

**Welcome To The 75<sup>th</sup>  
HPC User Forum  
Meeting  
October 10 to 11, 2019**



# Thank You To Our Sponsors!

- **EPCC**
- **AMD**
- **Cray**
- **Intel**
- **Panasas**

# Benefits Of Joining The HPC User Forum

**Hear about best practices (and lessons learned)**

**Access to a full information service: on HPC, HPDA, AI, cloud, QC, etc.**

- Market results, forecasts, vendor shares
- Analysis of market developments & trends
- In-depth profiles of leading sites and achievements

**Inquiry time with Hyperion Research analysts**

- Topics of your choice
- Custom cuts from our data structures

**For more information:**

**<http://hpcuserforum.com/>**



# Important Dates For Your Calendar

## 2019 HPC USER FORUM MEETINGS:

- October 7 to 8, Lugano, Switzerland at CSCS
- October 10 to 11, Edinburgh, Scotland at EPCC

## 2020 U.S. EVENTS

- March 30 to April 1, Princeton Marriott at Forrestal, Princeton, New Jersey
- September 8 to 10, Loews Ventana Canyon, Tucson, Arizona

# CHAIRMAN'S WELCOME

# HPC User Forum Mission

**To Improve The Health Of The  
High Performance Computing Industry  
Through Open Discussions, Information-  
sharing And Initiatives Involving  
HPC Users In Industry, Government And  
Academia  
Along With HPC Vendors  
And Other Interested Parties**



# The HPC User Forum: 74 Meetings Worldwide Since 2000

Amsterdam, Netherlands (SARA)

Annecy, France

Bangalore, India (Indian Institute of Technology)

Beijing, China (Chinese Academy of Sciences)

Bologna, Italy (CINECA)

Bristol, UK

Bruyères-le-Châtel, France (Teratec)

Canberra, Australia

Geneva, Switzerland (CERN)

Kobe, Japan (RIKEN)

Lausanne, Switzerland (EPFL)

London, UK (Imperial College)

Manchester, UK (Manchester University)

Melbourne, Australia

Munich, Germany (LRZ)

New Delhi, India (Indian Institute of Science)

Paris, France (GENCI)

Seoul, Korea (National Institute of Supercomputing & Networking)

Stuttgart, Germany (HLRS)

Warsaw, Poland (University of Warsaw)

Yokohama, Japan (Earth Simulator Center)

Zurich, Switzerland (ETH Zurich)

United States (many locations)

# Introduction

## HPC User Forum Steering Committee

**Paul Muzio**

Chairman, Industry Expert

**Rupak Biswas**

NASA Ames  
Vice Chairman

**Earl Joseph**

Executive Director,  
Hyperion Research

**Vijay Agarwala**

Virginia Tech.

**Alex Akkerman**

Ford Motor Company

**Doug Ball**

HPC Expert

**Mike Bernhardt**

Exascale Computing  
Project

**Steve Conway**

Vice President,  
Hyperion Research

**Steve Finn**

Imagine IT

**Merle Giles**

Moonshot Research

**Keith Gray**

BP

**Arno Kolster**

Providentia Worldwide

**Doug Kothe**

Oak Ridge National Laboratory

**Jysoo Lee**

KAUST

**David Martin**

Argonne National Laboratory

**Jeff Broughton**

NERSC/Lawrence  
Berkeley National Lab

**Paul Buerger**

Industry Expert

**Clayton Chandler**

Credit Suisse Group AG

**Candace Culhane**

Los Alamos National Labs

**Sharan Kalwani**

Industry Specialist  
Consultant

**Simon Burbidge**

University of Bristol (UK)

**Michael Resch**

HLRS, University of Stuttgart

**Ryan Quick**

Providentia Worldwide

**Stephane Requena**

GENCI

**Vince Scarafino**

Industry Expert

**Suzy Tichenor**

Oak Ridge National Laboratory

» [SEE ALL BIO's](#)



# The HPC User Forum: [www.hpcuserforum.com](http://www.hpcuserforum.com)



FAQs on  
Hyperion  
Research

Latest  
News

[Home](#) [About](#) [Events](#) [Research](#) [Privacy Policy](#) [Join](#)



**NEXT EVENT**  
**SEPTEMBER 9-11, 2019**  
ARGONNE NATIONAL LABORATORY  
CHICAGO, IL



**COMING INTERNATIONAL EVENTS**  
**OCT 7-8: LUGANO, SWITZERLAND**  
**OCT 10-11: EDINBURGH, SCOTLAND**



[DETAILS](#) | [AGENDA](#)

[REGISTER NOW](#)

INNOVATION  
AWARDS

MEETING  
PRESENTATIONS

FUTURE  
MEETINGS

# HPC Market Update

# The Hyperion Research Team

**Earl Joseph**

Research studies & strategic consulting

**Steve Conway**

Strategic consulting, HPC UF, Big Data, AI

**Bob Sorensen**

Strategic research, government studies, QC

**Alex Norton**

Special studies, new data analysis, surveys

**Mike Thorp**

Global sales management

**Kurt Gantrish**

Global sales management

**Jean Sorensen**

Business manager

**Tom Christian**

Survey design & executive interviews

**Nishi Katsuya**

Japan research and studies

# Hyperion Research HPC Activities

- Track all HPC servers sold each quarter
- 4 HPC User Forum meetings each year
- Publish 85 plus research reports each year
- Visit all major supercomputer sites & write reports
- Assist in collaborations between buyers/users/vendors
- Assist governments in HPC plans & strategies
- Assist buyers/users in planning and procurements
- Maintain 5 year forecasts in many areas/topics
- A worldwide ROI measurement system
- HPDA program (includes ML/DL/AI)
- HPC Cloud usage tracking
- Quarterly tracking of GPUs/accelerators
- Cyber Security
- Quantum Computing



# Evolving Issues On Our Minds

## **New major growth areas require different types of systems and solutions**

- AI, ML and DL
- Big Data (HPDA) and advanced analytics
- Non-traditional new HPC users from the enterprise space

## **Non-x86 processors could alter the landscape**

- Both base processor and accelerators
- From China and Europe, plus ARM, AMD, and others

## **The race for exascale is driving up budgets for HPC**

## **China has a larger impact than before**

- i.e. new domestic processors
- i.e. Lenovo is expanding

## **HPC in the cloud is gaining traction**

# Top Trends in HPC



**2018 was a very strong year with over 15% growth -- \$13.7 billion (US\$) in revenues!**

- Supercomputers grew 23% = \$5.4 billion in 2018

**The top systems have started growing again after over 4 years of softness**

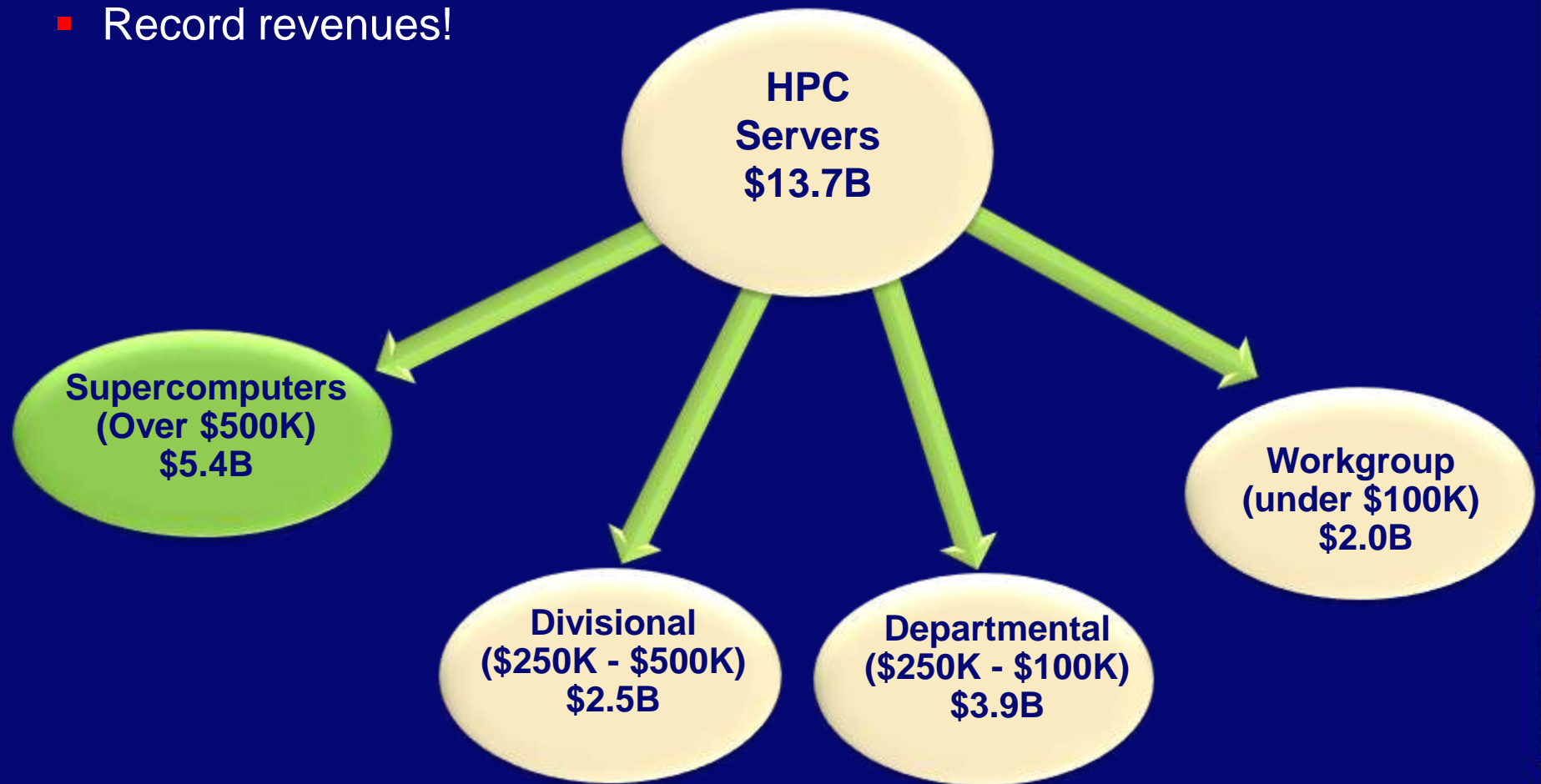
- The profusion of Exascale announcements are generating a lot of buzz

**Big data combined with HPC is creating new solutions**

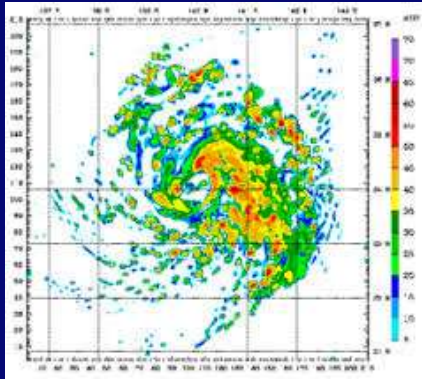
- Adding many new users/buyers to the HPC space
- AI/ML/DL & HPDA are the hot new areas

# The Worldwide HPC Server Market: \$13.7 Billion in 2018

- Record revenues!



# HPC Servers By Verticals/Sectors(\$000 US)



## WW HPC Systems Revenue by Applications

	2018
<b>Bio-Sciences</b>	1,245,865
<b>CAE</b>	1,521,850
<b>Chemical Engineering</b>	205,891
<b>DCC &amp; Distribution</b>	780,184
<b>Economics/Financial</b>	746,418
<b>EDA / IT / ISV</b>	984,887
<b>Geosciences</b>	1,029,041
<b>Mechanical Design</b>	63,137
<b>Defense</b>	1,403,164
<b>Government Lab</b>	2,616,822
<b>University/Academic</b>	2,420,440
<b>Weather</b>	560,631
<b>Other</b>	127,757
<b>Total Revenue</b>	13,706,088
<b>Source: Hyperion 2019</b>	-



# HPC Market By Vendor Shares

OEM	2018 Sales (\$ Millions)	Share %
HPE/HP	4,766	34.8%
Dell EMC	2,857	20.8%
IBM	971	7.1%
Lenovo	957	7.0%
Inspur	788	5.8%
Sugon (Dawning)	462	3.4%
Cray	313	2.3%
Fujitsu	269	2.0%
Penguin	244	1.8%
NEC	201	1.5%
Atos	150	1.1%
Other	1,728	12.6%
Grand Total	13,706	100.0%

# High Growth Areas: HPDA-AI



- HPDA is growing faster than overall HPC market
- AI subset is growing faster than all HPDA

Table 1

Forecast: Worldwide HPC-Based AI Revenues vs Total HPDA Revenues (\$ Millions)

	2018	2019	2020	2021	2022	2023	CAGR 18-23
WW HPC Server Revenues	13,706	14,495	15,780	17,376	18,983	19,947	7.8%
Total WW HPDA Server Revenues	3,153	3,598	3,932	4,737	5,467	6,450	15.4%
Total HPC-Based AI (ML, DL, and Other)	747	938	1,094	1,399	1,810	2,725	29.5%

Source: Hyperion Research 2019

Table 2

Forecast: Worldwide ML, DL & Other AI HPC-Based Revenues (\$ Millions)

	2018	2019	2020	2021	2022	2023	CAGR 18-23
ML in HPC	532	675	875	1130	1479	1940	29.5%
DL in HPC	177	216	301	392	510	665	30.3%
Other AI in HPC	38	47	66	80	95	120	25.9%
Total	747	938	1,242	1,602	2,084	2,725	29.5%

Source: Hyperion Research 2019

# HPC Market Forecasts

Worldwide THPC Revenue Forecasts			
	2018	2023	CAGR 18-23
<b>Supercomputer</b>	5,361,603	8,029,838	8.4%
<b>Divisional</b>	2,449,270	3,527,414	7.6%
<b>Departmental</b>	3,879,445	5,536,962	7.4%
<b>Workgroup</b>	2,015,770	2,884,803	7.4%
<b>Total</b>	13,706,088	19,979,016	7.8%
<b>Source: Hyperion 2019</b>	-	-	

# HPC Market Ecosystem Forecast (\$000 USD)



Revenues by the Broader HPC Market Areas			
	2018	2023	CAGR 18-23
<b>Server</b>	13,706,088	19,979,016	7.8%
<b>Storage</b>	5,547,188	7,771,184	7.0%
<b>Middleware</b>	1,582,892	2,217,801	7.0%
<b>Applications</b>	4,627,492	6,413,592	6.7%
<b>Service</b>	2,229,921	2,858,820	5.1%
<b>Total Revenue</b>	27,693,580	39,240,413	7.2%
<b>Source: Hyperion 2019</b>			

HPC cloud (CSP) usage raises forecast to \$44 billion

**IN SUMMARY:**  
**SOME PREDICTIONS**

# Our Prediction On When & Where Exascale Systems Will Be Installed

## Projected Pre-Exascale and Exascale Acceptances 2020-2025

Year Accepted	China	EU	Japan	US	Total Installations	Total Price
2020	1 pre-exascale	1 pre-exascale		1 pre-exascale	3-4	~\$750 Million
2021	1 pre-exascale 1 near-exascale	1 pre-exascale	1 (Post K Accepted)	1 pre-exascale	4-5	~\$1,900 Million
2022	1 or 2 exascale	1 near-exascale	?	2 exascale	4-5	~\$1,700 Million
2023	1 exascale	1 exascale	1 near-exascale (\$100 million)	1 or 2 exascale	4	~\$1,500 Million
2024	1 exascale	1 exascale	?	2 exascale	4	~\$1,400 Million
2025	2 exascale	1 or 2 exascale	1 near-exascale (\$100 million)	1 exascale	5-6	~\$1,600 Million

# Many New Processors/Accelerators Are on The Way



## Choices of processing elements (CPUs, accelerators) will increase

- x86 will remain the dominant HPC CPU, but indigenous CPUs will gain ground
- **New processors from Japan, China and Europe are being developed**

## NVIDIA is the dominant accelerator today, but many companies are developing very targeted accelerators

- AI startups and large companies are developing processors designed for specific workloads

## Processors exploiting ARM IP are planned for Europe (EPI), Japan (Post-K computer) and China!

# The Exascale Race Will Drive New Technologies



**The global Exascale race is boosting funding for the Supercomputers market segment and creating widespread interest in HPC**

**Exascale systems are being designed for HPC, AI, HPDA, etc.**

- This will drive new processor types, new memories, new system designs, new software, etc.

**In some cases HPC has become too strategic to depend on foreign sources**

- This has led to indigenous technology initiatives



# Artificial Intelligence Will Grow Faster Than Everything Else



**The AI market is at an early stage but already highly useful (e.g., visual and voice recognition)**

- Once better understood, there are many high value use cases that will drive adoption

**The trust (transparency) issue that strongly affects AI today will be overcome in time**

**Learning models (ML, DL) have garnered most of the AI attention, but graph analytics will also play a crucial role with its unique ability to handle temporal and spatial relationships**

# Conclusions

## **HPC is a high growth market**

- Growing recognition of HPC's strategic value

## **HPDA, AI, ML & DL are growing very quickly**

- The HPDA, AI, ML & DL markets will expand opportunities for vendors

## **Vendor share positions shifted greatly in 2015, 2016, 2017 & again in 2019 and may continue to shift**

- e.g., HPE acquisition of Cray

## **Software continues to lag hardware**

- New systems designs and system complexity is making software even further behind
- Applications will need major redesign

# Questions?

Please email:

[ejoseph@hyperionres.com](mailto:ejoseph@hyperionres.com)

Or check out:

[www.HyperionResearch.com](http://www.HyperionResearch.com)

[www.hpcuserforum.com](http://www.hpcuserforum.com)



# Agenda: Thursday Afternoon

- 13:00** Welcome/Introductions: Mark Parsons, EPCC; Paul Muzio and Steve Conway, HPC User Forum
- 13:15** HPC at EPCC
- 13:45** EuroHPC Update, Leonardo Flores, European Commission
- 14:15** Vendor Technical Update: Cray
- 14:30** The UK Exascale Project, Mark Parsons, EPCC
- 15:00** The EU Fortissimo Project: HPC for SMEs, Bastian Koller, HLRS/University of Stuttgart
- 15:30** Networking Break
- 16:00** Vendor Technical Update: AMD
- 16:15** Vendor Technical Update: Panasas
- 16:30** ARM and The UK Catalyst Project, Simon Burbidge, University of Bristol
- 17:00** The European Processor Initiative, Jean-Marc Denis, EPI
- 17:30** End of First Day Meeting
- 17:30** After-Meeting Socializing

# Welcome To The Second Day Of The HPC User Forum Meeting



# Thank You To Our Sponsors!

- **EPCC**
- **AMD**
- **Cray**
- **Intel**
- **Panasas**

# Agenda: Friday Afternoon

- 8:20** Welcome/Logistics: Mark Parsons, EPCC; Paul Muzio and Steve Conway, HPC User Forum
- 8:30** ECMWF and The NEXTGenIO Project, Tiago Quintino
- 9:00** Vendor Technology Update: Intel
- 9:15** Climate: Accelerating MPAS-Ocean on GPUs, Rob Aulwes, Los Alamos National Laboratory
- 9:45** Metadata & Archiving: Recap of the April 2019 HPC User Forum Session, Paul Muzio
- 10:15** Networking Break
- 10:45** The Post-K Computer Project, Satoshi Matsuoka, RIKEN
- 11:15** Large Scale Industrial Simulations Using HPC, Leigh Lapworth, Rolls-Royce
- 11:45** The Exascale Computing Project's Application Software Strategy, Todd Munson, Argonne National Laboratory
- 12:15** The DiRAC Astronomy & Particle Physics Theory Community, Mark Wilkinson
- 12:45** Advanced Computing at NASA, Rupak Biswas
- 13:15** Meeting wrap up and plans for future HPC User Forum meetings, Paul Muzio, Rupak Biswas and Steve Conway
- 13:30** Meeting ends



# Important Dates For Your Calendar

## 2019 HPC USER FORUM MEETINGS:

- October 7 to 8, Lugano, Switzerland at CSCS
- October 10 to 11, Edinburgh, Scotland at EPCC

## 2020 U.S. EVENTS

- March 30 to April 1, Princeton Marriott at Forrestal, Princeton, New Jersey
- September 8 to 10, Loews Ventana Canyon, Tucson, Arizona



# Thank You To Our Sponsors!

- EPCC
- AMD
- Cray
- Intel
- Panasas

**Thank You  
For Attending The  
HPC User Forum  
Meeting!**



# Questions?

Please email:

[sconway@hyperionres.com](mailto:sconway@hyperionres.com)

Or check out:

[www.HyperionResearch.com](http://www.HyperionResearch.com)

[www.hpcuserforum.com](http://www.hpcuserforum.com)

