



## Update

# Emerging and Disruptive Technologies in High-Performance Computing: HPC User Forum, September 15-17, 2014, Seattle, Washington

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## IN THIS UPDATE

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This IDC update captures part of the proceedings at the 54th HPC User Forum held in Seattle, Washington. With the ever-increasing demand for more powerful HPC and a growing list of new applications and use cases for these systems, a number of government HPC centers are currently in the planning and development stages of new systems that will carry them into the next three to five years. Earl Joseph, HPC program VP at IDC moderated a dynamic and highly engaging disruptive technologies panel at the HPC User Forum. The participants of the disruptive technologies panel included Rich Brueckner – insideHPC; Geoff Noer – Panasas; Peter Hopton – Iceotope; Victor Wright – Altair; Peter Linnell – SUSE; Herb Zien – LiquidCool Solutions; Barry Bolding – Cray; Murray – D-Wave; Gerrold Klein – HP; Steve Oberlin – NVIDIA; Alan Swan – Terascale; Gary Brown – Adaptive Computing; Bill Kramer – NCSA; Steve Legensky – Intelligent Light; Gabriel Loh – AMD; and Martin Hack – Skytree Inc. Steve Conway, HPC research VP at IDC moderated a dynamic and highly engaging emerging technologies panel at the HPC User Forum. The participants of the emerging technologies panel included Jan Odegard – Rice University; John Goodhue – Massachusetts Green High-Performance Computing Center (MGHPCC); Jack Collins – National Cancer Institute; Martin Hack – Skytree; Geoff Noer – Panasas; and Michael Resch – High Performance Computing Center Stuttgart (HLRS).

Government HPC centers are facing an increasingly complex set of requirements that include increased capabilities and payoff for existing scientific applications, inclusion of new requirements for big data analytics, and exploration of architectures that use accelerators and coprocessors. IDC notes that in order to address these requirements, government HPC centers are looking to share costs and technical resources by exploring new partnerships that include intragovernment cooperation and expanding industrial partnerships.

## Emerging HPC Requirements and Major Trends Panel – The Top Trends/Factors That Will Influence the Future of HPC

Steve Conway, HPC research VP at IDC served as the moderator of a dynamic and highly engaging emerging technologies panel, which included a discussion involving the participants.

What do you consider to be the single most important trend that will influence the future of HPC?

## Participant Overviews

- **Jan Odegard, Rice University:** Software, software, software! To deliver the software and solutions that we need, we need people. We need educated people who can deliver performance. We are getting to the tail end of CMOS transistor trending. According to Linley group, the cost per transistors might actually go up. We need an alternative to CMOS. We need to focus on the next thing. Software will be the biggest pain point. We need the next level of computational scientists and supporting folks.
- **John Goodhue, MGHPCC:** HPC is now transitioning from a minority activity to something that is mainstream. HPC is similar to networking in 1990s where it evolved from fringe activity to mainstream. Users have to focus more on getting things to work, especially software, and realize cutting-edge science. Bio-life sciences and social sciences are poster children of these trends. The Northeastern University is one of the exemplar universities in this effort. We are moving from Unix that was on bare metal to a virtual environment comprising hypervisor and software-defined networking.
- **Jack Collins, National Cancer Institute:** Workloads, workloads, and workloads! Qualified people are the most expensive part of our workloads. We had really efficient software. Confluence of big data and heterogeneous processors are causing complexities in software development. Computational problem is a science problem, but moreover, it is a business problem. Clouds have begun to democratize access to HPC. Services like Amazon have simplified access to compute resources.
- **Martin Hack, Skytree:** Partnership between academia and private entities can open new avenues to research. For example, mathematics is one such area where we need new innovations driven through applied math to address various disciplines of sciences. We need new kind of research in pure mathematics. Many math challenges have been solved through appropriate application of technologies. Multiscale models are one of the areas where math is still in the 18th century. It calls for a new way of thinking.
- **Geoff Noer, Panasas:** Data management and data compression and reduction techniques are going to be crucial. We see a new challenge for storage industry. Hard drives are not increasing in size at the same rate as they used to. Drives aren't getting faster, but they are getting larger with much slower rates of access. This is putting pressures across storage ecosystem. We will need new levels of investments in all levels of storage technologies.
- **Michael Resch, HLRS:** None of the panelists who commented before me mentioned HPC. All of the panelists spoke about adjacent issues, like software, workloads, etc. There is a very real risk of HPC disappearing over time. The future of HPC is uncertain in that it will be a very different kind of future, which might not look like big iron.

## Disruptive Technologies Panel

Earl Joseph, HPC program VP at IDC served as the moderator of a dynamic and highly engaging disruptive technologies panel, which included a discussion involving the participants.

## Participant Overviews

- **Rich Brueckner, insideHPC:** Virtualization of HPC using technologies like hypervisors has the potential to be highly disruptive.

- **Geoff Noer, Panasas:** HPC end users are starting to replace hardware RAID with software through various mechanisms, including distribution of file fragments across files. HPC end users are also architecting storage infrastructure for "always on" usage modes.
- **Peter Hopton, Iceotope:** Liquid cooling will be disruptive, especially total liquid cooling. Totally liquid-cooled infrastructure will result in no fans or air flow in the datacenter, no CRAC units. It will also eliminate the need for raised floor.
- **Victor Wright, Altair:** Exascale HPC will require disruptive improvements in architecture and processors.
- **Peter Linnell, SUSE:** Systemd is a new way of launching services and daemons. It's not disruptive but it's controversial. It solves some basic problems compared to traditional methods.
- **Herb Zien, LiquidCool Solutions:** It never made much sense to use air to move heat around. The transition to liquid-based cooling in datacenters should have been made years ago. This solves the air pollution issue and a host of other issues. Keep water out of the datacenter. Water as a liquid is the enemy.
- **Barry Bolding, Cray:** NVRAM for data and compute-intensive architectures. On the compute side, the future could be no moving parts. On the data-intensive side, you could create a very effective system on a chip. But the real disruption will be a single set of software for both the compute- and data-intensive sides.
- **Murray, D-Wave:** Quantum computing is innately disruptive. It has a broad impact on system architectures and algorithmic solution approaches. Currently, D-Wave has delivered technology that solves optimization problems efficiently.
- **Gerrold Klein, HP:** Single cores with accelerators on a single chip. That's why we created Project Moonshot. Software is the key.
- **Steve Oberlin, NVIDIA:** Attack of the killer smartphone. Mobile processors like ARM could potentially be disruptive in HPC. Earlier this year, NVIDIA unified GPU and Tegra architecture.
- **Alan Swan, Terascale:** We provide the software stack for storage appliances for Dell and NetApp. Cost is being driven quickly out of HPC systems. We see big push coming for software RAID because this reduces cost. Also disruptive: open file systems. Hardware companies will need to become more software companies. Today's HSM is not sufficient – will in future be more of a cluster solution that's policy driven.
- **Gary Brown, Adaptive Computing:** HPC bursting to virtual clusters, with job isolation. We are seeing new use cases emerge – for example, multiple hospitals sharing one physical datacenter for their medical records. Also need to run one patient's work on one isolated compute node. Canadian hospital consortium is another exemplar use case. Adaptive computing infrastructure can extend to cloud. Also disruptive: high-throughput computing, which tends to be short, small, and single core. We have a scheduler that can take millions of tasks and run them as one.
- **Bill Kramer, NCSA:** We see two key disruptors: The movement for using ARM and similar processors in HPC. Another disruptor is software reliability.
- **Steve Legensky, Intelligent Light:** Change toward open source and free apps is an illusion. Unless someone pays quality people, software reliability won't happen. The good software like ANSYS and others will have a hard time surviving if software people don't get paid.

- **Gabriel Loh, AMD:** From AMD's perspective, we think die-stacking technologies (3D stacking) will be hugely disruptive. This is happening now and greatly improves memory. It moves the DRAM closer to compute. Still need conventional memory to provide the needed capacity for an HPC system.
- **Martin Hack, Skytree:** Automachine learning.

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### Related Research

Additional research from IDC in the technical computing hardware program includes the following documents:

- *Worldwide Broader HPC 2014-2018 Forecast: Servers, Storage, Software, Middleware, and Services* (IDC #248835, June 2014)
- *When Massive Data Never Becomes Big Data* (IDC #lcUS24922014, June 2014)
- *Worldwide Technical Computing Server 2014-2018 Forecast* (IDC #248779, May 2014)
- *Perspectives on High-Performance Data Analysis: The Life Sciences* (IDC #248348, May 2014)
- *Global HPC Market Dynamics in 2013* (IDC #248137, April 2014)
- *Industrial Partnership Programs and High-Performance Computing: HPC User Forum, April 7-9, 2014, Santa Fe, New Mexico* (IDC #248113, April 2014)
- *Disruptive Technologies in High-Performance Computing: HPC User Forum, April 7-9, 2014, Santa Fe, New Mexico* (IDC #248112, April 2014)
- *Advances in Processors, Coprocessors, and Accelerators in High-Performance Computing: HPC User Forum, April 7-9, 2014, Santa Fe, New Mexico* (IDC #248111, April 2014)
- *International Perspectives on Industrial High-Performance Computing Partnerships: HPC User Forum, April 7-9, 2014, Santa Fe, New Mexico* (IDC #248122, April 2014)
- *Worldwide HPC Public Cloud Computing 2014-2017 Forecast* (IDC #247846, April 2014)
- *Summary of IDC's 2014 Research in the Use of HPC by Oil and Gas Organizations* (IDC #247704, March 2014)
- *IBM Sale to Lenovo Opens Opportunity for Other HPC Vendors* (IDC #lcUS24694314, February 2014)
- *IDC's Worldwide High-Performance Computing Predictions 2014* (IDC #WC20140211, February 2014)
- *Seagate Looking for the X Factor in Its Acquisition of Xyratex* (IDC #lcUS24555413, December 2013)
- *Micron Demonstrates Technologies to Address Emerging Challenges in Big Data Applications* (IDC #244843, December 2013)

- *Market Analysis Perspective: Worldwide HPC, 2013 – Directions, Trends, and Customer Requirements* (IDC #244742, December 2013)
- *HPDA Pulse: 2013 Software and Consulting Market Analysis* (IDC #244513, November 2013)
- *HPDA Pulse Results: 2013 Hardware and Storage Market Analysis* (IDC #244493, November 2013)
- *HP FY13: Revenue Declines Abate on Stronger Core Business* (IDC #lcUS24466413, November 2013)
- *Catalyst Supercomputer Heralds Shift to More Balanced Architectures* (IDC #lcUS24437513, November 2013)
- *China Eyes 10,000-Fold Data Reduction for Internet of Things* (IDC #lcUS24392513, October 2013)
- *HPC User Forum, October 2013, Seoul, Korea* (IDC #243786, October 2013)
- *Tools and Techniques for Technical Computing in Life Sciences: HPC User Forum, September 2013, Boston, Massachusetts* (IDC #243778, October 2013)
- *Perspectives on Quantum Computing: HPC User Forum, September 2013, Boston, Massachusetts* (IDC #243777, October 2013)
- *National and International Initiatives: HPC User Forum, September 2013, Boston, Massachusetts* (IDC #243776, October 2013)
- *Issues in High-Performance Computing: HPC User Forum, September 2013, Boston, Massachusetts* (IDC #243775, October 2013)
- *High-Performance Data Analysis in the Life Sciences: HPC User Forum, September 2013, Boston, Massachusetts* (IDC #243774, October 2013)
- *Chinese Research in Processor Designs for High-Performance Computing and Other Uses* (IDC #243502, October 2013)
- *World's Fastest Supercomputer Set to Reach Customer in October 2013* (IDC #lcUS24300913, September 2013)
- *The Broader HPC Market 2012-2017 Forecast: Servers, Storage, Software, Middleware, and Services* (IDC #242742, August 2013)
- *IDC's Worldwide Technical Server Taxonomy, 2013* (IDC #242725, August 2013)
- *China Regains Top Supercomputer Title* (IDC #lcUS24190613, June 2013)
- *10 Things CIOs Should Know About High-Performance Computing* (IDC #241565, June 2013)
- *Worldwide High-Performance Data Analysis 2013-2017 Forecast* (IDC #241315, June 2013)
- *Top Issues for HPC Sites: HPC User Forum, April 29-May 1, 2013, Tucson, Arizona* (IDC #241463, June 2013)

## About IDC

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