

Liquid Cooling Canada's Largest Radio Telescope: The Canadian Hydrogen Intensity Mapping Experiment (CHIME)



Canada's newest and largest radio telescope, the Canadian Hydrogen Intensity Mapping Experiment (CHIME), formally launched on September 7, 2017 at the Dominion Radio Astrophysical Observatory. This novel telescope is optimized to map large volumes of the universe, which requires a large instantaneous field of view (~200 square degrees) and broad frequency coverage (400-800 MHz). The digitized signals collected by CHIME are processed to form a 3-dimensional map of hydrogen density, used to measure the expansion history of the universe.

The Customer

CHIME is a collaboration among 50 Canadian scientists from the University of British Columbia, the University of Toronto, McGill University, and the National Research Council of Canada (NRC). The CHIME telescope is located in the mountains of British Columbia's Okanagan Valley at the NRC's Dominion Radio Astrophysical Observatory in Kaleden.

Customer Challenge

The HPC nodes at CHIME reside directly adjacent to the telescope in sealed containers that function as Faraday cages to prevent leakage of electromagnetic interference from the servers. The CHIME collaboration realized early in its planning process that cooling the GPU intensive servers with traditional air conditioning would be difficult and costly, and turned to CoolIT Systems to deliver a high-density liquid cooling solution.

CoolIT Systems Solution

Using highly efficient Direct Contact Liquid Cooling (DCLC™) technology, CoolIT Systems designed a custom Rack DCLC™ solution to meet CHIME's needs to optimize computational power within a dense, containerized environment. The CHIME data center contains 256 liquid cooled General Technics GT0180 custom 4u servers across 26 racks. The liquid is managed with CoolIT Systems Rack DCLC CHx40. This unit features centralized pumping to supply liquid to the Passive Coldplate Loop which provides dedicated CPU and dual GPU cooling. The CHx40's are rack-mounted, liquid-to-liquid Coolant Distribution Units that can manage 40kW+ of cooling capacity per rack using warm water to cool the servers. The need for additional chillers or other expensive cooling was eliminated by the integration of a simple dry cooler, which was installed outside the container to efficiently lower the temperature of the specialized coolant.



“We chose to work with CoolIT Systems because their solutions are modular and robust, and as a result the most flexible and efficient for our situation. With the custom liquid cooling solution, we can drastically reduce CHIME's energy consumption and squeeze additional processing out of the GPUs.”

Dr. Keith Vanderlinde,
University of Toronto

Our Modular Approach

CoolIT Systems custom Rack DCLC™ solution for CHIME is a flexible, three module installation that includes:

Passive Coldplate Loop

The in-server components manage heat loads from the CPU and dual GPUs with dedicated coldplates. Each Passive Coldplate Loop terminates in a Stäubli dry-break quick disconnect, allowing for safe and simple removal of servers from the cabinet.



Rack Manifold

A pair of vertical manifolds are installed at the back of each rack, to interface between the Passive Coldplate Loops and the CHx40 CDU. This allows simple decoupling of a single server without the need to remove a neighboring system by way of the quick disconnects.



Coolant Distribution Unit (CDU)

Each rack is outfitted with a 2U, liquid-to-liquid CHx40 CDU which circulates coolant through the racks and servers and rejects this energy to a facility water feed connected to the outdoor heat rejection system.



Customer Benefits

With a successfully installed CoolIT Systems Rack DCLC solution, CHIME is running a high-density HPC system that is available for a wide array of astronomical research. CoolIT's solution design permits the continuous operation of the world's largest low-frequency radio correlator system, without requiring any active cooling components. Additionally, liquid cooling the GPU and CPU chips significantly lowers their operating temperatures, opening up new opportunities to improve their performance and power-efficiency.

HPC Setup

- 256 custom 4u servers across 26 racks
- 26 CoolIT Systems Rack DCLC™ CHx40 CDU's
- Stainless steel Rack Manifolds in each rack, featuring dry-break quick disconnect technology
- Liquid cooled components:
 - CPUs: Intel® Xeon® Processor E5-2620 v3
 - GPUs: Dual AMD FirePro S9300x2

Results

- 100% of total IT load managed by liquid cooling
- 183kW total heat load managed
- Significantly lowered data center OPEX
- Reduced noise pollution

As of XX Month, 2018, the CHIME project will be expanding with a further 13 liquid cooled racks being installed.

For more information on how CoolIT Systems custom Rack DCLC™ solutions can enable higher rack densities, reduce energy costs and maximize compute performance, contact sales@coolitsystems.com.