



## Mellanox InfiniBand Helps Smash SC09 Cluster Challenge for StonyBrook

### Situation

The Supercomputing Conference (SC) is the premier international conference for high-performance computing, networking, storage and analysis. It draws over 11,000 researchers, scientists, engineers, and computing experts from around the world. Last year, SC09 was held on November 14-20, at the Oregon Convention Center in Portland. Each year, the conference features a Student Cluster Competition where undergraduate student teams compete against each other to perform scientific application benchmark runs on clusters.

The competition provides an opportunity for the teams to showcase their cluster design skills and the capabilities of these systems. The students integrate and install these clusters using vendor-sponsored hardware, all under strict power requirements of no more than 3120 Watts, and the hardware, along with the metered power units, must fit into a single rack.

The rules state that teams shall consist of up to six students and a supervisor. Students are classified as those who have not been granted a degree from a four-year college or university. This leaves the door open for high school students. Supervisors are not permitted to provide anything but pizza, snacks and soda: No Technical Assistance.

Seven teams submitted proposals to compete in the Student Cluster Competition, and four teams were chosen to participate in the final live competition at SC09, including the team from Stony Brook University. The Stony Brook team was sponsored by AMD, Dell and Mellanox Technologies and included two freshman, one sophomore and three seniors from a range of majors such as biology, applied mathematics and computer science.



Back row from left to right are Yuwei (Ethan) Gui, Xincheng Zhang, Aaron Pellman-Isaacs, Anthony Biondo, Jan W Kasiak, William Chan, and Xiangmin (Jim) Jiao. Front row are the competition organizers Jeanine Cook and George "Chip" Smith.

The workloads that the teams need to run are split into two categories: benchmark runs and application runs:

- HPCC (benchmark category): High Performance Computing Challenge benchmark
- NWChem (application category): A computational chemistry code developed by the Molecular Sciences Group at PNNL
- Chombo (application category): A set of tools for implementing finite difference methods for the solution of partial differential equations
- WRF (application category): Weather research and forecasting
- VisIT (application category): A free interactive parallel visualization and graphical analysis tool

One of the main factors in winning the Cluster Competition is implementation time. Students must integrate the cluster within the space of a few short weeks leading up to the show and have two days to perform benchmarks and to run the

required applications at the event.

The partnership with the sponsoring vendors enables the students to develop relationships with the vendors and to learn from their engineers. The Stony Brook students built their cluster using technology provided by Dell, Mellanox and AMD. The cluster consisted of five Dell PowerEdge M905 blade servers, with 20 AMD 6-core "Istanbul" Opteron processors and 320GB of memory, all interconnected with Mellanox 40Gb/s InfiniBand.

Once the cluster is built, it needs to perform according to the HPC Challenge benchmarks and run OS-neutral scientific applications under real-world workloads. Teams are given a set of applications combined with predefined data sets and have two days to demonstrate application output. Judges, representing industry experts, academia and national labs, are present to evaluate results and observe the teams. Students continually showcase their progress during the competition. The winning team is chosen based on workload completed, benchmark performance, and overall knowledge of the applications and race to correctly complete the greatest number of applications during the competition period while never exceeding a dictated power limit.

Most of the students' efforts in the 2009 competition involved getting the applications to run properly with associated data sets before the clock ran out. They were also challenged with power constraints during the event. The project required a power consumption budget of less than 3120 Watts (120 volts and 26 amps).

For connectivity, the Stony Brook team utilized InfiniBand provided by Mellanox. Mellanox's InfiniBand demonstrates up to 96 percent system utilization, and powers almost 40 percent of the world's fastest supercomputers. By matching InfiniBand with the CPU cores and the large host memory, the Stony Brook cluster was able to process the data sets at a significantly faster speed than competitor teams. One of the competitor teams chose to use 10 Gigabit

Ethernet as the interconnect between the servers, which lead them to lose the competition due to the superior performance and efficiency of the Mellanox InfiniBand interconnect.

The student's ingenuity won the day, aided by Mellanox 40Gb/s InfiniBand connecting Dell systems and AMD processors. The ability to excel in running these applications was key for the Stony Brook team. Points are based on the successful processing of data sets and displaying output on the monitors for visitors to observe. In earning first place, judges complimented Stony Brook for all elements of their project, and in particular cited them for their ability to excel in application runs as well as for the presentation and visualization of their results.

The competition was a win for Stony Brook, a win for InfiniBand and a win for the field of cluster computing. "Some other teams had more than two months in advance to work on the cluster. We had less than two weeks before the competition after receiving all the hardware. The ability for the cluster design a winning solution under these circumstances is a testament to both the dedication and skill of the Stony Brook Team as well as the technology that we used to build it" said Professor Jim Jiao, the faculty coach for the team.



Yuwei (Ethan) Gui (left) and Anthony Biondo working during the competition



350 Oakmead Parkway, Suite 100, Sunnyvale, CA 94085  
Tel: 408-970-3400 • Fax: 408-970-3403  
[www.mellanox.com](http://www.mellanox.com)

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