

The JUNO Data Acquisition System

Integrated detector-scale readout, online processing, web operation and stable physics data taking

JUNO Work in Progress, June 2026.

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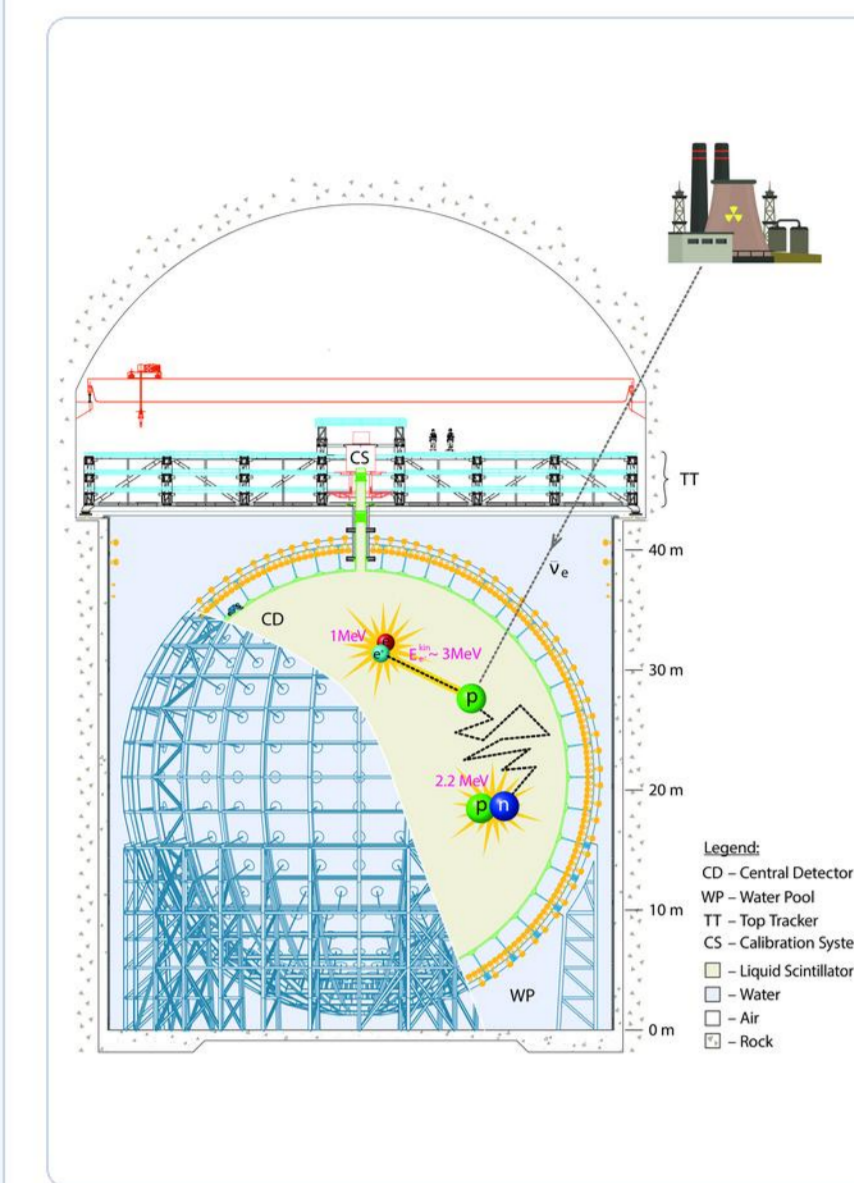
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中国科学院高能物理研究所
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Detector scale and DAQ

Experiment context and DAQ scale



JUNO is a 20 kt liquid scintillator detector 700 m underground. Its DAQ records >45k PMT channels and waveform plus T/Q data.

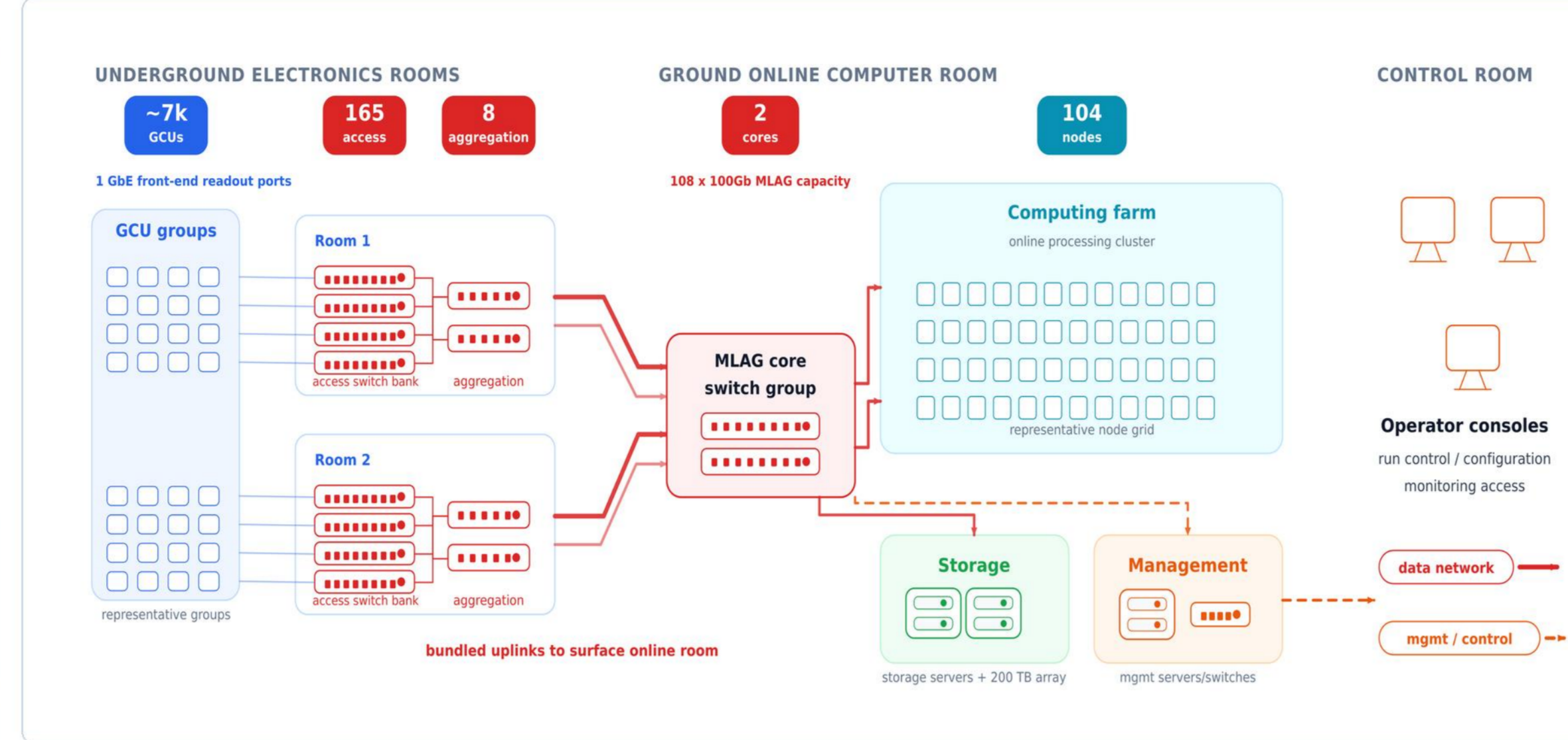
CD large	17,612
CD small	25,600
WCD large	2,400
Front-end	~7,000
DAQ TCP links	>10,000

Hardware deployment

Physical topology from underground electronics to ground online processing

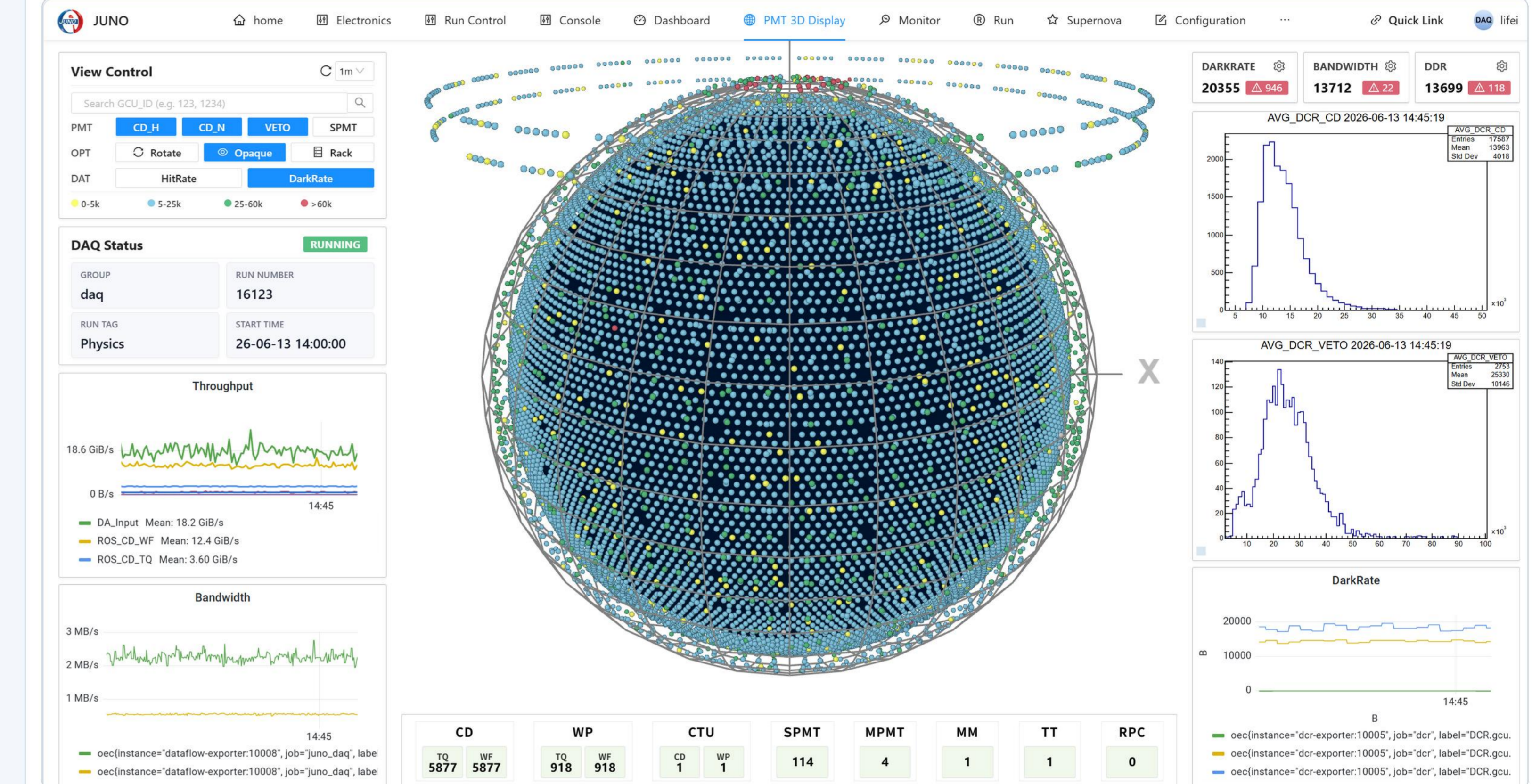
Underground readout, switching layers and the ground online room are separated. Data, storage, management and web-control paths remain distinct.

- >40 GB/s raw FEE input at 1 kHz trigger rate
- ≥60 GB/s processing reserve at 1.5 kHz trigger rate



Hardware topology: underground rooms, switching layers, online farm, storage and operation access.

Operation, monitoring and control



3D PMT status display for channel occupancy, rates and health.

DAQ software and online processing

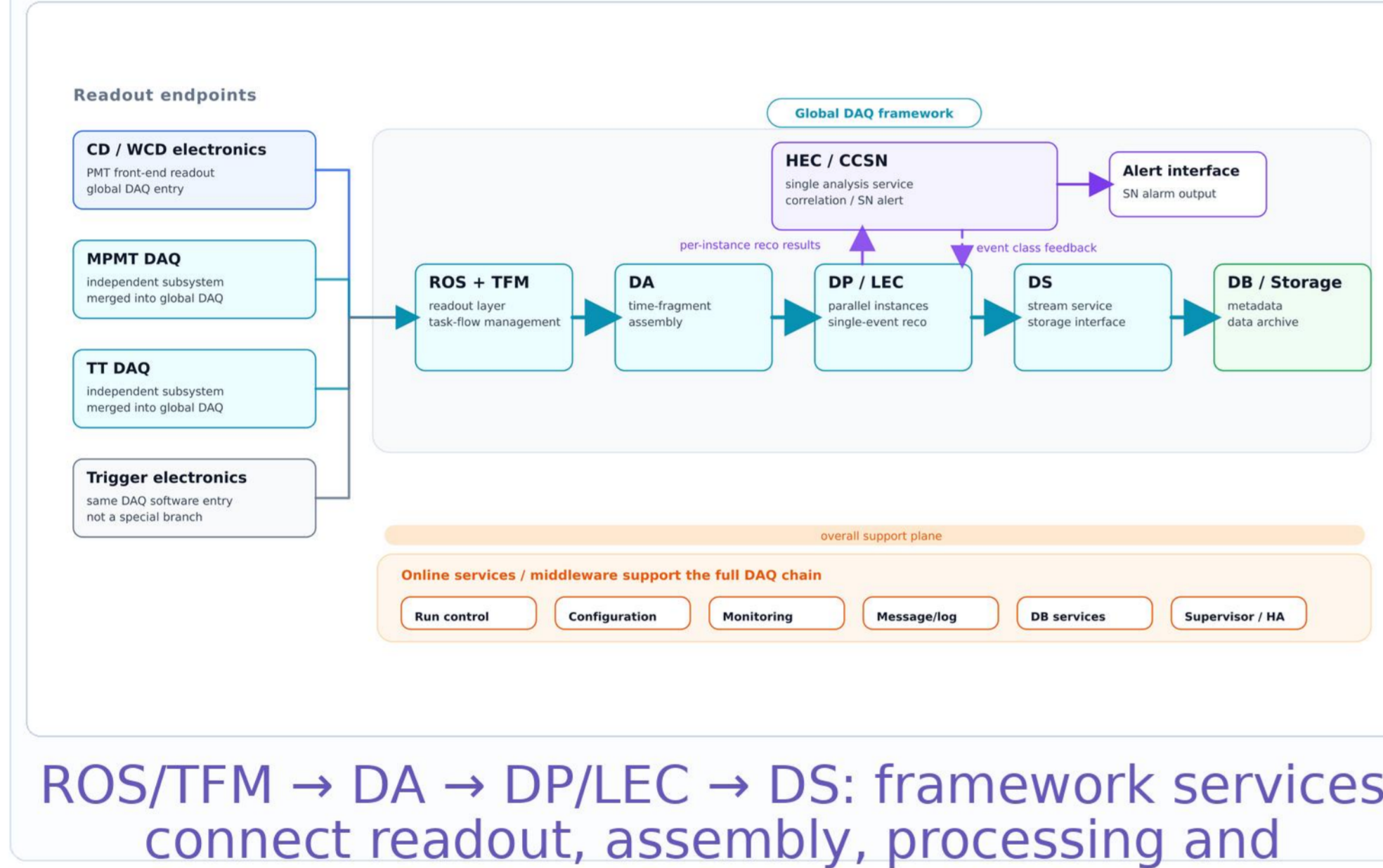
Readout services, online processing, DP workflow and RO performance comparison

The software layer coordinates readout services, run control, configuration, monitoring, message transport and storage selection. It preserves waveform plus T/Q data while supporting online reconstruction and event classification.

Stream roles

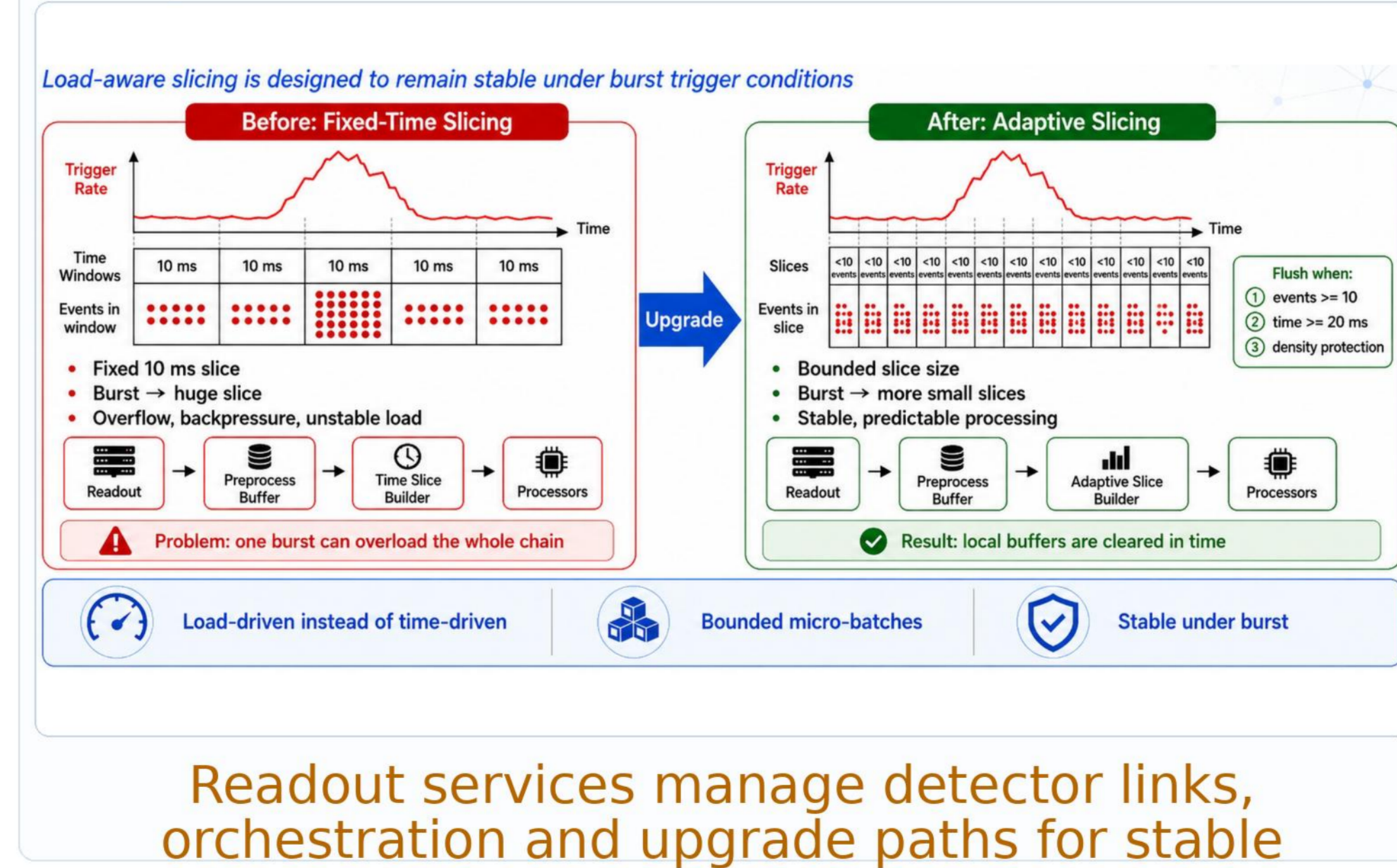
Main stream	WF + T/Q
MM stream	separated
Low-energy	SW-triggered
TT / MPMT	dedicated

Software architecture



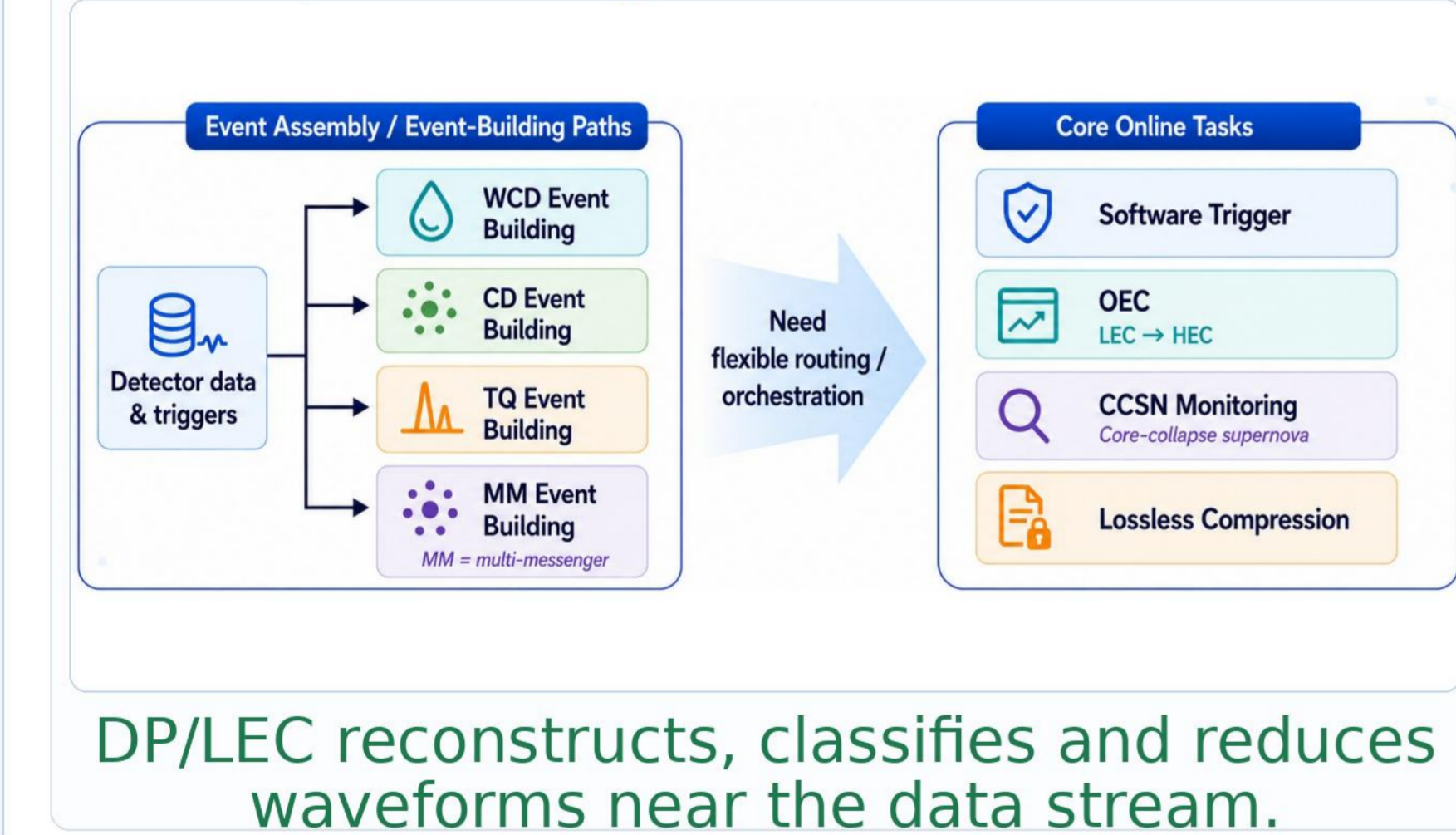
ROS/TFM → DA → DP/LEC → DS: framework services connect readout, assembly, processing and

ROS / RO software



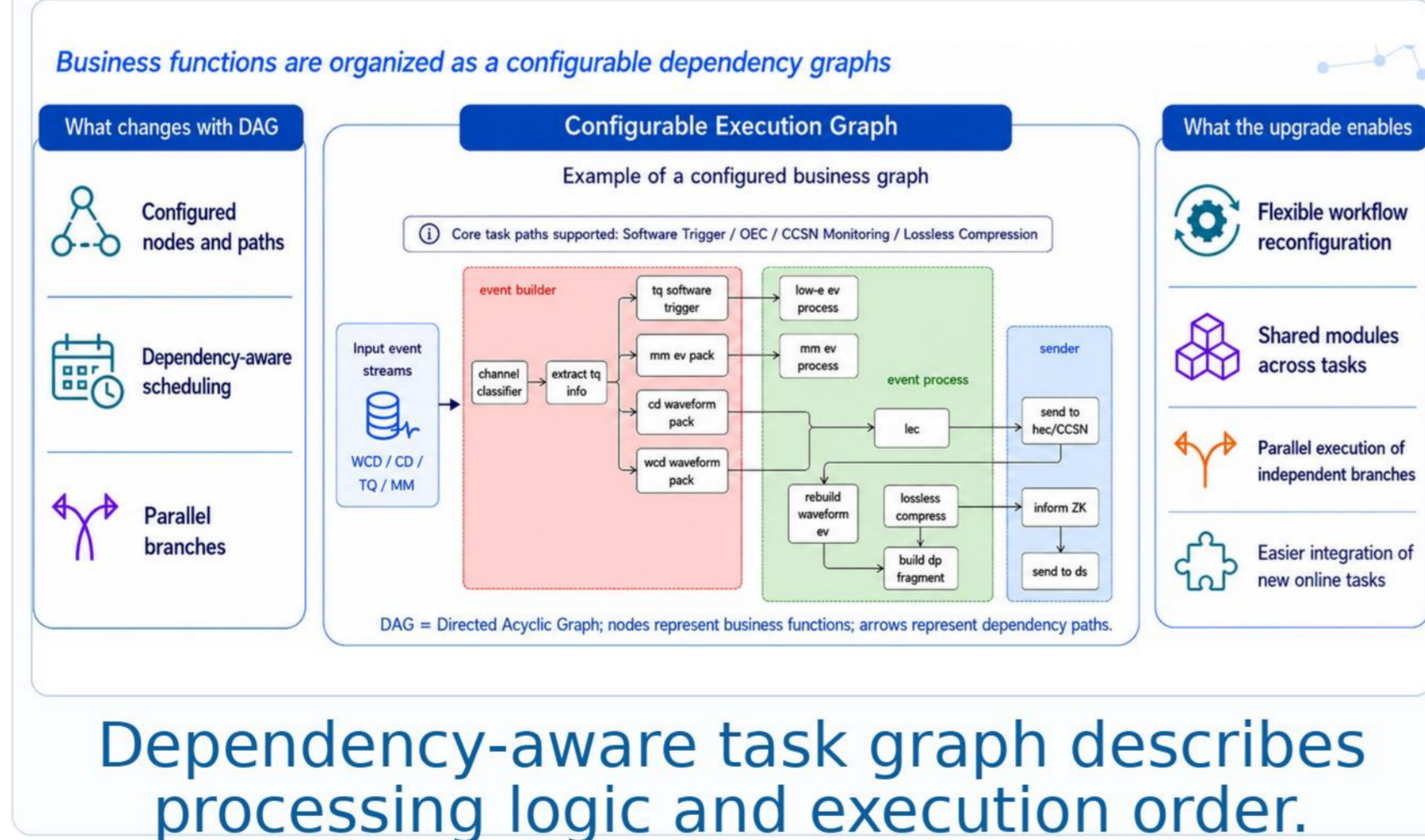
Readout services manage detector links, orchestration and upgrade paths for stable

Online processing



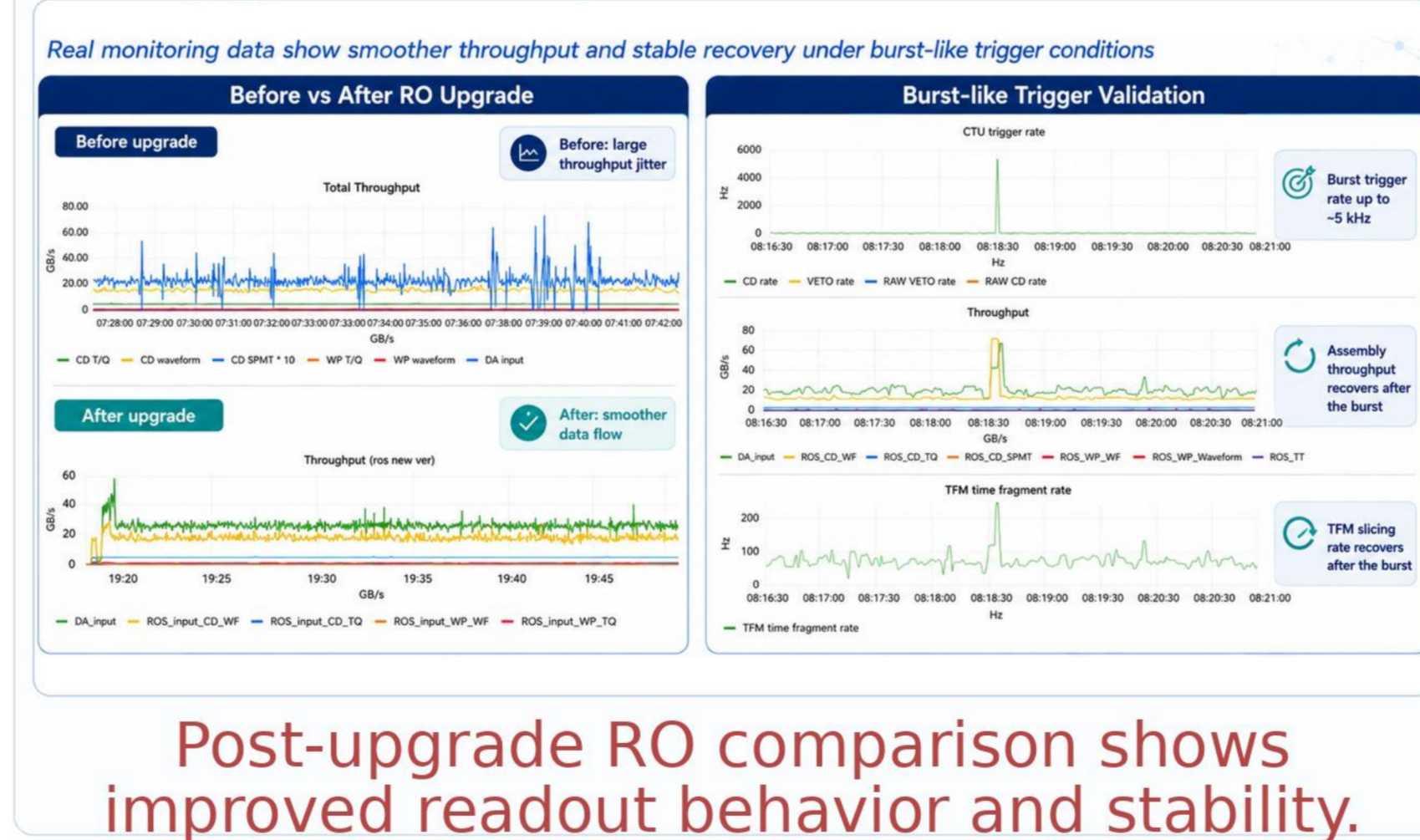
DP/LEC reconstructs, classifies and reduces waveforms near the data stream.

DP DAG workflow

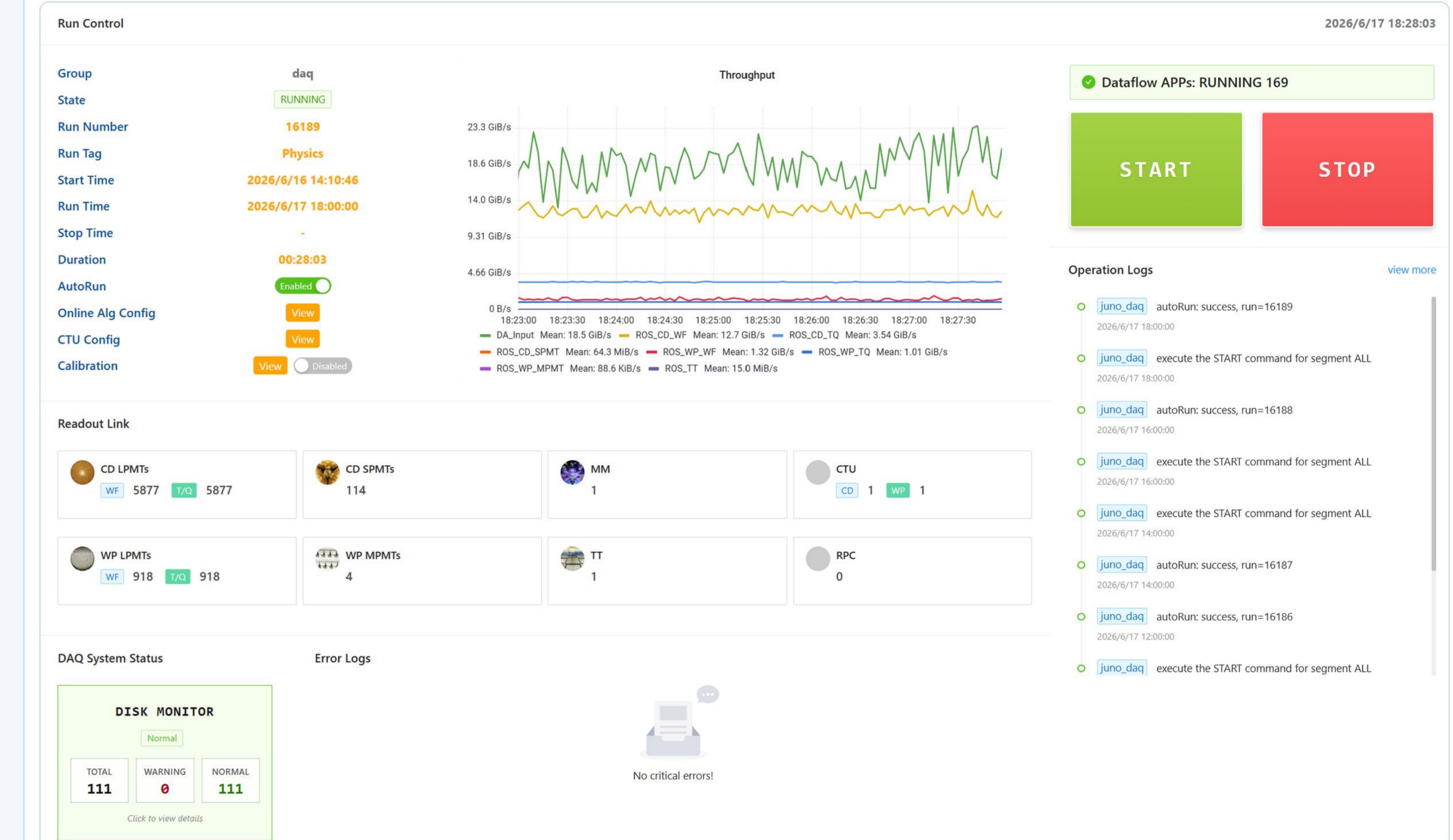


Dependency-aware task graph describes processing logic and execution order.

RO upgrade comparison



Post-upgrade RO comparison shows improved readout behavior and stability.

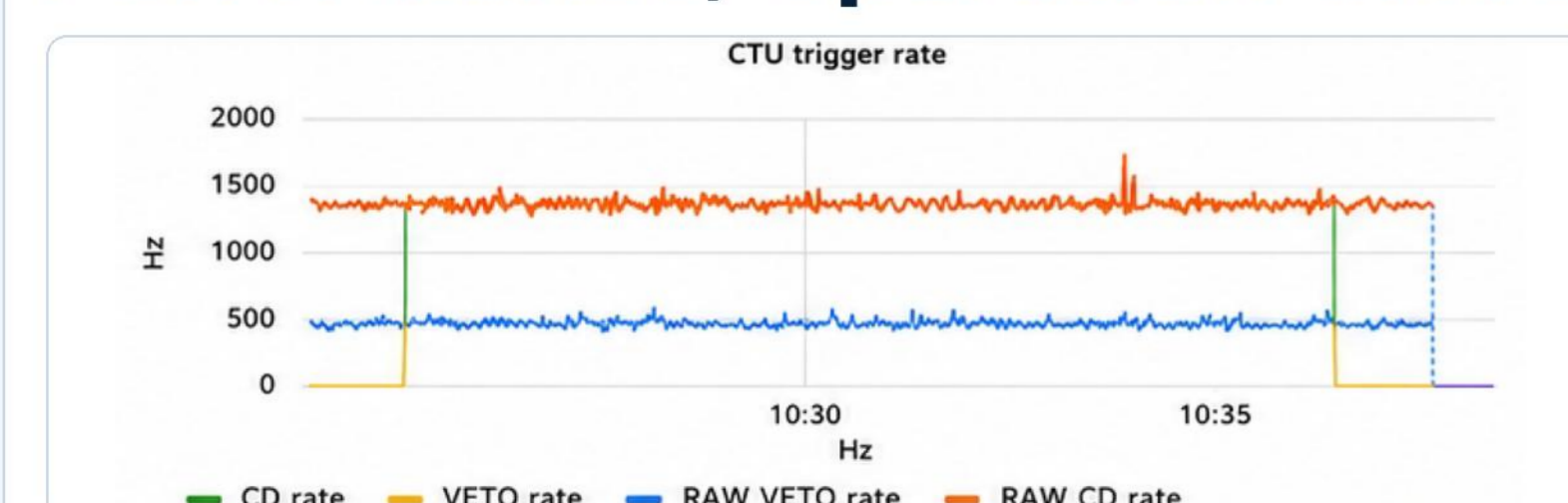


Run Control shows state, run number, throughput, readout links and logs.

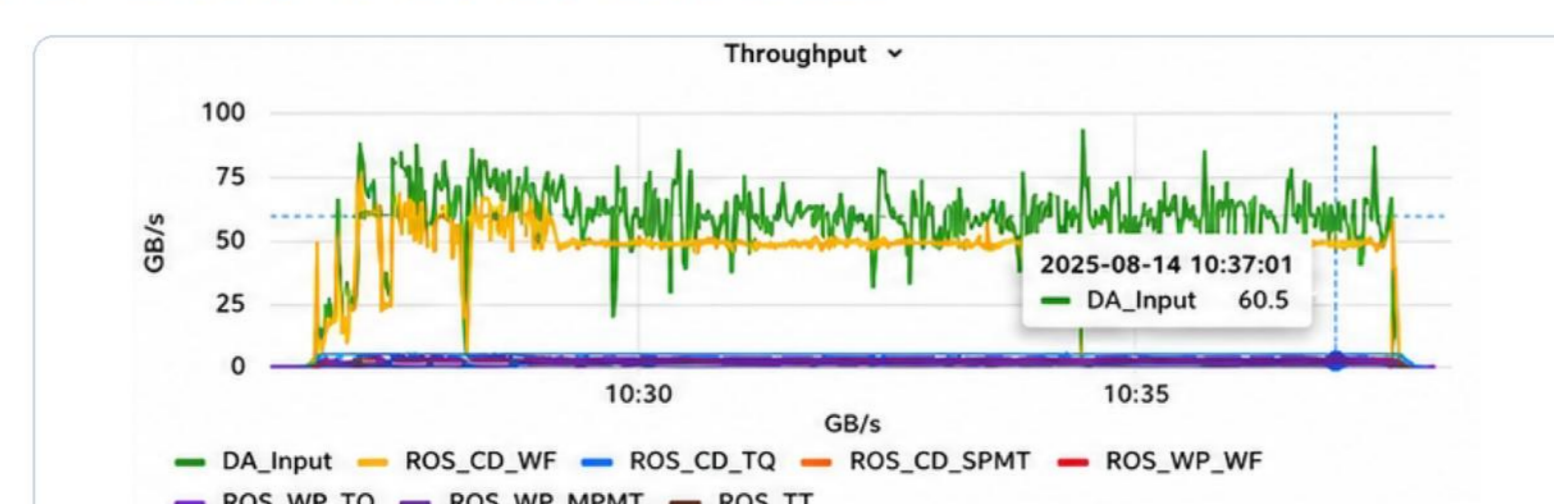
Web monitoring functions

- Run control / AutoRun: start-stop actions, run tags and operation logs.
- Readout links: CD LPMT/SPMT, WP, MM, TT, CTU and RPC states.
- DAQ monitors: throughput, trigger rate, APP status, disk and errors.
- Detector, network and service pages: channel health, alarms and history.

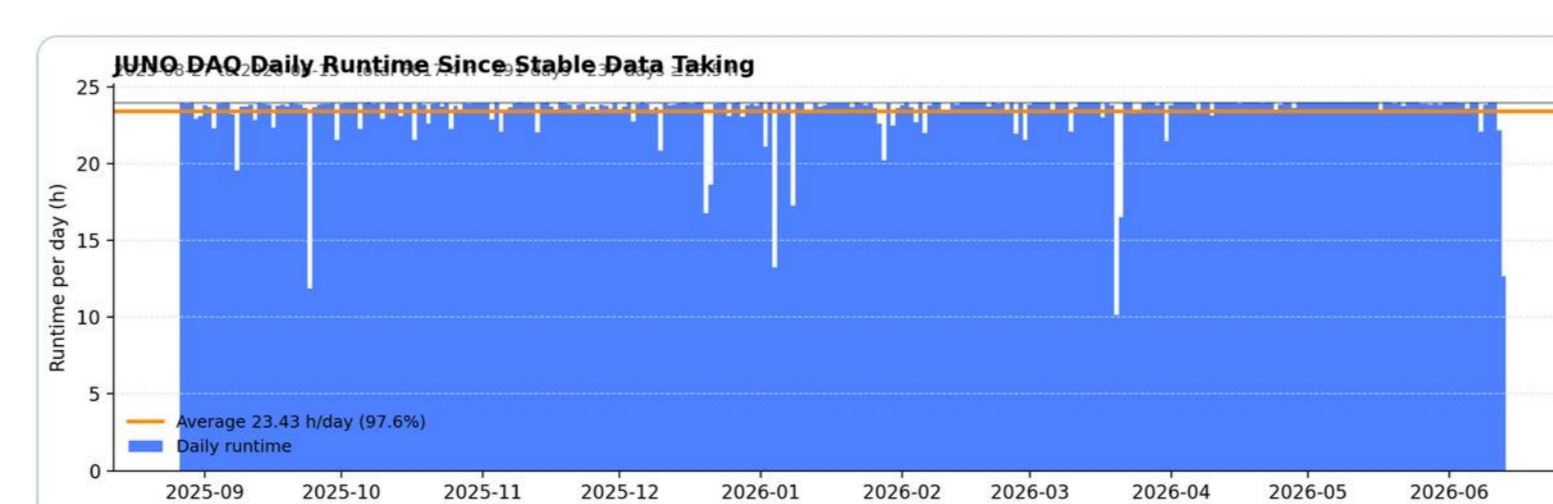
Performance, operation evidence and references



CTU trigger rate near 1.5 kHz.



DAQ throughput near 60 GB/s.



Long-term daily runtime evidence.

97.77% runtime efficiency
~20 GB/s current readout

6828 h runtime, 291 days
~60 MB/s stored output

References and source material

- Abusleme et al., JUNO physics and detector, PNP 123 (2022).
- An et al., Neutrino physics with JUNO, J. Phys. G 43 (2016).
- Chen et al., JUNO DAQ data-flow software, IEEE TNS 72 (2025).
- Wu et al., JUNO DAQ online software, IEEE TNS 72 (2025).
- JUNO DAQ operational status, progress and RT reports, 2025-2026.
- JUNO online monitoring, run-control and runtime records.