

Cnuas Facility Twin, Datasheet

Campus digital twin, OpenUSD scene generation, power model and live ORV3 telemetry



Document DS-CNU-030 • **Revision** A • **Issued** 03 August 2026 • **Status** Published

Item	Value
Part	cnuas-facility
Type	Facility digital twin and power model
Package	cnuas-facility, version 0.1.0
Version	8eb4167-dirty
Repo	PacketFive/cnuas

1. Overview

The facility twin generates a hyperscale AI and HPC data centre campus as an OpenUSD scene, computes its electrical and thermal load, and animates the scene from live readings taken off the emulated Open Rack V3 power shelf. It is what connects a rack of emulated hardware to the site scale question every operator eventually asks: how much power does this draw, and what has to be built to supply it.

The scene opens in any OpenUSD capable viewer, including NVIDIA Omniverse and Isaac Sim.

Key features

- Declarative campus specification, from site dimensions down to rack rows.
- Three building footprints, the I, H and E shapes hyperscale operators build.
- Data halls with rack rows, cold and hot aisle spacing, and support rooms.
- Site features: yards, roads, plant compounds, groves and lakes.
- Power roll-up from rack to hall to building to campus, with plant sizing.
- Live sampling of the emulated Open Rack V3 shelf over Modbus, written back onto the scene as typed attributes.

2. Module map

Module	Responsibility
spec.py	Declarative campus, building and hall specification, and the reference campus
catalog.py	Equipment catalogue, dimensions and power rating per rack and plant type
plan.py	Resolves a specification into placed rooms, racks, plant and roads
layout.py	Rectangle mathematics, building footprints, rack row layout
geom.py	Geometry and material primitives
usd.py	Writes the campus OpenUSD scene graph
schema.py	The cnuas: attribute namespace carried on the scene
power.py	Load roll-up and plant sizing
orv3.py	Modbus client and register decoding for the power shelf
live.py	Samples the shelf and animates the scene



Module	Responsibility
units.py	Named dimensional constants
cli.py	Command line front end

3. Command reference

Command	Purpose
build	Write the campus OpenUSD stage
power	Print the power roll-up
rooms	Print the room programme
live	Sample the Open Rack V3 shelf and animate the stage

4. Scene specification

Parameter	Reference value
Campus name	Cnuas Ridge AI Campus
Site footprint	1000 m by 800 m
Buildings	3, one each of the I, H and E footprints
Data halls	16 across the three buildings
Design power usage effectiveness	1.15
Target campus load	Close to 300 MW
Stage root	/World
Scene branches	/World/Looks, /World/Site, /World/Yards, /World/Buildings, /World/Prototypes
Default output format	.usda, with .usdc and .usd also supported

5. Equipment catalogue

Entry	Rated load
Cnuas Open Rack V3, 24 OpenU	6 kW
GB200 NVL72 class rack	132 kW
Storage rack	12 kW
Network rack	15 kW
Medium voltage switchgear, transformer, generator, coolant distribution unit, fan wall, indirect evaporative cooler, dry cooler	Sized by the power model

6. Power model

Quantity	Definition
Information technology load	Sum of rack ratings in scope
Facility load	Information technology load multiplied by the power usage effectiveness



Quantity	Definition
Overhead	Facility load less information technology load
Heat rejected	Equal to the information technology load
Density	Load per unit floor area

Roll-up functions run at hall, building and campus scope. Plant counts are derived from the resulting load.

Plant	Unit size used for sizing
Generator	3000 kW
Cooler	3500 kW
Coolant distribution unit	2000 kW

7. Live telemetry

Item	Value
Source	Emulated Open Rack V3 power shelf
Protocol	Modbus remote terminal unit framing
Transport	Serial line or a TCP endpoint, by default port 3485 on the loopback address
Decoded from the power supply	Voltage, current, power, fan speed, temperature
Decoded from the battery backup	State of charge and unit state
Write back	Typed attributes in the cnuas: namespace on the corresponding scene primitives

The shelf itself is emulated by the BMC stack, which runs the power shelf firmware and presents the RS-485 segment.

8. Validation

Area	Test	Cases
Power roll-up and plant sizing	tests/test_power.py	8
Footprints, rectangles and rack rows	tests/test_layout.py	17
Scene graph generation	tests/test_usd.py	13
Shelf sampling and scene animation	tests/test_live.py	21

All 59 cases pass. See the Validation Matrix.

9. Operating notes

- The twin models geometry, load and telemetry. It does not perform computational fluid dynamics, electrical fault studies or structural analysis, and the plant counts are sizing estimates rather than engineering designs.
- Building footprints are limited to the I, H and E shapes in this revision.



10. Integration information

Item	Value
Repo	PacketFive/cnuas
Source	facility/src/cnuas_facility/
Entry point	cnuas-facility
Python	3.10 or later
Dependencies	OpenUSD Python bindings
Viewers	Any OpenUSD viewer, including NVIDIA Omniverse and Isaac Sim

11. Revision history

Revision	Notes
A	First publication. Reference campus, catalogue ratings and plant unit sizes read from the source.

PacketFive, Packet Five Networks Ltd., Dublin, Ireland.

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