement	Member
Hardware Architecture	<ul style="list-style-type: none">▪ OpenPOWER profile of architecture<ul style="list-style-type: none">– Power8 ISA Book 1, 2, 3	Member
	<ul style="list-style-type: none">▪ Coherent Accelerator Interface	Member

* Proposed charter under development

Summary of CAPI Advantages

Accelerator performance

Coherency and Address Translation provide improved access to memory / cache data & interaction with system processors

CPU efficiency

eliminates the overhead of managing the I/O subsystem

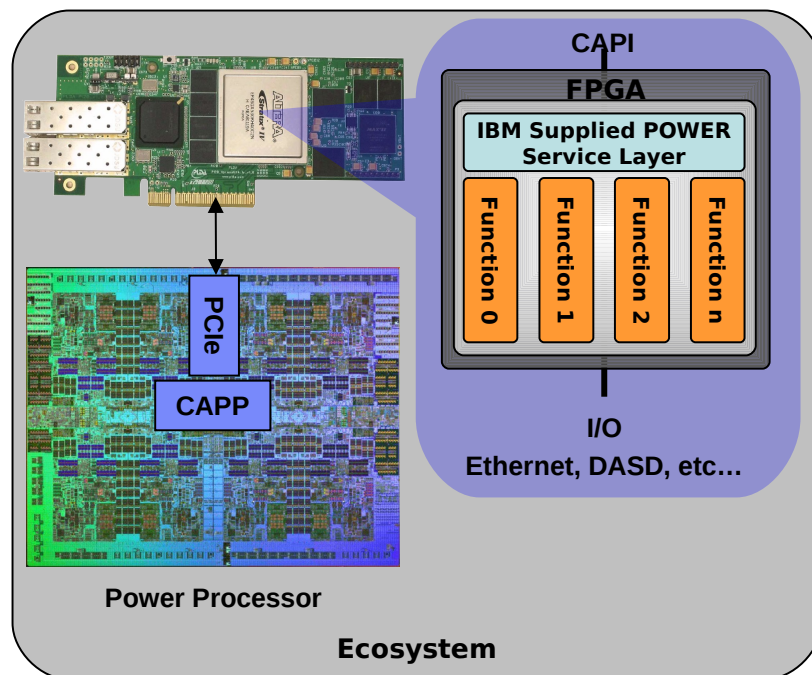
Wide applicability

able to accelerate in new ways, eg pointer chasing
enables a broader set of workloads as candidates for acceleration

Programmer Efficiency

focus on the workload rather than on communicating with the device

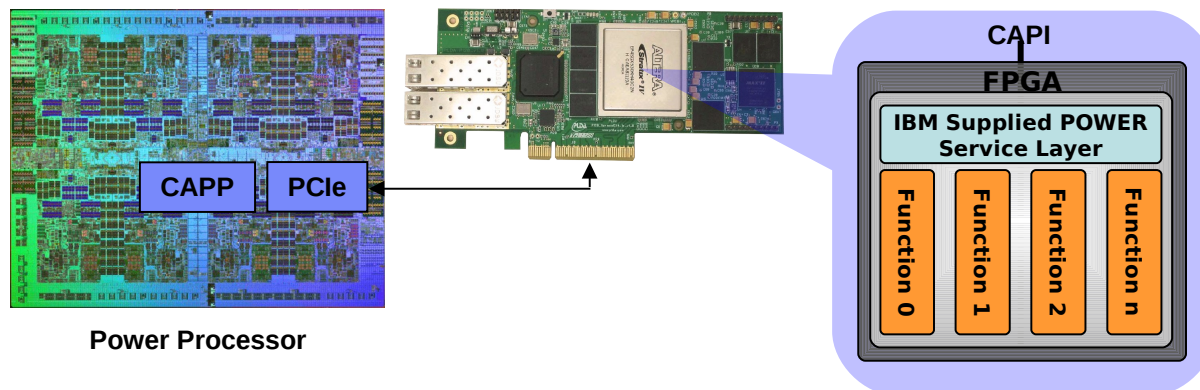
What is CAPI?



CAPI: Coherent Accelerator Processor Interface

- Simple SMP Coherence Protocol transported over PCI Express interface
- Support Unit in the Processor (“CAPP”) provides isolation and filtering
- Standard “POWER Service Layer” in accelerator device manages caching and address translation
- Accelerator Functional Units operate as part of the application at user level (just like a CPU)

CAPI Overview



Typical I/O Model Flow



Flow with a Coherent Model



Advantages of Coherent Attachment Over I/O Attachment

- **Virtual Addressing & Data Caching**
 - Shared Memory
 - Lower latency for highly referenced data
- **Easier, More Natural Programming Model**
 - Traditional thread level programming
 - Long latency of I/O typically requires restructuring of application
- **Enables Applications Not Possible on I/O**
 - Pointer chasing, etc...

Monte-Carlo CAPI Acceleration



Running
1 million iterations

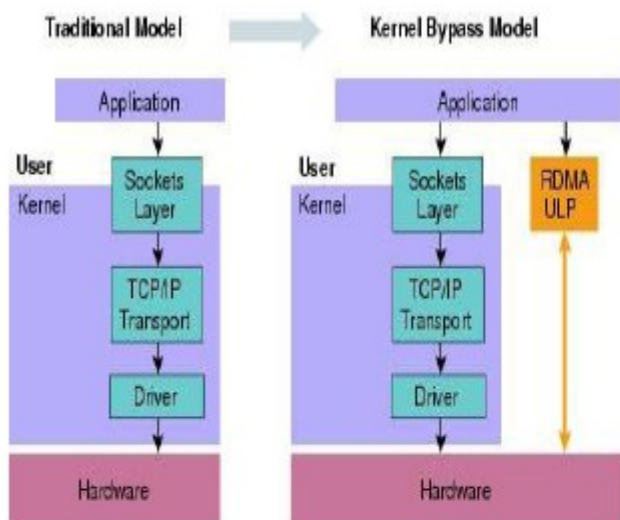
At least
250x Faster
with CAPI FPGA +
POWER8 core

Full execution of a Heston
model pricing for a single
security:

1. SOBOL sequence generator (pRNG)
2. Inverse Normal to create the non-linear distribution
3. Path-generation
4. Pay-off function

Easier to Code: reduces C code writing by **40x** compared to non-CAPI FPGA

Business analytics acceleration



IBM Power Systems and Mellanox® Technologies partnering to simultaneously accelerate the network and compute for NoSQL workloads

10x
Higher
Throughput

Dramatically faster
responsiveness to
customers!

Utilizing high speed
interconnect with
RDMA (Ethernet,
InfiniBand)

10x
Lower Latency

Increasing your
datacenter
efficiency!

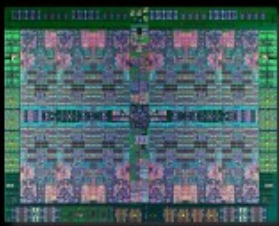
Leveraging POWER8
high throughput low
latency I/O

"Applications that historically struggled with scalability and performance can now benefit from In-Memory processing," said Terri Virnig, Vice President, IBM Power Ecosystem. "Our collaborative efforts with Mellanox resulted in a robust architecture with Power8-based systems and high-performance interconnects designed to tackle the Big Data processing requirements of today."

IBM & NVIDIA Accelerating Computing

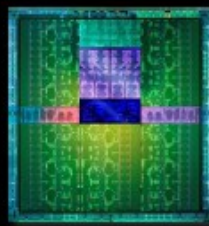
Next-Gen IBM Supercomputers and Enterprise Servers

Long term roadmap
integration



POWER
CPU

+



Tesla
GPU

OpenPOWER Foundation

Open ecosystem built on
Power Architecture



Google



TYAN

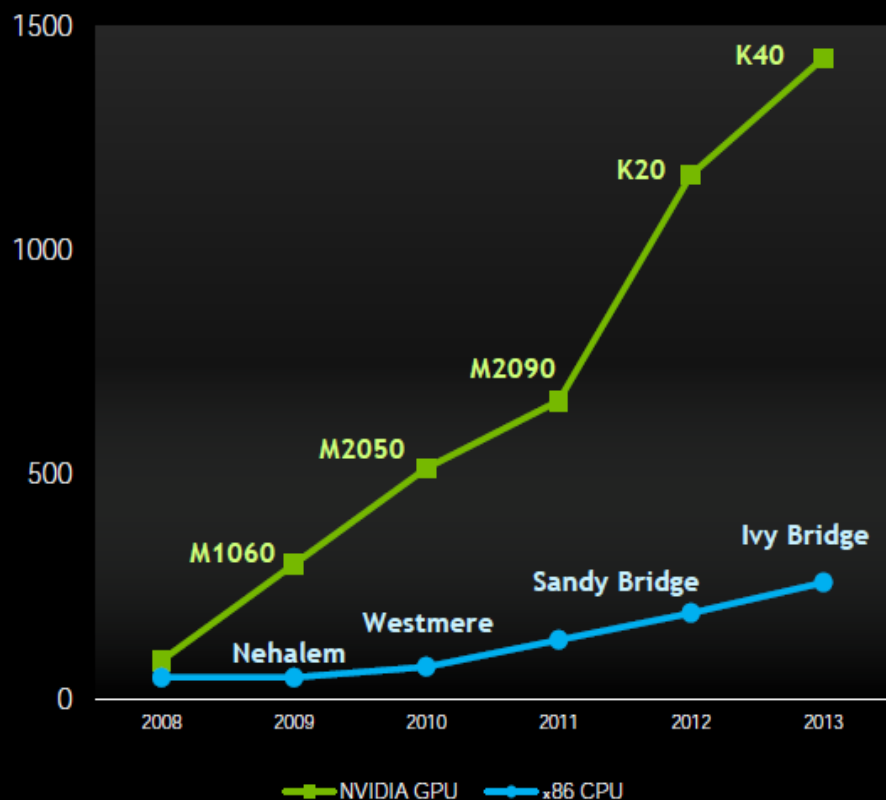
& 30+ more...

1st GPU-Accelerated POWER-Based Systems Available in Oct 2014

Performance Gap Continues to Grow

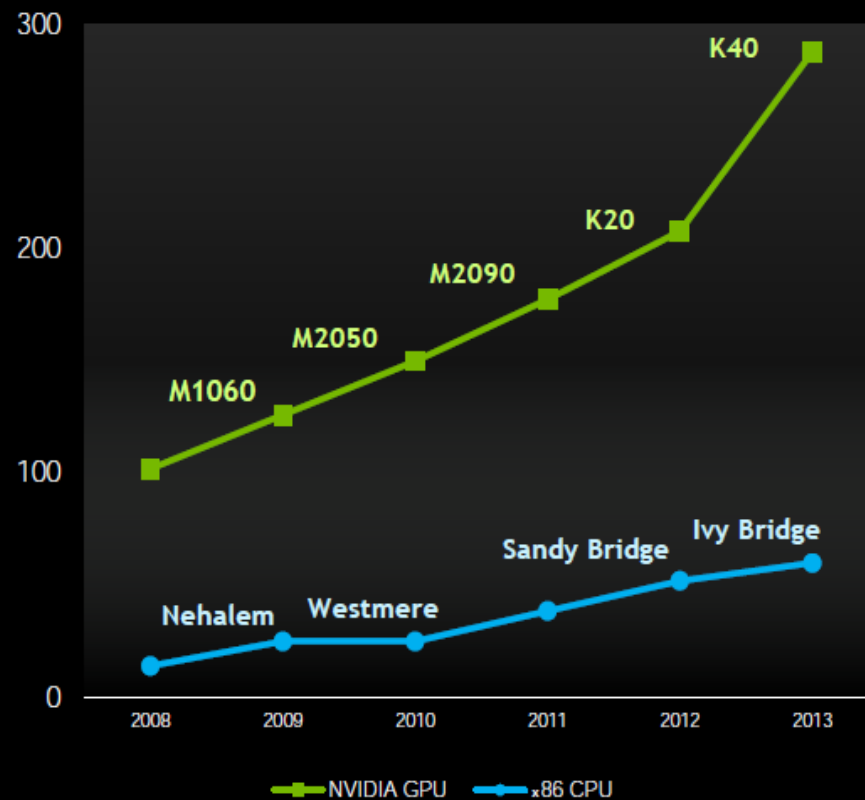
Peak Double Precision FLOPS

GFLOPS



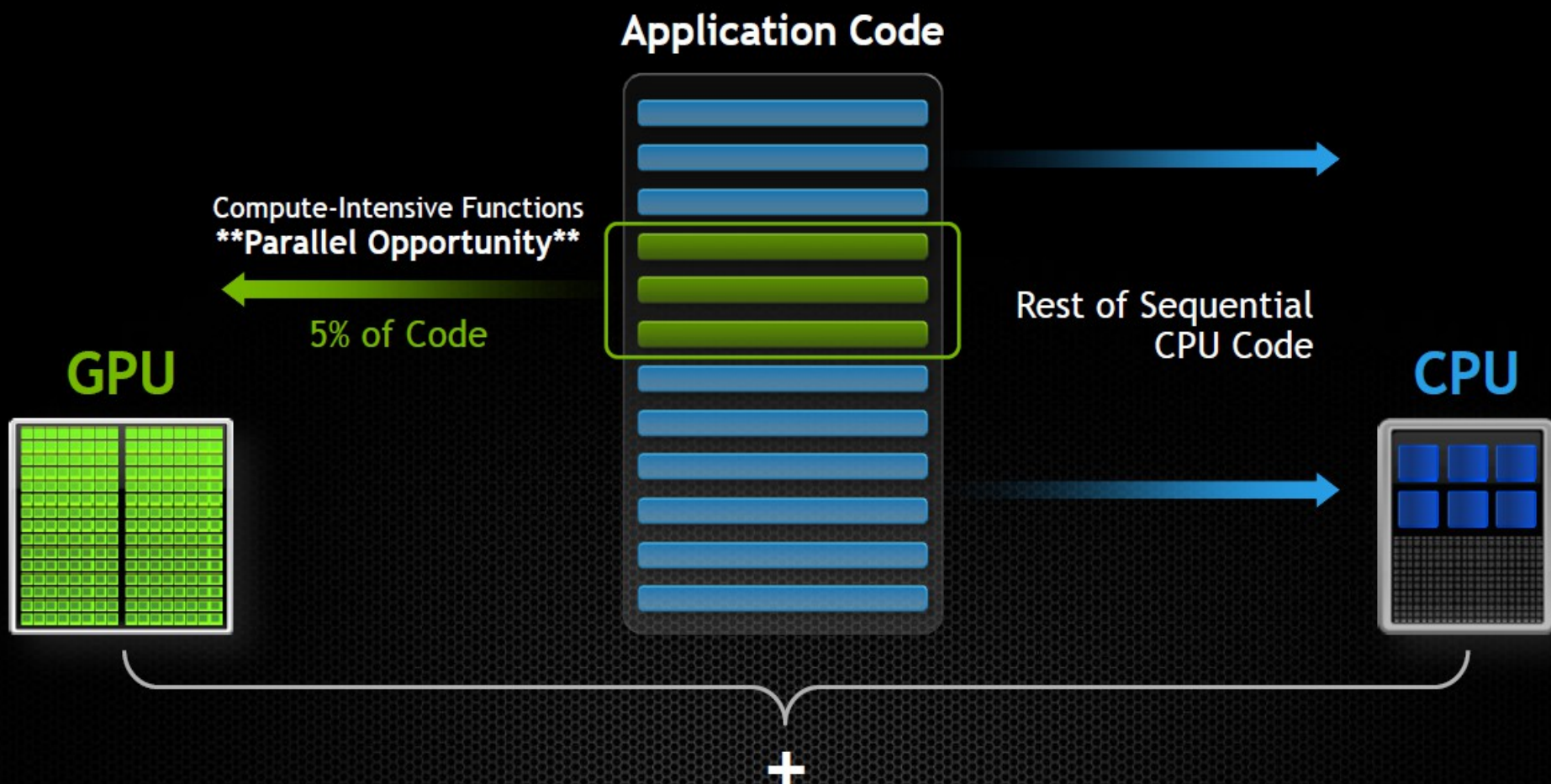
Peak Memory Bandwidth

GB/Sec



How GPU Acceleration Works

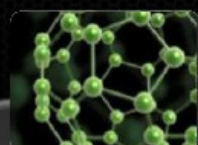
The Right Processor for the Job



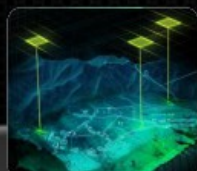
Accelerating Mainstream Datacenters



Oil & Gas



Higher Ed



Government



Supercomputing



Finance



Web 2.0

Schlumberger



PETROBRAS



Paradigm



Chinese Academy of Sciences

Georgia Tech



HARVARD School of Engineering and Applied Sciences



STANFORD UNIVERSITY



Air Force Research Laboratory

Raytheon



Naval Research Laboratory

MITRE



CSCS

Swiss National Supercomputing Centre



NCSA

Tokyo Institute of Technology



OAK RIDGE National Laboratory

J.P.Morgan



BARCLAYS



STANDARD LIFE



BNP PARIBAS



MUREX™

Baidu 百度



SHAZAM

amazon.com

GPU Acceleration Coming to Java

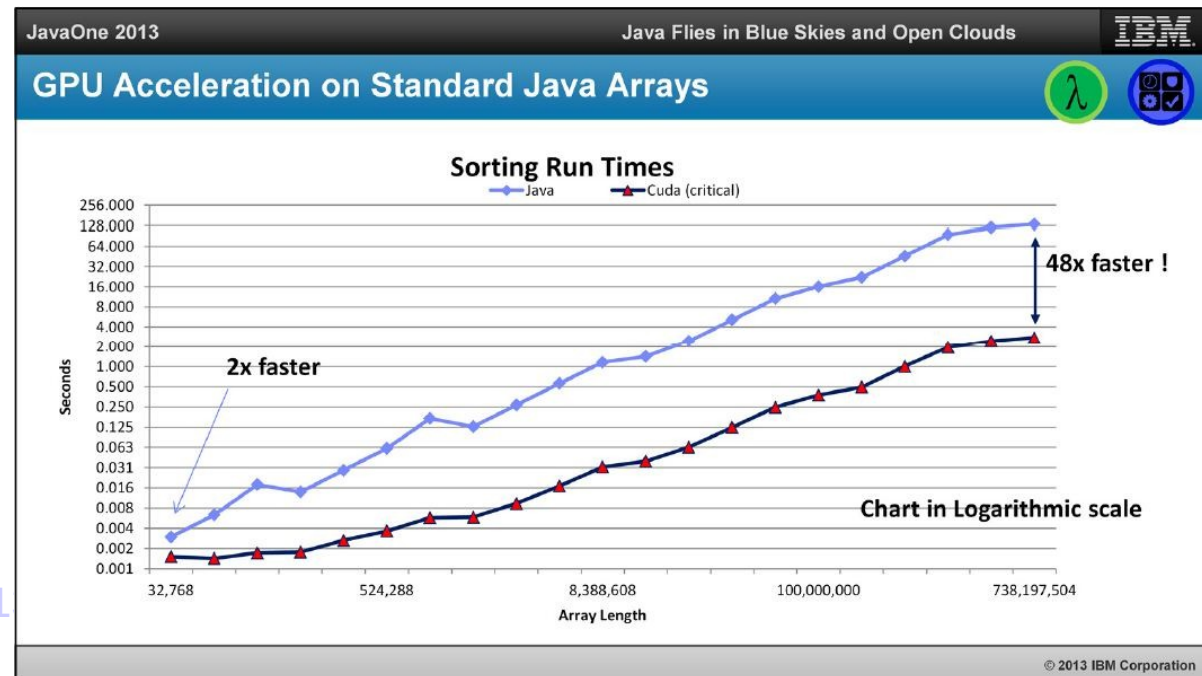
- “Duimovich also referenced **OpenPOWER**, which is a new ecosystem around the POWER architecture driving innovation to the platform by leveraging the power of open markets and partners like NVIDIA. **The Java on GPU development is one in a series of impacts of the OpenPOWER announcement.**” - **John Duimovich**, IBM's Chief Technology Officer of Java

- <http://blogs.nvidia.com/blog/2013>



GPU Acceleration Coming to Java, Says IBM Exec

By Sumit Gupta on September 22, 2013

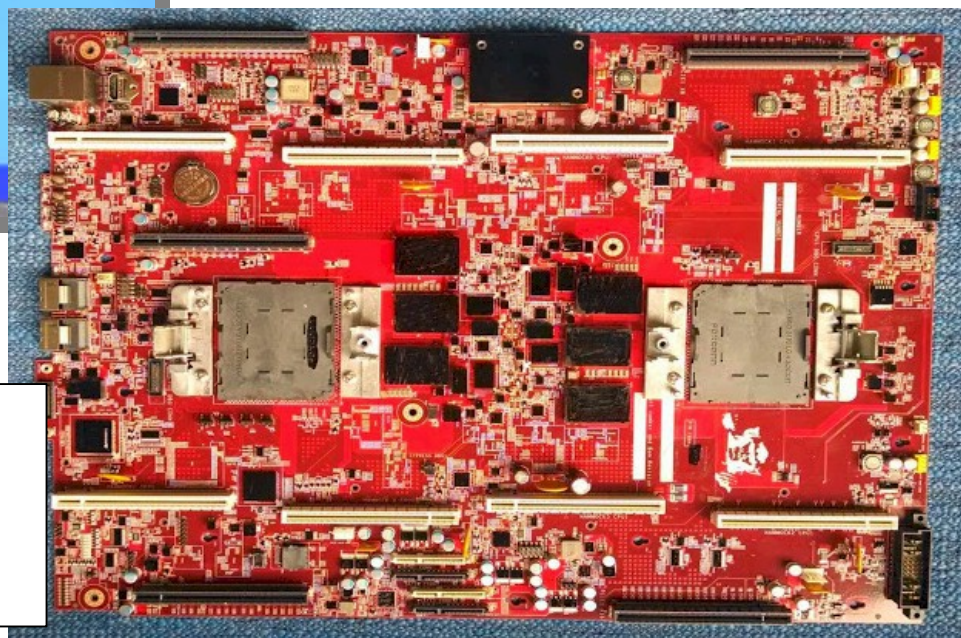


Non-IBM POWER8 products



The Tyan reference (ATX) board, SP010, measures 12" by 9.6"

- one single-chip module (SCM)
- four DDR3 memory slots
- four 6 Gb/sec SATA peripheral connectors
- two USB 3.0 ports
- two Gigabit Ethernet network interfaces
- keyboard and video
- intended for developers



The Google reference board

- two single-chip module (SCM)
- four modified SATA ports
- Google use only

Announcing a new generation of

Power Systems: Open innovation to put data to work

Designed for Big Data

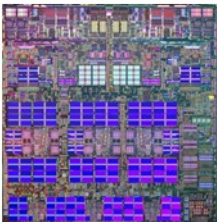
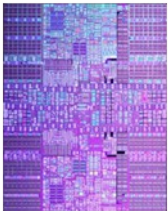
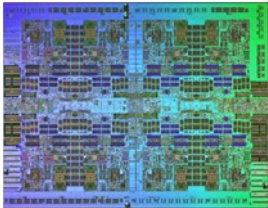
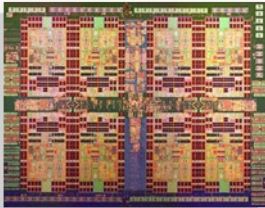
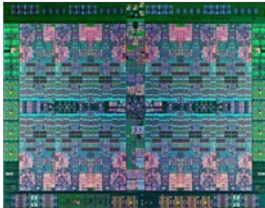
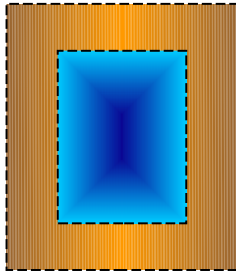
First server processor
generation optimized for
big data and analytics
with POWER8
innovative design

Superior Cloud Economics

Superior cloud
price/performance
advantages and
security to move data-
centric applications to
the cloud

Open Innovation Platform

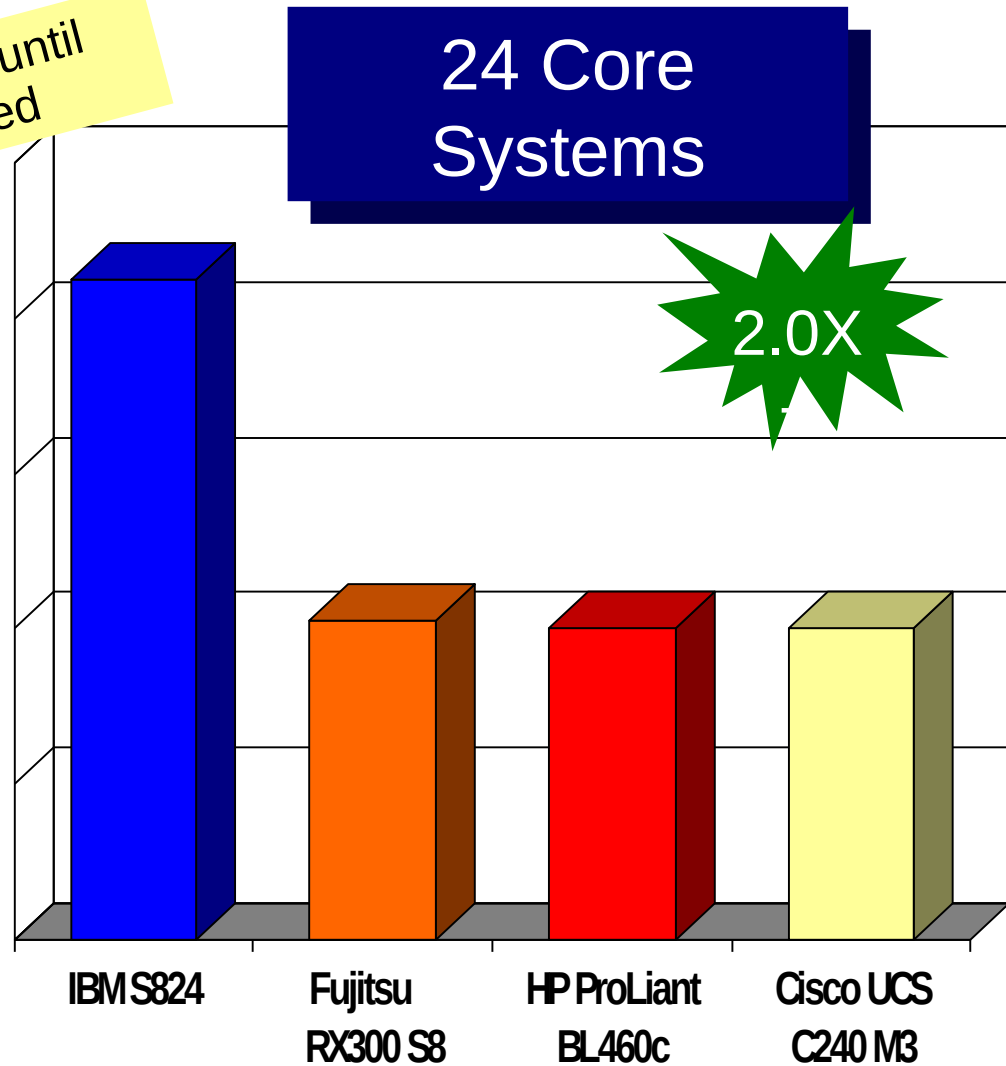
Delivering an open
server ecosystem
revolutionizing the way
IT is developed &
delivered

	POWER5 2004	POWER6 2007	POWER7 2010	POWER7+ 2012	POWER8	POWER9
						
Technology	130nm SOI	65nm SOI	45nm SOI eDRAM	32nm SOI eDRAM	22nm SOI eDRAM	✓ Extreme Analytics Optimization
Compute						✓ Extreme Big Data Optimization
Cores	2	2	8	8	12	✓ On-chip accelerators
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	

Early view – do not share until
audited results approved

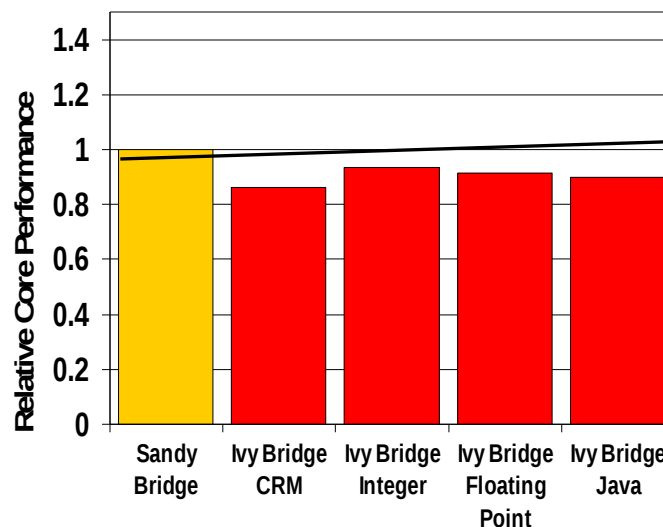
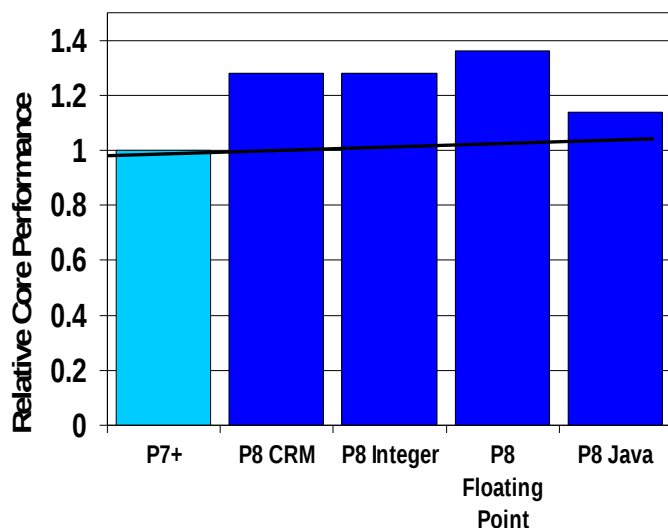
2X

Better performance
Than nearest x86
competition



POWER8 moves forwards while x86 moves backwards

IBM POWER processors continue to deliver improved core performance – up to +35% versus POWER7+ while Intel went backwards (-10%) with Ivy Bridge versus Sandy Bridge.



Performance is based on published x86 data and published/projected POWER7+ & POWER8. Workloads are ERP, Integer, Floating Point, Java

Power Systems: Innovation to put data to work

POWER8 Signature Innovation

Processor and Memory

- Up to 12-core POWER8 processor card
- Simultaneous Multithread Thread (SMT) 8 per core
- Transactional Memory
- Java™ Code Optimization w/HW Assist

I/O Improvement

- PCIe Gen 3
- Coherent Accelerator Processor Interface

RAS

- RAID 0, 5, 6, 10 in the base, JBOD storage
- Concurrent maintenance PCIe Gen3 slots

New naming



**Power Systems
S824**

- 2-socket, 4U
- Up to 24 cores
- AIX, IBM i, Linux



**Power Systems
S814**

- 1-socket, 4U
- Up to 8 cores
- AIX, IBM i, Linux



**Power Systems
S822**

- 2-socket, 2U
- Up to 20 cores
- AIX & Linux



**Power Systems
S822L**

- 2-socket, 2U
- POWER8 processor
- Up to 24 cores
- Linux only



**Power Systems
S812L**

- 1-socket, 2U
- POWER8 processor
- Up to 12 cores
- Linux only
- 2H14

1 & 2 Sockets



POWER8 Scale-Out April 2014 System Highlights

Affordability with improved performance, virtualization, energy efficiency and reliability for IBM i, AIX and Linux applications

Power S812L / S822L

1 & 2 socket, 2 rack units
with 10-12 and 20-24 cores
Up to 1 TB of memory
Linux only
S812L GA September 2014
S822L GA June 2014



Power S814

1 socket, 4 rack units
6 & 8 core processor options *
Up to 512GB of memory with exp
Tower & rack



Scale-out Linux server based on open technology

*Scale-out technology for mid-sized business solutions
* 4 core option available 2H14*

POWER8 architecture

Power S822

2 socket, 2 rack units
6-20 total core processor options
Up to 1TB of memory



Scale-out application server for secure infrastructure built on open technology



Power S824

2 sockets, 4 rack units
6-24 total core processor options
Up to 1TB of memory with exp






Scale-out technology server for faster insights from data

Attractive TCA

PowerLinux 7R1 vs. Dell R720

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

Dell PowerEdge R720 \$16,935  	IBM PowerLinux 7R1 \$15,404  
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PowerLinux 7R2 vs. HP DL380 G8

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





HP ProLiant DL380 G8 \$21,707  	IBM PowerLinux 7R2 \$23,957  
--	--

PowerLinux 7R4 vs. HP DL580 G7

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

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

Power IFLs vs. Intel x86 scale out

\$16,935  8-cores	\$21,707  16-cores	<p>Power IFL</p> <p>\$8,591* (4-cores) \$78,280 (32-cores)</p>  <p>Activate 4 cores per Power IFL</p>
\$67,439  32-cores		

* Does not include Linux OS

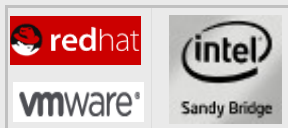
IBM Power 822L pricing comparison (\$US) – vs. *Ivy Bridge*

Comparable TCA

Linux on Intel
Ivy Bridge +
VMware
Vs.
Linux on Power8
with PowerVM

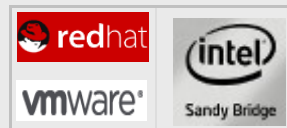
Dell PowerEdge
R720

\$28,366



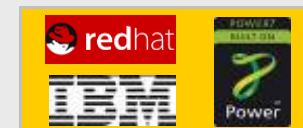
HP ProLiant
DL380 G8

\$29,829



IBM Power
822L

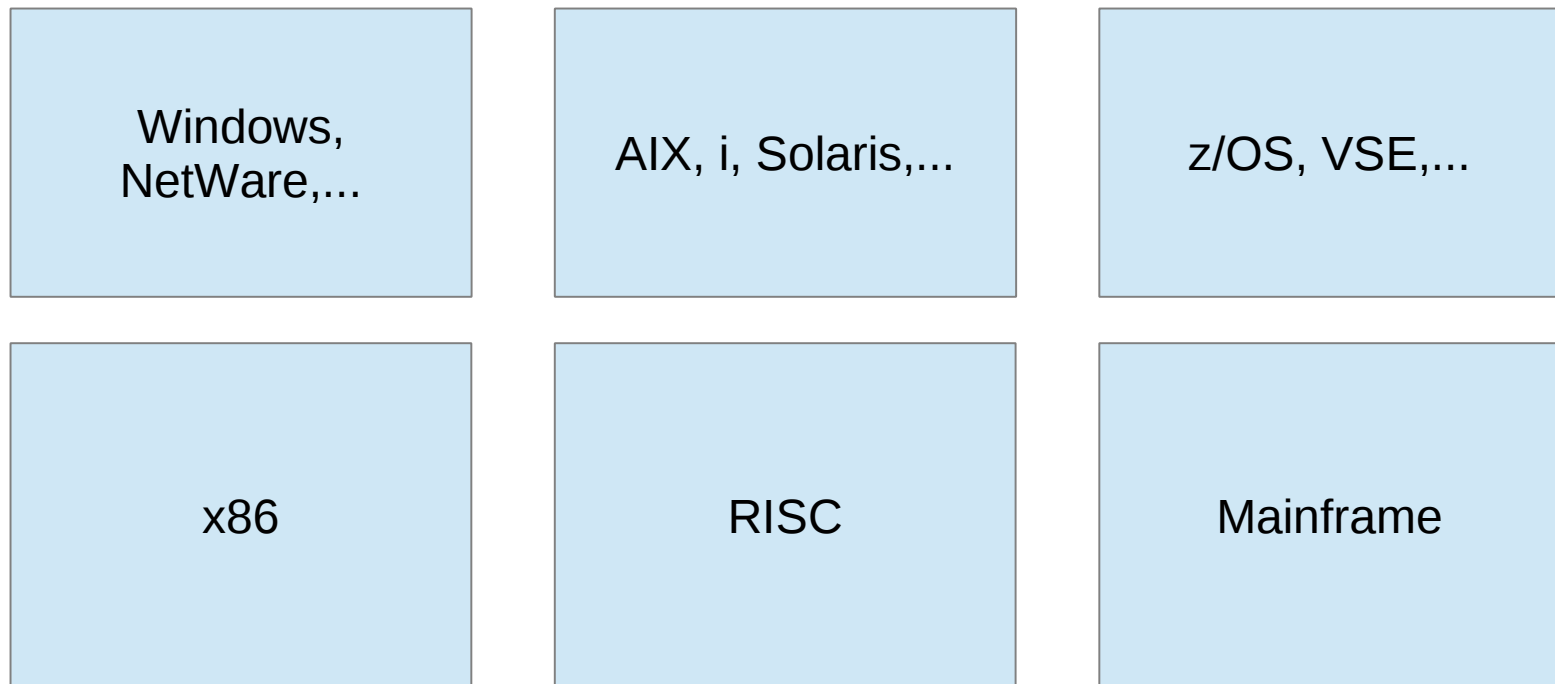
\$29,264



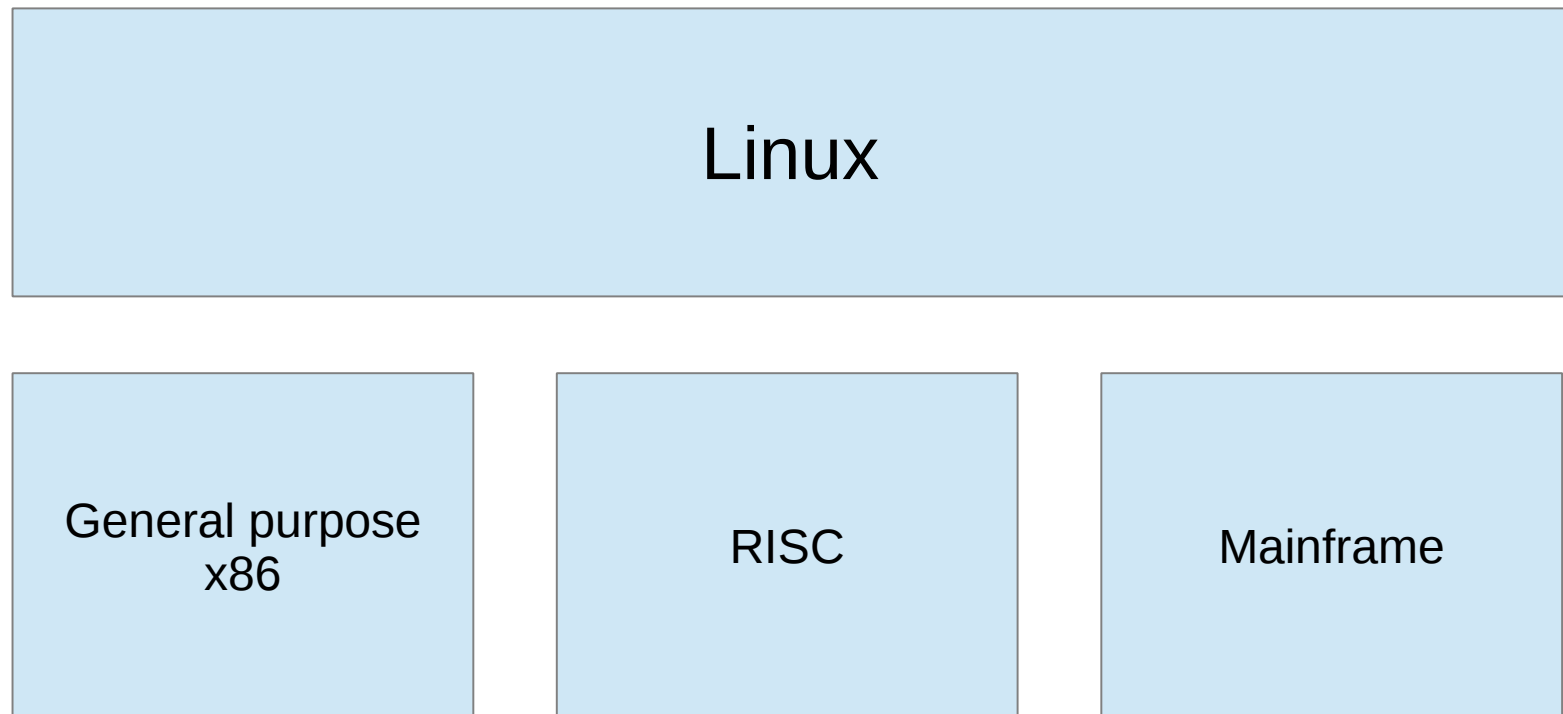
Server list price* -3-year warranty, on-site	\$12,605	\$14,068	\$14,895
Virtualization - OTC + 3yr. 9x5 SWMA	\$10,064 VMware vSphere Enterprise 5.1	\$ 10,064 VMware vSphere Enterprise 5.1	\$9,880 PowerVM for IBM PowerLinux
Linux OS list price - RHEL, 2 sockets, unlimited guests, 9x5, 3 yr. sub./ supp.	\$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: (Total cost of acquisition)	\$28,366	\$29,829	\$29,264

Server model	Dell R720	HP ProLiant DL380p G8	IBM Power 822L
Processor / cores	Two 2.7 GHz , E5-2697, Ivy Bridge, 12-core processors		Two 3.4 GHz POWER8, 10-core
Configuration	64 GB memory, 2 x 300GB 15k HDD, 10 Gb two port		Same memory, HDD, NIC

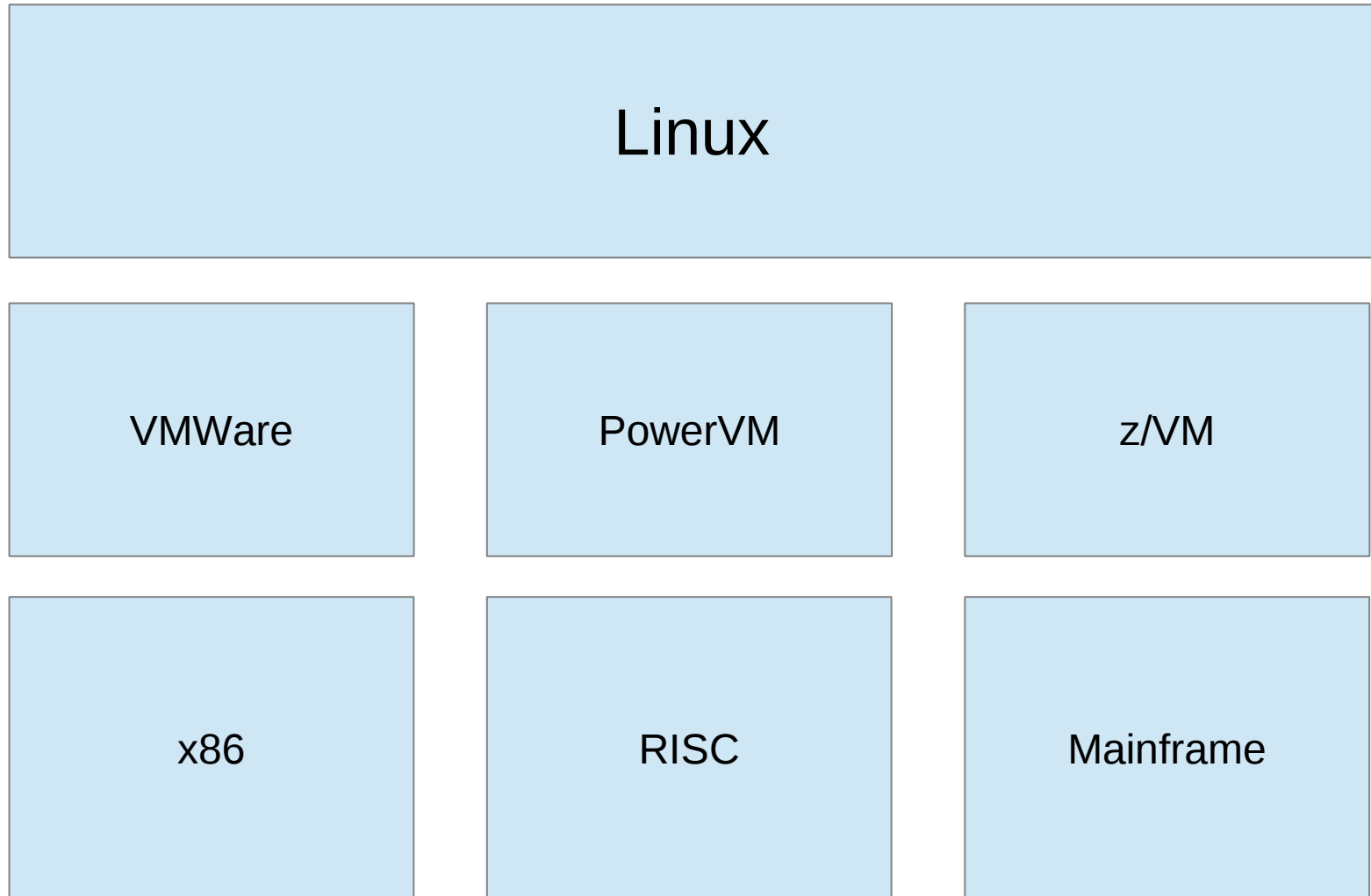
Evolution of the datacenter



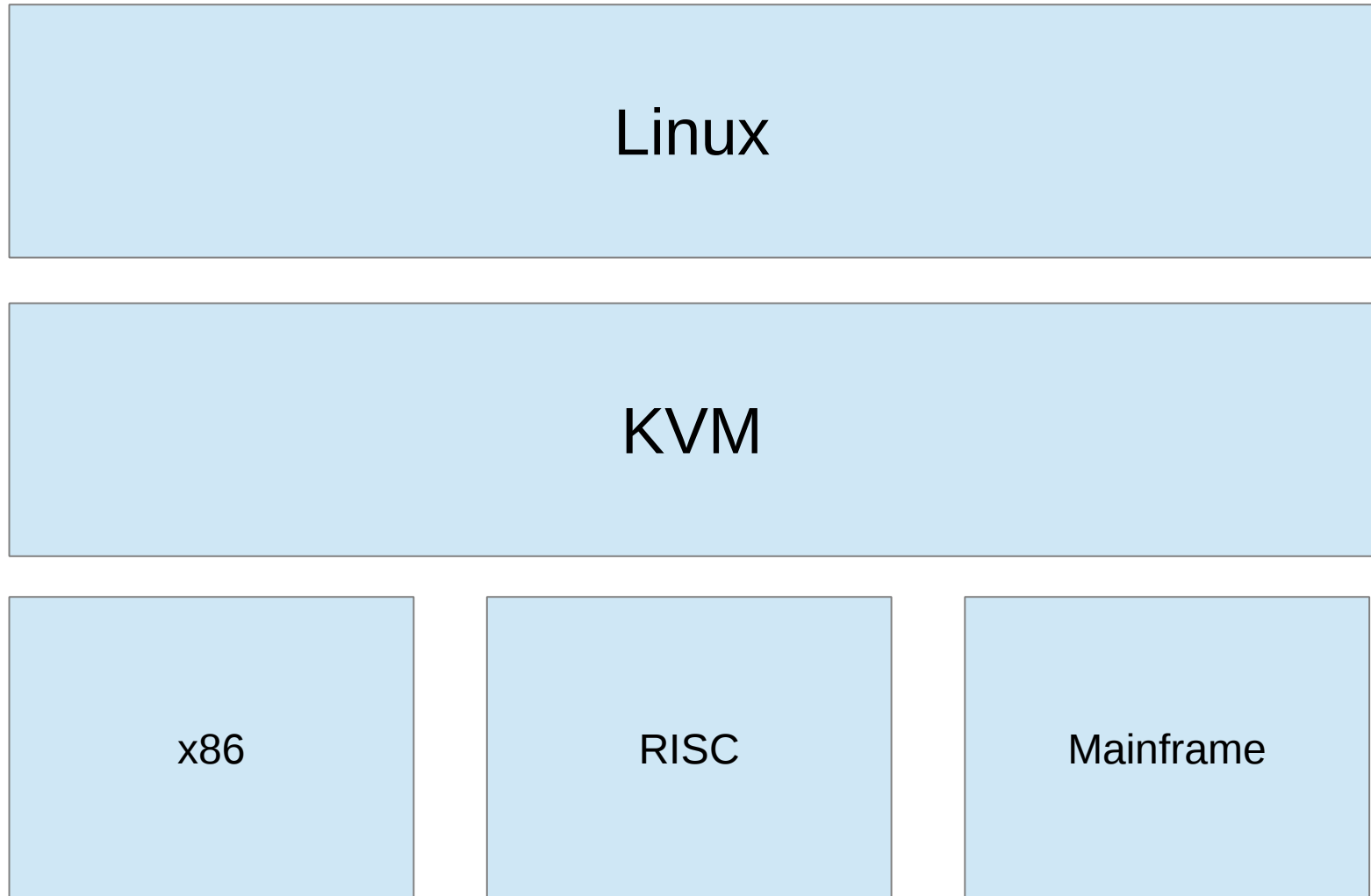
Evolution of the datacenter



Evolution of the datacenter



Evolution of the datacenter



Linux on Power – Hypervisor choice

Market need: customer wants to avoid coping with multiple virtualization engines :

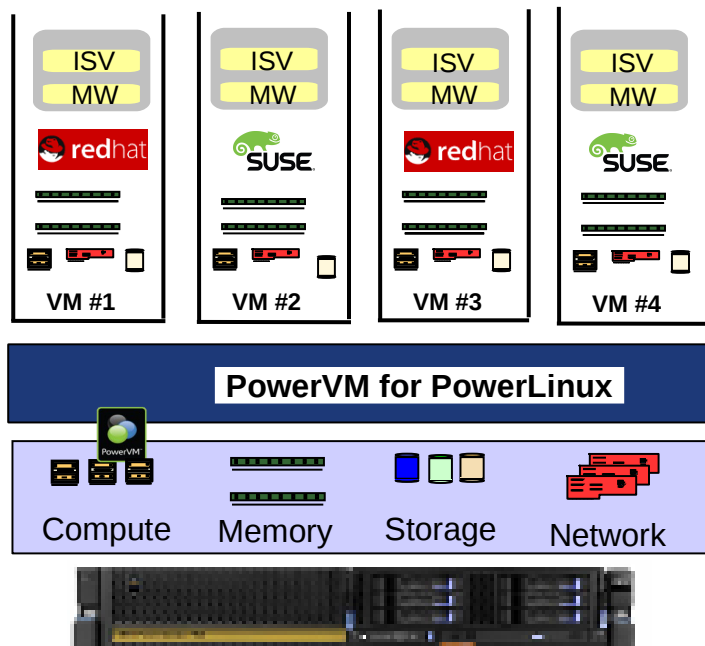
- Skills
- Migration issues
- Processes
- Licensing

Fact : KVM is the only virtualization available on every platform :

- KVM is a versatile virtualization engine :
 - Intel
 - Power
 - System z (zBX)
 - IBM Pure Systems
- Optimized for POWER8
- KVM centers for excellence opened :
 - KVM Center of Excellence in Beijing
 - KVM Center of Excellence for Wall Street in NY

PowerLinux enables flexible, more efficient delivery

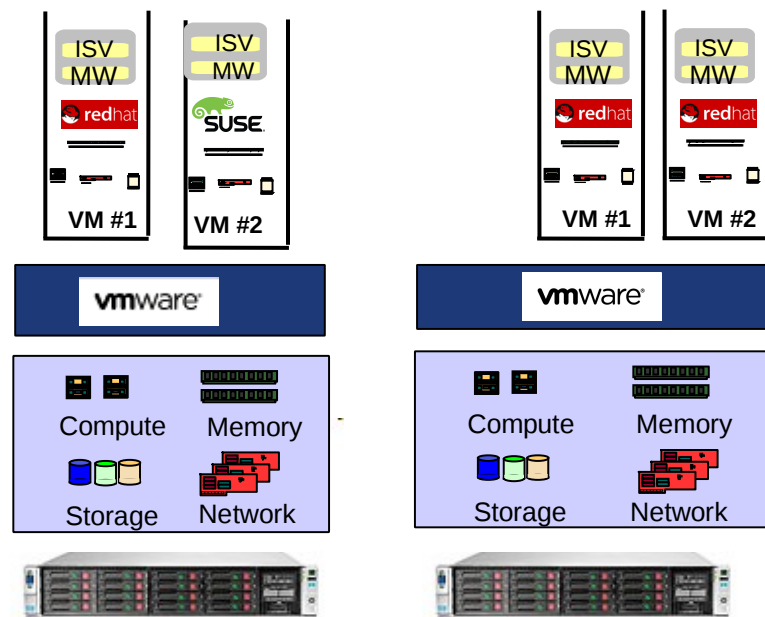
PowerLinux and PowerVM Benefits



47-53% average sustained utilization

- Move resources to the workload
 - Memory - dynamically add or remove
 - Compute, Storage - shared pools
 - Linear scalability, high demand workloads
 - Changes transparent to running workloads
- HW hypervisor
- 0 security vulnerabilities, I/O driver isolation

x86 Linux with VMware comparison



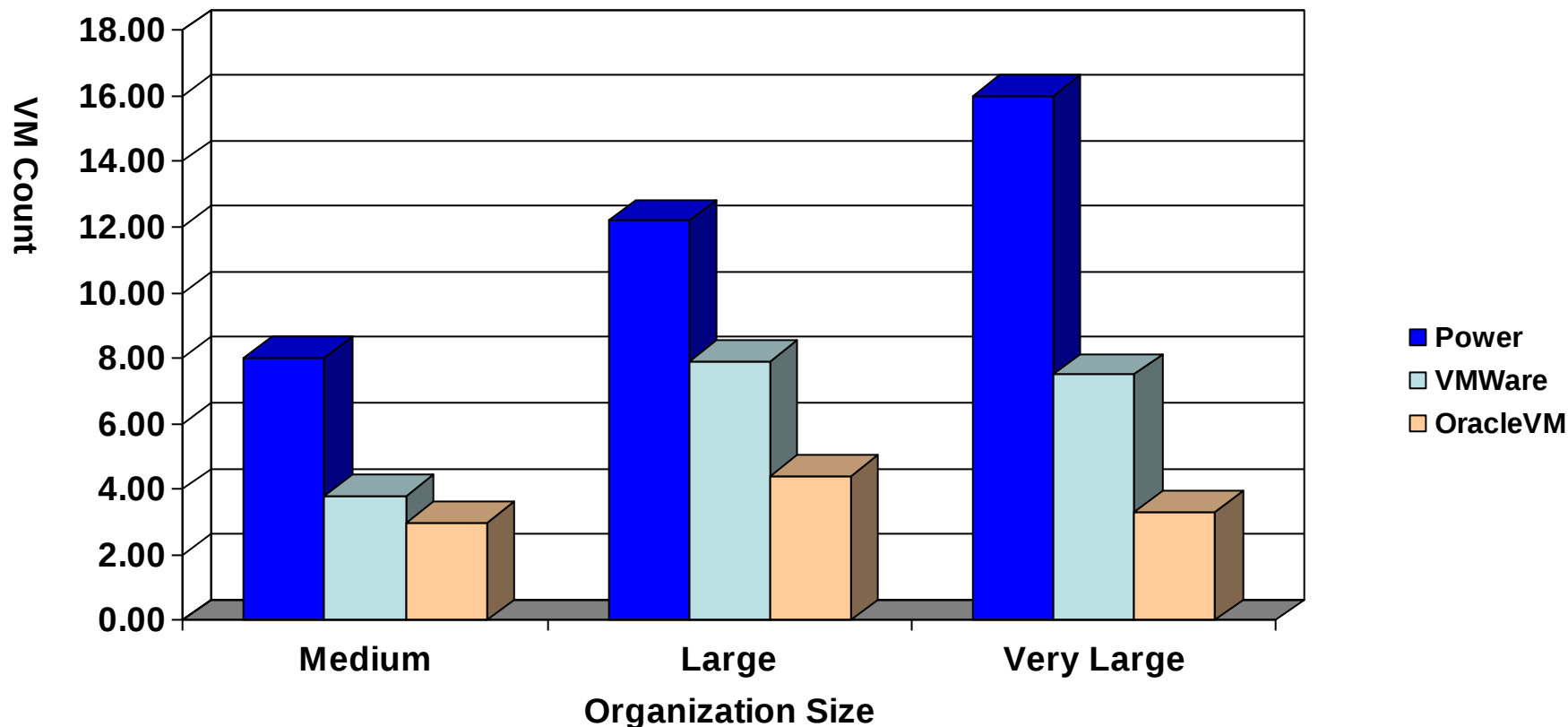
30-35% average sustained utilization

- Less flexible resource allocation
 - Memory - add but not remove
 - Compute – add and remove (no OS support)
 - Smaller workloads, less throughput per VM
 - Move workloads to the resources
- SW hypervisor
- 113 security vulnerabilities, sw patch maint.

Survey confirms superior workload Density

- Survey included more than 61,320 environments
- Industry representation covers manufacturing, distribution, healthcare, retail, financial, public sector, communications, and a miscellaneous group

Workload Density Summary












Source: <http://www-03.ibm.com/systems/power/software/virtualization/platformmatters.html>

PowerKVM & Power Goals & Strategy

- Provide Open Source Server Virtualization Offering for Power Targeted to new Linux Workloads
- Provide simplicity and familiarity for VMware and **KVM** Intel Linux Admins
- Accelerate adoption of Power Linux Systems by having a Linux oriented virtualization offering
- Allow cloud providers to easily integrate Power Linux servers into their **OpenStack** environments

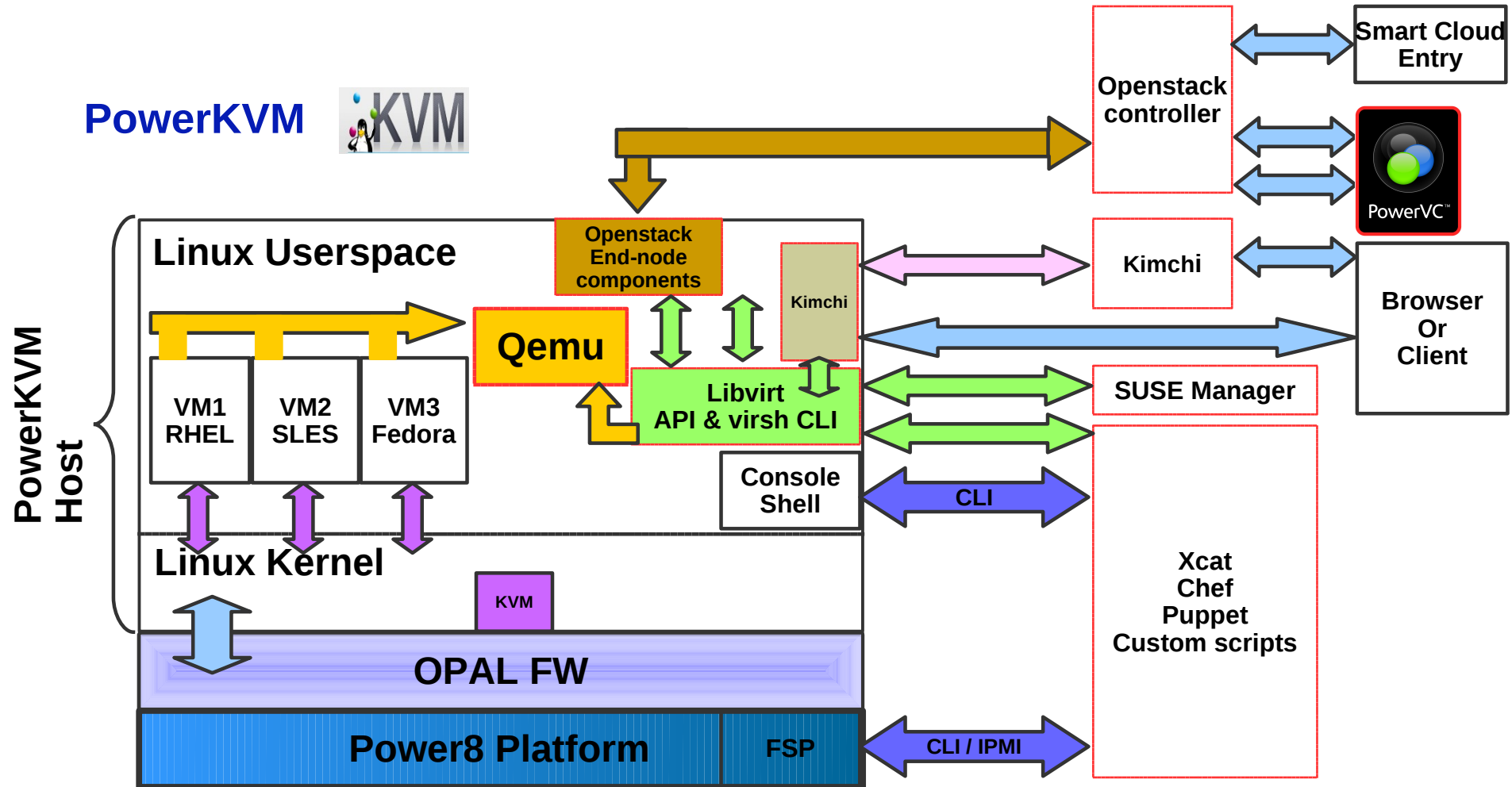


PowerVM to PowerKVM Comparison

	PowerKVM 	PowerVM 
Managers	PowerVC, OpenStack, libvirt, Open Source Tools	HMC, IVM, FSM, PowerVC, ISD VMControl
Guest VM Types	  	   
Host Software	Linux MCP/KVM Hypervisor	VIO Server IO Virtualization
Firmware	Linux Firmware Hardware Abstraction Boot services Standalone Diagnostics	Phyp Firmware - Hypervisor
Hardware	Power 8 Linux only Hardware	P6, P7, P8 Hardware

KVM on Power... What?

PowerKVM



PowerKVM Exploits POWER8 Micro-Threading



Traditional PowerVM and PowerKVM Dispatches the complete core to the VM

CPU Core



SMT1-8

PowerKVM with Micro-Threading Dispatches Multiple VMs on a single core at the same time.

CPU Core 4/1 Division



SMT1-2

Good for many small VMs / Workloads. Enabled with the PowerKVM ppc64_cpu command. 4/1 Division is only option initially.

PowerVM vs PowerKVM Comparison

	PowerVM	PowerKVM
GA Availability	Now since 2004	Q2 2014
Supported Hardware	All P6, P7, P7+, P8 Systems	S812L, S822L
Supported Guest OS	AIX, IBM i & Redhat, SUSE Linux	Redhat, SUSE & Ubuntu Linux
Workload Mobility	Supports AIX, IBM i & Linux	Linux
Basic Virtualization Management	IVM/HMC/FSM	Virtman/libvirt/Kimchi
Advanced Virtualization Management	PowerVC/VMControl	PowerVC, Vanilla OpenStack
Admin Type	Power Centric	Linux/x86 Centric
Established Security Track Record on Power	Yes	No
Open Source Hypervisor	No	Yes
Complete Hardware Awareness & Exploitation	Yes	Partial

Simple Decision Tree – When should I use PowerKVM?

1. Using P8 scale-out Linux only (S812L, S822L) Hardware?

Yes = PowerKVM assuming characteristics below

Characteristics of a client interested in PowerKVM

Open Source Oriented, Not Power Knowledgeable, KVM Already in Use, Linux only workloads, Linux Centric Admins

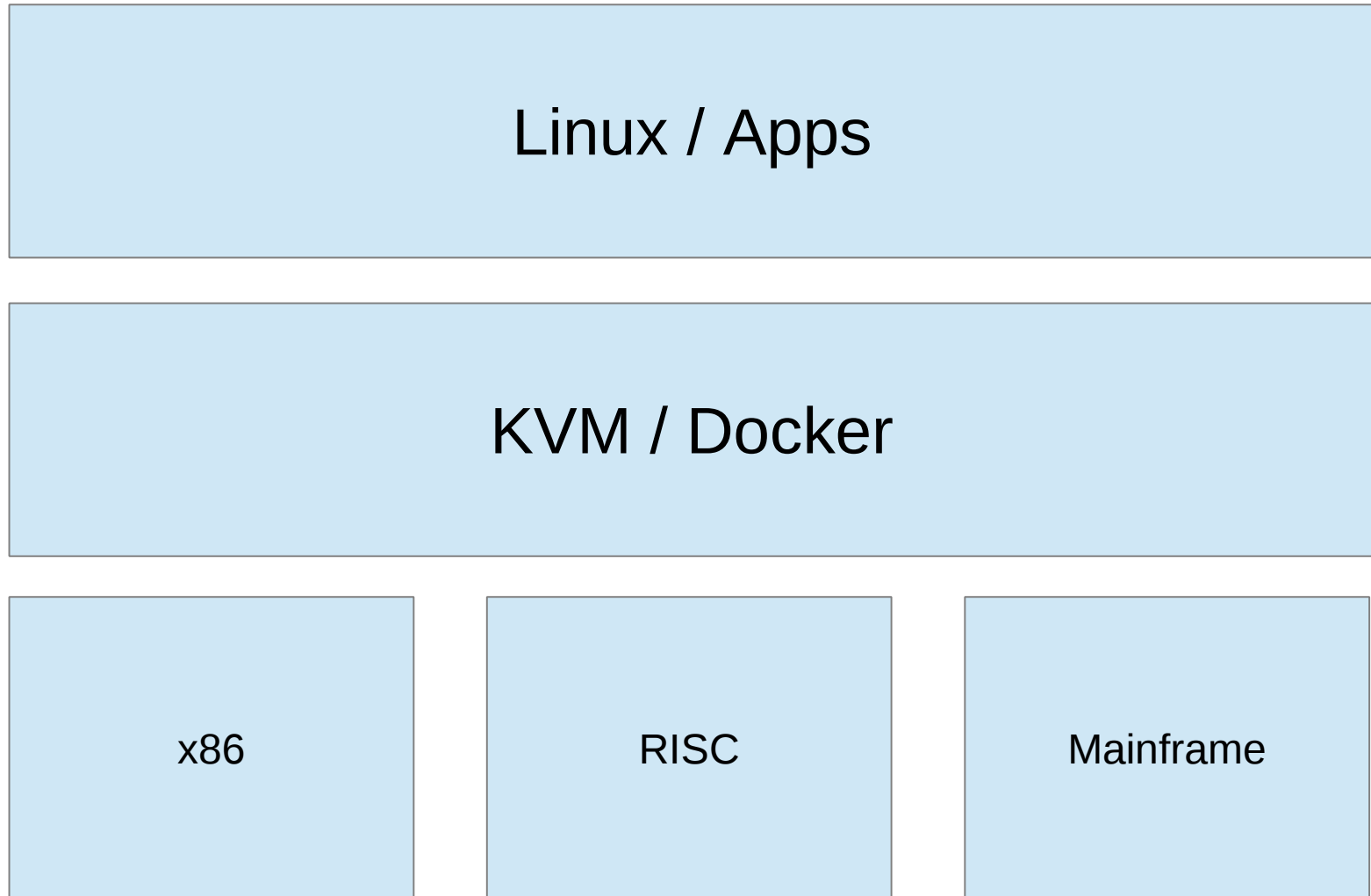
Otherwise ...

Use PowerVM

PowerVM is the only Choice For Following Criteria

- AIX or IBM i workloads
- Pre-P8 Machines
- Mobility is required between physical servers supporting multiple OS es (AIX, IBM i & Linux)

Evolution of the datacenter



Linux on Power – Open

Market perception: Power is a proprietary architecture

- No sharing of technical specs
- Only IBM can build Power servers
- Only certified BPs can sell PowerLinux
- Only supported distros (RHEL and SLES) are allowed

Fact : The IBM Power Systems are more open than Intel

- OpenPOWER consortium implies sharing of technical specs
- Firmware and system software being open sourced
- PowerLinux is open distribution
- KVM and Ubuntu GA in June 2014
- Choice of commercial AND community distros :
 - RHEL
 - SLES
 - Ubuntu
- Fedora : http://fedoraproject.org/get-fedora-options#2nd_arches
- OpenSuse : <http://download.opensuse.org/ports/ppc/>
- Debian : <http://www.debian.org/distrib/>
- CentOS : 2H 2014

PowerLinux supports RHEL and SLES releases

SUSE and Red Hat Enterprise versions supporting POWER7:



✓ SUSE Linux Enterprise Server 11

- Full support of POWER7 (native mode)
- Earliest supported release: SLES 11 base
- Last update: SP2 GA February 2012

✓ SUSE Linux Enterprise Server 10

- Enabled for POWER7 in P6-compatibility mode
- Earliest supported release: SP3
- Last update: SP4 GA April 2011



✓ Red Hat Enterprise Linux 6

- Full support of POWER7 (native mode)
- Earliest supported release: RHEL 6 base
- Last update: U3 GA June 2012 (U4 planned for Feb. 2013)

✓ Red Hat Enterprise Linux 5

- Enabled for POWER7 in P6-compatibility mode
- Earliest supported release: U5
- Last update: U8 GA February 2012

Canonical

The company behind Ubuntu

2004

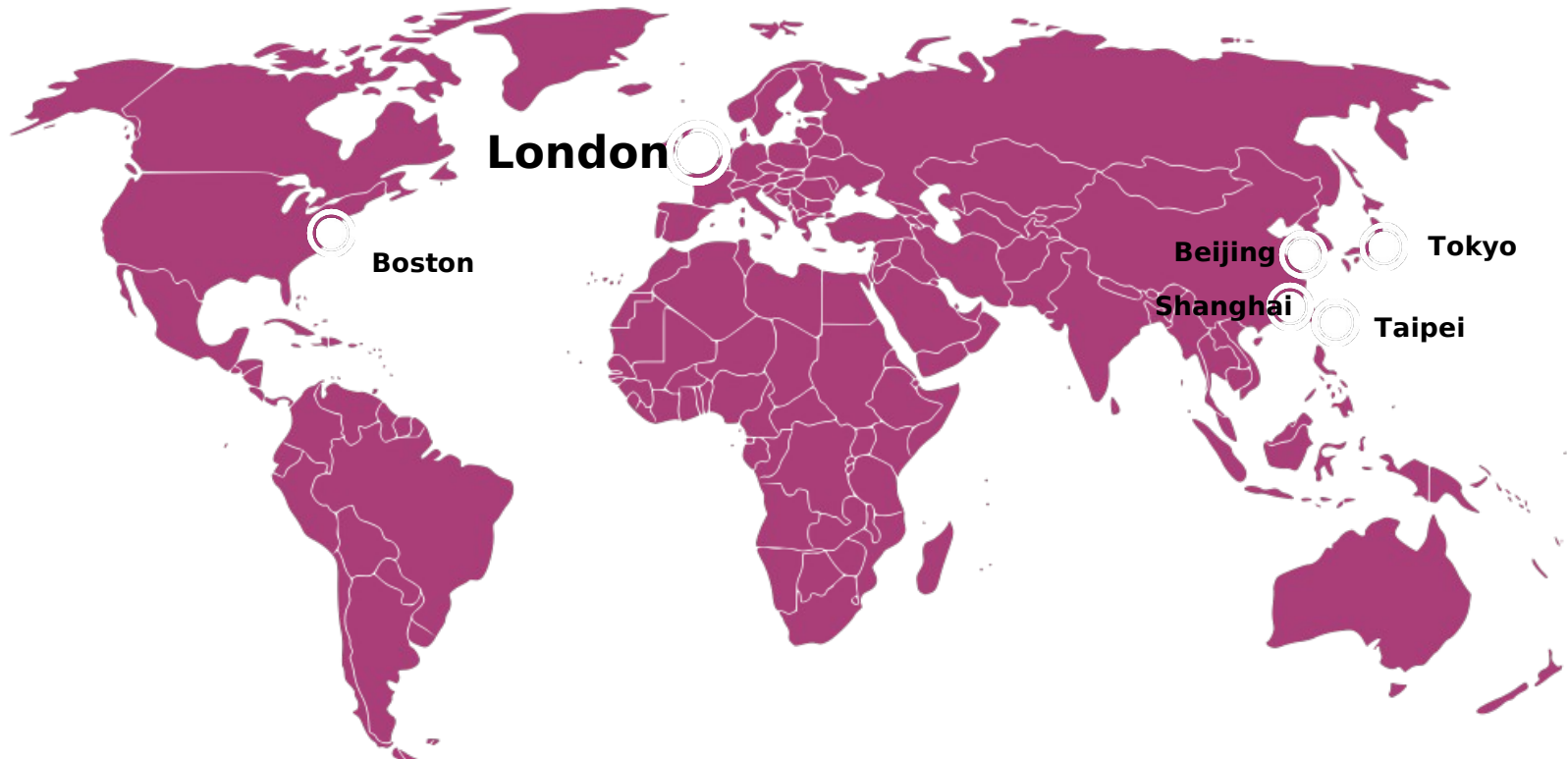
FOUNDED

600+

EMPLOYEES

30+

COUNTRIES



A different model

Ubuntu OS available at no-cost but supported when you need it to be.



fedora



CentOS



SUSE



debian



openSUSE



redhat

The Ubuntu Scale Out and Cloud Partner Ecosystem expands with IBM Power8

- *“Openness is also key to cloud and scale out and IBM has not forgotten about this either. **With Power8, led by the OpenPOWER Foundation, IBM accelerated the opening up of the server architecture design to facilitate an increase in implementations of the POWER architecture across a diverse vendor ecosystem. Today the OpenPOWER foundation announced 25 new members as well as a roadmap for future OpenPOWER developments.**” - John Zannos, Vice President of Cloud Alliances*

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The Ubuntu Scale Out and Cloud Partner Ecosystem expands with IBM Power8



The adoption of public and private clouds has continued to grow, and Canonical has been at the forefront, focusing on scale out and cloud architectures. We have designed Ubuntu, Ubuntu OpenStack and Juju to be optimized for cloud and scale out. Beyond that we recognise that the right ecosystem of hardware and ISVs partners needs to be in place to make sure there is a rich set of solutions.

IBM has announced its next generation of Power Systems which supply an excellent balance of performance and value. More interesting than the speeds and feeds though is focus on two things close to our own hearts: volume and openness.

With Power8, IBM is working to optimize Power as a server platform for scale out and cloud computing. This has meant designing systems to run the completely Open Source software stacks that dominate scale out computing. As smart devops everywhere already know, when it comes to scale out and cloud computing, Ubuntu leads with significant margins so we are pleased to confirm that Ubuntu 14.04 LTS, released just recently on April 17th supports IBM Power8 Linux servers running PowerKVM. One of the key requirements with Ubuntu on Power8 was the automation of provisioning, management and scaling of systems. Much work has gone in to enabling MAAS (Metal As A Service) and Juju (workload orchestration tool) to simplify bringing an entire ecosystem of scale out applications to Power. Whether it is MongoDB, Elastic Search, Cassandra for data analytics, OpenStack for cloud infrastructure or Cloudfoundry for Platform as a Service, Juju can deliver complete solutions to Power instantly to the point where admins do not have to treat Power any differently from any other platform and can focus on scale. That drives volume.

Openness is also key to cloud and scale out and IBM has not forgotten about this either. With Power8, led by the OpenPOWER Foundation, IBM accelerated the opening up of the server architecture design to facilitate an increase in implementations of the POWER architecture across a diverse vendor ecosystem. Today the OpenPOWER foundation announced 25 new members as well as a roadmap for future OpenPOWER developments. This openness was one of the key factors helping us decide to bring Ubuntu to Power Systems, as we understand how it acts as the oxygen needed for clouds and scale out to thrive. Developers love openness, they love Ubuntu too, so Power8, with Ubuntu has all the makings of a formidable combination. We look forward to seeing how it fares.

 **John Zannos**
Vice President of Cloud Alliances
Posted on 28th April 2014
Filed under: [News](#), [Cloud](#), [Server](#)

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What Linux Distributions in various Power Environments?

Linux	Release	Endian	Dedicated LPAR	PowerVM Guest	PowerKVM Guest
Redhat	5.10	Big	✓	✓	✗
Redhat	6.4	Big	✓	✓	✗
Redhat	6.5	Big	✓	✓	✓
SUSE	11 SP3	Big	✓	✓	✓
Exploits P8 Ubuntu	14.04	Little			

1. Select the applications you want to run on Linux on Power
2. Then look at the Linux distributions that are available for those apps
3. Pick your Linux distribution of choice

Linux integration on IBM Power Systems

▪ Factory pre-load

- Distribution or hypervisor of choice
- Virtualization setup for VMs and virtual I/O server
- Plug-in, configure install parameters & connect to Simplified Setup Tool



▪ Installation toolkit

- Includes Simplified Setup Tool for popular workloads
- Provides LTC experience based workload tuning
- Install over 20 value-add RAS and productivity tools
- Browse and search over 60 Linux guides, manuals



▪ SDK (Software Development toolkit)

- Free Eclipse-based development environment

SDK for PowerLinux



▪ Advanced Toolchain

- Latest FSF tools (GNU), IBM bundled, tested, supported

YUM repository



▪ YUM repository

- Single access URL for these value add tools and others

▪ Community resources

- The PowerLinux portal
- Chiphopper Program
- Innovation Centers
- Linux Technology Ctrs.
- Virtual Loaner Program
- Open Source Lab at Oregon State University

Team PowerLinux



Chiphopper Program



Virtual Loaner



OpenPOWER is an easy migration

OpenPOWER software commonality

- Linux – to provide commonality for:
 - Operating system management
 - Operating system feature
 - Application programming model
- Little Endian – to provide source code and data commonality
 - Ubuntu 4/14
 - SUSE 10/14
 - Red Hat 2015
- KVM – to provide virtualization management and feature commonality
- Firmware interfaces – to provide platform management commonality

Migrating software to OpenPOWER

- Software written in interpreted languages (Javascript, PHP, Perl, Python, Ruby, Java, etc.)
 - Generally, no work is required.
- Software written in compiled languages (C/C++, Fortran, etc.)
 - Generally, this requires just a simple recompile for POWER.
- Rarely, dependencies on specific behaviors can require source code modification:
 - Multi-threaded applications that don't use standard synchronization models and depend upon specific memory ordering behavior (unusual)
 - Applications that depend upon specific memory page sizes (rare)

Power Analytics & Big Data Solutions to gain insights from data

Industry's **best platform** for compute intensive **analytics workloads**

Linux

Big Data Analytics Solutions

Analyze massive amounts of structured and unstructured, time-sensitive data



InfoSphere Streams
InfoSphere BigInsights
Open Source Apache Hadoop
Platform Symphony

AIX

Linux

Custom Designed Business Analytics Solutions

BI and Predictive Analytics of real-time and historical data



DB2 Web Query for i

Cognos
SPSS



DB2 with BLU Acceleration

AIX

Expert Integrated Operational Analytics Solutions

Real-time continuous analysis of operational data streams



PureData

IBM Data Engine for Analytics – Power Systems Edition (IDEA)

Align your analytics infrastructure to your enterprise strategy
with an infrastructure that enables business speed analytics

A customized infrastructure solution with integrated software optimized for Big Data & Analytics workloads

Benefits

- Rapid Deployment
- Complete, pre-assembled & tested infrastructure with big data & analytics software preloaded
- On-site services for fast configuration & data center integration
- Intelligent cluster management & automation for effective deployment
- Flexibility
 - Easily set-up & manage workloads for multiple tenants
 - Adjustable resource allocation to meet diverse LOB demands
 - Scalable & extendable as needs change and as the enterprise grows
- Efficiency
 - Reliability without data duplication
 - Tailored Big Data & Analytics optimizations
 - Lays the foundation for consolidating traditional data analytics with new workloads such as Hadoop

SOD: April 28

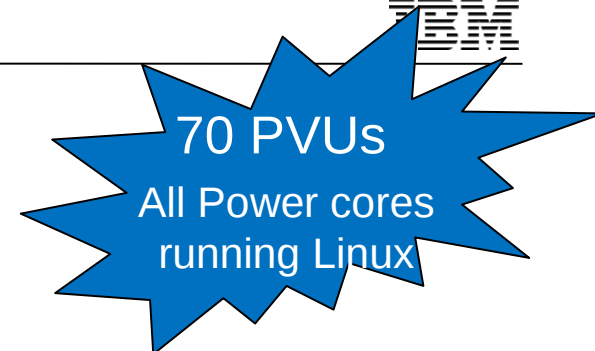
Announce: Oct 2014

GA: Dec 2014



* Big Data & Analytics Software:
Primary SW stack includes BigInsights
+ Streams for High Velocity Data
Ingest and BigInsights + DataStage for
Data Warehouse Modernization

SWG's 70 PVU Licensing



- Applies to SWG PVU licensed software products for **ALL** Power cores **running Linux**

- **70 PVU pricing previously only available for 1-2 socket servers**


- PowerLinux 7R1/7R2, p260/p270 and Power 710/720/730/740
- Intel SandyBridge/IvyBridge servers

- **70 PVU pricing includes:**

- Power IFLs
- Power 750 to Power 795
- PowerLinux 7R4
- Flex System p460

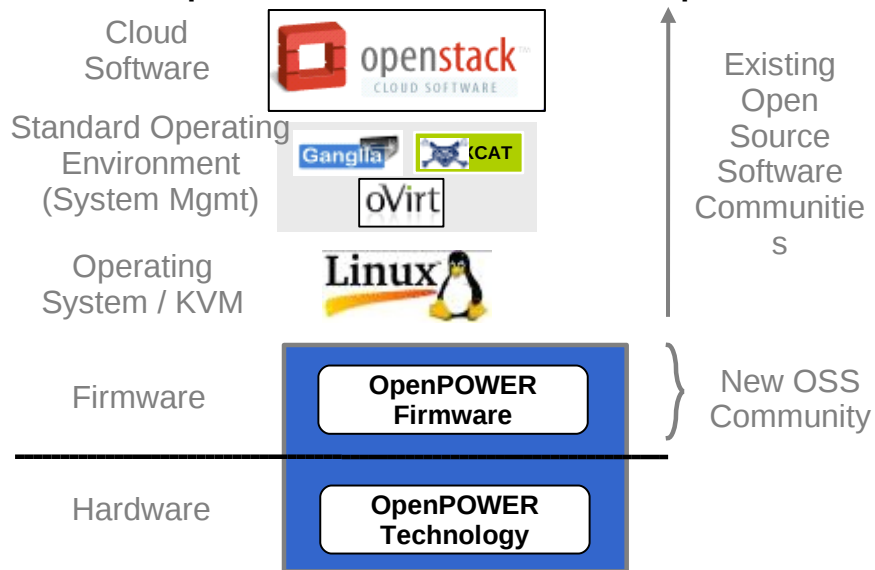
- **Applies to Power8**

PVU Table per Core (section 1 of 2 - RISC and System z)

Processor Technologies									
		Processor Brand		Processor Type					
Processor Vendor	Processor Name	Server model numbers	Maximum number of sockets per server	Cores per socket					PVUs per Core
				(1)	(2)	(4)	(6)	(8)	(12)
	POWER Systems cores running Linux OS	7R1, 7R2, 7R4 POWER IFL, p24L Any POWER System core running Linux	All			■	■	■	■
		770, 780, 795	> 4			■	■	■	
	POWER7 ⁴	750, 755, 760, 775, PS704, p460, Power ESE	4			■	■	■	
		PS700-703, 710-740, p260, p270	2			■	■	■	
	POWER6	550, 560, 570, 575, 595	All		■				
		520, JS12, JS22, JS23, JS43	All		■				

Ecosystem Enablement

Power Open Source Software Stack Components

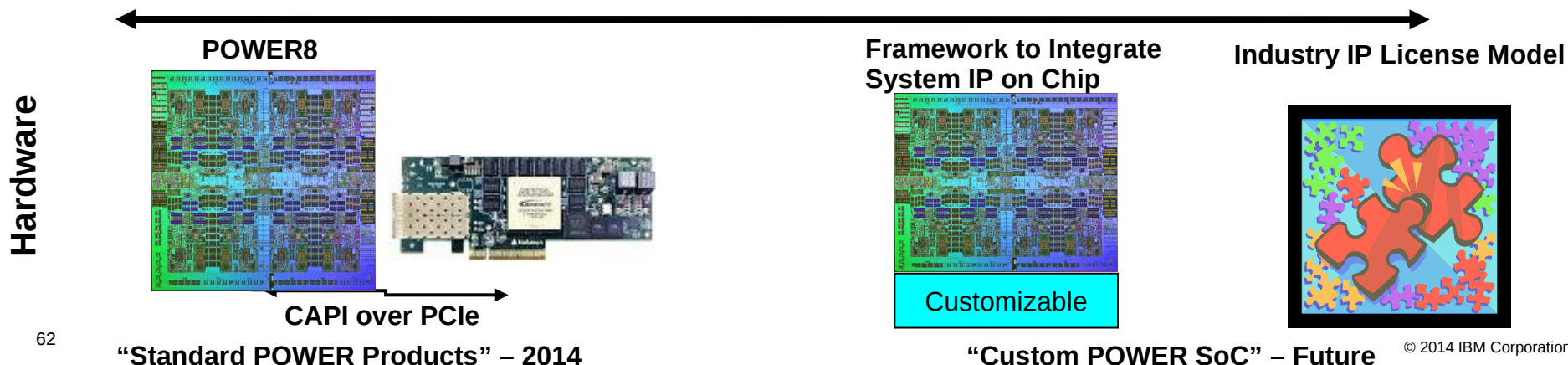


System Operating Environment Software Stack

A modern development environment is emerging based on tools and services



Multiple Options to Design with POWER Technology Within OpenPOWER



OVH : FIRST LARGE MSP POWER8 ADOPTION

Client & Challenge

Client : OVH

First French and European MSP : 170.000 INTEL x86 servers, 12 DataCenters and 700 000 customers.

Industry : They currently support wide public Cloud offerings : VoIP, PaaS & SaaS, Web hosting, VPS, CMS, blogs, e-commerce platforms, Open Source distributions, Anti-DDoS protection, LAMP, Panels, databases.

Challenge :

Proof that **POWER8** can bring higher performance than INTEL for various applications and environments including **MySQL**, **PostgreSQL**, **Hadoop** and Cloud virtualization.

Proof that POWER8 servers will be able to integrate seamlessly in OVH current **Cloud OpenStack infrastructure** in compliance to their internal procedures.

After some porting and performance improvement efforts in IBM LTC Lab at Toulouse on a POWER8 pre-GA system around the **OVH OpenSource** and hardware stacks, the POWER pre-GA server was shipped to OVH which conducted the tests with dedicated support from various worldwide IBM Labs.

OVH tests showing POWER8 superior performance compared to INTEL and better flexibility and VM density with **PowerKVM**, with large room of improvement convinced OVH to propose to their customers a **Cloud POWER8 offering** in September 2014.

IBM POWER8 - Solution and Benefits

Solution

First WW PowerKVM Power8 signing of a large European MSP :

- 133 x S822L POWER8 servers sold for 1 M€
- Ubuntu PowerLinux
- PowerKVM Virtualisation
- Openstack Cloud infrastructure



Key Client Benefit

- POWER8 performance and scalability vs INTEL
- POWER8 saving costs compared to INTEL with better economics compared to VMware/ usual solutions
- POWER8 enablement for new workloads

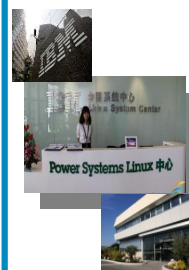
Why we Won and Lessons learned

- Strong IBM POWER8 and OpenPower Strategy & Roadmap (CAPI)
- OVH CEO and Sales team relationship : together in Google/OpenPower April announcement in San Francisco
- OVH CTO and Pre-Sales team relationship
- Continuous and day to day STG POWER Research Labs support : LTC Labs worldwide support, SWG performance labs support

Linux momentum is growing on Power Systems



An **open ecosystem**, using the POWER Architecture, to **share expertise, investments, and server-class intellectual property** to serve customers' evolving needs.



Linux Centers. Offering access to hardware technical support, porting assistance, demos, toolkits, hands-on labs
Beijing | Austin | New York | Montpellier | Tokyo



Global Linux ISV Development
NEW. Power Development Cloud gives Linux developers who want to prototype applications access to Power
NEW. 50,000 new developers from Ubuntu development community



Regional Ecosystem Initiative

Recruiting key solutions:
+ Open Source Tools
+ Middleware
+ Industry Solutions

\$1B

in new Linux and open source technologies for IBM Power Systems.

PowerLinux combines the unparalleled performance of Power Systems with the capabilities and cost effectiveness of Linux.

IBM Power Systems are the ultimate systems for today's compute-intensive workloads, delivering:

- Dynamic efficiency, with intelligent, workload-based resource allocation
- Business analytics—optimized for big data and compute-intensive applications
- Enhanced compliance through automated, policy-based security

Linux is a robust and uniquely extensible operating system built on open source innovation, delivering:

- Significant cost savings
- Uncompromising stability & security
- Industry-leading flexibility and performance
- Rich opportunities for innovation

PowerLinux



PowerLinux integrates these two powerful technologies to deliver the highest levels of:

- Efficiency
- Availability
- Security
- Reliability
- Scalability
- Cost savings

Summary

1. Linux on Power is financially attractive

TCA

TCO

2. Linux on Power is technically attractive

Performance

RAS

3. OpenPOWER provides rich ecosystem

4. Choice of virtualization technology

KVM

PowerVM

ONE SIZE DOES NOT FIT ALL