Agenda

1. Linux on Power Overview

2. Linux on Power Ecosystem

3. The future of Linux on Power
Linux on Power Overview
Power Systems Strategy

**Power Solutions:** Enable businesses with next generation applications and Big Data/Analytics solutions

- Leverage industry standard Linux
- Provide differentiated client value jointly with IBM Software and ISVs
- Facilitate integration and insights across all data sources

**Open Platform for Choice:** Open the Power Architecture

- Enable collaborative innovation with OpenPOWER Consortium
- Deliver Open and optimized development tools and scripting languages
- Leverage OpenStack for comprehensive resource management solutions

**Power Charter:** Long term commitment to Power

- Drive leadership and innovation for core business and new applications
- Demonstrate the strong economics of the platform
- Ensure strong ecosystem of skills and solutions
Power Systems Strategy: Embrace Shift to Open and Linux

2Q13
- Power Systems Linux Centers: Beijing, Austin and NYC
- KVM support for Power (SOD)

2H13
- OpenPOWER Foundation
  - Partnering with global innovators
  - First open platform for community: chips, systems, software, cloud infra.
- $1B IBM Investment in Linux on Power
- Power Systems Linux Centers: Montpellier, Tokyo
- PowerLinux 7R4
- Power Integrated Facility for Linux
- ‘Power First’ SWG solutions for Linux

1Q14
- OpenPOWER: Samsung and Suzhou PowerCore
- Power Development Cloud
- SoftLayer Integration with Power (SOD)

2Q14
- First of a New Generation
  - Open and Collaborative
  - Innovate faster
  - Designed for Data & Analytics
  - Instantaneous Insights
  - Cloud Innovations
  - Economics for Growth

SOD for 2Q Watson
Linux on Power Systems combines the unparalleled performance of Power 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 and enabling of new workloads

Linux on Power Systems integrates these two powerful technologies to deliver the highest levels of:
- Efficiency
- Availability
- Security
- Reliability
- Scalability
- Cost savings
Power Scale-out Servers

Power Systems S812L
- 1-socket, 2U
- POWER8 processor
- Up to 24 cores
- 1 TB memory
- 9 PCIe Gen3 slot
- Linux only
- CAPI support (2)
- PowerVM & PowerKVM

Power Systems S822L
- 2-socket, 2U
- POWER8 processor
- Up to 20 cores
- 1 TB memory
- 9 PCIe Gen3 slot
- Linux only
- CAPI support (4)
- PowerVM

Power Systems S822
- 2-socket, 2U
- Up to 20 cores
- 1 TB memory
- 9 PCIe Gen3 slot
- AIX & Linux
- CAPI support (4)
- PowerVM

Power Systems S814
- 1-socket, 4U
- Up to 8 cores
- 512 GB memory
- 7 PCIe Gen3
- AIX, IBM i, Linux
- CAPI support (2)
- PowerVM

Power Systems S824
- 2-socket, 4U
- Up to 24 cores
- 1 TB memory
- 11 PCIe Gen3
- AIX, IBM i, Linux
- CAPI support (4)
- PowerVM

Power Systems S824L
- 2-socket, 4U
- Up to 24 cores
- NVIDIA GPU
- CAPI support (2)

NEW
Announce
October 6th

© 2014 IBM Corporation

© 2014 International Business Machines Corporation
IBM and NVIDIA deliver new acceleration capabilities for analytics, big data, and Java

- Runs pattern extraction analytic workloads faster
- Provides new acceleration capability for analytics, big data, Java, and other technical computing workloads
- Delivers faster results and lower energy costs by accelerating processor intensive applications

**Power System S824L**
- Up to 24 POWER8 cores
- Up to 1 TB of memory
- Up to 2 NVIDIA K40 GPU Accelerators
- Ubuntu Linux running bare metal
Linux now drives many of the leading edge workloads....and key ones run better on Power vs. x86
Linux support for POWER

- **RHEL 7**
  - Public beta available for existing RHEL customers
  - POWER8 (native mode) and POWER 7/7+ at GA

- **RHEL 6**
  - POWER8 supported with U5 (P7-compatibility mode)
  - Full support of POWER6 and POWER7 (native mode)

- **Fedora**
  - Fedora 16 was first release to re-launch POWER
  - Fedora 20 has POWER8 support

- **Supported add-ons**
  - JBoss
  - High Performance Network Add-on

- **SLES 11**
  - POWER8 with SP3 (P7-compatibility mode)
  - POWER7+ encryption, RNG accelerators with SP3
  - Full support of POWER7 (native mode)

- **SLES 10**
  - POWER7 supported with SP3 (P6-compatibility mode)
  - Full support of POWER6 (native mode)

- **openSUSE**
  - openSUSE 12.2 re-launched for IBM POWER
  - openSUSE 13.2 includes POWER8 support

- **Ubuntu 14.04**
  - POWER8 enabled (native mode)
  - No official support for POWER7+ and older systems
  - No support for 32-bit applications. 64-bit only.
  - Supported in KVM only at this time

- **Supported add-ons**
  - JuJu Charms
  - MaaS (Metal as a Service)
  - Landscape

- **Debian**
  - Community enablement in process
**POWER8 Processor Is **Purpose Built** Which Results in Superior Performance**

<table>
<thead>
<tr>
<th></th>
<th>Sandy Bridge EP</th>
<th>Ivy Bridge EP</th>
<th>Ivy Bridge EX</th>
<th>POWER 7+ Systems</th>
<th>POWER8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E5-26xx v2</td>
<td>E7-88xx v2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clock rates</strong></td>
<td>1.8–3.6GHz</td>
<td>1.7-3.7GHz</td>
<td>1.9-3.4 GHz</td>
<td>3.1–4.4 GHz</td>
<td>3.0–3.9 GHz</td>
</tr>
<tr>
<td><strong>SMT options</strong></td>
<td>1,2*</td>
<td>1, 2*</td>
<td>1, 2*</td>
<td>1, 2, 4</td>
<td>1, 2, 4, 8</td>
</tr>
<tr>
<td><strong>Max Threads / sock</strong></td>
<td>16</td>
<td>24</td>
<td>30</td>
<td>32</td>
<td>96</td>
</tr>
<tr>
<td><strong>Max L1 Data Cache</strong></td>
<td>0</td>
<td>32KB*</td>
<td>32KB*</td>
<td>32KB</td>
<td>64KB</td>
</tr>
<tr>
<td><strong>Max L2 Cache</strong></td>
<td>256 KB</td>
<td>256 KB</td>
<td>256 KB</td>
<td>256 KB</td>
<td>512 KB</td>
</tr>
<tr>
<td><strong>Max L3 Cache</strong></td>
<td>20 MB</td>
<td>30 MB</td>
<td>37.5 MB</td>
<td>80 MB</td>
<td>96 MB</td>
</tr>
<tr>
<td><strong>Max L4 Cache</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>128 MB</td>
</tr>
<tr>
<td><strong>Memory Bandwidth</strong></td>
<td>31.4-51.2 GB/s</td>
<td>42.6-59.7 GB/s</td>
<td>68-85** GB/s</td>
<td>100 – 180 GB/sec</td>
<td>230 - 410 GB/sec</td>
</tr>
</tbody>
</table>

* Intel calls this Hyper-Threading Technology (No HT and with HT)
*32KB running in “Non-RAS mode” Only 16KB in RAS mode
**85GB running in “Non-RAS mode” = dual-device error NOT supported
Simultaneous Multi-Threading Can Be a Major Performance Enhancement

SMT allows separate instruction streams, or threads, to run concurrently on the same physical processor, or core

- **SMT1**: Largest unit of execution work
- **SMT2 / SMT4**: Smaller units 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

SMT = Simultaneous Multi-Threading
SMT Has A Major Effect On Performance – Power vs. Intel x86

- Run the same WebSphere application on Intel Sandy Bridge and Power7+ in SMT 1, 2, and 4 modes and compare the throughputs

<table>
<thead>
<tr>
<th>Mode</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMT1</td>
<td>600 TPS</td>
</tr>
<tr>
<td>SMT2</td>
<td>240 TPS</td>
</tr>
<tr>
<td>SMT4</td>
<td>2.5x</td>
</tr>
</tbody>
</table>

Power7+
4.2 GHz (Linux)

Intel Sandy Bridge
2.9 GHz (Linux)

Max of 2 SMTs
### Web Applications on PowerLinux customers: 3 distinct types

<table>
<thead>
<tr>
<th>Midsize Insurer</th>
<th>Oil and Gas Producer</th>
<th>Regional Department Store</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lausanne, Switzerland</strong></td>
<td><strong>Birmingham, Alabama</strong></td>
<td><strong>Pennsylvania</strong></td>
</tr>
<tr>
<td><strong>Consolidate and modernize POWER and x86 workloads</strong></td>
<td><strong>Consolidate and simplify IT for costs savings, faster turnaround</strong></td>
<td><strong>Headroom for peak online shopping days with ½ the servers</strong></td>
</tr>
</tbody>
</table>

#### Midsize Insurer

- **Retraites Populaires**
  - New, high value user services
  - Superior flexibility and ability to dynamically respond to user and workload requirements
  - Fully virtualized environment with PowerVM on POWER7
  - **WebSphere on Power Linux LPARs for new Java apps**
  - Cobol/RPG apps on i LPARs
  - Smooth evolution of IBM i
  - Lower TCO via consolidated HW and SW investments

#### Oil and Gas Producer

- **Energen**
  - Consolidated 20 Sun servers and 15 x86 servers to 2 Power Systems running PowerVM
  - Saving $500,000 per year on Oracle licensing costs for SAP environment running on AIX
  - More savings by consolidating 15 x86 servers running Open Source web apps, networking to **PowerLinux and PowerVM**
  - Reduced runtime for batch jobs from 24 hours to 2 hours
  - Increased utilization by 2.5 - 3x

#### Regional Department Store

- **Bonton**
  - 2.5x more orders/min., headroom to support busiest shopping days
  - Replace HP, VMware with 50% fewer PowerLinux 7R2s, PowerVM
  - Big software savings, ½ # cores
  - POWER7+ Java performance + PowerVM virtualization efficiency
  - Smooth migration of WebSphere, Java workload to Linux on Power
  - Integrated PowerLinux servers w/ existing storage, network infrastr.
  - Stellar hands-on assistance by IBM Lab Services during PoC
PowerLinux enables flexible, more efficient delivery for public or private cloud

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.
## Why Power

- How customers use Linux on Power Systems today
- How and why they use Power vs. x86 for Linux

### Workload advantages

#### Web, Collaboration and Infrastructure
- Four threads/core
- 72% more throughput, 40% lower cost/workload
- 50% better performance and 30% lower TCA

#### Analytics & Research
- Four threads/core
- 90 GB/sec memory b/w
- Large memory, parallel, small jobs on same node
- Dynamic Energy Optimization

#### Business Applications
- 80% faster to setup VMs
- 65% less datacenter space
- 40% better performance
- 47-53% avg. utilization
- Dynamically add/remove resources

#### Database
- Dense, low cost racks or blades w/ 8 cores/socket
- Four threads/core
- Linear scalability, higher throughput
- Zero security vulnerabilities vs. 113

### Workload advantages

#### HPC applications for Life Sciences
- IBM InfoSphere BigInsights
- NARUS
- China Telekom

#### Big Data
- WATSON
- Hadoop
- IBM InfoSphere BigInsights
PowerKVM v2.1
Open Virtualization Choice for Linux-only Scale-out Servers

- Kernel-Based Virtual Machine (KVM) Linux based virtualization for Scale Out POWER8 Linux Servers
- Processor and memory sharing and over commitment enables higher VM and workload consolidation
- Dynamic addition & removal of virtual devices
- Live VM Migration enables higher availability and allows workload balancing
- Exploits P8 Features like Micro-Threading providing greater scheduling granularity vs x86 virtualization
- Exploits performance, scalability and security built into Linux
- Managed by PowerVC and open source tools which provides flexible familiar Linux admin tools
- Supports Redhat, SUSE, Ubuntu Linux Guests

Announce – 4/28 GA – 6/10

- Reduces IT Infrastructure costs
- Optimize Linux workload consolidation at a lower cost
- Simplify your virtualization management using open source tools

Optimize Linux Workload Consolidation and scale out of workloads at a lower cost of ownership
Maintain flexibility and agility by exploiting Open Source Community
Leverage traditional Linux admin skills on Power Systems to administer virtualization
Use open source tools like OpenStack to manage virtualization
IBM Software Apps available for Linux by Workload Category

150+ SWG Products available for Linux on Power today and growing
SWG 70 PVU pricing on licensed software products for ALL Power cores running Linux

**Big Data and Analytics:**
- **Big Data:** InfoSphere BigInsights, InfoSphere Streams, Data Explorer
- **Analytics:** Cognos BI, Cognos TM1, AlgoOne, SPSS
- **Data services:** DB2®, Informix, InfoSphere™
- **Enterprise Content Management:** IBM Web Content Manager, WebSphere Portal

**Cloud Delivery**
- **SoftLayer:** Watson in 2Q, additional services in 2H
- **SmartCloud Entry, OpenStack support, BlueMix, Cloud Foundry**
- **Cloud:** SmartCloud Monitoring, Provisioning, Orchestration, Storage Productivity Center, …

**Open Engagement** *(connect to Systems of Record)*
- **Mobile:** IBM Worklight, WAS Liberty Profile, IBM Mobile Portal Accelerator
- **Social:** WebSphere Portal, IBM Web Content Manager, Connections
- **Business application middleware:** WebSphere Application Server, WAS Liberty Profile, WebSphere Process Server, WebSphere Commerce, …
- **Infrastructure services:** WebSphere MQSeries®, WebSphere Message Broker, WebSphere Ent. Service Bus, DB2 Connect™, IBM JVM, Eclipse SDK

**Support:**
- **Development and test:** WAS Liberty Profile, Rational® ClearCase/Quality Manager/Team Concert, IBM XL C/C++, XL Fortran, ESSL
- **High Availability, Security:** Tivoli® System Automation, IBM Security Identity Manager
April 2014: Introducing offerings to deliver simplified consumability
- Power Systems Solutions Optimized for POWER

**Big Data & Analytics**

**Enhanced:** IBM Solution for BLU Acceleration: Power Systems Edition
Highly scalable with Capacity on Demand for non-disruptive upgrades

**NEW:** IBM Solution Hadoop: Power Systems Edition
Storage-dense, optimized platform to simplify & accelerate big data analytics

**NEW:** IBM Solution for Analytics: Power Systems Edition
- 50x faster reporting and analytics
- Cognos Business Intelligence
- SPSS predictive analytics
- DB2 BLU for data warehouse

**Mobile**

**NEW:** Mobile Scale Out Sales Offering with Worklight & WebSphere Application Server
Efficiently develop, test, connect, run, and manage mobile and omni-channel applications

**Linux** = Linux-focused solutions

**Cloud**

**Private Cloud:** Update: Solution Edition for Cloud
Open source Linux solution for scale-out cloud services

**Public Cloud:** NEW: Solution Edition for Scale out Cloud
Pre-installed entry cloud system offers ability to get up and running in a day

**Hybrid Cloud:** NEW: SmartCloud Entry for Power Systems
Next Generation with OpenAPIs delivers open cloud stacks

**Public Cloud:** Update: Power Systems Solutions for Service Providers
Enhanced with new POWER8 scale-out configs, PowerKVM support, PowerVC enhancements and PAYG+

© 2014 IBM Corporation
Linux Myth

Power is too expensive for running Linux

myth buster

Power provides platforms with comparable TCA to x86
# IBM Power 822L pricing comparison ($US) – vs. Ivy Bridge

## Comparable TCA

**Linux on Intel Ivy Bridge + VMware**

**Vs.**

**Linux on Power7+ with PowerVM**

<table>
<thead>
<tr>
<th>Server list price*</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3-year warranty, on-site</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Virtualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>- OTC + 3yr. 9x5 SWMA</td>
</tr>
<tr>
<td>VMware vSphere Enterprise 5.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Linux OS list price</th>
</tr>
</thead>
<tbody>
<tr>
<td>- RHEL, 2 sockets, unlimited guests, 9x5, 3 yr. sub./ supp.</td>
</tr>
<tr>
<td>Red Hat subscription and Red Hat support</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total list price: (Total cost of acquisition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$28,366</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Server model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell R720</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processor / cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two 2.7 GHz, E5-2697, Ivy Bridge, 12-core processors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 GB memory, 2 x 300GB 15k HDD, 10 Gb two port</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IBM Power 822L</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Server list price*</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3-year warranty, on-site</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Virtualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>- OTC + 3yr. 9x5 SWMA</td>
</tr>
<tr>
<td>VMware vSphere Enterprise 5.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Linux OS list price</th>
</tr>
</thead>
<tbody>
<tr>
<td>- RHEL, 2 sockets, unlimited guests, 9x5, 3 yr. sub./ supp.</td>
</tr>
<tr>
<td>Red Hat subscription and Red Hat support</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total list price: (Total cost of acquisition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$28,366</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Server model</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP ProLiant DL380p G8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processor / cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two 3.4 GHz POWER8, 10-core</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same memory, HDD, NIC</td>
</tr>
</tbody>
</table>

* Based on US pricing for Power S822L announcing on April 28, 2014 matching configuration table above. Source: hp.com, dell.com, vmware.com
### IBM Power 822L: Comparison ($US) - Scale-Out Cloud

#### Comparable TCA

<table>
<thead>
<tr>
<th>Linux on Intel Ivy Bridge + KVM Vs. Linux on POWER8 + KVM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell PowerEdge R720</td>
</tr>
<tr>
<td>$21,300</td>
</tr>
</tbody>
</table>

### Server list price*

- 3-year warranty, on-site

<table>
<thead>
<tr>
<th>Server list price*</th>
<th>Dell R720</th>
<th>HP ProLiant DL380p G8</th>
<th>IBM Power 822L</th>
</tr>
</thead>
<tbody>
<tr>
<td>$12,605</td>
<td>$14,068</td>
<td>$14,895</td>
<td></td>
</tr>
</tbody>
</table>

### Virtualization

- 2 sockets, 3 yr. 9x5 sub./supp.

<table>
<thead>
<tr>
<th>Virtualization</th>
<th>Dell R720</th>
<th>HP ProLiant DL380p G8</th>
<th>IBM Power 822L</th>
</tr>
</thead>
<tbody>
<tr>
<td>KVM for Red Hat on x86 (RHEV)</td>
<td>$2,998</td>
<td>$2,998</td>
<td>$2,998</td>
</tr>
</tbody>
</table>

### Linux OS list price

- RHEL, 2 sockets, unlimited guests, 9x5, 3 yr. sub./supp.

<table>
<thead>
<tr>
<th>Linux OS list price</th>
<th>Dell R720</th>
<th>HP ProLiant DL380p G8</th>
<th>IBM Power 822L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat subscription and Red Hat support</td>
<td>$5,697</td>
<td>$5,697</td>
<td>$4,489</td>
</tr>
</tbody>
</table>

### Total list price: (Total cost of acquisition)

<table>
<thead>
<tr>
<th>Total list price: (Total cost of acquisition)</th>
<th>Dell R720</th>
<th>HP ProLiant DL380p G8</th>
<th>IBM Power 822L</th>
</tr>
</thead>
<tbody>
<tr>
<td>$21,300</td>
<td>$22,763</td>
<td>$22,382</td>
<td></td>
</tr>
</tbody>
</table>
New Power Integrated Facility for Linux (IFL)
Get Enterprise Server Benefits At Fraction Of The Cost

- Special bundle consisting of:
  - 4 core activations
  - 4 PowerVM Enterprise Edition license
  - 32 GB memory activations
  - Runs only Linux (Red Hat or SUSE)

- Priced competitively vs. equivalent Linux stand-alone server
  - US List Price is $8,591 per IFL
  - Without IFL pricing, this bundle would be worth $49,568 on a 780 (US List price)

- Requires existing 770, 780, 795 systems with inactive cores and memory

- IBM Middleware is priced at 70 PVU
  - Same as 2-socket x86 server

Linux on Power Ecosystem
ISVs are critical to the IBM Power Ecosystem

Focus Areas in 2014

- Leverage IBM Ecosystem - Differentiate
- Gain Platform share in Big Data, Mobile and Cloud
- Build Regional ISV Ecosystem
- Develop Open Software Linux community for Power
- Create incremental value around existing Power base

Available on All Linux Servers

Data & Analytics
- hadoop
- redis
- MongoDB
- Splunk
- AsiaInfo
- Zettaset
- inspur
- Guidewire
- Datameer
- CHILIAD
- Zato

Cloud
- openstack
- Apache
- JBoss
- DNS
- FINEOS
- TEMENOS
- OpenLDAP
- Eucalyptus
- perl
- Platform Computing
- Sichuan Yinhai Software

Mobile
- Zend
- PHP
- Netweaver
- Sybase
- Kony
- RabbitMQ
- fiserv
- ACI

IBM North America Power Systems
Ecosystem Strategy for Linux on Power

**Power Solutions:**
Team with key Partners including IBM Software to deliver solutions
- Differentiated capabilities with big data/analytics, mobile and industry specific solutions
- Enable developers with built-in stack optimization, accelerators and emerging technologies

**Open Platform for Choice:**
Open the Power Architecture
- Provide comprehensive Linux capabilities including open source stacks
- Leverage collaborative innovation driven by OpenPOWER Consortium
- New/enhanced platform, virtualization and cloud management solutions through Open Stack and KVM

**Ecosystem Role:** Extend community role in delivering client value
- Build a broad, connected ecosystem including MSPs, to deliver new solutions
- Engage Start-up community through the Global Entrepreneur Program
- Extend reach to the individual developer community to build a strong base of Power Linux skills in the marketplace
- Expand Academic Programs to reach the Higher Education student community, driving Power Linux content and courseware into top Universities
Porting Linux applications to Power Systems

Most applications port with a simple recompile and test

- **95% of Linux on x86 applications** written in C/C++ port to Linux on Power with **no source code change**, just a simple recompile and test\(^1\)
  - Canonical reported an average of 250 open source applications ported per day on Ubuntu. 95% of the Ubuntu 14.04 LTS compiled software ported with a simple recompile and test

- **100% of well written Linux on x86 applications** written in scripting (Java) or interpretive languages **will run as is** with no changes\(^2\)

- IBM is committed to further simplifying porting and development on Linux on Power
  - Embrace open standards and partner with open communities such as OpenPOWER, OpenStack, Ubuntu, and Cloud Foundry
  - New tooling and function such as BlueMix
  - Provide easier means to build apps leveraging existing code in the open communities

---

1. Includes C/C++ and other compiled languages. Assumes 16 hours of dedicated time and prior experience with the application code and its dependencies (e.g. language, libraries, web application, database) and that dependencies already ported and installed. Assumes no platform or device specific dependencies.

2. Interpretive languages include PHP, Python, Perl, Ruby, Java, etc. Assumes 8 hours of dedicated time and prior experience with the application code and its dependencies (e.g. language, libraries, web application, database) and that dependencies already ported and installed. Assumes no platform or device specific dependencies.
North America Linux on Power ISV Team

- Recruiting new ISVs to Linux on Power!!!!!
- Working with existing ISVs to port their applications to Power
- Enabling and educating new ISVs
- Liaison between IBM field sellers and ISVs
- Facilitating IBM briefings, porting center request, and technical assistance
- Driving solutions by introducing ISVs to business partners
- End user meetings with ISVs
Linux Resources for Power ISVs and Developers to Support the Ecosystem

**Power Systems Linux Centers**

- Beijing
- New York
- Tokyo
- Austin
- Montpellier

**Linux Centers**
- One-stop for ISVs, developers
- HW access, technical support, demos, toolkits, Hands-on labs, and how to guides

**Power Development Cloud**

- Quick access of porting environments to Linux ISV
- Fast resolution to ISV questions and problems

**Regional Ecosystem Initiative**

- Greater China
- North America
- Europe

**Recruiting Key Solutions**

- Open Source Tools
- Middleware
- Industry Solutions

**IBM Innovation Centers**

- Over 40 centers world wide
- North America
- Europe
- Asia
- Africa
- Latin America

**IBM Innovation Centers**

- Technical Expertise - Architects, IT Specialists
- Destination Facilities - Workshops, Briefings, Port, Test
- Hands-on Infrastructure – Access to the latest IBM HW and SW

**Technical Assistance**

- Access to Power Hardware
- Chiphopper porting assistance
- Free Eclipse-based development environment

$1,000,000,000

Investment in Power Systems solutions for Linux and open source workloads.
Future of Linux on Power
Industry trends

• The number of companies designing & building servers is increasing
  – Traditionally there have been few companies designing systems: HP, IBM, SUN, Dell, etc.
  – Today there are many more: Google, Microsoft, Facebook, Rackspace, Huawei, Sugon, Inspur, etc.
  – A fairly mature ecosystem including the Taiwanese ODMs is a key enabler of this trend

• Numerous disruptive forces are impacting these custom system designs and driving designers to consider new ways of innovating
  – Ability to handle rapid growth in Big Data & Analytics based solutions
  – Choice and Innovation
  – CPU SOC integration drive need for chip development

• These trends create a need for a server targeted “chip-system-software” ecosystem
  – IBM has technology and a software stack ready to meet these needs
  – IBM recognizes the need to work with partners to create this ecosystem
  – IBM recognizes the need for choice and options in processor sourcing
OpenPOWER™ gives ecosystem partners a license to innovate

- OpenPOWER will enable data centers to rethink their approach to technology.
- Member companies may use POWER for custom open servers and components for Linux based cloud data centers.
- OpenPOWER ecosystem partners can optimize the interactions of server building blocks – Microprocessors, Networking, I/O & other components – tuned for performance.

How will the OpenPOWER Foundation benefit clients?
- OpenPOWER technology creates greater choice for customers
- Open and collaborative development model on the Power platform will create more opportunity for innovation
- New innovators will broaden the capability and value of the Power platform

What does this mean to the industry?
- Game changer on the competitive landscape of the server industry
- Will enable and drive innovation in the industry
- Provide more choice in the industry

Platinum Members

Altera
IBM
Google
NVIDIA
Samsung
Tyans

Suzhou PowerCore Technology
Building collaboration and innovation at all levels

Welcoming new members in all areas of the ecosystem
100+ inquiries and numerous active dialogues underway
Google Announcement

I'm excited to show off a Google POWER8 server motherboard in the OpenPOWER booth at the Impact 2014 conference in Las Vegas. We're always looking to deliver the highest quality of service for our users, and so we built this server to port our software stack to POWER (which turned out to be easier than expected, thanks in part to the little-endian support in P8)

*Google's Gordon MacKean: Chairman of the OpenPOWER Foundation*
Why CAPI is Better than Traditional PCIe

![Power Processor Diagram]

Typical I/O Model Flow

1. DD Call
2. Copy or Pin Source Data
3. MMIO Notify Accelerator
4. Acceleration
5. Poll / Int Completion
6. Copy or Unpin Result Data
7. Ret. From DD Completion

Flow with a Coherent Model

- Shared Mem. Notify Accelerator
- Acceleration
- Shared Memory Completion

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…
Enabling the Art of the Possible on POWER8

CAPI enables I/O devices to operate on memory in the same way that general purpose processors can operate on memory.
CAPI and Linux enable innovation from the OpenPOWER Foundation

**Smart Acceleration enabled by CAPI**
(Coherent Accelerator Processor Interface) 
Technology

Smart, simplified attach for accelerators: flash memory, networking & FPGAs

Improves performance, reduces latency, and provides more workload for your dollar

Leveraged by emerging applications built on Linux

CAPI Development Platform enables innovators to create entirely new classes of IT solutions

CAPI is evolving with open technology
Wrap-up
Where to find more information?

Power Systems Linux Portal
(Product Information)
www.ibm.com/systems/power/software/linux/

The OpenPOWER Foundation
http://openpowerfoundation.org/

The PowerLinux Community
(developerWorks)
plus.google.com/communities/100156952249293416679

@ibmpowerlinux
Questions?

Grace Liu – gliu@us.ibm.com – (214) 418-2859
Backup
And how has that changed customers? Their buying habits have flipped!

**UNIX Market Priorities**

- #1: Benchmarks
- #2: Differentiation
- #3: TCO

**Linux Market Priorities**

- #1: TCA
- #2: Standardization
- #3: Performance

The “Technologist's Challenge” becomes providing value-add in a standard's-based market.
Power Systems delivering on the promise of open innovation

- **USD1 billion**: Linux on Power investment
- **5 Power Systems Linux Centers**
- **IBM Watson**
- **OpenPOWER Foundation**
- **SoftLayer Integration**
- **1000's of Engineers**
- **More than 9,000 patents**
- **POWER8**: 6 years USD2B R&D investment with hundreds of patents
China Mobile Communications Corp. – Linux Cloud Pool

Mobile phone company
700+ million subscribers

Support more web services for mobile clients with less resources

China Mobile

- Up to 2x more workloads per server with PowerLinux 7R2 and PowerVM
- First non-Intel x86 with VMware platform for Linux Cloud Pool
- Support new value added services for smartphones, tablets and other smart devices
- Significantly better performance for Java and web application workloads
- More efficient, secure virtualization
- Shared pools of CPU, memory, storage can be dynamically allocated
PowerKVM supports an open deployment architecture

Enablement strategy:
- Bring base components in parity with KVM on x86 – "KVM should be KVM"
- Co-exists peacefully with other end-points, whenever makes sense.
- Enables hybrid clouds with common management environments

Manage
Provision
Deploy
Procure

Platform Management
- Custom management
  - Cloud based

H/W Management
- Custom scripting
  - Heavily Automated
  - Open technologies

PXE
IPMI

OpenStack
Custom Scripts

xCat
Puppet
Chef
Custom Scripts

Linux Userspace

Qemu
Libvirt
API & vssh CLI
Console Shell

Power8 Platform
Service Processor
PowerVM to PowerKVM Comparison

<table>
<thead>
<tr>
<th>PowerKVM</th>
<th>PowerVM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Managers</strong></td>
<td>PowerVC, OpenStack, libvirt, Open Source Tools</td>
</tr>
<tr>
<td><strong>Guest VM Types</strong></td>
<td>HMC, IVM, FSM, PowerVC, ISD VMControl</td>
</tr>
<tr>
<td><strong>Host Software</strong></td>
<td>VIO Server IO Virtualization</td>
</tr>
<tr>
<td><strong>Firmware</strong></td>
<td>Phyp Firmware - Hypervisor</td>
</tr>
<tr>
<td><strong>Hardware</strong></td>
<td>Power 8 Linux only Hardware</td>
</tr>
<tr>
<td><strong>Firmware</strong></td>
<td>Power 8 Linux only Hardware</td>
</tr>
</tbody>
</table>

- PowerKVM
  - Linux MCP/KVM Hypervisor
  - Linux Firmware
  - Hardware Abstraction
  - Boot services
  - Standalone Diagnostics

- PowerVM
  - Phyp Firmware - Hypervisor
  - P6, P7, P8 Hardware
Superior performance economics for scale-out Clouds

Get up and running quickly with fast pre-built and pre-installed solutions

IBM Power Systems Solution Edition for Scale Out Cloud

Open source Linux solution for scale-out clouds services

- Flexibility, agility and interoperability with open source virtualization and cloud management
- Accelerated insights for big data and compute intensive Cloud services

Features

- Flexible 1 or 2 socket scale-out form factor
- Simplified management stack
- Choice of RedHat, SUSE or Ubuntu Linux
- PowerKVM hypervisor
- Cloud Manager with OpenStack
- Built on POWER8 technology for optimized performance for databases, analytics, Java, and web 2.0 services

Get up and running quickly with fast pre-built and pre-installed solutions
Power Systems 2014 ISV Linux Ecosystem

Power Systems will deliver compelling new Linux Solutions capabilities

- **31+ New Linux solutions** spanning Data to Insights, Cloud, Open Platform, and Others

- Linux on Power solutions capabilities can compliment existing solutions across the Power Ecosystem
  - Ex: Zato’s healthcare analytics solution provides powerful new data to insights capabilities by leveraging existing patient data from systems like EPIC and Cerner

- **Currently 800 existing ISV solutions** on Linux for Power and growing
  - Ex: 9 New Linux ISVs bring along >100,000 Developers to the Power Ecosystem.

- Focus on recruiting ISV partners that brings a broader community of new developers to the Power Ecosystem
POWERS8 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

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

Processor Service Layer (PSL)
- Present robust, durable interfaces to applications
- Offload complexity / content from CAPP

POWERS8
- Coherence Bus
- CAPP
- PCIe Gen3
  *Transport for encapsulated messages*

Custom Hardware Application Accelerator
- FPGA or ASIC

Custom Hardware Application Accelerator
OpenPOWER Proposed Ecosystem Enablement

**Power Open Source Software Stack Components**
- Cloud Software
- Standard Operating Environment (System Mgmt)
- Operating System / KVM
- Firmware
- Hardware

**System Operating Environment Software Stack**
A modern development environment is emerging based on tools and services

- Existing Open Source Software Communities
- New OSS Community

**Power Open Source Software Stack Components**
- OpenPOWER Firmware
- OpenPOWER Technology

**Multiple Options to Design with POWER Technology Within OpenPOWER**
- **POWER8**
- CAPI over PCIe
- **“Standard POWER Products”** – 2014

**Framework to Integrate System IP on Chip**
- Customizable

**Industry IP License Model**
- **“Custom POWER SoC”** – Future
Power System S824L

Processor
- 2x 10-core 3.42GHz or
- 2x 12-core 3.02GHz

Memory
- Total 16 DDR3 CDIMM slots
- 16,32,64 GB CDIMM @ 1600 Mbps
- 1TB capacity, 384GB/s bandwidth max

Storage
- JBOD, RAID 0,10,5,6
- 12 SFF Disk Drive, 1 DVD

LAN adapters
- 2x 10GBASE-T adapter or
- 2x 10Gb SFP+ Fiber SR plus 2x 1GE adapter

GPU adapter (1 min or 2 max)
- El Capitan nVidia K40 GPU adapter

Power supply
- 2+2 1400W PS

O/S Capable
- Linux Ubuntu (14.10)

Hypervisor Capable
- OPAL, No virtualization

PCIe Gen3 Slots
- 4 PCIe x16 G3 FHFL slots
- 6 PCIe x8 G3 FHHL slots
- CAPI capable on PCIe x16 slots

Native I/O
- USB 3.0 (2 front, 2 rear)
- System Management 1GE (2 rear)
- System port (rear), USB 2.0 (2 rear)