National Nuclear Security Administration Ensures Safety and Security of U.S. Nuclear Stockpile with Cray® XC40™ "Trinity" Supercomputing Solution

NNSA's Cray XC40 Supercomputer Guarding Against Nuclear Meltdown

The U.S. hasn't developed a nuclear weapon since 1992. It means the nation's nuclear stockpile is aging. And when nuclear weapons age, they can fail or act unpredictably.

Maintaining the safety, security and reliability of the country's nuclear weapons is critical. In response, the U.S. government formed the Stockpile Stewardship Program under the direction of the National Nuclear Security Administration (NNSA). The agency has the job of maintaining this delicate stockpile without the use of nuclear testing. In order to do so, they rely heavily on supercomputing simulations. So when the NNSA needed to upgrade their high performance computing infrastructure, they turned to Cray.

The NNSA's computing workloads demand constantly increasing geometric and physics fidelities while also maintaining rapid time to solution. They needed a system designed to provide increasing computational capability.

They selected an integrated Cray supercomputer, storage and I/O acceleration solution. Dubbed "Trinity," the entire system includes a Cray® XC™ series supercomputer, Cray® Sonexion® parallel file storage and DataWarp™ I/O accelerator technology. The Cray XC supercomputer is installed with state-of-the-art Intel® Xeon® processors (codenamed "Haswell") and will be upgraded in-place to introduce best-of-class processing technologies delivering new capabilities and improved performance, including the future Intel® Xeon Phi™ processors (codenamed "Knights Landing"). Trinity will target the largest and most demanding simulations for NNSA, including support across a wide set of software codes.

THE TRINITY PROJECT

The Trinity project is managed and operated by Los Alamos National Laboratory and Sandia National Laboratories under the Alliance for Computing at Extreme Scale (ACES) partnership, part of the NNSA's Advanced Simulation and Computing Program (ASC). The system is physically located in Los Alamos at the Nicholas Metropolis Center for Modeling and Simulation.

National Nuclear Security Administration

Los Alamos NATIONAL LABORATORY EST.1943

Sandia National Laboratories

TRINITY HIGH-LEVEL TECHNICAL SPECIFICATIONS

Operational lifetime	2015 to 2020
Capability	8x to 12x improvement over Cielo in fidelity, physics & performance capabilities
Architecture	Cray XC40 system
Memory capacity	>2 PB of DDR4 DRAM
Peak performance	>40 PF
Intel® Xeon™ (Haswell) nodes	9,436
Intel® Xeon Phi™ (Knights Landing) nodes	>9,000
Parallel file system capacity (usable)	78 PB
Parallel file system bandwidth (sustained)	1.6 TB/s
Burst buffer storage capacity (usable)	3.65 PB
Burst buffer bandwidth (sustained)	3.28 TB/s
Footprint	<5,200 sq ft
Power requirement	<10 MW

GARY GRIDER:

"Los Alamos National Laboratory has been investigating burst buffer capabilities for years and the DataWarp technology in the Cray XC40 Trinity system will provide the first multi-petabyte, multi-terabyte-per second burst handling capability ever. We expect DataWarp to be the first step in leveraging node-local non-volatile storage, which will decrease our TCO going forward."

"Both Los Alamos and Sandia have a long history with Cray, going back to the beginning of the supercomputing era and most recently with the Cielo platform. That history continues with the Trinity platform that will provide next generation supercomputing in support of the U.S. nuclear security enterprise."

High Performance Computing Division Leader, Los Alamos National Laboratory

A HALF CENTURY OF COLLABORATION

The Trinity installation builds on Cray's nearly 50-year relationship with Los Alamos National Laboratory and Sandia National Laboratories.

- 1966-1976 – Early CDC supercomputing systems co-designed by Seymour Cray
- 1976 – Cray-1 vector processing supercomputer
- 1983 – Cray X-MP multiple vector processor supercomputer
- 1988 – Cray Y-MP supercomputer
- 1994 – Cray T3D massively parallel processing (MPP) supercomputer
- 2002 – Sandia's Cray "Red Storm" MPP commodity processor supercomputer
- 2010 – LANL's Cray® XE6™ "Cielo" system: in continuous operation and #57 on the July 2015 Top500 list
- 2014-2015 – Cray XC series "Trinity" system: eight times greater applications performance than Cielo

CRAY XC SERIES SUPERCOMPUTERS

The Cray XC series is a groundbreaking adaptive supercomputing architecture that delivers sustained, scalable application performance and investment protection with easy upgradability. Each system is capable of integrating processor/coprocessor hybrid compute nodes and is HPC-optimized across hardware, software, interconnect, network, power, cooling and packaging. Cray XC systems can be configured for small commercial applications up to the largest datacenter environments, scaling from one to 200+ cabinets.

CRAY SONEXION STORAGE

The Cray Sonexion scale-out Lustre storage system delivers precision performance at scale to an HPC cluster or supercomputer of choice, with the fewest number of components.

CRAY DATAWARP I/O ACCELERATOR

The Cray XC series DataWarp applications I/O accelerator technology delivers a balanced and cohesive system architecture from compute to storage. It allocates storage dynamically in either private (dedicated) or shared modes. Storage performance quality of service can be provided to individual applications, based on the user's policies.

FOR MORE INFORMATION OR TO CONTACT:

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NATIONAL NUCLEAR SECURITY ADMINISTRATION
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LOS ALAMOS NATIONAL LABORATORY
www.lanl.gov

SANDIA NATIONAL LABORATORIES
www.sandia.gov

Literature links:
Los Alamos National Laboratory – The Trinity Advanced Technology System: www.lanl.gov/projects/trinity/specifications.php
Cray XC40 Series Product Brochure: www.cray.com/CrayXC40Brochure