Hewlett Packard Enterprise

FULFILLING THE ASPIRATIONS OF SINGAPORE'S RESEARCHERS

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Hewlett Packard Enterprise

POWERING GREAT SCIENCE AROUND THE GLOBE

NERSC

Argonne NATIONAL LABORATORY

OAK RIDGE National Laboratory

Lawrence Livermore National Laboratory

CSCS
Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre

Los Alamos NATIONAL LABORATORY

EuroHPC Joint Undertaking

LUMI

HPE achieves world's first exaflop with the Frontier System

OAK RIDGE NATIONAL LABORATORY'S FRONTIER SUPERCOMPUTER

- **74 HPE Cray EX cabinets**
- **9,408 AMD EPYC CPUs, 37,632 AMD GPUs**
- **HPE Slingshot 11 interconnect**
- **700 petabytes of storage capacity, peak write speeds of 5 terabytes per second using Cray ClusterStor Storage System**

TOP500

#1

ORNL's Frontier supercomputer is #1 on the TOP500.

1.1 exaflops of performance on the May 2022 Top500 list.

GREEN500

#1

ORNL's Frontier supercomputer is #1 on the GREEN500.

62.68 gigaflops/watt power efficiency.

HPL-AI

#1

ORNL's Frontier supercomputer is #1 on the HPL-AI list.

6.88 exaflops on the HPL-AI benchmark.

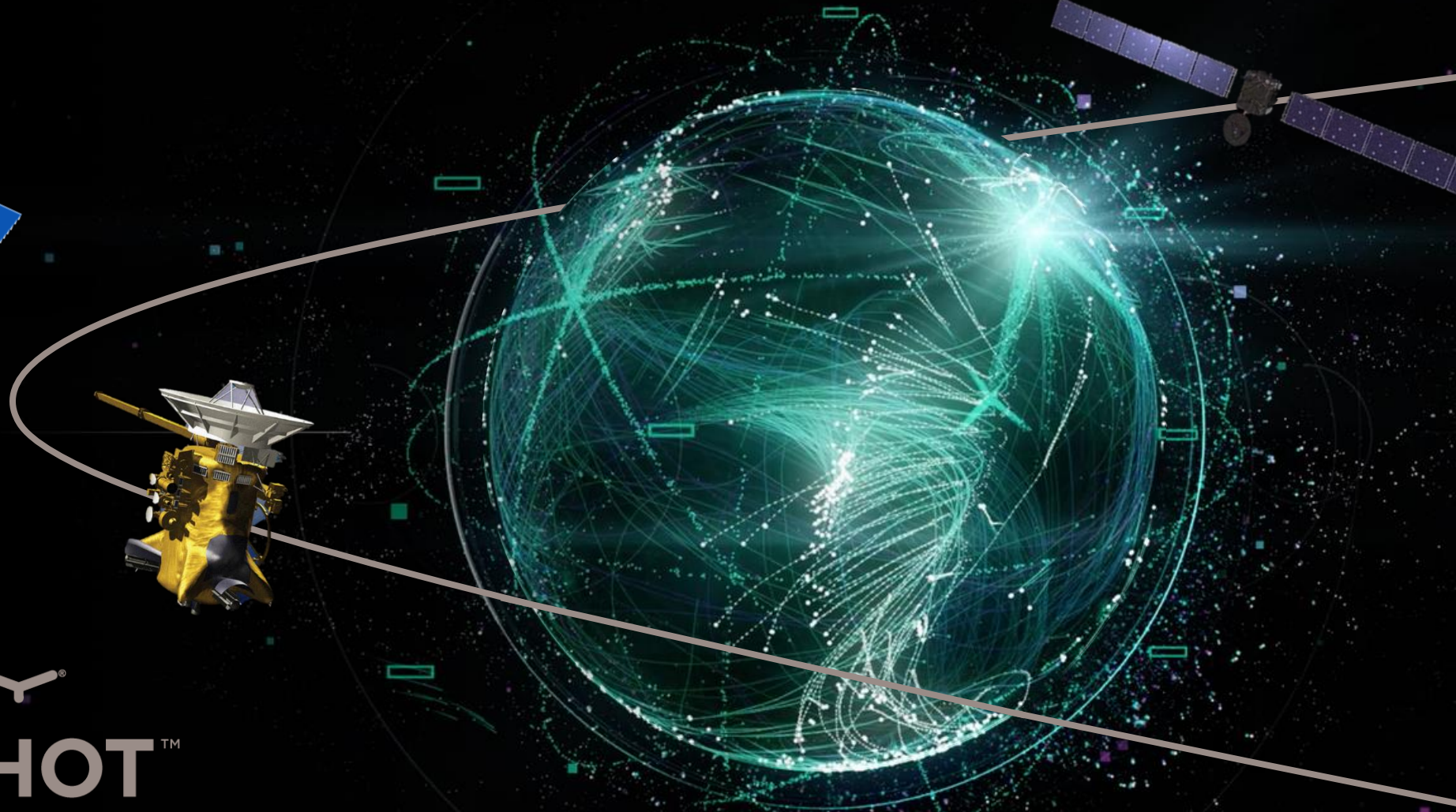
Sources: May 30, 2022 Top500 release

"Anyone can build a fast CPU.
The trick is to build a fast system."

Seymour Cray, Founder, Cray Research, Inc.

Recipe For a World Class HPC System

HPE TECHNOLOGIES POWERING EXASCALE



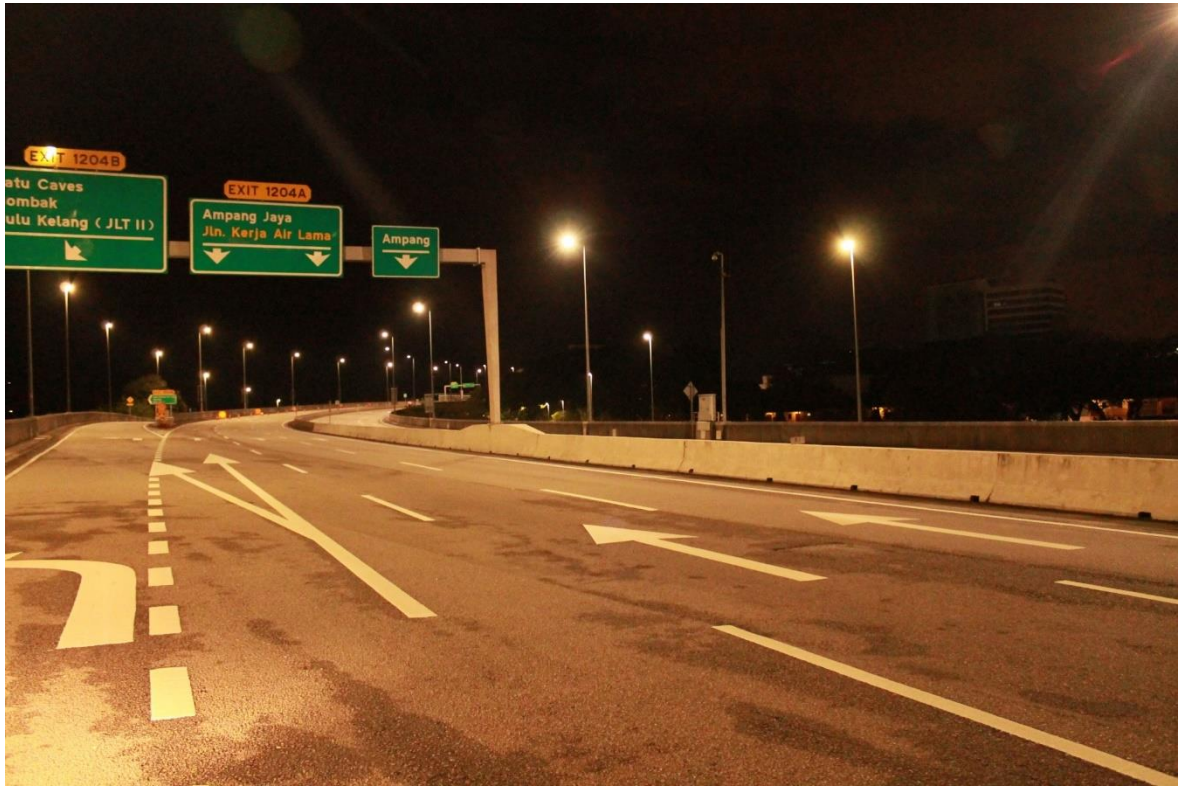
CRAY®

SLINGSHOT™

High Performance Ethernet Network

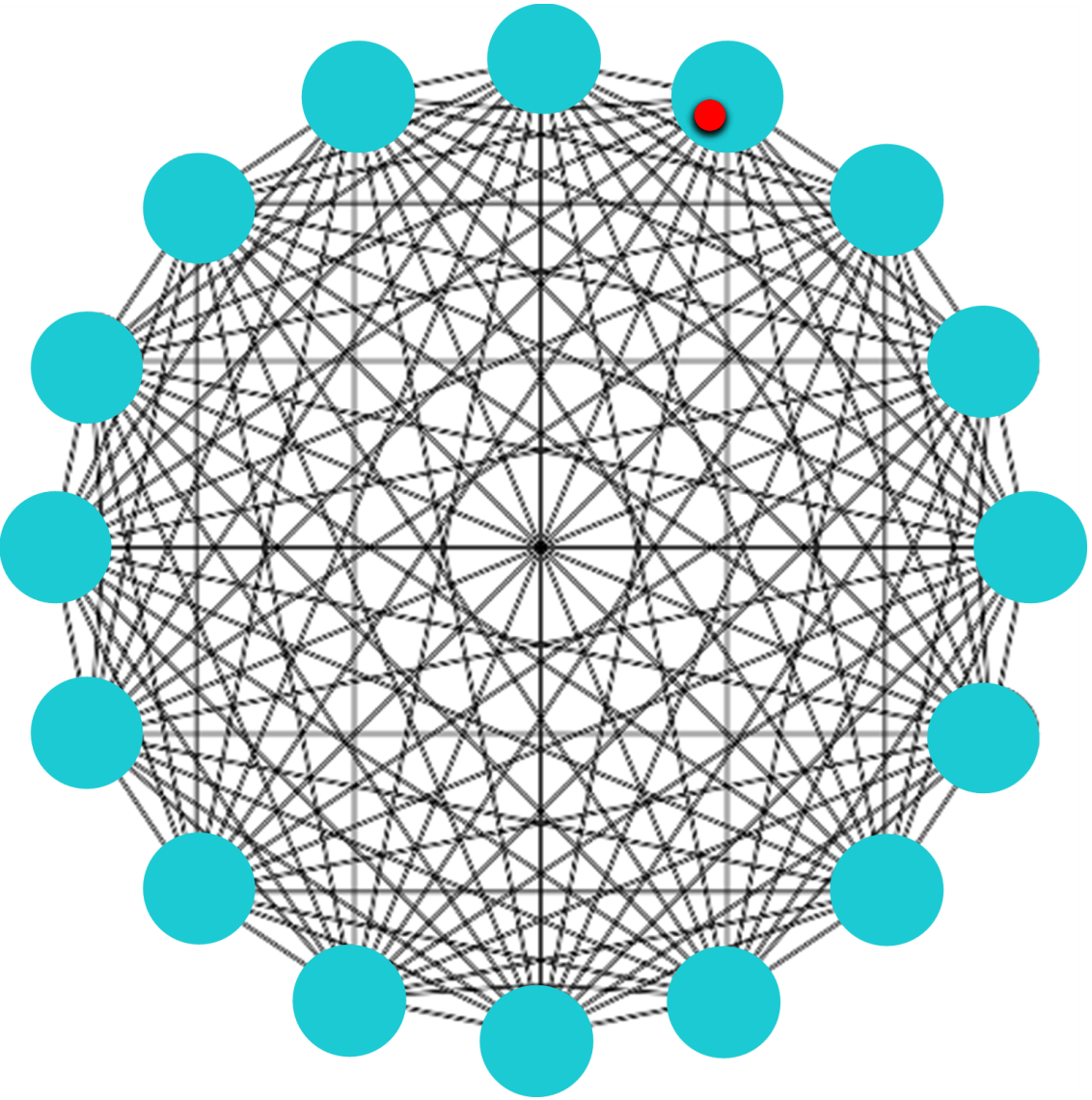
Congested Interconnect

Your commute at 4:00 AM

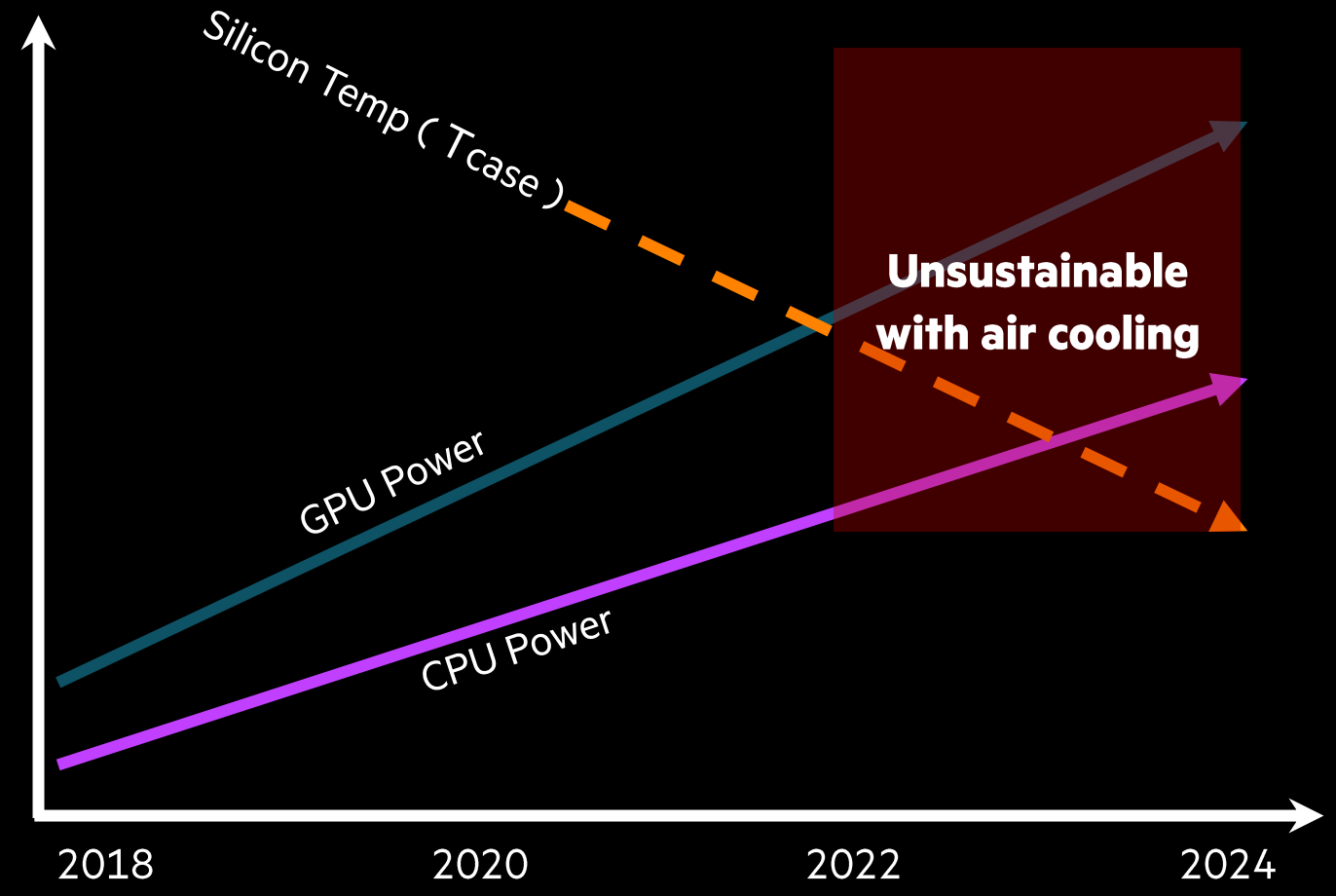


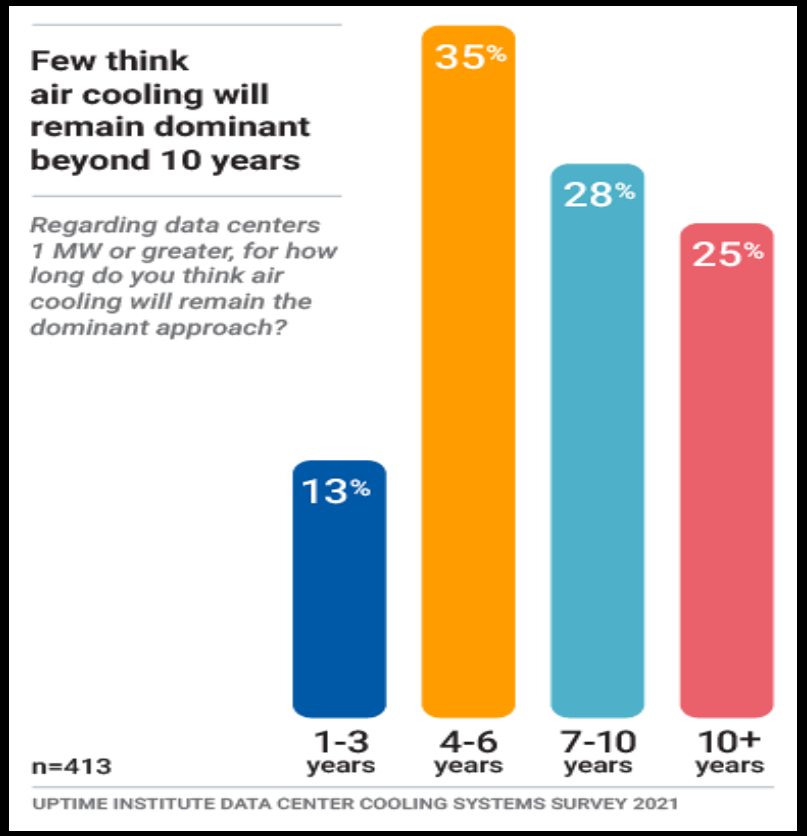
Your commute at rush hour

Slingshot : Fine-Grain Adaptive Routing – 3 Hops to Anywhere



THE COOLING DILEMMA





WHY LIQUID COOLING?

Performance

Reliable top-bin CPU/GPU operation

Sustained turbo modes

Density

More servers per rack

Fewer racks required

Efficiency

More effective heat capture

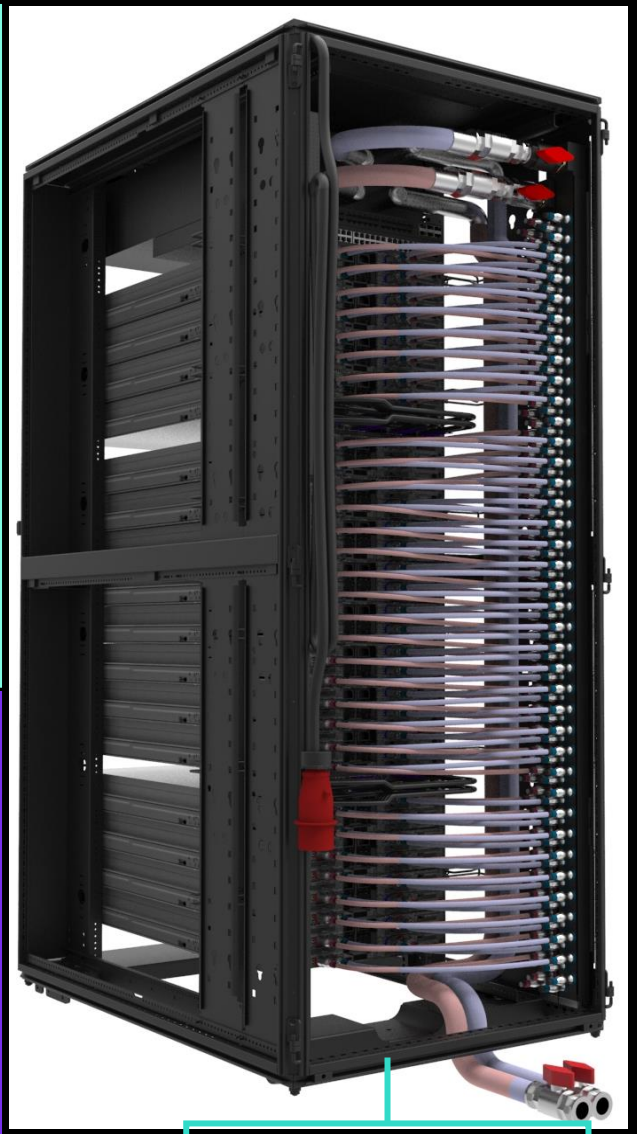
Lower cooling power required

DIRECT LIQUID COOLING SYSTEM OVERVIEW

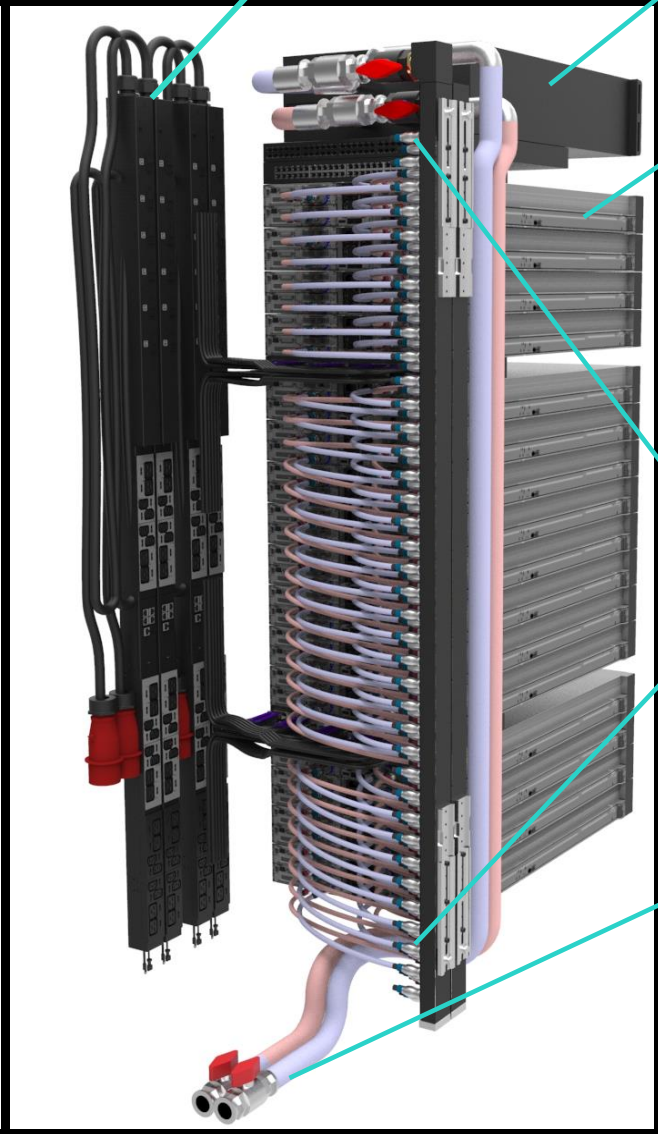
- Supports water temperatures of up to 40°C (W3 ASHRAE spec facility water) with specific configurations.
- One facility water connection pair per rack
- Contact your HPE representative for specific flow rates for your datacenter water temperature and configuration
- MODBUS protocol compliant for BMS monitoring

Cooling Options

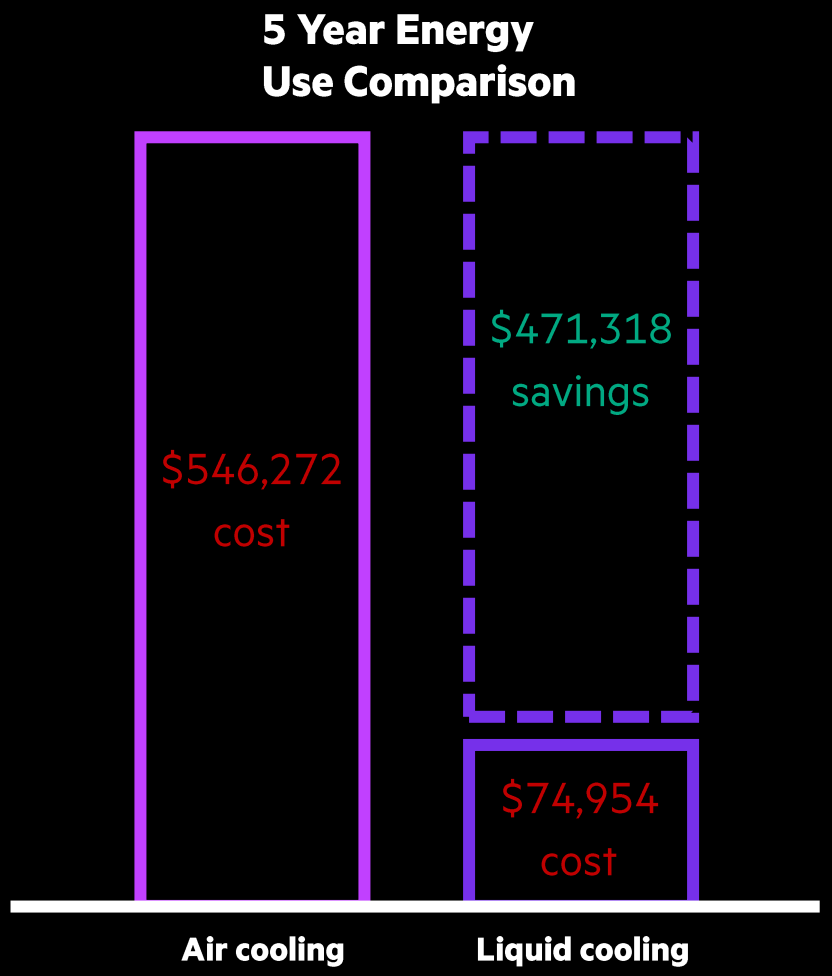
- Processor DLC cooling system removes most of the heat to water at the lowest price point
- Processor plus memory DLC, additional heat to water to reduce hot aisle heat load
- Room neutral options available
- CDU monitoring software available



42U or 48U HPE Standard 800mm x 1200mm rack

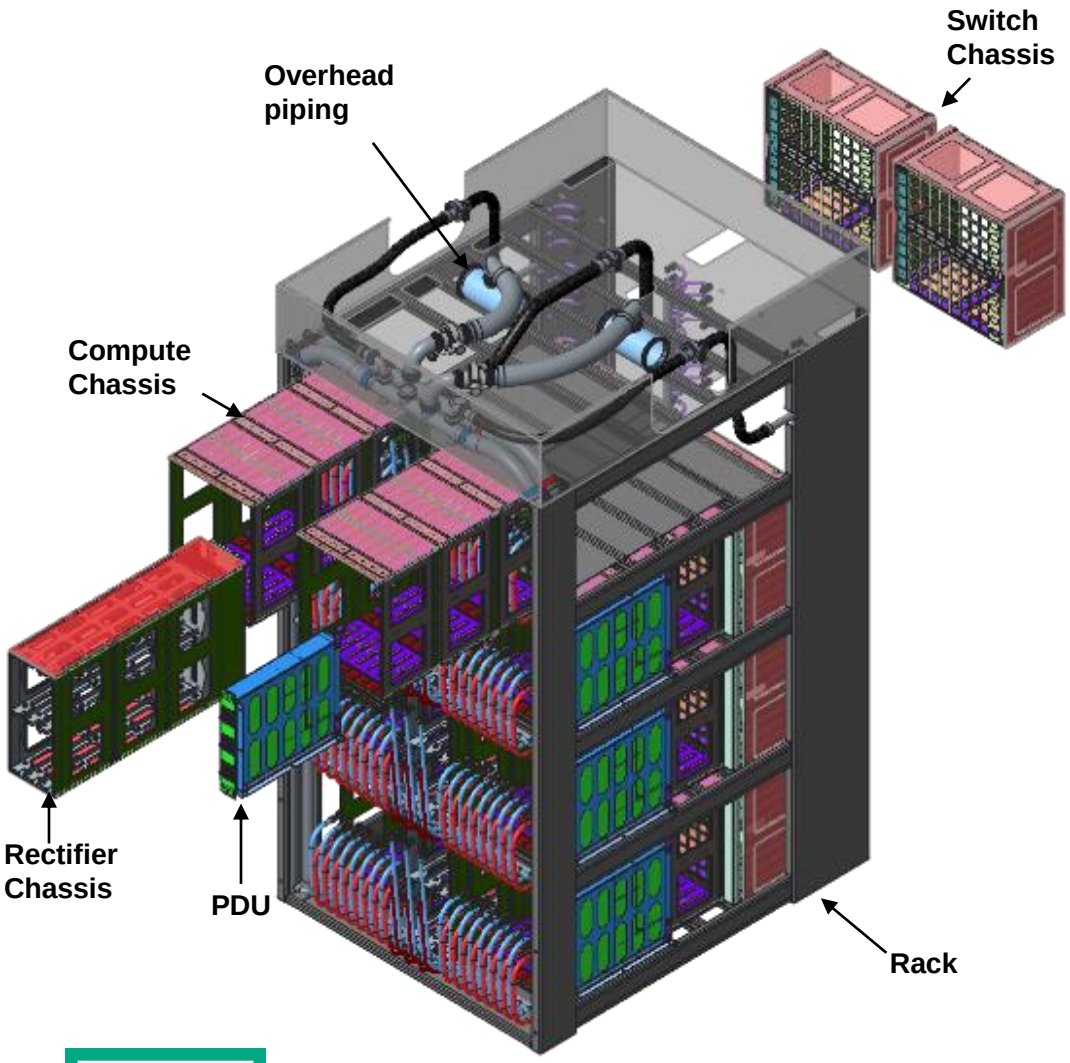


FINANCIAL OUTCOMES: Additional hardware through savings

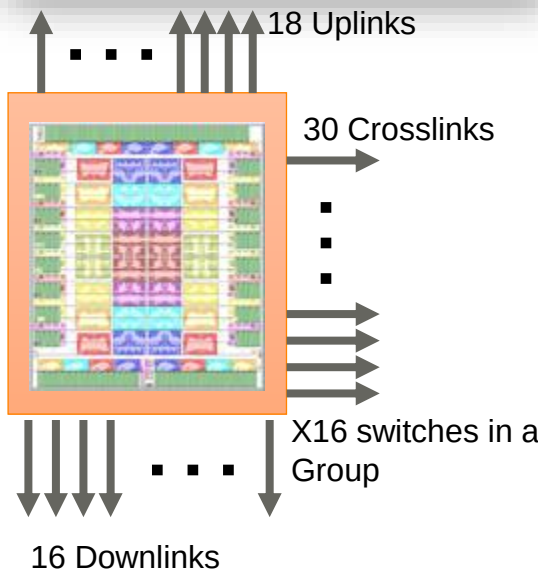


Example compares air cooled DL380 Gen 10 to XL220N DLC servers
All Liquid cooling and Air-cooling estimates are based on 6 racks with total of 504 servers and assume no power constraints within a rack.
Estimated cooling costs are based on 10.5 cents per KW/h over a 5-year period

HPE CRAY EX SUPERCOMPUTER CABINET -4 X DENSITY



- **64 compute blades**
  - 4-8 sockets/blade
  - 256-512 sockets/cabinet
  - **32,768 cores per Cabinet with 64 cores CPU- capable to 49k+ cores/cabinet with 96 cores CPU**
- **Scalable power & cooling**
  - W3 (32C) or W4 (45C) water (limitation applies on the CPUs)
  - Modular power up to 300 KW
  - 400-480 VAC feeds



THE IMPACT OF LEADERSHIP-CLASS SUPERCOMPUTING

CANCER RESEARCH

Researchers are racing to cure cancer. Supercomputing will help get there.

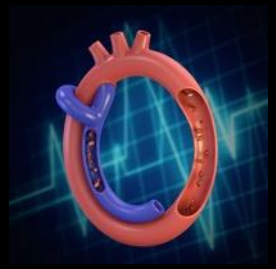
CLIMATE SCIENCE

Supercomputing helps save lives by anticipating dangerous weather and natural disasters like wildfires and hurricanes.

RENEWABLE ENERGY

Ocean waves are changing the renewable energy world and supercomputing is helping make it possible.

HEART TREATMENTS

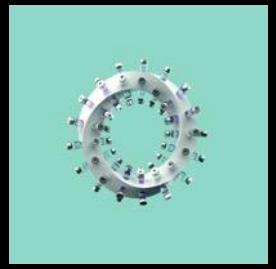


Supercomputing is used to reengineer artificial valves and increase life expectancy and quality.

ENGINE MANUFACTURING

Supercomputing is used to design quieter, more durable and more efficient jet engines.

VACCINE DEVELOPMENT



Supercomputing speeds-up vaccine development, producing life-saving cures.

TIRE MANUFACTURING

Supercomputers are reinventing the wheel — literally — to drive tire safety and performance.

SPACE TRAVEL

Supercomputing supports human spaceflight, improve satellite imaging, & observing our planet to find ways to protect it.

RENEWABLE ENERGY

Supercomputing advances green energy like solar, advancing the earth's transition to renewable energy.

HPE CRAY COMPREHENSIVE SOFTWARE STACK

HPE offers a comprehensive software stack designed to seamlessly transition supercomputing capabilities from development into production.

- The HPE Cray software stack prepares your system to perform like a supercomputer and run like a cloud.
- The stack is a key enabler for unlocking the full power of supercomputing, decreasing IT complexity so that you can get results from your HPC and converged workloads faster and move economically.

Scalability

Support for systems regardless of their size and their pace of growth

Productivity

Maximize use of available computing resources

Performance

Best performance for all workloads regardless of underlying architecture

Cloud as an Experience

Everything as a service resources available from everywhere, anytime

HPE GREENLAKE FOR HPC

HPE GreenLake for HPC gives you choice in how you utilize supercomputing technologies.

- Our cloud service and business delivery model provides the security, simplicity, and control of on-premises IT backed by the agility and scalability of the cloud.
- HPE GreenLake makes it simple to gain value from your investment by allowing you to pay only for what you use, so you can focus on innovation.

Data & HPC Expertise

To define, deliver, and integrate the right solution, reliably

Delivered as a Service

Self-service, pay-per-use, scalable, managed for you

Leadership Technology

Industry-leading technology developed to solve the world's biggest problems

Flexible hybrid models for customers offer elasticity of their HPE GreenLake for HPC service

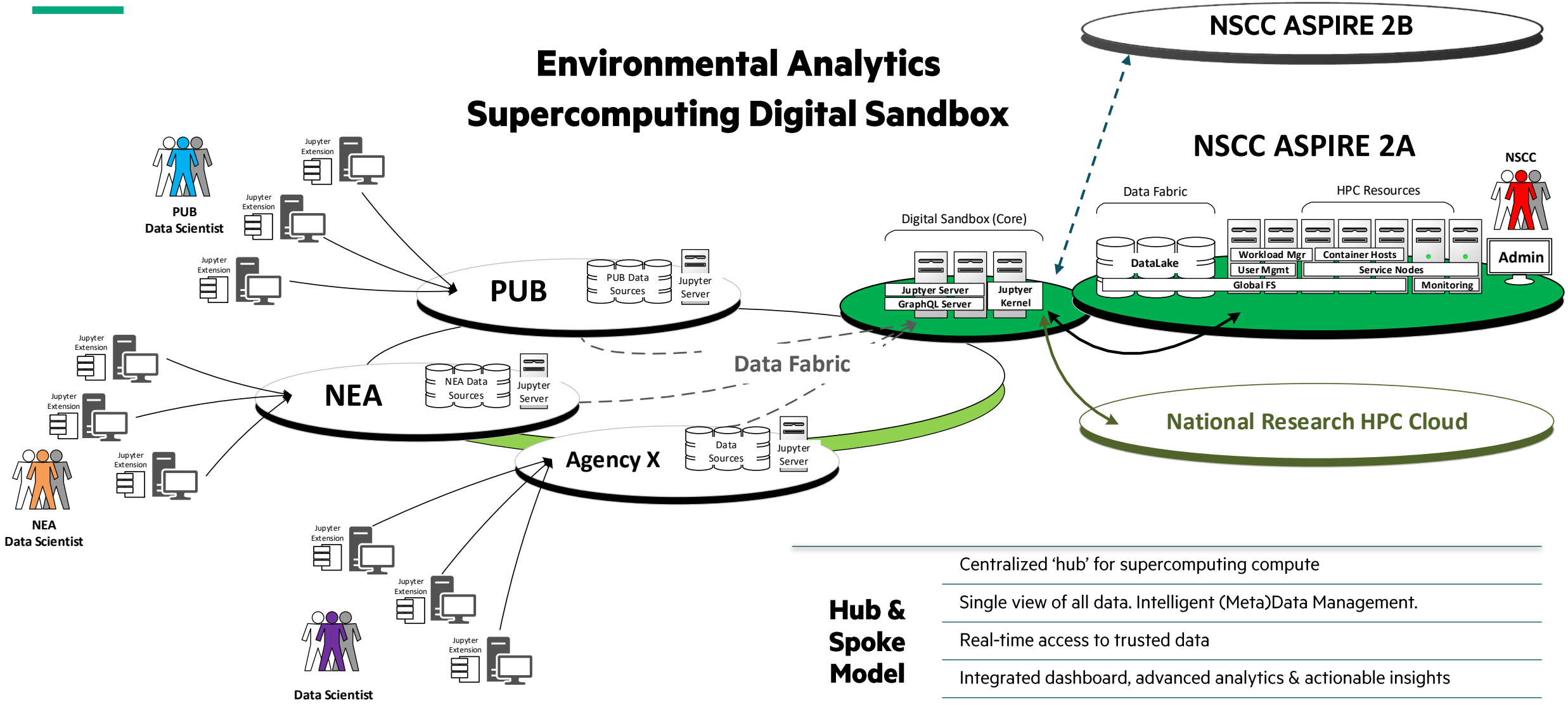
HPE GreenLake for HPC to private cloud or to a public cloud

Multi-cloud connector APIs (Hybrid Cloud APIs) that we will publish and drive to become industry standard on how to program submitting HPC to a diverse pool of computing

Ability to orchestrate data-center scale workflows with user-defined policies to determine best computing target where to execute a job

COLLABORATION INITIATIVES – KONG HOE

SANDBOX ARCHITECTURE



Hub & Spoke Model

- Centralized 'hub' for supercomputing compute
- Single view of all data. Intelligent (Meta)Data Management.
- Real-time access to trusted data
- Integrated dashboard, advanced analytics & actionable insights
- Practical security controls


NSCC USERS ARE ASPIRATIONAL AND WILL BE ABLE TO
SOLVE WORLD LEADING PROBLEMS
TO BENEFIT SINGAPORE

THANK YOU