

Validating Extreme IT Loads: A Cost-Effective Cooling Test Methodology using Server Emulators

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Introduction

As Artificial Intelligence (AI) workloads drive data center power densities to unprecedented levels, the transition from air to liquid cooling is becoming critical. However, validating these next-generation technologies using production silicon presents significant technical and financial risks. This poster proposes a cost-effective test methodology developed by RISE Research Institutes of Sweden to address these challenges using custom server emulators.

Methodology

The core of our methodology is a highly controlled "hybrid" environment capable of testing air and liquid cooling simultaneously.

Server Emulators

The innovation in our test beds lies in the substitution of real IT equipment with the in-house engineered server emulators. In collaboration with Hillstone it has been introduced to the market.



- **Commercial form factor:** LGA4677-1 sapphire Rapids
- **TDP:** adjustable up to **2000W**.
- **Reliability:** integrated control system to adjust die power and temperatures. Additional built-in safety features.
- **Cost Reduction:** Emulators cost a fraction of real servers, significantly lowering the CAPEX required for testing.
- **Risk Mitigation:** Destructive testing (e.g., pump failure simulation) can be performed without risking expensive logic hardware.

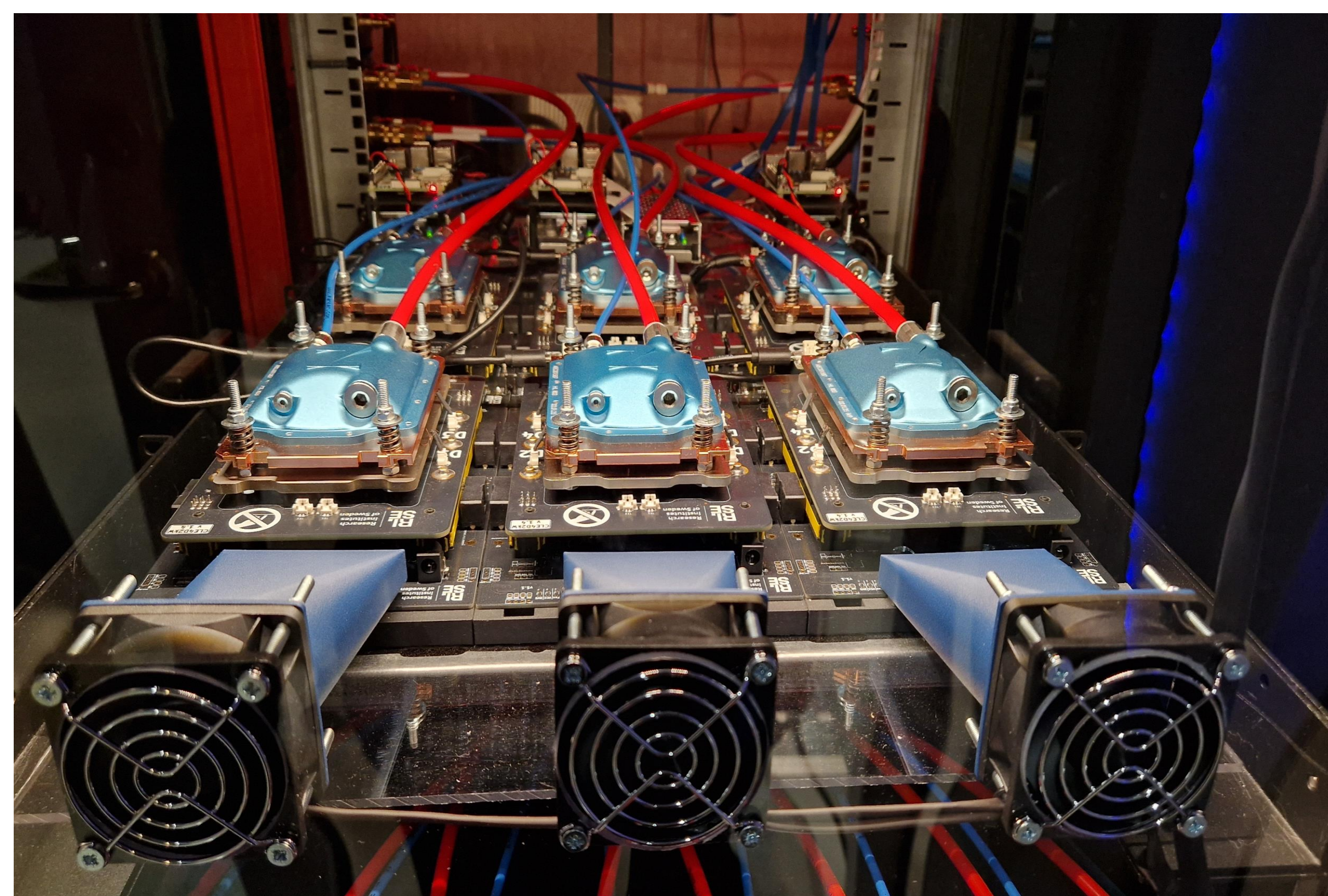
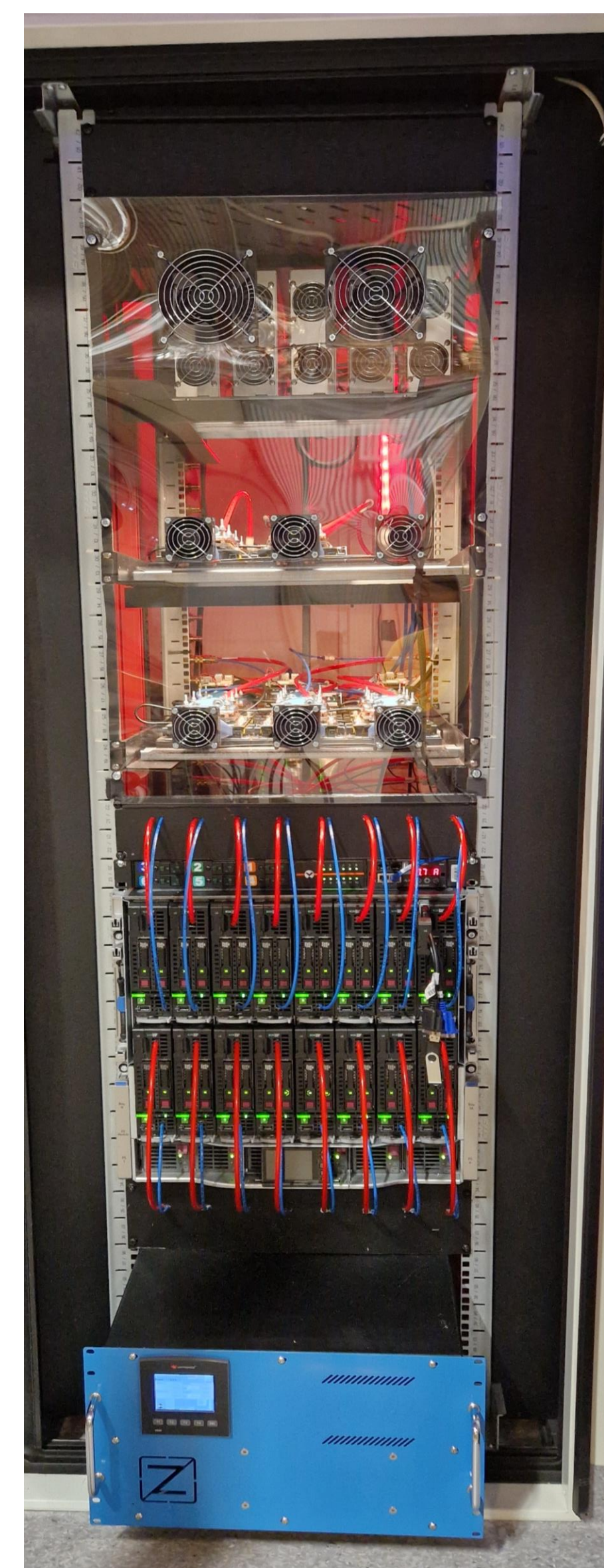
Use Cases

1. HEATWISE: EU-funded project. 20kW hybrid cooling approach.

- Liquid loop: ZutaCore's HyperCool® Heat Rejection Unit (HRU) which employs a two-phase Direct-to-Chip (DLC) liquid cooling technology handles the primary heat load from high-density components.
- Air loop system: A precision air cooling system manages the residual heat from non-liquid cooled components.
- System optimization aided by a Digital Twin.

2. H-DINI: VINNOVA- funded project.

- Scaling up to **1MW** rack challenge. In **partnership** with Ericsson, ABB, Alfa Laval, Castrol and others.
- Significant **industrial relevance**. The emulator-base methodology allows **validation** of power distribution, cooling limits, and heat recovery strategies in controlled, safe environment and at **lower cost**.



RISE 2U Server emulator with Zutacore coldplates.

Hillstone
DATACENTRE TESTING

HEATWISE
Funded by
the European Union

H-DINI