



Modular Integrated Sustainable Datacenter

Functional testing laboratory and additional facilities to perform tests Deliverable D1.2

Deliverable: 1.2

Work-package: WP1

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MODULAR INTEGRATED
SUSTAINABLE DATACENTER



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Nederland



This activity is conducted in the scope of Modular Integrated Sustainable Data Center (MISD) project which received funding from the Netherlands Enterprise Agency (RVO) under the 8ra initiative (IPCEI-CIS)

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Introduction

Deliverable 1.2 involves setting up an open staging lab for MISD and IPCEI-CIS partners to validate their concepts and to invite hardware suppliers who are willing to support this project. Within the lab all necessary infrastructure components are in place to be able to perform a wide range of tests. Monitoring on several levels enables the user to generate the needed input to compare and report. Connectivity is in place to enable remote control and to connect test environments together.

Specifications

Floor space

The lab environment consists of 2 rooms, the staging lab and the battery room. The staging lab has a footprint of about 50m2 and contains:

- Cooling circuit
- Fiber drums
- Patch rack
- Several IT cooling solutions
- Power distribution panel
- Monitoring equipment
- Controller boards
- Desk
- Monitor

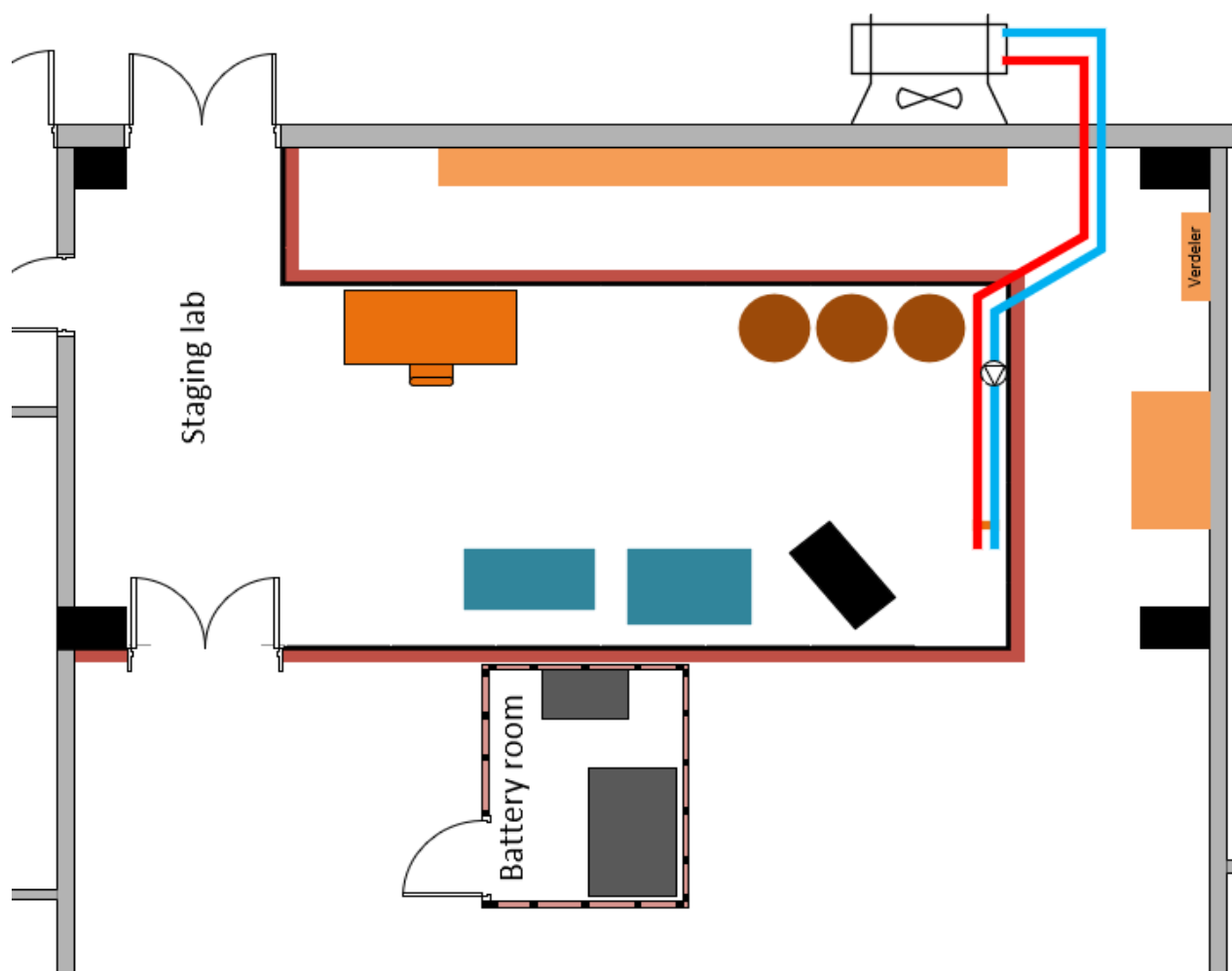
The battery room (under construction) has a footprint of about 7m2, is fire resistant for 60min and contains:

- BESS (battery energy storage system)
- Server rack
- Air conditioner
- Fire suppression system



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Drawing floor plan



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Power

The total power available for the lab is 45kW and consists of a power distribution system with a combination of several outlets, types and sizes. The main breaker size is 63A 3-fase. Each rack or cooling solution is provided with 32A 1-fase PDU.

Main power distribution:

- 63A three-phase inlet
- 6x schuko 16A single-phase outlet
- 1x CEE 63A three-phase outlet
- 3x CEE 32A three-phase outlet
- In and outlets are measured

Rack PDU's

- 32A single phase inlet (from main power distribution)
- Two 16A groups
- Each group 12x C13 outlet
- All outlets are measured
- All outlets are switchable

Cooling distribution

- 32A three-phase inlet (from main power distribution)
- 4x 16A single-phase outlet
- 3x 16A three-phase outlet

Cooling

To be able to cool different solutions with high temperature outputs we installed a cooling system with the intelligence to control based on return temperature. The cooling capacity is sufficient to cool IT load up to 40kW depending on return and outside temperature. The higher the delta T between return and outside temperature the more capacity is available. This system is also equipped with a heat exchanger that enables the option of using the heat to warm the office space in the datacenter. From the valves of the cooling circuit there are hoses connected with drip free quick connect couplings to connect the IT cooling solutions.

The cooling circuit consists of:

- Dry cooler with 2 extraction fans
- Grundfos circulation pump (variable speed)
- 2 smart valves to connect the IT cooling solutions
- Thermal expansion tank
- Pressure sensor



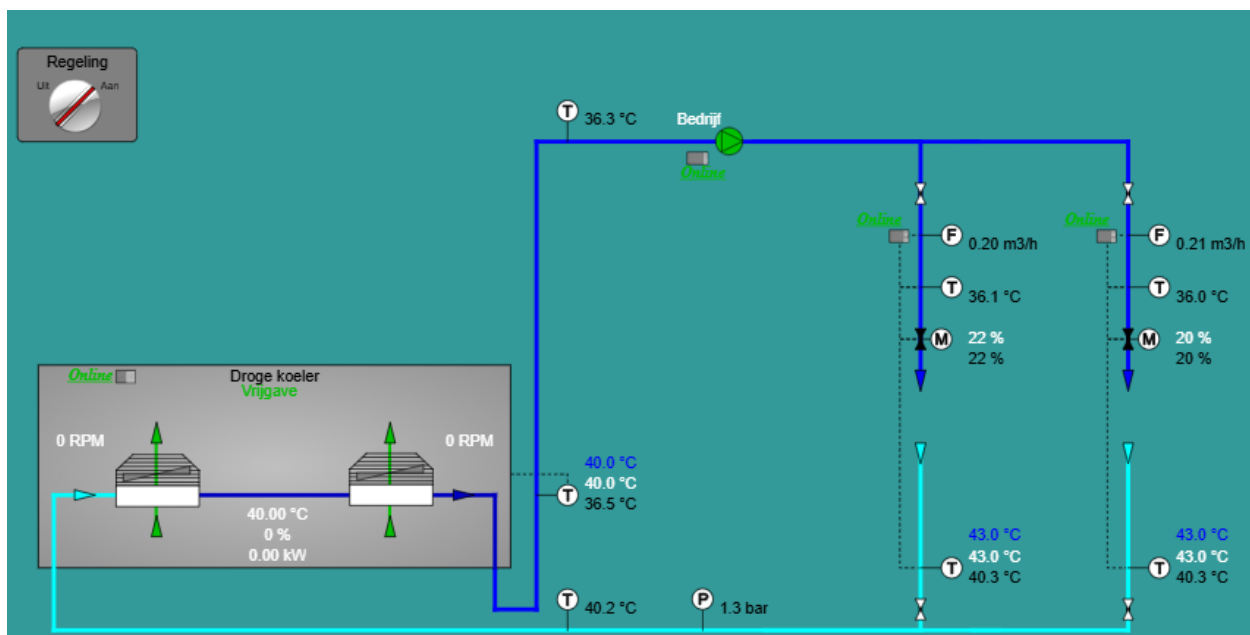
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- Flow sensor
- Supply and return temperature sensors
- Adjustable bypass

The heat exchanger consists of:

- Plate exchanger
- Grundfos primary circuit pump (variable speed)
- Grundfos secondary circuit pump (variable speed)
- Supply and return temperature sensors
- By pass in the primary circuit

Drawing of main cooling circuit



Monitoring

There are several monitoring solutions implemented. The cooling circuit has its own system for monitoring and controlling and is provided by Scheider. This system generates a monthly report with the most important data such as PUE, EPI, energy, temperature, fan speed, system pressure, etc.

This system monitors and logs the following data:

- Temperatures
- System pressure
- Water flow
- Pump speed
- Fan speed
- Operating hours
- Operating mode
- Energy heat and electrical
- Power heat and electrical
- Fault codes

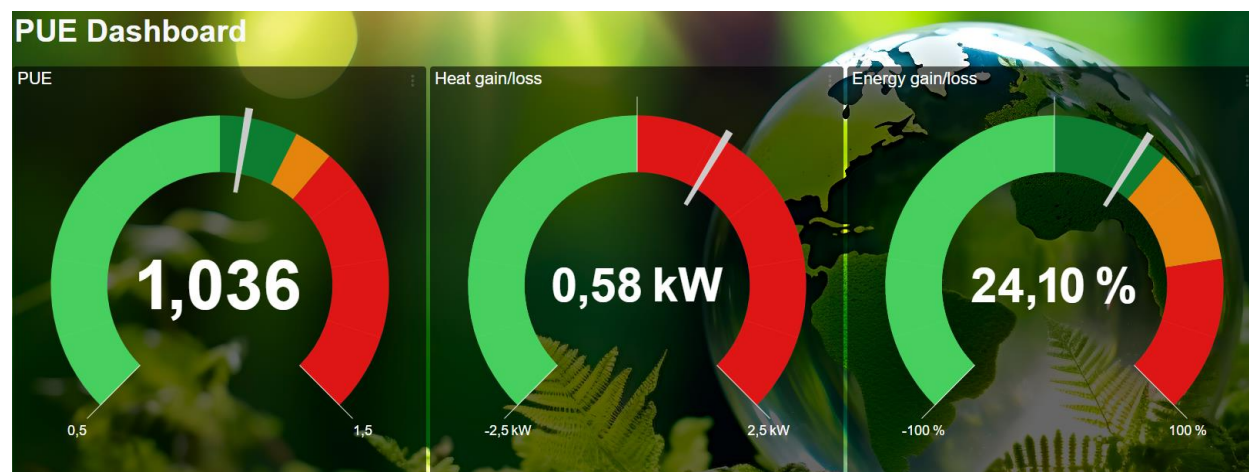
For monitoring hard contacts an AKCP unit is installed. This unit acts on alarms from connected hardware and is also capable of monitoring several external temperature sensors through Modbus. These temperature sensors are placed at locations specified by the partner who's performing the tests. This unit can also be used for other sensors needed for test purposes such as humidity, leak, power, alarming, etc.

A management server is installed that currently runs Observium. This program monitors all network and IT related hardware based on SNMP. It also monitors and collects data from the AKCP and the PDU's. We are also looking at Grafana as a replacement for Observium.



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Dashboard Schneider

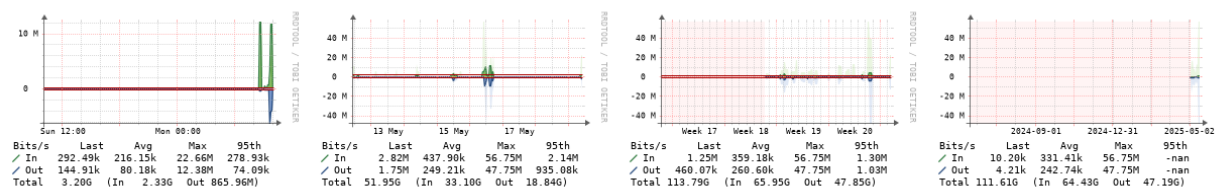


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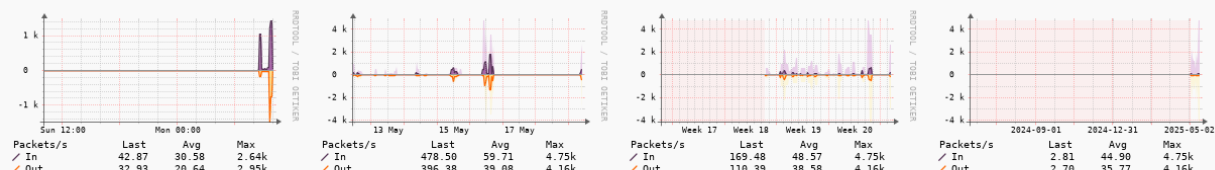
Dashboard Observium

Hostname / Domain / Location	Operating System / Hardware Platform
 192.168.1.21	 Cisco IOS 15.0(2)SE (IPSERVICESK9) WS-C3560G-24TS-S
 192.168.1.22 Staginglab	 Netgear OS FS726T
 192.168.1.3	 Powertek PDU 3.10.6
 192.168.1.4	 Powertek PDU 3.10.6
 192.168.1.5	 Powertek PDU 3.10.6
 192.168.1.53	 ERS Software (BOSS) 10.4.6.005 Virtual Services Platform 7024XLS
 192.168.1.6 System Location	 AKCP securityProbe securityProbe SEC-PXAV401r
 192.168.1.75	 Juniper JunOS 19.4R3.11 (Ethernet Switch) EX3400-24T
 localhost Unknown	 Linux 6.11.0-26-generic (Ubuntu 24.04) X8DT6 x86 [64bit]

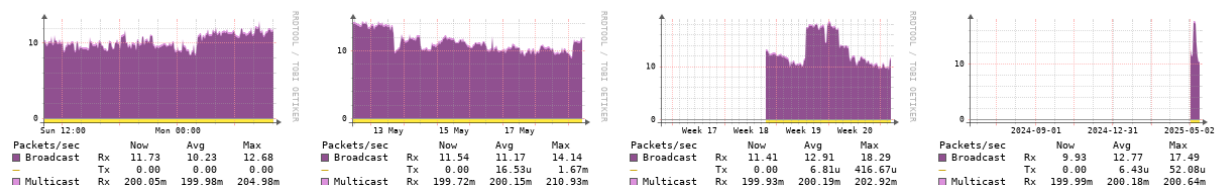
Traffic



Unicast Packets



Non Unicast Packets



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Network infrastructure

For the uplink with the internet there is a 1G up/down /27 supplied by Eurofiber. The IP range is 144.178.121.192 to 144.178.121.222. This IP range should be sufficient to assign addresses per test project. The internal network is still in development and depends on the use cases.

We currently have several switches installed who are primarily used for the out-of-band network. To be able to create a real fiber optic distance between test environments the lab is equipped with three fiber optic spans of 2km with 48 fibers each. These spans have been spliced in such a way that several lengths are possible. These lengths per span are 8km, 16km and 24km. Adva has provided us with 4 layer 2 switches for the fiber optic routes between the IT environments to test on latency restrictions.

IT hardware

BetterBe has provided the lab with 32 servers for testing purposes. These servers are about 10 years old but should be sufficient for the tests to be performed. Eurofiber Cloud Infra will provide 4 new Dell servers that have been ordered and need to be adjusted for immersion cooling. Those new servers will be deployed in the second-generation immersion tank from Asperitas.



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Immersion cooling

Asperitas has provided the lab with an immersion tank for testing purposes. This tank has got the following specifications:

Capacity		Liquid	
ASHREA W3 solution footprint	18kW/m ² , 32°C	Circulation method	Convection drive, no pumps
Electrical capacity	Up to 44kW	Liquid product	Shell S5X Hydrocarbon
Cooling capacity/ U	Up to 1.6kW/U, typical 32kW	Liquid amount (tank full of IT)	Minimum 708 litres
IT capacity (Servers)	24U/ 220U (19" & 21" up to 900mm in height)	Facility requirements	
IT capacity (Switches)	Up to 8x 19" air-based switches	Liquid containment	Integrated, dual hull system
Non-IT Power /kW	0W/kW _{IT}	Fire suppression recommendation	General datacenter recommendations apply, check with local regulations
Non-IT overhead/ m ²	TBD	Tier capability	Fully 2N Power, ride-through time on cooling
Other		Autonomous safety system	Integrated & Support options (based on Asperitas propriety PDUs or alternative vendor PDUs)
Heat rejection efficiency	Circa 97%	Environment conditions	-20°C to 50°C non-condensing
Reliability	Static equipment - no pumps	Electrical connection	Based on Asperitas proprietary PDUs or alternative vendor PDUs
Serviceability	All parts serviceable	Switch gear, electrical selectivity	Based on Asperitas proprietary PDUs or alternative vendor PDUs
Dimensions		Water input (depends on IT)	Above dew-point temperature
Dimension (L x D x H) without Switch mounting	1500mm x 715mm x 1550mm	Water output	Δt typical 10°C
Height clearance requirement	2300mm	Water connection	4x 1" BSPP thread connector
Weight		Water flow rate	Typically, 2 m ³ /h
Transport weight	550Kg		
Operational weight (without IT)	1,120Kg		
Operational weight (with IT)	1,840Kg		

In the coming period Asperitas will supply the lab with a second-generation immersion solution that can cool more IT-load per m². Apart from Asperitas we have an immersion solution from Submer that enables us to compare these cooling solutions on efficiency.

Future expansion

We are currently building a battery room that will contain a BESS (battery energy storage system) which is already on site with a capacity of 130kWh. The BESS is capable of loading and unloading at 45kW of power. Furthermore, a solar panel installation will be built on top of the datacenter with a capacity of around 30kW. Both systems will be used by the orchestration layer (under development by TNO) to enable load shifting based on power availability.



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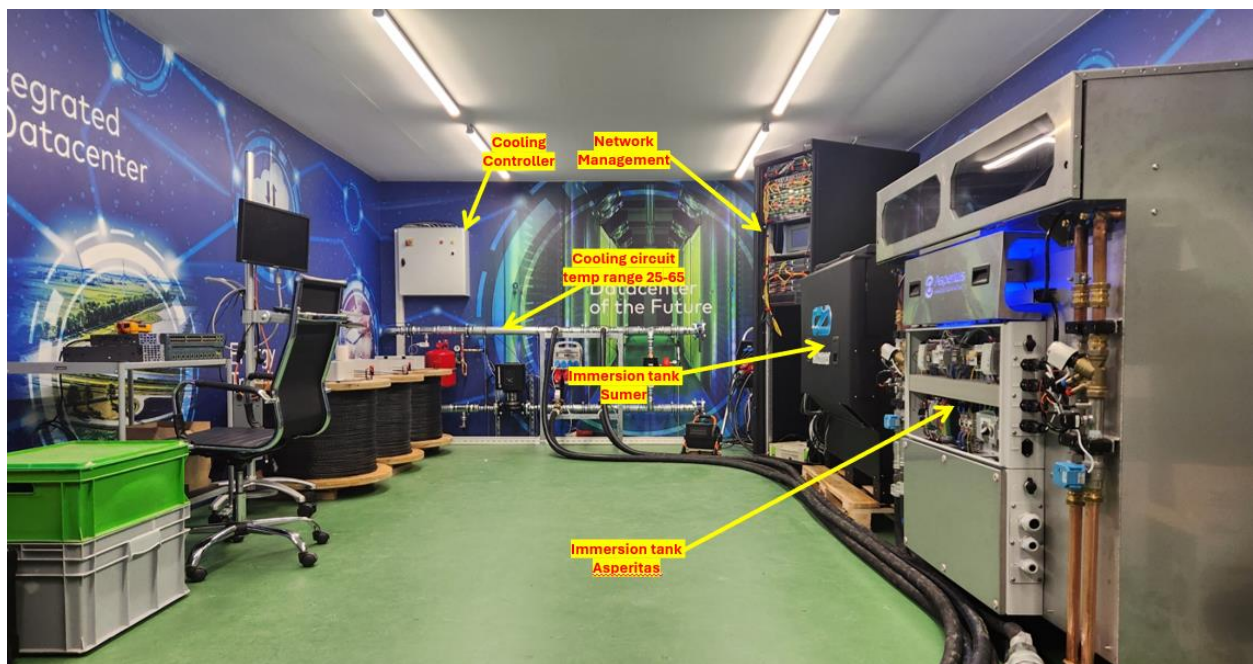
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Pictures of the staging lab



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