

**Catalyst Supercomputer Heralds Shift to  
More Balanced Architectures**

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With peak performance of 150TF, [the new Catalyst supercomputer](#) codeveloped by Cray and Intel for Lawrence Livermore National Laboratory won't inhabit the upper reaches of the TOP500 list. Its vital stats are impressive for a different reason — as a forerunner of what IDC believes will be a long-term trend to reverse the extreme compute centrism of today's HPC systems.

For years, HPC architectures have tilted further and further away from optimal balance between processor speed, memory access, and I/O speed. As successive generations of HPC systems have upped peak processor performance without corresponding advances in per-core memory capacity and speed, the systems have become increasingly compute centric and the well-known "memory wall" has gotten worse. This trend has narrowed the systems' breadth of applicability by limiting the scalability of more and more applications. To make matters worse, now comes the HPC Big Data era that will require superb memory and I/O capabilities, sometimes with little need for computing prowess.

The Catalyst supercomputer bucks this trend by outfitting each of its 324 nodes with 128GB of DRAM and an eye-popping 800GB of NVRAM on the 304 compute nodes. Livermore reports that Catalyst (named for its intended heavy use in bioinformatics) has aggregate bandwidth on par with the lab's 16.3PF highly productive Sequoia supercomputer. That means bandwidth similar to that of a supercomputer with 108 times the peak performance of Catalyst.

It's also interesting that Catalyst is not based on a custom architecture. The system is a tricked-out, turbo-charged standard Cray CS300 cluster that qualified as a third-generation upgrade under DOE NNSA's Tri-Lab Capacity Cluster (TLCC) program. Here are additional Catalyst vital statistics:

- 304 compute nodes (128GB DRAM and 800GB NVRAM per node)
- 12 Lustre router nodes (128GB DRAM and 3,200GB NVRAM per node)
- 2 log-in nodes (128GB DRAM)
- 2 management nodes (128GB DRAM)
- 2 NFS router nodes (128GB DRAM)
- Processors: Intel Xeon ES-2695v2 processors (12 cores, 2.4Ghz)
- NVRAM: Intel SSD 910 Series (800GB, 1/2 height PCIe 2.0, 25nm, MLC)
- Fabric: Intel True Scale Fabric (dual-rail QDR-80)
- Storage software: Intel Lustre, Livermore DIMMAP (Data Immersion MMAP), and SCR (Scalable Checkpoint Restart)

The Catalyst press release indicates that collaborators Livermore Lab, Cray, and Intel regard this supercomputer not just as a workhorse but also as a test vehicle whose users will provide valuable input for optimizing the designs of future supercomputers.

IDC sees Catalyst as a welcome addition to the growing number of HPC systems around the world that are functioning as living laboratories to help set technology and architectural directions for the future. Others in this category are the ARM-heavy Mont Blanc system in Barcelona, the Comet system at TACC, the Longson processor-based Sunway BlueLight supercomputer in Jinan (China), the healthcare incarnation of IBM's Watson, and at least a dozen others.

We are living in interesting times again, in the positive sense that considerable HPC innovation and experimentation are occurring. The HPC market has matured to the point where key elements are in place for the foreseeable future, such as the continuing dominance of Linux-based clusters. In this larger context,

Catalyst and other efforts to restore better architectural balance can be seen as attempts to correct a market excess — the extreme compute centrism that exists today.

A correction of this kind will likely take more than a decade to play out, and it is too soon to tell how much of a correction HPC market demand will eventually support. But IDC is excited to track all of the creative initiatives that together will affect the future of the HPC industry. We welcome your thoughts and comments at [hpc@idc.com](mailto:hpc@idc.com).

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