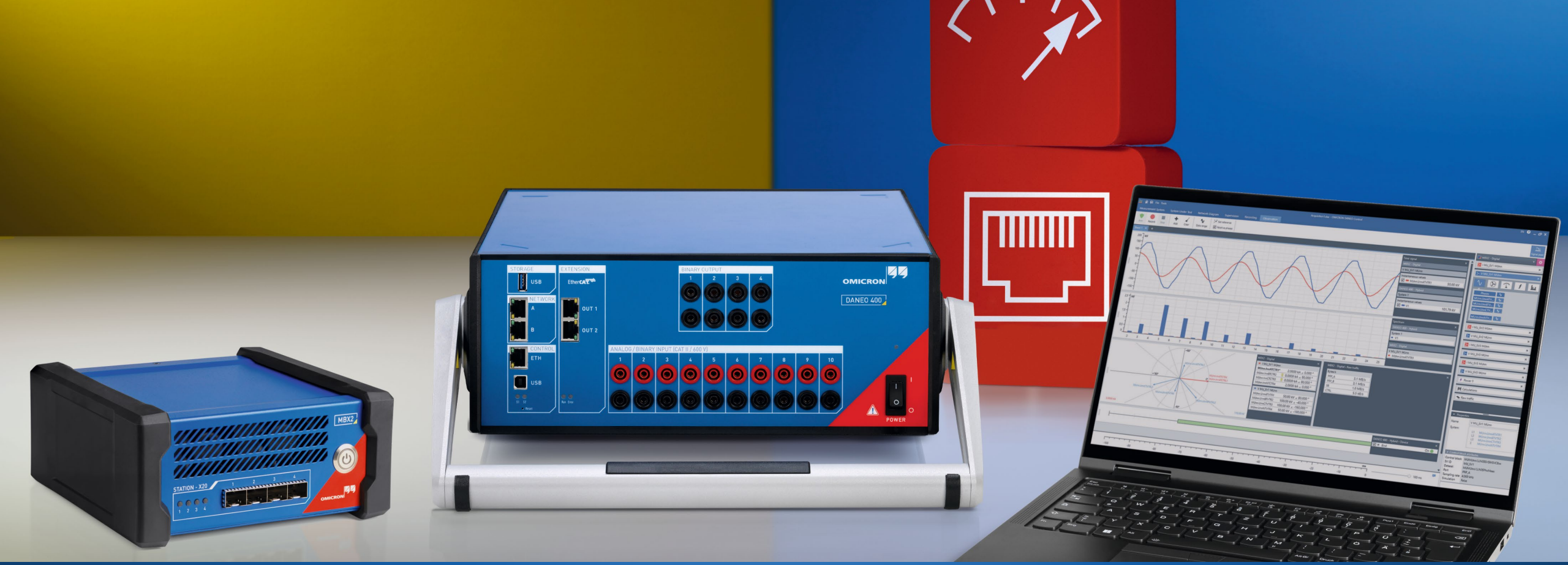

DANEO Control

Signal and Network Analyzer for Substation Automation Systems

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DANEO Solution

- Advanced **measurement and recording system**
  - **Hybrid** – conventional signals and messages on the communication network
  - **Digital** – sufficient performance for digital substations
  - **Distributed** – multiple time-synchronized units

- **Network traffic analyzer** for testing and troubleshooting substation communication networks

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Main applications

- Network traffic observation
- Verification of IEC 61850 process bus traffic based on SCL information
- Measurement and (virtual) wiring check
- Troubleshooting sporadic events with targeted supervision and recording
- Communication network testing and performance assessment
- PTP time synchronization testing
- Merging Unit and LPIT testing
- Sampled Values publishing

One software – Multiple devices

DANEO 400

Portable **hybrid** signal and network analyzer.

MBX2

Portable **digital** signal and network analyzer for digital substations.

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DANEO 400: The hybrid device

Mass storage interface

Extension interfaces

Network interfaces

4 binary outputs

Control interfaces

10 analog / binary inputs

Your benefits with DANEO 400

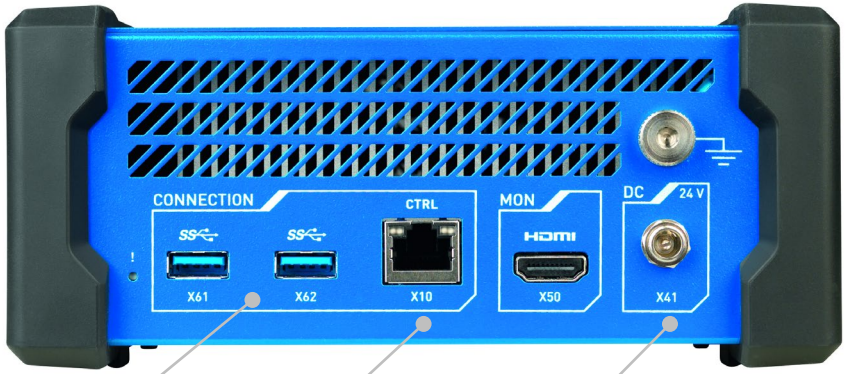
- Simultaneous processing of analog signals and network communication traffic
  - Comparison of analog with digital signals (MU testing)
  - Binary outputs for trigger indication
  - Binary I/O accessory EXB1
- Distributed time-synchronized analog measurement and fault recording system
- IEC 61850 process bus testing
  in substations with limited number of SV streams

DANEO MBX2: The digital device

DIN-rail mounting

4 x SFP ports

Secure cryptoprocessor



USB ports (not supported yet)

Control Ethernet port

DC input

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Your benefits with DANEO MBX2

- Optimized for digital-only environments with sufficient performance for digital substations
  - More Sampled Value streams supported
  - More measurement signals for Phasor, RMS, and Harmonics
- Small and portable or installation with DIN-rail and DC power supply
- More network interfaces and flexibility with SFPs
  - 4 dedicated ports for connection to different segments of communication networks
  - High flexibility due to SFPs for media-specific transceiver (fiber-optic and copper)
- Cybersecurity
  - Future-proof and cybersecure device

Comparison DANEO 400 and MBX2

Device	DANEO 400	MBX2
Analog/binary inputs	10	0
Network ports	3 x Ethernet (A, B, ETH) EMCON 200 accessory for fiber connections available	1 x Control Ethernet (CTRL) 4 x SFP slots (1,2,3,4) SFP transceiver module (copper, fiber) accessories available
Network TAP	Yes	Not supported yet
USB ports	1 x Control port 1 x External storage	Not supported yet
Internal storage	~ 60 GB	~ 240 GB
Binary I/O extension	Yes EXB1 accessory	No
Binary outputs	4	0
Built-in capabilities	Not designed for permanent installation; only with some workarounds and compromises	DIN-rail mounting accessory
Power supply	AC	AC 48-60 VDC 110-220 VDC

License options

License	DANEO 400 Basic	DANEO 400 Standard	DANEO MBX2 Basic	DANEO MBX2 Standard
SV measurement and recording	n/a	5	8	24
SV supervision	n/a	10	16	32
Phasor, RMS, frequency measurements	34 channels	34 channels	64 channels	64 channels
Harmonics measurement	12 channels 25th orders	12 channels 25th orders	32 channels 64th orders	32 channels 64th orders
GOOSE input signals	n/a	244	512	512
SV quality attribute mappings	n/a	256	256	256
SV publishing (only 9-2 LE streams)	n/a	3	8	16
IED discover and server verification	n/a	yes	Not supported yet	Not supported yet

One solution - Multiple use cases

- Measurement and recording
- Network testing
  - Verification IEC 61850 process bus traffic and redundancy check
  - Targeted supervision of network traffic
  - Assessment of network performance
- Merging Unit testing

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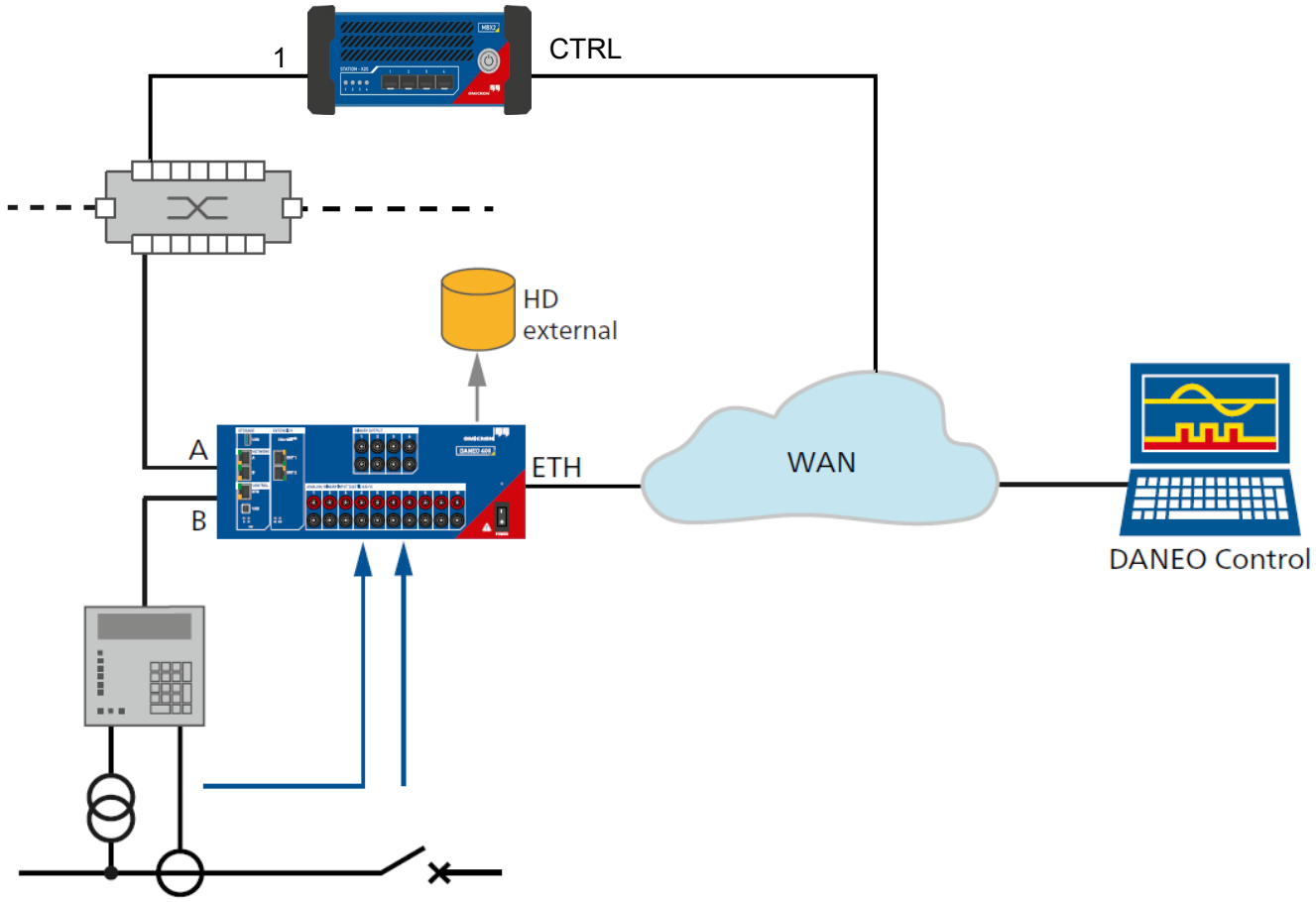
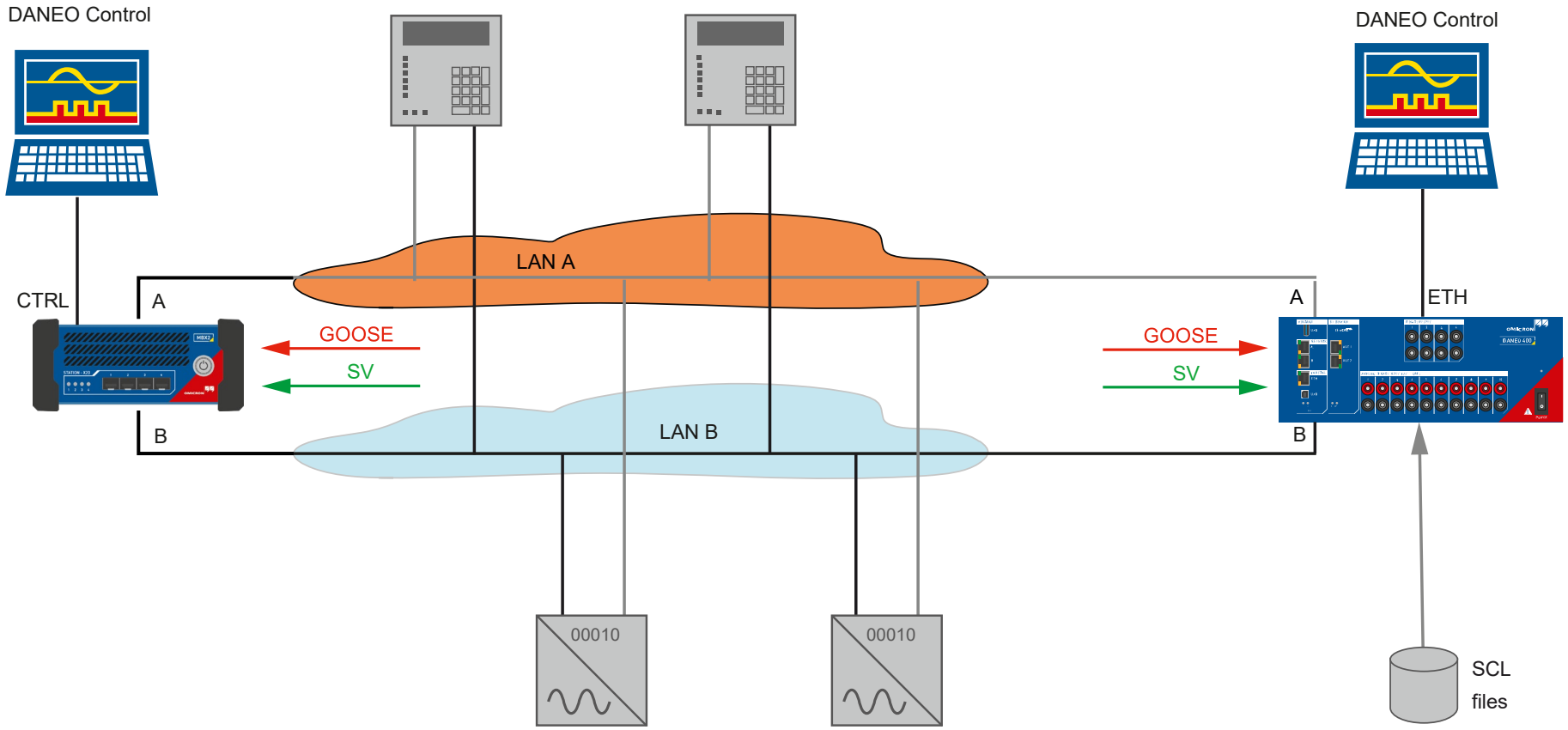
Measurement and recording

- Conventional signals and messages on the communication network
- Unattended operation
- External storage option
  (only for DANEO 400)
- Remote control



Verification of IEC 61850 process bus traffic and redundancy check

- Verify process bus traffic based on SCL information
- PRP and HSR redundancy network topologies



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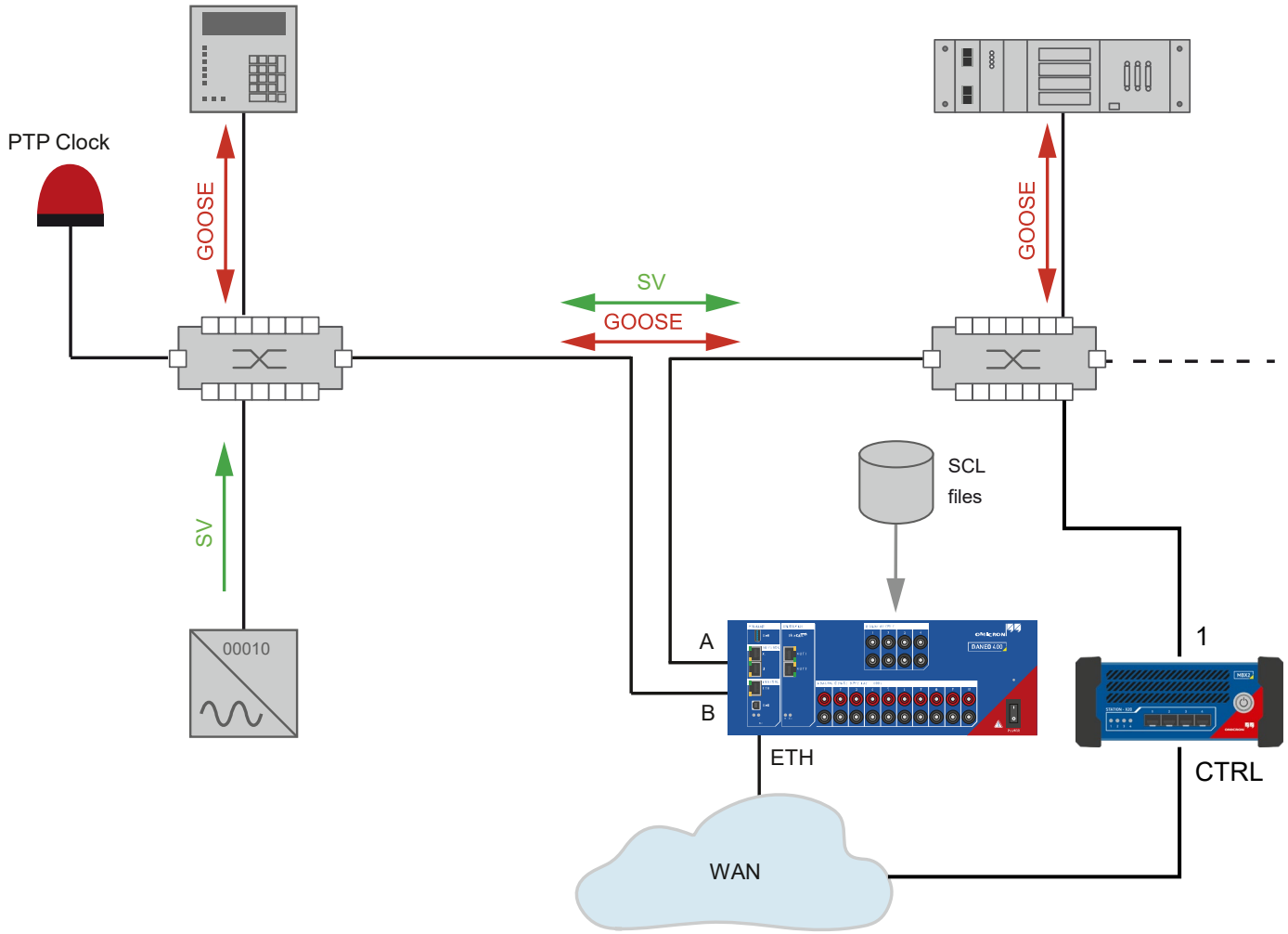
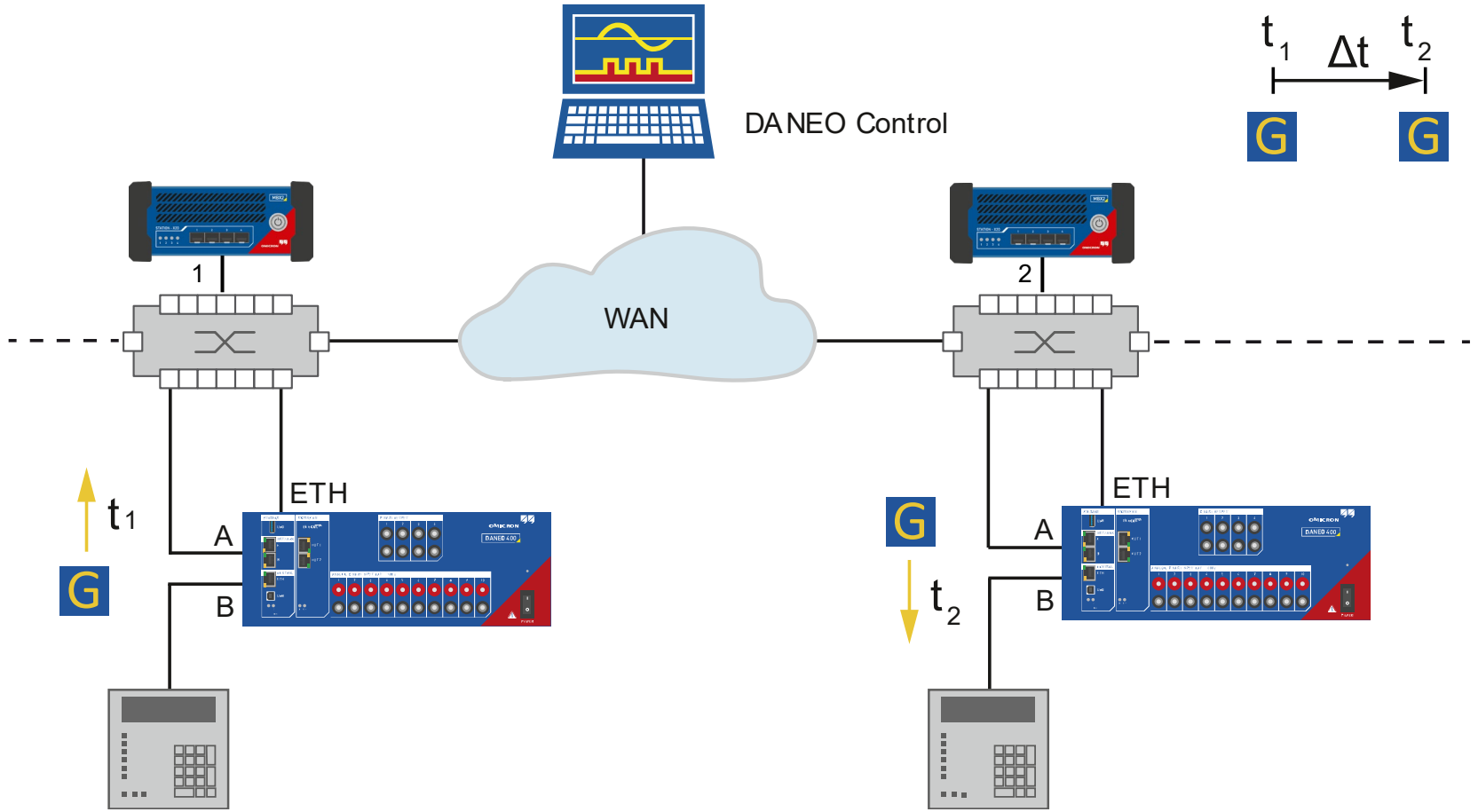
Targeted supervision of network traffic

- Detection of GOOSE, R-GOOSE, Sampled Values, and PTP issues
- Actions for events
- Integrated Network TAP
  (only for DANEO 400)



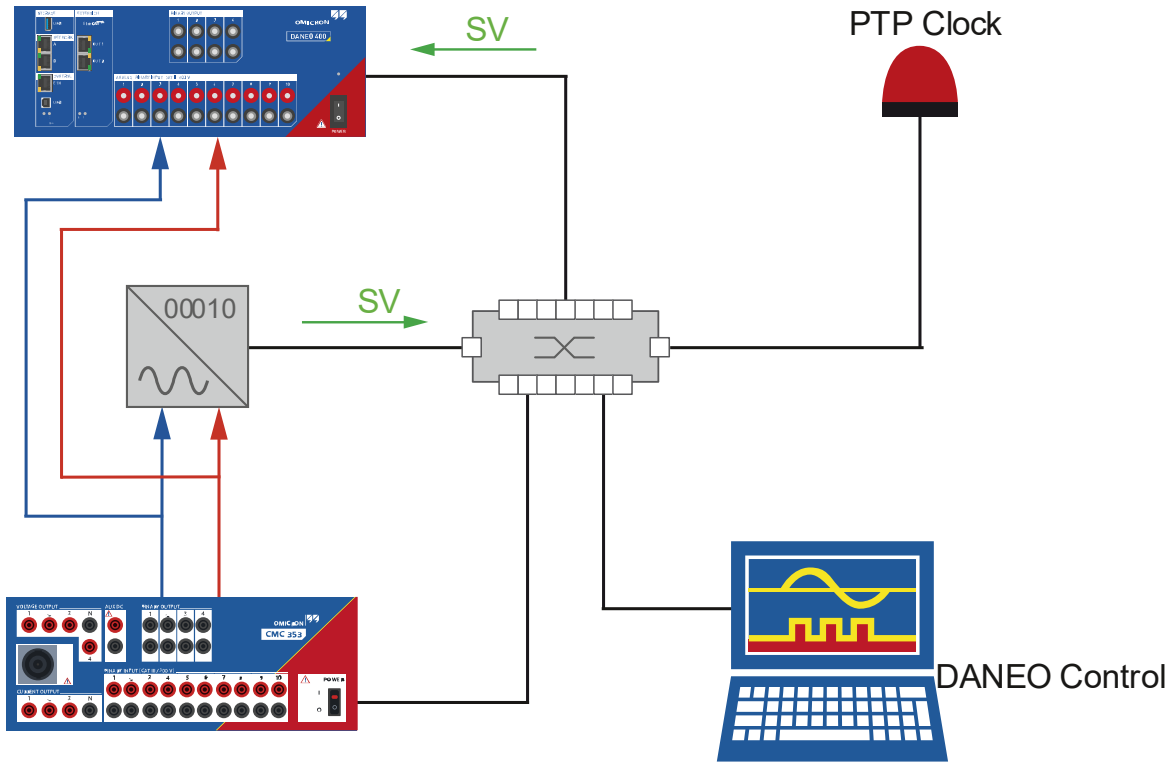
Network performance assessment

- Bandwidth usage
- Packet propagation delays

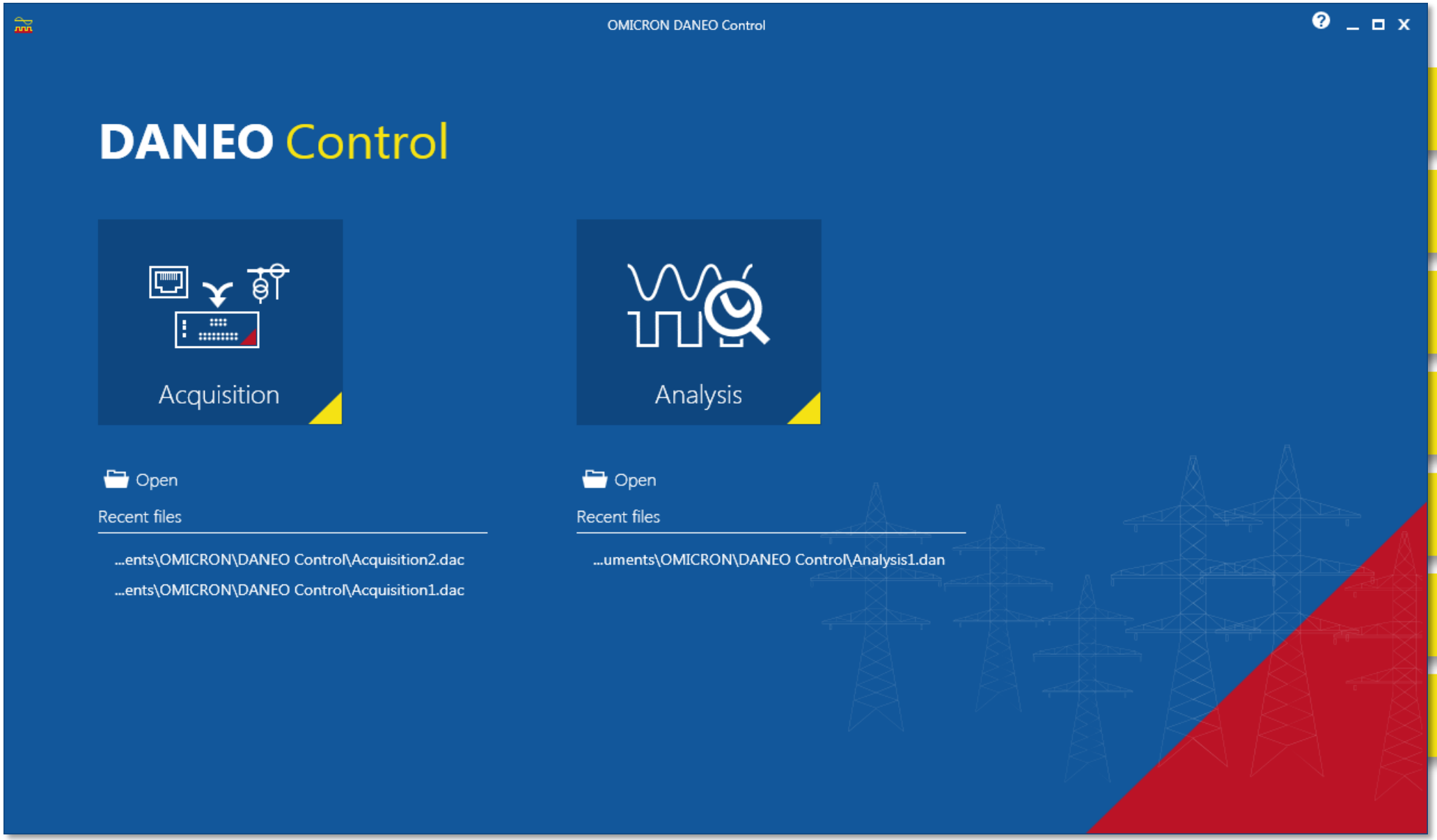


Merging Unit testing

- Comparison of inputs with outputs
- Performance analysis (packet intervals, packet delays)
- Troubleshooting of data anomalies, packets dropped, synchronization or quality problems



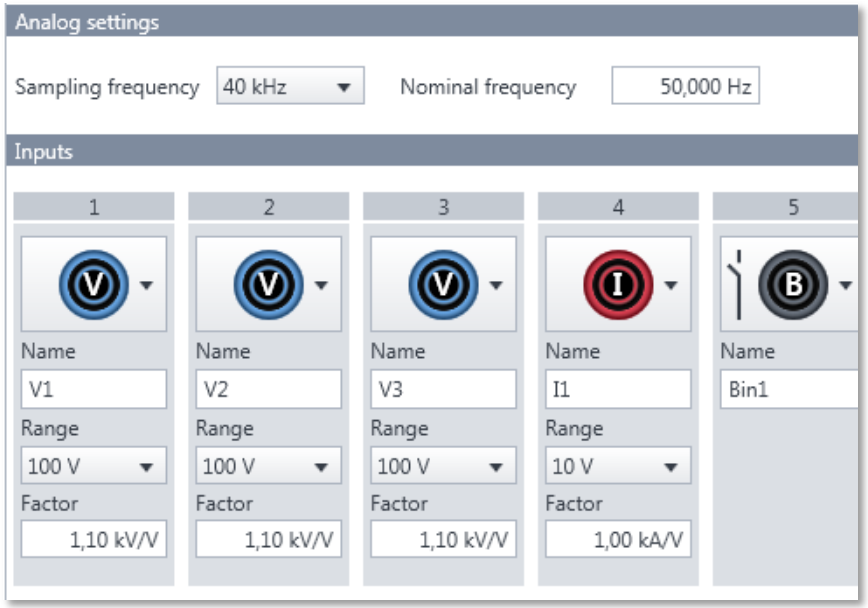
DANEO Control - data acquisition and analysis



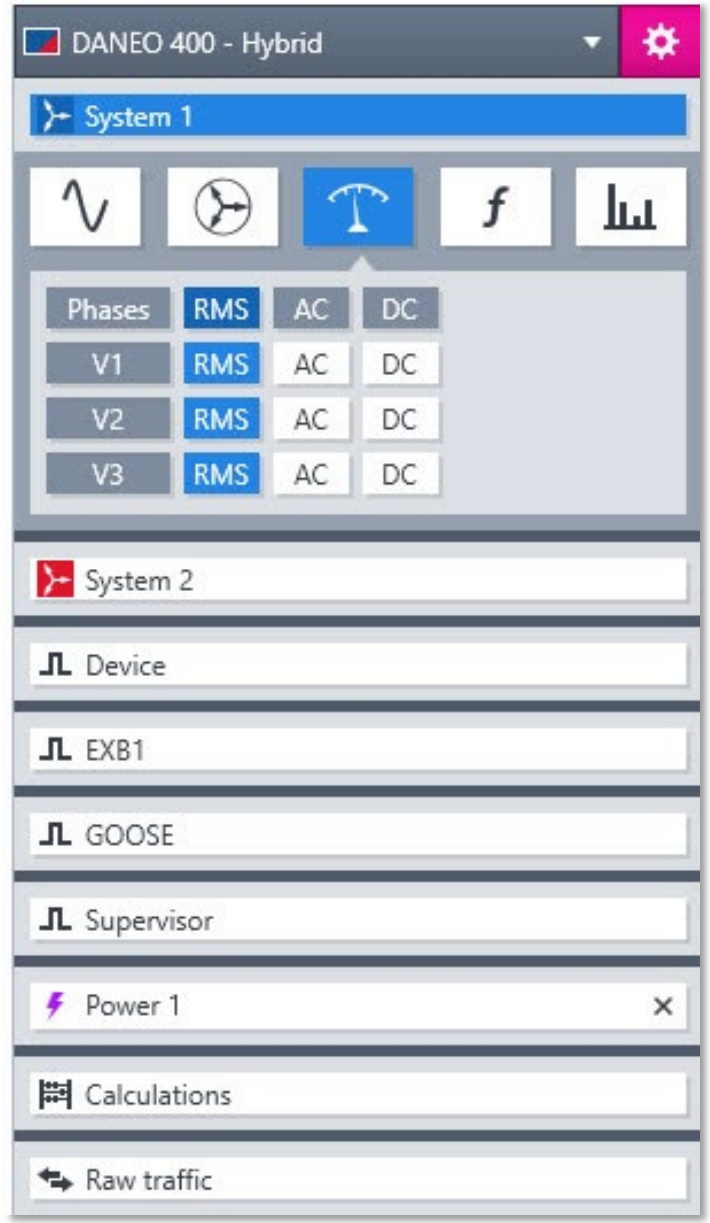
- Configuration
- Observation
- Verification
- Supervision
- Recording
- Analysis
- Documentation

Configuration

- Measurement system
  - Device connections, time source, and inputs
  - Harmonics, phase and power systems, calculated signals
- System under test
  - Import IEDs from SCL files
  - Map GOOSE, R-GOOSE, and SV data to signal pool



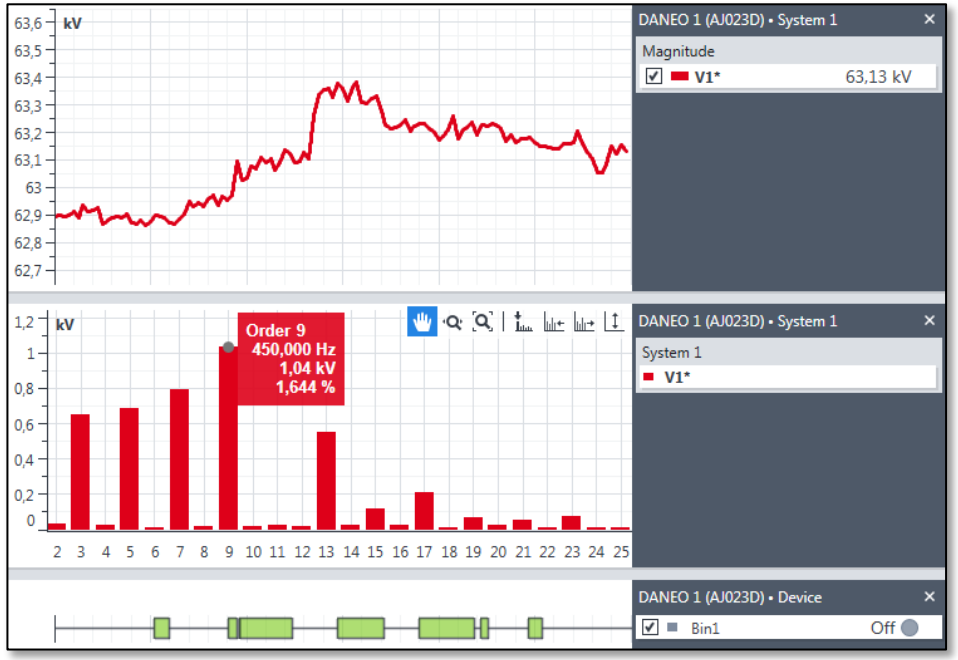
Analog and binary input configuration



Signal pool

Observation

- Measurement of live values and most recent history
- Instantaneous values
- Phasor diagrams and harmonics spectrum
- GOOSE, R-GOOSE, and SV values and statistics



Live values and recent history

ISIO_AM174KCB/LLN0GOGCB

Details

Statistics

	A	B	ETH
Receive time			2017-02-01 16:09:12.054
Packet count			656
Status changes seen			136
Status changes missed			3
Retransmissions missed			12
Duplicates seen			0
Time to live expired			False
Time to live expired count			2
Packet delay:			
Minimum			2,60 ms
Maximum			4,09 s
Average			32,93 ms

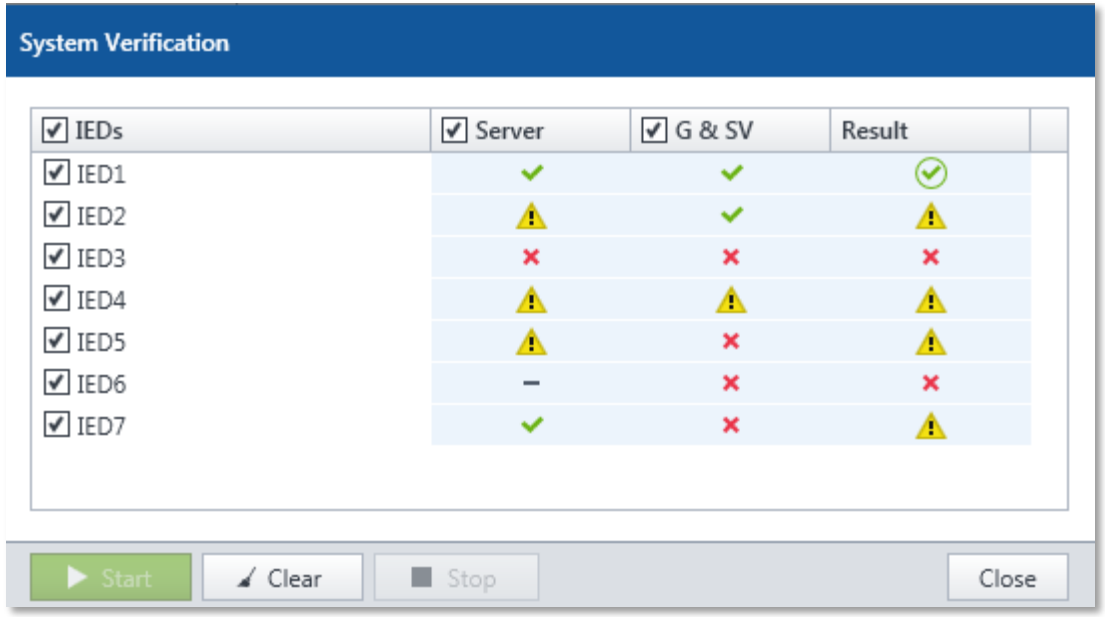
DataSet - ISIO_AM174KCB/LLN0$GooseDataSet1

Name	Type	Value	Ports
DA XCBR1.Pos.stVal	Dbpos	01	A B ETH
DA XCBR1.Pos.q	Quality	Good	A B ETH
DA XCBR2.Pos.stVal	Dbpos	00	A B ETH
DA XCBR2.Pos.q	Quality	Good	A B ETH

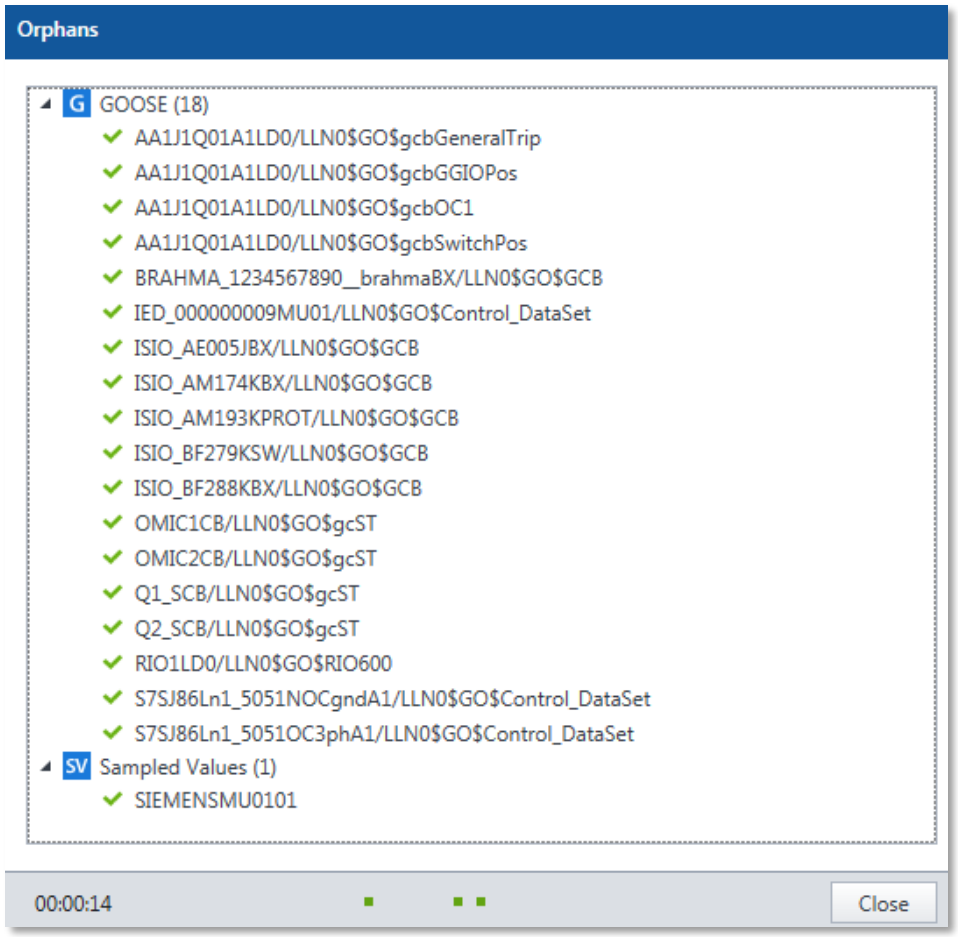
GOOSE data values and statistics

Verification of IEC 61850 process bus traffic

- Verify process bus traffic based on SCL information
- List all GOOSE, R-GOOSE and SV orphans
- Check differences and missing IEDs



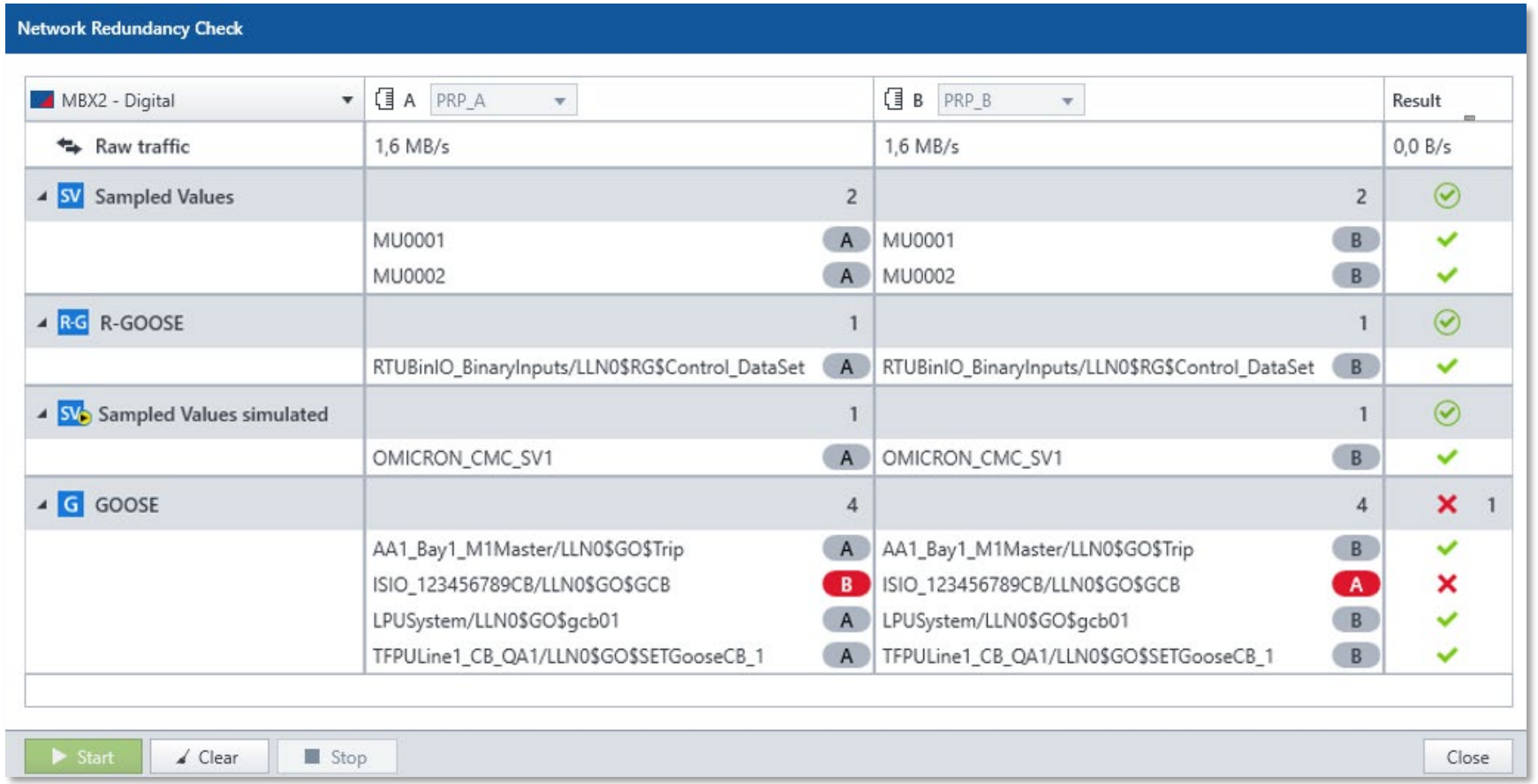
Verification overview



GOOSE and SV orphans list

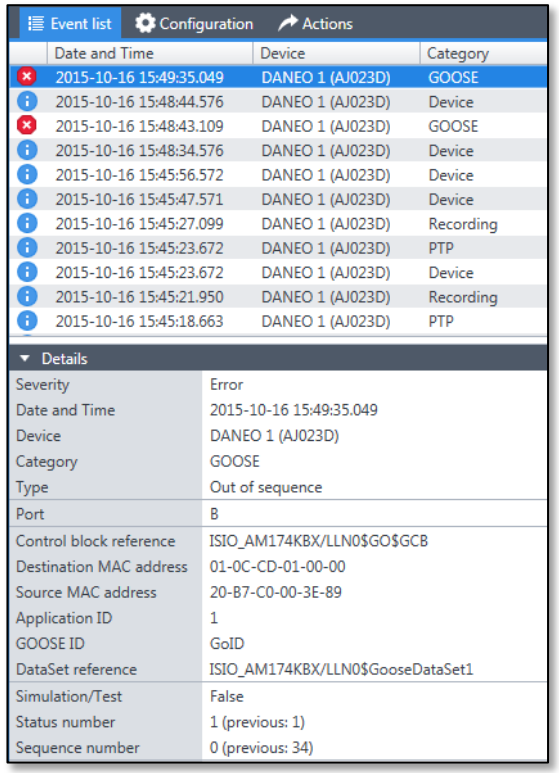
Process bus network redundancy check

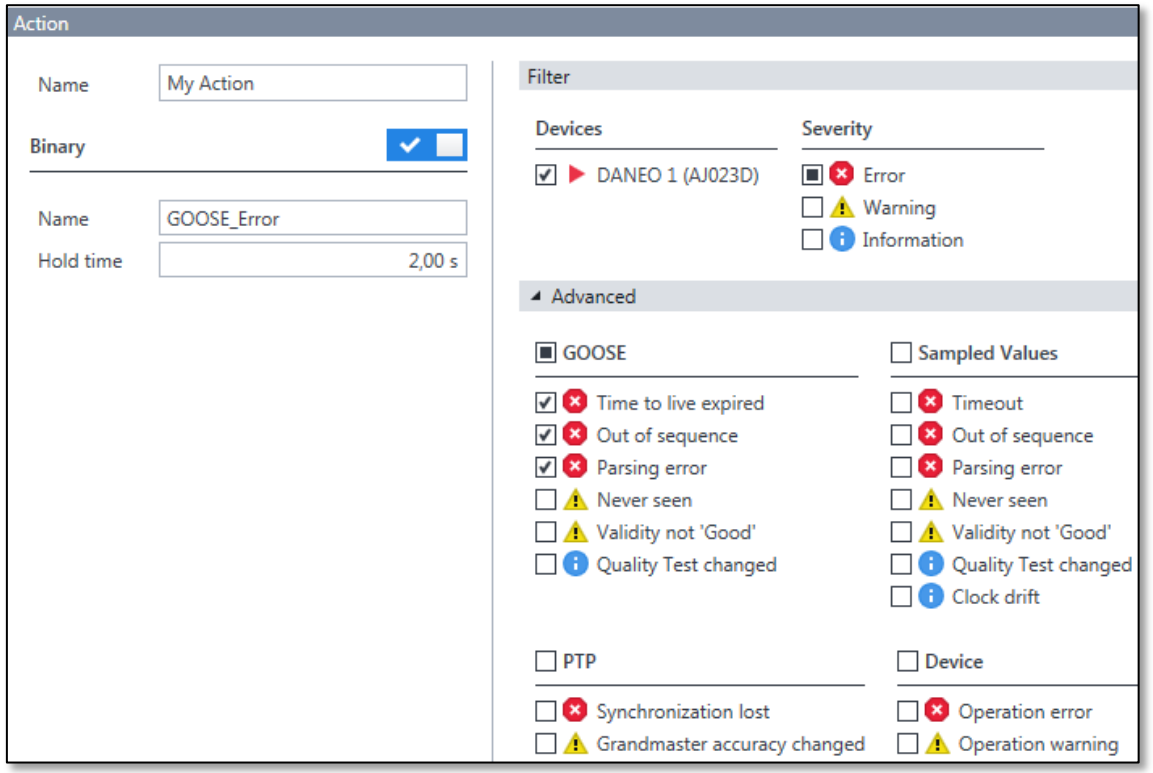
- Compare raw traffic and IEC 61850 GOOSE, R-GOOSE, Sampled Values
- Automatic detection of issues in PRP trailers and HSR headers or incorrect cabling of IEDs



Targeted supervision

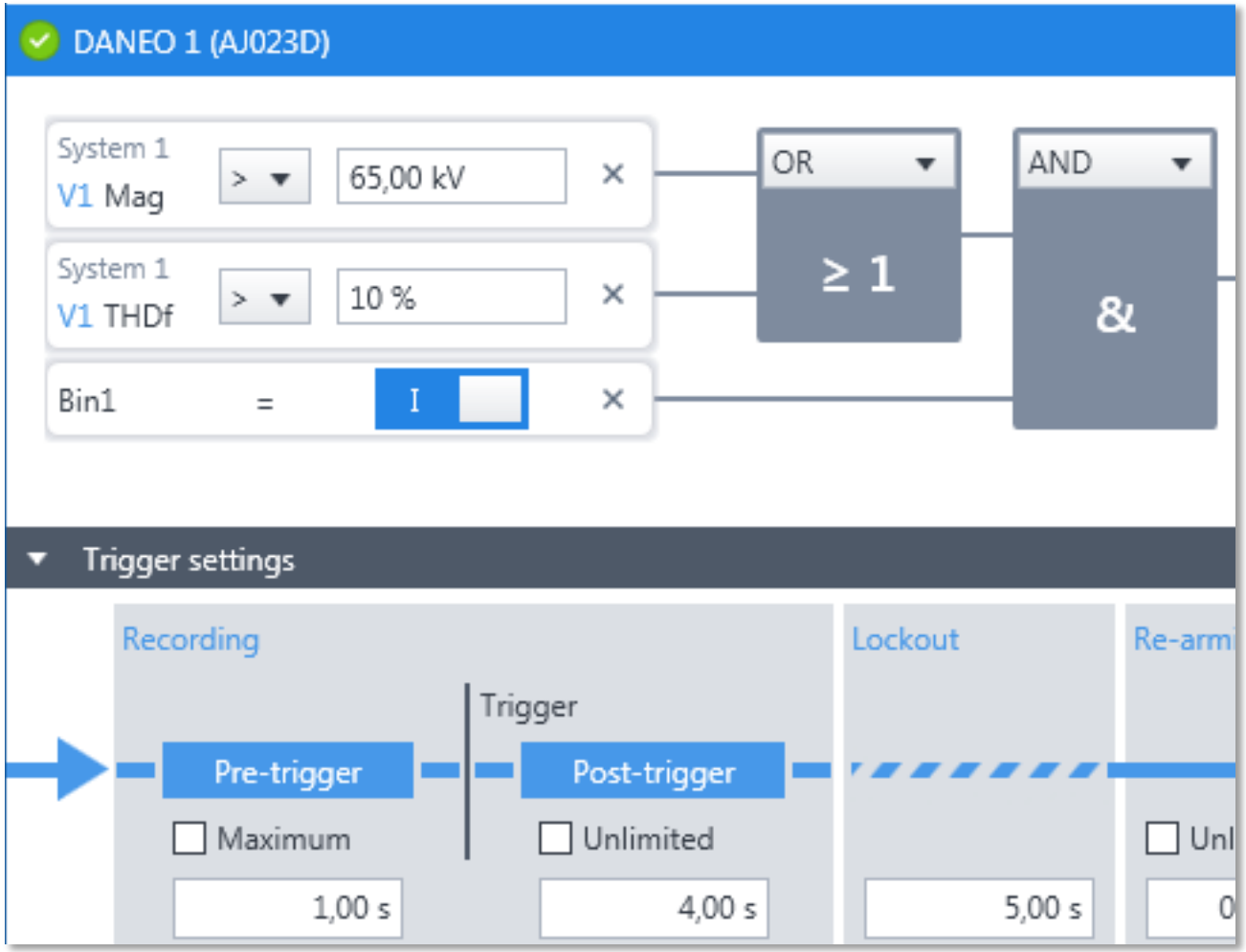
- Live view of supervisor event list
- Select GOOSE, R-GOOSE and Sampled Values for supervision
- Define actions for triggering recordings





Recording

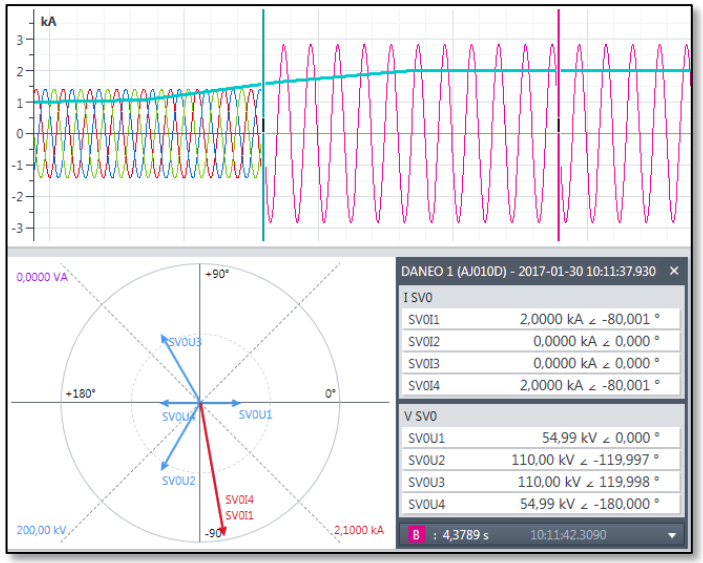
- Select signals from the signal pool
- Configure network traffic capture with filter options
- Define trigger conditions
- Store recordings on the internal disc or external USB storage



Trigger conditions

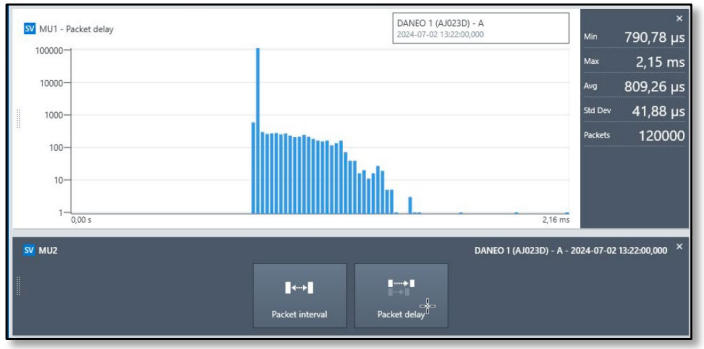
Analysis

- Analyze signals in aggregated time-aligned view
- Check network traffic and analyze hidden circumstances on the network
- Analyze timing of Merging Units
- Measure propagation delay of network packets
- Browse supervisor events archive
- Export data in COMTRADE or PCAP format



Time Signal view

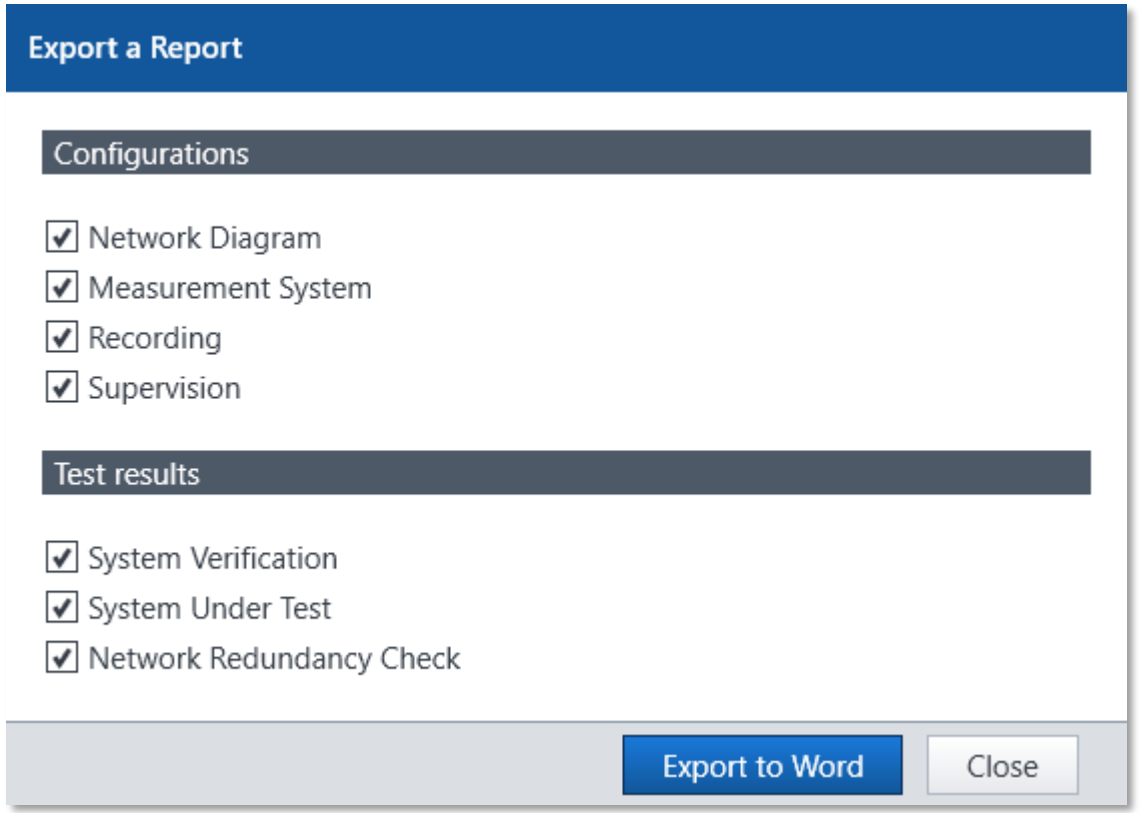
Packet propagation delay



Sampled Values timing

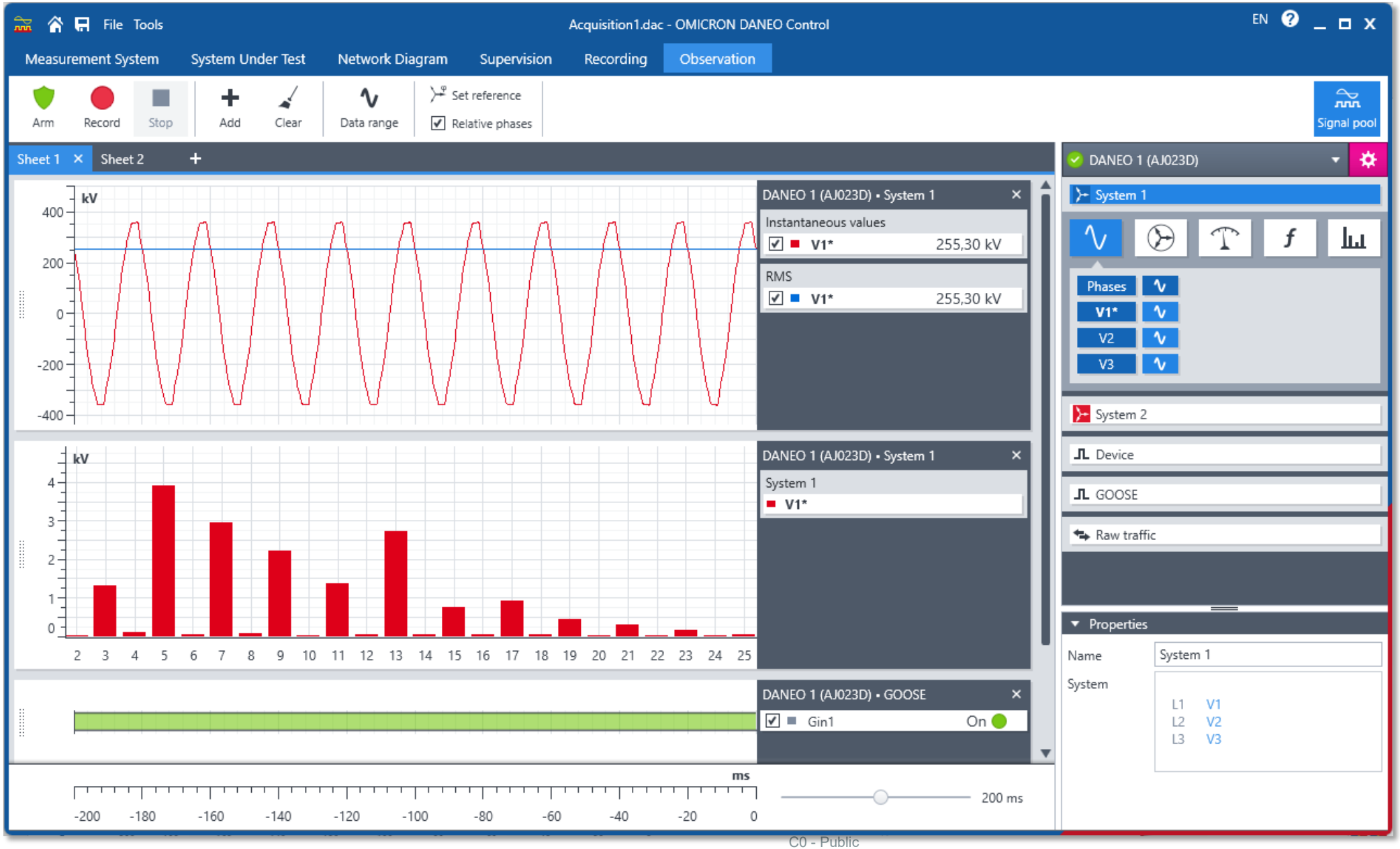
Documentation

- Measurement system configuration
- Test results and analysis of recordings
- Export reports as MS Word



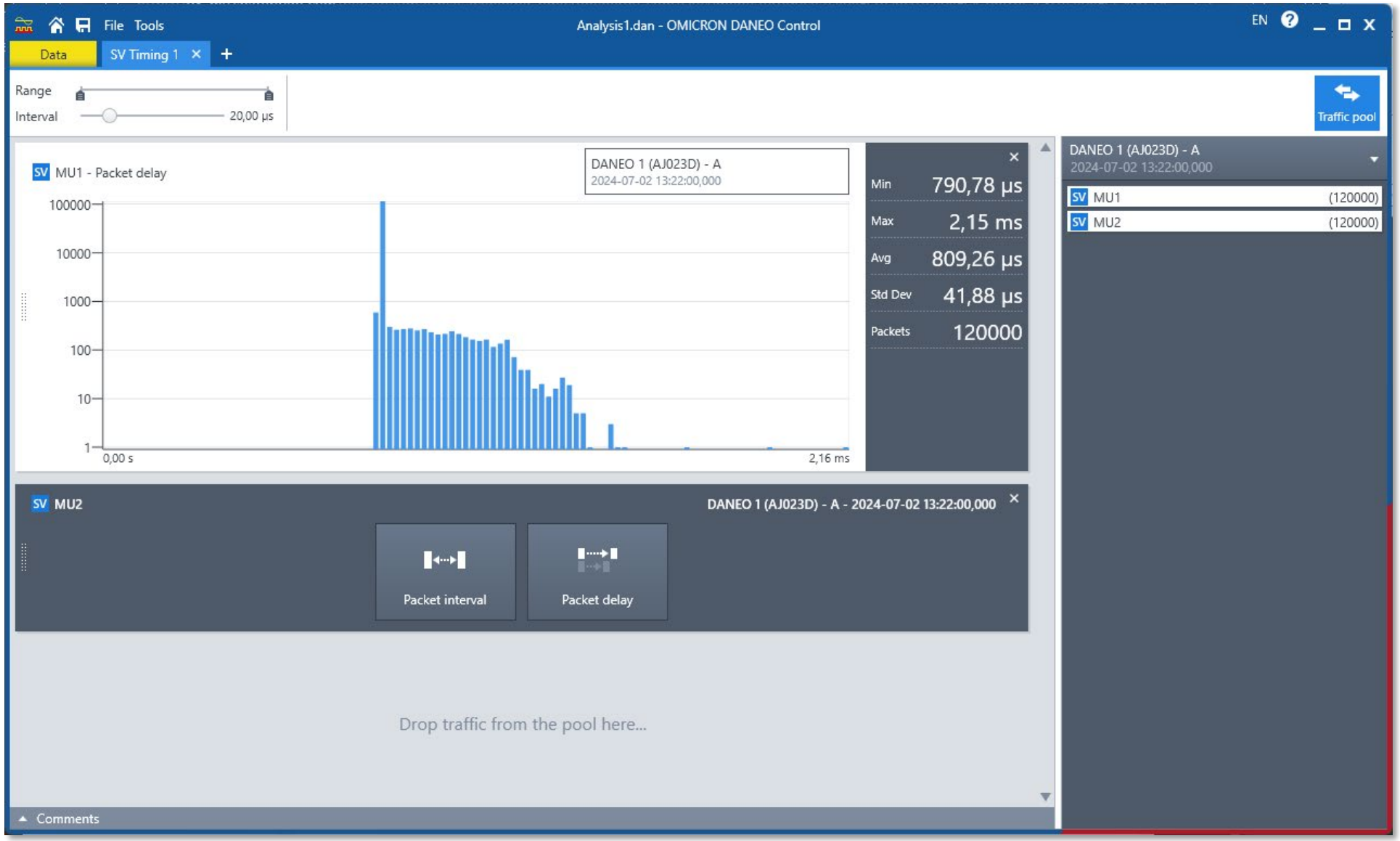
Report content selection

Observation of actual values and recent history

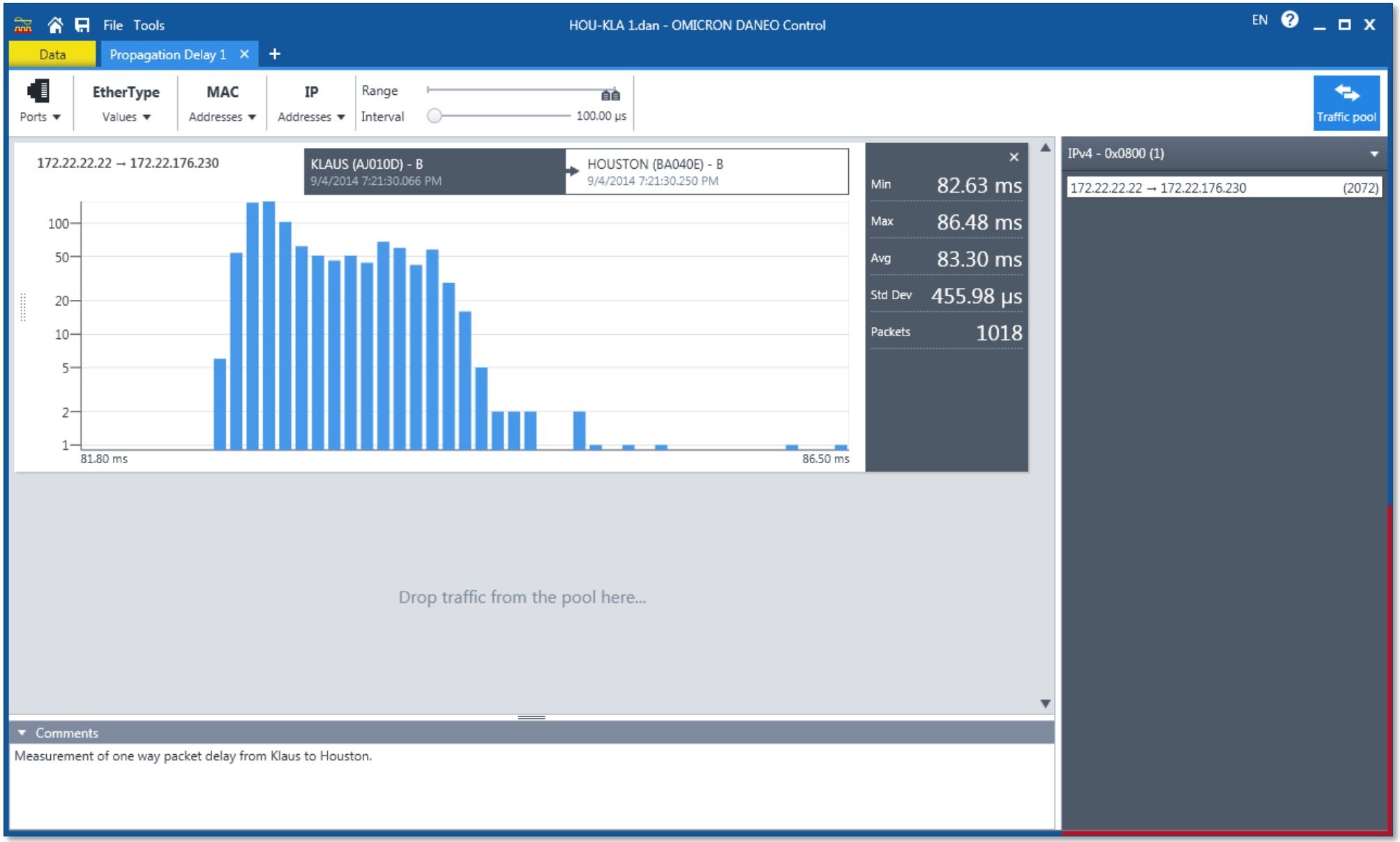


Time Signal analysis

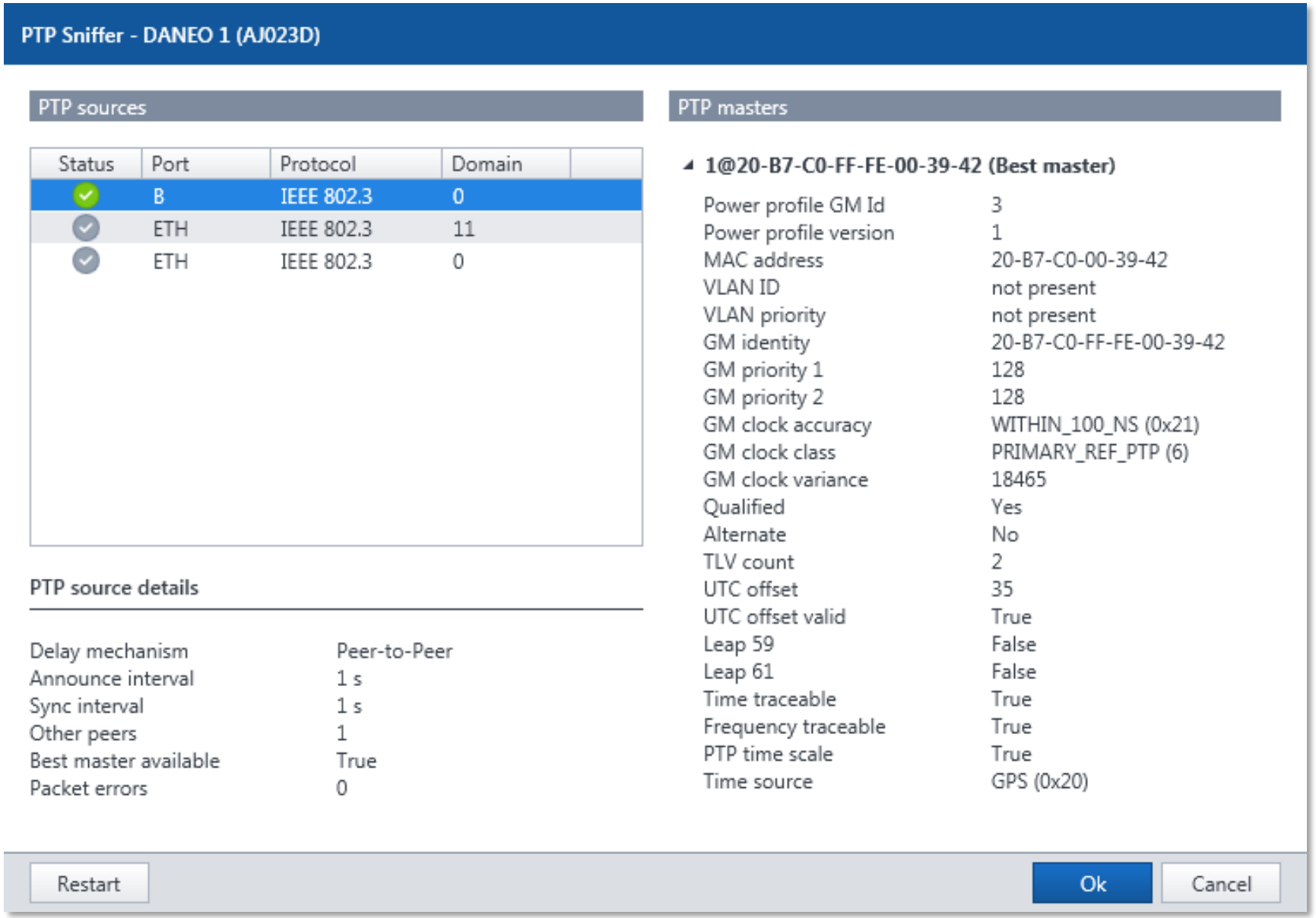
Sampled Values timing analysis



Propagation delay measurement



PTP Sniffer



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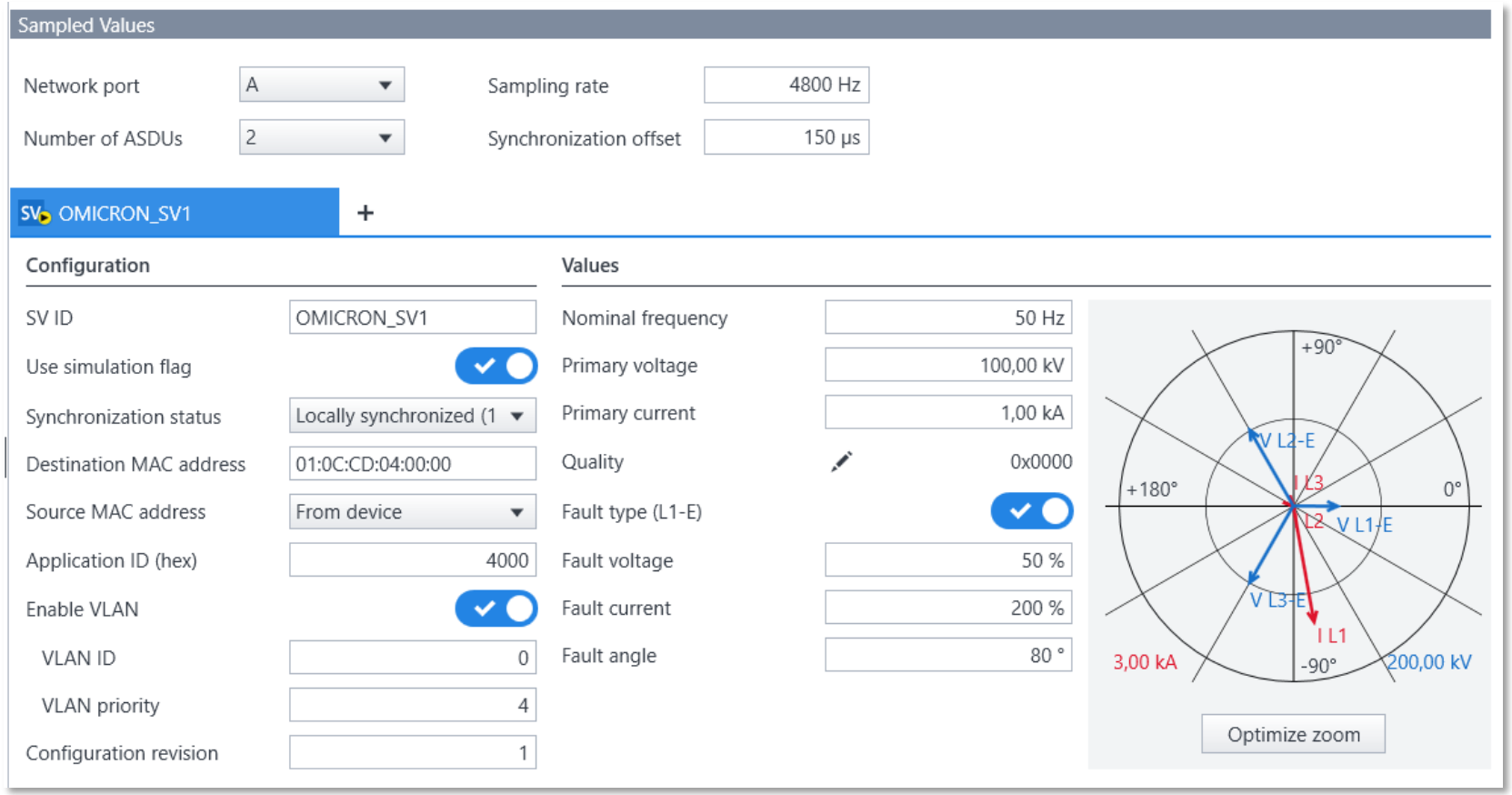
Sampled Values publishing

- Easy configuration in DANEO Control
- Up to 16 SV streams (IEC 61850 9-2LE) per device
- Nominal static values or single-phase fault injection



IEEE 1588 / PTP grandmaster clock accessory

- If no PTP present on the network
- Dedicated clock delivers time for the DANEO 400
- Integrated GPS receiver
- Power Profile IEEE C37.238

- OMICRON PTP grandmaster clocks
  - CMGPS 588 – „the blue egg“
    dedicated accessory for DANEO that uses the power profile
  - OTMC 100p – „the red egg“
    generic configurable clock with power profile support

EXB1 – binary I/O extension accessory

- Only for DANEO 400
- Each EXB1 adds 8 binary inputs and outputs to the measurement system
- Connected via EtherCAT extension interface
  - EXB1 devices powered with PoE
  - Daisy chaining of multiple EXB1 units

DANEO Solution

- Measurement in power systems
- Distributed time synchronized recordings
- Understands IEC 61850 GOOSE, R-GOOSE, Sampled Values
- Analyzing communication networks and their performance

Thank you for your attention.