Lawrence Livermore National Laboratory

LLNL Redefines High Performance Computing with Fusion Powered I/O

FUSION-iO®

The Challenge

Lawrence Livermore National Laboratory (LLNL) knew it had a daunting task providing the Data Intensive Testbed for the National Nuclear Security Administration's Advanced Simulation and Computing program's Hyperion Project. It would need to deliver supercomputing performance, while at the same time reducing power consumption to meet new energy initiatives. Enter Fusion-io.

The Solution

LLNL used Fusion's ioMemory technology to create the world's highest performance storage array. Using Fusion's ioSANs and ioDrive Duos, the cluster achieves more than an unprecedented 52,000,000 IOPS and 400GB/s aggregate bandwidth.

Incredibly, Fusion's ioMemory allowed LLNL to accomplish this feat in just two racks of appliances– something that would take a comparable hard disk-based solution over 54 racks. In fact, it would take over 100 of the SPC-1 benchmark's leading all-flash vendor systems combined to match the performance, at a cost of over $300 million.

"This new technology will allow us to meet the performance requirements critical to fulfilling our national security missions well into the future, while dramatically reducing power consumption and satisfying new energy conservation initiatives."

Mark Seager,
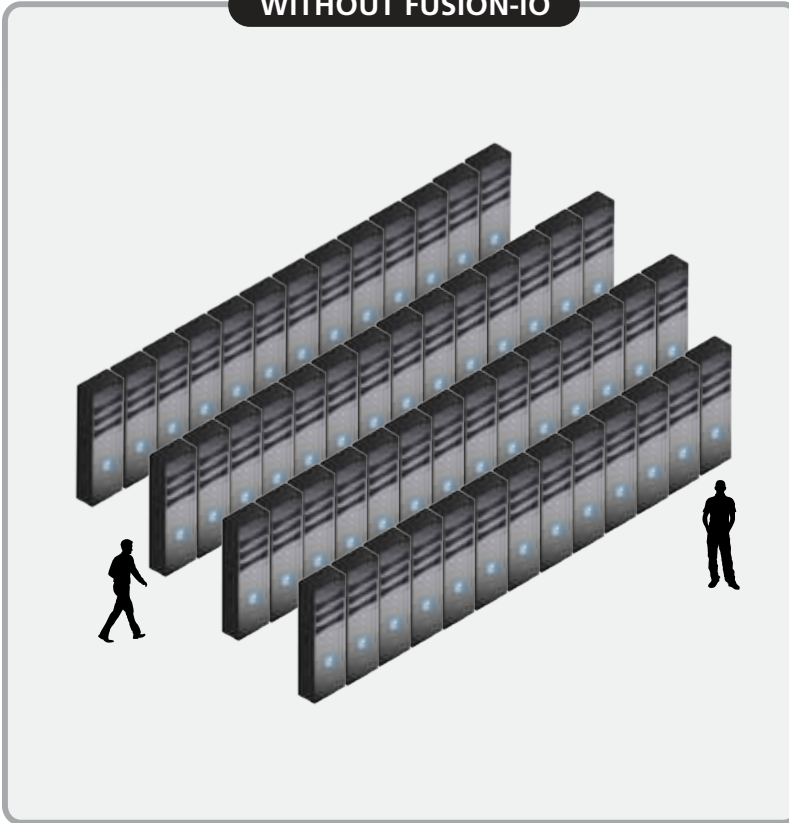*Head of Advanced Computing Technology, Lawrence Livermore National Laboratory.*

DATA CENTER FOOTPRINT **WITHOUT FUSION-IO**

- 320 nodes
- 22400 hard disks
- 80 SAN controllers
- 54 racks
- 640 DDR InfiniBand™ links

DATA CENTER FOOTPRINT **WITH FUSION-IO**

- 80 nodes
- 160 320GB ioDrive Duos
- 160 320GB ioSANs
- 2 racks
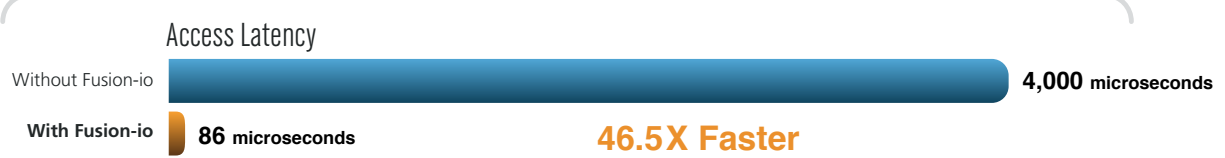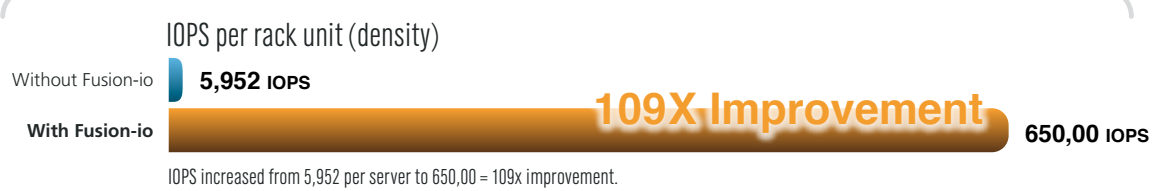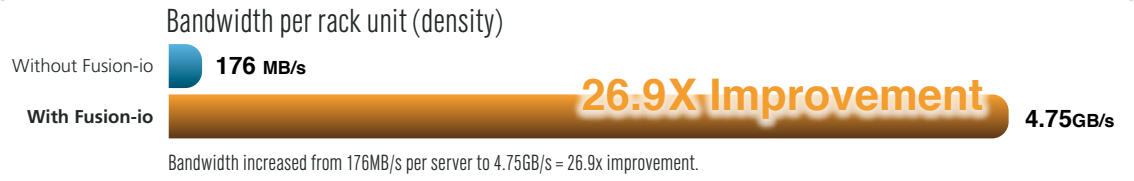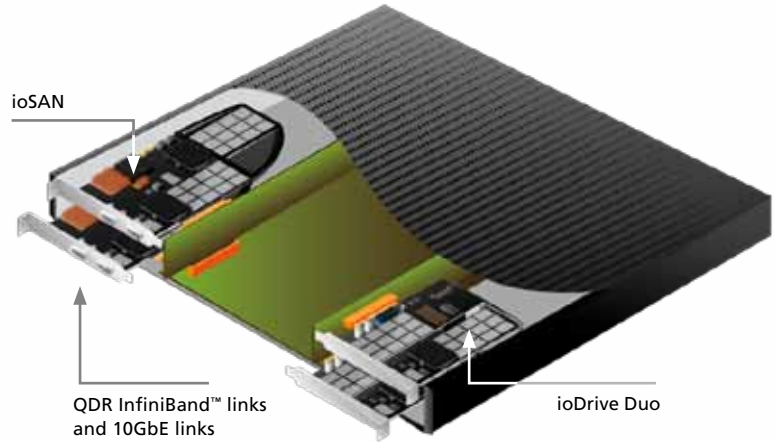- 160 QDR InfiniBand™ links
- 160 10GbE links

WITHOUT FUSION-IO

WITH FUSION-IO

SINGLE NODE SPECIFICATIONS

- Dual socket 1U storage appliance
- Two ioDrive Duo 320GB
- Two ioSAN 320GB connected via 2 x QDR InfiniBand™ links and 2 x 10GbE links

ioSAN

QDR InfiniBand™ links and 10GbE links

ioDrive Duo

Bandwidth per rack unit (density)

Without Fusion-io **176 MB/s**

With Fusion-io

26.9X Improvement

4.75GB/s

Bandwidth increased from 176MB/s per server to 4.75GB/s = 26.9x improvement.

IOPS per rack unit (density)

Without Fusion-io **5,952 IOPS**

With Fusion-io

109X Improvement

650,00 IOPS

IOPS increased from 5,952 per server to 650,00 = 109x improvement.

Access Latency

Without Fusion-io **4,000 microseconds**

With Fusion-io **86 microseconds**

46.5X Faster

FUSION-iO®

About Lawrence Livermore National Laboratories

As a premier national security laboratory, Lawrence Livermore's mission is to advance and apply science and technology to:

- Ensure the safety, security, and reliability of the U.S. nuclear deterrent

- Reduce or counter threats to national and global security

- Enhance the energy and environmental security of the nation

- Strengthen the nation's economic competitiveness

At LLNL, teams of physicists, chemists, biologists, engineers and other researchers work together to achieve technical innovations and scientific breakthroughs and transform these advances into solutions to nationally important problems.

We continually push the frontiers of knowledge to build the scientific and technological foundation that will be needed to address the national security issues of the future.

About the Hyperion Data Intensive Testbed

Lawrence Livermore National Laboratories created the testbed for the National Nuclear Security Administration's Advanced Simulation and Computing program's Hyperion initiative, a project designed to accelerate the development of the high-performance computing capabilities needed to ensure the safety, security and reliability of the nation's aging nuclear deterrent without underground testing.

About the National Nuclear Security Administration

NNSA is responsible for the management and security of the nation's nuclear weapons, nuclear nonproliferation, and naval reactor programs. It also responds to nuclear and radiological emergencies in the United States and abroad. Additionally, NNSA federal agents provide safe and secure transportation of nuclear weapons and components and special nuclear materials along with other missions supporting the national security.

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