Exascale at SC12

November, 2012

With the SC12 conference only a few days away, we wanted to take a look at all things Exascale for the thousands of HPC community stakeholders traveling to Salt Lake City. As the computing landscape changes, we can always count on finding the first discussions of new high-end technology at the SC conference.

We asked SC12 Technical Program Chair, Rajeev Thakur, to give us a summary of the many exascale topic discussions included in this year's program.

We hope to see many of you in Salt Lake City, and we hope you enjoy this Exascale Report exclusive article with links to all the exascale-related discussions at SC12.

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The Exascale Report™

Exascale at SC12

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The international HPC community is actively working toward developing the next generation of high-performance computers that will be capable of 1 exaflops/s (10^{18} flops/s) or more of performance. These activities of the community are well represented in the program of the SC12 conference—the premier international conference on high-performance computing, networking, storage, and analysis.

Looking through the programs of past SC conferences, exascale first appeared in the official SC program in SC08 in Austin, Texas, where there was a workshop, three BoFs, three Exhibitor Forum talks, a Masterworks talk, and a Disruptive Technologies panel with the word exascale in the title or abstract. The initial exploratory meeting of the International Exascale Software Project (IESP) was also held at SC08.

Since then, exascale-related topics have received substantial coverage at SC conferences. The upcoming SC12 conference in Salt Lake City, Nov. 10–16, offers the HPC community the opportunity to participate in numerous events related to exascale. Listed below are no less than 75 events that explicitly mention exascale or extreme scale in the title or abstract! In addition, the SC12 program, available online at http://sc12.supercomputing.org/schedule/, includes many other events that implicitly relate to exascale. The SC12 exhibit hall will also showcase numerous companies and research organizations promoting their latest products and technologies, many of which will be important in the development of future extreme-scale systems. A satellite event

not part of the official SC12 program is a workshop organized by funding agencies from several countries on early results of the G8 exascale projects.

As we move closer to exascale, I expect future SC conference programs to reflect this change as well, with a transition from speculation to practice, as systems, software, and algorithms become more suited for exascale. The performance results in the submissions for the Gordon Bell Prize, for example, will begin to reflect the approach of exascale. At the same time, we will see the beginning of the post-exascale era, with panels and other sessions devoted to what it would take to go beyond exascale (zettascale).

Although some solutions developed for exascale will be unique to systems of that size, an important benefit of exascale is that it will enable smaller systems that are far more powerful than those available today. Such powerful and energy-efficient smaller systems will benefit many industrial and academic users. In fact, we may see such "petaflop-in-a-rack" systems on display at the SC show floor in the future!

Exascale-Related Events at SC12

Keynote
1. Physics of the Future, Michio Kaku, Tue 8:30–10:00

Invited Talks
1. The Costs of HPC-Based Science in the Exascale Era, Thomas Ludwig, Tue 2:15–3:00
2. A Journey to Exascale Computing, William J. Harrod, Thu 8:30–9:15
3. The Evolution of GPU Accelerated Computing, Steve Scott, Thu 9:15–10:00
4. Application Performance Characterization and Analysis on Blue Gene/Q, Bob Walkup, Thu 11:15-12:00

Papers
1. Hybridizing S3D into an Exascale Application using OpenACC, Tue 10:30–11:00
2. Early Evaluation of Directive–Based GPU Programming Models for Productive Exascale Computing, Tue 1:30–2:00
3. Alleviating Scalability Issues of Checkpointing Protocols, Tue 2:00–2:30
4. Byte-Precision Level of Detail Processing for Variable Precision Analytics, Wed 10:30–11:00
5. Combining In-Situ and In-Transit Processing to Enable Extreme-Scale Scientific Analysis, Wed 11:00–11:30
6. Classifying Soft Error Vulnerabilities in Extreme-Scale Scientific Applications Using a Binary Instrumentation Tool, Wed 1:30–2:00
7. Containment Domains—A Scalable, Efficient, and Flexible Resiliency Scheme for Exascale Systems, Wed 2:00–2:30 (Best Student Paper Finalist)
8. Extending the BT NAS Parallel Benchmark to Exascale Computing, Thu 1:30–2:00
9. What Scientific Applications Can Benefit from Hardware Transactional Memory, Thu 2:30–3:00
10. Communication Avoiding and Overlapping for Numerical Linear Algebra, Thu 3:30–4:00
11. Communication-Avoiding Parallel Strassen—Implementation and Performance, Thu 4:00–4:30

Gordon Bell Prize Finalist
1. Billion-Particle SIMD-Friendly Two-Point Correlation on Large-Scale HPC Cluster Systems, Tue 1:30–2:00
2. Extreme-Scale UQ for Bayesian Inverse Problems Governed by PDEs, Tue 2:30–3:00
3. The Universe at Extreme Scale—Multi-Petaflop Sky Simulation on the BG/Q, Wed 1:30–2:00

Panels
1. Exascale and Big Data IO—Which Will Drive Future IO Architectures, Standards and Protocols—Should They be Open or Proprietary, Wed 1:30–3:00
2. Visualization Frameworks for Multi-Core and Many-Core Architectures, Wed 3:30–5:00

Tutorials
1. Supporting Performance Analysis and Optimization on Extreme-Scale Computer Systems, Mon 8:30–12:00
2. The Practitioner's Cookbook for Good Parallel Performance on Multi- and Manycore Systems, Mon 8:30–5:00
3. Asynchronous Hybrid and Heterogeneous Parallel Programming with MPI/OmpSs for Exascale Systems, Mon 1:30–5:00
4. The Global Arrays Toolkit—A Comprehensive, Production- Level, Application-Tested Parallel Programming Environment, Mon 1:30–5:00

Workshops
1. 3rd Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems—ScalA, Sun 9:00–5:30
2. Third Annual Workshop on Energy Efficient High Performance Computing—Redefining System Architecture and Data Centers, Sun 9:00–5:30
3. The Second International Workshop on Network-aware Data Management, Sun 9:00–5:30
4. 3rd International Workshop on Performance Modeling, Benchmarking and Simulation of High Performance Computing Systems, Mon 9:00–5:30
5. 7th Parallel Data Storage Workshop, Mon 9:00–5:30
6. The 5th Workshop on Many–Task Computing on Grids and Supercomputers, Mon 9:00–5:30
7. The 7th Workshop on Ultrascale Visualization, Mon 9:00–5:30
8. Preparing Applications for Exascale Through Co–design, Fri 8:30–12:30
9. Extreme–Scale Performance Tools, Fri 8:30–12:30

Birds of a Feather Sessions (BoFs)
1. Exascale IO Initiative: Progress Status, Tue 12:15–1:15
2. System wide Programming Models for Exascale, Tue 12:15–1:15
3. Implementing Parallel Environments: Training and Education, Tue 12:15–1:15
4. Exascale Research—The European Approach, Tue 5:30–7:00
5. HPC Runtime System Software, Tue 5:30–7:00
6. Building an Open Community Runtime (OCR) framework for Exascale Systems, Wed 12:15–1:15
7. The Way Forward: Addressing the data challenges for Exascale Computing, Wed 12:15–1:15
8. Unistack: Interoperable Community Runtime Environment for Exascale Systems, Wed 12:15–1:15
9. Operating Systems and Runtime Technical Council, Wed 5:30–7:00
10. Co–design Architecture and Co–design Efforts for Exascale: Status and Next Steps, Wed, 5:30–7:00
11. Power and Energy Measurement and Modeling on the Path to Exascale, Wed 5:30–7:00
12. Using Application Proxies for Exascale Preparation, Wed 5:30–7:00
13. Cool Supercomputing: Achieving Energy Efficiency at the Extreme Scales, Wed, 5:30–7:00
14. The Green500 List, Wed, 5:30–7:00
15. Resilience for Extreme–scale High–performance Computing, Thu 12:15–1:15

Posters (Tue 5:15–7:00, Wed/Thu 8:30–5.00)
1. Matrices Over Runtime Systems at Exascale
2. Collective Tuning: Novel Extensible Methodology, Framework and Public Repository to Collaboratively Address Exascale Challenges
3. FusedOS: A Hybrid Approach to Exascale Operating Systems
4. Distributed Metadata Management for Exascale Parallel File System
5. An Exascale Workload Study
6. Evaluation of Magneto–Hydro–Dynamic Simulation on Three Types of Scalar Massively Parallel Computers
7. Memory-Conscious Collective IO for Extreme-Scale HPC Systems
8. Networking Research Activities at Fermilab for Big Data Analysis
9. Advances in Gyrokinetic Particle-in-Cell Simulation for Fusion Plasmas to Extreme Scale
10. Statistical Power and Energy Modeling of Multi-GPU kernels
11. Programming Model Extensions for Resilience in Extreme Scale Computing
12. Asynchronous Computing for Partial Differential Equations at Extreme Scales
13. Gossip-Based Distributed Matrix Computations

Scientific Visualization Showcase (Tue 5:15–7:00, Wed/Thu 8:30–5.00)
1. Computational Fluid Dynamics and Visualization

Doctoral Showcase
1. Total Energy Optimization for High Performance Computing Data Centers, Wed 11:15–11:30
2. Distributed File Systems for Exascale Computing, Wed 3:30–5:00
3. Paving the Road to Exascale with Many–Task Computing, Wed 3:30–5:00
4. Programming and Runtime Support for Enabling In-Situ/In-Transit Scientific Data Processing, Thu 3:30–5:00

Exhibitor Forum
1. Mellanox Technologies—Paving the Road to Exascale Computing, Tue 11:00–11:30
2. Runtimes and Applications for Extreme-Scale Computing, (E.T. International, Inc.) Wed 11:30–12:00
3. Findings From Real Petascale Computer Systems and Fujitsu's Challenges in Moving Towards Exascale Computing, Wed 2:00–2:30
4. Innovation and HPC Transformation, (HP), Wed, 11:30–12:00

Broader Engagement Workshops
1. Broader Engagement and Education in the Exascale Era, Sun 8:30–10:00
2. Programming Exascale Supercomputers, Sun 11:15–12:00
3. Heading Towards Exascale—Techniques to Improve Application Performance and Energy Consumption Using Application–Level Tools, Mon 4:15–5:00
4. The Growing Power Struggle in HPC, Mon 3:30–4:15

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A Global Perspective

The voice of the emerging exascale community