Accelerating HPC and AI innovation for today and tomorrow

Mike Vildibill
VP, Advanced Technologies & Exascale Development

Steve Tolnai
HPC Asia Pacific & Japan

19 October 2017
Hewlett Packard Enterprise - Who we are

We make hybrid IT simple
To power your right mix to accelerate innovation

We have the expertise to make it happen
To accelerate your outcomes from digital transformation

We power the Intelligent Edge
To create your next generation of digital experiences
## SGI and HPE integration update

| Overall Status | - Careful approach to integrating the companies **without business disruption**  
|                | - All engineering, product management, marketing, manufacturing and back office functions have been integrated  
|                | - Legal merge in Japan on **1 August 2017**  
|                | - Full integration will **complete on 31 October 2017**  
| Technology and portfolio | - Product line portfolio **consolidated** with fully integrated roadmap  
|                | - “**Best of the best**” technologies of platforms and software for HPC and AI  
|                | - HPE SGI 8600, UV and Enhanced Hypercube Network Technology Integration  
| Services and Support | - **Comprehensive global services & support** for HPC and AI under Pointnext Services  
|                | - **SGI services teams will integrate on 1 August** and remain intact under Pointnext  
|                | - Commitment to continued exceptional customer experience and satisfaction  
| Sales and Account Coverage | - **SGI sales teams will fully integrate on 31 October 2017**  
|                | - HPC focus and account coverage will **deepen and grow**  
|                | - SGI and HPE sales teams are **already working together**  

HPC and AI context, HPE strategy and portfolio
HPC, big data analytics and AI empower the data-driven enterprise

Simulation and modeling for science, research and business

Analysis of high volume machine, human and business data

Deep Learning and Cognitive computing
Pattern recognition and Artificial Intelligence

Managing data unstructured data; images, audio and video, backup and recovery
HPE Strategy: Accelerate HPC and AI leadership today and into the future

- HPC and AI compute solutions
- HPC and AI storage solutions
- Deep Learning and AI solutions

Optimised platforms

Horizon 1
6 to 12 months

Horizon 2
next 12 to 24 months

Horizon 3
next 24 to 48 months

HPC and AI advanced technology and development

Metrics
- Domain expertise
- Customer loyalty
- Share growth
- Innovation

Solutions
- Risk Compliant Archive
- Trade and Match
- Quantitative Finance Library
- Next Gen Sequencing Analytics
- CAE Solution
- Fraud Detection

- Software stacks
- Lustre
- Remote Graphics
- Cognitive Computing Toolkit

- NRE efforts
- Forward selling
- Early ships
- Time-to-market
HPE is a strong leader in the HPC Market
TOP500: 49th edition – vendor trends from 2012 to 2017
HPE delivering Green HPC for Academic Research
Tokyo Institute of Technology

Tsubame 3.0, a modified HPE ICE XA System at the GSIC Center, Tokyo Institute of Technology

#1 on Green500, June 2017
# HPE purpose-built portfolio for HPC

## HPC Industry Solutions

<table>
<thead>
<tr>
<th>HPC Industry Solutions</th>
<th>Financial Services</th>
<th>Academia, Research, Gov't</th>
<th>Life Sciences, Health</th>
<th>EDA / CAE Manufacturing</th>
<th>Oil and Gas, Energy</th>
<th>Weather and Climate Research</th>
</tr>
</thead>
</table>

## Advisory, Professional and Operational Services – HPE Flexible Capacity for HPC, HPE Datacenter Care for Hyperscale

## Supercomputing / Enterprise / Commercial HPC

<table>
<thead>
<tr>
<th>HPC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE SGI 8600</td>
<td>Liquid cooled, delivering industry leading performance, density and efficiency</td>
</tr>
<tr>
<td>HPE Apollo 6000 Gen10</td>
<td>Extreme Compute Performance in High Density</td>
</tr>
<tr>
<td>HPE Apollo 6000 Gen9</td>
<td>Rack-scale HPC</td>
</tr>
<tr>
<td>HPE Apollo 2000 Gen9</td>
<td>The bridge to enterprise scale-out architecture</td>
</tr>
</tbody>
</table>

## HPE Performance Software Suite

- HPE Performance Software - Core Stack
- HPE Insight Cluster Management Utility
- HPE SGI Management Suite
- HPE Performance Software – Message Passing Interface

## Emerging HPC

<table>
<thead>
<tr>
<th>HPC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE Apollo 6500 Gen9</td>
<td>Rack-scale GPU Computing</td>
</tr>
</tbody>
</table>

## In-memory HPC

<table>
<thead>
<tr>
<th>HPC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE Integrity MC990 X</td>
<td>Scale-up, shared memory HPC, UV Technologies</td>
</tr>
<tr>
<td>HPE Integrity Superdome X</td>
<td></td>
</tr>
</tbody>
</table>

## HPC Storage

<table>
<thead>
<tr>
<th>HPC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE Apollo 4520</td>
<td>Large-scale, storage virtualization &amp; tiered data management platform</td>
</tr>
<tr>
<td>HPC Data Management Framework Software</td>
<td></td>
</tr>
</tbody>
</table>

## Choice of Fabrics

- Intel® Omni-Path Architecture
- Mellanox InfiniBand
- HPE FlexFabric Network

## Additional Storage Options available
HPE has a comprehensive, purpose-built portfolio for Deep Learning

**Deep Learning solutions**

- Financial services
- Government and academia
- Life Sciences, Health
- Autonomous vehicles/mfg.

### Compute for Core data center Training model

<table>
<thead>
<tr>
<th>HPE SGI 8600</th>
<th>Compute for Core data center Inference engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petaflop scale for Deep Learning and HPC</td>
<td>HPE Apollo 2000</td>
</tr>
<tr>
<td>Liquid cooled, delivering industry leading performance, density and efficiency</td>
<td>The bridge to enterprise scale-out architecture</td>
</tr>
<tr>
<td>Rack-scale GPU computing with up to 8 GPUs per compute node</td>
<td>High compute density, ease of use and simplicity</td>
</tr>
</tbody>
</table>

### Compute for Core data center Inference engine

- HPE Apollo 2000
- HPC Storage
- Choice of Fabrics

<table>
<thead>
<tr>
<th>HPE Performance Software Suite</th>
</tr>
</thead>
<tbody>
<tr>
<td>- HPE Performance Software - Core Stack</td>
</tr>
<tr>
<td>- HPE Insight Cluster Management Utility</td>
</tr>
<tr>
<td>- HPE SGI Management Suite</td>
</tr>
<tr>
<td>- HPE Performance Software – Message Passing Interface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HPC Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE Apollo 4520</td>
</tr>
<tr>
<td>HPC Data Management Framework Software</td>
</tr>
<tr>
<td>Large-scale, storage virtualization &amp; tiered data management platform</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Choice of Fabrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Intel® Omni-Path Architecture</td>
</tr>
<tr>
<td>- Mellanox InfiniBand</td>
</tr>
<tr>
<td>- HPE FlexFabric Network</td>
</tr>
</tbody>
</table>

### Edge analytics and Inference engine

- HPE Edgeline EL4000 Converged Edge System
- Unprecedented deep edge compute and high capacity storage, based on open standards
- Right-sized and more portable servers on the “Intelligent Edge”
Simplifying HPC and AI adoption with packaged solutions
Industry Solutions across FSI, Life Sciences and Manufacturing

<table>
<thead>
<tr>
<th>Risk Compliant Archive Solution</th>
<th>Trade and Match Server Solution</th>
<th>HPC for Trader Workstation</th>
<th>HPE ANSYS CAE Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplify enterprise storage while adhering to regulatory compliance standards</td>
<td>Minimize system latency for high-frequency trading operations</td>
<td>Reliable, density optimized, high performance solution with greater throughput, low latency</td>
<td>Turn-key, fully managed HPC clusters for CAE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HPE Fraud Detection Solution leveraging Compute with GPUs</th>
<th>HPE Next Generation Sequencing Solution</th>
<th>HPE Quantitative Finance Library Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated, real-time fraud detection Deep Learning solution</td>
<td>Highly scalable, reliable solutions for genome analytics</td>
<td>Enhance FSI application software performance by enabling accelerators</td>
</tr>
</tbody>
</table>
**HPC and AI technology partner ecosystem**

Technology and go-to-market innovation with key industry leaders

<table>
<thead>
<tr>
<th>HPC Solutions Alliance</th>
<th>HPC Fabric collaboration</th>
<th>Deep Learning collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>- HPE and Intel HPC Alliance since Jul 2015</td>
<td>- HPE and Mellanox collaboration announced Jun</td>
<td>- HPE and NVIDIA collaboration forged May 2017</td>
</tr>
<tr>
<td>- Centers of Excellence</td>
<td>- InfiniBand and Gen-Z open Standards</td>
<td>- Centers of Excellence</td>
</tr>
<tr>
<td>- Code Modernization</td>
<td>- In-network computing</td>
<td>- Deep Learning Institute</td>
</tr>
<tr>
<td>- Intel Xeon Phi, OPA, software</td>
<td>- HPC Fabric for HPE SGI 8600 and New HPE Apollo 6000 Gen10</td>
<td>- Product development, benchmarking, engineering</td>
</tr>
<tr>
<td>- Product development, benchmarking, engineering</td>
<td>- Joint Development with HPE Advanced Dev Team - Exascale</td>
<td></td>
</tr>
</tbody>
</table>
Accelerating HPC and AI innovation for today and tomorrow
Introducing optimized solutions, a new Compute experience and advanced technologies for the future

Workload optimized for extreme performance
More performance, efficiency and scale to accelerate business innovation

Secure, agile, flexible Compute experience
A better way to protect data, manage infrastructure and control economics

Exascale and advanced technology programs
More expertise and flexibility to plan future technology roadmap

Powered by the world’s most secure industry-standard servers¹ for HPC and AI

¹ Based on new silicon root of trust technology and other comprehensive security features, verified by InfusionPoints
# Accelerating HPC and AI innovation for today and tomorrow

## Workload optimised for extreme performance

**New HPE SGI 8600**  
Next gen petaflop scale, liquid cooled supercomputer  
- Greater performance, scale and efficiency

**New HPE Apollo 6000 Gen10**  
Next gen air cooled, purpose built enterprise HPC solution  
- Best in class performance, rack scale efficiency

**New HPE Apollo 10 Series**  
- Cost effective platforms for AI and emerging applications  
- NEW collaboration for AI application in precision medicine

## Secure, agile, flexible Compute experience

**New HPE Performance Software Suite**: Out-of-the-box HPC stack, enhanced cluster system management and acceleration tools

**New Services and Consumption Model**  
- New Advisory, Professional and Operational Services  
- HPE Flexible Capacity for HPC

## Exascale and advanced technology programs

**DoE PathForward Exascale Program**  
- New Exascale program to create reference designs  
- Inspired by Memory-Driven Computing and Hewlett Packard Labs technologies

**New disruptive technology based system architecture**  
- ARM processor based system  
- Proof of concepts with select customers

---

Substantiation for quantifiable benefits in speaker notes
New optimized solutions to enhance performance, efficiency and scale
Solution for the world’s most complex supercomputing problems
HPE SGI 8600 System optimized for performance, scale and efficiency

Leading performance
- **Fastest Distributed Memory Systems on the planet**\(^1\) for message passing with performance validated on SPECmpiM\_2007 and SPECmpiL\_2007 both peak and base results.
- **Legacy of leading benchmark** and real world application performance\(^2\)

Ease of use
- HPE SGI Management Suite:
  - Provisioning of **thousands of nodes in minutes**\(^3\)
  - From detailed system health monitoring to fine-grained power management
- **Quick time to solution** with off the shelf OS and applications

Density / Scale / Efficiency
- **Scaling to >10,000 nodes without additional switches**\(^4\) using integrated switches and hypercube technology
- **Substantial savings in cooling costs**\(^5\) with “Closed-loop Airflow” which ensures no air within the cell is mixed with data center air

---

1, 3, 4, 5 Substantiation for quantifiable benefits in speaker notes

SPEC and the benchmark name SPEC MPI are registered trademarks of the Standard Performance Evaluation Corporation (SPEC). All rights reserved. The stated results are published as of May 12, 2017; see spec.org.
Tokyo Institute of Technology deploys the most advanced & largest Open Platform for Big Data analysis

**TSUBAME 3.0** delivering 47.2 Petaflops at half-precision set for AI Computing

- Deep Learning platform to monitor and observe data processing for *pattern recognition and anomaly detection*
- *Largest Tesla P100 SXM2 deployment to date* with 2,160 NVLink-enabled GPUs
- Powerful enough to support significant AI and scientific HPC workloads providing *unprecedented ability to analyze large data sets.*

**Massively Parallel**
- 540 Compute Nodes, 2160 GPUs
- >7.7 Million NVIDIA CUDA Cores
- 4 Ports of Intel® Omni-Path per node

Note: SGI ICE XA is now HPE SGI 8600 and will be externally announced on May 10th, 2017
**Solution for complex commercial HPC challenges**

HPE Apollo 6000 Gen10 System purpose-built for performance and rack scale efficiency

**Leading performance**
- Uses the new *Intel® Xeon® Processor Scalable family*
- Increase performance and future proofing with persistent storage on memory bus; support for *Intel® Xeon® Phi*, Integrated OPA Switch and *Intel® NVMe SSD drives*

**Rack-scale efficiency**
- *Improve rack level RASM features* through system integration
- *Quickly deploy, service, and manage* with cold aisle front accessible nodes

**Purpose-built for HPC**
- *Optimize full network switch utilization* with node to fabric alignment
- *Automate task scheduling and management* with Insight Cluster Management Utility

Fast, secure and resilient compute, storage and fabric technologies built with rack level efficiencies to deliver **exceptional price performance**

---

1, 2: Substantiation for quantifiable benefits in speaker notes.
World’s largest chemical company creates chemistry with HPC
HPE supercomputer enables global digital transformation at BASF

BASF Supercomputer
- **Debuted** at #65 on June TOP500
- Designed to be one of the *world’s largest supercomputers*
- **1st Supercomputer to use Intel® Xeon® Processor Scalable family**
- Drive digitalization of **BASF’s worldwide research**
- Shorten modeling / simulation times (**months to days**)
- Solve complex problems while **decreasing discovery time**
- Run virtual experiments to **reduce time-to-market, lower costs**

**Key features**
- HPE Apollo 6000 Gen10 System
- > 1 Petaflop using Next Gen platform
- Intel® Omni-Path architecture
- Multitude nodes
- Work simultaneously on highly complex tasks
- Dramatically reduce processing time

“The new supercomputer will promote the application and development of complex modeling and simulation approaches, opening up completely new avenues for our research at BASF.”

— Dr. Martin Brudermueller, Vice Chairman of the Board of Executive Directors and CTO, BASF

BASF Cluster - HPE Factory Build in Houston, TX, May 2017
HPC FSI Trade & Match 2.0: Unique HPE/Intel Gold 61xx processor
2 Tiered approach to address both FSI & EDA

HPE Gen 10 Servers Trade & Match Offering

2 Tiered Approach

Electronic Design Automation applications
- Apollo 6000 Gen10 1P & 2P configuration
- Max density for high frequency configs

Financial Services Industry
- ProLaint DL380: 1P & 2P configurations
- Standard form factor for co-lo deployments

Gen9 vs. Gen10 Benchmark Comparison

<table>
<thead>
<tr>
<th></th>
<th>SPECint_base 2006</th>
<th>SPECint_2006</th>
<th>SPECint_rate_base2006</th>
<th>SPECint_rate_2006</th>
<th>LINPAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>G9 E5-1680v3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G10 61xx Gold 1P</td>
<td>78.6</td>
<td>82.4</td>
<td>547</td>
<td>572</td>
<td>647.5</td>
</tr>
<tr>
<td>G10 61xx Gold 2P</td>
<td>80</td>
<td>84.1</td>
<td>1120</td>
<td>1180</td>
<td>1105</td>
</tr>
</tbody>
</table>

*Spec Int rate result compares Gen 9 vs. Gen 10

Up to 2.5X performance increase over Gen 9 Trade & Match Solution

Optimised for applications that run best at high frequency and low core count
Global Energy Company uses supercomputer to pinpoint 200 million-barrel cache

Supercomputer for energy exploration
- $2 billion in recoverable oil in 7,000 feet of water 150 miles from the coast
- Long obscured by a salt dome, the oil reserves were revealed by using a supercomputer and mathematical algorithm to interpret the seismic data in a new way.
- 1st large scale deployment of HPE Apollo 6000 with Intel® Xeon Phi™

2 weeks and a more accurate model using HPC

VS.

1 year using traditional analytics methods
A new Compute experience for HPC and Artificial Intelligence
AI versus Competitors
Imagine accelerated apps and faster business insights
Introducing “A New Compute Experience” for HPC and AI

Security
Protect against Cyber attacks with HPE Secure Compute Lifecycle

Software-defined
Enhance agility with comprehensive software environment

Economic control
“Pay as you go” with on-demand consumption model

Powered by the world’s most secure industry-standard servers¹

¹ Substantiation for quantifiable benefits in speaker notes
Security embedded firmware to protect against cyber attacks

World’s most secure industry-standard servers¹ for HPC and AI

Silicon Root of Trust
- Only HPE offers industry standard servers with **firmware anchored into the silicon**
- **Impenetrable protection** through entire supply chain: manufacturing, distribution, shipping, configuration and installation.

Secure Recovery
- **Recovering firmware to known good state** after detection of compromised code
- **Options to recover** to factory settings or last know good or not recovering at all taking server off-line
- Ability to recover other server settings

Commercial National Security Algorithms
- Only HPE offers the **highest level of security**
- Typically used for handling the most confidential and secret information
- Uses the **highest level of cryptography** in the industry
- No increase in server latency

Firmware Runtime Validation
- **Daily checking** of firmware every 24 hours verifying validity and credibility of UEFI, CPLD, iLO, IE, and ME.
- Valid and secure Firmware copy **stored in lock-box**
- **Alert of compromised code** through iLO audit logs

¹HPE offers the **world’s most secure servers** for HPC and AI.
# Comprehensive, integrated software portfolio to enhance agility

## Software Stack

**HPE Performance Software - Core Stack** for HPE Apollo, HPE ProLiant

## System Management

**HPE SGI Management Suite** for HPE SGI 8600
**HPE Insight Cluster Management Utility** for HPE Apollo, HPE ProLiant

## Workload Management

**Adaptive**, Altair PBS Works, Slurm

## Software Development

**HPE Performance Software - Message Passing Interface**
**Intel® Parallel Studio XE**
**allinea FORGE**, RogueWave, PGI

**NVIDIA CUDA Toolkit**
**OpenACC**, Mellanox HPC-X:
OpenSHMEM, Berkeley UPC, MXM, FCA

## Visualization

Remote Visualization Software

## Data Management

**HPE Clustered Extents File System (CXFS)**
**HPE Data Management Framework (DMF)**
**Intel® Enterprise Edition for Lustre**

## Fabric Software

Intel Omni-Path Fabric Software, Mellanox OFED

## System Software

Available Dec. 2017

**Mellanox OFED**

**CentOS**, redhat
**HPE Pointnext Services innovation overview**

**Advisory Services**
Create a blueprint of your future state environment allowing for innovation and growth with Advisory, Design, Implementation, and Integration Services

**Professional and Operational Services**
Flawless and on-time implementation, on-budget execution, and creative configurations to get the most out of software and hardware

**Flexible infrastructure consumption model**
By the end of 2018:

50%

Pay as you go models will account for 50% of on-premises and off-premises physical IT and datacenter asset spending by 2018

New consumption-based IT providing scalable capacity on demand, pay only for what you use; servers, storage, networks, software & services

**Faster service delivery** to your key business stakeholders with HPE Pointnext Services from the Core data center to Intelligent Edge
Advanced technology programs for innovation roadmap guidance, choice and flexibility
HPE wins Department of Energy grant to develop Exascale prototype

HPE leads the charge into Exascale computing

- Research grant over three years to develop a reference design for Exascale
- Funding for Hewlett Packard Enterprise’s best and brightest technology talent
- Extends HPE’s market leadership in HPC
- Validates HPE’s strategy to double down on infrastructure and builds on the SGI acquisition
- Inspired by Hewlett Packard Labs technology advancements (i.e. Memory-Driven Computing, silicon photonics and Advanced Non Volatile Memory)
- Ecosystem innovation with partners and Gen-Z consortium
Let’s Talk. Join us at the HPE Exhibit.

• Join HPE on the Showfloor to learn more about HPE High Performance Computing Solutions

• Complete the HPE Survey Form for your chance to win* a Titan Drone

• Prize will be drawn on Friday 20 October 2017 during the morning tea break at the HPE Exhibit #04
HPE HPC innovation with NASA...
Thank You