

**Welcome To The 73rd
HPC User Forum
Meeting
September 9 to 11, 2019**



Introduction: Logistics

We have a very tight agenda (as usual)

- Please help us keep on time!

Review handouts

- Note: We will post most of the presentations on the web site

Dinner events

Thank You To Our Sponsors!

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- Cray
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- Nvidia
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Silver:

- Altair
- Wave Computing

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: 72 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

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BP

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Los Alamos National Labs

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The HPC User Forum: www.hpcuserforum.com



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



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



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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

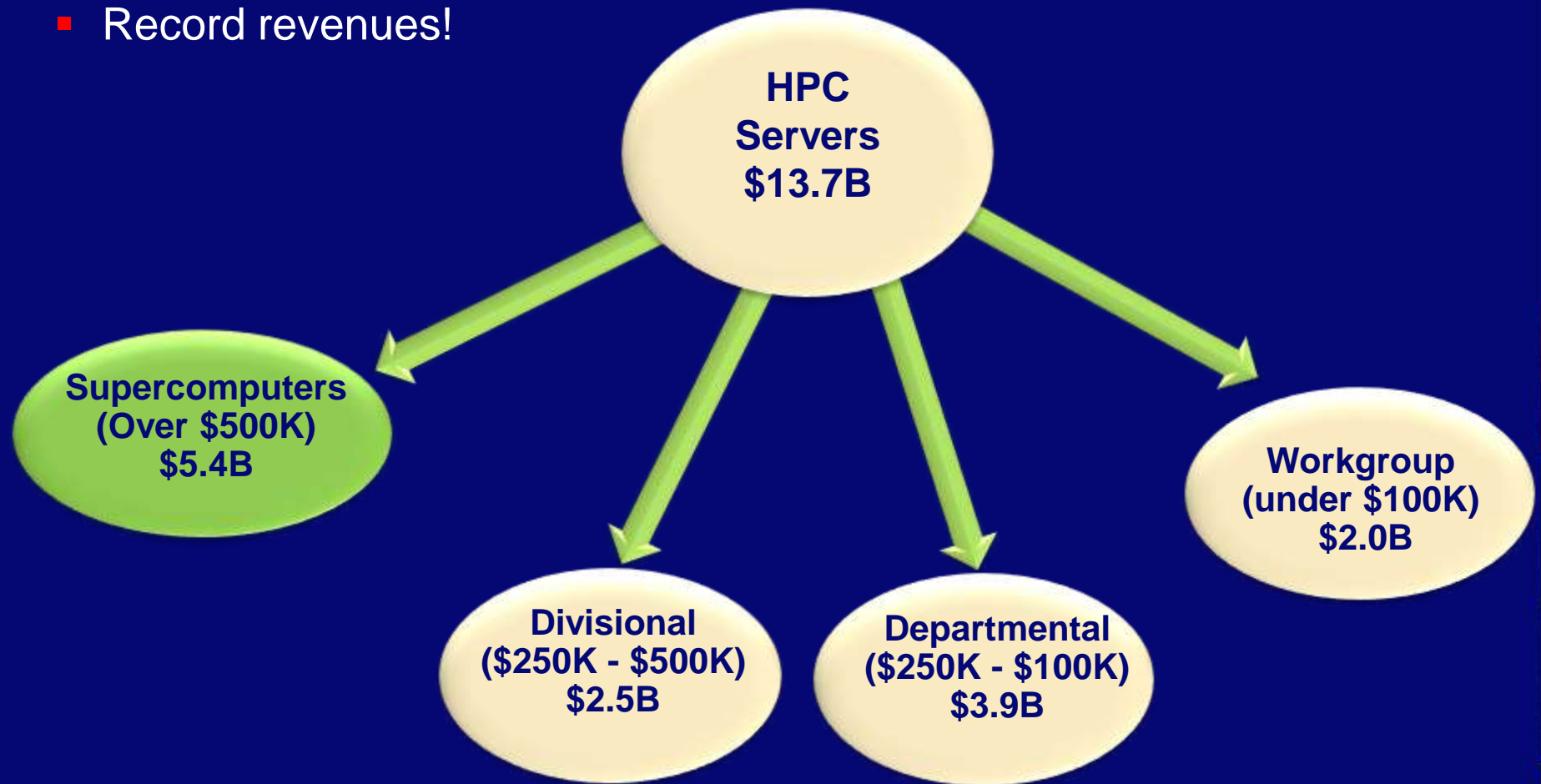
- The profusion of Exascale announcements are generating a lot of buzz

Big data combined with HPC is creating new solutions

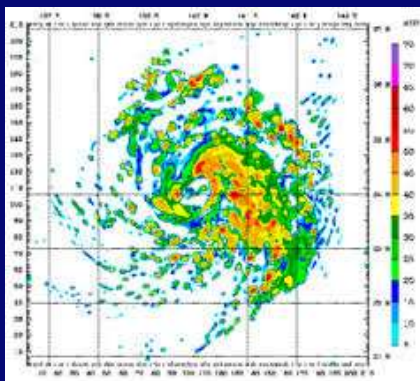
- Adding many new users/buyers to the HPC space
- AI/ML/DL & HPDA are the hot new areas

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

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
Supercomputer	5,361,603	8,029,838	8.4%
Divisional	2,449,270	3,527,414	7.6%
Departmental	3,879,445	5,536,962	7.4%
Workgroup	2,015,770	2,884,803	7.4%
Total	13,706,088	19,979,016	7.8%
Source: Hyperion 2019	-	-	

HPC Market Ecosystem Forecast (\$000 USD)

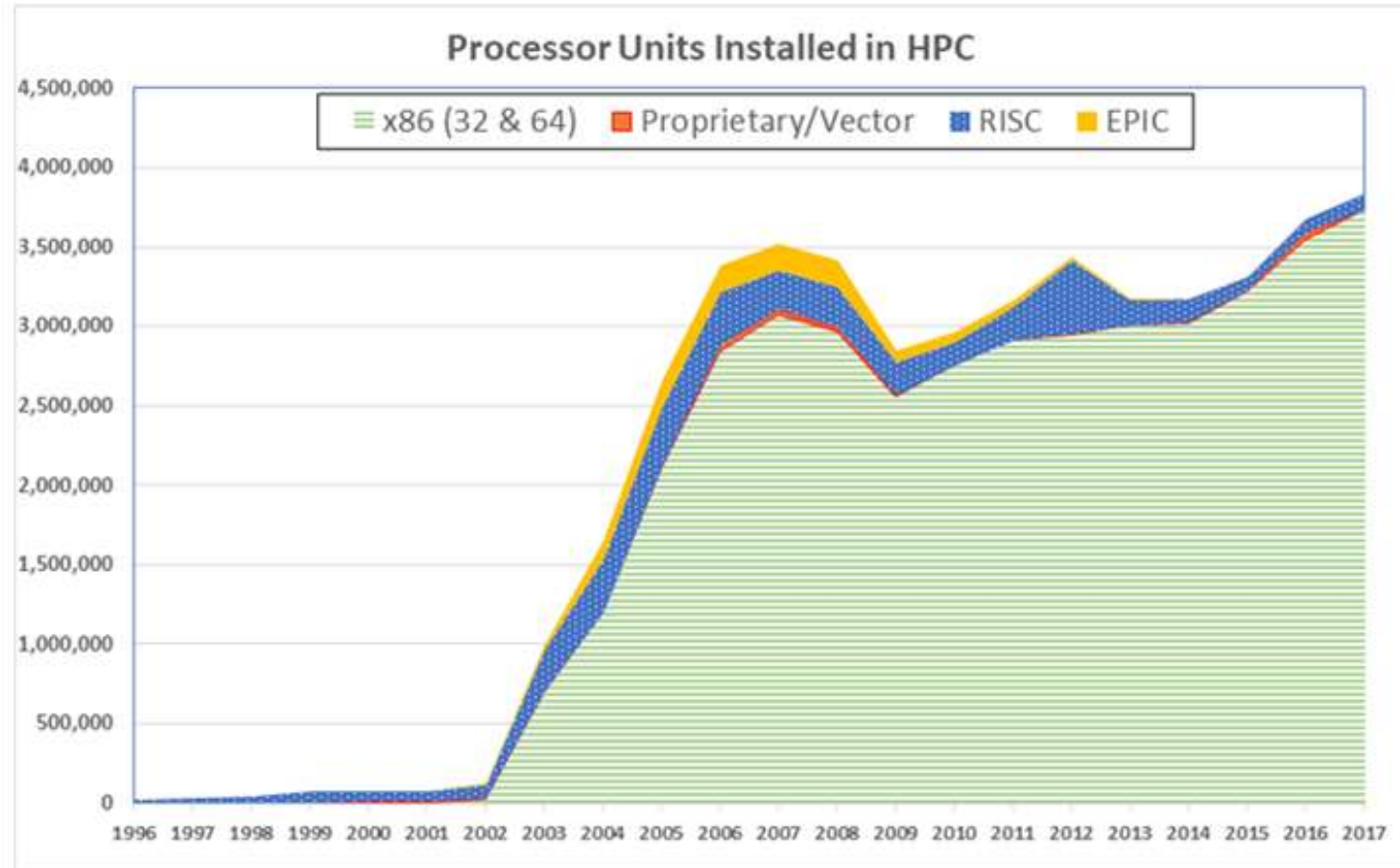


Revenues by the Broader HPC Market Areas			
	2018	2023	CAGR 18-23
Server	13,706,088	19,979,016	7.8%
Storage	5,547,188	7,771,184	7.0%
Middleware	1,582,892	2,217,801	7.0%
Applications	4,627,492	6,413,592	6.7%
Service	2,229,921	2,858,820	5.1%
Total Revenue	27,693,580	39,240,413	7.2%
Source: Hyperion 2019			

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

Tipping Points: How Quickly HPC Buyers Can Change

Processor Units Installed in HPC from 1996 to 2017



Source: Hyperion Research, 2018

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

Or check out:

www.HyperionResearch.com

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Agenda: Tuesday Morning

- 8:00 AM** Welcome and HPC Market Update: Paul Muzio, Rupak Biswas, Earl Joseph and Steve Conway
Morning Session Chair: David Martin
- 8:15 AM** Welcome, Valerie Taylor, Director of Argonne's Mathematics and Computer Science Division
- 8:30 AM** Welcome and Overview of HPC at Argonne National Laboratory, David Martin, ANL
- 8:45 AM** AI for Science, Rick Stevens, ANL
- 9:30 AM** The Cray Shasta Architecture, Steve Scott, Cray
- 10:00 AM** Networking Break
- 10:30 AM** CSCS (Swiss National Supercomputing Center) Update, Thomas Schulthess, CSCS
- 11:00 AM** ECP Applications Development, Andrew Siegel, ANL
- 11:30 AM** Vendor Technology Update: Intel
- 11:45 AM** Vendor Technology Update: Dell EMC
- 12:00 PM** Networking Lunch

**Please Return
By 1:00 PM**



Agenda: Tuesday Afternoon

Afternoon Session Chair: Paul Muzio

- 1:00 PM The European Processor Initiative, Jean-Marc Denis, EPI
- 1:30 PM Update on Exascale Computing Project (ECP), Doug Kothe, Director, ECP
- 2:00 PM HPC and Data Down Under: The Pawsey Supercomputing Centre, Square Kilometre Array and HPC in Australia, Mark Stickells, The Pawsey Supercomputing Centre
- 2:30 PM Vendor Technology Update: HPE
- 2:45 PM Networking Break
- 3:15 PM (Un)Obscured By Clouds - Applying Cloud Techniques To High Performance Systems Integrations, Arno Kolster, Providentia Worldwide
- 3:45 PM Enabling Performance Portable Climate Simulations on Aurora, Nichols Romero, ANL
- 4:15 PM The Cancer Computer, Roy Chartier, Cancer Computer
- 4:45 PM Meeting Ends
- 5:30 PM **Special Dinner Event and Tour at the Advanced Photon Source (Building 402, near the Guest House). Note: There are three tour times starting at 5:30 PM.**

Welcome To The Second Day Of The HPC User Forum Meeting



Thank You To Our Sponsors!

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Gold:

- Cray
- IBM
- Nvidia
- Panasas
- Supermicro

Silver:

- Altair
- Wave Computing

Innovative Technologies Panel: Process

Panelists are asked to present in under 5 minutes an innovative technology that could change the HPC industry.

Each presenter is asked to address 4 questions:

1. What is the innovative technology?
2. Why it is disruptive?
3. What does it do for the end user?
4. What could you use from buyers/partners/others to bring this technology to market sooner or make it better?

Agenda: Wednesday Morning

- 8:00 AM Welcome: Paul Muzio, Rupak Biswas, Earl Joseph and Steve Conway
Morning Session Chair: Rupak Biswas
- 8:15 AM HPDA-AI Research Findings: Steve Conway, Hyperion Research
- 8:30 AM Research Using the Blue Waters Supercomputer, Brett Bode, NCSA
- 9:00 AM HPC in Industry, Brendan McGinty, NCSA
- 9:30 AM Using HPC for Engine Design Optimization, Pei Yuanjiang, Aramco Services
- 10:00 AM Networking Break
- 10:30 AM Innovative Technologies Panel Session, Earl Joseph, Hyperion Research (chair)
Panel members: Altair, AMD, Cray, IBM, Panasas, Red Hat, Supermicro
- 11:30 AM Vendor Technology Update: AMD
- 11:45 AM Vendor Technology Update: AWS
- 12:00 PM Networking Lunch

**Please Return
By 1:00 PM**



Agenda: Wednesday Afternoon

Afternoon Session Chair: Keith Gray

- 1:00 PM HPC at BP, Keith Gray, BP
- 1:30 PM ANL Exascale Training Program, Ray Loy, ANL
- 2:00 PM How the Results of Summit and Sierra are Influencing Exascale, Al Geist, ORNL
- 2:30 PM Vendor Technical Update: IBM Quantum Computing
- 2:45 PM Vendor Technology Update: NEC
- 3:00 PM Cloud Computing Research Findings, Alex Norton, Hyperion Research
- 3:15 PM Networking Break
- 3:45 PM HPC Edge Computing in Urban Environments, Nicola Ferrier, ANL
- 4:15 PM Using Graphs for Unstructured Data, Keshav Pingali, TACC
- 4:45 PM Computational Evaluation of Commercial Cloud HPC with a Global Atmospheric Model, Daniel Arevalo, Divine Consulting
- 5:15 PM Meeting Wrap-Up, Paul Muzio, Rupak Biswas, Earl Joseph and Steve Conway

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