ANTELOPE USER GROUP 2026 · OPATIJA, CROATIA

Scaling Antelope

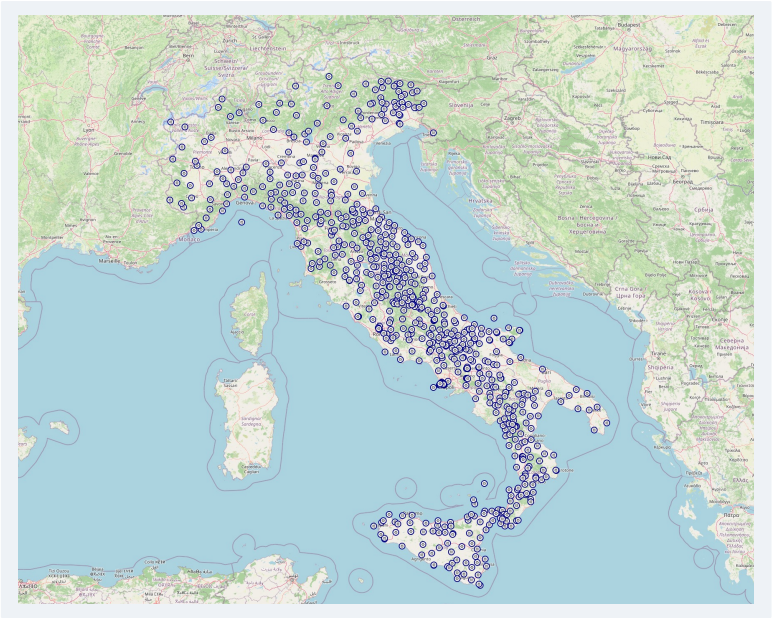
Containerizing an acquisition and processing system with 700+ stations



G. Ludovico Manto · Geovis srl

In collaboration with Kinemetrics, BRTT, DPC and University of Trieste

Context · the RAN CAED



Run by DPC

Italy's National Accelerometric Network is operated by the Italian Department of Civil Defense.

Where people live

Stations are sited near population centres to record what the public actually feels.

Cellular backbone

Each station communicates over the cellular network over a private APN.

One CAED in Rome

A single acquisition & processing datacenter on-prem at DPC’s headquarters in Rome.

The network today

735

open stations

multiple sensor brands (456 Kinemetrics)

143 GiB

ingested data every day

~45 GiB after compression

85 TiB

continuous waveform archive

since 2017

Multi-subnet

by design

single platform across different vendors and mantainers

And it keeps growing

What's coming

- Continuous expansion: ~ 20 new stations every year
- ~300 new Lunitek stations from an EU-funded project
- Plan to acquire ~100 stations from the Structure Monitoring Network already run by DPC

How to properly scale the CAED to accommodate this substantial growth?

TODAY

735

stations across the country

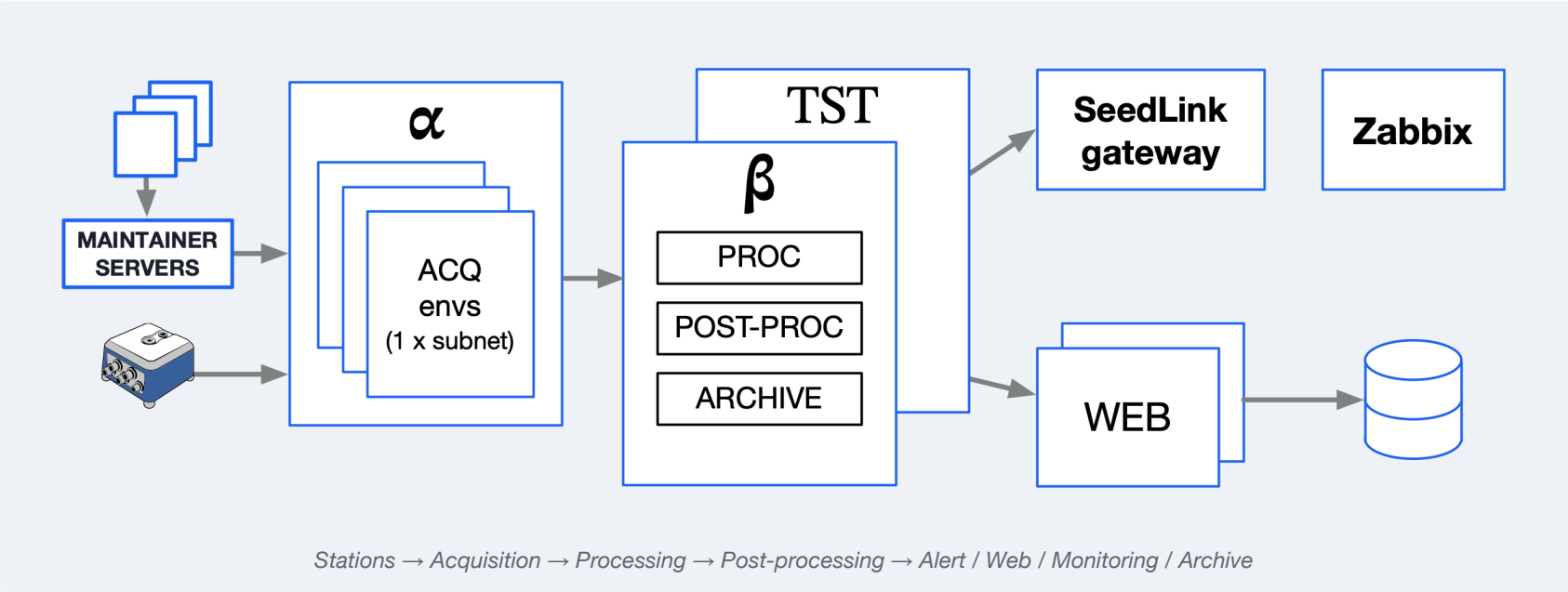
↓

TOMORROW

~1000+

almost 1200 with tributary networks

Current architecture: a fleet of VMs



Today's dataflow: from stations to archive

Daily operational pain

Routine work is expensive; growth makes it worse.

Management is manual

Adding or replacing a sensor means repetitive, hand-driven steps across several VMs.

Scaling = cloning VMs

More throughput today means provisioning and configuring yet another VM.

Single points of failure

Critical functions live on individual VMs, any outage takes a service with it.

Low visibility

Non-technical staff lack a clear, real-time view of pipeline and station status.

Upgrades are risky

Software updates touch live systems without a clean staging path.

Fragmented system

Last 10 years growth is approaching a limit, changing one part risks unexpected side effects.

Why containers and not more VMs?

VMs + Ansible/Terraform automate provisioning. Containers go further.

VMs WITH ANSIBLE / TERRAFORM

- Provisioning automated, OS state still drifts
- Heavy and slow to spin up; one full OS per replica
- Application coupling lives inside each VM
- Upgrade = run a playbook on a running host

CONTAINERS

- Immutable artifact: application + dependencies
- Seconds to scale, lightweight, many more on the same node
- Orchestrator handles scaling, placement, health and retries
- Upgrade = replace the image, deploy a new revision

IaC and containers solve different problems, containers replace OS-coupled workloads

Design goals

Horizontal scalability

Add capacity by adding instances.

Redundancy & continuity

No single point of failure, production keeps running through changes.

Observability

Status useful to both technical and non-technical staff.

Maintainability

Clean upgrade paths and a versioned, reproducible stack.

Multi-network by design

One platform for all subnetworks and partner systems.

The new system at a glance

Cloud-native on Nutanix

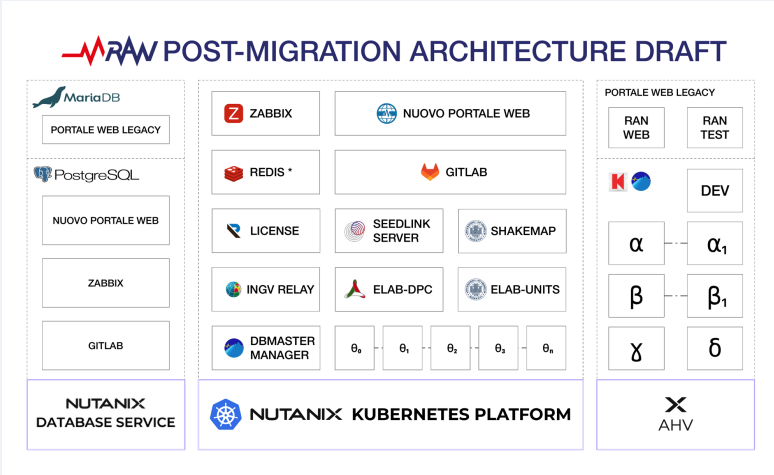
Containers replaces most of the VM fleet with K8s along side of AHV and Nutanix DB Service.

Antelope+ the stack

Tighter integration with other platform such as GitLab and Zabbix to further expand the Antelope suite capabilities.

Central system management

Central DBmaster, external web-services relay and concurrent templated test environments



Post-migration architecture draft with K8s + DaaS+ AHV

Horizontal scale · Built-in redundancy · Observable · Reproducible

Building blocks

Containers solve many problems, but not every problem.

STAYS ON VM

managed with Ansible

- GitLab
- Stateful databases (NDB)
- Services that don't gain from containers

When the workload is OS-coupled or already well-managed, containers add overhead.

CONTAINERIZED

stateless, scalable

- Antelope Edge and Processing stages
- Custom Post-Processing
- Custom companion stages
- Zabbix
- Web stack & APIs

Stateless workloads benefit from immutability, fast replication and orchestrator-managed health.

PIPELINES

orchestrated, multi-stage

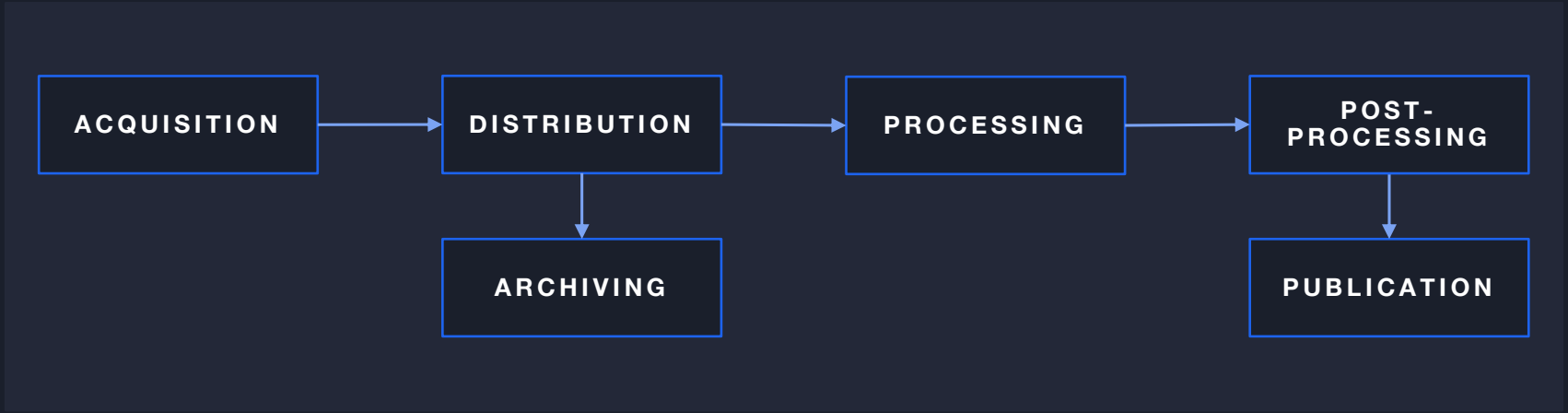
- DBmaster update
- Processing replicas (θ_0 … θ_n)
- Post-processing flows

Multi-stage workflows with probes and ctrl, runnable as units the heart of the new system.

3 · SUBSYSTEMS OVERVIEW

Stage by stage

Role, origin, target and HA / monitoring angle of each one.



1 · Edge (Acquisition)

Role: ingest streams from stations, one environment per subnet.

TODAY

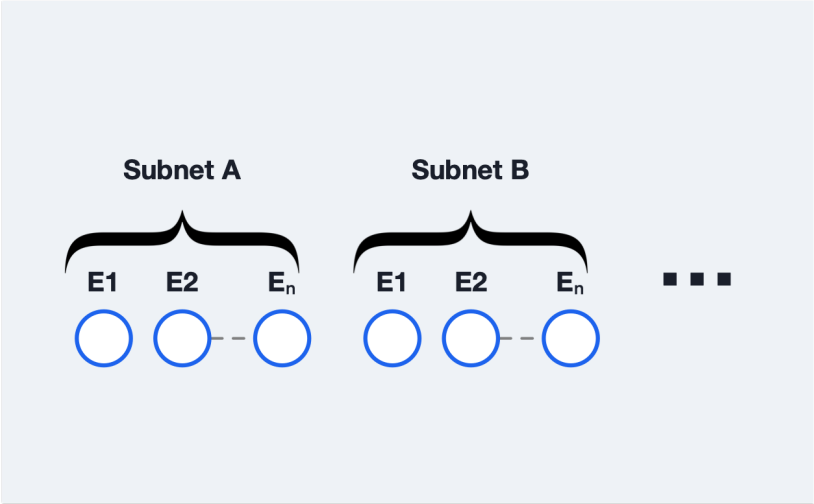
Acquisition VM collecting data with a dedicated Antelope environment for each subnet.

TARGET

Containerised edge units, scalable and redundant.

REDUNDANCY

Active-active edge with load balancing (E1/E2, ~50/50 load), one stream per station



2 · Distribution

Role: accentrate and distribute on one main ring buffer.

TODAY

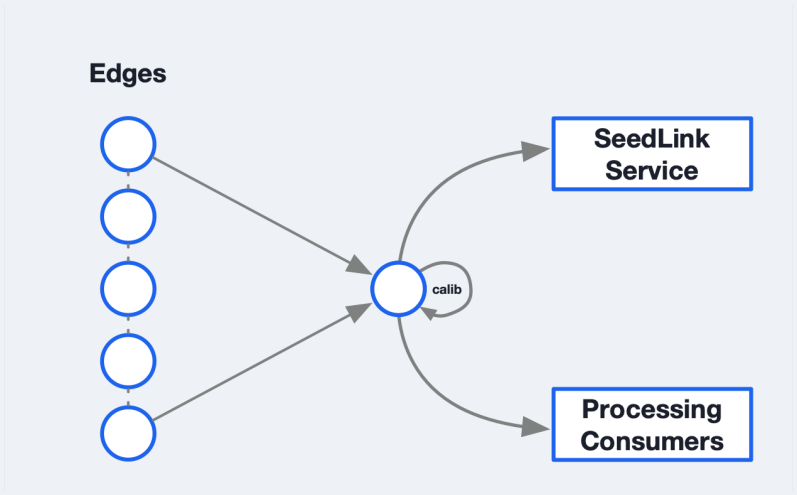
None. Standard orb2orb routing across VMs, concentering everything in the processing environment ring-buffer.

TARGET

A new middle distribution layer for accentration, calibration and data management. Seedlink rollout directly from this stage.

REDUNDANCY

Replication ability, no update downtimes



3 · Processing

Role: detection, measurement and association of seismic events.

TODAY

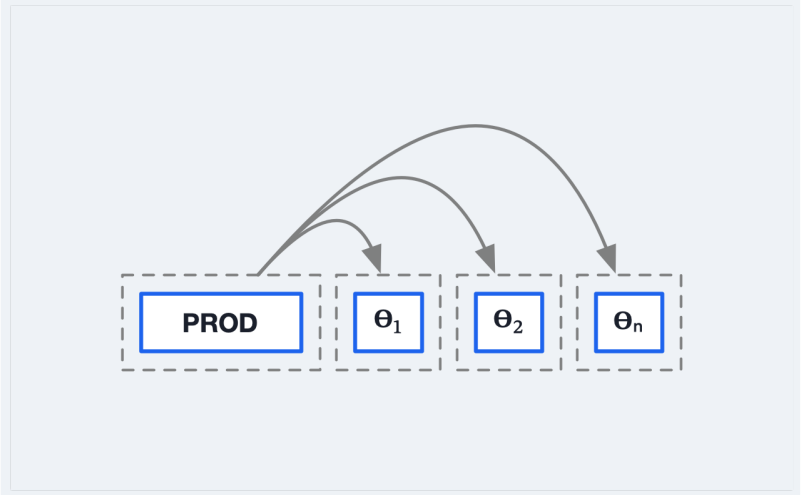
Single processing VM running (orbdetect, orbwfmeas, orbassoc, orbevproc, rtbackup, event_archive…) with a testbed twin for staging new configurations.

TARGET

Just procecessing with orchestrated test replicas (θ_0 … θ_n) forked from the production template.

SCALABILITY

Multiple replicas for testing multiple configuration displacements at the same time



4 · Post-processing

Role: turn detected events into alerts, magnitudes, ground-motion params and reports.

TODAY

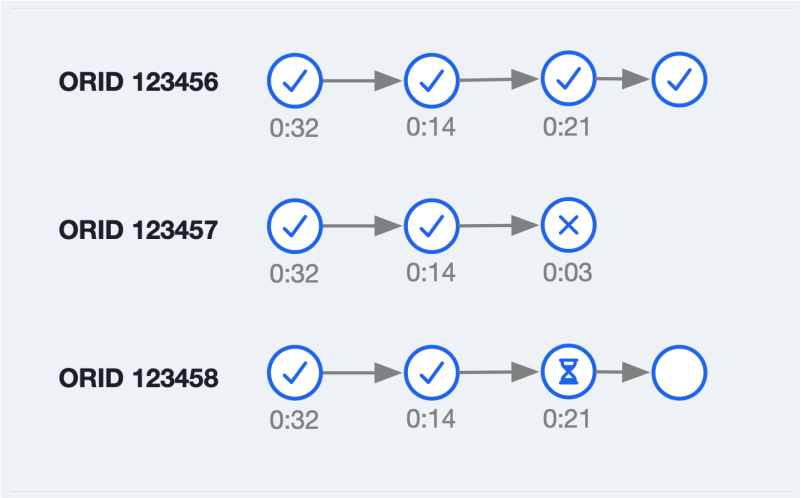
Custom post-processing chain on the same processing VM. Resource contention between processing and post-processing.

TARGET

Containerized post-processing pipeline driven by probes/ctrls, plenty of space for parallelization under dedicated resources.

OBSERVABILITY

Pipeline monitoring provides status flow charts readable also from non-technical staff.



5 · Publication

Role: deliver products to officers and public.

TODAY

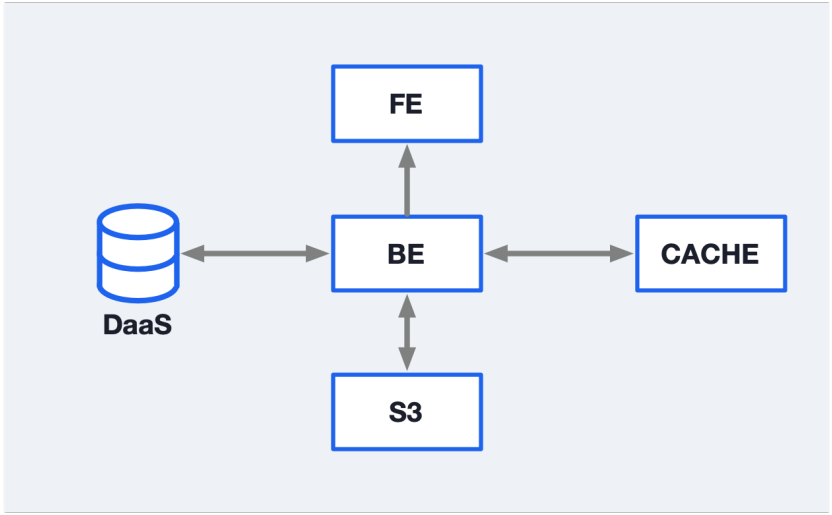
Internal: SMS, Telegram, mail reports, shakemaps
Public: web portal

TARGET

New cloud-native web infrastructure with modern look built on the same stack as Antelope cloud services.

SCALABILITY

Stateless web services scale horizontally, database is hosted and replicated by Nutanix Database Service (DaaS).



6 · Archiving

Role: long-term storage of continuous waveforms, events and units data.

TODAY

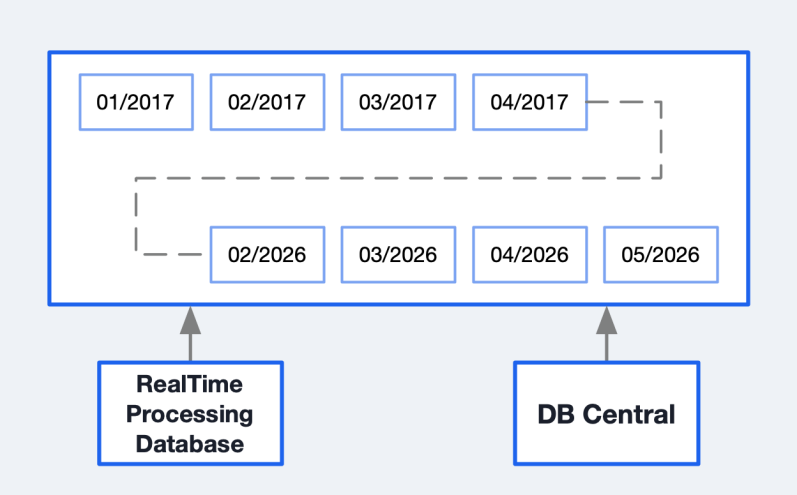
Continuous Waveform Archive (rtbackup), Event Subset Archive (event_archive), data duplication, divided by month.

TARGET

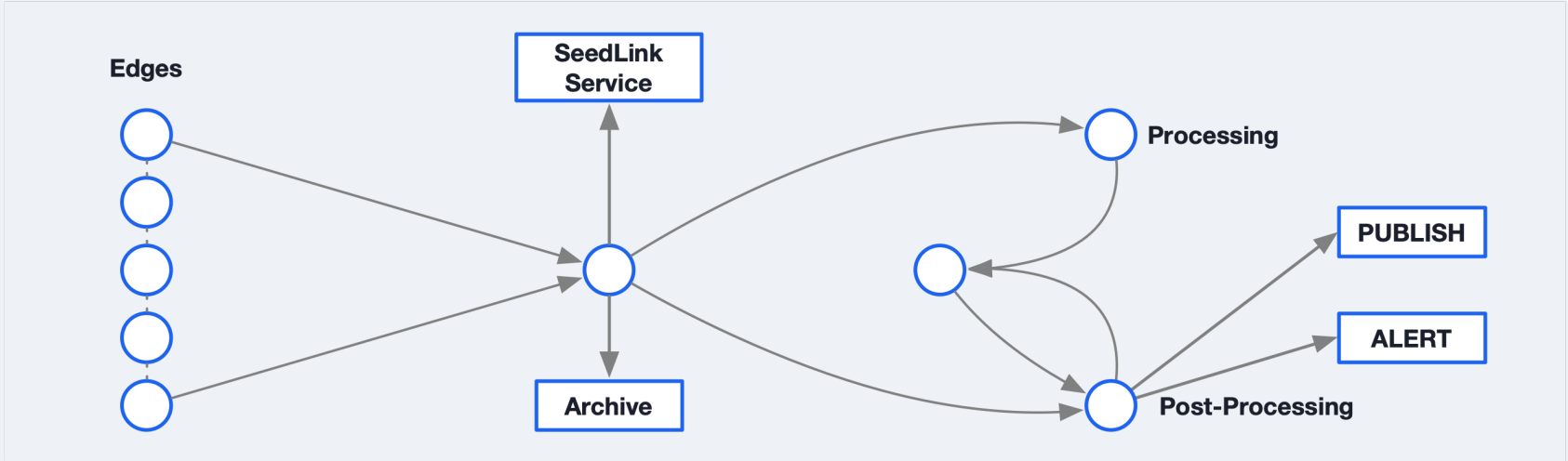
Centrally managed shared archive tier with built-in events and origins metadata, browsable as one single database.

REDUNDANCY

Geographically distributed DR database copies.



Putting it together



COMPANIONS

GitLab

Single source of truth for code, images and configurations.

Monitoring

Centralised supervision for technical and non-technical staff.

Pipelines

Probes and ctrl per stage, orchestrated end to end.

Thank you

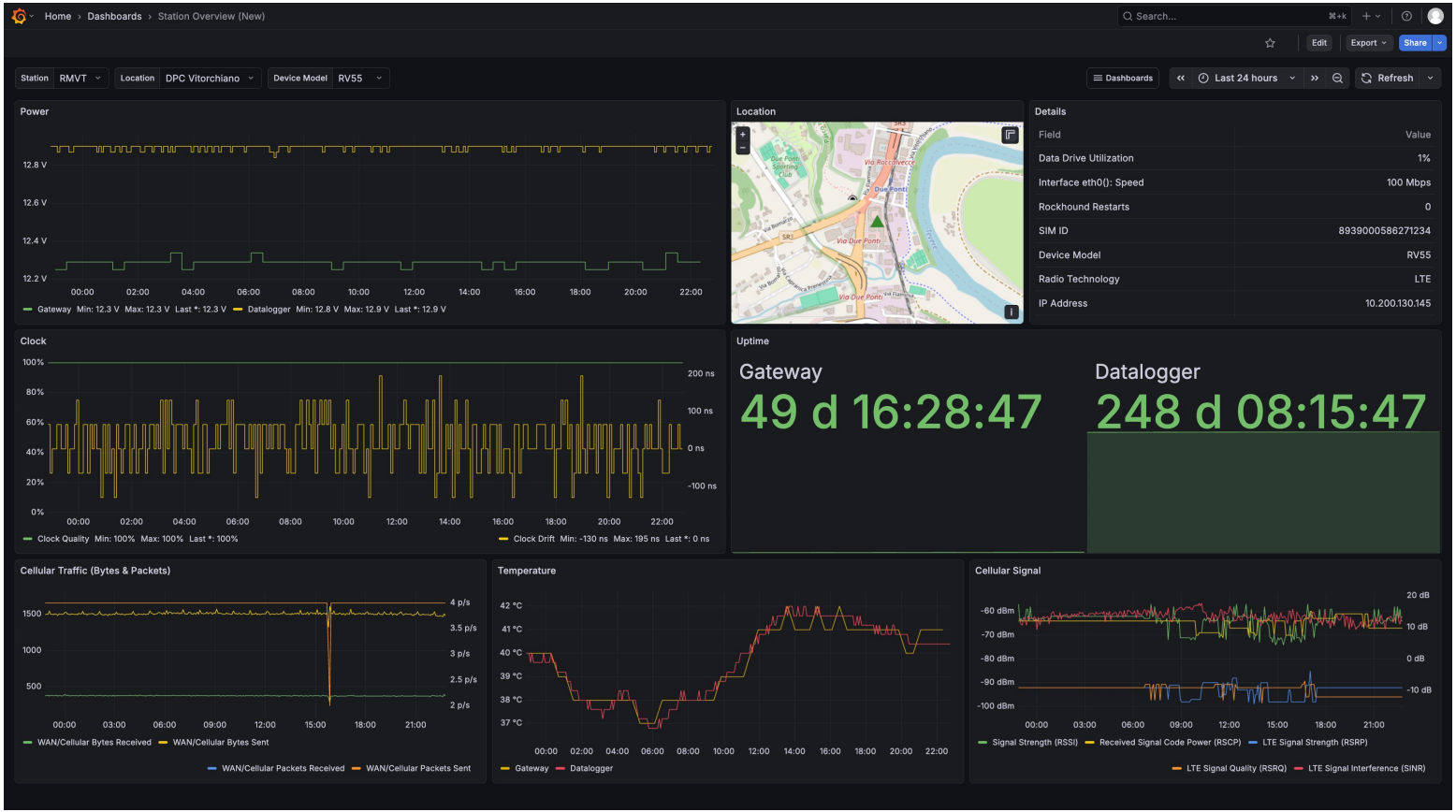
Questions?



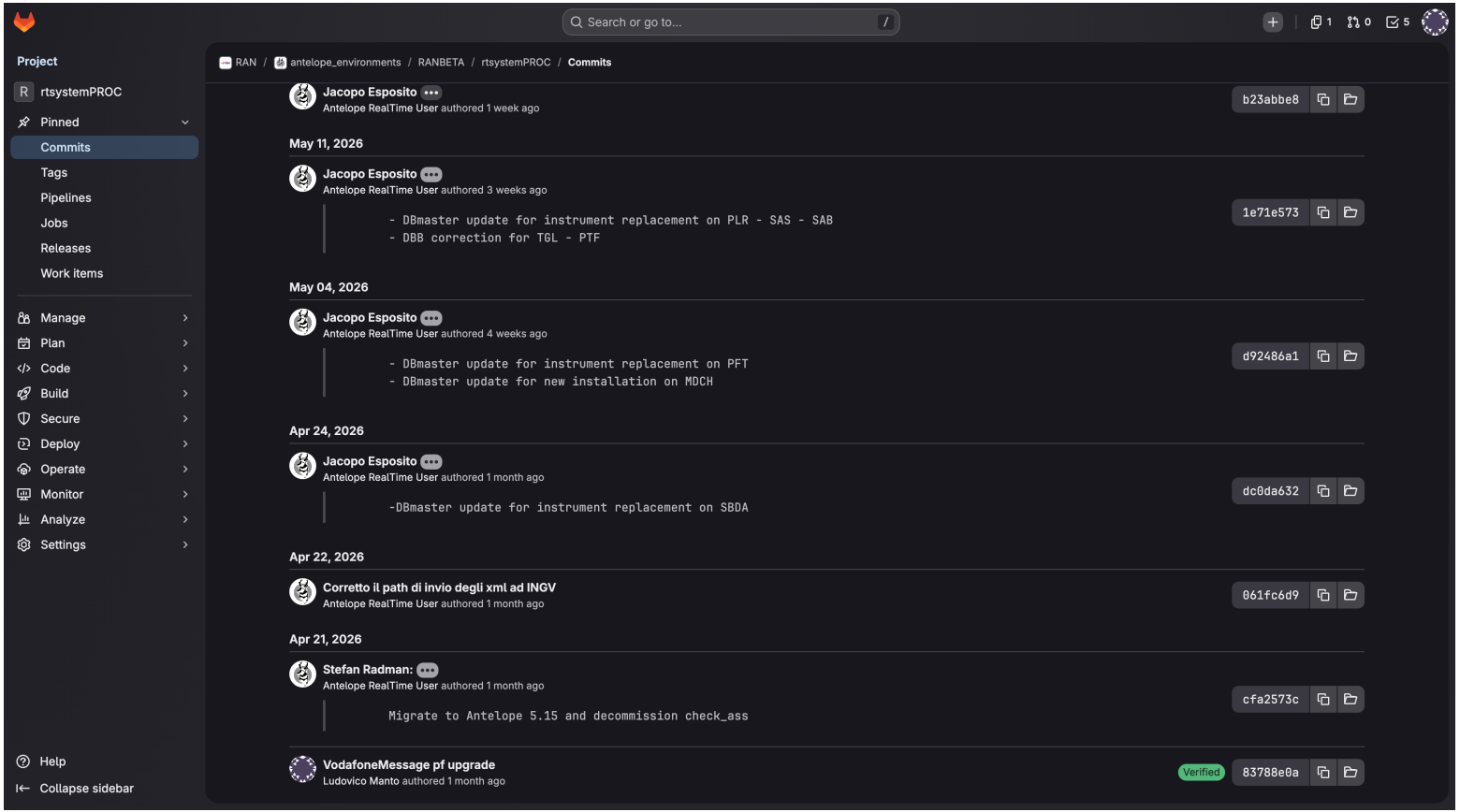
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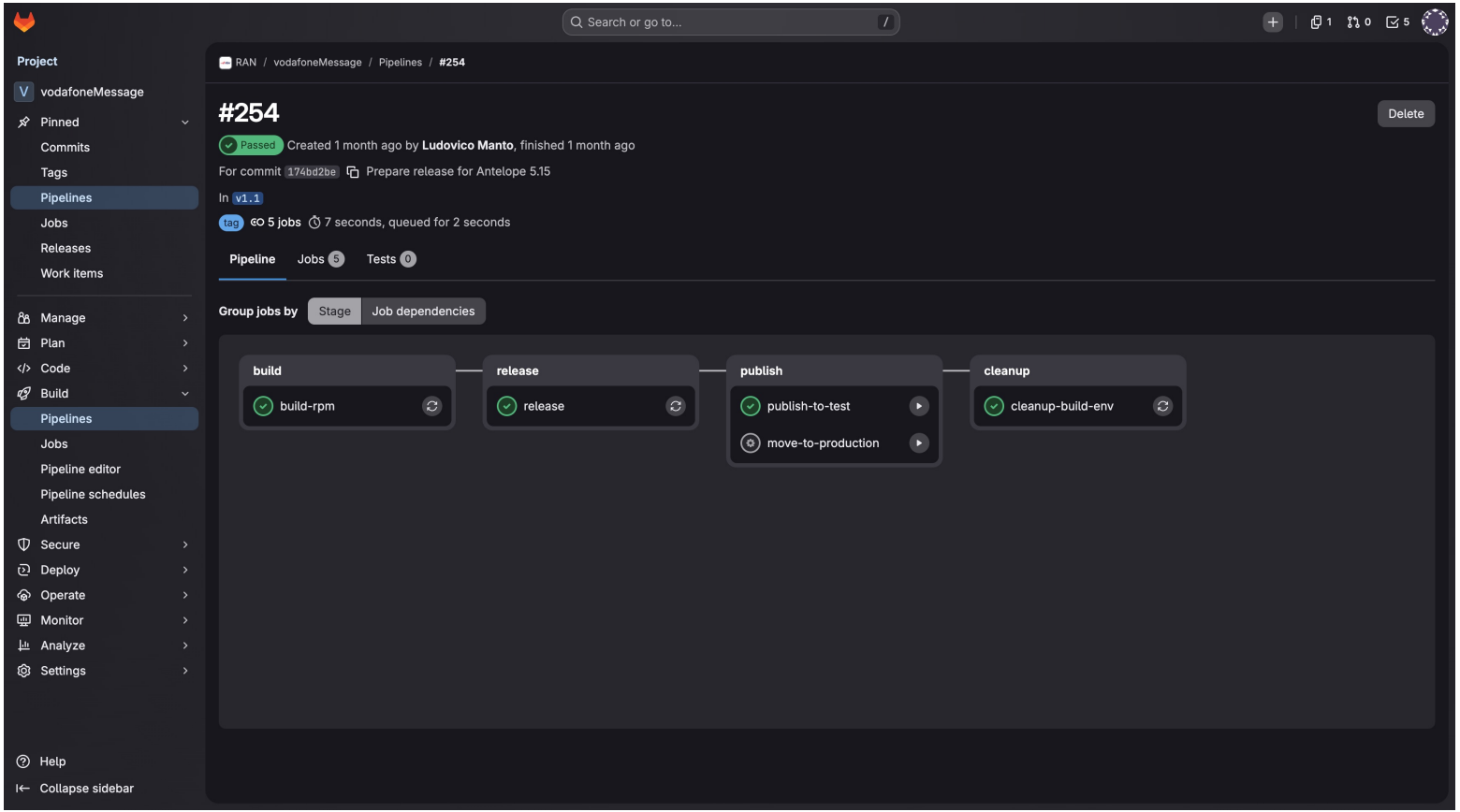
BACKUP


Home › Dashboards › Station Overview (New)
Search...
Edit
Export
Share
Station RMVT
Location DPC Vitorchiano
Device Model RV55
Dashboards
Last 24 hours
Refresh
Power
12.8 V
12.6 V
12.4 V
12.2 V
00:00 02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00
Gateway Min: 12.3 V Max: 12.3 V Last *: 12.3 V
Datalogger Min: 12.8 V Max: 12.9 V Last *: 12.9 V
Location
Via Roccavecce
Due Ponti
Via Due Ponti
Details
Field Value
Data Drive Utilization 1%
Interface eth0(): Speed 100 Mbps
Rockhound Restarts 0
SIM ID 8939000586271234
Device Model RV55
Radio Technology LTE
IP Address 10.200.130.145
Clock
100% 80% 60% 40% 20% 0%
200 ns 100 ns 0 ns -100 ns
00:00 02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00
Clock Quality Min: 100% Max: 100% Last *: 100%
Clock Drift Min: -130 ns Max: 195 ns Last *: 0 ns
Uptime
Gateway
49 d 16:28:47
Datalogger
248 d 08:15:47
Cellular Traffic (Bytes & Packets)
1500 1000 500
4 p/s 3.5 p/s 3 p/s 2.5 p/s 2 p/s
00:00 03:00 06:00 09:00 12:00 15:00 18:00 21:00
WAN/Cellular Bytes Received
WAN/Cellular Bytes Sent
WAN/Cellular Packets Received
WAN/Cellular Packets Sent
Temperature
42 °C 41 °C 40 °C 39 °C 38 °C 37 °C
00:00 02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00
Gateway
Datalogger
Cellular Signal
-60 dBm -70 dBm -80 dBm -90 dBm -100 dBm
20 dB 10 dB 0 dB -10 dB
00:00 03:00 06:00 09:00 12:00 15:00 18:00 21:00
Signal Strength (RSSI)
Received Signal Code Power (RSCP)
LTE Signal Strength (RSRP)
LTE Signal Quality (RSRQ)
LTE Signal Interference (SINR)

BACKUP


Search or go to...
Project
rtsystemPROC
Pinned
Commits
Tags
Pipelines
Jobs
Releases
Work items
Manage
Plan
Code
Build
Secure
Deploy
Operate
Monitor
Analyze
Settings
Help
Collapse sidebar
RAN / antelope_environments / RANBETA / rtsystemPROC / Commits
Jacopo Esposito
Antelope RealTime User authored 1 week ago
b23abbe8
May 11, 2026
Jacopo Esposito
Antelope RealTime User authored 3 weeks ago
- DBmaster update for instrument replacement on PLR - SAS - SAB
- DBB correction for TGL - PTF
1e71e573
May 04, 2026
Jacopo Esposito
Antelope RealTime User authored 4 weeks ago
- DBmaster update for instrument replacement on PFT
- DBmaster update for new installation on MDCH
d92486a1
Apr 24, 2026
Jacopo Esposito
Antelope RealTime User authored 1 month ago
-DBmaster update for instrument replacement on SBDA
dc0da632
Apr 22, 2026
Corretto il path di invio degli xml ad INGV
Antelope RealTime User authored 1 month ago
061fc6d9
Apr 21, 2026
Stefan Radman:
Antelope RealTime User authored 1 month ago
Migrate to Antelope 5.15 and decommission check_ass
cfa2573c
VodafoneMessage pf upgrade
Ludovico Manto authored 1 month ago
Verified
83788e0a

BACKUP


Search or go to...
Project
vodafoneMessage
Pinned
Commits
Tags
Pipelines
Jobs
Releases
Work items
Manage
Plan
Code
Build
Pipelines
Jobs
Pipeline editor
Pipeline schedules
Artifacts
Secure
Deploy
Operate
Monitor
Analyze
Settings
Help
Collapse sidebar
RAN / vodafoneMessage / Pipelines / #254
#254
Delete
Passed
Created 1 month ago by Ludovico Manto, finished 1 month ago
For commit 174bd2be
Prepare release for Antelope 5.15
In v1.1
tag
5 jobs
7 seconds, queued for 2 seconds
Pipeline
Jobs 5
Tests 0
Group jobs by
Stage
Job dependencies
build
build-rpm
release
release
publish
publish-to-test
move-to-production
cleanup
cleanup-build-env