



RTDS & DOBLE ENGINEERING

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DOBLE ENGINEERING COMPANY



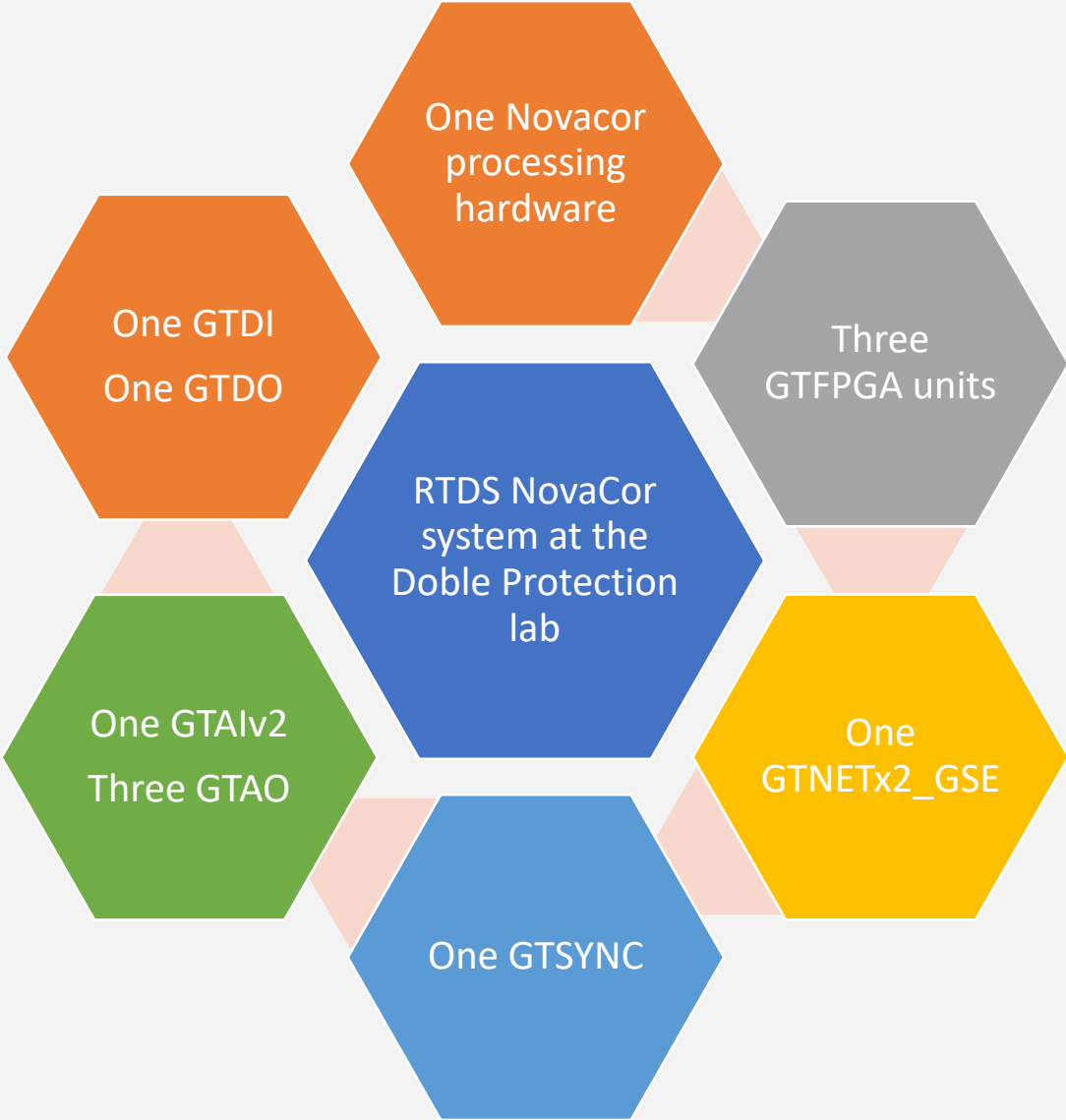
AGENDA

- Introduction
- Doble Engineering's RTDS NovaCor system
- Network architecture
- RTDS in the Network
- Configuration
- Test
- Conclusions

INTRODUCTION

- Doble Engineering Company supports its clients in the electric power industry to improve operations and optimize system performance
- Testing protection schemes, evaluating insulation conditions, and assessing risk across your transformer fleet with Doble diagnostic test equipment and software
- Doble offers comprehensive diagnostic equipment and software solutions to verify system protection
- Doble uses an RTDS Novacor System to validate the development of the new test equipment to verify the operation of the new digital substations based on IEC 61850

THE DOBLE ENGINEERING'S RTDS NOVACOR SYSTEM



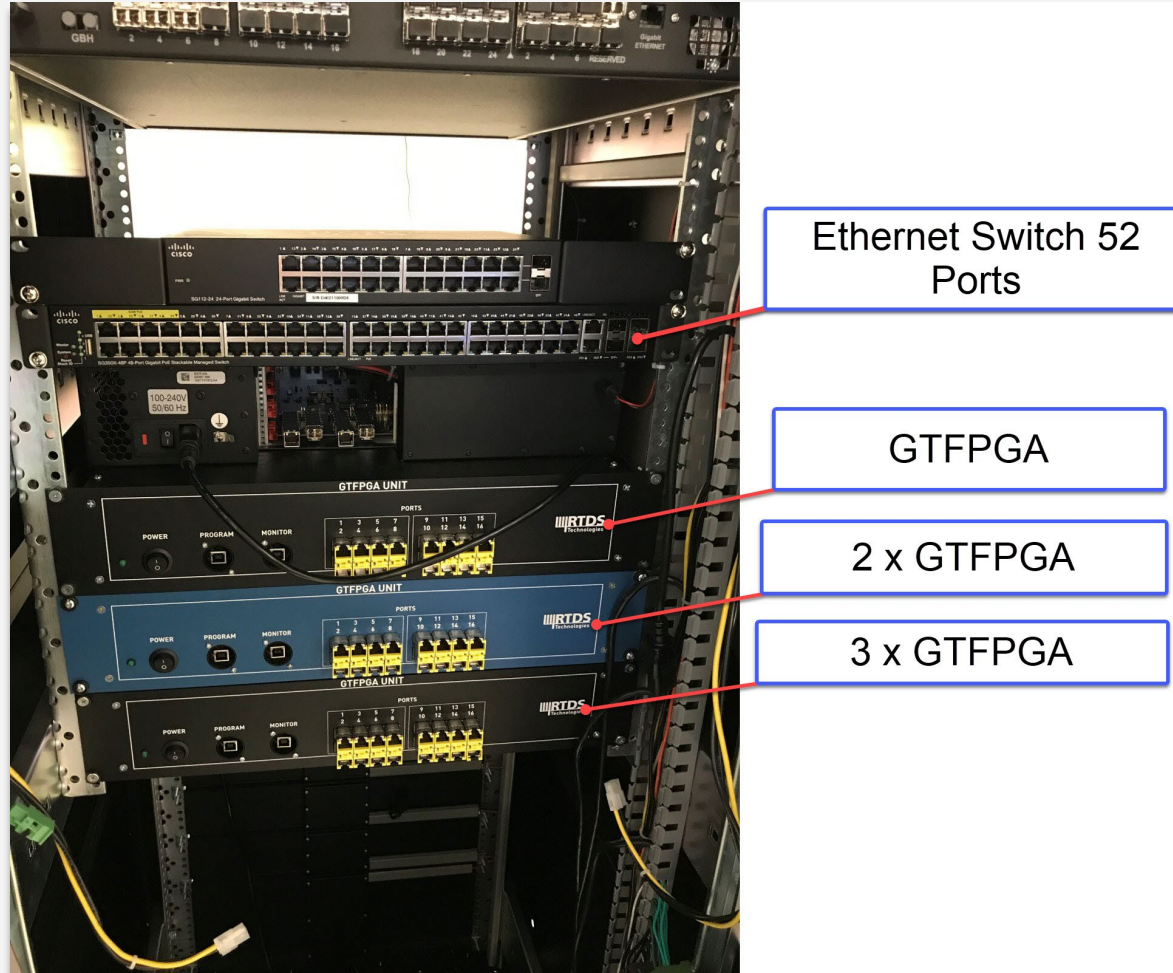
THE DOBLE ENGINEERING'S RTDS NOVACOR SYSTEM

The GTFPGA Unit significantly increases the number of SV data streams that can be input and output from the RTDS Simulator



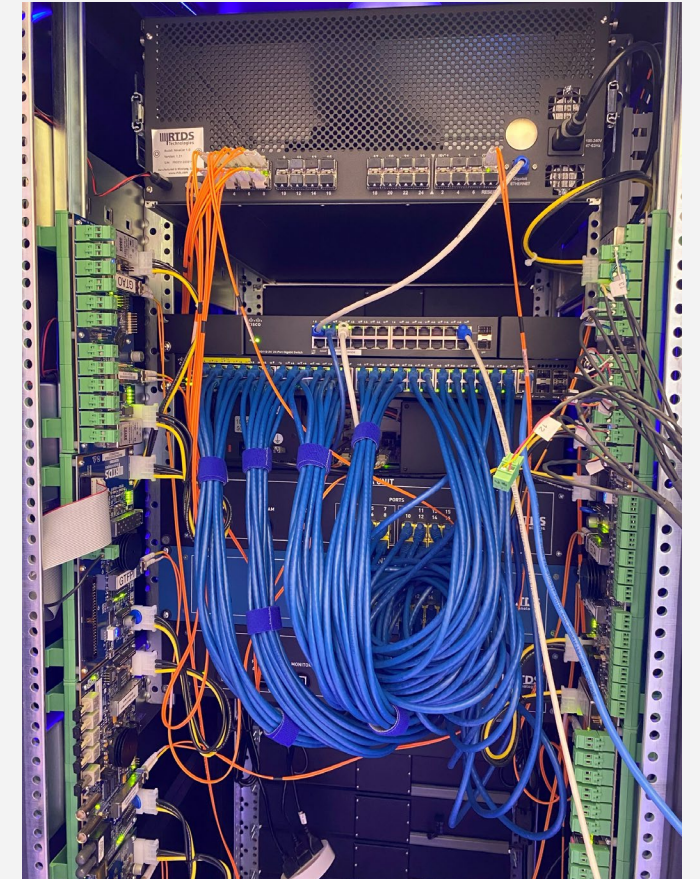
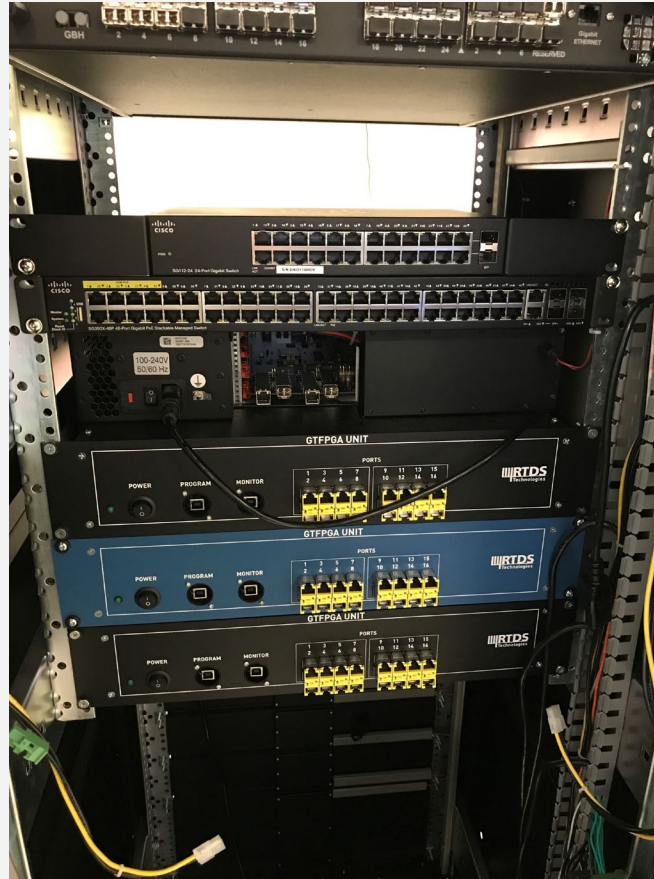
From RTDS Technologies

THE DOBLE ENGINEERING'S RTDS NOVACOR SYSTEM

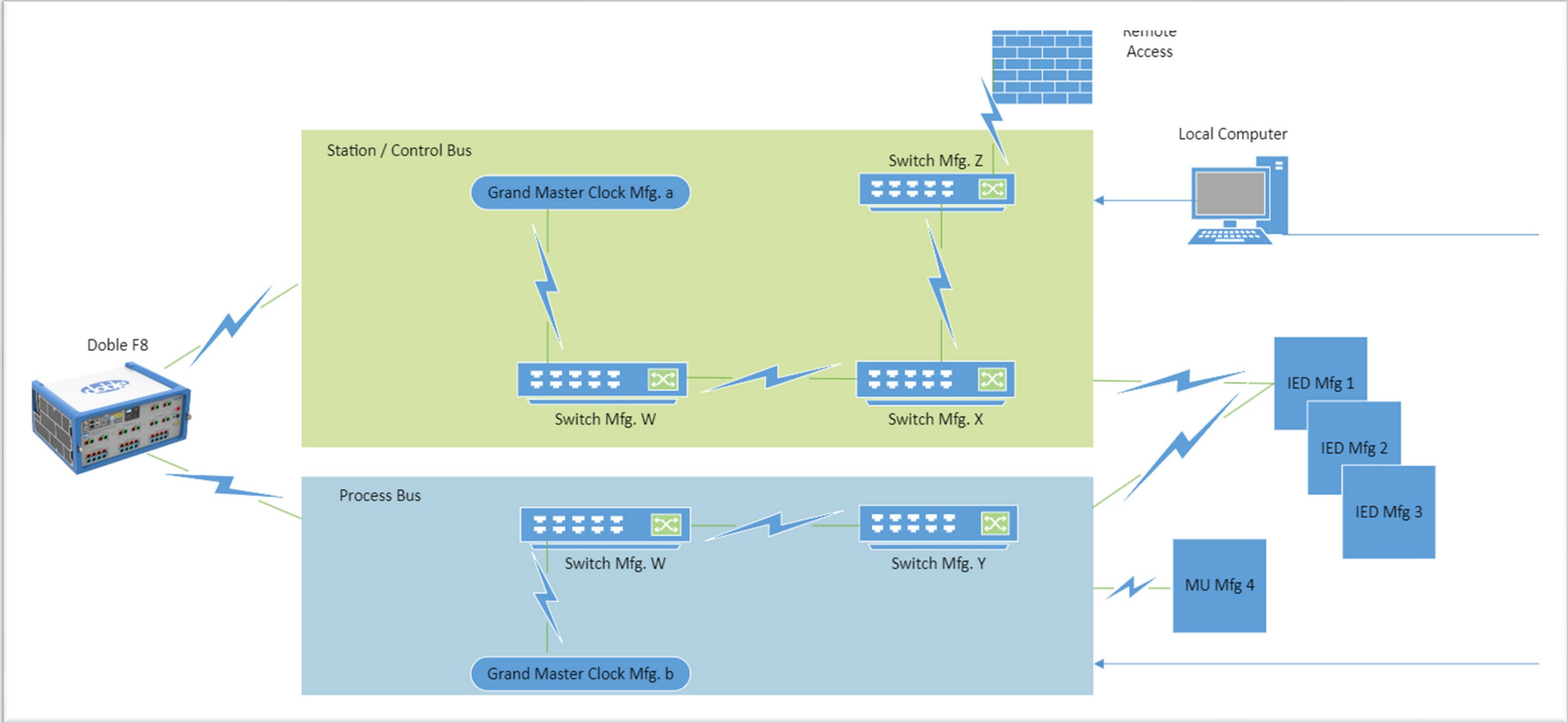


THE DOBLE ENGINEERING'S RTDS NOVACOR SYSTEM

- This configuration allows us to simulate until 48 Sampled Values stream that we use to test our new test devices
- Some Sampled Value parameters can be changed during the simulation, like:
 - Simulation
 - Lost packages
 - Stream manipulation

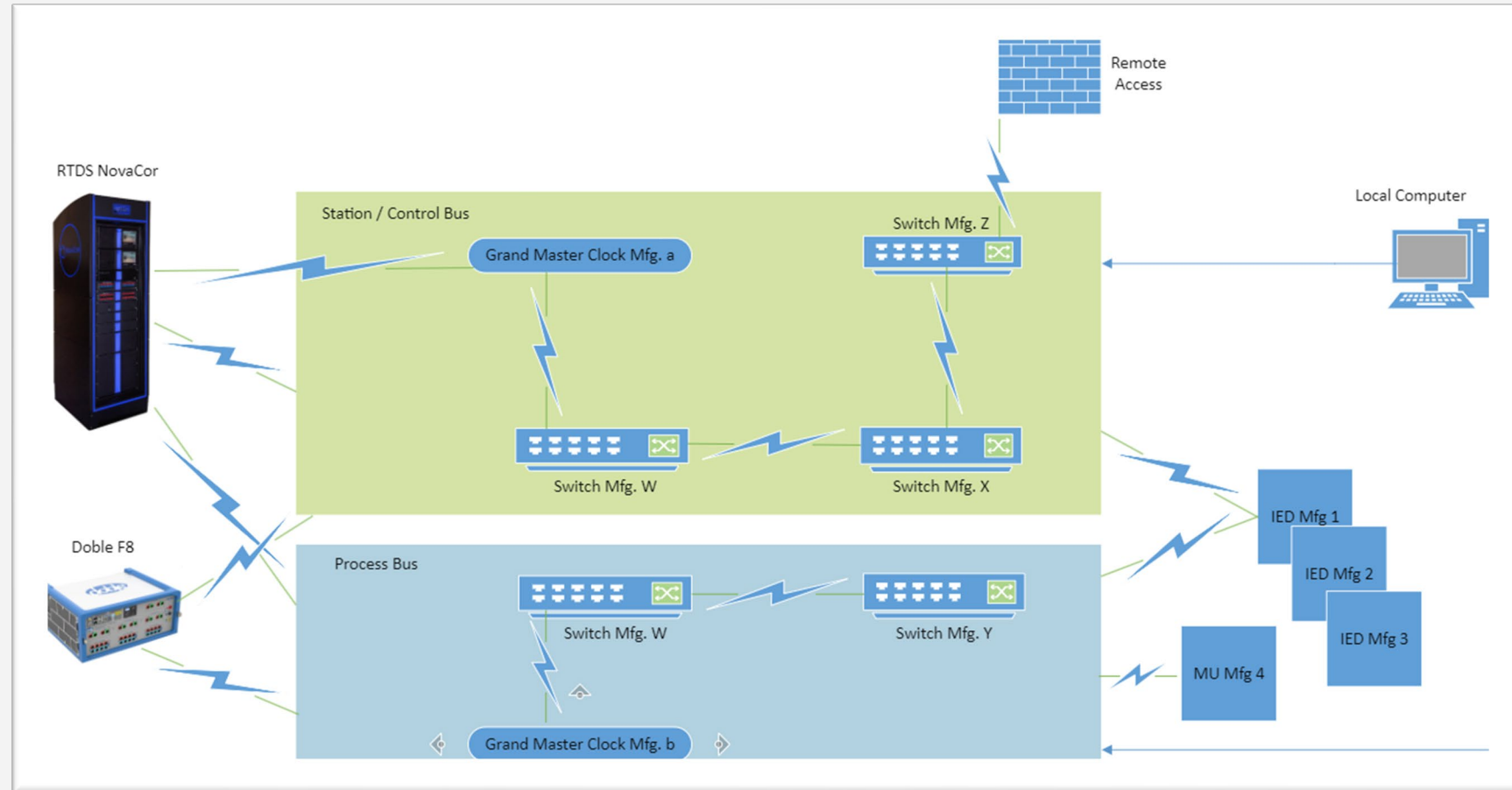


DOBLE'S PROTECTION LAB NETWORK



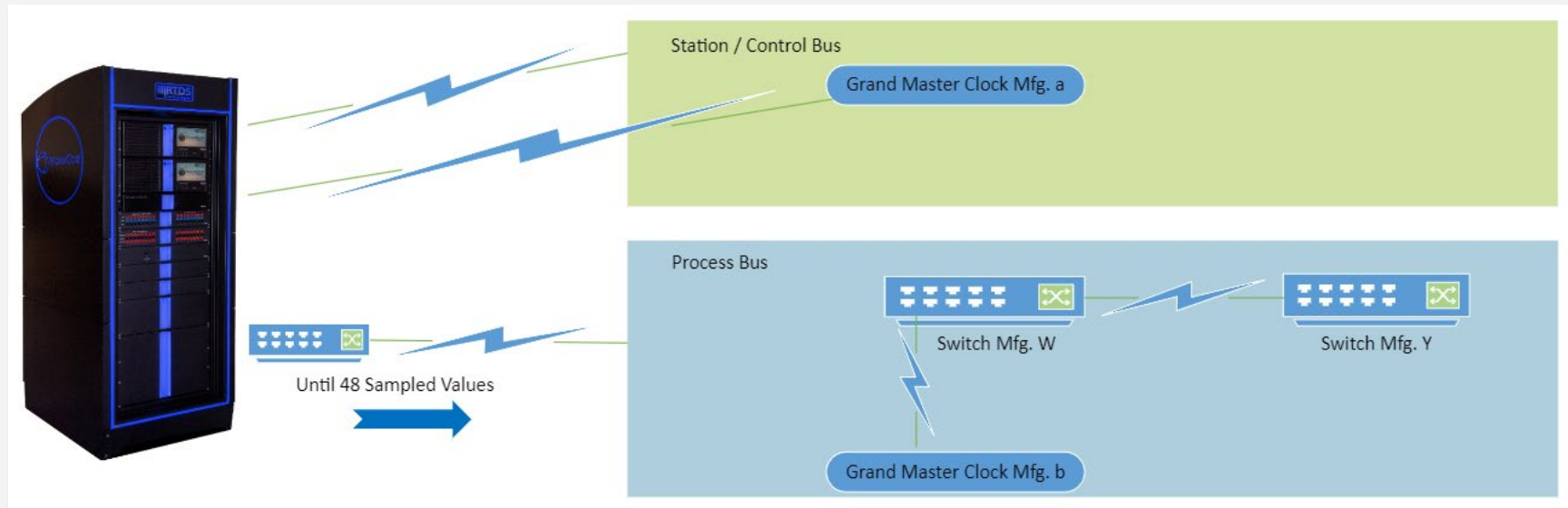
CONNECTION OF THE RTDS IN THE NETWORK

- RTDS has a connection to:
 - Station / Control Bus
 - Process Bus
 - Direct connection to a GMC



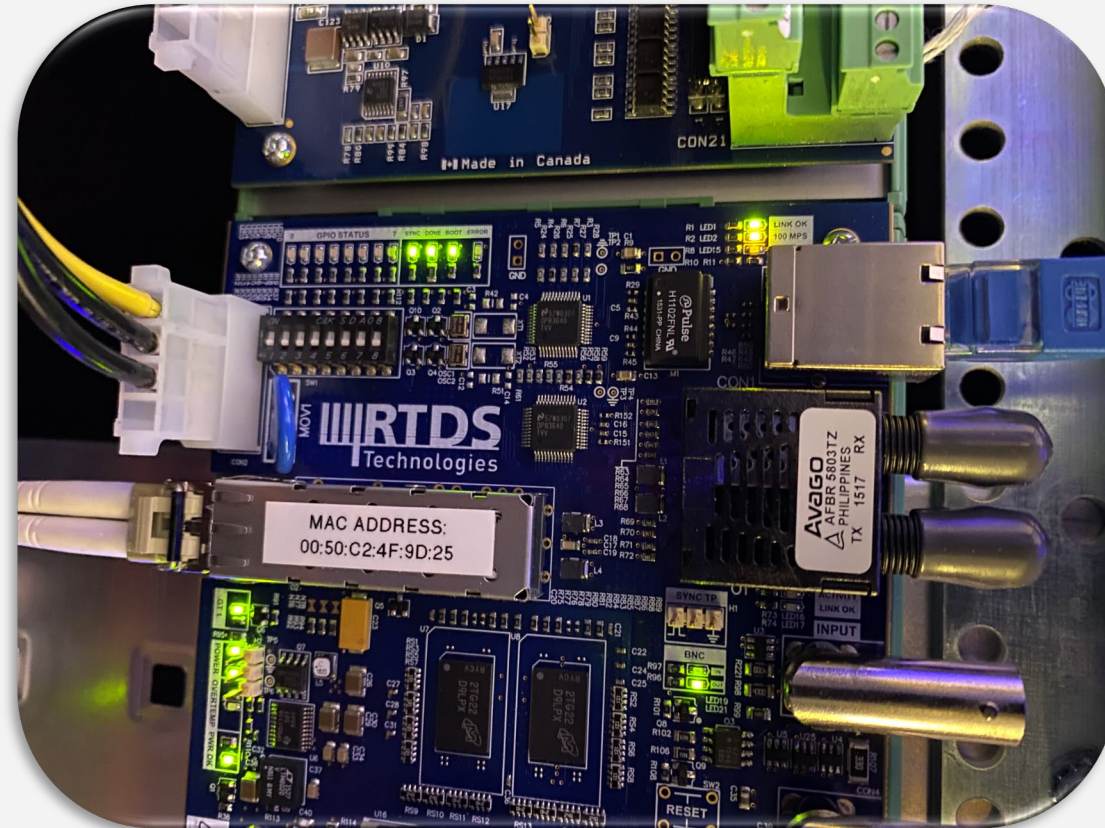
CONNECTION OF THE RTDS IN THE NETWORK

- RTDS is connected to the Process Bus
- Allowing to send high traffic information into the network, in this scenario, up to 48 SV



CONNECTION OF THE RTDS IN THE NETWORK

- From the GMC exist a direct connection to the GTSYNC card
- Confirmation of the LEDs of synchronization

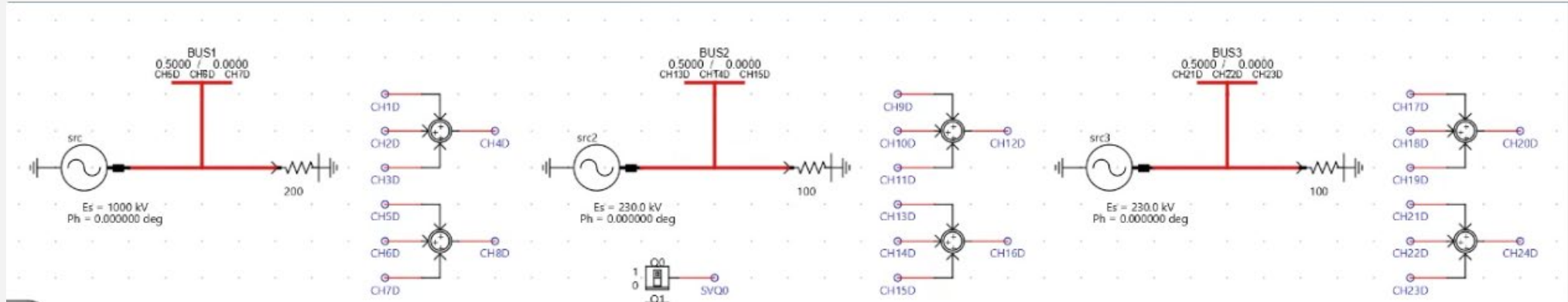


CONFIGURATION

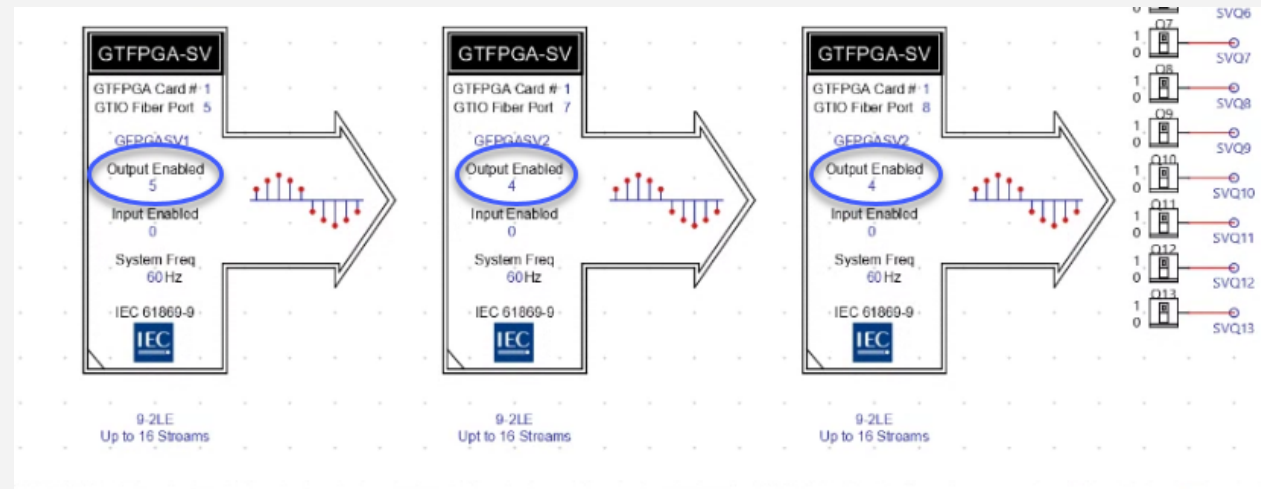
- With a Telnet connection, the configuration to have synchronization using Precision Time Protocol (PTP) IEEE 1588

```
PER> 64
Current GTSYNC configuration:
Ethernet port      : Copper RJ45
IP address        : 192.168.7.203
Subnet mask       : 255.255.255.0
Gateway IP address : 192.168.7.1
SNTP server IP address : 0.0.0.0
PTP mode          : Slave-only
PTP profile       : IEEE C37.238-2011
PTP domain        : 93
Holdover mode     : Enabled
Sync mode         : IEEE 1588
Transmit VLAN tags : Enabled
VLAN ID           : 0
VLAN priority     : 4
Sync correction   : 0
GTSYNC→GTWIF skew : 750
Override time source : YES
Advertised time source : PTP
IRIG-B output time quality override : Disabled
BNC output format : 1PPS
Fiber1 output format : 1PPS
Fiber2 output format : 1PPS
Fiber3 output format : 1PPS
Fiber4 output format : 1PPS
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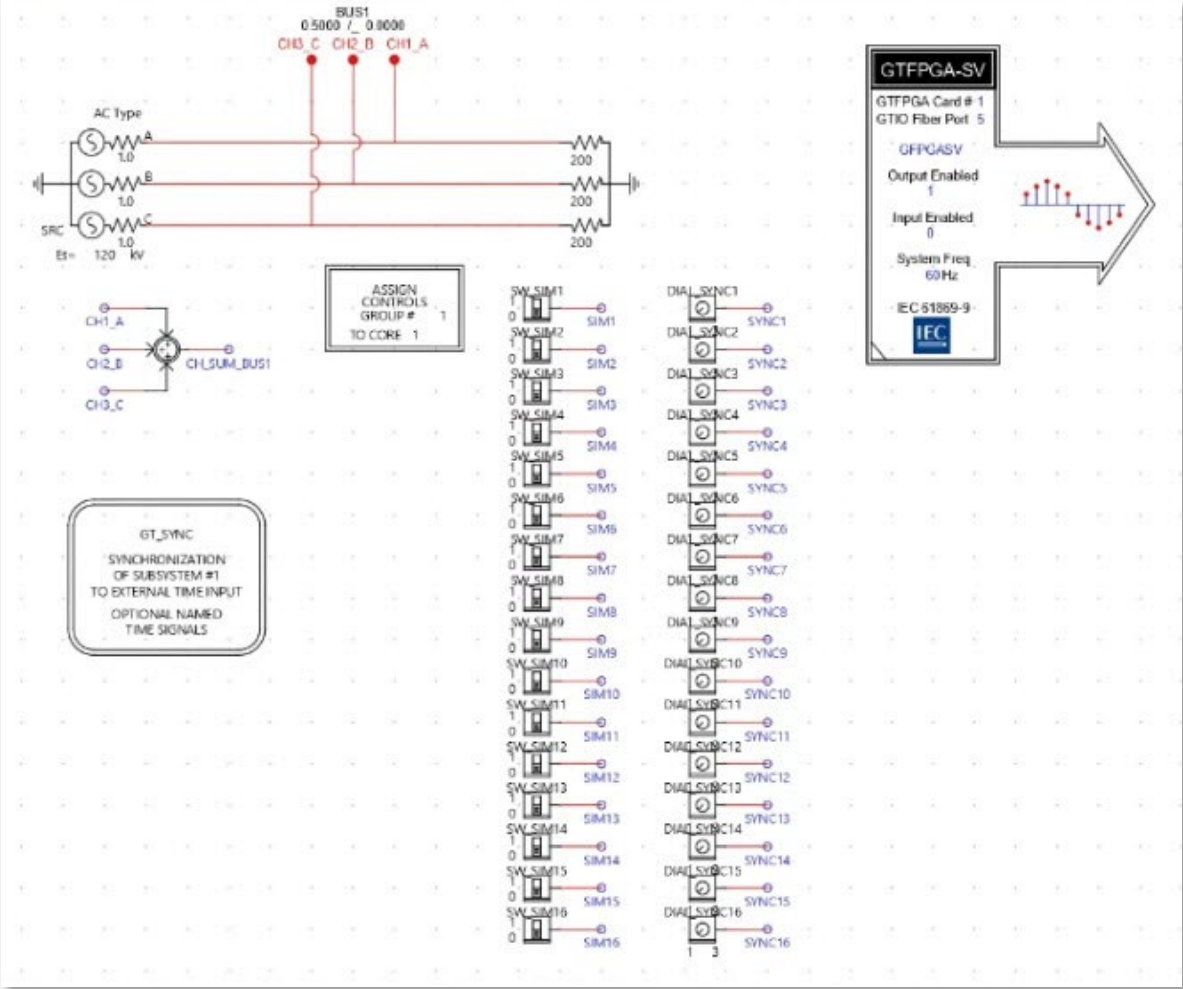
RTDS SIMULATION CONFIGURATION



- A simple power system to generate the variables
- Same signal of reference



RTDS SIMULATION CONFIGURATION



RUNNING THE SIMULATION WITH 13 SV

Normal Traffic

Detailed Port Statistics Port 17

Receive Total	
Rx Packets	198
Rx Octets	21586
Rx Unicast	92
Rx Multicast	23
Rx Broadcast	83
Rx Pause	0
Receive Size Counters	
Rx 64 Bytes	108
Rx 65-127 Bytes	67
Rx 128-255 Bytes	5
Rx 256-511 Bytes	18
Rx 512-1023 Bytes	0
Rx 1024-1526 Bytes	0
Rx 1527- Bytes	0
Receive Queue Counters	
Rx Q0	198
Rx Q1	0
Rx Q2	0
Rx Q3	0
Rx Q4	0
Rx Q5	0
Rx Q6	0
Rx Q7	0
Receive Error Counters	
Rx Drops	0
Rx CRC/Alignment	0
Rx Undersize	0
Rx Oversize	0
Rx Fragments	0
Rx Jabber	0
Rx Filtered	0

After 2 s **With 13 SV**

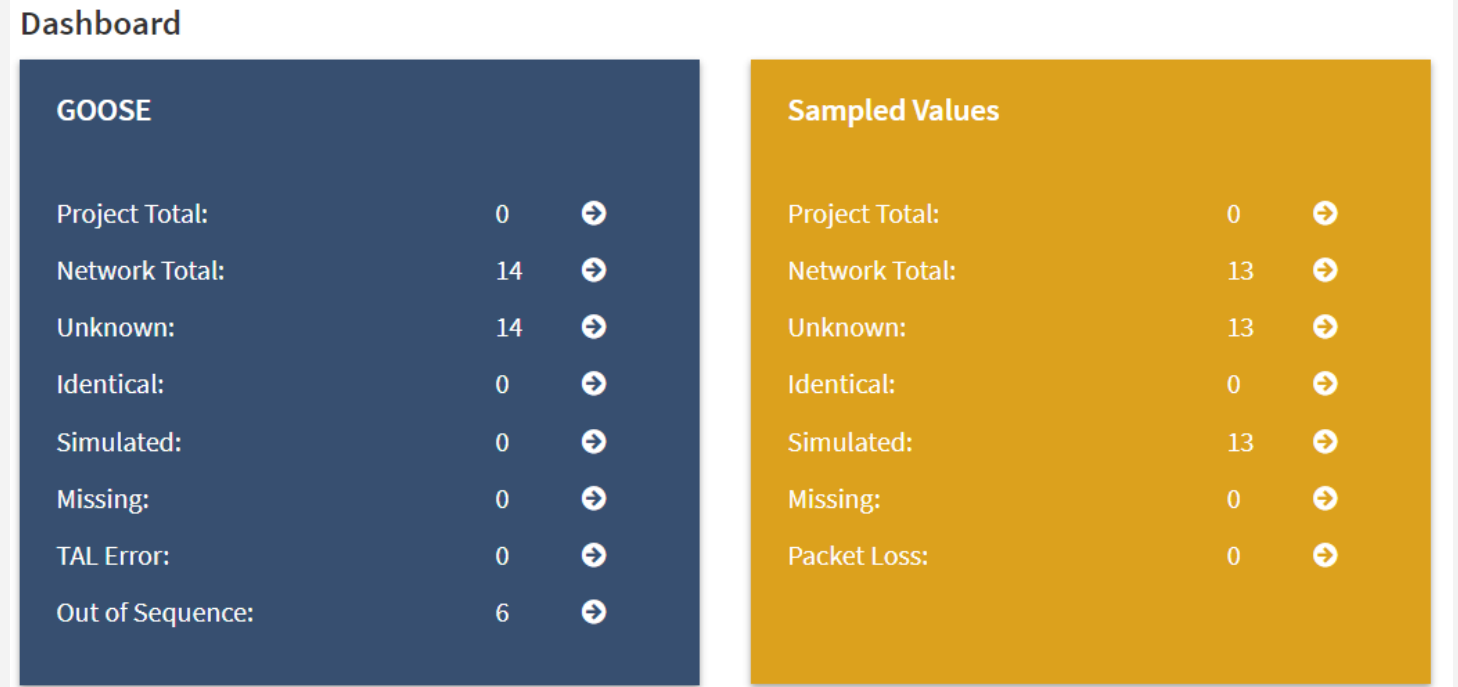
Detailed Port Statistics Port 17

Receive Total	
Rx Packets	5159
Rx Octets	399713
Rx Unicast	4400
Rx Multicast	166
Rx Broadcast	593
Rx Pause	0
Receive Size Counters	
Rx 64 Bytes	4526
Rx 65-127 Bytes	455
Rx 128-255 Bytes	36
Rx 256-511 Bytes	134
Rx 512-1023 Bytes	6
Rx 1024-1526 Bytes	2
Rx 1527- Bytes	0
Receive Queue Counters	
Rx Q0	5159
Rx Q1	0
Rx Q2	0
Rx Q3	0
Rx Q4	0
Rx Q5	0
Rx Q6	0
Rx Q7	0
Receive Error Counters	
Rx Drops	0
Rx CRC/Alignment	0
Rx Undersize	0
Rx Oversize	0
Rx Fragments	0
Rx Jabber	0
Rx Filtered	0

- Increasing gradually the number of SV in the network to see the performance and monitoring the information

EVALUATION OF THE DATA IN THE NETWORK USING DOBLE'S TOOLS

- Developing new monitoring technologies can help us verify that the information in the network match with the design and reference files



RUNNING THE SIMULATION WITH 48 SV

Normal Traffic		After 2 s		With 47 SV	
Detailed Port Statistics Port 17		Detailed Port Statistics Port 17		Detailed Port Statistics Port 17	
Receive Total		Receive Total		Receive Total	
Rx Packets	151	Rx Packets	369665	Rx Packets	369665
Rx Octets	16930	Rx Octets	56565702	Rx Octets	56565702
Rx Unicast	58	Rx Unicast	4243	Rx Unicast	4243
Rx Multicast	20	Rx Multicast	365283	Rx Multicast	365283
Rx Broadcast	73	Rx Broadcast	139	Rx Broadcast	139
Rx Pause	0	Rx Pause	0	Rx Pause	0
Receive Size Counters		Receive Size Counters		Receive Size Counters	
Rx 64 Bytes	92	Rx 64 Bytes	4289	Rx 64 Bytes	4289
Rx 65-127 Bytes	38	Rx 65-127 Bytes	87	Rx 65-127 Bytes	87
Rx 128-255 Bytes	5	Rx 128-255 Bytes	316844	Rx 128-255 Bytes	316844
Rx 256-511 Bytes	16	Rx 256-511 Bytes	48442	Rx 256-511 Bytes	48442
Rx 512-1023 Bytes	0	Rx 512-1023 Bytes	3	Rx 512-1023 Bytes	3
Rx 1024-1526 Bytes	0	Rx 1024-1526 Bytes	1	Rx 1024-1526 Bytes	1
Rx 1527- Bytes	0	Rx 1527- Bytes	0	Rx 1527- Bytes	0
Receive Queue Counters		Receive Queue Counters		Receive Queue Counters	
Rx Q0	151	Rx Q0	369668	Rx Q0	369668
Rx Q1	0	Rx Q1	0	Rx Q1	0
Rx Q2	0	Rx Q2	0	Rx Q2	0
Rx Q3	0	Rx Q3	0	Rx Q3	0
Rx Q4	0	Rx Q4	0	Rx Q4	0
Rx Q5	0	Rx Q5	0	Rx Q5	0
Rx Q6	0	Rx Q6	0	Rx Q6	0
Rx Q7	0	Rx Q7	0	Rx Q7	0
Receive Error Counters		Receive Error Counters		Receive Error Counters	
Rx Drops	0	Rx Drops	0	Rx Drops	0
Rx CRC/Alignment	0	Rx CRC/Alignment	0	Rx CRC/Alignment	0
Rx Undersize	0	Rx Undersize	0	Rx Undersize	0
Rx Oversize	0	Rx Oversize	0	Rx Oversize	0
Rx Fragments	0	Rx Fragments	0	Rx Fragments	0
Rx Jabber	0	Rx Jabber	0	Rx Jabber	0
Rx Filtered	0	Rx Filtered	0	Rx Filtered	0

- In an Ethernet switch installed in the Process Bus, the increase of traffic of packets, also to confirm that does not exist any drops of packages that can compromise the information between devices



TEST ANALYSIS

Drag a column header and drop it here to group by that column

SV ID	Applicatio...	Configurati...	Routable	Multicast	IP Address		MAC Address		ID
					Source IP	Destinatio...	Source	Destination	
SMV44MU0401	4000	1	false	true			60-15-92-10-03-53	01-0C-CD-04-01-A4	0000
SMV42MU0201	4000	1	false	true			60-15-92-10-03-51	01-0C-CD-04-01-A2	0000
SMV7MU0701	4000	1	false	true			(leeeRegi) 70-B3-D5-54-20-72	01-0C-CD-04-01-A7	0000
SMV8MU0801	4000	1	false	true			(leeeRegi) 70-B3-D5-54-20-73	01-0C-CD-04-01-A8	0000
SMV5MU0501	4000	1	false	true			(leeeRegi) 70-B3-D5-54-20-70	01-0C-CD-04-01-A5	0000
SMV6MU0601	4000	1	false	true			(leeeRegi) 70-B3-D5-54-20-71	01-0C-CD-04-01-A6	0000
SMV2MU0201	4000	1	false	true			(leeeRegi) 70-B3-D5-54-20-6D	01-0C-CD-04-01-A2	0000
SMV41MU0901	4000	1	false	true			60-15-92-10-03-50	01-0C-CD-04-01-A1	0000
SMV1MU0101	4000	1	false	true			(leeeRegi) 70-B3-D5-54-20-6C	01-0C-CD-04-01-A1	0000
SMV45MU0501	4000	1	false	true			60-15-92-10-03-54	01-0C-CD-04-01-A5	0000

1 - 48 of 48 items

- Having in the network 48 SV and using a monitoring tool to go through the information and know the details of each SV stream in the network

TEST ANALYSIS

Drag a column header and drop it here to group by that column.

Control Block Reference	GOOSE ID	Applica...	Configurati...	Routable
UR_T60Master/LLN0\$GOSGoCB01	TX_TRIP	0000	1	false
PROT_1LD0/LLN0\$GOSGCB_S3_TEST_F	PROT_1LD0/LLN0.GCB_S3_TEST_F	0005	100	false
NE01_0435_08B1_RIO1PLD0/LLN0\$GOSGCB_CNTRL_RCBA	NE01_0435_08B1_RIO1PLD0/LLN0.GCB_CNTRL_RCBA	0BB9	100	false
SIEMENS_DOBLE_LABLn1_5051OC3phA1/LLN0\$GOSControl_DataSet	SIEMENS_DOBLE_LAB/Ln1_5051OC3phA1/LLN0/Control_DataSet	0001	20001	false
SIEMENS_DOBLE_LABApplication/LLN0\$GOSControl_DataSet	SIEMENS_DOBLE_LAB/Application/LLN0/Control_DataSet	0002	10001	false
SEL_351_1CFG/LLN0\$GOSPTOC	SEL_351_1	0005	1	false
SEL_351_1CFG/LLN0\$GOSMMXU	SEL_351_1	0003	1	false
PROT_1LD0/LLN0\$GOSGCB_S3_TEST_I	PROT_1LD0/LLN0.GCB_S3_TEST_I	0007	100	false
SEL_421_4_qaCFG/LLN0\$GOSGooseDSet15	Sub1Bay1	0005	1	false
PROT_1LD0/LLN0\$GOSGCB_S3_TEST_Z	PROT_1LD0/LLN0.GCB_S3_TEST_Z	0006	100	false

- Also, the information of GOOSE messages in the network and use it as a trigger condition to monitor the behavior of the IEDs and confirm the correct operation

CONCLUSIONS

- The system RTDS NovaCor helps us to create a huge amount of data in the network in less time and with fewer devices
- Having a system RTDS is helping Doble Engineering to have a quick development of solutions for our clients

THANK YOU

Questions?

