Hewlett Packard Enterprise

intel

# BEYOND SUPER
## POWERING THE EXASCALE ERA

**April Neoh**
Account Executive for HPC/AI and Big Data Storage
april.neoh@hpe.com

# HPC
# IT'S A NEW ERA

## EXASCALE ERA

**MODELING & SIMULATION** + **ARTIFICIAL INTELLIGENCE** + **BIG DATA ANALYTICS**

Running on one machine in mission-critical workflows

# FUTURE EXASCALE SYSTEMS


## ANL “Aurora”

- More than 1 EF Sustained performance
- Future Intel Xeon CPU and Intel $X^e$ architecture and Slingshot interconnect
- Mixed AI and HPC workload


## ORNL “Frontier”

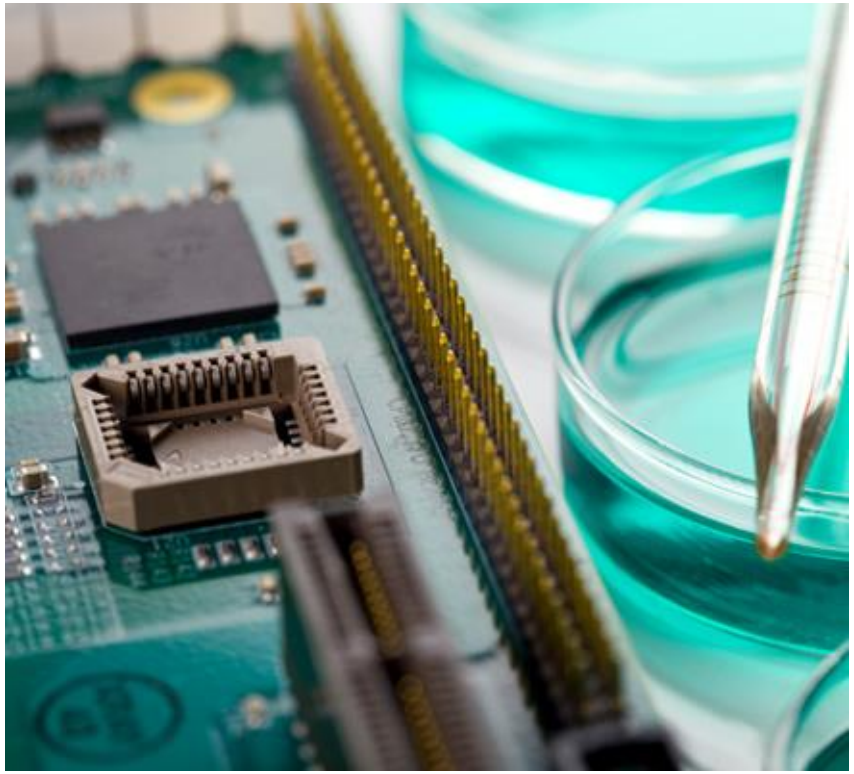
- More than 1.5 EF Sustained performance
- Future AMD EPYC CPU and Radeon GPU and Slingshot interconnect
- Mixed AI and HPC workload


## LLNL “El Capitan”

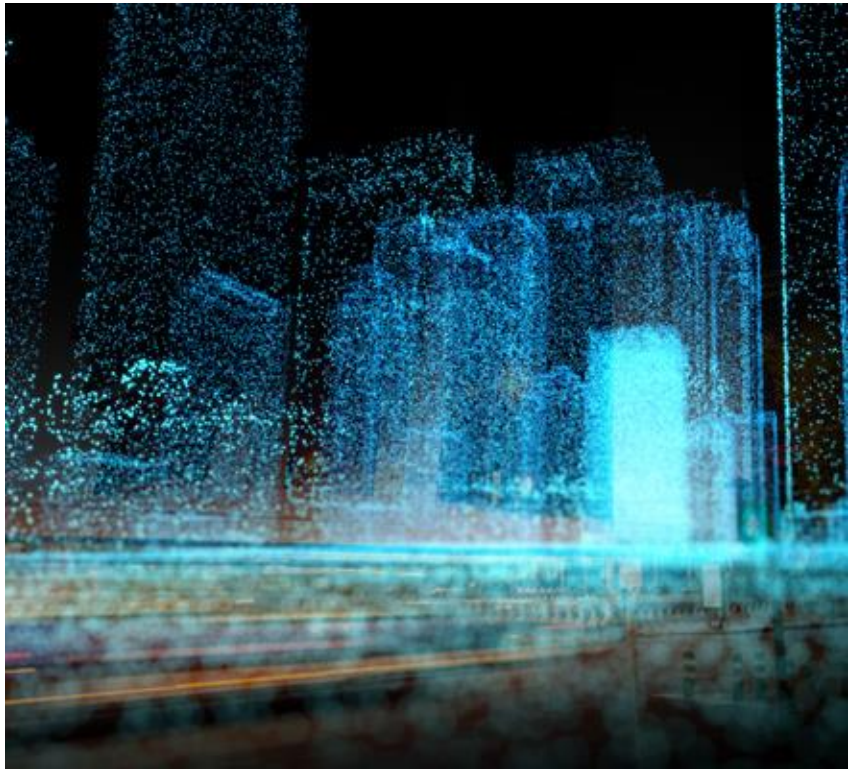
- More than 1.5 EF Sustained performance
- Processor and Accelerator Vendor TBD; Slingshot interconnect
- Mixed AI and HPC workload

# THE WORLD IS NOW HYPER-CONNECTED

Everyone and every *thing*
is connected and sharing data



Security and intelligence
are embedded everywhere



Data is the new currency

# WHY CRAY?

"The reason we bought Cray is they have the foundational technology in the connect fabric and the software stack to manage these *data-intensive workloads*.

That ultimately manifests itself in some sort of HPC cluster and in the future an Exascale supercomputer. You should expect us to take those technologies which are designed for scale, speed, and latency into the commercial space."

CRN Oct 16, 2019 – Best of Breed Conference 2019

http://www.crn.com/slide-shows/data-center/antonio-neri-outposts-is-aws-bid-to-lock-data-in-public-cloud/1

# COMPREHENSIVE HPC AND AI PORTFOLIO

## BRINGING TOGETHER THE BEST OF HPE AND CRAY

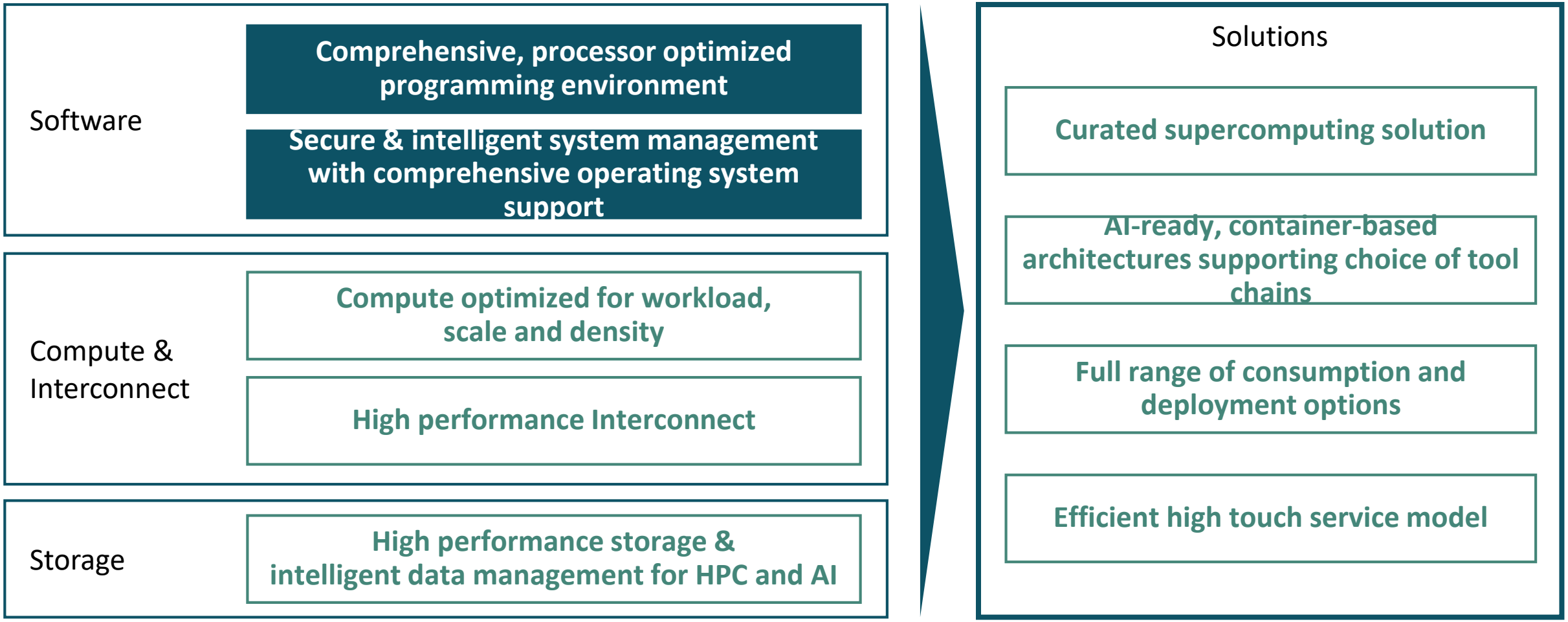
| | |
|---|---|
| Software | **Comprehensive, processor optimized programming environment**<br>**Secure & intelligent system management with comprehensive operating system support** |
| Compute & Interconnect | **Compute optimized for workload, scale and density**<br>**High performance Interconnect** |
| Storage | **High performance storage & intelligent data management for HPC and AI** |

Solutions

- **Curated supercomputing solution**
- **AI-ready, container-based architectures supporting choice of tool chains**
- **Full range of consumption and deployment options**
- **Efficient high touch service model**

# COMPREHENSIVE HPC AND AI PORTFOLIO

## BRINGING TOGETHER THE BEST OF HPE AND CRAY



# A FULL SOFTWARE EXPERIENCE

| | Personalised Experience | Optimised Experience |
|---|---|---|
| Programming Environment | **Cray Programming Environment** | |
| Message Passing Interface | **HPE Message Passing Interface (MPI)** (Optimized for InfiniBand Fat-tree, Dragonfly and Enhanced Hypercube) | **Cray MPI** (Optimized for Cray Slingshot and Dragonfly) |
| Operating Systems | **RHEL, CentOS, TOSS, SLES** | **Cray's Linux Environment** (SLES + optimizations) |
| System Management | **HPE Performance Cluster Manager** (Cluster with HA) | **Cray System Management** (Microservices architecture) |

# COMPREHENSIVE HPC AND AI PORTFOLIO

## BRINGING TOGETHER THE BEST OF HPE AND CRAY

| | |
|---|---|
| Software | Comprehensive, processor optimized programming environment |
| | Secure & intelligent system management with comprehensive operating system support |
| Compute & Interconnect | Compute optimized for workload, scale and density |
| | High performance Interconnect |
| Storage | High performance storage & intelligent data management for HPC and AI |

Solutions

- Curated supercomputing solution
- AI-ready, container-based architectures supporting choice of tool chains
- Full range of consumption and deployment options
- Efficient high touch service model

# CRAY SUPERCOMPUTERS: BUILT FOR THE EXASCALE ERA

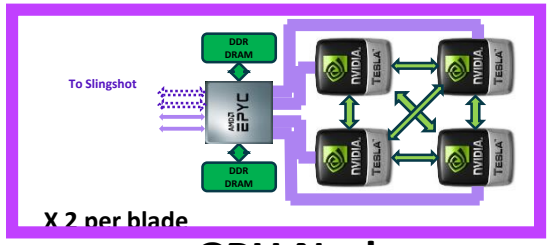
Choice of enclosures for optimal density, efficiency, and cost per individual requirements

## The Exascale Supercomputer

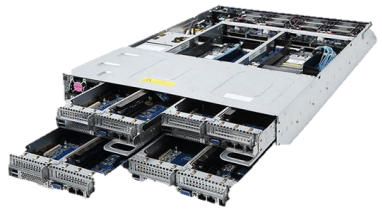

**Liquid Cooled Cabinet (Project Olympus)**


**Air cooled Standard Cabinet**

**Compute (AMD) Node**




**GPU Node**



**Standard Compute Node**

**Optimized Software experience**
Slingshot, Shasta SW, CLE, CPE

**Choice of processors & accelerators**
AMD EPYC Rome, NVIDIA GPUs, AMD GPUs, Intel GPUs

**Dense and scalable rack infrastructure**
64 blades per rack, upgradability, upto 300KW, scales to 100s of cabinets

# CRAY SLINGSHOT - BREAKTHROUGH INTERCONNECT

## Interconnect for the Exascale era

**Massive growth of data and real-time data flows**

**Mission critical workloads running simultaneously – HPC, AI, and Big Data**

**Requires active and intelligent management of dataflows within your system**

- State of the art line bandwidth & latency, with high radix
  - 200 Gbps
  - 64 port switch
- Optimized dragonfly topology to minimize hops, maximize performance and reliability
  - Scale to 100,000's of nodes in three hops
  - ~90% of links use inexpensive, highly reliable copper cables (versus expensive active optical)
- Advanced flow control features address congestion & bottlenecks
  - Adaptive Routing
  - Quality of Service
  - Congestion Control


**Crossing the exascale threshold marks the start of the next era of supercomputing**

**Cray Slingshot is a complete rethinking of the interconnect for this new era**

# THE PERSONALISED EXPERIENCE

## HPC Purpose-Built Compute Portfolio for HPC

HPE POINTNEXT

Advisory, professional, operational services | HPE GreenLake Flex Capacity | Hybrid HPC

### Supercomputing/enterprise/commercial HPC

**HPE SGI 8600**

Liquid cooled, petaflop scale for HPC and AI

**HPE Apollo 6000 Gen10**

Air-cooled, HPC at rack scale

**HPE Apollo 2000 Gen10**

The bridge to enterprise scale-out architecture

**HPE Apollo 20**

Intel CLX-AP performance with air / liquid efficiency

### Adaptive cooling

**HPE Adaptive Rack Cooling System**

Higher power density with less data center heat

### ProLiant DL

**HPE DL325**

2P Performance at 1P Economics

**HPE DL385**

Flexible AMD Compute for HPC Workloads

**HPE DL360**

2P Intel Server in 1U

**HPE DL380**

Industry Leading Server

### Emerging HPC

**HPE Apollo 6500 Gen10**

Enterprise platform for accelerated computing

**HPE Apollo 70**

HPC cluster ready arm-based server

**Cray CS-500 / HPE Apollo 35**

Best AMD performance in dense HPC platform

### In-memory HPC

**HPE Superdome Flex Server**

Solve complex, data-intensive problems **holistically** at **unparalleled** scale with **single-system** simplicity

**5U, 4-socket chassis**

### Networking for HPC

- Intel Omni-Path architecture
- Mellanox InfiniBand
- HPE FlexFabric network

# COMPREHENSIVE HPC AND AI PORTFOLIO

## BRINGING TOGETHER THE BEST OF HPE AND CRAY

| | |
|---|---|
| Software | Comprehensive, processor optimized programming environment |
| | Secure & intelligent system management with comprehensive operating system support |
| Compute & Interconnect | Compute optimized for workload, scale and density |
| | High performance Interconnect |
| Storage | **High performance storage & intelligent data management for HPC and AI** |

Solutions

- Curated supercomputing solution
- AI-ready, container-based architectures supporting choice of tool chains
- Full range of consumption and deployment options
- Efficient high touch service model

# WE ARE CONVERGING ON CLUSTERSTOR E1000

| | FROM | | TO |
|---|---|---|---|
| |  |  |  |
| | HPE Scalable Storage for Lustre | Cray ClusterStor L300 | Cray ClusterStor E1000 |
| Fast NVMe Flash for ML/DL workloads | No | No | Yes |
| Aligning the data flow with the workflow | No | No | Yes |
| Strong position in high-end HPC | No | Yes | Yes |
| Single system image management | No | Yes | Yes |
| Standard factory integration/validation | No | Yes | Yes |
| Leading HDD performance efficiency | No | Yes | Yes |
| ZFS data path option | Yes | No | Yes |
| Lustre LTS release 2.12 | Yes | No | Yes |
| High density 4U106 enclosures | Yes | No | Yes |
| Benefits of being an HPE product | Yes | No | Yes |

# AI & ADVANCED ANALYTICS SOLUTIONS

**Choice of Distro, ISVs, Open Source**

Cloudera | MapR | Kafka | Spark | Flink | H2O | Dataiku | PyTorch | TensorFlow

**AI Ready Architectures**

HPE BlueData | NVIDIA GPU Cloud | Cray Urika | Do-It-Yourself

**Optimization Tools & Resources** (included)

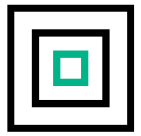
HPE Elastic Platform for Analytics Sizer | HPE Deep Learning Cookbook | HPE Big Data Analytics Reference Architectures

**Elastic Platform for Analytics Building Blocks**

- Density optimized for AI and Analytics
- Modular, flexible architecture for an edge-to-cloud data pipeline
- Workload validated and optimized
- Elastic, independent scaling

**Compute Blocks**

HPE Apollo 2000 chassis with
HPE ProLiant XL170r Gen10
HPE ProLiant XL190r Gen10 w/GPUs
Cray Supercomputers



**AI/ML High Density Blocks**

HPE Apollo 6500 Gen10 w/GPUs

**Storage Blocks**

HPE Apollo 4200/4500 Gen10
Cray ClusterStor E1000

# COMPREHENSIVE HPC AND AI PORTFOLIO

## BRINGING TOGETHER THE BEST OF HPE AND CRAY

| | |
|---|---|
| Software | Comprehensive, processor optimized programming environment |
| | Secure & intelligent system management with comprehensive operating system support |
| Compute & Interconnect | Compute optimized for workload, scale and density |
| | High performance Interconnect |
| Storage | High performance storage & intelligent data management for HPC and AI |

Solutions

- **Curated supercomputing solution**
- **AI-ready, container-based architectures supporting choice of tool chains**
- Full range of consumption and deployment options
- Efficient high touch service model

# COMPREHENSIVE HPC AND AI PORTFOLIO

## BRINGING TOGETHER THE BEST OF HPE AND CRAY

| | |
|---|---|
| Software | Comprehensive, processor optimized programming environment |
| | Secure & intelligent system management with comprehensive operating system support |
| Compute & Interconnect | Compute optimized for workload, scale and density |
| | High performance Interconnect |
| Storage | High performance storage & intelligent data management for HPC and AI |

Solutions

- Curated supercomputing solution
- AI-ready, container-based architectures supporting choice of tool chains
- **Full range of consumption and deployment options**
- **Efficient high touch service model**

# OPTIONS TO MEET A FULL RANGE OF AS A SERVICE NEEDS

**GreenLake Flexible Capacity**

- HPE GreenLake Flexible Capacity

**HPC Platform as a Service**

- Ready for BlueData, RedHat OCP and Singularity
- HPCM (and APIs), VMware and Cray's software environment

**Managed HPC as a Service**

- As a service offerings (Advania, ScaleMatrix, Markley)
- Data center offerings (Equinix, CyrusOne)
- SI partners (Accenture, DXC)

**HPC as a Service in the Public Cloud**

- ClusterStor in Azure
- Cray in Azure for Manufacturing
- Cray in Azure for EDA

**Public Cloud Ecosystem**

**Managed Service, Off-Premises**

**Cloud Architecture**

**Consumption-based**

**Strategic partner to manage end-to-end, Hybrid HPC and AI portfolio across deployment and consumption models**

# THANK YOU