Update

International Perspectives on Industrial High-Performance Computing Partnerships: HPC User Forum, April 7–9, 2014, Santa Fe, New Mexico

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IN THIS UPDATE

This IDC update captures part of the proceedings of the 52nd HPC User Forum held April 7–9, 2014, in Santa Fe, New Mexico. The topic covered in detail in this document is industrial high-performance computing (HPC) partnerships outside of the United States. This document is a near-verbatim record of the talks given on this topic.

"Case History and Best Practices from the United Kingdom's Hartree Centre (Daresbury Sci-Tech Campus)": Cliff Brereton, STFC

I'll also talk about our relationship with Lawrence Livermore National Laboratory (LLNL).

Douglas Hartree was an early scientific computing innovator. We're based at Daresbury, in Cheshire, United Kingdom.

e-Infrastructure

The 2011 Tildesley Report ultimately led to £160 million of investment through the U.K. Department for Business, Innovation & Skills (BIS) to enhance the economic impact of software and modeling. 25% of this investment was to set up the Hartree Centre, and the rest was for universities and the Edinburgh Parallel Computing Centre (EPCC). The United Kingdom and most of Europe do not compete globally on price but on innovative products and services, such as through ARM, BAE, Bentley, GlaxoSmithKline, Unilever, and JLR. The center makes services available to companies of all sizes, not for free. We believe visualization is the key. Physical prototyping is expensive and difficult, sometimes impossible to do (e.g., a heart attack).

The value of modeling and simulation is highlighted in the report titled *E-infrastructure: The Ecosystem for Innovation – One Year On.* For example, it costs £500,000 to do each physical crash test versus £12 for a virtual simulation of a car crash. Our customers define value as more sales/customers, better outcomes, and cheaper product design. We have a manufacturing partnership with Unilever R&D Labs.

The Hartree Centre

Hartree Centre projects include:

- Engineering/manufacturing: Vehicle testing, consumer electronics design, consumer packaged goods design
- Environment
- Life science: Genomics for better crop design
- Energy: Advanced battery cell design, wellhead extraction
- Financial services

Hartree systems include:

- Blue Joule: 98,000 cores, 1.2PF
- Blue Wonder: 20,000 cores
- 9PB of disk storage and 15PB of tape storage
- 3 Visualization walls
- Big data analytics cluster (288TB)
- NVIDIA Tesla GPU cluster

Hartree employees number:

- 48 employees in 2014, with 20 more coming

Hartree services include:

- Collaborative R&D
- Software and algorithms
- Training and skills, including a high school summer course involving Jack Dongarra
- PaaS

Partnership with Livermore Lab

We chose LLNL, and they chose us to partner with. The agreement signed in August 2013 calls for the parties to share know-how and information related to competitive advantage. It includes an IBM commitment. The industrial partnerships we'll tackle together will be big and complex; otherwise, there would be no reason not to handle them alone. We'll have industry days where we gather clients together for workshops, and we'll have joint projects in engineering, life sciences (drug development), and other fields.

"HPC Industrial Engagement Initiatives: Realities, Myths and Dreams": Andy Jones, Numerical Algorithms Group (NAG)

For industrial use cases, go to **www.hector.ac.uk/casestudies/**.

Political necessity – government directives – is driving many HPC centers' engagements with industry, so in some cases centers do this because they are supposed to. Other centers do it to increase revenue. Industry has been using HPC for decades, and HPC centers have been trying to engage with industry nearly as long, but success stories are still pretty rare. Engaging with industry is hard work and different from business as usual for the centers.

HPC centers sometimes think they are the only ones with HPC expertise, but industry often has it, too. HPC centers tend to talk about partnerships and collaborations but tend to be terrified of calling them customers. HPC centers also often assume that all users have huge problems, but industry's problems many times are smaller. HPC centers are also terrified of admitting that they are competing with each other for industrial customers and collaborators.

Prices range from 3 cents/core hour to more than 30 cents. At 30 cents you need to be competing on more than price.

HPC consultant hourly fees range from $140 to $340. Centers also offer training courses for anywhere from free to full market rates. Most centers aren't deriving much income from industrial engagements today. The top 4 challenges working with industry include software licenses, getting contracts, confidentiality, and finding staff.

"TERATEC: A European Industrial Initiative": Hervé Mouren, TERATEC

This initiative is European, based in Paris, and led by industry. Industry needs HPC in many domains, including energy, healthcare, services, and the media. HPC is becoming an engine for the economy.

Eight years ago, TERATEC had 6 users from aerospace and energy, including EDF, Total, and CE. These 6 companies decided to start an initiative to launch HPC for themselves and their supply chains. Today, TERATEC has 80 members. TERATEC includes industrial users, technology providers, and research centers. One user is a cosmetics company that uses simulation because it is no longer allowed to do animal testing.

A few years ago, a decision was made to have a physical ecosystem for TERATEC. Today, we have the TERATEC Campus 30km south of Paris, next to CEA-DAM. CEA's very large computing center is within CEA's classified site. TERATEC has a 60MW electrical supply. The TERATEC Campus includes a business incubator, research labs, space for firms using HPC, and the European HPC Education Institute. The campus opened in June 2012. Our campus hosts many collaborations with industry.

We have three labs:

- The Exascale Computing Research Lab, led by Intel
- CEA and Bull share a lab focused on codesign
- The SystemX Technological Research Institute

2013–2014 is a turning point when we launched the European Technology Platform for High Performance Computing (ETP4HTC), and we are preparing the French national supercomputing plan and extending from French collaborations to European and international initiatives.

We host a large conference each year in the Paris area. The TERATEC 2014 Forum will be a two-day conference, with an exhibit area. The second day of the forum is working sessions. Last ;year, more than 1,000 people attended. We focus not only on what's happening today but on future plans.

The European Technology Platform for HPC is about competitiveness and job creation. ETP4HPC is an organization led by European HPC technology providers, aimed at building a competitive HPC value chain in Europe. It is recognized by the European Commission (EC). Within ETP4HPC are ETPs for specific industries such as aerospace. IBM and Intel are among the founding members because of their strong European presences. The organization is led by a strategic research agenda, and the format is public-private partnerships. One of the goals is to expand Europe's HPC user base.

2016 will be the first demonstration of technologies, and 2020 will be the demonstration of fully developed technologies. We are charged with addressing the needs of industry and science and the grand challenges of society. We will have EC funds of €700 million to implement the strategic research agenda for 2014–2020. This will be matched by industrial investments. There are 16 founding members.

The New Face of Industry in France

France launched 34 industrial sector-based initiatives, one of which is on supercomputers, which TERATEC was asked to lead. Gerard Roucairol, chairman, TERATEC, leads the supercomputer initiative.

The goals are to help develop the next generation of supercomputers, including new architectures and software for health, agro, urban systems, materials, manufacturing, and multimedia. These are our six sector-specific initiatives in supercomputing. The initiatives include dissemination of the results and training.

"HPC Application Innovation Strategy": Leijun Hu, Inspur Information

Inspur participates in the Tianhe-1A and Tianhe-2 programs. App domains include DCC, CFD, seismic, medical imaging, FSI, and more. In 2013, we installed the Tianhe-2 supercomputer with peak of 54.9PF. In 2015, our target is 100PF. This is the second phase of the Tianhe-2 system program. China plans a second 100PF system in 2015–2016.

China's 863 Plan

The 100PF supercomputers are part of the China 863 plan, which is the 12th five-year plan of China. It also includes spending of RMB100 million ($16 million) on parallel software R&D and RMB200 million ($32 million) on a software development platform. The plan has three target areas: HPC systems, HPC applications, and HPC talent cultivation.

The Asian Student Supercomputer Challenge (ASC) is part of the talent cultivation goal. 82 teams from 5 continents registered for ASC14, of which 16 teams are finalists. Finalists build their own small cluster and run five apps on it and also optimize one application on Tianhe2. The ASC14 final will be held April 21-25 at Sun Yat-sen University, Guangzhou. The ASC14 includes only students from Asia, but it will be worldwide in future years.

HPC Application Optimization Strategy

We are very involved in system platform optimization, technical architecture innovation, and algorithm innovation. We plan to exploit CPU, GPU, and MIC. Challenges include modifying legacy applications, especially commercial apps where source code is not available. In the beginning, we just rely on our feeling for the attributes of an application (e.g., whether it is IO-intensive or not). Then we use our application analyzer to figure out attributes in detail. We show this in an Excel-like table and on a Kiviat chart.

Not many scientists are familiar with the computers, so we set up a GUI that makes it easier to exploit the cluster. While the problem is running, the GUI also shows the progress. If the job is not performing as it should, the GUI alerts the user to take corrective action.

Our vendor collaborations include the Intel-Inspur Parallel Computing Joint Lab and the NVIDIA-Inspur Cloud Supercomputing Center. We also have published books, including the first book about programming MIC (December 2012).We have gotten very good speedups with MICs on appropriate applications.

HPC Talent Cultivation

The HPC talent cultivation program includes:

- MIC/GPU certification training
- The ASC supercomputing challenge
- Publications
- HPC university courses

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Related Research

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

- *Worldwide High-Performance Data Analysis 2013-2017 Forecast* (IDC #241315, June 2013)
- *Experiences in HPC: HPC User Forum, April 29-May 1, 2013, Tucson, Arizona* (IDC #241455, June 2013)

- *HPC in Aerospace, Astrophysics, and Astronomy: HPC User Forum, April 29–May 1, 2013, Tucson, Arizona* (IDC #241451, June 2013)
- *Top Issues for HPC Sites: HPC User Forum, April 29–May 1, 2013, Tucson, Arizona* (IDC #241463, June 2013)
- *Potential Disruptive Technologies Panel: HPC User Forum, April 29–May 1, 2013, Tucson, Arizona* (IDC #241452, June 2013)
- *Advanced Visualization: HPC User Forum, April 29–May 1, 2013, Tucson, Arizona* (IDC #241446, June 2013)
- *Worldwide Technical Computing Server 2013–2017 Forecast* (IDC #241154, May 2013)
- *Supercomputers Exceed 50% of the HPC Server Market in 2012* (IDC #240426, April 2013)
- *Changing Market Dynamics: HPC Meeting Big Data and IDC's Projected Evolution of the Market* (IDC #240365, March 2013)
- *Livermore Lab Expands Industry Partnerships: Economic Security Is Vital for National Security* (IDC #240232, March 2013)
- *Worldwide Technical Computing 2013 Top 10 Predictions* (IDC #239421, February 2013)
- *High-Performance Data Analysis at NASA JPL* (IDC #238254, December 2012)
- *Advanced Research at the South Ural State University Supercomputing Center* (IDC #238225, December 2012)
- *The Economic Value of HPC in Science and Industry: HPC User Forum, September 2012, Dearborn, Michigan* (IDC #237182, October 2012)
- *Big Data in HPC: HPC User Forum, September 2012, Dearborn, Michigan* (IDC #237180, October 2012)
- *How Nations Are Applying High-End Petascale Supercomputers for Innovation and Economic Advancement in 2012* (IDC #236341, August 2012)
- *Tokyo Institute of Technology: Global Scientific Information and Computing Center* (IDC #236243, August 2012)
- *Shanghai Supercomputer Center* (IDC #236245, August 2012)
- *Petascale Supercomputing at the University of Tokyo* (IDC #236292, August 2012)
- *HPC Application Leadership at the Supercomputing Center of Chinese Academy of Sciences* (IDC #236281, August 2012)
- *India Broadening Access to Supercomputing* (IDC #IcUS23621912, July 2012)
- *Institute of Process Engineering, Chinese Academy of Sciences* (IDC #236204, July 2012)
- *How Fujitsu Built the World's Fastest Supercomputer in Record Time and Ahead of Schedule* (IDC #235733, July 2012)
- *Europe Sharpens Its Focus on Exascale Computing* (IDC #IcUS23555112, June 2012)
- *IBM Returns Supercomputer Crown to United States* (IDC #IcUS23547812, June 2012)

- *Potential Disruptive Technologies: HPC User Forum, April 2012, Richmond, Virginia* (IDC #234742, May 2012)
- *The Broader HPC Market: Servers, Storage, Software, Middleware, and Services* (IDC #234682, May 2012)
- *HPC End-User Site Update: RIKEN Advanced Institute for Computational Science* (IDC #233690, March 2012)
- *National Supercomputing Center in Tianjin* (IDC #233971, March 2012)
- *Worldwide Data Intensive-Focused HPC Server Systems 2011-2015 Forecast* (IDC #232572, February 2012)

About IDC

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