



# Plataforma de Monitoramento & Testes IEC 61850

Workshop Cigré : “Subestação Digital: Desafios e Perspectivas”

João Jorge ([joao.jorge@omicronenergy.com](mailto:joao.jorge@omicronenergy.com))





# ▶ Plataforma de Monitoramento Agenda:

- ▶ Composição do Painel OMICRON
- ▶ Posicionamento das principais Soluções de Monitoramento OMICRON
- ▶ Detalhes dos resultados obtidos
- ▶ Testes Adicionais
- ▶ Roadmap OMICRON
- ▶ Conclusões







# Painel de Monitoramento OMICRON

# ► Painel de Monitoramento

Arsenal de Monitoramento  
proposto:

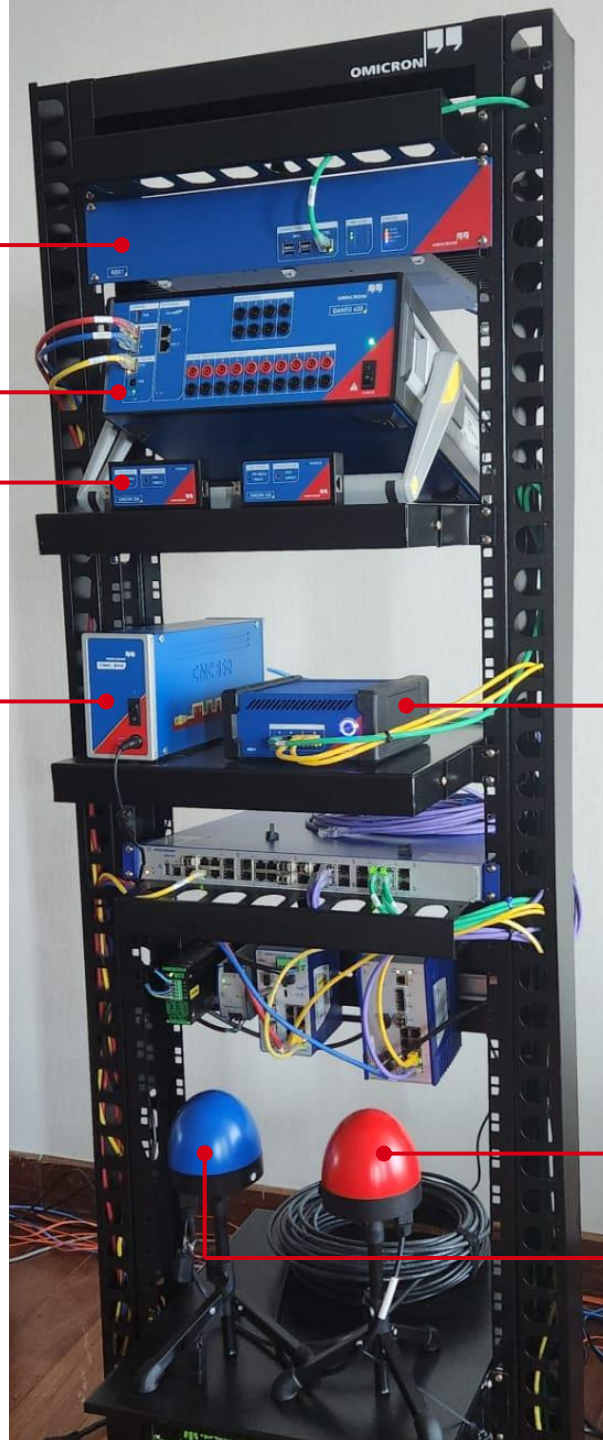
► **StationGuard**  
RBX1

► **DANEO 400**

► **EMCON 200**

► **CMC 850**

► Switches PTPv2 Transparentes para SB & PB



► **StationScout**  
MBX1

► **IEDScout**  
MBX1

► **OTMC 100p**

► **CMGPS 588**



# Resumo de Soluções



CMIRIG-B



EMCON 200



CMGPS 588  
OTMC 100p

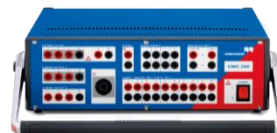


ISIO 200

DANEO 400



StationGuard



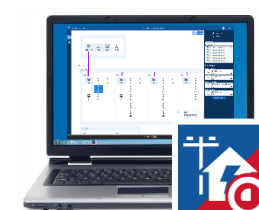
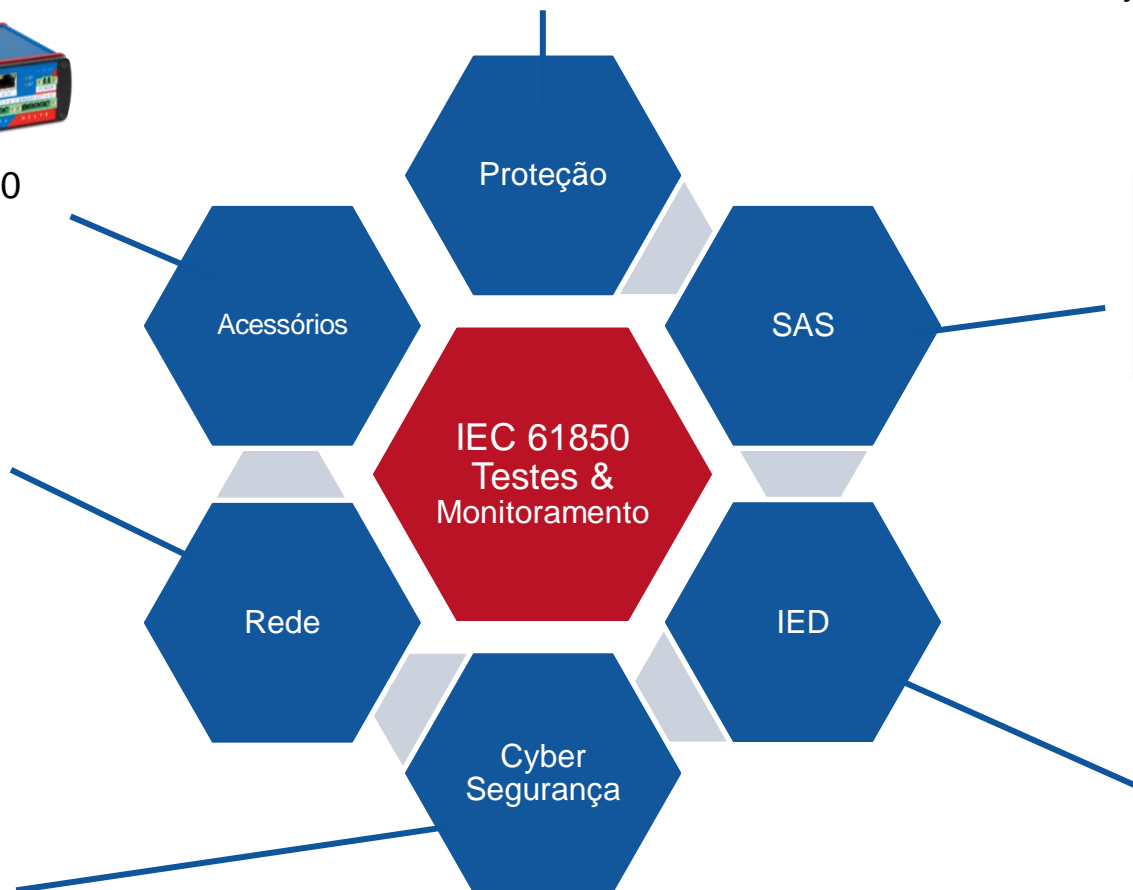
CMC test sets



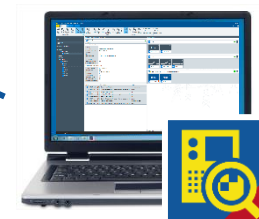
Test Universe



RelaySimTest



StationScout



IEDScout





# Posicionamento das principais Soluções de Monitoramento OMICRON



# ► CMC 850

- Equipamento para testes de proteção dedicado para IEC 61850
- Foco em serviços de comunicação de tempo real como GOOSE e Sampled Values
- Controlada por Test Universe e/ou RelaySimTest
- Leve (1,7 Kg) e pequena (85 x 145 x 325 mm)



Interface de extensão  
por ex., para CMIRIG-B

Saídas de baixo nível 1 - 6

Saídas de baixo nível 7 - 12

Porta  
USB

- 2 portas Ethernet Gigabit independentes para**
- controle via PC
  - [IEC 61850](#) GOOSE e Sampled Values
  - IEEE 1588 time synchronization (CMGPS 588, OTMC100p ou qualquer outro GPS PTPv2 de qualquer fabricante)

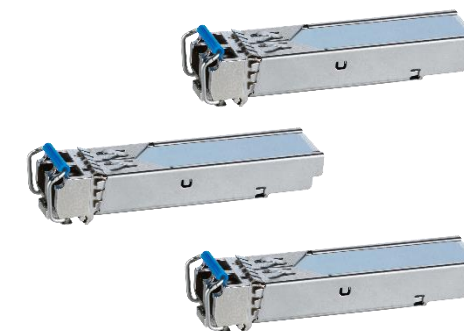
- Certificação Kema / DNV / TUV para a publicação de GOOSE e SV



# ▶ EMCON 200

## Conversor de mídia Ethernet PTP Transparente

- ▶ Interconecta redes Ethernet de fibra óptica a redes RJ45 elétricas
- ▶ PTP Transparent Clock em conformidade com IEEE 1588 (PTPv2)
- ▶ Suporta velocidades de 100 MBit/s e 1 Gbit/s
- ▶ Alimentado via PoE ou USB
- ▶ Slot SFP desbloqueado para qualquer módulo Gbic de fibra óptica de qualquer fabricante



Transceivers SPF intercambiáveis

- Monomodo
- Multimodo
- Velocidade Fast ou Giga



# ► GPS IEEE 1588 / PTP grandmaster clock

- Antena e receptor **GPS** e **Glonass** integrados (24 canais)
- Alimentado via **PoE** e **à prova d'água** (grau IP67)

## ► OMICRON PTP grandmaster clocks

### ► GMGPS 588 – “foginete azul”

GPS acessório não configurável, suporta PTP power profile e é plug and play para testes ponta a ponta com CMCs

### ► OTMC 100p – “foginete vermelho”

GPS totalmente configurável e com suporte a vários perfis:

- > IEEE 1588 Default Profile
- > IEEE C37.238-2011-Power Profile
- > IEEE C37.238-2017-Power Profile
- > IEC/IEEE 61850-9-3:2016-Power Utility Profile
- > SNTP-NTP/SNTP Server (funciona em paralelo com o PTP)
- > suporta SNMP



\* o OTMC possui versão industrial para instalação permanente em subestações



# ▶ DANE0 400 (Gravação, Análise e Supervisão de Redes IEC)

Processamento dedicado para o monitoramento de Subestações Digitais

Interface USB 3.0 para memória externa extra  
(ex.: HD externo de vários TB para gravações de rede)

Interfaces para acessórios

## Interfaces de rede

**3 portas Ethernet Gigabit** independentes para

- controle via PC
- [IEC 61850](#) GOOSE e Sampled Values
- IEEE 1588 time synchronization (CMGPS 588, OTMC100p ou qualquer outro GPS PTPv2 de qualquer fabricante)

**Portas A e B suportam modo TAP**

permite conectar o equipamento “em série” com qualquer topologia Ethernet, investigações detalhadas e medições avançadas de latência, permite também conectar o equipamento em topologias de anel como HSR ou RSTP

Interface de controle USB



4 saídas binárias

10 entradas analógicas / binárias

Medição analógica de 40kHz

\*Memória interna de 60GB  
SSD para gravações

# ► O oráculo de redes IEC 61850



- **Medição e Gravação Híbrida** de sinais convencionais (analógicos & binários) e mensagens na rede de comunicação
- **Gravação Distribuída** com múltiplos DANEOS sincronizados via PTP
- **Verificação** de comunicação IEC 61850 baseada em arquivos SCL (detecção e comparação)
- Observação ao vivo de valores digitais e de medição IEC 61850 (**Osciloscópio Digital**)
- **Análise** de tráfego sofisticada e alinhada no tempo
- Medição de **latência** ou **delays de propagação** (ex. para GOOSE e SV)
- **Operação Desatendida** em instalações permanentes ou semipermanentes
- Sniffer analisador de fontes de tempo **IEEE 1588 (PTP)**
- **Supervisão** do sistema e notificação em caso de eventos
- **Documentação** de resultados





# Sniffer PTP

## Constatação de funcionalidade

## Detecção de problemas

- ▶ Not P2P.
- ▶ Not layer 2 (IEEE 802.3).
- ▶ The announce or sync interval is not one second.
- ▶ No qualified master is available (e.g. due to dropped packets in the network).
- ▶ The announced accuracy of the master is not sufficient (within 500ns).
- ▶ There is a peer delay conflict (peer delay messages from more than one device on the same link).
- ▶ Other possible errors which are indicated:
- ▶ If VLAN tags are present when the power profile is used.
- ▶ Parsing errors of PTP messages ("Packet errors" is not zero).
- ▶ Wrong UTC offset ("UTC offset" is zero or invalid).
- ▶ Rogue masters (multiple masters sending announce messages although they should not according to the BMCA). This can be detected if there
- ▶ are multiple masters in the "PTP masters" list and all of them are active (indicated with bold font).

### PTP Sniffer - DANE0 MNO (DJ160G)

#### PTP sources

Status	Port	Protocol	Domain
✓	ETH	IEEE 802.3	0
✓	A	IEEE 802.3	0

#### PTP source details

No peer-to-peer.

Delay mechanism	None
Announce interval	1 s
Sync interval	1 s
Other peers	0
Best master available	True
Packet errors	0

#### PTP masters

##### 1@20-B7-C0-FF-FE-00-D3-22 (Best master)

Power profile GM ID	0
Power profile version	2
MAC address	20-B7-C0-00-D3-22
VLAN ID	not present
VLAN priority	not present
GM identity	20-B7-C0-FF-FE-00-D3-22
GM priority 1	128
GM priority 2	5
GM clock accuracy	WITHIN_100_NS (0x21)
GM clock class	PRIMARY_REF_PTP (6)
GM clock variance	18465
Qualified	True
Alternate	False
TLV count	2
UTC offset	37
UTC offset valid	True
Leap 59	False
Leap 61	False
Time traceable	True
Frequency traceable	True
PTP time scale	True
Time source	GPS (0x20)

Restart

OK

Cancel

# Sniffer PTP

## Registro de tudo o que acontece com relação ao sincronismo

- ▶ Troca de master clock
- ▶ Alteração na precisão anunciada
- ▶ Falhas em Geral, etc

Event List exhibe eventos de PTP, GOOSE e SV

Acquisition1.dac - OMICRON DANEO Control

Measurement System System Under Test Network Diagram **Supervision** Recording Observation

Start Stop Clear Delete all Devices ▼ Severity ☒ ☒ ☒ ☒ ☒ ☒ Category ☐ ☒ ☐ ☒ ☒ ☒ ☐ ☒

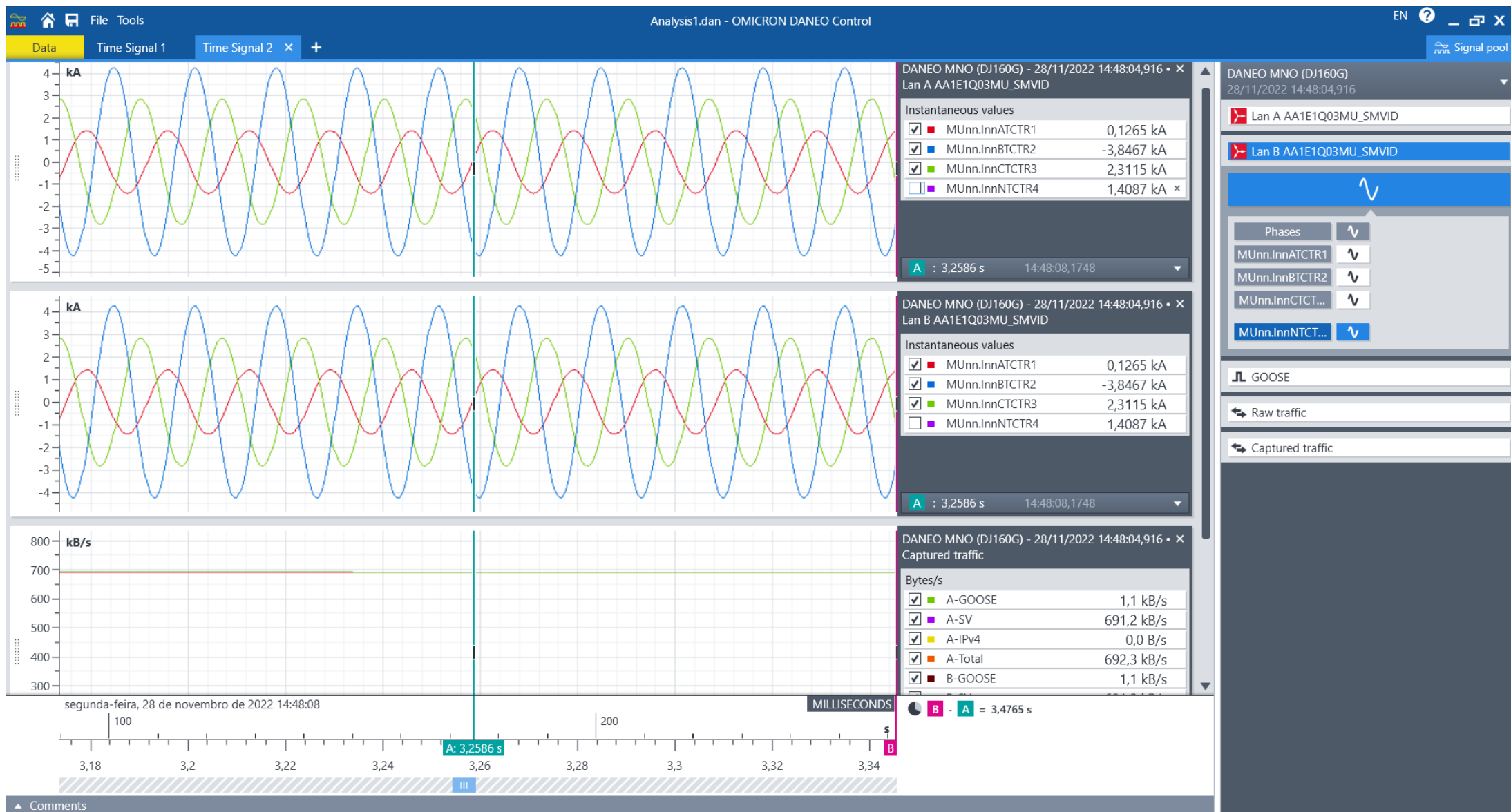
Event list Configuration Actions

▼ 🔍

	Date and time	Device	Category	Type	Description
⚠	28/11/2022 13:49:36,806	DANEO MNO (DJ160G	PTP	Grandmaster accuracy changed	UNKNOWN (0xfe) (WITHIN_100_NS (0x21))
✖	28/11/2022 13:49:11,797	DANEO MNO (DJ160G	PTP	Synchronization lost	
ℹ	28/11/2022 13:47:13,755	DANEO MNO (DJ160G	PTP	Synchronization established	
ℹ	28/11/2022 13:47:13,752	DANEO MNO (DJ160G	Device	Time change	28/11/2022 13:47:13,755
✖	28/11/2022 13:47:07,750	DANEO MNO (DJ160G	PTP	Synchronization lost	
ℹ	28/11/2022 13:42:39,524	DANEO MNO (DJ160G	PTP	UTC offset updated	37 s (0 s)
ℹ	28/11/2022 13:42:39,524	DANEO MNO (DJ160G	Device	Time change	28/11/2022 13:42:36,640
ℹ	28/11/2022 13:42:36,640	DANEO MNO (DJ160G	PTP	Synchronization established	
ℹ	28/11/2022 13:42:33,522	DANEO MNO (DJ160G	PTP	Grandmaster ID changed	20:b7:c0:ff:fe:00:d3:22
ℹ	28/11/2022 13:42:24,093	DANEO MNO (DJ160G	Device	Network port connected	A



# Osciloscópio de rede



# Caça fantasmas de rede

- Variedade de possibilidades de detecções e alarmes personalizáveis



## Devices

☒  DANE MNO (DJ160G)

## Severity


☐  Error

☐  Warning

☐  Information

## Advanced

☐  GOOSE

☐  Time to live expired

☐  Out of sequence

☐  Parsing error

☐  Never seen

☐  Validity not 'Good'

☐  Quality Test changed

☐  Sampled Values

☐  Timeout

☐  Out of sequence

☐  Parsing error

☐  Never seen

☐  Validity not 'Good'

☐  Quality Test changed

☐  Clock drift

☐  PTP

☐  Synchronization lost

☐  Grandmaster accuracy changed

☐  Synchronization established

☐  Grandmaster ID changed

☐  UTC offset updated

☐  Device

☐  Operation error

☐  Operation warning

☐  Power on

☐  Reboot on error

☐  Time change

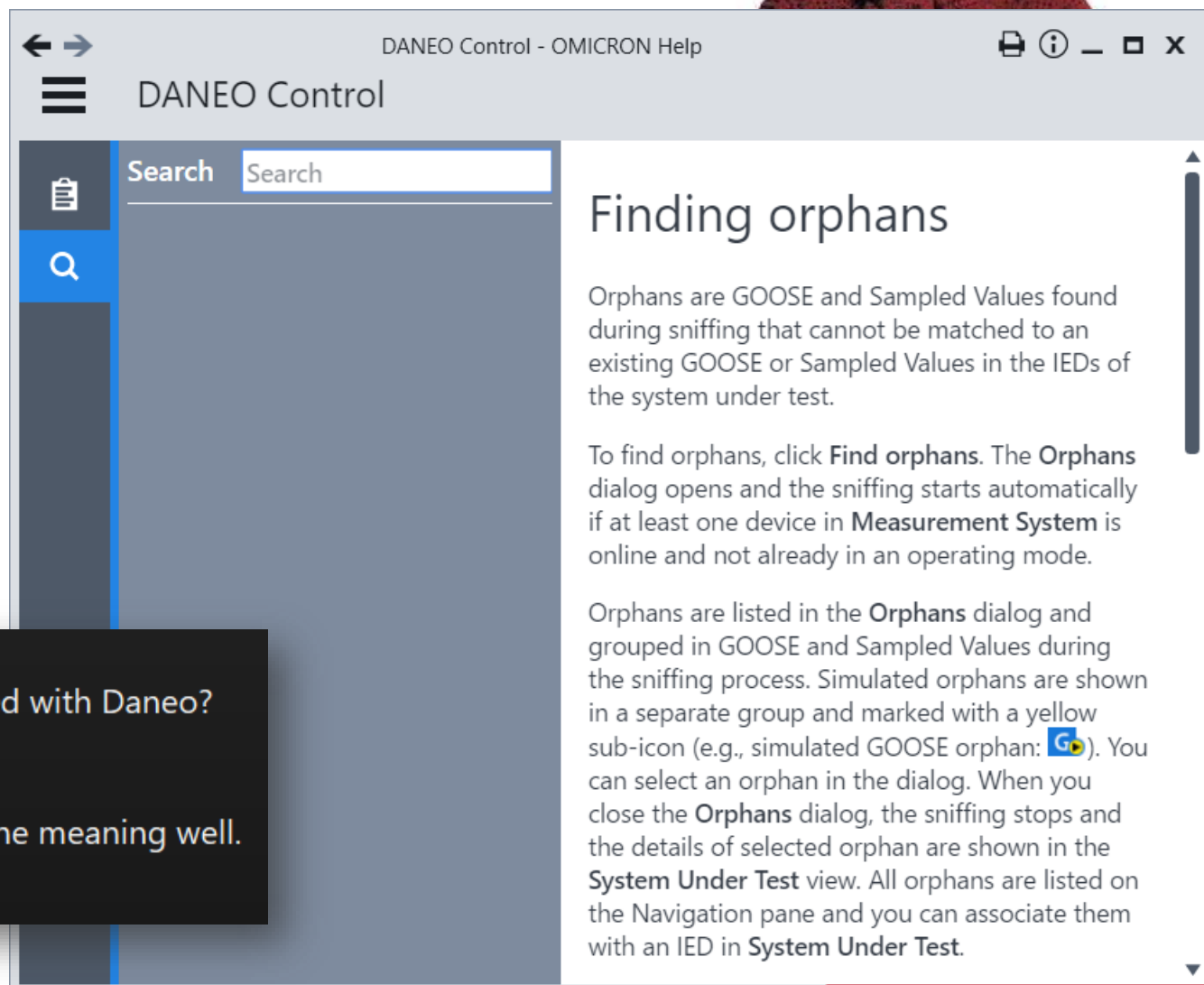
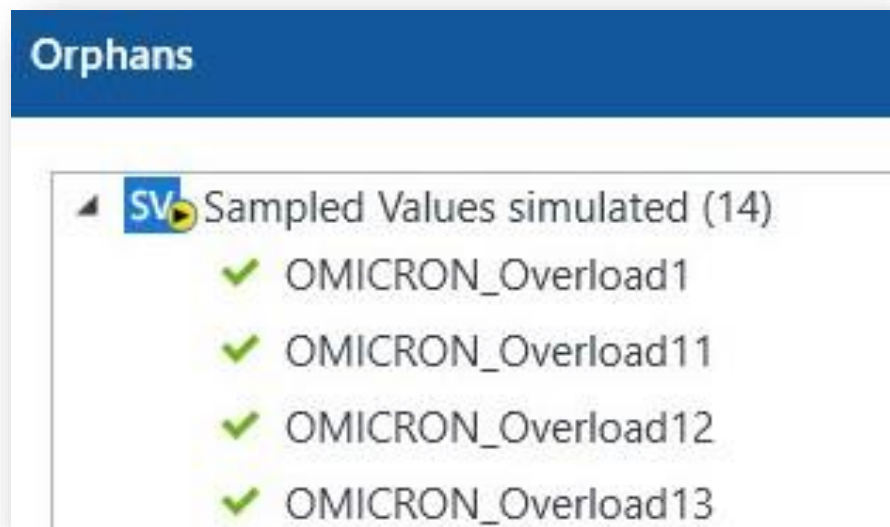
☐  Network port connected

☐  Network port disconnected

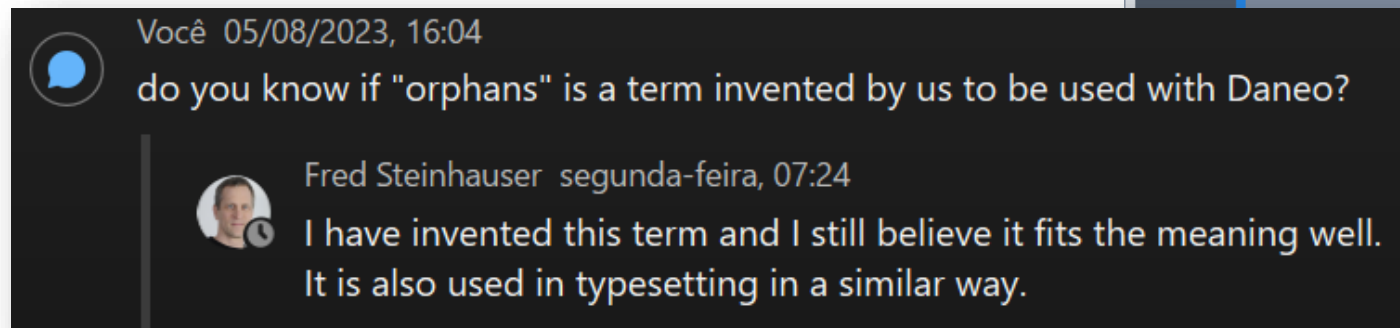


# ▶ Encontra mensagens não esperadas - ÓRFÃOS

- ▶ **ÓRFÃOS** : Qualquer mensagem GOOSE ou SV presente na rede e não definida em nenhum dos arquivos SCL da subestação

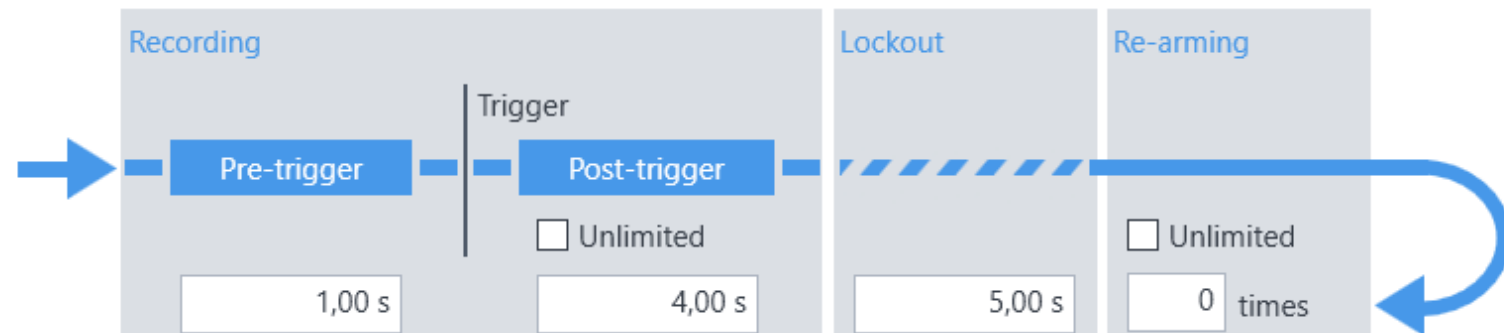


Dr. Fred Steinhauser, idealizador do DANE0 (há 10 anos)



# Oscilógrafo de rede

- ▶ Registro paralelo da rede e de sinais analógicos
- ▶ Ferramentas próprias para analisar registros



**Export**

☒ COMTRADE

- ☒ DANE MNO (DJ160G) 28/11/2022 14:48:04,916
  - ☒ Analog
  - ☒ Binary
  - ☒ Traffic

☒ PCAP

- ☒ DANE MNO (DJ160G) 28/11/2022 14:48:04,916
  - ☒ A
  - ☒ B

Folder

C:\Users\JoaJor00\Documents\OMICRON\DANE MNO Control

COMTRADE

File name2022-11-28-14-48-04

Data file typeBinary

☐ Resampling40,000 kHz

Open exported files

☐ Open COMTRADE in TransView

☐ Open PCAP in IEDScout

☐ Open PCAP in SVScout

☐ Open PCAP in Wireshark

☐ Open folder in Windows Explorer

Export

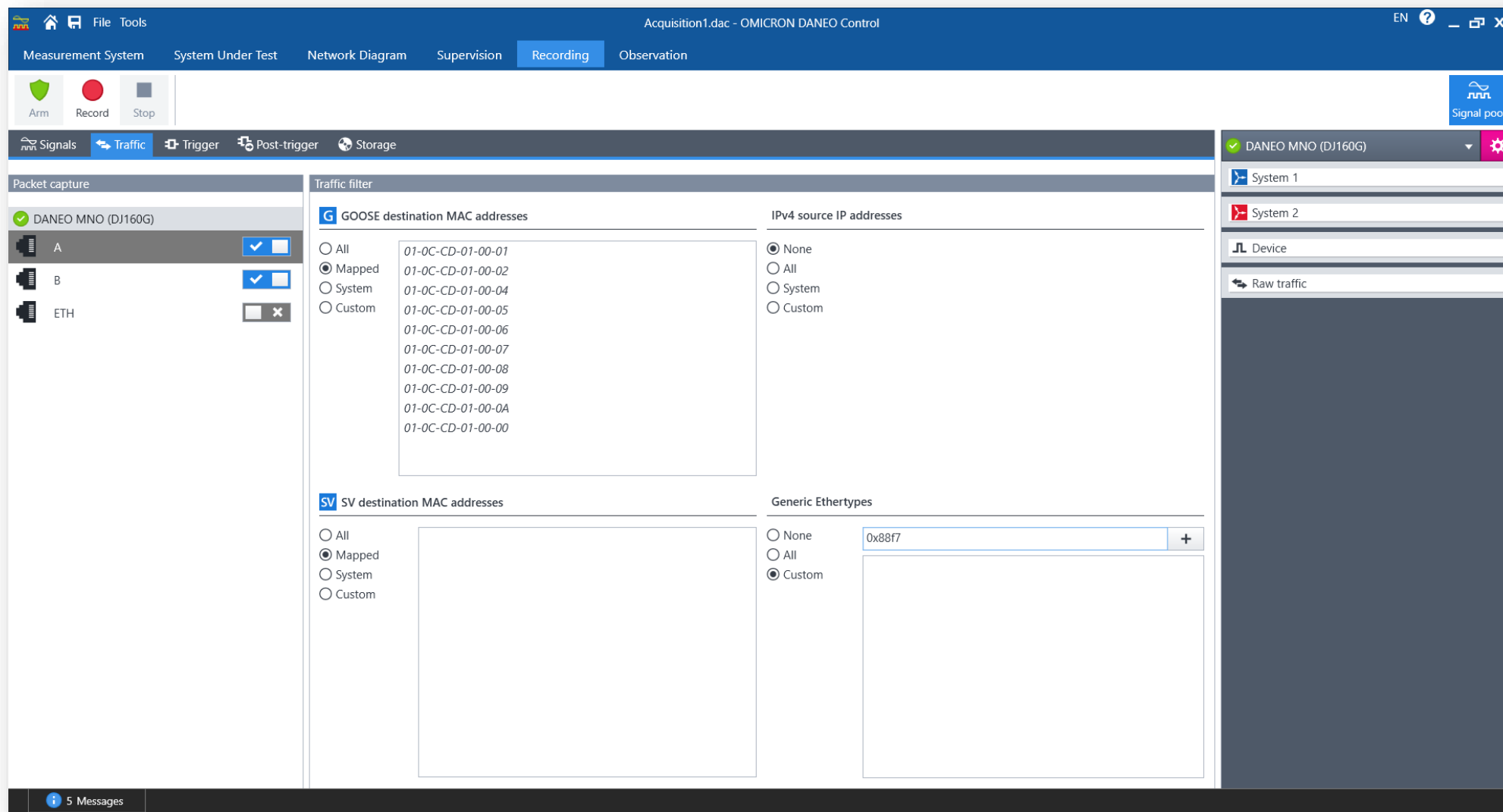
Close





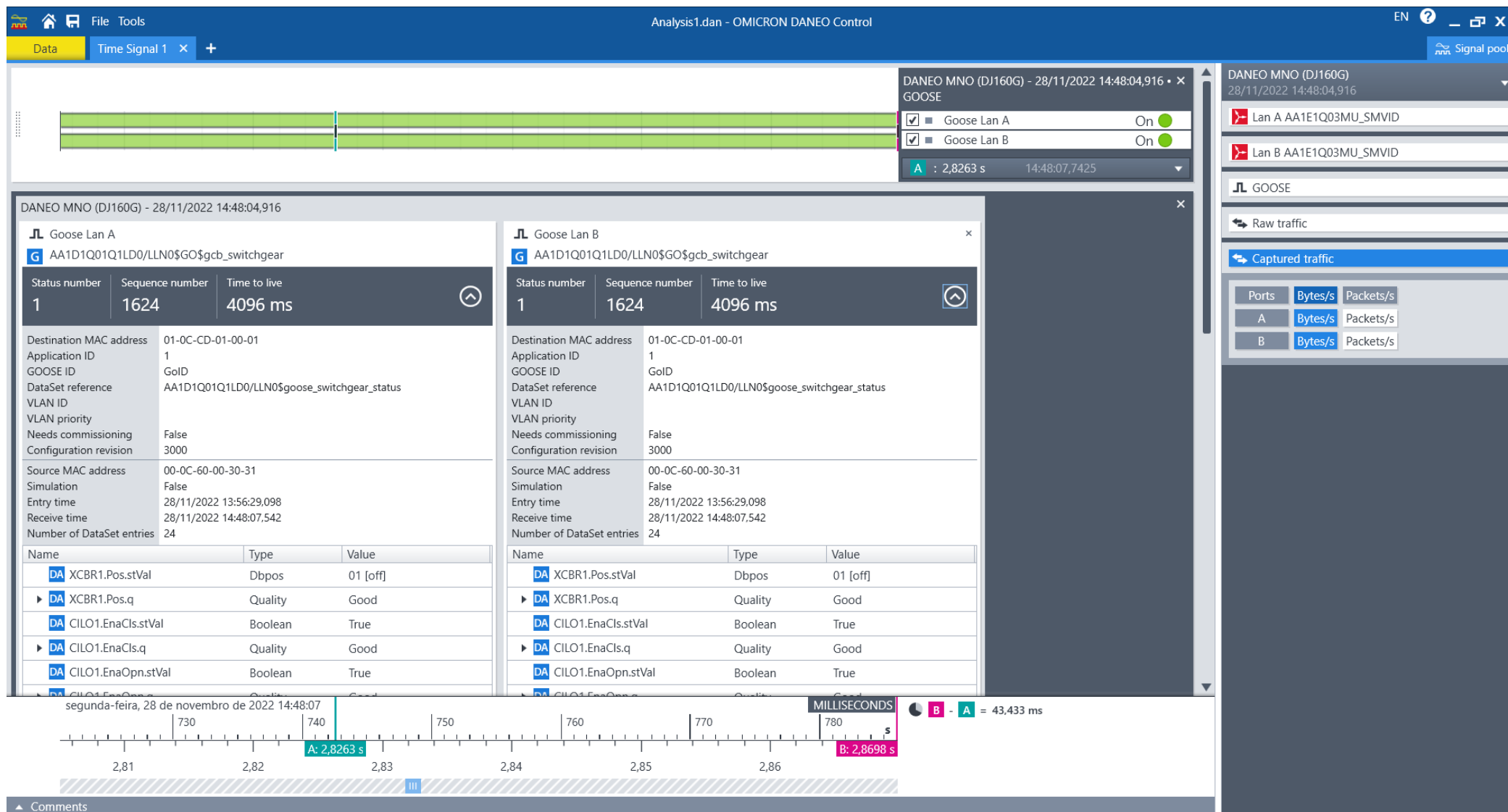
# ► Oscilógrafo de rede

- Registro paralelo da rede e de sinais analógicos
- Ferramentas próprias para analisar registros



# Oscilógrafo de rede

- ▶ Registro paralelo da rede e de sinais analógicos
- ▶ Ferramentas próprias para analisar registros



# Certificador de redes

- ▶ Se conecta em qualquer arquitetura, HSR ou PRP
- ▶ Mostra estatísticas e erros de GOOSE e SV em ambas redes redundantes
- ▶ Encontra mensagens alheias ao definido no SCL (mensagens não esperadas ou órfãos)

The screenshot displays the OMICRON DANEO Control software interface. The top menu bar includes File, Tools, and a status bar showing 'Acquisition1.dac - OMICRON DANEO Control'. The main window is divided into several panes:

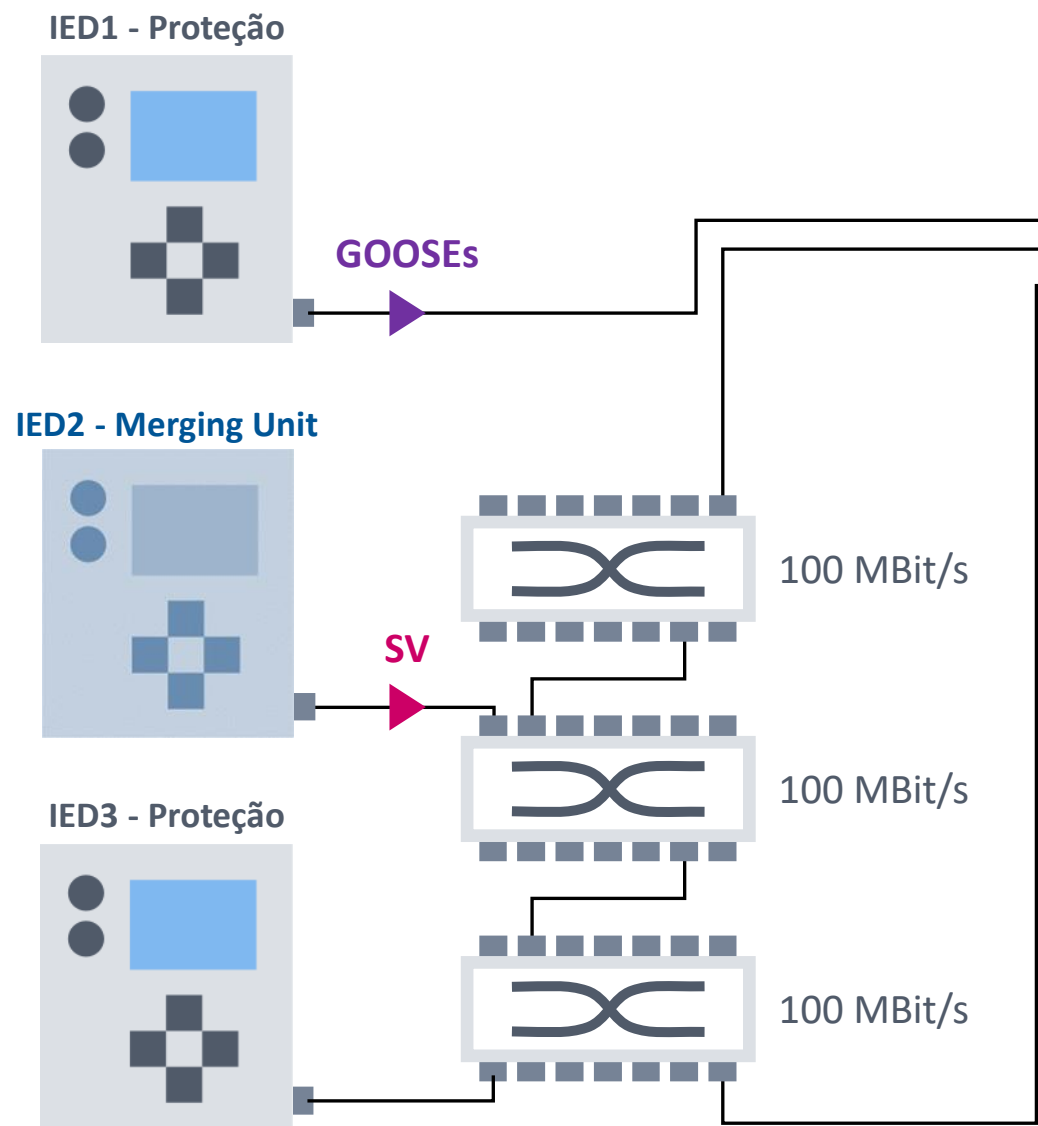
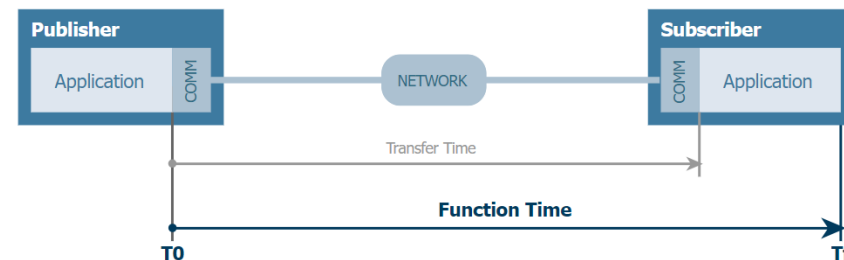
- Left Pane:** Contains a tree view with 'AA1D1Q05Q1' expanded, showing 'IED properties' (GOOSE, LD CBSW, Data Model) and 'Orphans' (GOOSE (14), SV Sampled Values (1)).
- Center Pane:** Displays 'SV AA1E1Q03MU\_SMVID' with 'Control block attributes' and 'Packet information' sections. The 'Statistics' section shows a table with columns A, B, and ETH.
- Right Pane:** Shows 'DANEO MNO (DJ160G)' with a 'Signal pool' button and a list of systems (System 1, System 2) and devices.

The 'Statistics' table in the center pane is as follows:

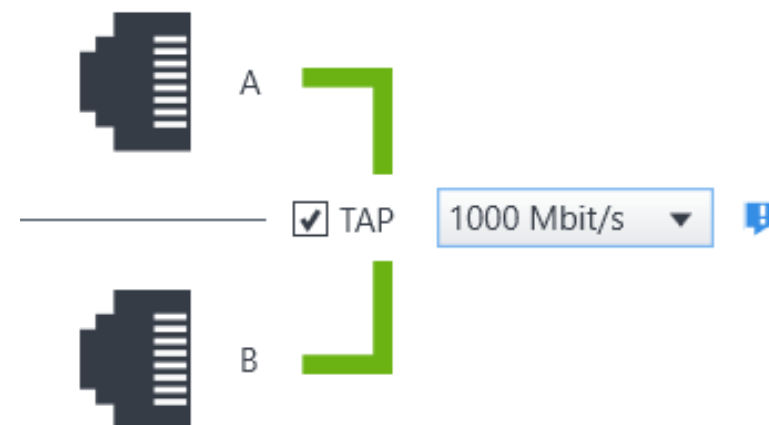
	A	B	ETH
Receive time	28/11/2022 14:39:38,810	28/11/2022 14:39:38,672	
Samples seen	33600	33600	
Samples missed	0	0	
Sampling rate	4,800 kHz	4,800 kHz	
Last packet smpCnt=0	28/11/2022 14:39:38,000	28/11/2022 14:39:38,000	
Clock drift (current)	-2,58 µs	-2,56 µs	
Clock drift (since start)	-416,00 ns	-384,00 ns	
Timed out	False	False	



# Medidor de latência de rede (transfer time)

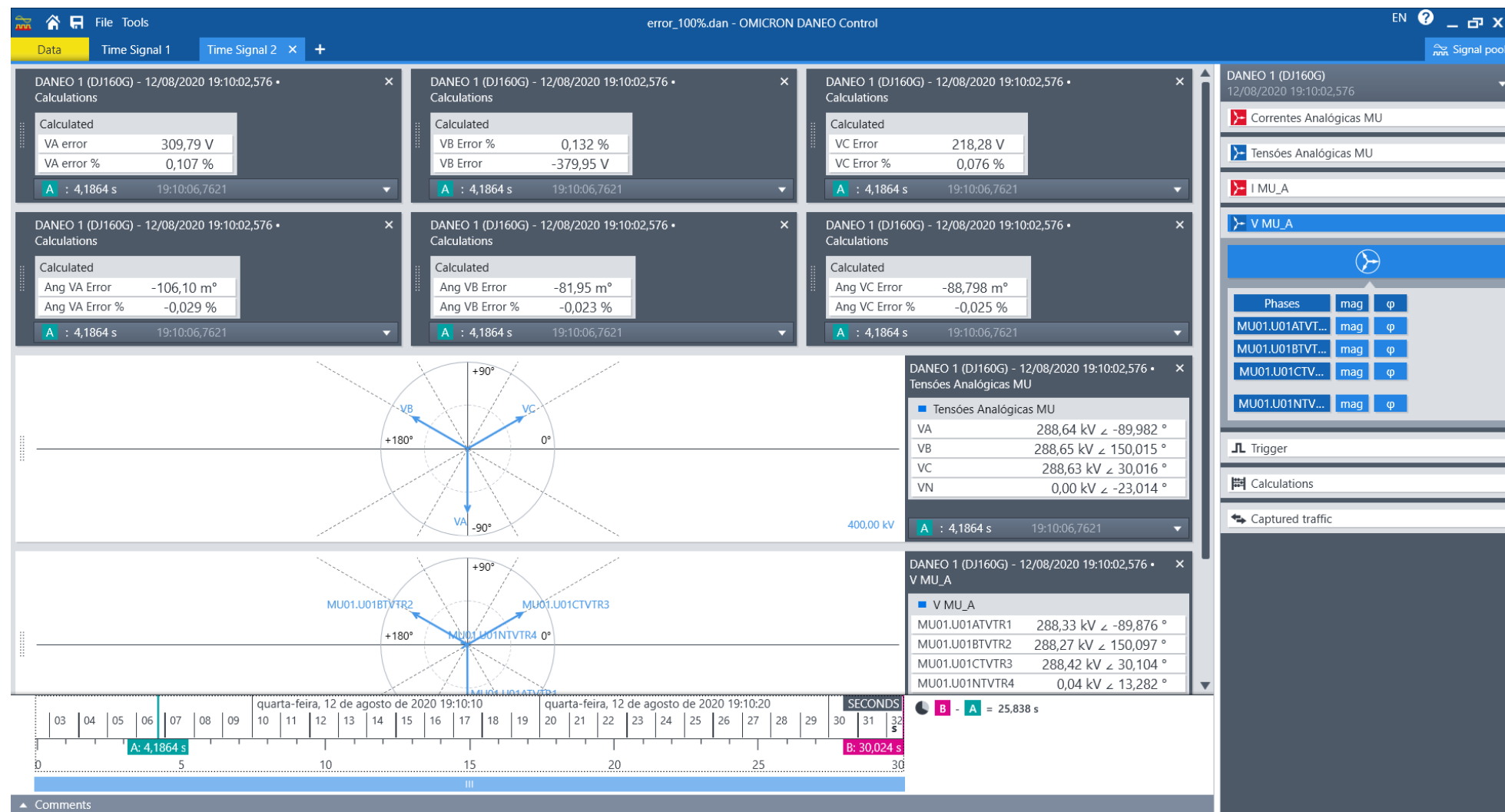


Detecção de mensagens duplicadas  
Porta em **Modo TAP**  
Medição local ou distribuída



# Certificador de MUs

- ▶ Depois de passar certo tempo exposta à intempéries no pátio, minha MU segue com a mesma performance?
- ▶ Cumpre com a precisão A/D (módulo e ângulo) segundo a IEC61869-9?
- ▶ Cumpre com o tempo de conversão analógico digital?
- ▶ Cumpre com o tempo de holdover mínimo?



# ► Verificação baseada em SCL

- Averigua se a comunicação presente na rede é exatamente igual ao definido nos arquivos SCL
- Método de comparação

System Verification				
<input checked="" type="checkbox"/> IEDs	<input checked="" type="checkbox"/> Server	<input checked="" type="checkbox"/> G & SV	Result	
<input checked="" type="checkbox"/> AA1D1Q01Q1	✓	✓	✓	
<input checked="" type="checkbox"/> AA1H1Q01Q1	✓	✓	✓	
<input checked="" type="checkbox"/> AA1D1Q02Q1	✓	✗	⚠	
<input checked="" type="checkbox"/> AA1D1Q02Q2	✓	✓	✓	
<input checked="" type="checkbox"/> AA1D1Q03Q1	✓	✓	✓	
<input checked="" type="checkbox"/> AA1D1Q03Q2	✓	✓	✓	
<input checked="" type="checkbox"/> AA1D1Q04Q1	✓	✓	✓	
<input checked="" type="checkbox"/> AA1D1Q05Q1	⚠	✗	⚠	



# Verificação baseada em SCL

## Apresenta diferenças

The screenshot displays the OMICRON DANEO Control software interface, specifically the 'System Under Test' tab. The interface is divided into several sections:

- Top Bar:** Contains the menu (File, Tools), the title bar (Acquisition1.dac - OMICRON DANEO Control), and the language (EN).
- Navigation Bar:** Includes tabs for Measurement System, System Under Test, Network Diagram, Supervision, Recording, and Observation.
- Toolbar:** Features icons for Import SCL, Add IED, Remove IED, Discover IED, Remove, Verification, Find orphans, Clear orphans, Override, and Reset values.
- Left Panel:** A tree view showing the system hierarchy. The 'AA1D1Q01Q1' node is expanded, showing 'IED properties', 'GOOSE' (with 'LD0' selected), 'Sampled Values' (with 'MUnn' selected), and 'Data Model' (with 'LD0' selected). Below this is the 'Orphans' section, which lists 14 GOOSE objects.
- Central Panel:** A comparison table between 'Defined' and 'Found' states for the selected control block 'AA1D1Q01Q1LD0/LLN0\$GO\$gcb\_switchgear'.

Defined		Found	
<b>Control block attributes</b>			
Control block reference	AA1D1Q01Q1LD0/LLN0\$GO\$gcb_switchgear	Control block reference	AA1D1Q01Q1LD0/LLN0\$GO\$gcb_switchgear
Destination MAC address	01-0C-CD-01-00-01	Destination MAC address	01-0C-CD-01-00-03
Application ID	1 (0x0001)	Application ID	1 (0x0001)
GOOSE ID	GoID	GOOSE ID	GoID
DataSet reference	AA1D1Q01Q1LD0/LLN0\$goose_switchgear_status	DataSet reference	AA1D1Q01Q1LD0/LLN0\$goose_switchgear_status
VLAN ID	0	VLAN ID	not present
VLAN priority	4	VLAN priority	not present
Needs commissioning	False	Needs commissioning	False
Configuration revision	3000	Configuration revision	5000
<b>Packet information</b>			
Source MAC address		Source MAC address	00-0C-60-00-30-31
Simulation		Simulation	False
Entry time		Entry time	28/11/2022 15:05:16,339
Status number		Status number	1
Sequence number		Sequence number	20
Time to live		Time to live	4096 ms
Number of DataSet entries		Number of DataSet entries	24
<b>Statistics</b>			
	A	B	
Receive time			
Packet count			
Status changes seen			
Status changes missed			
Retransmissions missed			
Duplicates seen			
Time to live expired			
- Right Panel:** A sidebar showing the system configuration. It includes a 'Signal pool' button and a list of systems (System 1, System 2) and devices (Device, GOOSE). Below this are 'Calculations' and 'Raw traffic' sections.

# ► DANEOS pelo Brasil

- GE São Paulo
- GE Reason
- ISA CTEEP
- Furnas
- Siemens
- Enel
- MEZ
- Eletronorte
- WEG
- Eletrosul\* (a ser entregue)
- etc



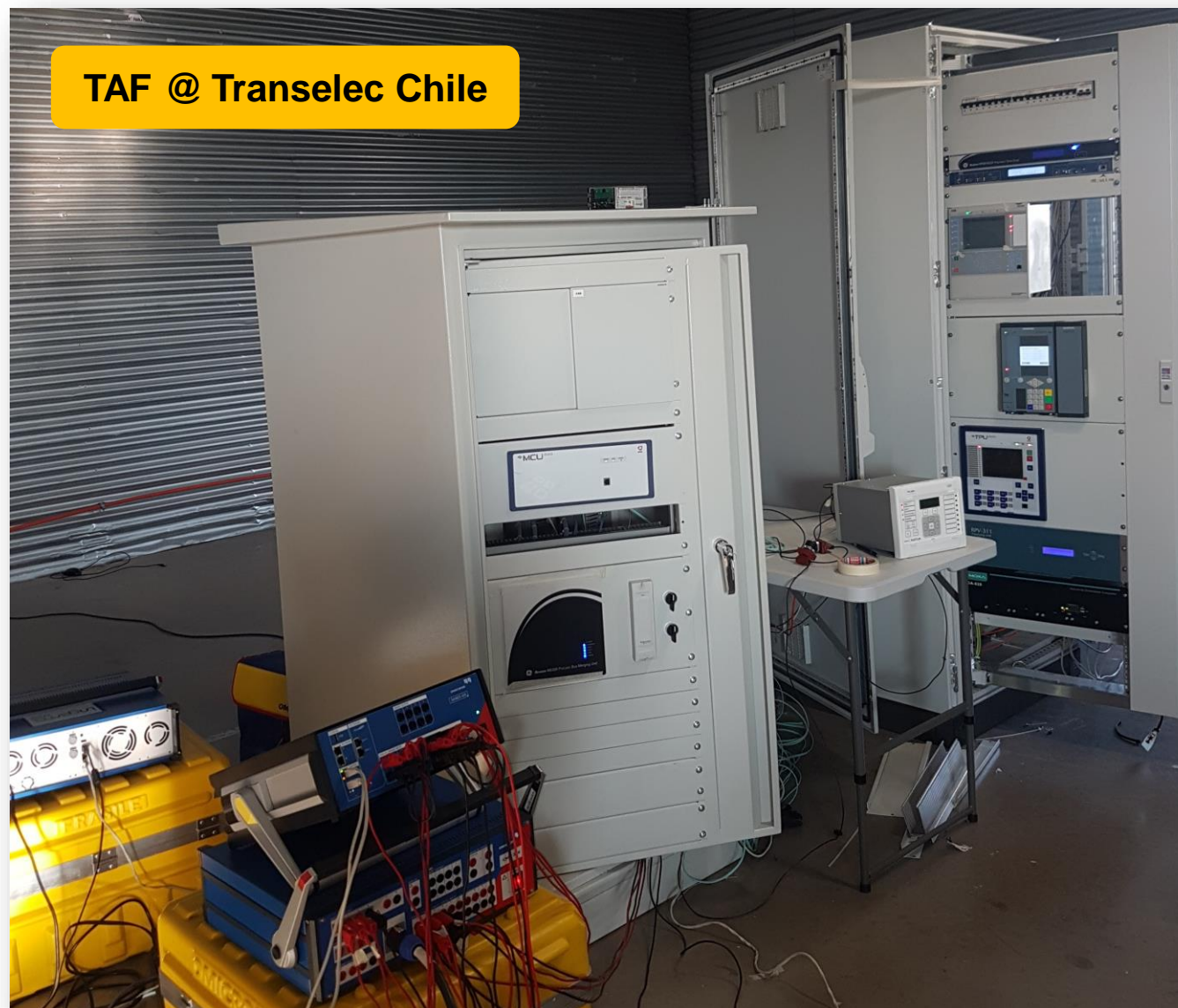
@ SE Nova Ponte (ISA CTEEP)



@ SE Lorena (ISA CTEEP)

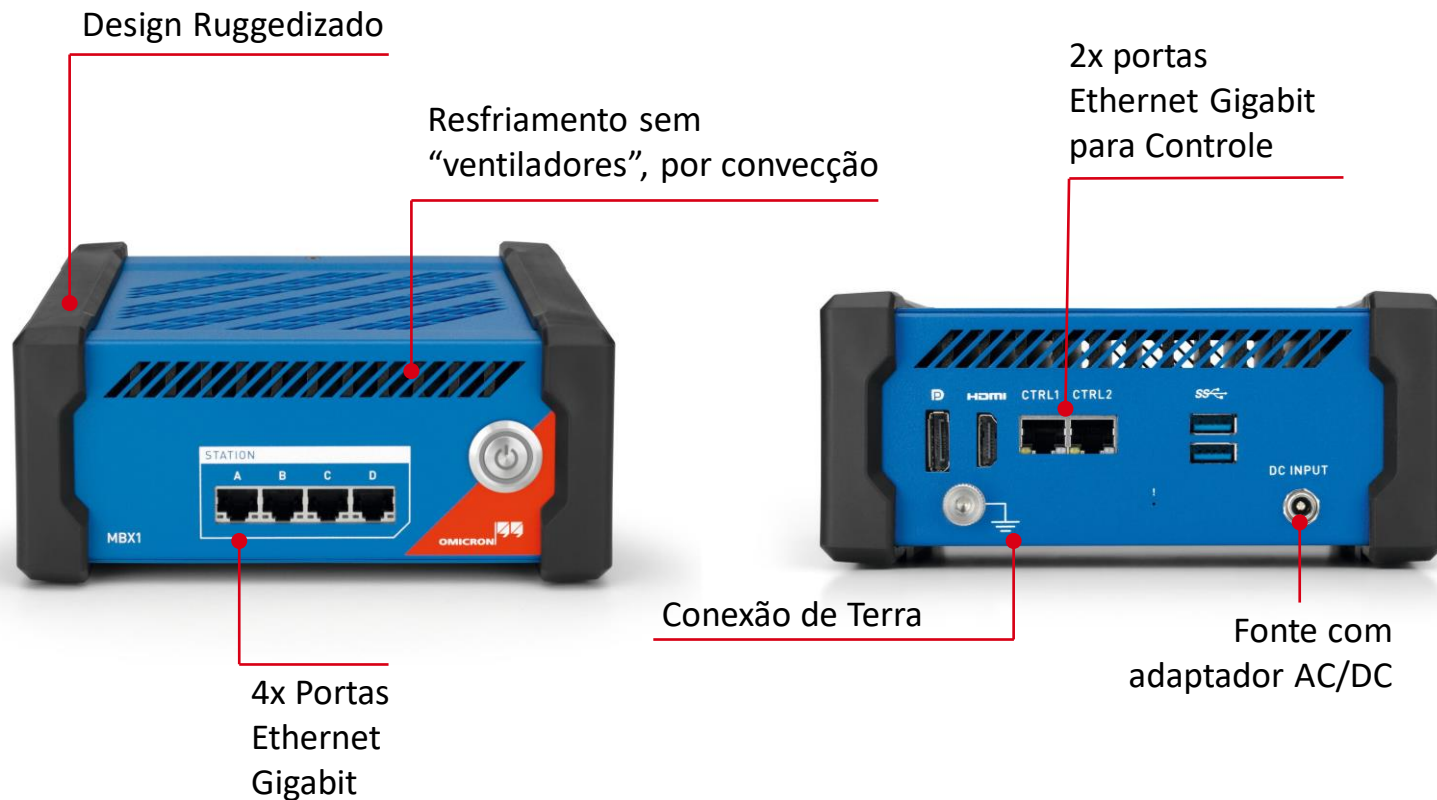
# ► DANEOS pela América Latina

- CFE México
- Transelec Chile
- EPM Colombia
- HMV Ingenieros Colombia
- Controles Uruguayi
- Southern Cooper Peru
- Transener Argentina
- Pro Energy Guatemala
- Siemens Peru
- Minera Escondida Chile
- Codelco Colombia
- etc





# ▶ MBX1



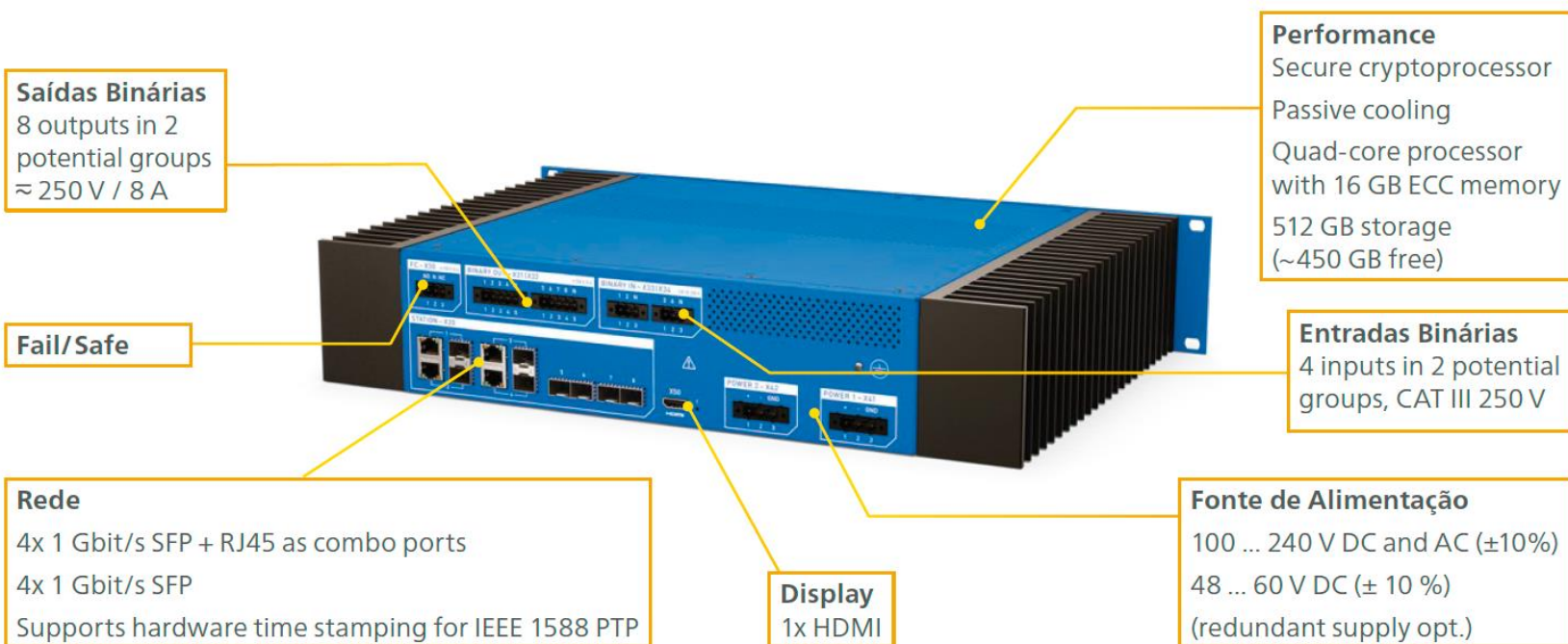
- ▶ Conexão Cyber Segura, Windows PC isolado da rede da subestação
- ▶ Cripto Processador
- ▶ Simulação de dezenas de IEDs
- ▶ Capacidade de processamento em tempo real
- ▶ Licença dentro do equipamento, não fica presa a um PC

- ▶ Hardware portátil projetado para subestações digitais
- ▶ Suporta as soluções de monitoramento e teste:



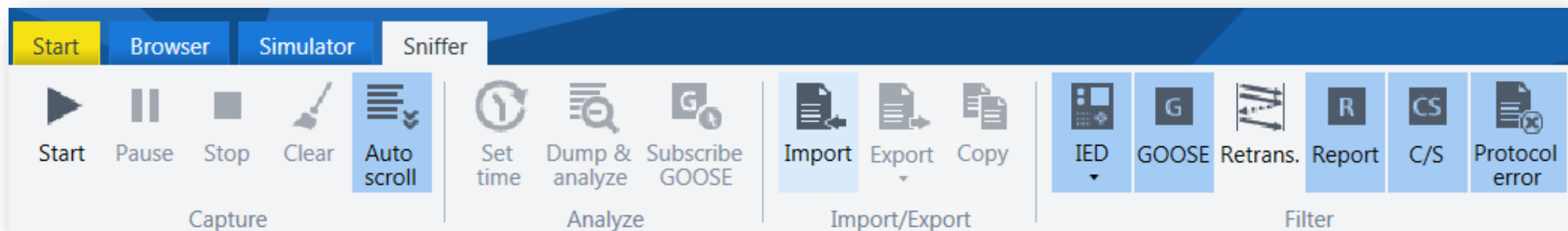
# RBX1

- ▶ Hardware de 19" Cyberseguro (criptoprocessador) projetado para instalação permanente em subestações digitais
- ▶ Processamento em tempo real
- ▶ Suporta as soluções de monitoramento e teste:



# IEDScout

- ▶ Baseado em dados SCL
- ▶ Descoberta/leitura de IEDs
- ▶ Mostra detalhes e descrições
- ▶ Gera arquivos SCL
- ▶ Usado para testes
- ▶ Simulação de IEDs
- ▶ Trabalha com Reports, GOOSE, MMS File Transfer, etc
- ▶ “Arrastar e Soltar” para o Monitor de Atividades
- ▶ Sniffer com filtros avançados para o StationBus





# IEDScout : Multímetro Digital com monitor online

Navegação  
entre  
diferentes  
IEDs  
conectados  
em paralelo

Vista de Detalhes,  
Descrições e Valores

Monitor de Atividades  
Pode usar diferentes  
protocolos (GOOSE, Report,  
Pooling Direto, etc)

The screenshot displays the OMICRON IEDScout software interface. The top menu bar includes options like Start, Browser, Simulator, and Sniffer. The left sidebar shows a tree view of IEDs, with 'P141' selected. The main area is divided into three panels:

- Data Model - Measurements - PriFouMMXU1:** A table showing various measurements and their values.
- Activity Monitor:** A grid of monitors displaying real-time data for different IEDs and protocols.
- Status History:** A table showing the history of status changes.

Name	Description	Value
Mod	Mode	on
Beh	Behaviour	on
TotW	Total real power in a three-phase circuit	228
TotVar	Total reactive power in a three-phase circuit	0
TotVA	Total apparent power in a three-phase circuit	228
TotPF	Average power factor for a three-phase circuit (per unit)	1 cos(phi)
Hz	Frequency	50
PPV	Phase to phase voltages	220 ± 0°; 220 ± -120°; 220 ± 120°
phsAB	Value of phase A to phase B measurement	220 ± 0°
cVal	Deadbanded complex value	220 ± 0°
mag	Deadbanded value	220
f	Floating point value	220
ang	Angle between phase voltage and current	0°
q	Quality of the attribute(s) representing the value of the data	good
Validity		good
Quality Details		
Overflow		false
OutOfRange		false
BadReference		false
Oscillatory		false
Failure		false
OldData		false
Inconsistent		false
Inaccurate		false
Source		process
Test		false
OperatorBlocked		false
t	Timestamp of the last change in one of the attribute(s) representing the value of the data	2021-11-04 11:19:34.520
LeapSecondsKnown		false
ClockFailure		false
ClockNotSynchron...		false
TimeAccuracy		10ms - T0
units	Units of the attribute(s) representing the value of the data	
db	Deadband	1000

Description	Code	Time
A General Interrogation was enforced for Report 'P141System/LLN0.urbA01'.	REP00005	13:03:51
Subscribed GOOSE of IED 'RED670'.	DAT00021	13:04:05
Successfully established connection of IED 'RED670'.	CON00010	13:04:53

# ▶ StationScout

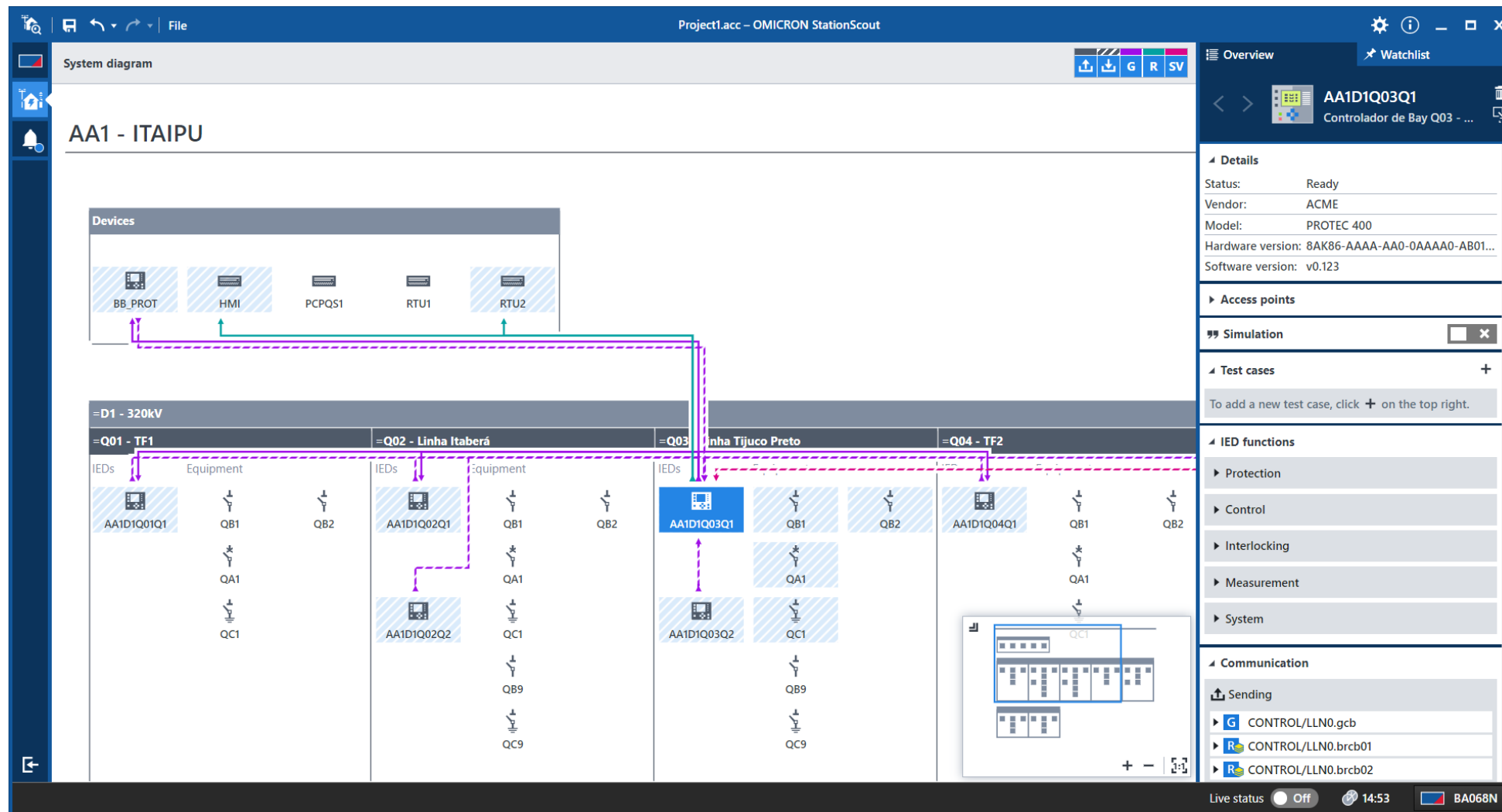


- ▶ ferramenta para monitoramento da rede IEC 61850, observando a subestação como um todo
- ▶ ferramenta para testes de controle automatizados usando mensagens IEC 61850
- ▶ ferramenta para testes de sinalização SCADA automatizados

- ▶ **StationScout simplifica** o monitoramento e de automação, controle e comunicação em sistemas de automação de subestações (SAS)
- ▶ **Status overview:** visualização clara da comunicação IEC 61850 de acordo como os arquivos SCL, valores e estados
- ▶ **Signal tracking:** permite desde uma visão geral até o detalhe de atributos de comunicação ou até mesmo detecção gráfica de falhas
- ▶ **Cyber security:** o hardware BX dedicado garante operação cyber segura
- ▶ **Simulação:** funções de simulação simplificam testes e comissionamento, IEDs fatantes ou IOs podem ser simulados
- ▶ **Definição de nomes próprios:** permite manuseio de equipamentos IEC 61850 de forma confortável ao invés de usar as abreviações do Datamodel dos IEDs
- ▶ **Testes Automatizados:** planos de teste de controle ou de sinalização para Scada podem ser executados automaticamente

# ▶ StationScout: Diagrama Zerofilar

- ▶ Análise de todos os enlaces de comunicação a partir de arquivos SCL
- ▶ **Diagrama Zerofilar** criado automaticamente





# ▶ StationScout (dados de Logical nodes de supervisão)

- ▶ Supervisão automática de dados sistêmicos importantes, LGOS, SLVS, LCCH, LTIM, etc

The screenshot displays the OMICRON StationScout software interface. The main window is titled "Project1.acc - OMICRON StationScout". The left sidebar shows a "System diagram" with a "Devices" section containing icons for ELIPSE, SAGE, and two server icons labeled "...rver\_Primary" and "...er\_Secondary". The main area shows a detailed system diagram for a 110kV system, including bays Q02, Q04, and Q05, with various IEDs (AA1E1Q02BCU, AA1E1Q04BCU, AA1E1Q05BCU) and equipment (QB1, QB2, Q0, QA1, QC1, QC2). A yellow callout box with the text "Ferramenta Ativa! Pooling MMS automático em todos os LNs de supervisão" is overlaid on the right side of the interface.

**Ferramenta Ativa! Pooling MMS automático em todos os LNs de supervisão**

The right sidebar shows the "Overview" tab for the selected logical node "AA1E1Q04BCU". The "System" section displays the following data:

Logical device LN	Local control
Logical device LN	ABB
Physical device information	Ok
Supervision of GOOSE subscription	Receiving
Supervision of GOOSE subscription	Receiving
Supervision of GOOSE subscription	Receiving
Supervision of sampled value subscription	Not received
Supervision of sampled value subscription	Receiving
A Time master supervision 1	20B7C0FFFE00D322
Access point diagnostic for redundant Ethernet ports	S1 Channel live
Access point diagnostic for redundant Ethernet ports	S3 Channel live

The "Communication" section shows the "Sending" status for the "LD0/LLN0.ConvTripGOOSE" message.

# StationScout

- Mostra agora que o IED está subscrevendo um SV em modo simulação

**Ferramenta Ativa!**  
Pooling MMS automático em todos os LNs de supervisão

The screenshot displays the OMICRON StationScout software interface. The main window shows a system diagram with various devices and their connections. The right-hand pane provides a detailed view of the selected device, AA1E1Q04BCU, showing its IED functions and system status.

**System Diagram:**

- Devices: ELIPSE, SAGE, ...rver\_Primary, ...er\_Secondary.
- Equipment: AA1E1Q02BCU, AA1E1Q04BCU, AA1E1Q05BCU, AA1E1Q02MU1, AA1E1Q04MU1, AA1E1Q05SCU1.
- Equipment: QB1, QB2, Q0, QA1, QC1, QC2.

**Device Details (AA1E1Q04BCU):**

- IED functions: Protection, Control, Interlocking, Measurement, Automation.
- System: Logical device LN, Physical device information, Supervision of GOOSE subscription, Supervision of sampled value subscription, A Time master supervision 1, Access point diagnostic for redundant Ethernet ports.

**Supervision Status:**

Supervision	Status
Supervision of GOOSE subscription	Receiving
Supervision of GOOSE subscription	Receiving
Supervision of GOOSE subscription	Receiving
Supervision of sampled value subscription	Not received
Supervision of sampled value subscription	Receiving with simulation flag.

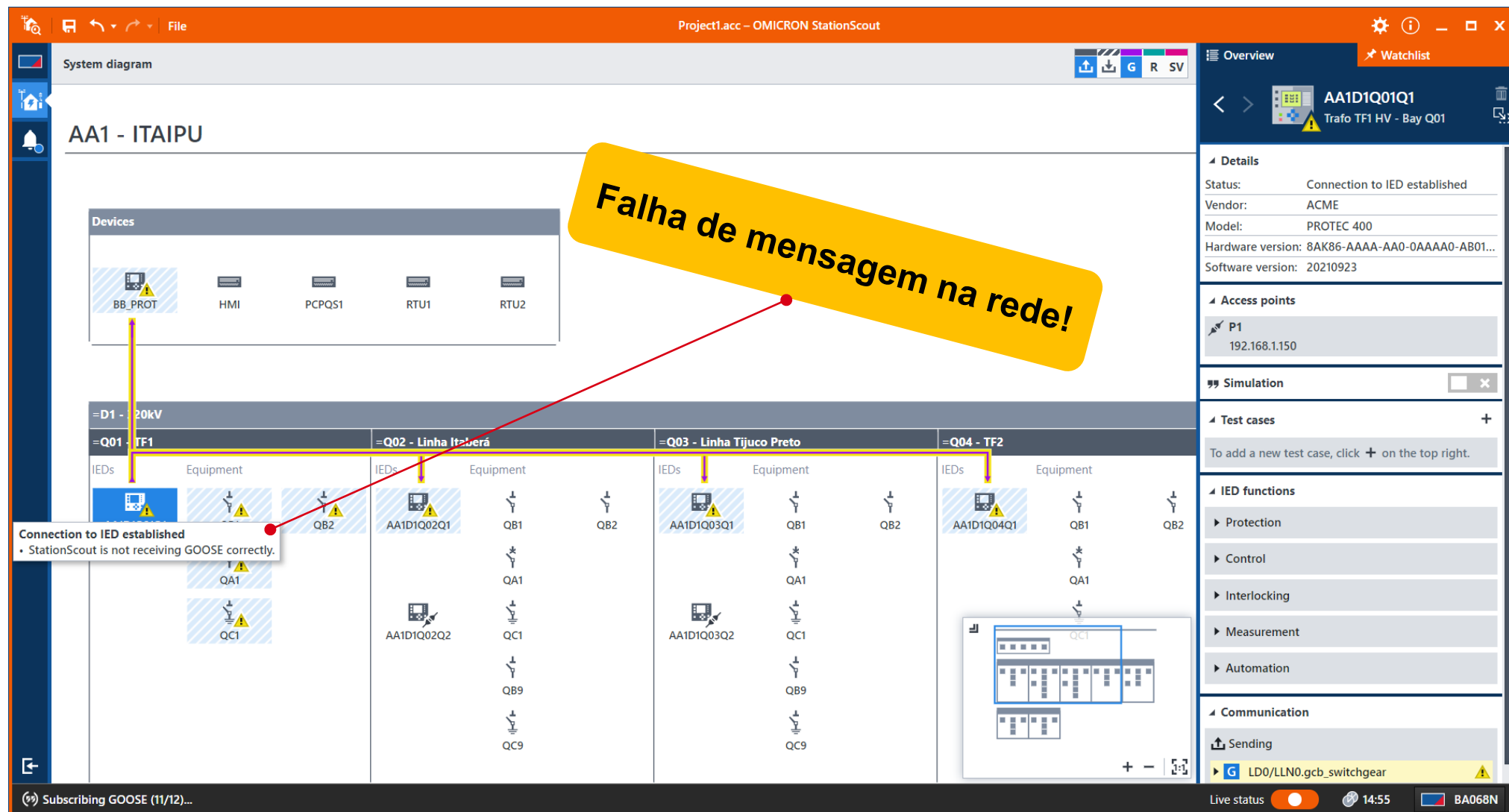
**System Information:**

System	Value
Logical device LN	Local control
Logical device LN	ABB
Physical device information	Ok Receiving simulated GOOSE/SV
Supervision of GOOSE subscription	Receiving
Supervision of GOOSE subscription	Receiving
Supervision of GOOSE subscription	Receiving
Supervision of sampled value subscription	Not received
Supervision of sampled value subscription	Receiving with simulation flag.
A Time master supervision 1	Z0B7C0FFFE00D522
Access point diagnostic for redundant Ethernet ports	S1 Channel live
Access point diagnostic for redundant Ethernet ports	S3 Channel live

**Pode-se entrar nos atributos de cada LN de supervisão e conhecer os detalhes de cada possível falha**

# StationScout

- ▶ Indicação gráfica de falha de comunicação
- ▶ Por análise da rede
- ▶ Por indicação dos Logical Nodes de Monitoramento dos IEDs
- ▶ O operador não precisa ser um especialista para notar uma possível falha



# StationScout

- Subscritor indica falha GOOSE (monitoramento automático LGOS e LSVS)

The screenshot displays the OMICRON StationScout software interface. The main window shows a system diagram titled "AA1 - ITAIPU". A yellow callout box with the text "Falha de mensagem prevista no subscritor!" (Message fault expected in the subscriber!) points to a specific IED in the diagram. The diagram is divided into four sections: "D1 - 20kV", "Q01 - TF1", "Q02 - Linha Itaberá", "Q03 - Linha Tijuco Preto", and "Q04 - TF2". Each section contains a list of IEDs and Equipment. The IEDs are represented by icons with a yellow warning triangle. The Equipment are represented by icons with a green checkmark. A tooltip for the IED "AA1D1Q01Q1" in the "Q01 - TF1" section displays the message: "Connection to IED established" and "Subscribing IEDs are not correctly receiving GOOSE." The right sidebar shows the "Overview" tab for the selected IED "AA1D1Q01Q1". It includes details such as Status (Connection to IED established), Vendor (ACME), Model (PROTEC 400), Hardware version (8AK86-AAAA-AA0-0AAAA0-AB01...), and Software version (20210923). The bottom status bar shows "Subscribing GOOSE (11/12)..." and "Live status" with a red indicator.

Project1.acc – OMICRON StationScout

System diagram

AA1 - ITAIPU

Devices

BB\_PROT HMI PCPQS1 RTU1 RTU2

Falha de mensagem prevista no subscritor!

=D1 - 20kV

=Q01 - TF1

IEDs Equipment

AA1D1Q01Q1 QB1 QA1 QC1

Connection to IED established

- Subscribing IEDs are not correctly receiving GOOSE.

AA1D1Q02Q2 QA1 QB9 QC9

=Q02 - Linha Itaberá

IEDs Equipment

AA1D1Q03Q1 QB1 QA1 QC1 QB9 QC9

=Q03 - Linha Tijuco Preto

IEDs Equipment

AA1D1Q04Q1 QB1 QA1 QC1 QB9 QC9

=Q04 - TF2

Overview

AA1D1Q01Q1

Trafo TF1 HV - Bay Q01

Details

Status: Connection to IED established

Vendor: ACME

Model: PROTEC 400

Hardware version: 8AK86-AAAA-AA0-0AAAA0-AB01...

Software version: 20210923

Access points

P1

192.168.1.150

Simulation

Test cases

To add a new test case, click + on the top right.

IED functions

- Protection
- Control
- Interlocking
- Measurement
- Automation

Communication

Sending

LD0/LLN0.gcb\_switchgear

Live status

14:54

BA068N

OMICRON



# StationScout

## Descrição detalhada do diagnóstico da falha

The screenshot displays the OMICRON StationScout software interface. The main window shows a system diagram for 'AA1 - ITAIPU' with a 'Devices' section containing BB\_PROT, HMI, PCPQS1, RTU1, and RTU2. Below this, there are four columns representing different equipment sections: =D1 - 20kV, =Q01 - TF1, =Q02 - Linha Itaberá, =Q03 - Linha Tijuco Preto, and =Q04 - TF2. Each column contains a list of IEDs and Equipment. A yellow callout box with the text 'Diagnóstico!' points to the BB\_PROT device. A red line connects this callout to the 'GOOSE warning' message in the right-hand pane. The 'GOOSE warning' message is titled 'AA1D1Q01Q1 LD0/LLN0.gcb\_switchgear' and lists three issues: 'Received VLAN ID '1' does not match VLAN ID '0' defined in SCL file.', 'Received destination MAC address '01:0C:CD:01:00:03' does not match destination MAC address '01:0C:CD:01:00:01' defined in SCL file.', and 'Received configuration revision '5,000' does not match configuration revision '3,000' defined in SCL file. Imported SCL file is not up to date.' The 'Details' section shows the status as 'GOOSE warning', enabled as 'True', and provides various configuration parameters. The 'Live status' section shows the entry time as '2022-11-28 15:05:16.339-0...' and a remaining time to live indicator. The 'Communication' section shows the live status as 'On' and the subscribers list.

**Diagnóstico!**

**GOOSE warning**

- Received VLAN ID '1' does not match VLAN ID '0' defined in SCL file.
- Received destination MAC address '01:0C:CD:01:00:03' does not match destination MAC address '01:0C:CD:01:00:01' defined in SCL file.
- Received configuration revision '5,000' does not match configuration revision '3,000' defined in SCL file. Imported SCL file is not up to date.

**Details**

Status:	GOOSE warning
Enabled:	True
Control block reference:	AA1D1Q01Q1LD0/LLN0\$G...
Destination MAC address:	01:0C:CD:01:00:01
Application ID:	1 (0001hex)
GOOSE ID:	GoID
Dataset reference:	AA1D1Q01Q1LD0/LLN0\$g...
VLAN ID:	0 (000hex)
VLAN priority:	4
Configuration revision:	3 000

**Live status**

Entry time:	2022-11-28 15:05:16.339-0...
Status number:	1
Sequence number:	194
Time allowed to live (ms):	4 096
Remaining time to live:	

**Communication**

Subscribers

Live status 14:55 BA068N

(29) Subscribing GOOSE (11/12)...

# StationScout

## Indicação clara e gráfica de problemas de sincronismo de tempo

The screenshot displays the StationScout software interface for 'Project1.acc - OMICRON StationScout'. The main window shows a 'System diagram' with a hierarchical view of the power system. A red box highlights a specific device, 'AA1D1Q03Q1', which is a switch controller. A tooltip for this device shows the following information:

- Value: Closed
- Quality: Good
- Time: 2022-11-28 15:14:32.985-03:00
- Accuracy: Unspecified
- Status: ⚠ Clock not synchronized ⚡ Real signal

The right-hand panel provides an 'Overview' of the selected device, including communication details (Sending: CONTROL/LLN0.gcb) and associated signals. A red circle highlights a warning icon (⚠) next to the signal 'QA1: Posição do Controlador de Chave' at 15:14:32, indicating a time synchronization issue.

The bottom status bar shows 'Subscribing GOOSE (11/12)...', 'Live status' toggle, and the time '14:58'.

# StationScout

## Indicação clara de problemas nos bits de qualidade

Project1.acc – OMICRON StationScout

System diagram

AA1 - ITAIPU

Devices: BB\_PROT, HMI, PCPQS1, RTU1, RTU2

IEDs: AA1D1Q02Q1, AA1D1Q02Q2, AA1D1Q03Q1, AA1D1Q03Q2, AA1D1Q04Q1, AA1D1Q05Q1

Equipment: QB1, QB2, QA1, QC1, QC9

QA1: Posição do Controlador de Chave

Value: **Bad state**

Quality: **Invalid, Out of range, Old data, Failure**

Time: 2022-11-28 15:15:25.404-03:00

Accuracy: ≤ 10 ms (T0)

Status: **Real signal**

Overview

AA1D1Q02Q1  
QA1

Communication

Sending

CONTROL/LLN0.gcb

Associated signals

QA1: Intertravamento

True	QA1: Habilitado para Fechar	13:56:29
True	QA1: Habilitado para Abrir	13:56:29

QA1: Controlador de Chave

QA1: Posição do Controlador de Chave

15:15:25

QA1: Religamento Automático

False	QA1: Operação	13:56:29
Pronto	QA1: Status do Religamento	13:56:29

QA1: Verificação de Sincronismo

True	QA1: Desbloqueio	13:56:29
------	------------------	----------

QA1: Disjuntor

QA1: Posição do Disjuntor

15:15:25

Live status On 14:59 BA068N

OMICRON

# StationScout

- Indicação clara e gráfica de modo Teste / Blocked / Test-Blocked de certo Logical Node

The screenshot displays the StationScout software interface. The main window shows a system diagram for 'AA1 - ITAIPU' with various equipment and logical nodes. A detailed view of a logical node, 'AA1H1Q01Q1' (Trafo TF1 LV - Bay Q01), is shown on the right. This view includes sections for 'Simulation', 'Test cases', 'IED functions', 'Protection', 'Control', and 'Interlocking'. The 'Control' section lists various functions, including 'QC9: Controlador de Chave', 'QA1: Controlador de Chave', 'QB1: Controlador de Chave', 'QB2: Controlador de Chave', 'QA1: Disjuntor', 'QC9: Chave de aterramento', 'QB1: Seccionadora', and 'QB2: Seccionadora'. A red circle highlights the 'QB1: Controlador de Chave' function, which is in 'Test' mode, indicated by a yellow warning icon and a tooltip that reads 'The function is in mode 'Test''.

Project1.acc - OMICRON StationScout

System diagram

AA1 - ITAIPU

Devices

- BB\_PROT
- HMI
- PCPQS1
- RTU1
- RTU2

Overview

AA1H1Q01Q1

Trafo TF1 LV - Bay Q01

Simulation

Test cases

To add a new test case, click + on the top right.

IED functions

Protection

Sobrecorrente Temporizada 1800 A Para Frente

Trip de Proteção Trip Mono/Tri

Control

QC9: Controlador de Chave

QA1: Controlador de Chave

QB1: Controlador de Chave

QB2: Controlador de Chave

QA1: Disjuntor

QC9: Chave de aterramento

QB1: Seccionadora

QB2: Seccionadora

Interlocking

Live status On 14:55 BA068N



# StationScout

## Supervisão dos LNs de sincronismo de tempo

The screenshot displays the OMICRON StationScout software interface. The main window is titled "Project1.acc - OMICRON StationScout". The left sidebar shows a "System diagram" view with a "Devices" section containing icons for ELIPSE, SAGE, and two clock icons labeled "...rver\_Primary" and "...er\_Secondary". Below this, a table shows the system configuration for a 110kV system, divided into three bays: Q02, Q04, and Q05. Each bay contains a list of IEDs and equipment. A red circle highlights a "GOOSE warning" message in the "Details" panel on the right, which states: "Clock error reported by IED: Issue with IED's time synchronization settings possible." The "Details" panel also shows various parameters for the GOOSE message, including Status, Enabled, Control block reference, Destination MAC address, Application ID, GOOSE ID, Dataset reference, VLAN ID, VLAN priority, and Configuration revision. The "Live status" section shows the entry time, status number, sequence number, time allowed to live, and remaining time to live. The "Communication" section shows the subscribers, and the "Transmitted signals" section shows the single, two or three pole tripping logic.

**System diagram**

**Devices**

- ELIPSE
- SAGE
- ...rver\_Primary
- ...er\_Secondary

**=E1 - 110kV - 110 kV**

=Q02 - Bay 0...	=Q04 - Bay 0...	=Q05 - Bay 05 Coupling
<b>IEDs</b>	<b>IEDs</b>	<b>IEDs</b>
AA1E1Q02BCU	AA1E1Q04BCU	AA1E1Q05BCU
AA1E1Q02MU1	AA1E1Q04MU1	AA1E1Q05SCU1
		<b>Equipment</b>
		QB1
		Q0
		QC1
		QB2
		QA1
		QC2

**Overview**

**AA1E1Q02BCU**

**LD0/LLN0.DigTripGOOSE**

**GOOSE warning**

- Clock error reported by IED: Issue with IED's time synchronization settings possible.

**Details**

Status: GOOSE warning

Enabled: True

Control block reference: AA1E1Q02BCULD0/LLN0\$GO\$DigTripGOOSE

Destination MAC address: 01:0C:CD:01:00:22

Application ID: 34 (0022<sub>hex</sub>)

GOOSE ID: AA1E1Q02BCULD0/LLN0.DigTripGOOSE

Dataset reference: AA1E1Q02BCULD0/LLN0\$DigTripGOOSE\_DS

VLAN ID: 5 (005<sub>hex</sub>)

VLAN priority: 6

Configuration revision: 1

**Live status**

Entry time: 2020-10-07 04:38:37.271-03:00

Status number: 24

Sequence number: 610

Time allowed to live (ms): 4 400

Remaining time to live:

**Communication**

**Subscribers**

- AA1E1Q04BCU

**Transmitted signals**

Single, two or three pole tripping logic

Live status **On**

20:28

AK031G

98%

POR 20:24

PTB2 29/11/2022

# StationScout

- Supervisão detalhada de Mode, Beh, Sim, com opção de controle

The screenshot displays the OMICRON StationScout software interface. The main window is titled "Project1.acc - OMICRON StationScout". The left sidebar shows a "System diagram" view. The central area displays a "Devices" section with icons for ELIPSE, SAGE, and two clock icons labeled "...rver\_Primary" and "...er\_Secondary". Below this, a table lists various components:

=E1 - 110kV - 110 kV		=Q02 - Bay 0...		=Q04 - Bay 0...		=Q05 - Bay 05 Coupling	
IEDs		IEDs		IEDs		Equipment	
AA1E1Q02BCU	AA1E1Q04BCU	AA1E1Q05BCU	QB1	QB2			
AA1E1Q02MU1	AA1E1Q04MU1	AA1E1Q05SCU1	Q0	QA1			
			QC1	QC2			

The right sidebar shows the "Overview" section for the "Logical device LN" (LD0/LLN0). It includes details such as Value (ABB), Category (System), and Behavior (On). Below this, there are sections for "Test cases" and "Communication". The "Associated signals" section is highlighted with a red circle, showing the following data:

Logical device LN	
on	LD0 - Mode
on	LD0 - Behaviour

The bottom status bar indicates "Live status On" and shows the time as 20:34. The Windows taskbar at the bottom shows the system clock as 20:30 on 29/11/2022.

# StationGuard

## Detecção de Intrusões e Monitoramento Funcional

### PASSIVO

- ▶ Mirror-Port do switch da subestação ou Network TAP
- ▶ Nenhuma interferência na comunicação do Station e Process Bus
- ▶ Sem bloqueios de comunicação (IDS)
- ▶ Apenas alarmes
- ▶ Também usa o diagrama Zerofilar
- ▶ Integração nos sistemas SIEM
  - ▶ Usando o protocolo syslog e plug-ins
- ▶ Integração em sistemas de tickets / ordens de serviço
  - ▶ Usando plug-ins e funções de exportação
- ▶ Integração em sistemas SCADA usando saídas binárias, MMS ou SNMP
  - ▶ Maneira fácil de colocar o status do IDS na sala de controle

# IDS

## Princípio Operativo

CYBERSECURITY  
FRAMEWORK  
VERSION 1.1

DETECT



# ► A solução StationGuard

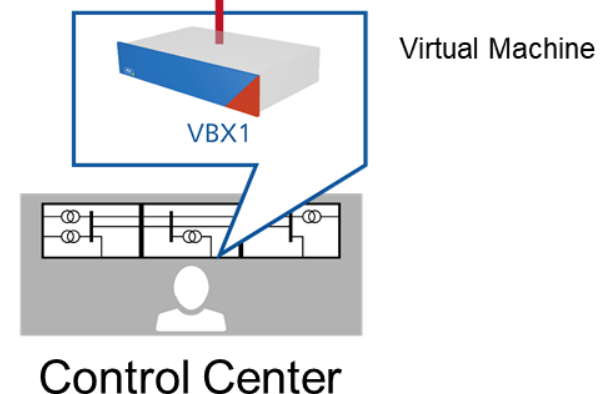
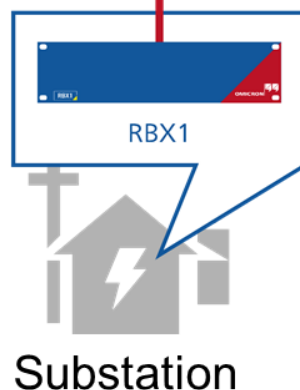
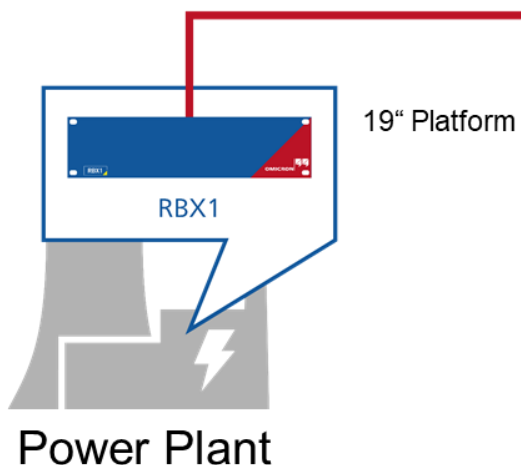
## ► GridOps

- Dashboard de gerenciamento de sensores RBX1
- Alarmes intuitivos
- Gerenciamento de vulnerabilidades



Central Management System

StationGuard Sensors



## ► VBX1

- Possibilidade de instalação do StationGuard em plataformas existentes usando máquina virtual



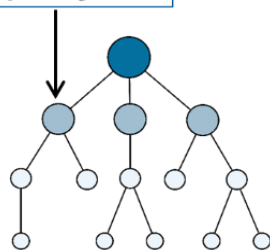
# Detecção de Intrusões

## StationGuard

### DEEP PACKAGE INSPECTION (verifica o conteúdo do layer de Aplicação)

OSI Layer	Example for Protocol / Technology	Component
7 Application end user layer	MMS	
6 Presentation syntax layer, encryption, authentication	ASN.1	
5 Session synch / send to ports, connection management	Session, RFC 1006	
4 Transport end-to-end connections, error control	TCP	
3 Network packets, routing and switching	IP	Router
2 Data Link frames, data flow control	Ethernet	Switch
1 Physical physical structure, transmission of bits	Coax, Fiber Optic	Cable, Hub

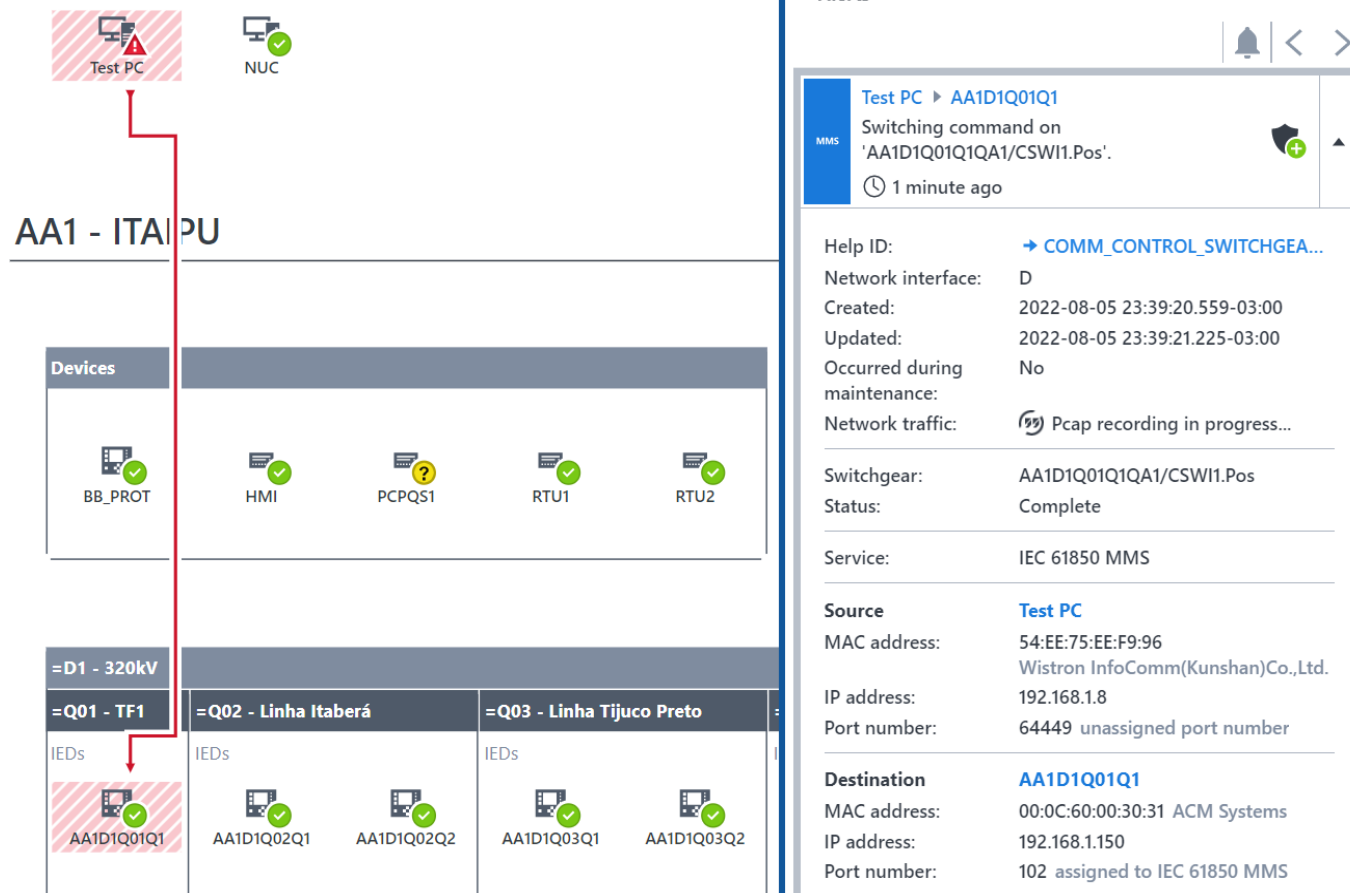
Fonte/Dest. MAC + Fonte/Dest. IP + VLAN + Porta Eth + Aplicação



Lista branca de permissões

# IDS

## Inspeção Profunda de Alarmes



# ▶ Monitoramento Funcional (o que realmente nos interessa neste Workshop)

## ▶ StationGuard

### ▶ Monitoramento Funcional da rede da subestação

- ▶ Uma vez que o conteúdo espelhado do tráfego da subestação estiver disponível para um sensor IDS, pode-se explorar ainda mais o layer de aplicação das mensagens de forma a detectar e alarmar até mesmo falhas funcionais na rede, como por exemplo a análise de bits de qualidade de mensagens, indicando por exemplo que um IED está publicando certo tráfego com indicação de falha de sincronismo de tempo, ou com qualidade indicando overflow de uma medição, entre outras possibilidades

⚠	2020-10-31 10:42:15.255Z	G	AA1D1Q01Q1 ▶ GOOSE multicast Configuration revision (ConfRev) newer than expected in GOOSE 'AA1D1Q01Q1LD0/LLN0\$GO\$gcb_switchgear'.
⚠	2020-10-31 10:42:15.255Z	G	AA1D1Q01Q1 ▶ GOOSE multicast Wrong VLAN identifier in GOOSE 'AA1D1Q01Q1LD0/LLN0\$GO\$gcb_switchgear'.
⚠	2020-10-31 10:42:15.255Z	G	AA1D1Q01Q1 ▶ GOOSE multicast Wrong destination MAC address in GOOSE 'AA1D1Q01Q1LD0/LLN0\$GO\$gcb_switchgear'.
⚠	2020-10-31 10:40:25.165Z	G	AA1D1Q03Q1 ▶ GOOSE multicast Unknown GOOSE 'AA1D1Q03Q1Protection/LLN0\$GO\$gcb_2' found on network.
⚠	2020-10-31 10:09:52.866Z	CS	Test PC ▶ AA1D1Q01Q1 Switching command on 'AA1D1Q01Q1QA1/CSWI1.Pos'.
⚠	2020-10-31 09:32:43.987Z	G	AA1D1Q03Q1 ▶ GOOSE multicast IED indicates time synchronization failure (ClockNotSynchronized) in GOOSE 'AA1D1Q03Q1CONTROL/LLN0\$GO\$gcb



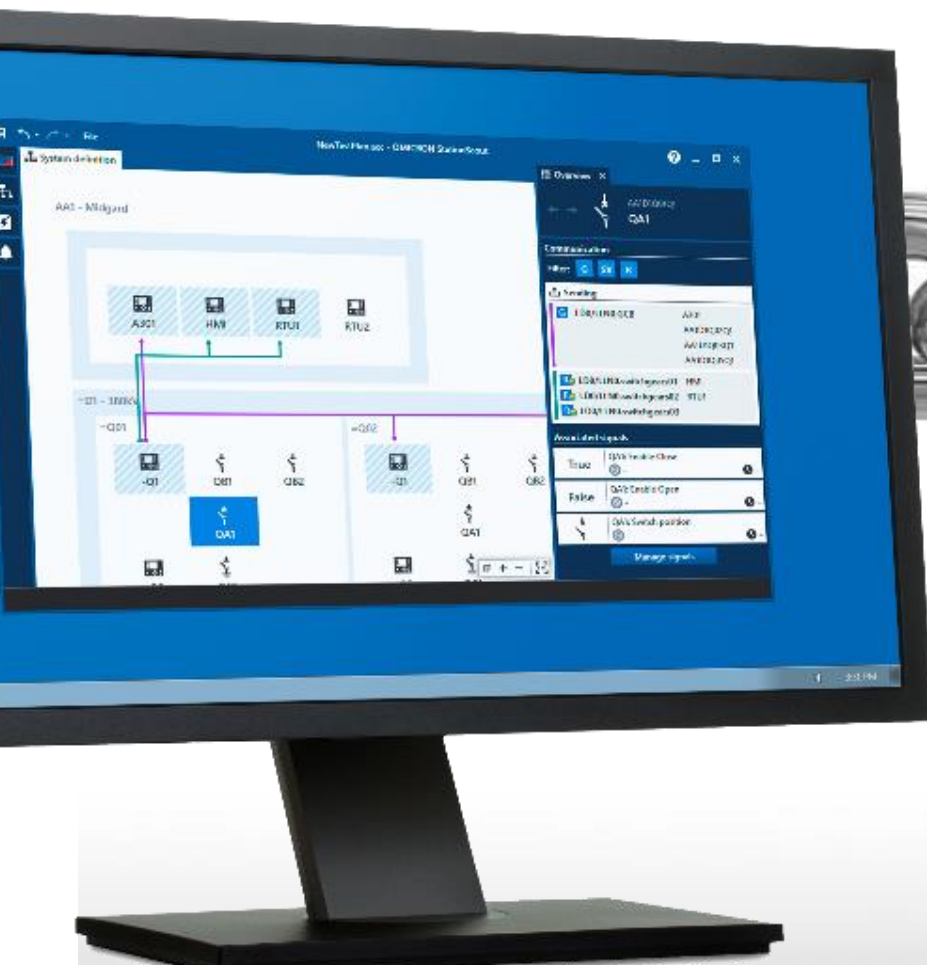
**Detalhes &  
resultados obtidos**



# ► Monitoramento Ideal



- União do monitoramento da rede mais o monitoramento dos próprios IEDs!





StationScout\_Cigré.acc – OMICRON StationScout

System diagram

## SAS Cigré - Sistema de Monitoramento OMICRON - StationScout

SE Floripa

525

Bay

Bay SEL

Bay GE

MUPMN2\_5D1

MUPMN2\_5L1

PMN2\_5L1

MU1

MU2

RL1

L90

MU320\_52A

MU320\_52C

Overview

Watchlist

Bay Siemens

Connection (MMS)

Simulation

Appearance

Content alignment

Vertical

Horizontal

Icon

Test cases

No test cases found.

Communication

Sending

- Application/LLN0.Control\_DataSet
- Application/LLN0.Control\_DataSet
- Application/LLN0.Control\_DataSet
- Application/LLN0.Control\_DataSet\_1
- Application/LLN0.Control\_DataSet\_1
- ComSupervision\_GOOSE/LLN0.Control\_DataSet
- Application/LLN0.A\_BRCB\_101
- Application/LLN0.A\_BRCB\_101
- Application/LLN0.A\_BRCB\_101
- Application/LLN0.A\_BRCB\_201

Show all (175)

Receiving

- MUPMN2\_5D1
- MUPMN2\_5L1
- PMN2\_5L1

Live status Off 14:37 BA068N

Sistema **StationScout** usado neste Workshop

**SIEMENS**

**OMICRON**

StationScout\_Cigré.ac – OMICRON StationScout

System diagram

## SAS Cigré - Sistema de Monitoramento OMICRON - StationScout

SE Floripa

525 kV

Bay Siemens

MUPMN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

Bay

MU1 MU2 RL1

Bay GE

L90 MU320\_52A MU320\_52C

Overview Watchlist

Bay SEL

Connection (MMS)

Simulation

Appearance

Content alignment

Vertical Horizontal

Icon

Test cases

No test cases found.

Communication

Sending

- CFG/LLN0.MU1\_GOOSE\_PB
- CFG/LLN0.MU2\_GOOSE\_PB
- CFG/LLN0.RL1\_GOOSE\_PB
- CFG/LLN0.Monitoring\_DEVICE
- CFG/LLN0.Monitoring\_DEVICE
- CFG/LLN0.Monitoring\_DEVICE
- CFG/LLN0.Monitoring\_ETH\_PRP
- CFG/LLN0.Monitoring\_FunctionTime
- CFG/LLN0.Monitoring\_FunctionTime
- CFG/LLN0.Monitoring\_FunctionTime

Show all (27)

Receiving

- MU1
- MU2
- RL1

Live status Off 14:37 BA068N

Sistema **StationScout** usado neste Workshop



StationScout\_Cigré.ace – OMICRON StationScout

System diagram

SE Floripa

525 kV

Bay Siemens

MUPMN2\_5D1

MUPMN2\_5L1

PMN2\_5L1

Bay SEL

MU1

MU2

RL1

Bay GE

L90

MU320\_52A

MU320\_52C

Overview

Watchlist

Bay GE

Connection (MMS)

Simulation

Appearance

Content alignment

Vertical

Horizontal

Icon

Test cases

No test cases found.

Communication

Sending

CTRL/LLN0.FastGOOSE1

CTRL/LLN0.FastGOOSE1

Master/LLN0.GoCB01

Master/LLN0.GoCB02

Master/LLN0.GoCB03

Master/LLN0.GoCB04

Master/LLN0.GoCB05

Master/LLN0.GoCB06

Master/LLN0.GoCB07

Master/LLN0.GoCB08

Show all (68)

Receiving

L90

MU320\_52A

MU320\_52C

Live status

Off

14:38

BA068N

Sistema **StationScout** usado neste Workshop



OMICRON StationGuard

System diagram

Bay SEL

RL1 MU2 MU1

Bay GE

L90 MU320\_52A MU320\_52C

Bay Siemens

MUPMN2\_5D1 PMN2\_5L1 MUPMN2\_5L1

OMICRON

DANEO 400 RBX1 OTMC 100p CMC850 João Laptop BRS30 RSP35 MAR1040 MBX1

SEL

...AMENTO SEL ...CH PRP A SEL GNSS SEL ...suário SEL #3 ...suário SEL #2 ...suário SEL #6 ...ipamento SEL SWITCH SB SEL ...suário SEL #1 ...genharia SEL ...CH PRP B SEL

GE

GNSS GE ...Usuário GE #1 ...CH PRP B GE ...CH PRP A GE

Cepel

...CH SB GERAL ...LETROSUL #1 ...LETROSUL #2 SCADA SAGE ...PRP A GERAL ...PRP B GERAL

Siemens

GNSS SIEMENS ...P B SIEMENS ...SIEMENS #2 ...P A SIEMENS GNSS Siemens ...TO SIEMENS ...SIEMENS #4 ...o SIEMENS #1 ...TO SIEMENS ...SB SIEMENS

Alerts

- Notebook Usuário SIEMENS #4 ▶ U126  
Checked connection status.  
28 seconds ago
- Notebook Usuário SIEMENS #4 ▶ U126  
'Manufacturing Messaging Specification' network traffic detected.  
33 seconds ago
- Notebook Usuário SIEMENS #4 ▶ U126  
Checked connection status.  
33 seconds ago

Apply configuration

Live status Off Maintenance Off 12:17 AK031G

Sistema **StationGuard** usado neste Workshop





Aproximadamente **50** testes

**3** ferramentas de **Monitoramento**

Seleção resultados a serem apresentados

# Ausência de GOOSE e SV na rede e no assinante



Ausência de Goose no DANE0

Ausência de Mensagens Previstas

Measurement System System Under Test Network Diagram **Supervision** Recording Observation

Start Stop Clear Delete all Devices Severity Category

Event list Configuration Actions

Date and time	Device	Category	Type	Description
03/08/2023 10:13:38,250	Oraculo IEC (DJ160G)	GOOSE	Time to live expired	MU1CFG/LLN

Control block attributes

Severity	Error
Date and time	03/08/2023 10:13:38,250
Device	Oraculo IEC (DJ160G)
Category	GOOSE
Type	Time to live expired
Port	A
Control block reference	MU1CFG/LLN0\$GO\$MU1_GOOSE_PB
Destination MAC address	01-0C-CD-01-00-11
Source MAC address	00-30-A7-17-CB-EB
Application ID	4113
GOOSE ID	MU1
DataSet reference	MU1CFG/LLN0\$GOOSE_PB
Simulation	False
Status number	489
Sequence number	1041
Time to live	2000 ms

DANE0400\_Cigre\_SEL.dac

Measurement System System Under Test Network Diagram Supervision Recording Observation

Import SCL Add IED Remove IED Discover IED Remove Verification Find orphans Clear orphans Reset values

MUPMN2\_SL1

IED properties

- GOOSE
  - LD Application
    - G LLN0.Control\_DataSet
    - G LLN0.Control\_DataSet\_1
- Sampled Values
  - LD Mod2\_MU1
    - SV MUP5AX\_E\_ST1
- Data Model
  - LD Application
  - LD BinIO
  - LD BinIO\_BinaryInputs
  - LD BinIO\_BinaryOutputs
  - LD Mod1
  - LD Mod1\_Channel1
  - LD Mod2
  - LD Mod2\_Channel1
  - LD Mod2\_MU1
  - LD PowS
  - LD PowS\_MeasPointI3ph1
  - LD Rec
  - LD Rec\_FaultRecorder
  - LD ComSupervision
  - LD ComSupervision\_GOOSE
  - LD PowS\_MeasPointV3ph1
  - LD PowS\_MeasPointV1ph1

G MUPMN2\_SL1Application/LLN0\$GO\$Control\_DataSet

Control block attributes

Control block reference	MUPMN2_SL1Application/LLN0\$GO\$Control_DataSet
Destination MAC address	01-0C-CD-01-00-30
Application ID	4144 (0x1030)
GOOSE ID	MUPMN2_SL1/Application/LLN0/Control_DataSet
DataSet reference	MUPMN2_SL1Application/LLN0\$DataSet
VLAN ID	300
VLAN priority	4
Needs commissioning	False
Configuration revision	260001

Packet information

Source MAC address	B4-B1-5A-09-B3-E6
Simulation	False
Entry time	2023-08-04 11:26:45.749
Status number	1
Sequence number	141
Time to live	3000 ms
Number of DataSet entries	100

Statistics

	A	B
Receive time	2023-08-04 11:31:08.617	2023-08-04 11:31:12.617
Packet count	8	10
Status changes seen	0	0
Status changes missed	0	0
Retransmissions missed	0	0
Duplicates seen	0	0
Time to live expired	True	True
Time to live expired count	1	1
Packet delay:		

# Ausência de GOOSE e SV na rede e no assinante

## Ausência de Mensagens Previstas na Rede



Ausência de SV no DANE0

Measurement System System Under Test Network Diagram Supervision Recording

Start Stop Clear Delete all Devices Severity Category

Event list Configuration Actions

Date and time	Device	Category	Type
2023-08-04 17:35:04.347	Oraculo IEC (DJ160G)	Sampled Values	Timeout
2023-08-04 17:35:04.215	Oraculo IEC (DJ160G)	Sampled Values	Timeout

Control block attributes

Severity	Error
Date and time	2023-08-04 17:35:04.215
Device	Oraculo IEC (DJ160G)
Category	Sampled Values
Type	Timeout
Port	B
SV ID	MUP5AX_E_ST1
Destination MAC address	01-0C-CD-04-00-30
Source MAC address	B4-B1-5A-09-B3-E6
Application ID	16447
Simulation	False
Timed out count	1

DANE0400\_Cigre\_Siemens.dac - O

Measurement System System Under Test Network Diagram Supervision Recording Observation

Import SCL Add IED Remove IED Discover IED Remove Verification Find orphans Clear orphans

MUPMN2\_5L1

IED properties

- GOOSE
  - LD Application
    - LLN0.Control\_DataSet
    - LLN0.Control\_DataSet\_1
  - Sampled Values
    - LD Mod2\_MU1
      - SV MUP5AX\_E\_ST1
  - Data Model
    - LD Application
    - LD BinIO
    - LD BinIO\_BinaryInputs
    - LD BinIO\_BinaryOutputs
    - LD Mod1
    - LD Mod1\_Channel1
    - LD Mod2
    - LD Mod2\_Channel1
    - LD Mod2\_MU1
    - LD PowS
    - LD PowS\_MeasPointI3ph1
    - LD Rec
    - LD Rec\_FaultRecorder
    - LD ComSupervision
    - LD ComSupervision\_GOOSE
    - LD PowS\_MeasPointV3ph1
    - LD PowS\_MeasPointV1ph1

DataSet reference: MUPMN2\_5L1Mod2\_MU1/LLN0\$PhsMeas3

VLAN ID: 300

VLAN priority: 6

Configuration revision: 90001

Optional fields: Gmlidentity

Packet information

Source MAC address: B4-B1-5A-09-B3-E6

Simulation: False

Synchronization status: Globally synchronized (2)

Grandmaster clock ID: 00-03-C7-FF-FE-01-72-90

Number of DataSet entries: 16

Statistics

	A	B
Receive time	2023-08-04 17:35:04.136	2023-08-04 17:35:04.136
Samples seen	63790	64426
Samples missed	0	0
Sampling rate	4.800 kHz	4.800 kHz
Last packet smpCnt=0	2023-08-04 17:35:04.002	2023-08-04 17:35:04.002
Clock drift (current)	-192.00 ns	224.00 ns
Clock drift (since start)	-40.00 ns	256.00 ns
Timed out	True	True
Timed out count	1	1
Packet interval:		
Minimum	269.20 µs	298.33 µs
Maximum	564.08 µs	535.04 µs
Average	416.67 µs	416.67 µs
Packet delay:		
Minimum	1.31 ms	1.31 ms
Maximum	1.47 ms	1.45 ms
Average	1.33 ms	1.33 ms

2 Messages

# Ausência de GOOSE e SV na rede e no assinante



Ausência de Mensagens Previstas na rede

The screenshot shows a network management interface with a blue header bar. The main content area has a yellow banner at the top with a warning icon and the text "GOOSE timeout" and "Previously present GOOSE message not available anymore." Below this is a "Details" section with a table of GOOSE message parameters. At the bottom, there is a "Live status" section with a table of GOOSE message status parameters. A blue banner at the very bottom states "No VLAN information available."

Details	
Status:	GOOSE timeout
Control block reference:	MUPMN2_5L1Application/LLN0\$GO\$Control_DataSet_1
Destination MAC address:	01:0C:CD:01:00:31
Application ID:	4 145 (1031 <sub>hex</sub> )
GOOSE ID:	MUPMN2_5L1/Application/LLN0/Control_DataSet_1
Dataset reference:	MUPMN2_5L1Application/LLN0\$DataSet_1
VLAN ID:	300 (12 <sub>hex</sub> )
VLAN priority:	4
Configuration revision:	10 001

Live status	
Entry time:	2023-08-04 11:26:45.749-03:00
State number:	1
Sequence number:	63
Time allowed to live (ms):	3 000
Remaining time to live:	

GOOSE antes lido no SS não está mais presente na rede



# Ausência de GOOSE e SV na rede e no assinante

Ausência de Mensagens Previstas na Rede



LGOS indica ausência de GOOSE no assinante (MU Desconectada)

StationScout\_Cigré.acc - OMICRON StationScout

System diagram

## SAS Cigré - Sistema de Monitoramento OMICRON - StationScout

SE Floripa

525 kV

Bay

MUPMN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

Bay SEL

MU1 MU2 RL1

Bay GE

L90 MU3

Overview

PMN2\_5L1  
SIEMENS 7SL87

IED functions

- Protection
- Control
- Interlocking
- Measurement
- Automation

System

Logical device LN	SIEMENS
Physical device LN	Ok
Time master supervision	0003C7FFFE017290
GOOSE subscription 1	Not received
GOOSE subscription 2	Receiving
GOOSE subscription 3	Not received
GOOSE subscription 4	Receiving
Sampled value subscription 1	Not received
Sampled value subscription 2	Receiving
Line_Physical communication channel supervision 1	Channel live
Physical communication channel supervision 1	Channel live
PRP_Physical communication channel supervision 1	Channel live
PTP_Physical communication channel supervision 1	Channel live

# Ausência de GOOSE e SV na rede e no assinante

## Ausência de Mensagens Previstas



StationScout\_Cigré.acc - OMICRON StationScout

System diagram

### SAS Cigré - Sistema de Monitoramento OMICRON - StationScout

**SE Floripa**

**525 kV**

**Bay Siemens**

MUPMN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

**Bay SEL**

MU1 MU2 RL1

**Bay GE**

L90 MU3

**Detalhe do LGOS quando indica ausência de GOOSE com falha na MU**

**Overview** **Watchlist**

PMN2\_5L1  
**GOOSE subscription 3**  
ComSupervision\_GOOSE/LGOS3

**Details**

Value: Not received  
Category: System  
Behavior: On

**Test cases**

To add a new test case, click + on the top right.

**Communication**

**Sending**

No communication found

**Associated signals**

GOOSE subscription 3

on	GOOSE subscription 3 - Operating mode of the domain logical node that may be changed by operator	09:02:26
on	GOOSE subscription 3 - Read-only value, describing the behaviour of a domain logical node	09:29:04
Ok	GOOSE subscription 3 - Reflects the state of the logical node related hardware and software	09:02:45
False	If true, the subscription needs commissioning, i.e., the received message does not conform the current subscri...	09:29:04
False	If true, the subscription is active and valid message forwarded to application, otherwise it is inactive or messag...	11:31:18
False	If true, subscribed messages with the simulation bit set are being received and accepted - 3	09:29:04
10001	Expected configuration revision number of the message - 3	09:29:04
10001	Configuration revision number of the received messages - 3	09:29:04
1	Integer status 3	11:31:18

Live status **On** 11:39 BA068N

# Ausência de GOOSE e SV na rede e no assinante



SEM FALHA DE LINK

StationScout\_Cigré.acc - OMICRON StationScout

System diagram

**Ausência de SV sem perda de link com a MU**

Cigré - Sistema de Monitoramento OMICRON - Stations

ripa

emens

MN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

Bay MU1 MU2 RL1

Bay GE L90

**Overview** Watchlist

RL1  
ICD-421-7S-R105-V0 for firmware R409-V0 or higher

Model: SEL\_421\_7S

Test cases  
To add a new test case, click + on the top right.

IED functions

- Protection
- Control
- Interlocking
- Measurement
- Automation

System

Physical device LN	Ok
Physical device LN	Ok
GOOSE subscription 1	Receiving
GOOSE subscription 2	Receiving
Logical device LN	Remote control
Sampled value subscription 1	Receiving
Sampled value subscription 2	Receiving
Sampled value subscription 3	Not received
Sampled value subscription 4	Not received
Time management	-180
Time master supervision	GPS
PB Physical communication channel supervision 1	P1 Channel live
SB Physical communication channel supervision 1	S1 Channel live
Logical device LN	Remote control

Communication

Sending

CFG/LLN0.RL1.GOOSE\_PB

Live status On 15:03 BA068N

# Ausência de GOOSE e SV na rede e no assinante



Ausência GOOSE no  
StationGuard

OMICRON StationGuard		
Severity	Date and time	Message
	2023-08-03 10:11:23.363-03:00	<div><div>G</div><div>MU1 ► GOOSE multicast address GOOSE 'MU1CFG/LLN0\$GO\$MU1_GOOSE_PB' disappeared from network.</div></div> <div><div>Help ID:</div><div>Network interface:</div><div>Created:</div><div>Updated:</div><div>Occurred during maintenance:</div><div>Network traffic:</div></div> <div><div>→ <a href="#">GOOSE_DISAPPEARED</a></div><div>X20:2</div><div>2023-08-03 10:11:23.363-03:00</div><div>2023-08-03 10:11:25.259-03:00</div><div>No</div><div> Download pcap files</div></div> <div><div>VLAN ID:</div><div>VLAN priority:</div></div> <div><div>100</div><div>4</div></div> <div><div>Source</div><div>MAC address:</div></div> <div><div>MU1</div><div>00:30:A7:17:CB:EB SCHWEITZER ENGINEERING</div></div> <div><div>Destination</div><div>MAC address:</div></div> <div><div>GOOSE multicast address</div><div>01:0C:CD:01:00:11</div></div>

Há um outro alarme de GOOSE  
Appeared quando ele retorna



# Mensagens Duplicadas



File Tools DANE0400\_Cigre\_Siemens.dac - OMICRON DANE0 Control

Measurement System System Under Test Network Diagram **Supervision** Recording Observation

Start Stop Clear Delete all Devices Severity Category

Event list Configuration Actions

	Date and time	Device	Category	Type	Description
✖	2023-08-04 11:51:21.878	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	MUPMN2_5D1ComSupervision_GOOSE/LLN0\$GO\$Control
✖	2023-08-04 11:51:21.878	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	MUPMN2_5D1ComSupervision_GOOSE/LLN0\$GO\$Control
✖	2023-08-04 11:51:21.875	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	PMN2_5L1Application/LLN0\$GO\$Control_DataSet_1; Statu
✖	2023-08-04 11:51:21.875	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	PMN2_5L1Application/LLN0\$GO\$Control_DataSet_1; Statu
✖	2023-08-04 11:51:21.870	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	MUPMN2_5D1Application/LLN0\$GO\$Control_DataSet; Sta
✖	2023-08-04 11:51:21.870	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	MUPMN2_5D1Application/LLN0\$GO\$Control_DataSet; Sta
✖	2023-08-04 11:51:21.201	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	PMN2_5L1Application/LLN0\$GO\$Control_DataSet; Status:
✖	2023-08-04 11:51:21.201	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	PMN2_5L1Application/LLN0\$GO\$Control_DataSet; Status:
✖	2023-08-04 11:51:20.647	Oraculo IEC (DJ160G)	GOOSE	Out of sequence	MUPMN2_5L1Application/LLN0\$GO\$Control_DataSet_1; S

▼ Control block attributes

Severity	Error
Date and time	2023-08-04 11:51:21.878
Device	Oraculo IEC (DJ160G)
Category	GOOSE
Type	Out of sequence
Port	A
Control block reference	MUPMN2_5D1ComSupervision_GOOSE/LLN0\$GO\$Control_DataSet
Destination MAC address	01-0C-CD-01-00-35
Source MAC address	B4-B1-5A-06-ED-CF
Application ID	4149
GOOSE ID	MUPMN2_5D1/ComSupervision_GOOSE/LLN0/Control_DataSet
DataSet reference	MUPMN2_5D1ComSupervision_GOOSE/LLN0\$DataSet
Simulation	False
Status number	2320 (previous: 2320)
Sequence number	9 (previous: 9)




**Detectado como fora de sequência mas Status e Sequence number são iguais em relação à mensagem anteriorz**



# Mensagens Duplicadas



GOOSE duplicado no SG

OMICRON StationGuard				
	2023-08-04 11:55:47.287-03:00		PMN2_5L1 ▶ GOOSE multicast address	
			Duplicate GOOSE 'PMN2_5L1Application/LLN0\$GO\$Control_DataSet' found. This might cause misoperations in receiving IEDs.	
		Help ID:		<a href="#">→ GOOSE_MESSAGE_SEEN_MULTIPLE_TIMES</a>
		Network interface:		X20:2, X20:3
		Created:		2023-08-04 11:55:47.287-03:00
		Updated:		2023-08-04 11:56:17.287-03:00
		Occurred during maintenance:		No
		Network traffic:		 Pcap recording in progress...
		VLAN ID:		–
		VLAN priority:		–
Source		PMN2_5L1		
MAC address:		B4:B1:5A:09:B6:79 Siemens AG Energy Management Division		
Destination		GOOSE multicast address		
MAC address:		01:0C:CD:01:00:33		

# Mensagens Duplicadas



GOOSE duplicado no SS

StationScout\_Cigré.acc - OMICRON StationScout

System diagram

## SAS Cigré - Sistema de Monitorament

**SE Floripa**

**525 kV**

**Bay Sielens**

MUPMN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

**Bay SEL**

MU1

**Overview**

PMN2\_5L1  
Application/LLN0.Control\_DataSet\_1

**GOOSE warning**  
• GOOSE message appeared on network more than once.

**Details**

Status:	GOOSE warning
Control block reference:	PMN2_5L1Application/LLN0\$GO\$Control_DataSet_1
Destination MAC address:	01:0C:CD:01:00:34
Application ID:	4148 (1034 <sub>hex</sub> )
GOOSE ID:	PMN2_5L1/Application/LLN0/Control_DataSet_1
Dataset reference:	PMN2_5L1Application/LLN0\$DataSet_1
VLAN ID:	300 (12C <sub>hex</sub> )
VLAN priority:	5
Configuration revision:	70001

**Live status**

Entry time:	2023-08-04 11:50:13.013-03:00
State number:	3950
Sequence number:	10
Time allowed to live (ms):	3000
Remaining time to live:	

**Communication**

**Subscribers**

- MUPMN2\_5D1
- MUPMN2\_5L1

**Transmitted signals**

GO Generic process I/O 1

False	GO Single point status 15		
False	GO Single point status 16		
False	GO Single point status 17		
False	GO Single point status 18		

Live status **On** 11:48 BA068N



# Erros de Configuração: Dataset e ConfRev

Diferenças detectadas para GOOSE

OMICRON DANE0 Control - DANE0400\_Cigre\_SEL.dac

Measurement System | System Under Test | Network Diagram | Supervision | Recording | Observation

Import SCL | Add IED | Remove IED | Discover IED | Remove | Verification | Find orphans | Clear orphans | Override | Reset values

**Defined**

**Found**

**Statistics**




**DataSet - MU1CFG/LLN0\$GOOSE\_PB**

**DataSet - MU1CFG/LLN0\$GOOSE\_PB.2**

7 Messages

# ▶ Erros de Configuração: Dataset e ConfRev

Diferenças detectadas para  
GOOSE

OMICRON StationGuard		
	2023-08-03 10:48:10.681-03:00	<div><div></div><div>MU1 ▶ GOOSE multicast address Wrong dataset reference (DatSet) in GOOSE 'MU1CFG/LLN0\$GO\$MU1_GOOSE_PB'.</div></div> <div><div>Help ID:</div><div>Network interface:</div><div>Created:</div><div>Updated:</div><div>Occurred during maintenance:</div><div>Network traffic:</div></div> <div><div>→ <a href="#">GOOSE_DATSET_MISMATCH</a></div><div>X20:2, X20:3</div><div>2023-08-03 10:48:10.681-03:00</div><div>2023-08-03 10:53:41.008-03:00</div><div>No</div><div> Download pcap files</div></div> <div><div>VLAN ID:</div><div>VLAN priority:</div></div> <div><div>Source</div><div>MAC address:</div></div> <div><div>Destination</div><div>MAC address:</div></div>
		<div><div>VLAN ID:</div><div>VLAN priority:</div></div> <div><div>Source</div><div>MAC address:</div></div> <div><div>Destination</div><div>MAC address:</div></div>

# Erros de Configuração: Dataset e ConfRev

Diferenças detectadas para GOOSE

The screenshot displays the OMICRON StationScout interface. The main window shows a system diagram with two bays, Bay SE and Bay GE. Bay SE contains PMN2\_5L1, MU1, MU2, and RL1. Bay GE contains L9. MU1 and RL1 are highlighted with yellow warning icons. A yellow line connects MU1 to RL1. The right panel shows the 'Overview' tab for MU1, displaying a 'GOOSE warning' and a table of details.

**GOOSE warning**

- Received dataset reference 'MU1CFG/LLN0\$GOOSE\_PB\_2' does not match dataset reference 'MU1CFG/LLN0\$GOOSE\_PB' defined in SCL file.
- Received configuration revision '2' does not match configuration revision '1' defined in SCL file. Imported SCL file is not up to date.

**Details**

Status:	GOOSE warning
Enabled:	True
Control block reference:	MU1CFG/LLN0\$GOSMU1_GOOSE_PB
Destination MAC address:	01:0C:CD:01:00:11
Application ID:	4113 (101 <sub>hex</sub> )
GOOSE ID:	MU1
Dataset reference:	MU1CFG/LLN0\$GOOSE_PB
VLAN ID:	100 (064 <sub>hex</sub> )
VLAN priority:	4
Configuration revision:	1

**Live status**

Entry time:	2023-08-03 10:50:23.184-03:00
State number:	1
Sequence number:	164
Time allowed to live (ms):	2 000
Remaining time to live:	

**Communication**

**Subscribers**

RL1	
-----	--

**Transmitted signals**

RB Generic process I/O 2

False	RB Single point controllable status output - 10		10:50:22
-------	---	--	----------

BK1A Circuit breaker 1

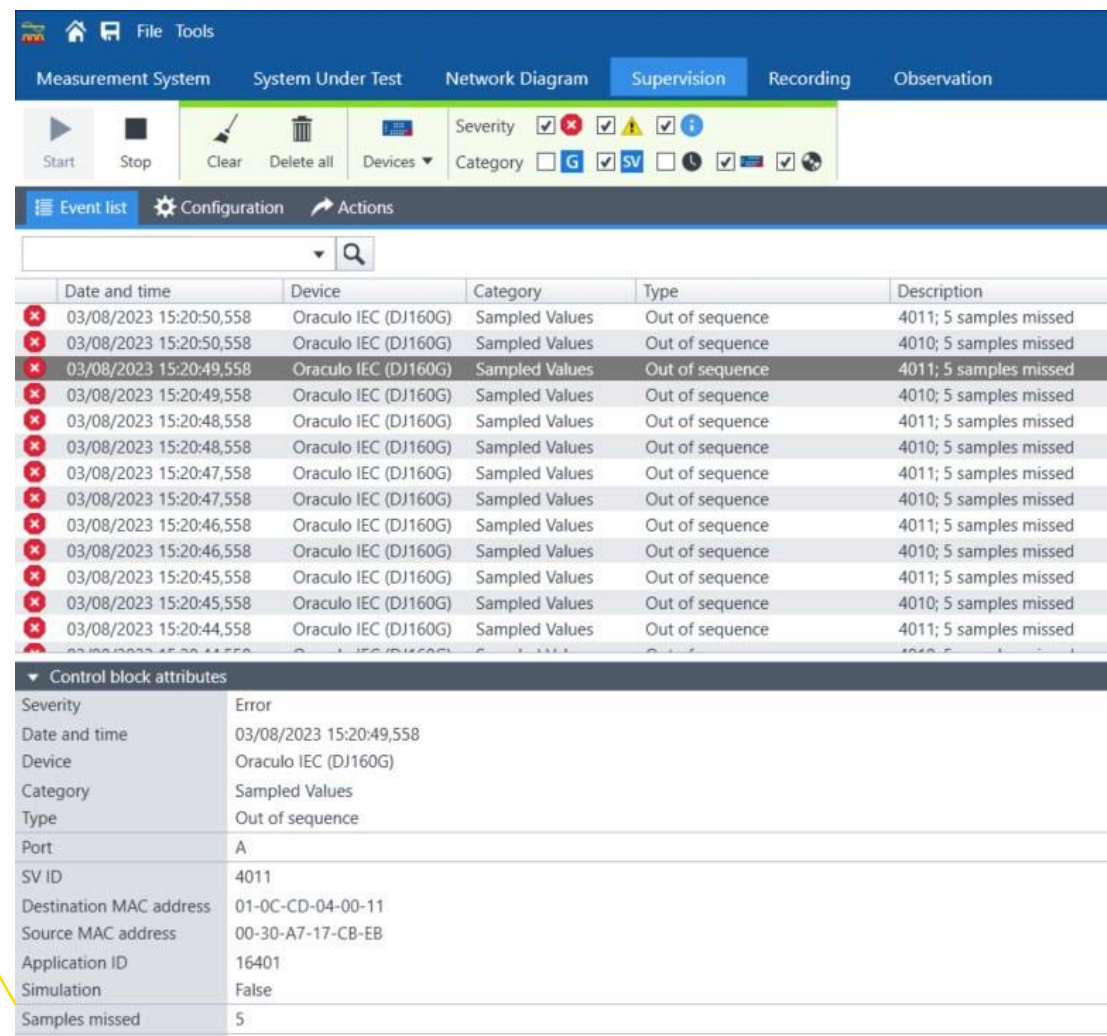
	BK1A Switch position 1		10:50:22
--	------------------------	--	----------

Subscribing GOOSE (3/13)...

Live status 10:50 BA068N

# GOOSE e SV fora de sequência & Perdas de Frame

(perda de 5 frames SV)  
Fora de sequencia



The screenshot shows the OMICRON NDT software interface. The 'Supervision' tab is active. The 'Event list' section displays a table of events. A yellow callout box points to a specific event in the list.

Date and time	Device	Category	Type	Description
03/08/2023 15:20:50,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed
03/08/2023 15:20:50,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4010; 5 samples missed
03/08/2023 15:20:49,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed
03/08/2023 15:20:49,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4010; 5 samples missed
03/08/2023 15:20:48,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed
03/08/2023 15:20:48,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4010; 5 samples missed
03/08/2023 15:20:47,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed
03/08/2023 15:20:47,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4010; 5 samples missed
03/08/2023 15:20:46,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed
03/08/2023 15:20:46,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4010; 5 samples missed
03/08/2023 15:20:45,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed
03/08/2023 15:20:45,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4010; 5 samples missed
03/08/2023 15:20:44,558	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 5 samples missed

Control block attributes	
Severity	Error
Date and time	03/08/2023 15:20:49,558
Device	Oraculo IEC (DJ160G)
Category	Sampled Values
Type	Out of sequence
Port	A
SV ID	4011
Destination MAC address	01-0C-CD-04-00-11
Source MAC address	00-30-A7-17-CB-EB
Application ID	16401
Simulation	False
Samples missed	5



# GOOSE e SV fora de sequência & Perdas de Frame

StationScout\_Cigré.acc – OMICRON StationScout

System diagram

ré - Sistema de Monitoramento OMICRON - StationScout

Bay SEL

Bay GE

MUPMN2\_5L1 PMN2\_5L1 MU1 MU2 RL1 L90 MU320\_52A MU320\_52C

Interpolado (perda de 1 frame SV)

RL1CFG/LSVS3.ErrStStVal  
Enumerated status 3  
Value: Interpolated  
Quality: Good  
Time: 2023-08-03 15:14:30.194-03:00  
Accuracy: ≤ 1 µs (T5)  
Leap seconds included

Overview

Watchlist

RL1  
Sampled value subscription 3  
CFG/LSVS3

Communication

Sending

CFG/LLN0.Monitoring\_LSVS

Associated signals

Sampled value subscription 3

0.63 ms	Measured value 3	15:07:19
9024.17 s	Measured value 3	15:07:18
0.96 s	Measured value 3	15:07:50
on	Sampled value subscription 3 - Behaviour	14:23:42
False	Subscription needs commissioning 3	14:23:42
True	Status of the subscription 3	15:07:19
False	Status showing that really Sim messages are received and accepted - 3	14:23:42
1	Expected configuration revision number 3	14:23:42
1	Configuration revision number of the received messages - 3	14:23:42
2	Integer status 3	15:07:19
Interpolated	Enumerated status 3	15:14:30
32	Integer status 3	15:14:30
0	Integer status 3	14:23:42
97	Integer status 3	15:14:30
False	Controllable single point 3	14:23:42

Live status On 15:12 BA068N

# GOOSE e SV fora de sequência & Perdas de Frame

Measurement System | System Under Test | Network Diagram | Supervision | Recording | Observation

Import SCL | Add IED | Remove IED | Discover IED | Remove | Verification | Find orphans | Clear orphans

MU320\_52A

- IED properties
  - GOOSE
    - LD CTRL
      - G LLN0.FastGOOSE1**
      - G LLN0.SW\_Status
  - Sampled Values
    - LD MU01
      - SV MU52A
  - Data Model
    - LD CTRL
    - LD MU01

Destination MAC address: 01-0C-CD-01-00-20  
Application ID: 4128 (0x1020)  
GOOSE ID: 52A  
DataSet reference: MU320\_52ACTRL/LLN0\$DigInpt  
VLAN ID: not present  
VLAN priority: not present  
Needs commissioning: False  
Configuration revision: 1

Packet information

Source MAC address: F8-02-78-10-68-E5  
Simulation: False  
Entry time: 07/08/2023 18:14:56,929  
Status number: 2789  
Sequence number: 22  
Time to live: 2000 ms  
Number of DataSet entries: 32

Statistics

	A	B	ETH
Receive time	07/08/2023 18:15:08,955	07/08/2023 18:15:08,955	
Packet count	331	275	
Status changes seen	28	24	
Status changes missed	0	4	
Retransmissions missed	0	10	
Duplicates seen	0	0	
Time to live expired	False	False	
Time to live expired count	0	1	
Packet delay:			
Minimum	944,80 µs	947,08 µs	
Maximum	966,54 µs	512,96 ms	
Average	947,88 µs	22,28 ms	

DataSet - MU320\_52ACTRL/LLN0\$DigInpt

73 Messages

Estatística da perda de frames para GOOSE

# GOOSE e SV fora de sequência & Perdas de Frame

**TTL expired + Out of Sequence quando o GOOSE retorna (o mesmo acontece com SV)**

The screenshot displays the OMICRON DANE0 Control software interface. The top menu bar includes File, Tools, and tabs for Measurement System, System Under Test (active), Network Diagram, Supervision, Recording, and Observation. Below the menu is a toolbar with icons for Import SCL, Add IED, Remove IED, Discover IED, Remove, Verification, Find orphans, and Clear orphans.

The left sidebar shows a tree view of the system under test, with MU320\_52A selected. Under IED properties, the GOOSE section is expanded, showing LD CTRL and LLN0.FastGOOSE1 (selected). Under Sampled Values, MU01 and MU52A are listed. Under Data Model, LD CTRL and LD MU01 are shown.

The main area displays the configuration for the selected GOOSE (LLN0.FastGOOSE1). The configuration includes:

- Destination MAC address: 01-0C-CD-01-00-20
- Application ID: 4128 (0x1020)
- GOOSE ID: 52A
- DataSet reference: MU320\_52ACTRL/LLN0\$DigInput
- VLAN ID: not present
- VLAN priority: not present
- Needs commissioning: False
- Configuration revision: 1

Below the configuration is the Packet information section, which includes:

- Source MAC address: F8-02-78-10-68-E5
- Simulation: False
- Entry time: 07/08/2023 18:14:56,929
- Status number: 2789
- Sequence number: 22
- Time to live: 2000 ms
- Number of DataSet entries: 32

The bottom section shows Statistics for the selected GOOSE. The statistics are presented in a table with columns A, B, and ETH.

	A	B	ETH
Receive time	07/08/2023 18:15:08,955	07/08/2023 18:15:08,955	
Packet count	331	275	
Status changes seen	28	24	
Status changes missed	0	4	
Retransmissions missed	0	10	
Duplicates seen	0	0	
Time to live expired	False	False	
Time to live expired count	0	1	
Packet delay:			
Minimum	944,80 µs	947,08 µs	
Maximum	966,54 µs	512,96 ms	
Average	947,88 µs	22,28 ms	

The bottom status bar shows 73 Messages and the DataSet - MU320\_52ACTRL/LLN0\$DigInput.

# Perda de Integridade

Measurement System | System Under Test | Network Diagram | Supervision | Recording | Observation

Import SCL | Add IED | Remove IED | Discover IED | Remove | Verification | Find orphans | Clear orphans | Override | Reset values

MU1

IED properties

- GOOSE
  - LD CFG
    - LLN0.MU1.GOOSE\_PB
- Sampled Values
  - LD CFG
    - SV 4010
    - SV 4011
- Data Model
  - LD CFG
  - LD PRO
  - LD MET
  - LD CON
  - LD ANN
  - LD MU01

Orphans

- GOOSE (1)
  - MU1CFG/LLN0\$GOOSE\_PB

Defined

Application ID: 4113 (0x1011)

GOOSE ID: MU1

DataSet reference: MU1CFG/LLN0\$GOOSE\_PB

VLAN ID: 100

VLAN priority: 4

Needs commissioning: False

Configuration revision: 1

Packet information

Source MAC address: [redacted]

Simulation: False

Entry time: 03/08/2023 11:19:56,884

Status number: 1

Sequence number: 287

Time to live: 2000 ms

Number of DataSet entries: 8

Statistics

	A	B	ETH
Receive time	03/08/2023 11:24:41,169	03/08/2023 11:24:41,169	
Packet count	54	54	
Status changes seen	0	0	
Status changes missed	0	0	
Retransmissions missed	0	0	
Duplicates seen	0	0	
Time to live expired	False	False	
Time to live expired count	0	0	
Packet delay:			
Minimum			
Maximum			
Average			

DataSet - MU1CFG/LLN0\$GOOSE\_PB

Name	Type	Value	Ports
DA BK1AXCBR1.Pos.stVal	Dbpos	01 [off]	ETH
DA BK1AXCBR1.Pos.q	Quality	Good	ETH
DO RBGGIO2.SPCSO10	Struct [3]		
DA DC1XSWI1.Pos.stVal	Dbpos	01 [off]	ETH
DA DC1XSWI1.Pos.q	Quality	Good	ETH
DA DC2XSWI2.Pos.stVal	Dbpos	01 [off]	ETH
DA DC2XSWI2.Pos.q	Quality	Good	ETH
DA StructAttribute 1	Struct [3]		ETH
DA StructAttribute 1.BooleanAttr	Boolean	False	ETH
DA StructAttribute 1.BitStringAtt	BitString [13]	00000000000000	ETH
DA StructAttribute 1.Timestamp	Timestamp	03/08/2023 11:19:56...	ETH

Found

Needs commissioning: False

Configuration revision: 1

Packet information

Source MAC address: 00-30-A7-17-CB-EB

Simulation: False

Entry time: 03/08/2023 11:19:56,884

Status number: 1

Sequence number: 287

Time to live: 2000 ms

Number of DataSet entries: 8

Statistics

	A	B	ETH
Receive time	03/08/2023 11:24:41,169	03/08/2023 11:24:41,169	
Packet count	54	54	
Status changes seen	0	0	
Status changes missed	0	0	
Retransmissions missed	0	0	
Duplicates seen	0	0	
Time to live expired	False	False	
Time to live expired count	0	0	
Packet delay:			
Minimum			
Maximum			
Average			

DataSet - MU1CFG/LLN0\$GOOSE\_PB

Name	Type	Value	Ports
DA BK1AXCBR1.Pos.stVal	Dbpos	01 [off]	ETH
DA BK1AXCBR1.Pos.q	Quality	Good	ETH
DO RBGGIO2.SPCSO10	Struct [3]		
DA DC1XSWI1.Pos.stVal	Dbpos	01 [off]	ETH
DA DC1XSWI1.Pos.q	Quality	Good	ETH
DA DC2XSWI2.Pos.stVal	Dbpos	01 [off]	ETH
DA DC2XSWI2.Pos.q	Quality	Good	ETH
DA StructAttribute 1	Struct [3]		ETH
DA StructAttribute 1.BooleanAttr	Boolean	False	ETH
DA StructAttribute 1.BitStringAtt	BitString [13]	00000000000000	ETH
DA StructAttribute 1.Timestamp	Timestamp	03/08/2023 11:19:56...	ETH

Oraculo IEC (D/160G)

GOOSE

Pos Lan A

Pos Lan B

Supervisor

Raw traffic




12 Messages

Detectado conteúdo do Dataset diferente



# ▶ Perda de Integridade

Detectado conteúdo  
do Dataset diferente

OMICRON StationGuard		
	2023-08-03 11:20:05.529-03:00	<div><div></div><div>MU1 ▶ GOOSE multicast address Wrong NumDataSetEntries number in GOOSE 'MU1CFG/LLN0\$GO\$MU1_GOOSE_PB'.</div></div> <div><div>Help ID:</div><div>Network interface:</div><div>Created:</div><div>Updated:</div><div>Occurred during maintenance:</div><div>Network traffic:</div><div>VLAN ID:</div><div>VLAN priority:</div><div>Source</div><div>MAC address:</div><div>Destination</div><div>MAC address:</div></div> <div><div>→ <a href="#">GOOSE_NUM_DATASET_ENTRIES_MISMATCH</a></div><div>X20:2, X20:3</div><div>2023-08-03 11:20:05.529-03:00</div><div>2023-08-03 11:20:26.548-03:00</div><div>No</div><div> Pcap recording in progress...</div><div>100</div><div>4</div><div>MU1</div><div>00:30:A7:17:CB:EB SCHWEITZER ENGINEERING</div><div>GOOSE multicast address</div><div>01:0C:CD:01:00:11</div></div>

# Perda de Integridade

Detectado conteúdo do Dataset diferente

System diagram

ema de Monitoramento OMICRON - StationScout

Bay SE

Bay GE

MU1

MU2

RL1

L90

Overview

MU1

CFG/LLN0.MU1\_GOOSE\_PB

GOOSE warning

- Received number of dataset entries '8' does not match number of entries '7' defined in SCL file.
- Dataset structure does not match the structure defined in SCL file. This could cause problems in receiving IEDs.

Details

Status:	GOOSE warning
Enabled:	True
Control block reference:	MUICFG/LLN0SGO\$MU1_GOOSE_PB
Destination MAC address:	01:0C:CD:01:00:11
Application ID:	4113 (1011 <sub>hex</sub> )
GOOSE ID:	MU1
Dataset reference:	MUICFG/LLN0SGOOSE_PB
VLAN ID:	100 (064 <sub>hex</sub> )
VLAN priority:	4
Configuration revision:	1

Live status

Entry time:	2023-08-03 11:19:56.883-03:00
State number:	1
Sequence number:	110
Time allowed to live (ms):	2 000
Remaining time to live:	

No VLAN information available.

Communication

Subscribers

RL1

Transmitted signals

RB Generic process I/O 2

False

RB Single point controllable status output - 10

BK1A Circuit breaker 1

BK1A Switch position 1

Live status On 11:19 BA068N

# Mensagem Corrompida

**Data Parser do SG  
detectou goose inválido**

# Software externo Ostinato Corrompeu GOOSE

[illegible]

# Mensagem Corrompida

Software externo  
Ostinato Corrompeu SV

Data Parser do DANE0  
detectou GOOSE inválido

The screenshot shows the 'Supervision' tab of the DANE0400\_Cigre\_Siem software. The interface includes a menu bar (File, Tools), a toolbar with buttons for Start, Stop, Clear, Delete all, and Devices, and a filter section for Severity and Category. The 'Event list' tab is active, displaying a table of events. The table has columns for Date and time, Device, Category, Type, and Description. Five events are listed, all with a severity of 'Error' (indicated by a red 'x' icon) and a type of 'Parsing error'. The description for all events is 'MUP5AX\_E\_ST1'. A yellow line highlights the first event in the table. Below the table, the 'Control block attributes' section is expanded, showing details for the selected event.

Date and time	Device	Category	Type	Description
2023-08-04 20:16:22.098	Oraculo IEC (DJ160G)	Sampled Values	Parsing error	MUP5AX_E_ST1
2023-08-04 20:16:21.598	Oraculo IEC (DJ160G)	Sampled Values	Parsing error	MUP5AX_E_ST1
2023-08-04 20:16:21.098	Oraculo IEC (DJ160G)	Sampled Values	Parsing error	MUP5AX_E_ST1
2023-08-04 20:16:20.598	Oraculo IEC (DJ160G)	Sampled Values	Parsing error	MUP5AX_E_ST1
2023-08-04 20:16:20.098	Oraculo IEC (DJ160G)	Sampled Values	Parsing error	MUP5AX_E_ST1

Control block attributes	
Severity	Error
Date and time	2023-08-04 20:16:22.098
Device	Oraculo IEC (DJ160G)
Category	Sampled Values
Type	Parsing error
Port	B
SV ID	MUP5AX_E_ST1
Destination MAC address	01-0C-CD-04-00-30
Source MAC address	B4-B1-5A-09-B3-E6
Application ID	16447
Simulation	False



# Detecção de eventos excessivos

For oscillating GOOSE, a chatter suppression service is provided for all the Boolean members configured in Fast datasets (TT6DataSet1 to TT6DataSet6). The Chatter or Oscillation on Booleans can flood the communication network with unwanted GOOSE messages. Hence, the UR oscillatory GOOSE feature monitors each Boolean data item that is configured in the fast datasets, which are scanned at fast rate of 2 ms. When four state changes are detected in 40 ms, the corresponding Boolean value is considered chattering and suppressed as long as the condition exists, and for a minimum period of one second. The oscillation event history is provided in the UR Web page IEC 61850 Oscillation History, with a buffer size of 16 events. While any of the Boolean is suppressed, the oscillatory GOOSE self-test message is activated and @Master/LPHD1.OscilGOOSE.stVal is set to TRUE.

StationScout\_Cigré.acc - OMICRON StationScout

System diagram

## Monitoramento OMICRON - StationScout

**Bay SEL**

- SL1
- MU1
- MU2
- RL1

**Bay GE**

- L90

**L90Master/LPHD1.OscilGOOSE.stVal**  
OscilGOOSE  
Value: **True**  
Quality: **Good**  
Time: 2023-08-07 17:49:49.357-03:00  
Accuracy: ≤ 10 ms (T0)  
Leap seconds included

**Overview**

Physical device LN  
Master/LPHD1

**Details**  
Value: Warning  
Category: System

**Test cases**  
To add a new test case, click + on the top right.

**Communication**  
Sending  
No communication found for applied filter

**Associated signals**  
Physical device LN

False	PBEthPort1 Fail operand	08:54:50
False	PBEthPort2 Fail operand	08:54:50
False	PTP FAILURE operand	08:54:50
False	SECOND ETHERNET FAIL operand	08:54:50
False	THIRD ETHERNET FAIL operand	08:54:50
True	OscilGOOSE	17:49:49

Live status **On** 17:48 BA068N

IED Indica  
GOOSE  
Oscilatório

## Mensagens não previstas (órfãos)

Orphans

SV Sampled Values (1)

✓ 4020

**Quando troca-se um parâmetro radical como o APP ID, é como se o SV anterior estivesse desaparecido e aparece um novo órfão. O mesmo vale para os parâmetros radicais do Control Block de GOOSE**

**Supervision**

Start Stop Clear Delete all Devices

Severity ☒ ☒ ☒ ☒ ☒ Category ☐ G ☒ SV ☐ ☒ ☒

Event list Configuration Actions

Date and time	Device	Category	Type	Description
03/08/2023 15:48:36,307	Oraculo IEC (DJ160G)	Sampled Values	Never seen	4010
03/08/2023 15:47:04,360	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 3842 samples missed
03/08/2023 15:47:04,239	Oraculo IEC (DJ160G)	Sampled Values	Out of sequence	4011; 3842 samples missed

Control block attributes

Severity	Warning
Date and time	03/08/2023 15:48:36,699
Device	Oraculo IEC (DJ160G)
Category	Sampled Values
Type	Never seen
Port	ETH
SV ID	4010
Simulation	False

# Avaliação de desempenho e latência

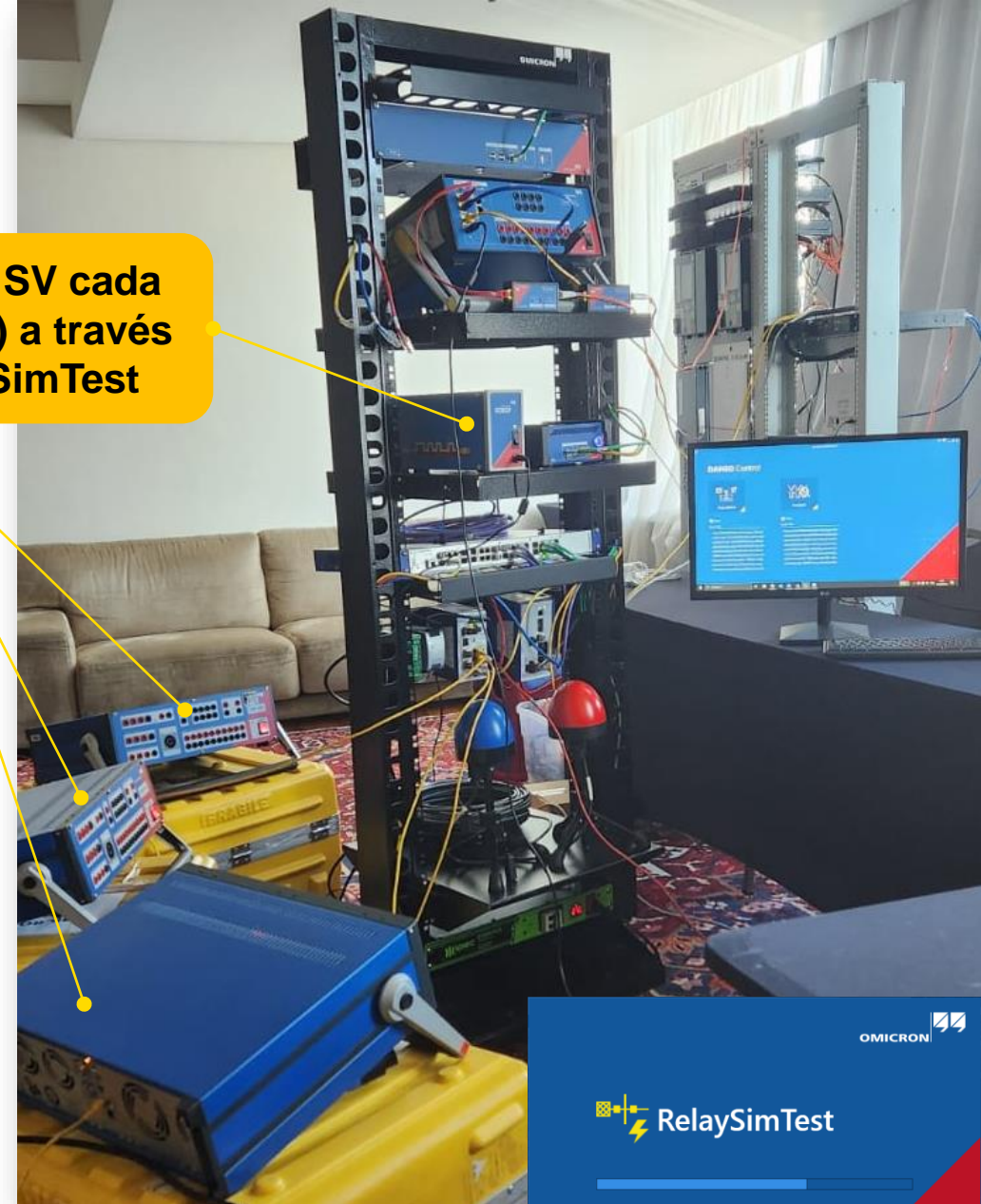
Verifique se há interferência entre GOOSEs e Sampled Values na rede

Aviso: Se você continuar, os GOOSEs e Sampled Values reais serão emitidos!

GOOSEs a serem simulados	Sinal de simulação	Encontrado na rede
Sampled Values a serem simulados		
SV JOAO_Overload - OMICRON_Overload1	Sim	✓ Nenhum duplicado
SV JOAO_Overload - OMICRON_Overload2	Sim	✓ Nenhum duplicado
SV JOAO_Overload - OMICRON_Overload3	Sim	✓ Nenhum duplicado
SV JOAO_Overload - OMICRON_Overload4	Sim	✓ Nenhum duplicado
SV JOAO_Overload_2 - OMICRON_Overload5	Sim	✓ Nenhum duplicado
SV JOAO_Overload_2 - OMICRON_Overload6	Sim	✓ Nenhum duplicado
SV JOAO_Overload_2 - OMICRON_Overload7	Sim	✓ Nenhum duplicado
SV JOAO_Overload_2 - OMICRON_Overload8	Sim	✓ Nenhum duplicado
SV JOAO_Overload_3 - OMICRON_Overload9	Sim	✓ Nenhum duplicado
SV JOAO_Overload_3 - OMICRON_Overload10	Sim	✓ Nenhum duplicado
SV JOAO_Overload_3 - OMICRON_Overload11	Sim	✓ Nenhum duplicado
SV JOAO_Overload_3 - OMICRON_Overload12	Sim	✓ Nenhum duplicado
SV JOAO_Overload_4 - OMICRON_Overload13	Sim	✓ Nenhum duplicado
SV JOAO_Overload_4 - OMICRON_Overload14	Sim	✓ Nenhum duplicado
SV JOAO_Overload_4 - OMICRON_Overload15	Sim	✓ Nenhum duplicado
SV JOAO_Overload_4 - OMICRON_Overload16	Sim	✓ Nenhum duplicado

Continuar Cancelar

4 malas injetando 4 SV cada  
(16 Streams no total) a través  
do software RelaySimTest



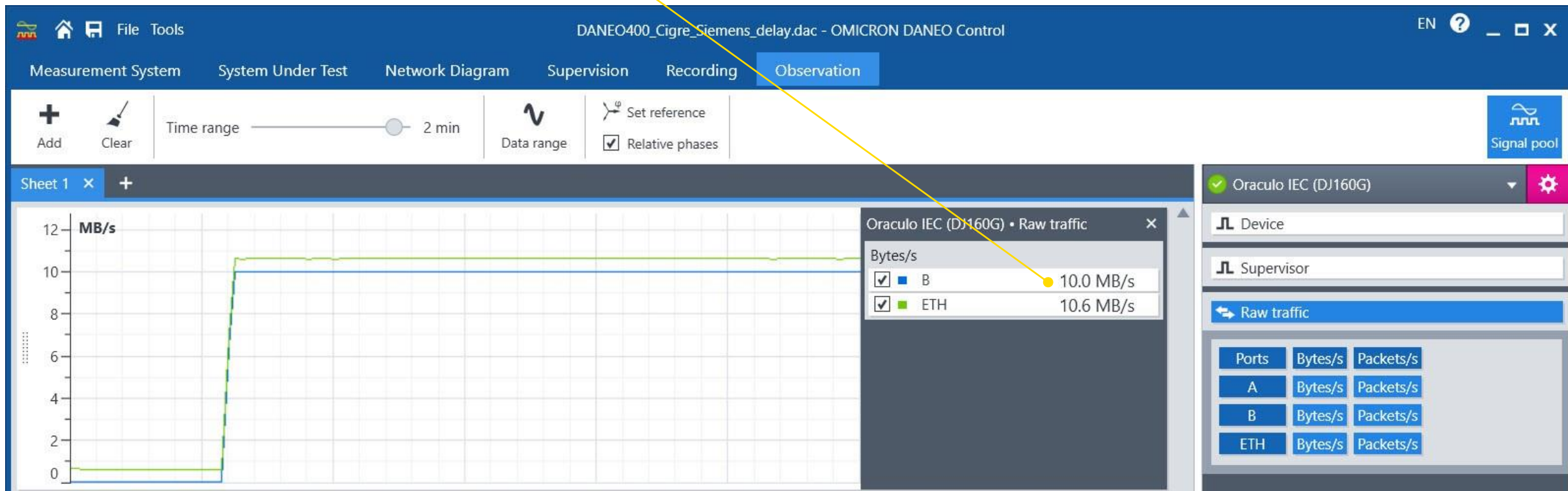
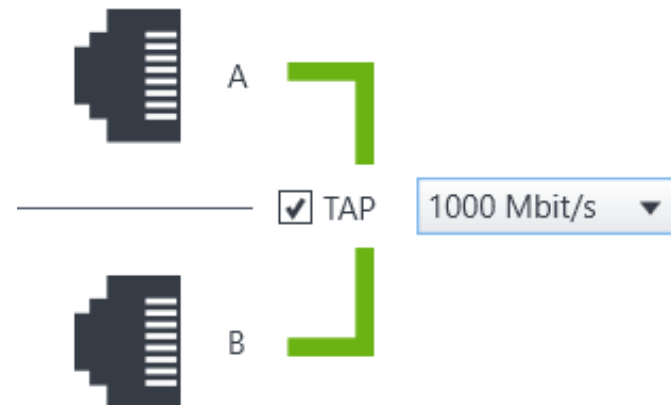
RelaySimTest



# Avaliação de desempenho e latência de rede

Carregamento da rede em mais de 80% (em Bytes)

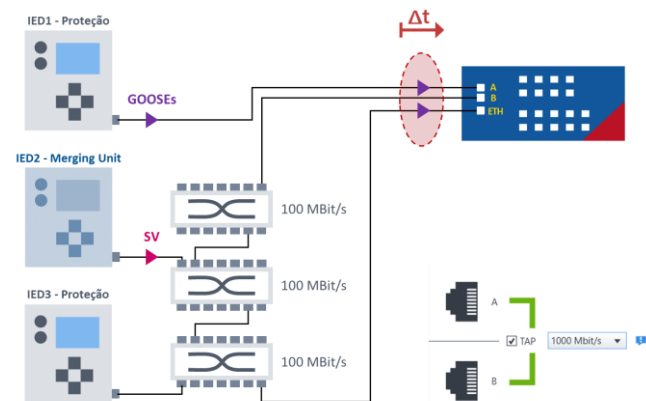
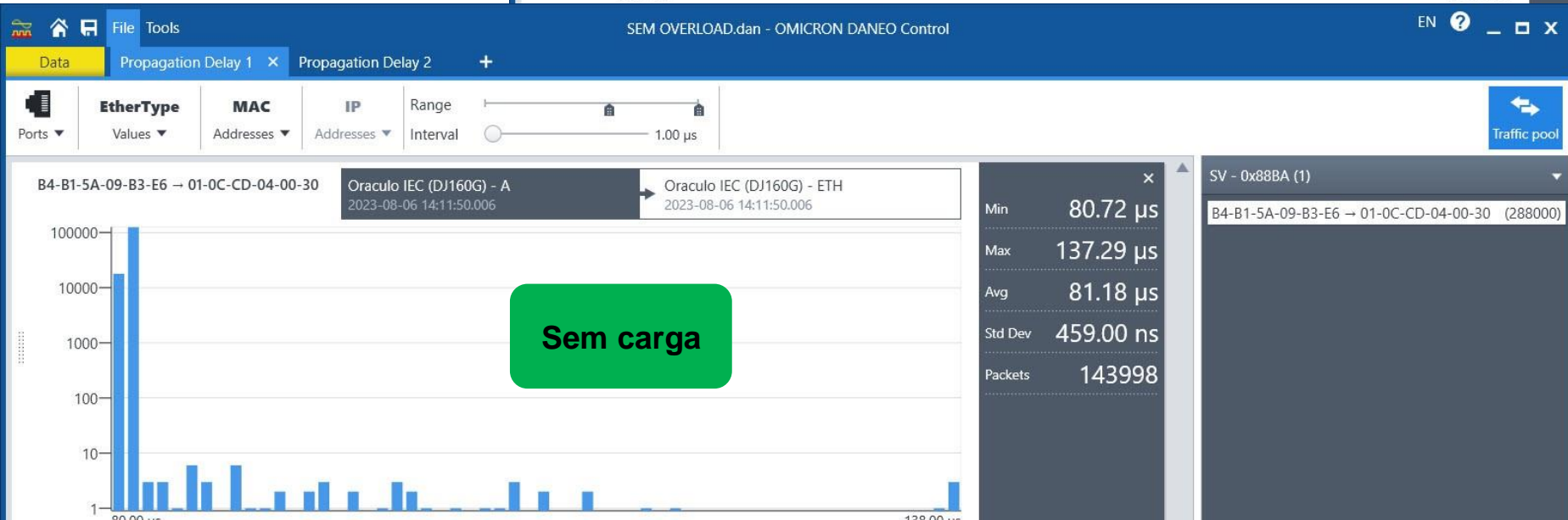
Utilização de Modo TAP para medir Latência de rede





# Avaliação de desempenho e latência de rede

Gravação de 30s,  
Observa-se  
incremento de  
Jitter e de  
Latência



# Avaliação de desempenho e latência de rede

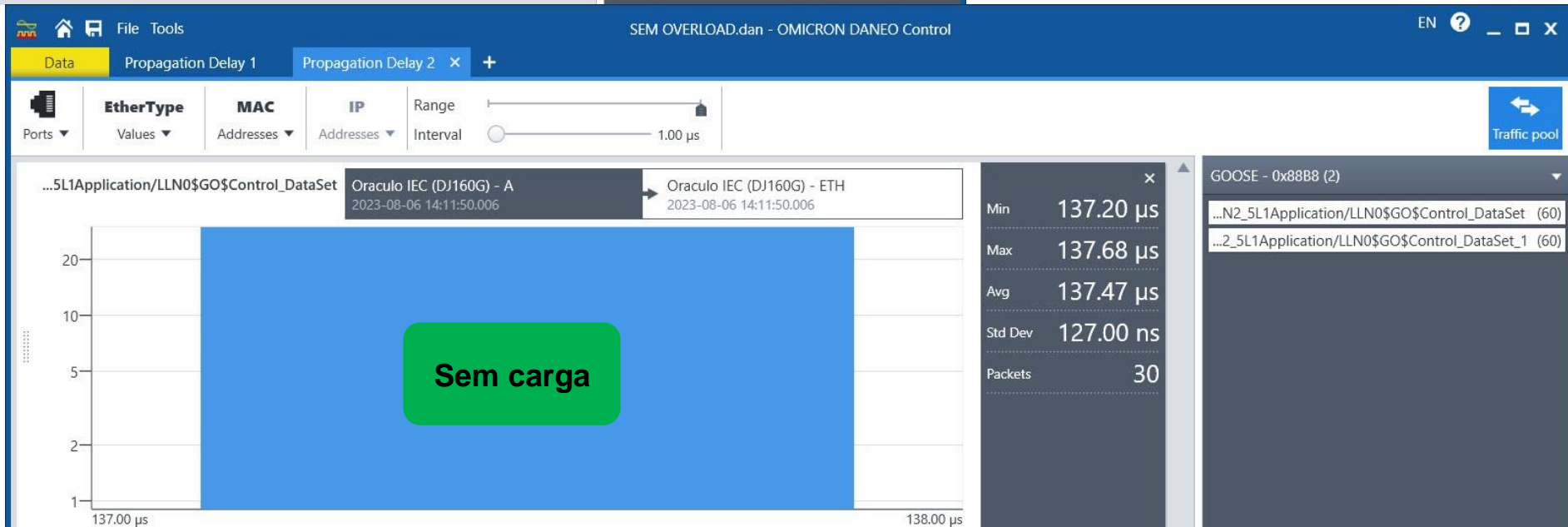


**Gravação de 30s, 1 Goose repetido cada 1 segundo**

**Observa-se incremento de Jitter e de Latência**

**Não há perda de pacotes**

**Foi notada perda de pacotes somente se houverem eventos de Goose sucessivos durante a gravação**



# ► Avaliação de desempenho e latência (function time)

The screenshot displays the OMICRON SEL software interface. The left sidebar shows the 'RL1' project structure with 'GOOSE' and 'LD CFG' expanded. The main panel shows the configuration for 'RL1CFG/LLN0\$GO\$RL1\_GOOSE\_PB'. The 'Control block attributes' section lists parameters like 'Control block reference', 'Destination MAC address', 'Application ID', 'GOOSE ID', 'DataSet reference', 'VLAN ID', 'VLAN priority', 'Needs commissioning', and 'Configuration revision'. The 'Packet information' section shows 'Source MAC address', 'Simulation', 'Entry time', 'Status number', 'Sequence number', 'Time to live', and 'Number of DataSet entries'. The 'Statistics' section shows a table of performance metrics.

Statistics	
	A
Receive time	03/08/2023 14:01:40,996
Packet count	42
Status changes seen	8
Status changes missed	0
Retransmissions missed	0
Duplicates seen	0
Time to live expired	False
Time to live expired count	0
Packet delay:	
Minimum	423,49 µs
Maximum	491,50 µs
Average	466,52 µs

A green callout box highlights the average packet delay value: **466us**.

**Usa o Entry Time do Goose Control Block e subtrai da hora local quando a mensagem chega no do Daneo**

**Hardware de Simulação SEL insere latência no circuito, que desta vez é medido no System Under Test. Esta medição só funciona se houverem eventos de Goose e só faz sentido se o DANEIO e o relé estiverem sincronizados.**

# Avaliação de desempenho e latência (function time)

The screenshot shows the SEL software interface with the 'System Under Test' tab selected. The left sidebar shows the 'Data Model' tree with 'LD GOOSE' expanded. The main panel displays the configuration for 'RL1CFG/LLN0\$GO\$RL1\_GOOSE\_PB'. The 'Control block attributes' section shows the following values:

Control block attributes	Value
Control block reference	RL1CFG/LLN0\$GO\$RL1_GOOSE_PB
Destination MAC address	01-0C-CD-01-00-10
Application ID	4112 (0x1010)
GOOSE ID	RL1
DataSet reference	RL1CFG/LLN0\$GOOSE_PB
VLAN ID	100
VLAN priority	4
Needs commissioning	False
Configuration revision	1

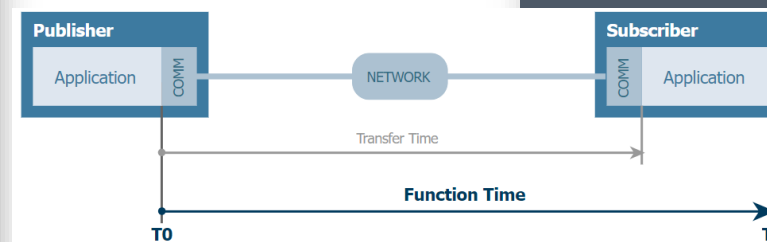
The 'Packet information' section shows the following values:

Packet information	Value
Source MAC address	00-30-A7-17-41-B0
Simulation	False
Entry time	03/08/2023 14:01:40,979
Status number	2889
Sequence number	3
Time to live	2000 ms
Number of DataSet entries	5

The 'Statistics' section shows the following values:

Statistics	Value
Receive time	03/08/2023 14:01:40,996
Packet count	42
Status changes seen	8
Status changes missed	0
Retransmissions missed	0
Duplicates seen	0
Time to live expired	False
Time to live expired count	0
Packet delay:	
Minimum	423,49 µs
Maximum	491,50 µs
Average	466,52 µs

A green box highlights the average packet delay value: **466us**.



The screenshot shows the SEL software interface with the 'System Under Test' tab selected. The left sidebar shows the 'Data Model' tree with 'LD GOOSE' expanded. The main panel displays the configuration for 'RL1CFG/LLN0\$GO\$RL1\_GOOSE\_PB'. The 'Control block attributes' section shows the following values:

Control block attributes	Value
Control block reference	RL1CFG/LLN0\$GO\$RL1_GOOSE_PB
Destination MAC address	01-0C-CD-01-00-10
Application ID	4112 (0x1010)
GOOSE ID	RL1
DataSet reference	RL1CFG/LLN0\$GOOSE_PB
VLAN ID	100
VLAN priority	4
Needs commissioning	False
Configuration revision	1

The 'Packet information' section shows the following values:

Packet information	Value
Source MAC address	00-30-A7-17-41-B0
Simulation	False
Entry time	03/08/2023 13:58:37,173
Status number	2802
Sequence number	4
Time to live	2000 ms
Number of DataSet entries	5

The 'Statistics' section shows the following values:

Statistics	Value
Receive time	03/08/2023 13:58:38,193
Packet count	88
Status changes seen	15
Status changes missed	0
Retransmissions missed	0
Duplicates seen	0
Time to live expired	False
Time to live expired count	0
Packet delay:	
Minimum	445,71 µs
Maximum	2,52 ms
Average	2,20 ms

A red box highlights the average packet delay value: **2,2ms**.

Hardware de Simulação SEL insere latência no circuito, que desta vez é medido no System Under Test. Esta medição só funciona se houverem eventos de Goose e só faz sentido se o DANEIO e o relé estiverem sincronizados.



# ► Avaliação de desempenho e latência (function time)

De forma parecida pode-se medir a latência para o SV, onde ambos DANE0 e MU devem estar sincronizados pelo mesmo GPS, compare-se a amostra do topo do segundo com a hora de chegada dela no DANE0

Delay artificialmente inserido na Lan A (1ms)

Lan B sem delay artificial (717us)

The screenshot shows the OMICRON DANE0 Control software interface. The 'System Under Test' tab is active. The left sidebar shows the 'MU1' configuration tree. The main area displays 'Control block attributes' and 'Packet information'. The 'Statistics' section at the bottom compares data for two lanes, A and B.

	A	B
Receive time	03/08/2023 18:43:12,531	03/08/2023 18:43:12,893
Samples seen	72000	74400
Samples missed	0	0
Sampling rate	4,800 kHz	4,800 kHz
Last packet smpCnt=0	03/08/2023 18:43:12,001	03/08/2023 18:43:12,001
Clock drift (current)	-8,00 ns	248,00 ns
Clock drift (since start)	120,00 ns	104,00 ns
Timed out	False	False
Timed out count	0	0
Packet interval:		
Minimum	23,92 µs	171,92 µs
Maximum	500,24 µs	244,81 µs
Average	208,33 µs	208,33 µs
Packet delay:		
Minimum	712,61 µs	716,02 µs
Maximum	1,03 ms	753,20 µs
Average	1,00 ms	717,48 µs

# ► Detecção de ausência/presença de sinais de sincronismo

StationScout\_Cigré.acc – OMICRON StationScout

System diagram

## SAS Cigré - Sistema de Monitoramento OMICRON - Station

SE Floripa

525 kV

Bay Siemens

MUPMN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

Bay SEL

MU1

Bay GE

MUPMN2\_5L1Application/LTMS0.TmSynErr

Value: False  
Quality: Good  
Time: 2023-08-07 09:34:36.692-03:00  
Accuracy: > 10ms (unspecified)  
Leap seconds included

Overview

MUPMN2\_5L1  
Time sync.  
Application/LTMS0

Value: 0003C7FFFE017290  
Category: System  
Behavior: On

Test cases

To add a new test case, click + on the top right.

Communication

Sending

R Application/LLN0.Report01

Associated signals

Time sync.

False	TmSynErr	09:34:36
0003C7FFFE017290	TmSrc	09:34:36
PTP	TmSrcTyp	09:34:36
True	TmChSt1	09:34:36
False	TmChSt2	09:24:08
False	LeapSecond	09:24:08
True	Sync	09:47:23

Subscribing GOOSE (6/13)...

Live status ☒ 09:45 BA068N

IED Sincronizado (LTMS)

# ► Detecção de ausência/presença de sinais de sincronismo

PTP Sniffer - Oraculo IEC (DJ160G)

PTP sources

Status	Port	Protocol	Domain
✓	A	IEEE 802.3	0
⊗	ETH	IEEE 802.3	0

PTP masters

▲ 1@00-03-C7-FF-FE-01-72-90 (Best master)

Power profile GM ID	--
Power profile version	--
MAC address	00-03-C7-01-72-90
VLAN ID	not present
VLAN priority	not present
GM identity	00-03-C7-FF-FE-01-72-90
GM priority 1	128
GM priority 2	100
GM clock accuracy	WITHIN_100_NS (0x21)
GM clock class	PRIMARY_REF_PTP (6)
GM clock variance	13056
Qualified	True
Alternate	False
TLV count	0
UTC offset	37
UTC offset valid	True
Leap 59	False
Leap 61	False
Time traceable	True
Frequency traceable	False
PTP time scale	True
Time source	GPS (0x20)

PTP source details

Usable

Delay mechanism	Peer-to-Peer
Announce interval	1 s
Sync interval	1 s
Other peers	1
Best master available	True
Packet errors	0

**Ausência PTP em uma das  
Lans**

# Redundância de sinais de sincronismo

## PTP Sniffer - Oraculo IEC (DJ160G)

### PTP sources

Status	Port	Protocol	Domain
✓	A	IEEE 802.3	0
✓	B	IEEE 802.3	0
✓	ETH	IEEE 802.3	0

### PTP source details

Usable

Delay mechanism	Peer-to-Peer
Announce interval	1 s
Sync interval	1 s
Other peers	1
Best master available	True
Packet errors	0

### PTP masters

#### 1@00-03-C7-FF-FE-01-72-90 (Best master)

Power profile GM ID	--
Power profile version	--
MAC address	00-03-C7-01-72-90
VLAN ID	not present
VLAN priority	not present
GM identity	00-03-C7-FF-FE-01-72-90
GM priority 1	128
GM priority 2	100
GM clock accuracy	WITHIN_100_NS (0x21)
GM clock class	PRIMARY_REF_PTP (6)
GM clock variance	13056
Qualified	True
Alternate	False
TLV count	0
UTC offset	37
UTC offset valid	True
Leap 59	False
Leap 61	False
Time traceable	True
Frequency traceable	False
PTP time scale	True
Time source	GPS (0x20)

Presença nas duas Lans

Classe Clock 6 (Global)



# Latência PTP

## Mean Path Delay

StationScout\_Cigré.acc – OMICRON StationScout

System diagram

### SAS Cigré - Sistema de Monitoramento OMICRON - Station

SE Floripa

525 kV

Bay Siemens

MUPMN2\_5D1 MUPMN2\_5L1 PMN2\_5L1

Bay SEL

MU1 MU2 RL1

Bay GE

L9

MUPMN2\_5L1Mod2\_Channel1/  
PTP\_LTPC1.MePathDItnms.stVal  
Mean path delay

Value: 8064349  
Quality: Good  
Time: 2023-08-07 10:25:25.651-03:00  
Accuracy:  $\leq 1 \mu\text{s}$  (T5)  
Leap seconds included

Overview

MUPMN2\_5L1  
IEEE 1588  
Mod2\_Channel1/PTP\_LTPC1

47	Clock accuracy	09:24:08
255	Clock class	09:24:17
B4B15AFFFE09B3E6	Clock identity	09:24:17
6	GM clock class	09:24:17
20B7C0FFFE00D322	GM clock identity	10:14:56
5	GM clock priority 1	10:19:37
5	GM clock priority 2	10:19:37
33	GM clock accuracy	10:19:37
8064349	Mean path delay	10:14:56
1	Number of ports	10:25:25
-53	Offset from master	09:24:17
True	UtcOffset valid	09:34:35
37	UtcOffset	09:24:17
20B7C0FFFE00D322	Master-clock identity	10:19:37

Live status On 10:23 BA068N

# ▶ Latência PTP

- ▶ A Latência é corrigida, ela não importa!
- ▶ A imprecisão importa!
- ▶ Certos perfis do PTP anunciam a imprecisão:
- ▶ Um outro erro que pode ser detectado pelo DANE0 é o intervalo incorreto entre as mensagens de anúncio, sync, etc.

Clock	Maximum time inaccuracy inserted
Grandmaster Clock	250 ns (en comparación con su referencia de tiempo)
Transparent Clock	50 ns (entre la entrada y la salida)
Boundary Clock	200 ns (entre el puerto maestro y el puerto esclavo)

Tabla 1 - Inexactitudes de tiempo aceptables por tipo de reloj

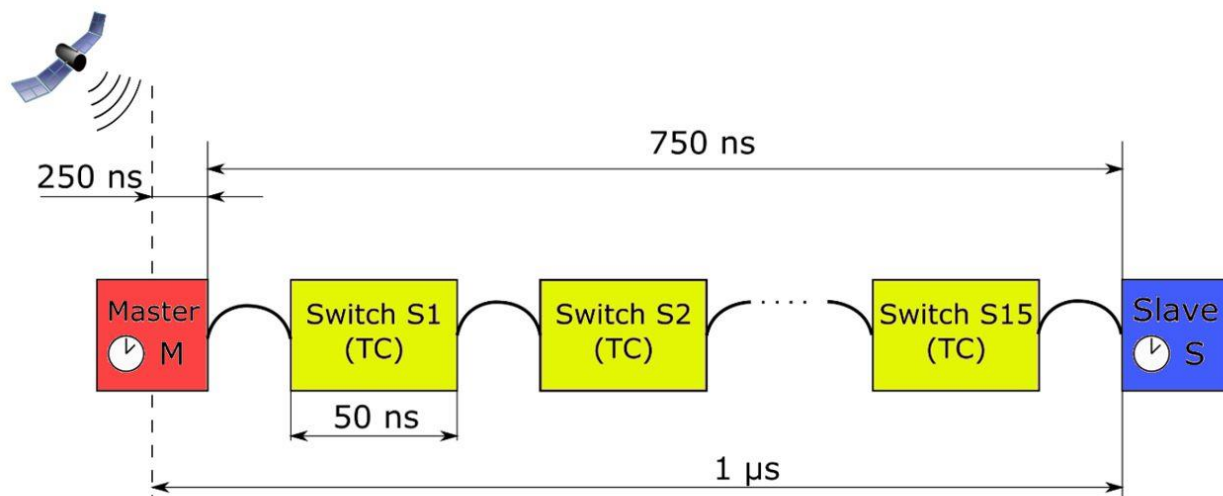



Ilustración 1 - Inexactitud de tiempo para una cadena de relojes transparentes

OMICRON



Time



Local	03/08/2023	20:20:53
UTC	03/08/2023	23:20:53
TAI	03/08/2023	23:21:30

PTP details - Port A

Synchronization status

Status	Slave
Offset from master	-6 ns
Peer mean path delay	32 ns
Steps removed	1

Master details

Port identity	2@00:30:a7:ff:fe:17:bb:5e
GM identity	00:30:a7:ff:fe:17:bb:5e
GM clock class	PRIMARY_REF_PTP (6)
GM clock accuracy	WITHIN_100_NS (0x21)
GM clock variance	18820
GM priority 1	128
GM priority 2	128
IEEE C37.238 GM ID	20
GM time inaccuracy	21 ns
Network time inaccuracy	49 ns

Time properties

UTC offset	37 s
UTC offset valid	True
Leap 59	False
Leap 61	False
Time traceable	True
Frequency traceable	True
PTP time scale	True
Time source	GPS (0x20)

# Comutação de fonte PTP

Vídeo de comutação PTP

## PTP Sniffer - Oraculo IEC (DJ160G)

### PTP sources

Status	Port	Protocol	Domain
✓	ETH	IEEE 802.3	0
✓	A	IEEE 802.3	0
✓	B	IEEE 802.3	0

### PTP source details

Usable

Delay mechanism	Peer-to-Peer
Announce interval	1 s
Sync interval	1 s
Other peers	1
Best master available	True
Packet errors	0

### PTP masters

#### 1@20-B7-C0-FF-FE-00-D3-22 (Best master)

Power profile GM ID	3
Power profile version	1
MAC address	20-B7-C0-00-D3-22
VLAN ID	not present
VLAN priority	not present
GM identity	20-B7-C0-FF-FE-00-D3-22
GM priority 1	5
GM priority 2	5
GM clock accuracy	WITHIN_100_NS (0x21)
GM clock class	PRIMARY_REF_PTP (6)
GM clock variance	18465
Qualified	True
Alternate	False
TLV count	2
UTC offset	37
UTC offset valid	True
Leap 59	False
Leap 61	False
Time traceable	True
Frequency traceable	True
PTP time scale	True
Time source	GPS (0x20)

# Comutação de fonte PTP

Registro de comutação PTP

File Tools DANE0400\_Cigre\_Siemens.dac - OMICRON DANE0 Control

Measurement System System Under Test Network Diagram **Supervision** Recording Observation

Start Stop Clear Delete all Devices Severity ☒ ☒ ☒ ☒ ☒ ☒ Category ☐ ☒ ☐ ☒ ☒ ☒ ☒ ☒

Event list Configuration Actions

	Date and time	Device	Category	Type	Description
	07/08/2023 10:29:43,975	Oraculo IEC (DJ160G)	PTP	Grandmaster ID changed	00:03:c7:ff:fe:01:72:90 (20:b7:c0:ff:fe:00:d3:22)
	07/08/2023 10:29:41,974	Oraculo IEC (DJ160G)	PTP	Synchronization lost	

▼ Control block attributes

Severity	Information
Date and time	07/08/2023 10:29:43,975
Device	Oraculo IEC (DJ160G)
Category	PTP
Type	Grandmaster ID changed
Port identity	1@00:03:c7:ff:fe:01:72:90 (previous: 1@20:b7:c0:ff:fe:00:d3:22)
GM identity	00:03:c7:ff:fe:01:72:90 (previous: 20:b7:c0:ff:fe:00:d3:22)
GM clock variance	13056 (previous: 18465)
GM priority 1	128 (previous: 5)
IEEE C37.238 GM ID	0 (previous: 3)
Frequency traceable	False (previous: True)





## Testes Adicionais

- ▶ Holdover MU
- ▶ Tempo de Processamento MU

## ► Holdover & IEC 61869

### 6.904.5 Holdover mode

When the external synchronization signal is lost, the merging unit shall go into a holdover mode. For the duration of the holdover period the merging unit shall continue to send samples maintaining the sample timing required for the measuring accuracy class. During holdover, the "SmpSynch" attribute in the SV messages shall remain unchanged, and the "SmpCnt" attribute in the SV messages shall increment and wrap as if a synchronization signal were present.

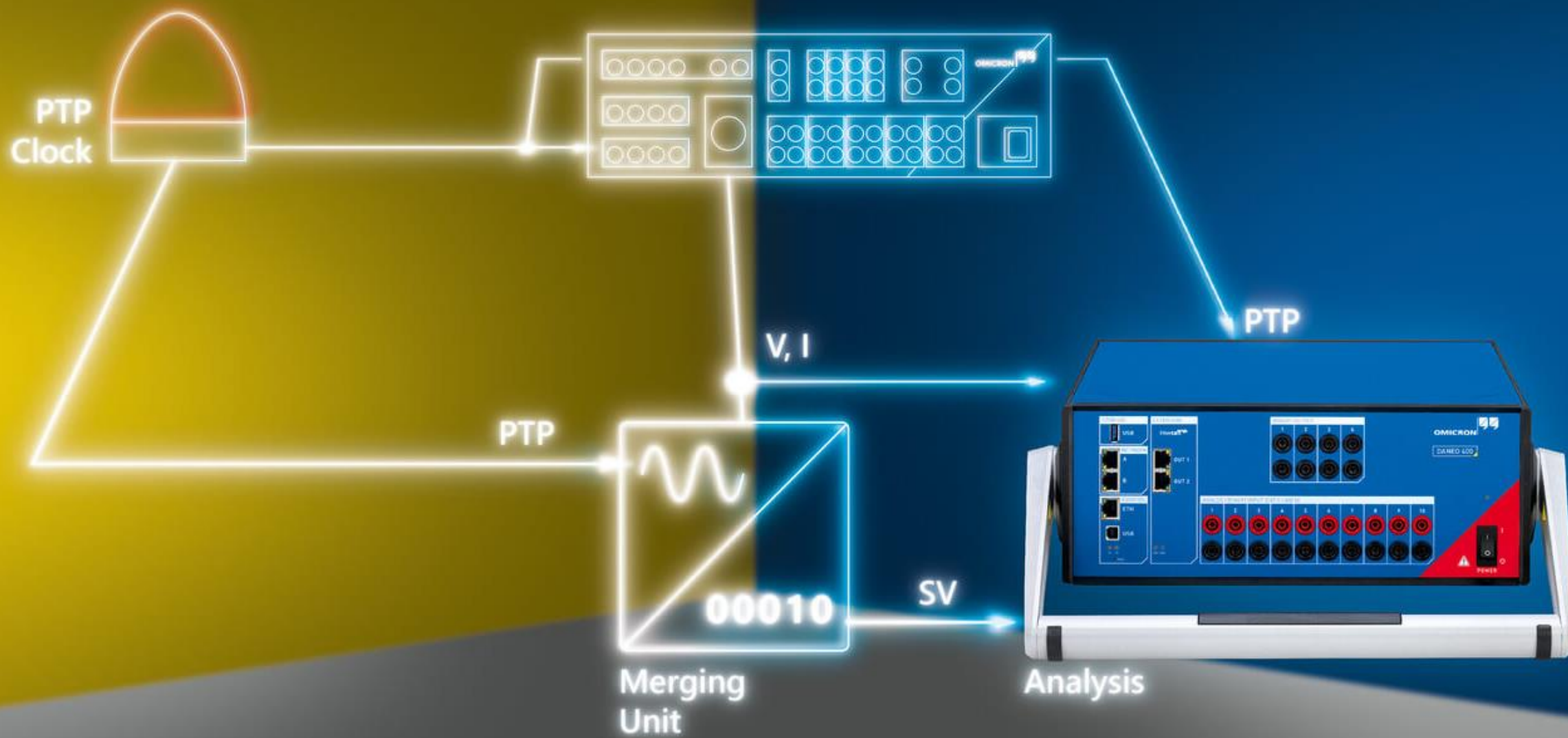
The minimum holdover duration shall be 5 s under stable temperature conditions.

When the synchronization signal resumes before holdover timeout, the sampled value messages shall continue as if the synchronizing signal were continuous.

5 s

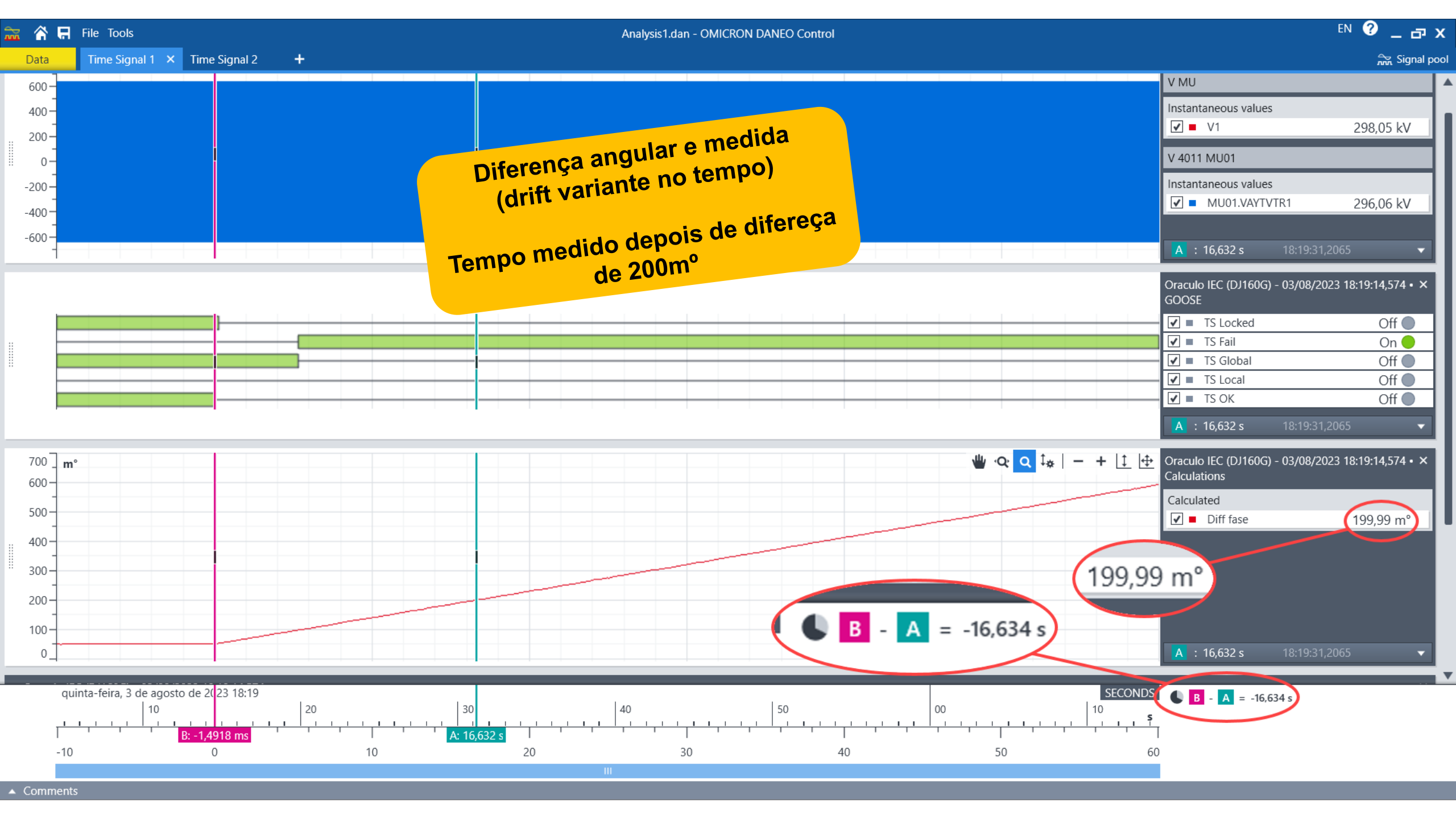


## ► Drift de tempo de MU (holdover time)











# Roadmap Soluções de Monitoramento OMICRON

# ► Roadmap StationGuard / StationScout



Capacidade  
de enviar  
alarmes para  
o SAGE ou  
qualquer  
outro Scada

## 4 Roadmap – Short Term .....7

- 4.8 SNMP server .....9
- 4.9 MMS server .....9

## 5 Roadmap – Medium Term .....9

- 5.7 More functional monitoring features ..... 10
- 5.8 More detailed supervision of Sampled Values ..... 10
- 5.9 PTP synchronization support..... 10
- 5.10 User interface and documentation in more languages..... 10

Atenderá  
aos  
requisitos  
do ONS

# ► Roadmap StationGuard / StationScout



## 4.8 SNMP server

An SNMPv3 server will be provided on the StationGuard sensor level including SNMP traps to indicate alert status.

## 4.9 MMS server

An MMS server will be provided on the StationGuard sensors for easy integration of alerts into SCADA systems.

Capacidade de enviar alarmes para o SAGE ou qualquer outro Scada

Atenderá aos requisitos do ONS

## 5.7 More functional monitoring features

We received several feature requests for additional functional checks to be performed by StationGuard. Based on this, we will continuously improve the functional monitoring in StationGuard.

## 5.8 More detailed supervision of Sampled Values

The StationGuard RBX1 hardware has all the capabilities to supervise many different parameters and the timing behavior of Merging Units and Sampled Values communication in general.

## 5.9 PTP synchronization support

When the detailed supervision support for Sampled Values is implemented, PTP synchronization support will also be added. The StationGuard RBX1 hardware is already capable of supporting the Precision Timing Protocol (PTP) Power Utility Profile needed for this.





# Conclusões



# Conclusões

- ▶ A redundância é necessária mas pode mascarar problemas de rede em uma das Lans A ou B e somente o monitoramento pode apontar a falha
- ▶ Confiar no auto monitoramento dos IEDs e Switches não é suficiente, eles podem falhar
- ▶ Sistemas de monitoramento idôneos e independentes devem ser adotados em subestações digitais
- ▶ Sistemas de Monitoramento e de Cyber Segurança (IDS) são complementares e devem ser considerados

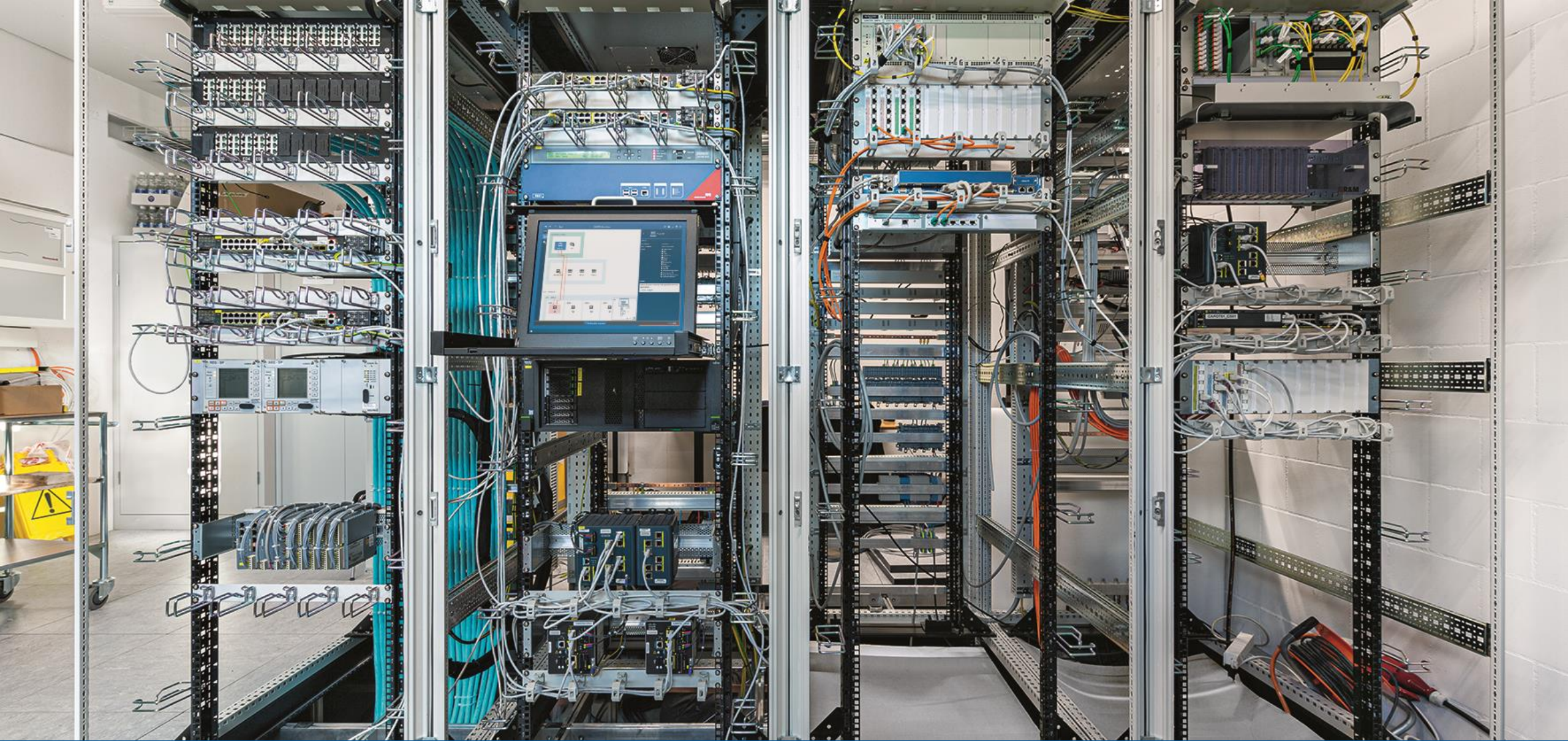


## ► Conclusões

- O operador não precisa ser um **especialista!** Ferramentas dedicadas e mais especializadas podem ser usadas para inspecionar os detalhes de uma falha na rede quando/depois de o Sistema de Monitoramento alarmar.
- A OMICRON oferece soluções de monitoramento cada vez mais completas graças ao input dos usuários
- O que não pode ser:
  - ▷ 100% garantido (mesmo que redundante)
  - ▷ 100% protegido**deve ser monitorado!**







**Obrigado pela atenção! Visite-nos na Plataforma no hall de exibição**

Emotions are energy. Our energy moves.





Participe do grupo  
IEC 61850 da  
OMICRON no **Linked in**

Procure por **OMICRON IEC 61850 Latinoamérica**

ou acesso o link: <https://www.linkedin.com/groups/9027188/>

ou escaneie o QR Code ao lado

