CASE STUDY

Lawrence Livermore deploys world's largest tape library from Spectra for exascale era success

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Todd Heer, Deputy Program Lead, Facilities Operations and User Support, LLNL

Spectra 23-Frame TFinity ExaScale Tape Library

Lawrence Livermore National Laboratory

For more than 60 years, the Lawrence Livermore National Laboratory (LLNL) has applied science and technology to make the world a safer place. Livermore's defining responsibility is ensuring the safety, security and reliability of the nation's nuclear deterrent. Since LLNL was created in 1952, computing has been essential to R&D, science and technology, and operations. Livermore Computing (LC) is making the world safer by shaping the frontiers of HPC, data sciences, and computer science. They design, develop and deploy HPC capabilities not only in support of Livermore's mission and program goals, such as the nation's Stockpile Stewardship Program, but to improve national security and advance U.S. economic competitiveness.

The Challenge

LLNL's high performance computing (HPC) users produce massive quantities of data, averaging 30 terabytes (the equivalent of 58 years' worth of digital music) every day. Not only must the data be kept indefinitely, but much of it is classified and must be protected with the highest standards of security. The solution is to safely archive—something Livermore Computing (LC) has been doing since 1967.

But, as with all technology, data storage hardware becomes antiquated and expensive to maintain, thus requiring significant upgrades and maintenance at fairly regular intervals (every several years). A well-run archive is a constant maelstrom on the backend, including data migration to newer technology and smooth, uninterrupted responsiveness to user needs.

"Moving to a completely new tape library is an enormous undertaking that's only done once every decade or two," says Todd Heer, who oversaw the procurement process. "This particular procurement was even more notable because we chose to go with a new vendor—Spectra Logic."

The Spectra TFinity ExaScale Tape Library on site at Lawrence Livermore National Laboratory.

CASE STUDY: Lawrence Livermore National Laboratory

The Solution

Lawrence Livermore National Laboratory (LLNL) is now home to the world's largest Spectra TFinity system, following a complete replacement of the tape library hardware that supports Livermore's data archives. Housed behind Sierra—the world's second fastest supercomputer—the new Spectra tape library helps the Laboratory meet some of the most complex data archiving demands in the world and offers the speed, agility, and capacity required to take LLNL into the exascale era.

The new Spectra TFinity system is novel in two ways: First, the tape cartridges they contain are stored differently, in terapacks (that is, 10 cartridges per pack), which means that more data can be stored in a smaller footprint.

"This physically denser storage solution is much better for LC," says Heer. "The Spectra libraries take up significantly less floor space than our previous libraries, which allows us to be more efficient and agile as the big computers come and go."

Second, the new tape library comes in a "rack form factor" (similar to traditional HPC systems, which hold their various components in multiple rack enclosures). This feature gives Livermore the option of growing the system, whenever necessary, simply by adding a frame or two. The current main configuration is 23 racks, which contain 128 IBM® TS1155 tape drives and 19,575 slots. (There is an additional six-frame Spectra tape library nearby that stores secondary copies of data on LTO-8 tape.) It is capable of storing 294 petabytes of uncompressed data, which is enough space to hold the entire written works of humanity, in every language, since the beginning of history six times over. The new technology represents a 50% or better density improvement over outgoing LC tape media.

Contrary to popular belief, half-inch tape storage technology continues to advance and thrive. According to Heer, it is the most economically priced storage medium, with the lowest bit error rate, and best power profile compared to other currently available storage technologies.

Heer explains, "Our plan is to procure maintenance in five-year increments and add just enough racks to allow for near-future growth, which realizes efficiencies in cost and overall size. We'll also be able to capitalize on ever-increasing tape drive capacities. In time, the library capacity will multiply simply as a function of generational drive technology improvements."

One aspect that has not changed is LC's reliance on tape drives rather than a disk-based option. Contrary to popular belief, half-inch tape storage technology continues to advance and thrive. According to Heer, it is the most economically priced storage medium, with the lowest bit error rate, and best power profile compared to other currently available storage technologies. While not ideal for RAM, or memory, quick random accesses, the trick is to leverage its strengths by applying the technology in write-once, read-seldom environments.

Another unique feature of the TFinity tape library is its custom front panel "skins," or coverings. Working with a graphic designer at Spectra, LC staff designed the panels to depict the evolution of LLNL supercomputers, research, and storage systems over the last six decades—offering visitors and tour groups a unique visual history of Livermore's HPC ecosystem.

Over the next year, LC's Data Storage Group will be planning and executing the wholesale swap of media and data from the old tape libraries to the new—a process that occurs, remarkably, with no downtime to the users.

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"We're really proud of this new system and the important role it plays for our HPC users today and in the future," says Heer.

The TFinity tape library is funded by the Advanced Simulation and Computing (ASC) program and serves the tri-lab community.

Why Spectra?

- Smallest tape library footprint
- 50% or better density improvement over outgoing solution
- Designed for easy growth
- Custom front panel skins
- Media and data migration with no downtime to the users

Environment Snapshot

- 23-frame Spectra® TFinity® ExaScale Tape Library
- 128 IBM® TS1155 tape drives
- 19,575 tape slots
- 21 SpectraVision cameras
- Up to 294PB of uncompressed data

Solution Recap

Spectra TFinity ExaScale Tape Library – With unsurpassed storage density packaged in the smallest footprint of any enterprise library on the market, the Spectra TFinity ExaScale offers industry-leading scalability with the speed necessary to meet requirements of the most demanding environments. Deployed by some of the most recognized organizations in the world, the Spectra TFinity ExaScale provides maximum flexibility by allowing you to select the tape technology that is the perfect fit for your business. In addition to LTO tape technology, the Spectra TFinity ExaScale is also compatible with IBM® TS11X0 enterprise tape technology and Oracle T10000x enterprise tape technology, enabling all three in the same library.

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