Astra Computer
New HPC Data Center

PRESENTED BY

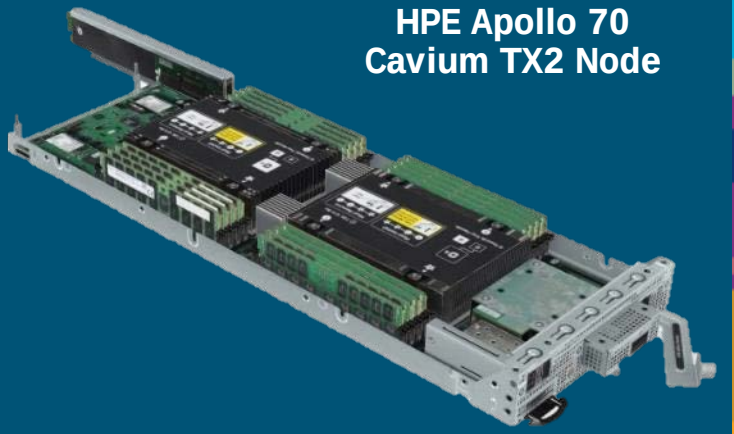
David J. Martinez

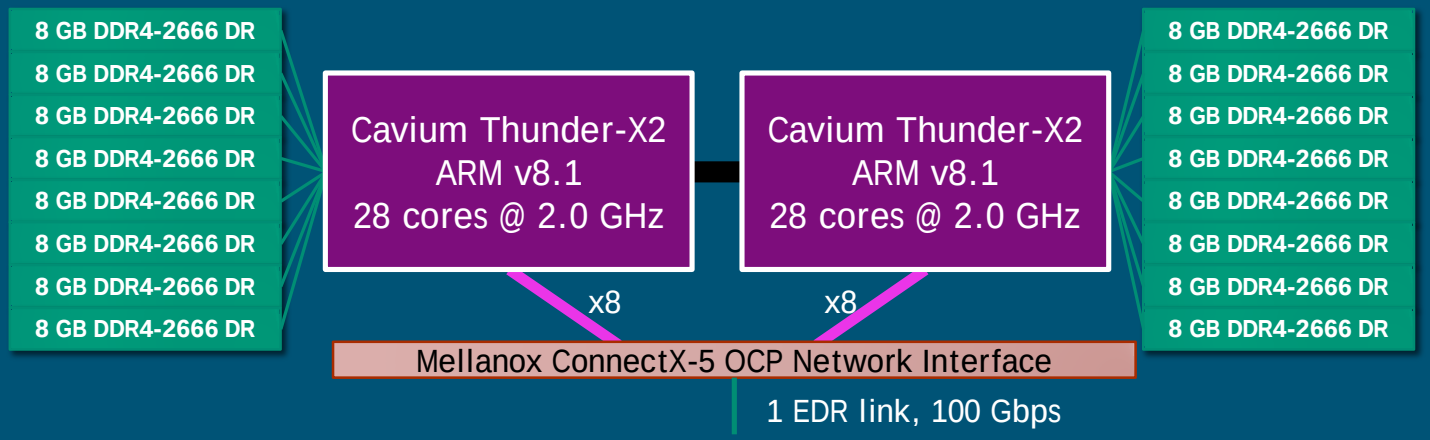
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Astra Architecture

- **2,592** HPE Apollo 70 compute nodes
  - Cavium Thunder-X2 **Arm** SoC, 28 core, 2.0 GHz
  - 5,184 CPUs, 145,152 cores, 2.3 PFLOPs system peak
  - 128GB DDR Memory per node **(8 memory channels per socket)**
  - Aggregate capacity: 332 TB, Aggregate Bandwidth: 885 TB/s
- Mellanox IB EDR, ConnectX-5
- HPE Apollo 4520 All–flash storage, Lustre parallel file-system
  - Capacity: 403 TB (usable)
  - Bandwidth 244 GB/s

HPE Apollo 70
Cavium TX2 Node





Astra Architecture

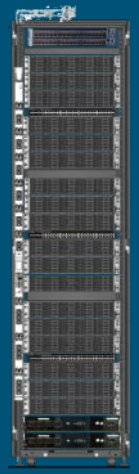
HPE Apollo 70 Chassis: 4 nodes

18 chassis/rack

72 nodes/rack

3 IB switches/rack
(one 36-port switch
per 6 chassis)

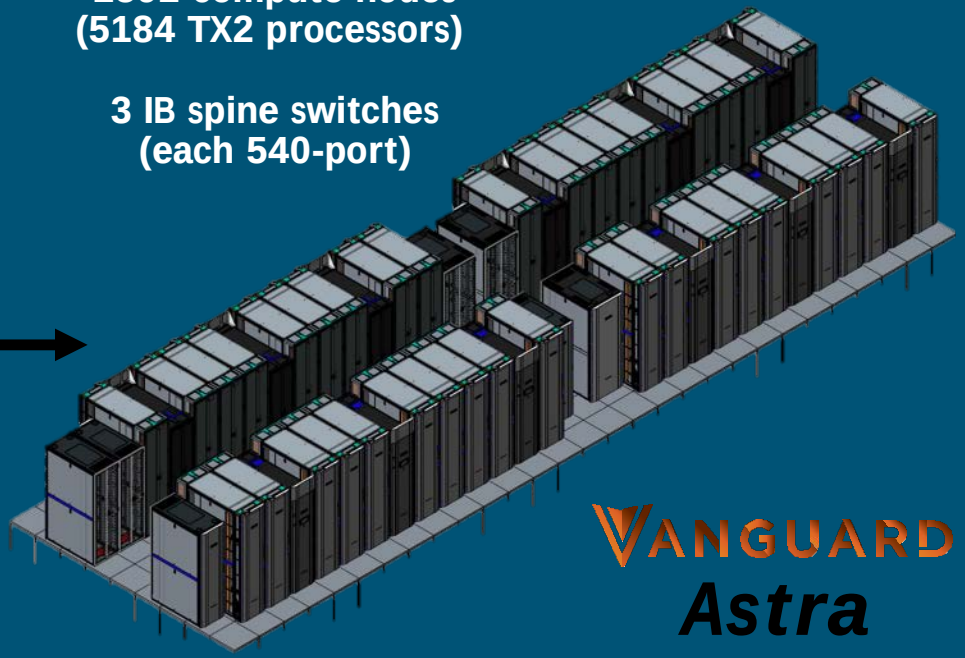
HPE Apollo 70 Rack



36 compute racks
(9 scalable units, each 4 racks)

2592 compute nodes
(5184 TX2 processors)

3 IB spine switches
(each 540-port)



VANGUARD
Astra

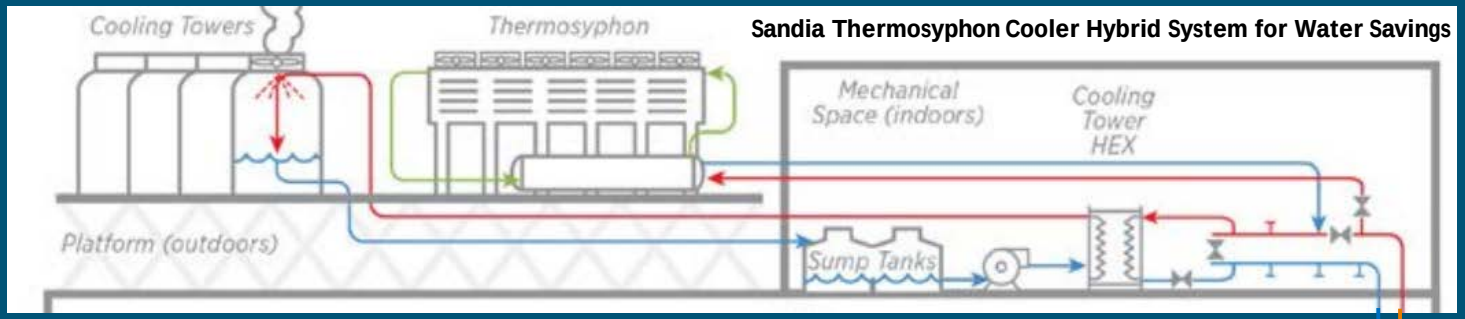
MCS Cooling Units

MCS back view

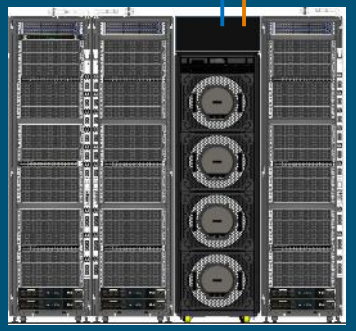
- Up to 150kW cooling capacity or 110kW in an N+1 fan configuration
- Supports 7C to 32C Facility inlet water temp
- Automatic Transfer Switch providing redundant power input
- Support for 380 to 480 VAC power input
- Includes four electrically commutated high efficiency centrifugal blowers
- Warm water cooling ready: support IT loads up to 75 kW at 30°C inlet water with 70 GPM and a server supply air temperature of 35°C. Input power support for 380-480VAC(3-phase)
- Extend cooling up to four racks with optional HPE Apollo 42U or 48U MCS racks

MCS front view

Astra Advanced Power and Cooling

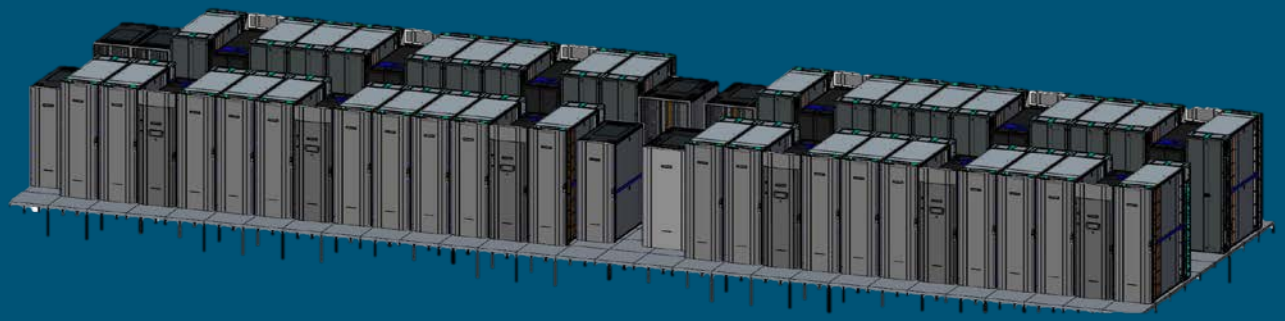


Sandia Thermosyphon Cooler Hybrid System for Water Savings

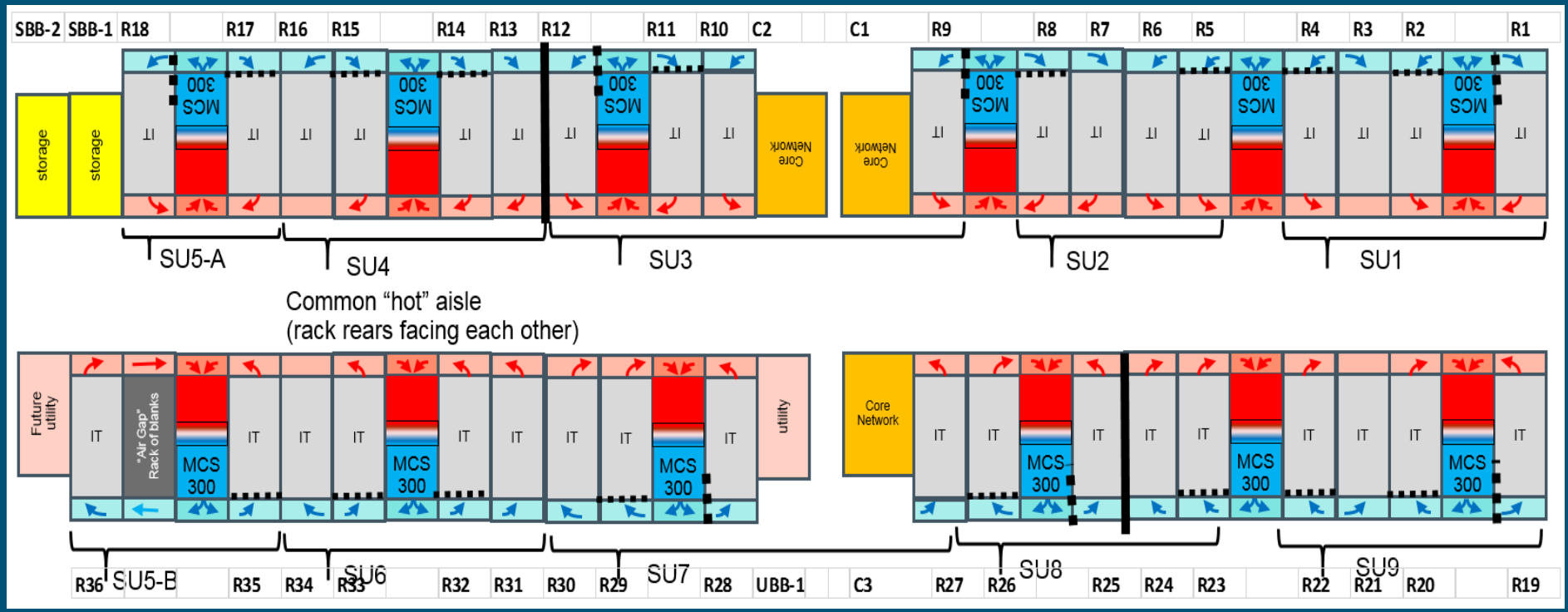


Extreme Efficiency:

- Total 1.2 MW in the 36 compute racks are cooled by only 12 fan coils
- These coils are cooled without compressors year round. No evaporative water at all almost 6000 hours a year
- 99% of the compute racks heat never leaves the cabinet, yet the system doesn't require the internal plumbing of liquid disconnects and cold plates running across all CPUs and DIMMs



Cooling system of Astra



New HPC data center build (725 East)

- Design build – Started in October 2017, completed October 2018
- LEED Gold certified
- 14,000 sq. ft.
- 85% warm water cooled 23˚C (74˚F) to 29˚C (84˚F) entering water temp
- Primary loop and secondary loop are non mechanical cooled 85% of the year
- Thermosyphon installed (water/energy savings)
- 15% air cooled outside air economization 3 stage 22˚C (72˚F) to 25˚C (77˚F)
- 4.5MW build out to 14MW - 1.5MW load centers
- Overhead buss system (1200 amp)
- 3 ft. raised floor 4,000 lbs. rated
- Open floor
  - No beams
- Natural light (northside) and led lights as well as motion sensors
- All automated control systems (DCIM tool installed)
- Overhead network cable structure

Aerial view of 725 East

- Adjacent data center non-load bearing wall
- Cooling units
  - 2 each
  - 1 additional

- Utilization of phase change on refrigerant
- Estimated 3 million gallons of water saved per year
- Place holder for 3 additional future installs

Process pumps

- 3500 GPM each
- Primary and back up valves installed
- Valves installed for third pump
- Heat exchanger

Flooring

- 3 ft raised flooring
- Process pipe pressure differential valve
- Process pipe 4” feeds every 12 ft. on center

- Flooring complete in late August
- Prep for arrival of computer
- Water/air cooled load banks were leased for load simulation of 1.4 MW load

Finished Flooring

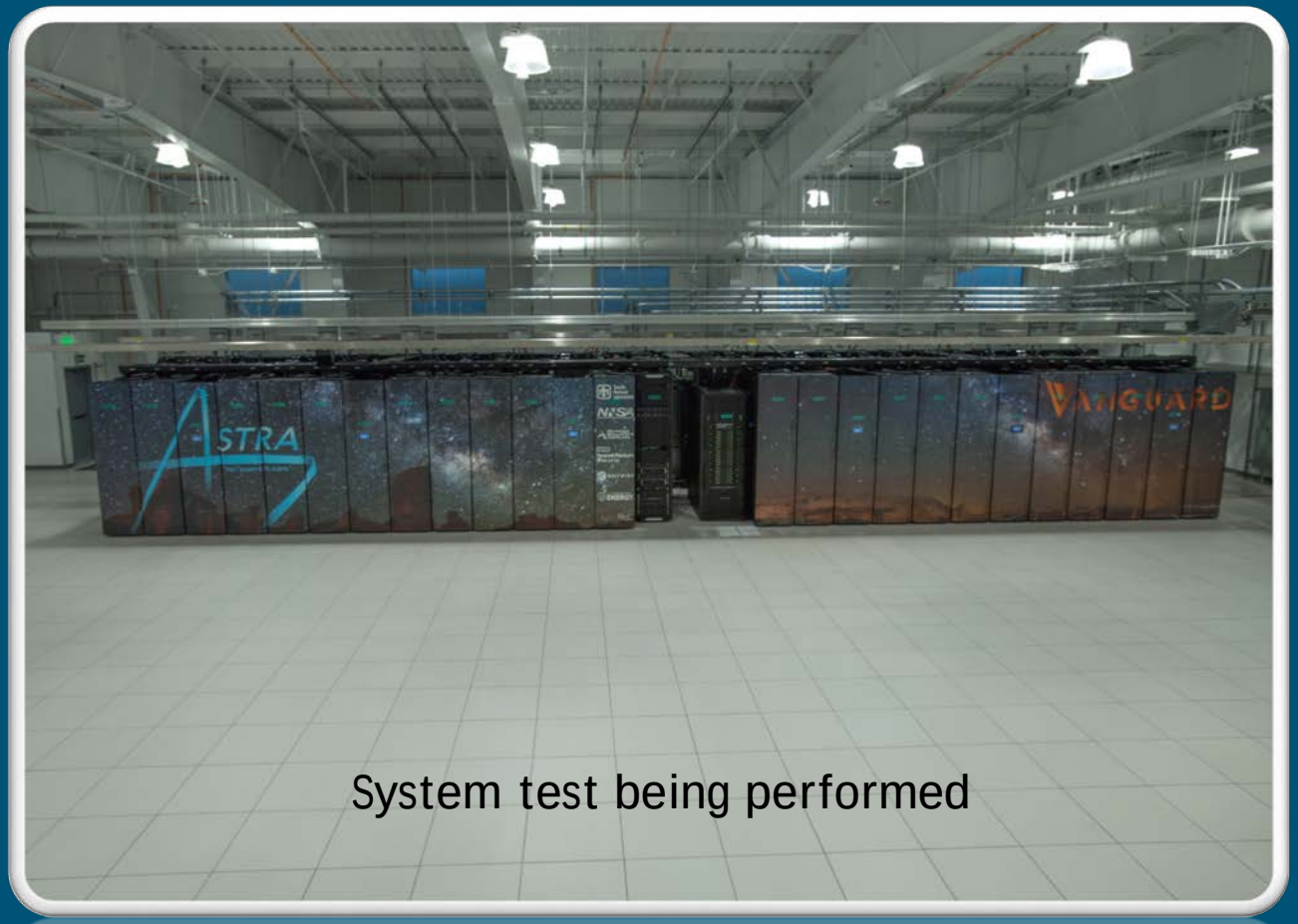
Installation of 1200 amp buss systems

- Flexibility for expansion
- All IT power connections are on separate feed

First Delivery of Astra System

- Dock under construction during first deliveries
- Dock lift was not operational

Astra System completion install



System test being performed

- Installation complete October 2018
- First measured PUE run 1.11