UC San Diego
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SDSC Shares HPCwire's 'Top Supercomputing Achievement' Awards

The San Diego Supercomputer Center (SDSC) at the University of California San Diego, is a recipient of two HPCwire 'Top Supercomputing Achievement' awards for 2016, recognizing the use of its high-performance *Comet* supercomputer to help verify Einstein's theory of gravitational waves.

The awards, won in both the online publication's annual Readers' Choice and Editors' Choice categories, also recognized the Open Science Grid (OSG), the National Science Foundation's Extreme Science and Engineering Discovery Environment (XSEDE), the Holland Computing Center at University of Nebraska-Lincoln (UNL), the National Center for Supercomputing Applications (NCSA), and the Texas Advanced Computing Center (TACC) at The University of Texas at Austin for their participation in verifying the existence of gravitational waves.

SDSC also won an HPCwire Editors' Choice Award for 'Best Use of High-Performance Computing (HPC) in the Cloud.' That award recognizes the collaboration between SDSC and Mellanoxto create a virtual off-loading computing processor used by SDSC's *Comet* supercomputer to optimize the processing of partner workloads.

The awards were presented at the 2016 International Conference for High Performance Computing, Networking, Storage and Analysis (SC16), in Salt Lake City, Utah.

"It's a great honor to receive these three awards from HPCwire," said SDSC Director Michael Norman. "It was very exciting for our team to be involved in the verification of such an important discovery. As a cosmologist myself, this discovery truly opens a new era of exploration for astronomers and astrophysicists. I'm also delighted that we were recognized for our work with Mellanox to make *Comet* an excellent resource for cloud computing."

"From thought leaders to end users, the HPCwire readership reaches and engages every corner of the high-performance computing community," said Tom Tabor, CEO of Tabor Communications, publisher of HPCwire. "Receiving their recognition signifies community

support across the entire HPC space as well as the breadth of industries it serves. We are proud to recognize these efforts and make the voices of our readers heard, and our congratulations go out to all the winners."

A Multi-Partner Collaboration

In February 2016 the NSF announced that for the first time, scientists detected gravitational waves in the universe as hypothesized by Albert Einstein about 100 years ago. On September 14, 2015 scientists at the NSF-funded Laser Interferometer Gravitational-Wave Observatory (LIGO) detected gravitational waves using both LIGO detectors. The waves reached Earth from the southern hemisphere, passed through the Earth, and emerged at the Earth's surface, first at the LIGO interferometer near Livingston, Louisiana, and then, seven milliseconds later and 1,890 miles away at the second LIGO interferometer in Hanford, Washington.

Frank Würthwein, SDSC's head of high-throughput computing, who is also the current Executive Director of the OSG, a multi-disciplinary research partnership specializing in high-throughput computational services funded by the U.S. Department of Energy and the NSF, worked in tandem with XSEDE researchers to make these resources available to LIGO scientists.

"There were a lot of institutions and researchers involved in this landmark discovery, as well as the actual verification process," said Würthwein, also a physicist with UC San Diego. "While HPC resources from all over have been used by LIGO for years, this award focused on the use of HPC for the actual verification of this amazing discovery."

XSEDE, the most advanced collection of integrated digital resources and services in the world, and the OSG provided access to numerous high-performance computing systems for LIGO researchers to verify the finding over the course of several months. A significant percentage of the resources used was provided by SDSC's petascale *Comet* supercomputer and TACC's *Stampede* supercomputer. The total data set of five terabytes was stored at the Holland Computing Center.

LIGO used *Comet's* new Virtual Cluster interface, provided via the OSG, for the analysis of the data. *Comet's* 'bare metal'-like approach means that a virtual cluster looks, feels, and performs almost exactly like the physical hardware. This enabled OSG to dynamically turn servers provisioned by *Comet* into an HTCondor pool and add new capability with very little additional overhead and significantly reduced administrative burden. More about *Comet's* virtual clusters is at http://www.sdsc.edu/News%20Items/PR20151112_comet_osg.html.

More details on the LIGO discovery can be found at:

http://www.sdsc.edu/News%20Items/PR20160225_ligo.html

https://www.xsede.org/xsede-resources-help-confirm-ligo-discovery.

https://www.xsede.org/xsede-resources-help-confirm-ligo-discovery

https://www.opensciencegrid.org/osg-helps-ligo-scientists-confirm-einsteins-last-unproven-theory/

The annual HPCwire Readers' and Editors' Choice Awards are determined through a nomination and voting process with the global HPCwire community, as well as selections from the HPCwire editors. The awards are an annual feature of the publication and constitute prestigious recognition from the HPC community. These awards are revealed each year to kick off the annual Supercomputing Conference, which showcases high-performance computing, networking, storage, and data analysis. More information on these awards can be found at the HPCwire website or on Twitter through the following hashtag: #HPCwireAwards.

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