

**Welcome To The 70<sup>th</sup>  
HPC User Forum  
Meeting  
September 4-6, 2018**



# Thank You To Our Sponsors!

- Tuesday Dinner - Dell EMC & Intel
- Wednesday Breakfast - HPE & NVIDIA
- Wednesday Lunch – AMD
- Wednesday PM Refreshments - Altair
- Wednesday Dinner - HPE & Intel
- Thursday Breakfast - Panasas
- Thursday AM Refreshments - Rescale
- Thursday Lunch - IBM
- Thursday PM Refreshments - HPE & NVIDIA

# Important Dates For Your Calendar

## HPC USER FORUM MEETINGS:

- October 1 to 2, Stuttgart, Germany
- April 22 to 24, 2019, Santa Fe, New Mexico
- September 9 to 11, 2019, Chicago Illinois, Argonne National Laboratory

## And Join us for the Hyperion SC18 Briefing:

- Tuesday, November 13, The Adolphus Hotel



# 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 event**

# 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: 69 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

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Chairman, Industry Expert

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NASA Ames  
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Executive Director,  
Hyperion Research

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# HPC Market Update

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The former IDC HPC analyst team

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Hyperion Research helps organizations make effective decisions and seize growth opportunities by providing research and recommendations in both high performance computing and emerging technology areas.

### Hyperion Research Holdings, LLC:

- Owns 100% of the IDC HPC assets
- Tracking the HPC market since 1986
- Headquarters:  
365 Summit Ave., St. Paul, MN 55102



# 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

**Kirsten Chapman**

Data collection and surveys

**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 and vendors
- Assist governments in HPC plans, strategies and direction
- Assist buyers/users in planning and procurements
- Maintain 5 year forecasts in many areas/topics
- Developing a worldwide ROI measurement system
- **HPDA program (includes ML/DL/AI)**
- **HPC Cloud usage tracking**
- **Quarterly tracking of GPUs/accelerators**
- **Cyber Security**
- **Quantum Computing**



# Top Trends in HPC



**He first half of 2018 is looking strong – Exceeded \$6 billion (US\$) in revenues!**

- 2017 was also a strong year

**The top systems has slowed for over 4 years**

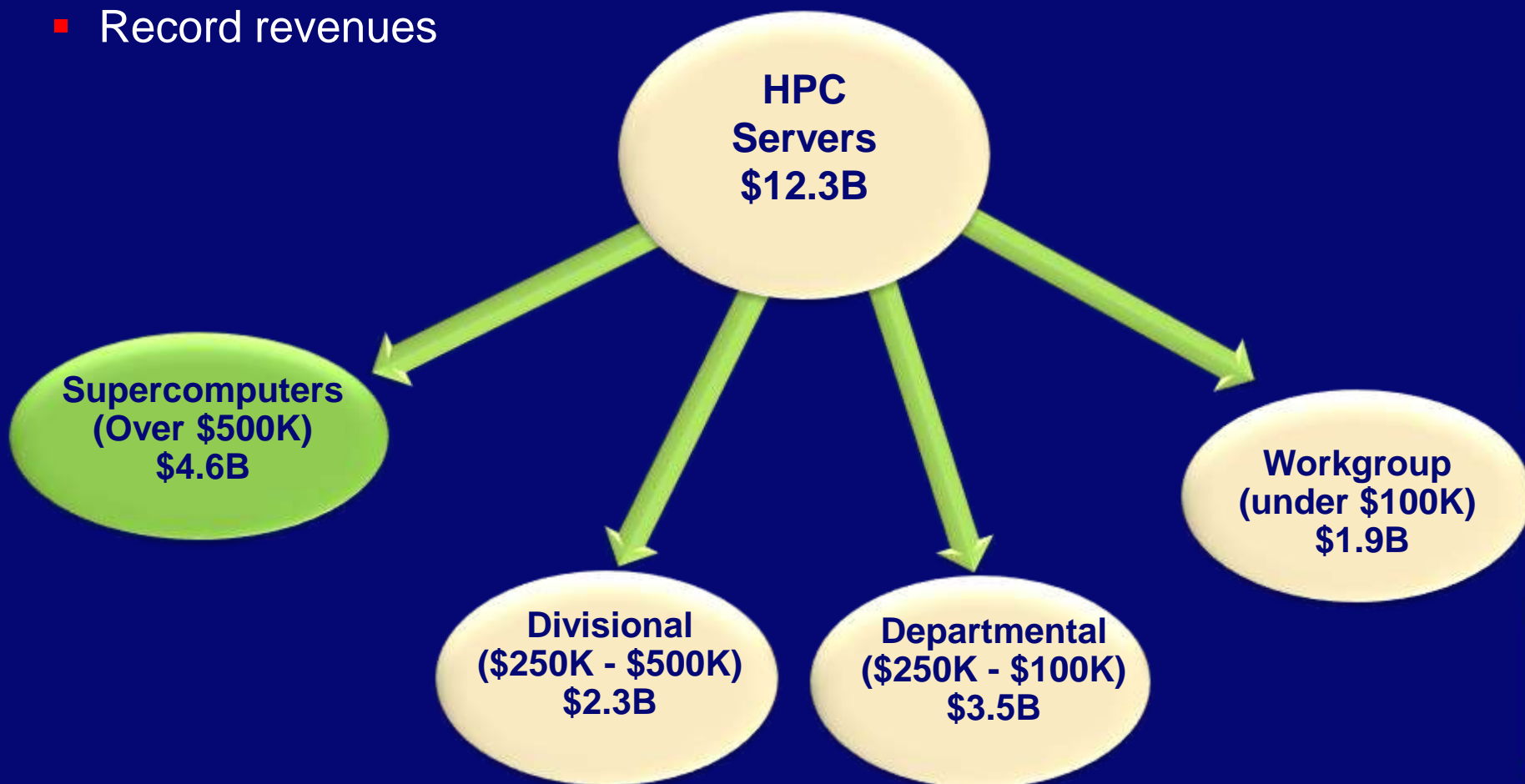
- But the profusion of Exascale announcements is generating a lot of buzz
- Governments are investing heavily in exascale systems

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

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

# The Worldwide HPC Server Market: \$12.3 Billion in 2017

- Record revenues



# 2017 HPC Market By Vertical (\$ Millions)

	2017
<b>Bio-Sciences</b>	1,114,627
<b>CAE</b>	1,361,539
<b>Chemical Engineering</b>	184,203
<b>DCC &amp; Distribution</b>	698,000
<b>Economics/Financial</b>	667,791
<b>EDA / IT / ISV</b>	881,140
<b>Geosciences</b>	920,642
<b>Mechanical Design</b>	56,487
<b>Defense</b>	1,255,355
<b>Government Lab</b>	2,341,167
<b>University/Academic</b>	2,165,472
<b>Weather</b>	501,574
<b>Other</b>	114,300
<b>Total Revenue</b>	12,262,296
<b>Source: Hyperion 2018</b>	-



# HPC Market By Vendor Shares (\$K)

Vendor	2016	2017	2017 Share %	2017/2016 Growth %
HPE/HP	3,877,593	4,194,470	33.8%	8.2%
Dell	2,013,824	2,330,134	18.8%	15.7%
Lenovo	908,532	869,895	7.0%	-4.3%
Inspur	727,243	740,207	6.0%	1.8%
IBM	491,959	575,130	4.6%	16.9%
Sugon (Dawning)	315,048	348,846	2.8%	10.7%
Cray	460,830	250,195	2.0%	-45.7%
Fujitsu	226,995	227,802	1.8%	0.4%
NEC	165,758	171,344	1.4%	3.4%
Penguin	136,250	158,750	1.3%	16.5%
Bull Atos	117,717	133,422	1.1%	13.3%
SGI	168,650	-		
Other	2,120,479	2,420,852	19.5%	14.2%
<b>Total</b>	<b>11,730,878</b>	<b>12,421,046</b>	<b>100.0%</b>	<b>5.9%</b>
<i>Source: Hyperion Research 2018</i>				

# HPC Market By Regions (\$K)

	2016	2017	2017
Data			%
HPC server N.A. Rev.	5,155,105	5,595,811	45.6%
HPC server EMEA Rev.	3,247,174	3,621,498	29.5%
HPC server Asia/Pac Rev.	2,284,973	2,171,111	17.7%
HPC server Japan Rev.	770,011	734,599	6.0%
HPC server ROW Rev.	137,365	139,278	1.1%
<b>Total</b>	<b>11,594,628</b>	<b>12,262,296</b>	
<i>Source: Hyperion Research</i>			

# New HPC Market Forecasts (\$ K)

	2017	2022	CAGR 17-22
<b>Supercomputer</b>	4,840,985	9,521,092	14.5%
<b>Divisional</b>	2,295,273	3,058,506	5.9%
<b>Departmental</b>	3,370,137	4,540,846	6.1%
<b>Workgroup</b>	1,755,901	2,436,173	6.8%
<b>Total</b>	12,262,296	19,556,617	9.8%
<b>Source: Hyperion 2018</b>	-	-	

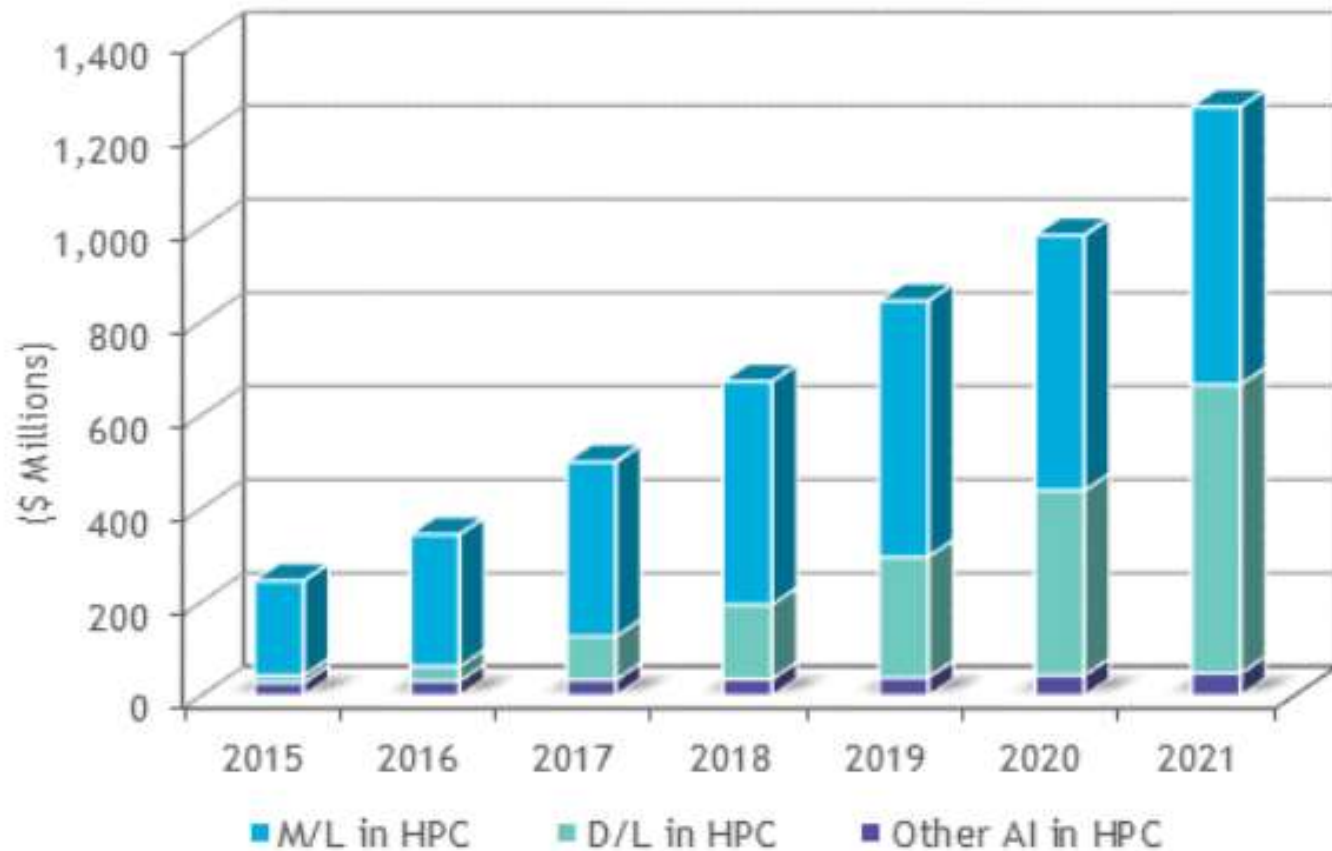
# New Forecast: The Broader HPC Market (\$ K)

<b>Revenues by the Broader HPC Market Areas</b>			
	2017	2022	CAGR 17-22
<b>Server</b>	12,262,296	19,556,617	9.8%
<b>Storage</b>	4,661,102	7,606,884	10.3%
<b>Middleware</b>	1,367,147	2,170,912	9.7%
<b>Applications</b>	3,961,491	6,277,996	9.6%
<b>Service</b>	2,022,090	2,798,378	6.7%
<b>Total Revenue</b>	24,274,126	38,410,788	9.6%
<b>Source: Hyperion 2018</b>			

# WW M/L, D/L, & AI Forecasts

FIGURE 2

## Worldwide M/L, D/L & AI HPC-Based Revenues



Source: Hyperion Research 2017

# EXASCALE UPDATE

# Exascale Race/Technologies

## Projected Exascale Dates and Suppliers

### U.S.



Sustained ES\*: 2022-2023

Peak ES: 2021

Vendors: U.S.

Processors: U.S. (some ARM?)

Initiatives: NSCI/ECP

Cost: \$600M per system, plus heavy R&D investments

### EU



PEAK ES: 2023-2024

Pre-ES: 2021-2022

Vendors: Likely European

Processors: Likely ARM or RICS-V

Initiatives: EuroHPC

Cost: Over \$350M per system, plus heavy R&D investments

### China



Sustained ES\*: 2021-2022

Peak ES: 2020

Vendors: Chinese (multiple sites)

Processors: Chinese (plus U.S.?)

13<sup>th</sup> 5-Year Plan

Cost: \$350-\$500M per system, plus heavy R&D

### Japan



Sustained ES\*: ~2022

Peak ES: Likely as a AI/ML/DL system

Vendors: Japanese

Processors: Japanese

Cost: \$800M-\$1B, this includes both 1 system and the R&D costs

They will also do many smaller size systems

# Exascale Race/Technologies

## Projected Exascale Investment Levels (In Addition to System Purchases)

### U.S.



\$1 to \$2 billion a year in R&D

Investments by both  
governments & vendors

Plans are to purchase  
multiple exascale systems  
each year

### EU



About 5-6 billion euros in total –  
and growing

Investments in multiple exascale  
and pre-exascale systems

Investments by country  
governments and from the EU

Large EU CPU funding

### China



Over \$1 billion a year in R&D

Investments by both  
governments & vendors

Plans are to purchase multiple  
exascale systems each year

Already investing in 3 pre-  
exascale systems starting in  
late 2018

### Japan



Planned investment of over  
\$1 billion\* (over 5 years) for  
both the R&D and purchase of  
1 exascale system

To be followed by a number of  
smaller systems ~\$100M to  
\$150M each

Creating a new processor and a  
new software environment

*\* Note that this includes both the system and R&D*



# Announced China Pre-Exascale Plans

Computer Name	Sunway Exascale Prototype	TianHe-2A	Sugon Prototype	Tianhe-3
Overview	Sunway Exascale Prototype	TianHe2 upgrade	Sugon Exascale Prototype	NUDT Exascale Prototype
Prime Developer /Industry Partner	NRCPC	NUDT/Inspur	Sugon /AMD	NUDT
Location	National Supercomputing Center in Jinan	National Supercomputing Center in Tianjin	TBD	National Super Computer Tianjin Center
Planned/Estimated Delivery Date	2018 1H	2018, 1H	2018, 1H	3Q 2018
Planned/Estimated Performance Pflops	2	94.97	5.12	100-300
Linpack/Peak Performance Ratio	75% (est.)	60% (est.)	60-70% (est.)	60-70% (est.)
Linpack Performance	1.5 PF	56.98	3.072-3.58	60-210
GF/Watt	TBD	5.27	10.24	TBD
Linpack GF/Watt	TBD	3.16	6.14-7.16	TBD

Source: Hyperion Research, 2018



*Note: some of these could slip into 2019*

# Chinese Pre-Exascale Efforts

**China is preparing to launch the first of three pre-exascale systems that will be based on three different architectures:**

- The first of those will be the Tianhe-2A system, a hybrid supercomputer that will use a mix of Intel Xeon processors and the Chinese made Matrix-2000 DSP accelerators and is expected to go online this year
  - The original Tianhe-1A system, ran on a combination of CPUs and GPUs, using runs both Xeon chips and Intel Xeon Phi “Knights Corner” co-processors
- Tianhe-2A (also known as Milkyway-2A) will come with 17,792 nodes – each with two Xeon “Ivy Bridge” CPUs and two Matrix-2000 accelerators – and will deliver a performance of 94.97 petaflops

From: <https://www.nextplatform.com/2018/02/14/look-whats-store-chinas-tianhe-2a-supercomputer/>

# Expected Chinese Exascale Plans

Computer Name	Sugon Exascale	Sunway 2020	NUDT 2020
Overview	Sugon Exascale (if selected)	Sunway Exascale (if selected)	TianHe-3 Prototype Follow-on
Prime Developer /Industry Partner	Sugon/AMD	NRCPC	NUDT
Location	City of Qingdao, the largest port in Shandong (?)		TBD
Organization	Sugon	Sunway	NUDT
Planned Delivery Date/ Estimated	2020, 4Q		2020-2021
Planned/Estimated Performance Pflops	1046	1000	1000
Linpack/Peak Performance Ratio	60-70% (est.)	60-70% (est.)	70-80% (est.)
Linpack Performance	627-732	600-700	700-800
GF/Watt	34.13	30 (est.)	20-30
Linpack GF/Watt	20.90	20-23 (est.)	23.3-32.0

# Summary of Chinese Exascale Efforts

**Broad-scale development from a number of suppliers:**

- NUDT
- Sunway
- Sugon

**Noticeable – and continued absence of major Chinese HPC suppliers:**

- Lenovo, and Inspur

**Indigenous HW dependence deepens**

# A EU-wide Exascale Development Plan

**In January 2018, the European Commission (EC) announced a financial framework for investing €1 billion in European supercomputers over the next two years**

- Under this framework, known as the EuroHPC Joint Undertaking, the European Union (EU) would contribute around €486 million
- The remainder would be supplied by EU member states and associated countries (and others)

**This is a schedule adjustment: one to two years later, from earlier plans, in order to develop the new EU processor (and the system for it)**

# A EU-wide Exascale Development Plan

**14 EU member states have already committed to contributing to the EUR €1B funding, virtually assuring the goal will be met**

**Sources of indigenous technology include the ETP4HPC initiative and CEA-RIKEN collaboration around ARMv8**

**The EU has divided vendors into three classes for purposes of awarding EU-funded projects:**

- European HPC vendors (based in Europe, doing R&D in Europe)
- International European vendors (based outside of Europe, doing R&D in Europe)
- Non-European vendors (based outside of Europe, not doing R&D in Europe)

# Key Motivators For the EU Project

**Provide European industry and in particular SME with a better access to supercomputers to develop innovative products**

**Indigenously produce world-class HPCs**

**Allow European scientists and industry to process their data in the EU, reducing problems related to privacy, data protection, commercial trade secrets, and ownership of data in particular for sensitive applications.**

***The Goal → Secure the EU's independent access to top HPC technology***

# In Summary

## **HPC is still expected to be a growth market**

- Growing recognition of HPC's strategic value
- HPDA, including ML/DL, cognitive and AI
- HPC in the Cloud will lift the sector writ large

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

- E.g., HPE acquisition of SGI & Lenovo buying IBM's x86 server business

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



# Questions?

Please email:

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Or check out:

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# Agenda: Wednesday Morning

- 78:15am Meeting Welcome and Announcements: Paul Muzio, Rupak Biswas, Earl Joseph and Steve Conway**
- 8:30am HPC Market Update and Exascale Programs Around the World, Earl Joseph**
- 8:45am Session: Leadership Computing Initiatives**
- EuroHPC and the European HPC Strategy, Leonardo Flores, European Commission
  - Exascale Computing Project Update, Doug Kothe, Oak Ridge National Laboratory
  - NSF Activities Related to Leadership-Class Computing, Irene Qualters
- 10:15am Break**
- 10:45am Session: Leadership Computing Initiatives (continued)**
- ExaAM: Transforming Additive Manufacturing through Exascale Simulation, John Turner, Oak Ridge National Laboratory
  - The European Processor Initiative, Jean-Marc Denis
- 11:45am Dell EMC Vendor Update**
- 12:00pm Networking Lunch**

**Please Return  
By 1:00PM**



# Agenda: Wednesday Afternoon

**1:00pm Session: Leadership Computing Initiatives (continued)**

- **NASA's Spaceborne Computer Program, Mark Fernandez, HPE**
- **Suitability of Commercial Clouds for NASA's HPC Applications, Bob Hood**

**2:00pm HPE Vendor Update**

**2:15pm Gaining a Competitive Edge with HPC Cloud Computing, William Edsall, Dow Chemical Company**

**2:45pm Networking Break**

**3:15pm HPC Innovations: Short Presentations, Moderated by Earl Joseph**

- **Altair, AMD, IBM, Penguin, Panasas, Rescale, Tachyum, and Univa**

**4:30pm Object Detection in Mobile Urban Complex Environments, Ruth Cheng, ERDC**

**5:00pm Networking Time**

**6:30pm Special Dinner Event at the Henry Ford Museum**



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



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- Thursday PM Refreshments - HPE & NVIDIA

# Agenda: Thursday Morning

- 8:30am**      **Session: Automated Driving Systems, Automotive Engineering, Sensor Networks**
- **Bridging the Automated Vehicle Gap: Consumer Trust, Technology and Liability, Kristin Kolodge, J.D. Power and Associates and Tina Georgieva, Miller Canfield**
  - **Computer Vision for Autonomous Vehicles, Xiaoming Liu and Garrick Brazil, Michigan State University (45 minutes)**
  - **Navigation/Localization Performance of Autonomous Vehicles," Dorota Grejner-Brzezinska, Ohio State College of Engineering**
- 10:15am**      **Scalable AI Solutions and HPC Systems: Examples from the Wild, Bob Zak, Intel**
- 10:30am**      **Networking Break**
- 11:00am**      **Session: Automated Driving Systems, Automotive Engineering, Sensor Networks (continued)**
- **AI for Autonomous Driving Will Revolutionize the Transportation Industry, Bill Veenhuis and Norm Marks, NVIDIA**
  - **Nek5000 Engine Simulation with Exascale Scaling, Muhsin Ameen, Argonne National Laboratory**
- 12:00pm**      **Networking Lunch**

**Please Return  
By 1:00PM**





# Agenda: Thursday Afternoon

- 1:00pm**    **Session: Automated Driving Systems, Automotive Engineering, Sensor Networks (continued)**
- **Use of HPC for AI Applications at Ford Motor Company, Bryan Goodman**
  - **Data Science meets CFD: FieldView Analytics in Engineering, Steve Legensky, Intelligent Light**
- 2:00pm**    **Vendor Technology Update**
- 2:15pm**    **Market Trends in the HPC Arena, Dave Kepczynski, General Electric**
- 2:45pm**    **Networking Break**
- 3:15pm**    **Manufacturing Science and Engineering at Argonne, Santanu Chaudhuri**
- 3:45pm**    **Leadership Computing at Argonne National Laboratory, the Future Home of A21, the First US Exascale System, David Martin**
- 4:15pm**    **Use of HPC to Drive Development of Advanced, More Fuel-Efficient Engines, Ron Grover, General Motors**
- 4:45pm**    **Meeting Wrap-Up, Paul Muzio, Rupak Biswas, Earl Joseph and Steve Conway**

# Important Dates For Your Calendar

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**Thank You  
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Meeting!**



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