

IEC 61850 Representation of Switchgear, Switch Controller and Interlocking Functions

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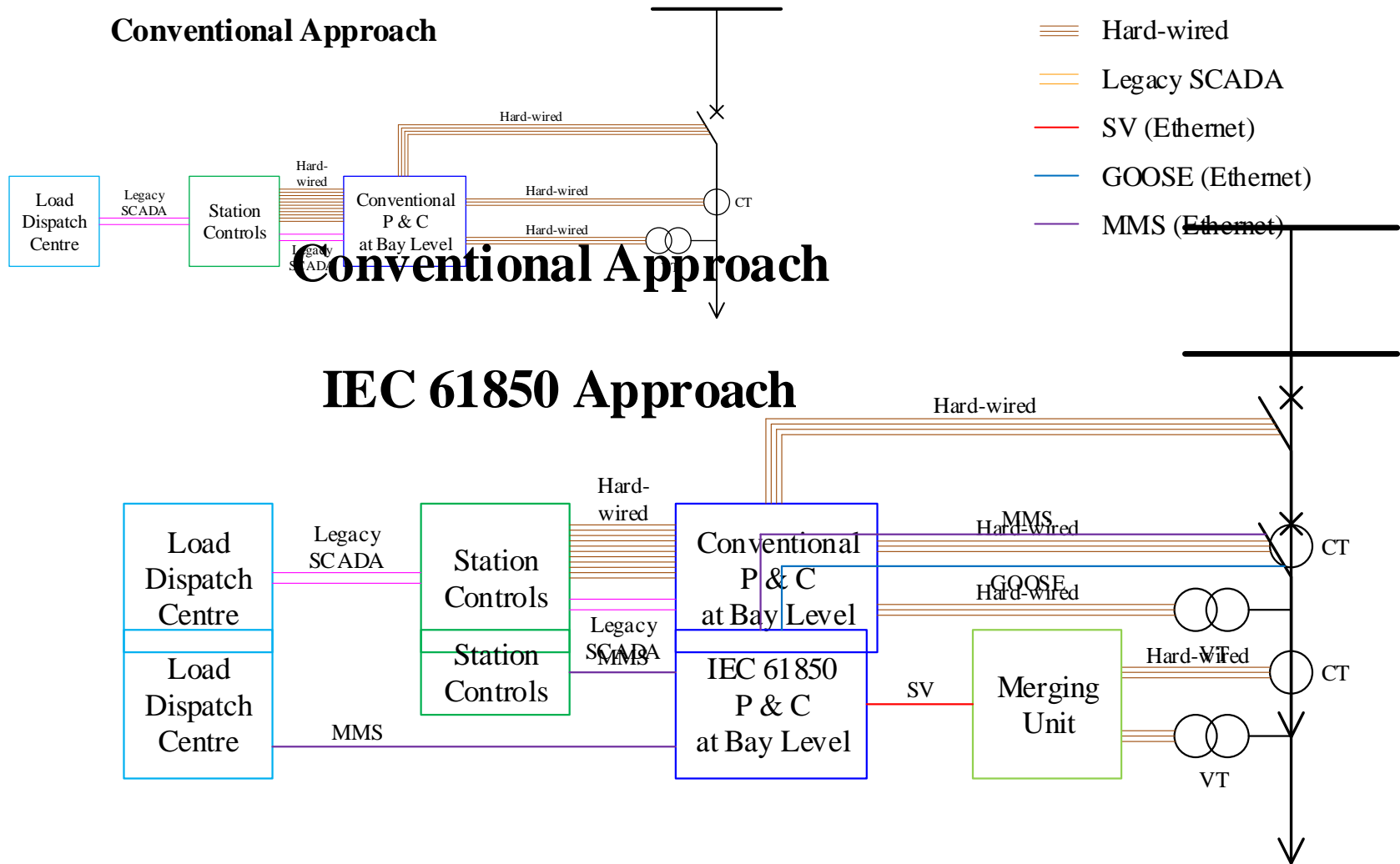
RTDS Technologies Inc., Canada

Outline

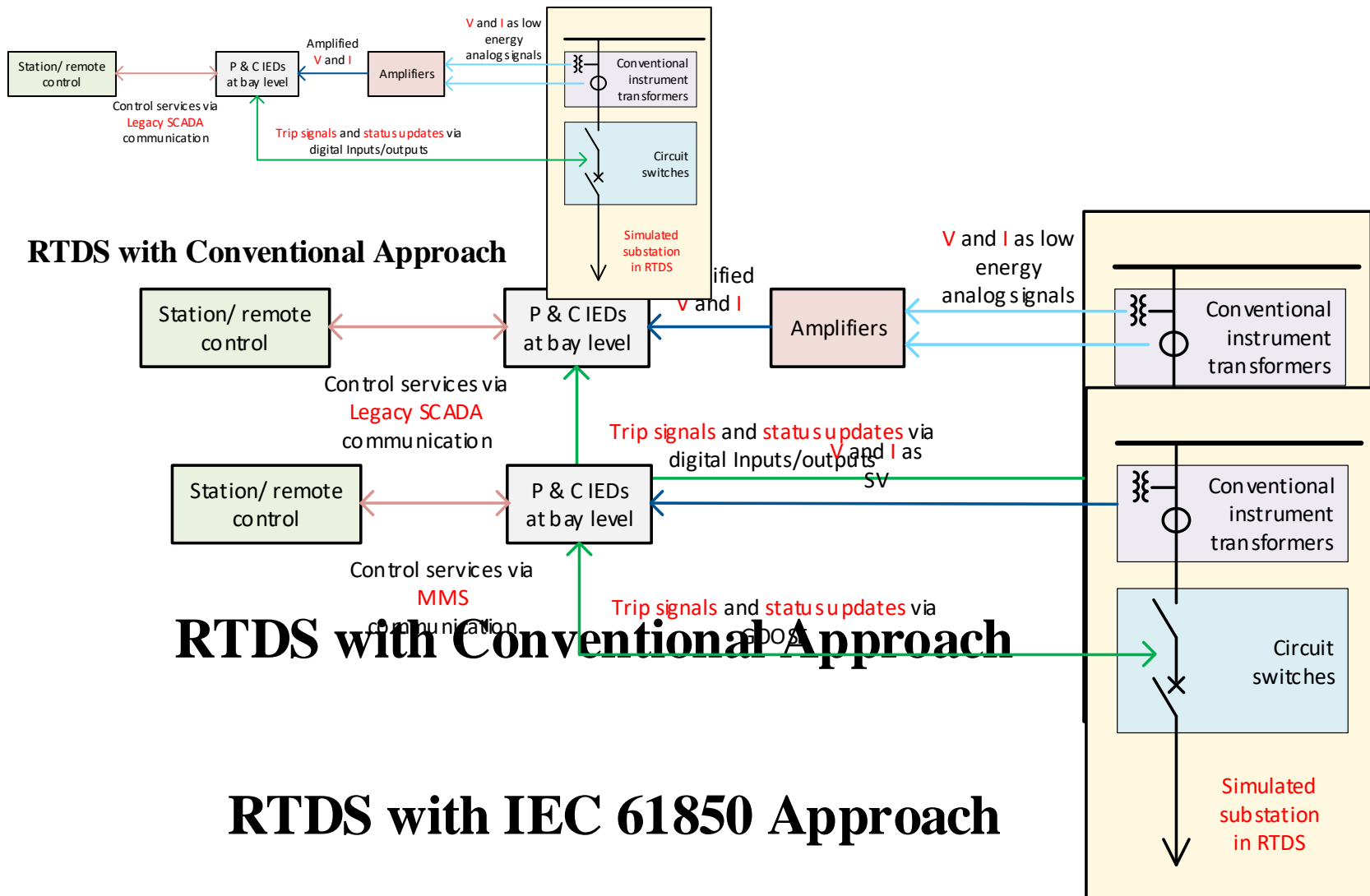
- Introduction
- Switchgear Modelling in IEC 61850
- Implementations in GTNET-GSE
- Test Procedure
- Results
- GOOSE Analyzer
- Conclusions

Introduction

Substation Protection, Control & Automation



Introduction



Switchgear Control

- **High voltage switchgear** in an electrical substation operates in response to either a **trip** or a **switch** (opening and closing) command
- Typically, only protection and control intelligent electronic devices (IEDs) at **bay level** can trip circuit breakers
- A circuit breaker can either be switched **locally with manual** control or by a command from **bay, station** or/and **remote levels**
- **IEC 61850** Standard defines **data models** for representing switchgear and their associated controls
- These data models can be read and controlled by communication protocols such as **MMS** and **GOOSE**

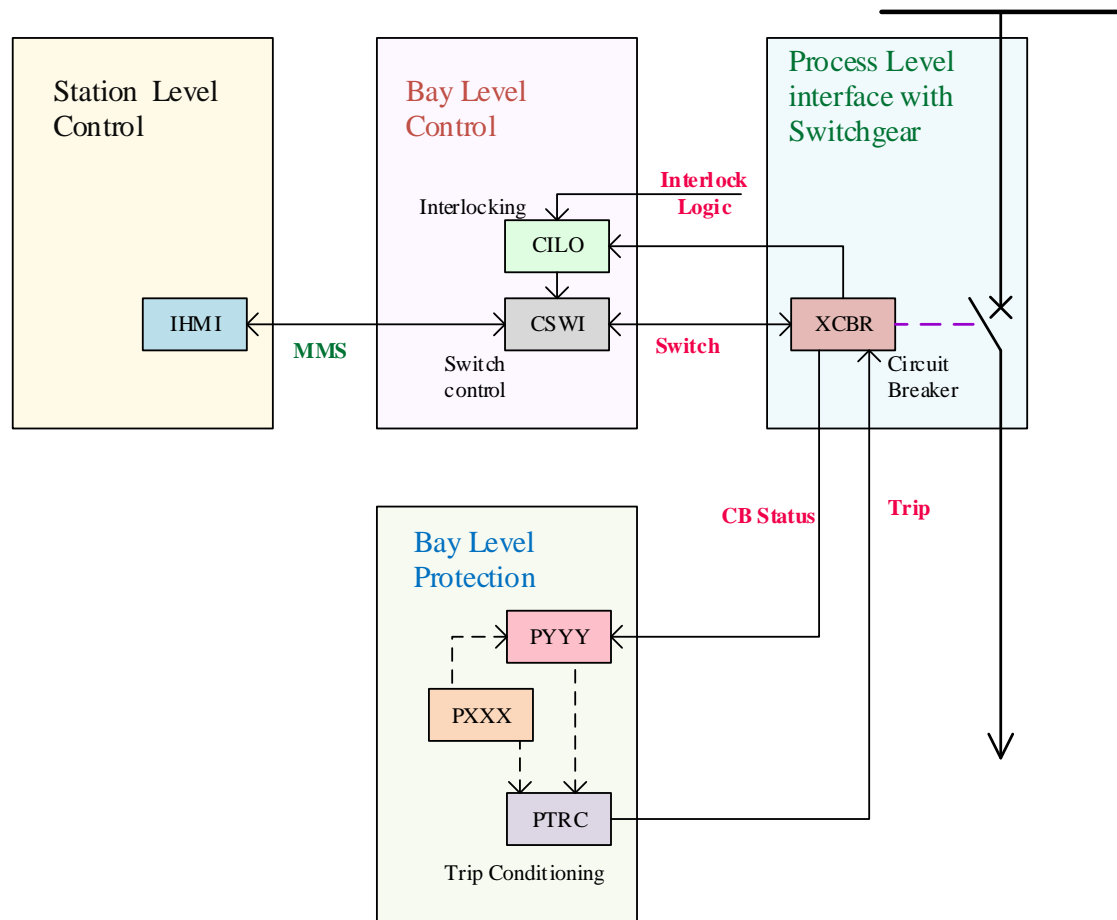
Logical Node Classes for Switchgear

- IEC 61850-7-4 defines **logical node** (LN) classes for representing switchgear and their associated controls

LN Class (IEC 61850-7-4)	Description
XCBR	Circuit Breakers - Switches with short circuit breaking capability
XSWI	Circuit Switches - Switches without short circuit breaking capability
CSWI	Switch Controller - Control all switching conditions above process level
CILO	Interlocking Function - Enable a switching operation if interlocking conditions are fulfilled

Switchgear Modelling in IEC 61850

- Information flow between logical nodes associated with switchgear operations



Control Models in IEC 61850

- A **MMS client** is capable of changing the state of data object instances of controllable **common data classes** (CDC)
- A control model facilitates this functionality
- As different applications require different control behaviours, IEC 61850 defines **four** control models;
 - Direct control with normal security
 - SBO (select before operate) control with normal security
 - Direct control with enhanced security
 - SBO control with enhanced security

Control Models in IEC 61850 (cont.)

Direct control vs SBO control

- Direct control model : Does not prevent multiple clients from trying to perform conflicting control actions
- Select before operate model : A client has to “select” the control object prior to operation. Once selected, the client is the only one allowed to perform control actions on the object

Normal security vs Enhanced security

- Normal security : No additional supervision of the status value by the control object
- Enhanced security : An additional supervision of the status value by the control object

Originator Category

- Originator category indicates who/what requested the change of state of a controllable value. Originator categories defined are;
 - **not-supported** : value shall not be used
 - **bay-control** : Control operation issued from an operator using a client located at bay level
 - **station-control** : Control operation issued from an operator using a client located at station level
 - **remote-control** : Control operation from a remote operator outside the substation
 - **automatic-bay** : Control operation issued from an automatic function at bay level
 - **automatic-station** : Control operation issued from an automatic function at station level
 - **automatic-remote** : Control operation issued from an automatic function outside of the substation
 - **maintenance** : Control operation issued from a maintenance/service tool
 - **process** : Status change occurred without control action

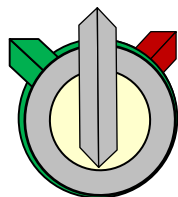
Control Parameters

- Control authority for switching can be varied using following parameters

Control parameter	Description (as per IEC 61850-7-4)
XCBR/XSWI.Loc	represents the status of an actual switch at the process and allows taking over the manual control authority
LLNO.MltLev	enables for more than one originator to hold control authority at the same time
CSWI.Loc	shows the control behaviour of the logical node (bay level)
CSWI.LocSta	shows the switching authority at station level

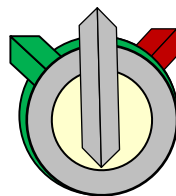
Control Authority – Single level

CSWI.LocSta



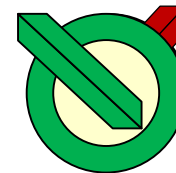
Unlock / Lock

CSWI.Loc

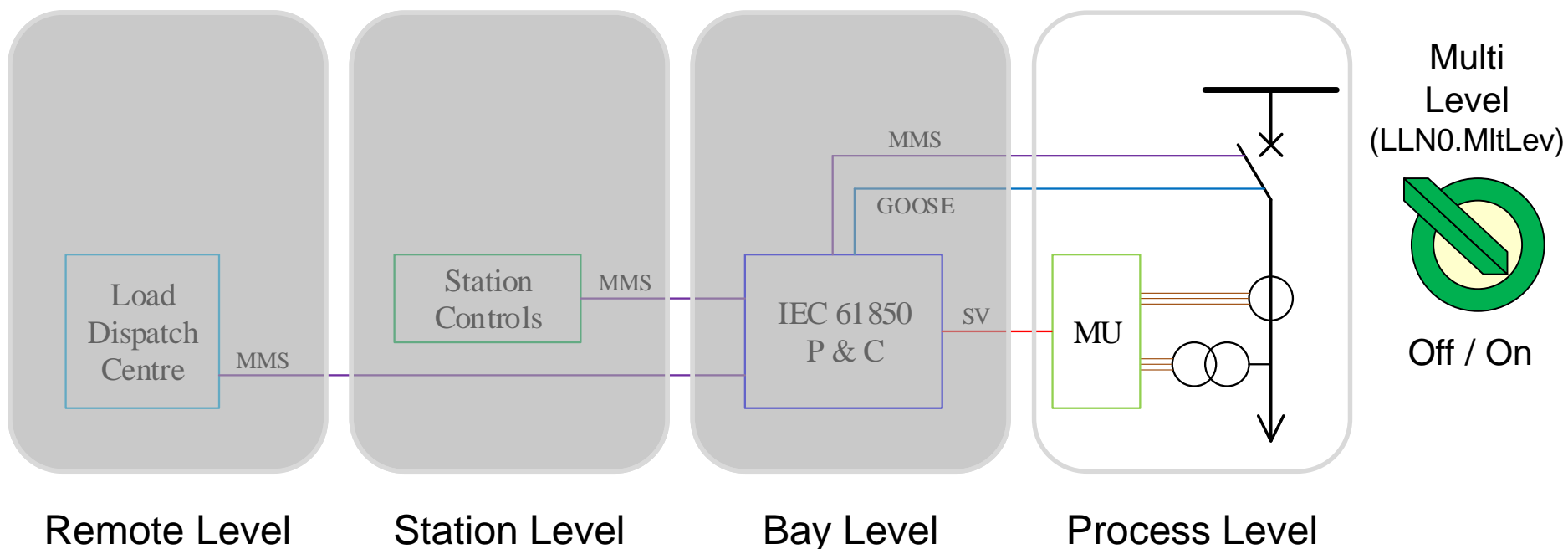


Unlock / Lock

XCBR.Loc

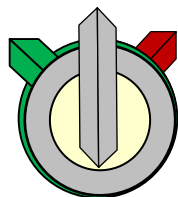


Unlock / Lock



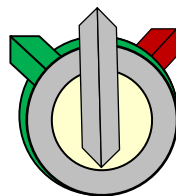
Control Authority – Multi level

CSWI.LocSta



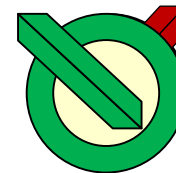
Unlock / Lock

CSWI.Loc

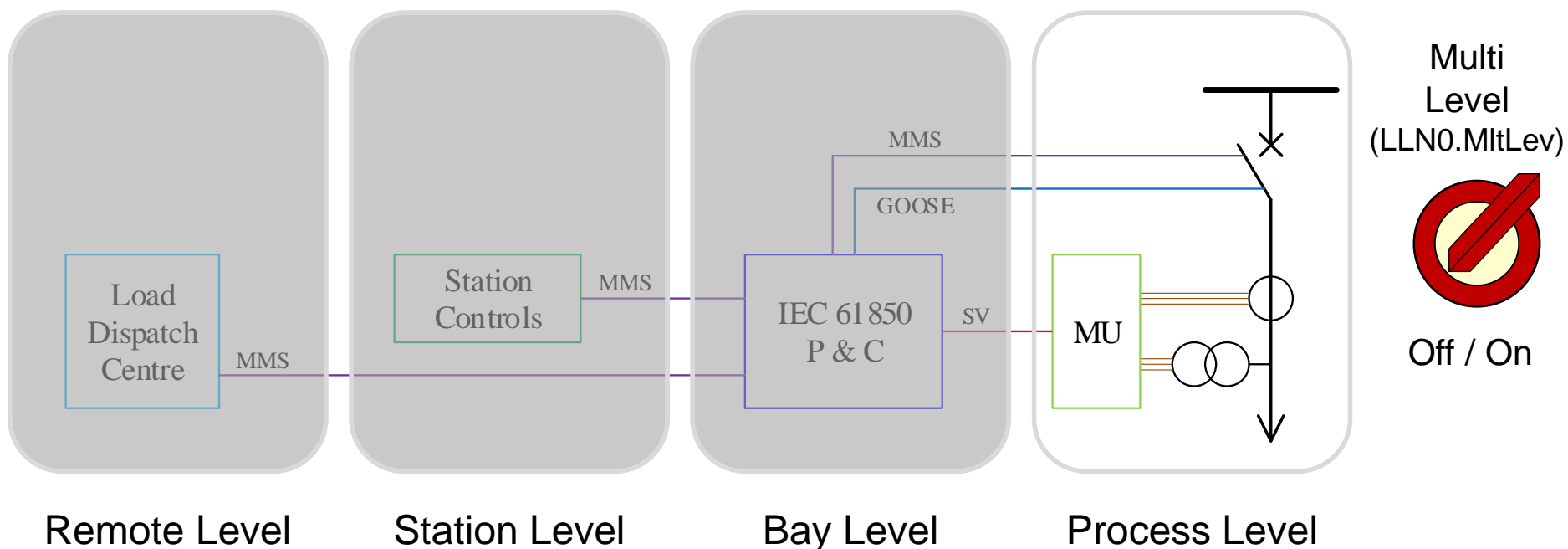


Unlock / Lock

XCBR.Loc



Unlock / Lock



Remote Level

Station Level

Bay Level

Process Level

Control Authority

- Annex B of IEC 61850-7-4 describes the relationship between control parameters and Control authority

Switch	Bay control			Manual control at switch (process)	Command from		
	Mode of switching for local control	Local control behavior	Control authority at station level		Bay	Station	NCC
XCBR.Loc XSWI.Loc	LLN0.MltLev	CSWI.Loc	CSWI.LocSta		Originator Category (OrCat)		
					Local Ctl (Bay)	Station	Remote
T	F	n.a.	n.a.	AA	NA	NA	NA
F	F	T	n.a.	AA	AA	NA	NA
F	F	F	T	AA	NA	AA	NA
F	F	F	F	AA	NA	NA	AA
T	T	n.a.	n.a.	AA	NA	NA	NA
F	T	T	n.a.	AA	AA	NA	NA
F	T	F	T	AA	AA	AA	NA
F	T	F	F	AA	AA	AA	AA

Loc Status

T = True

F = False

n.a. = not applicable

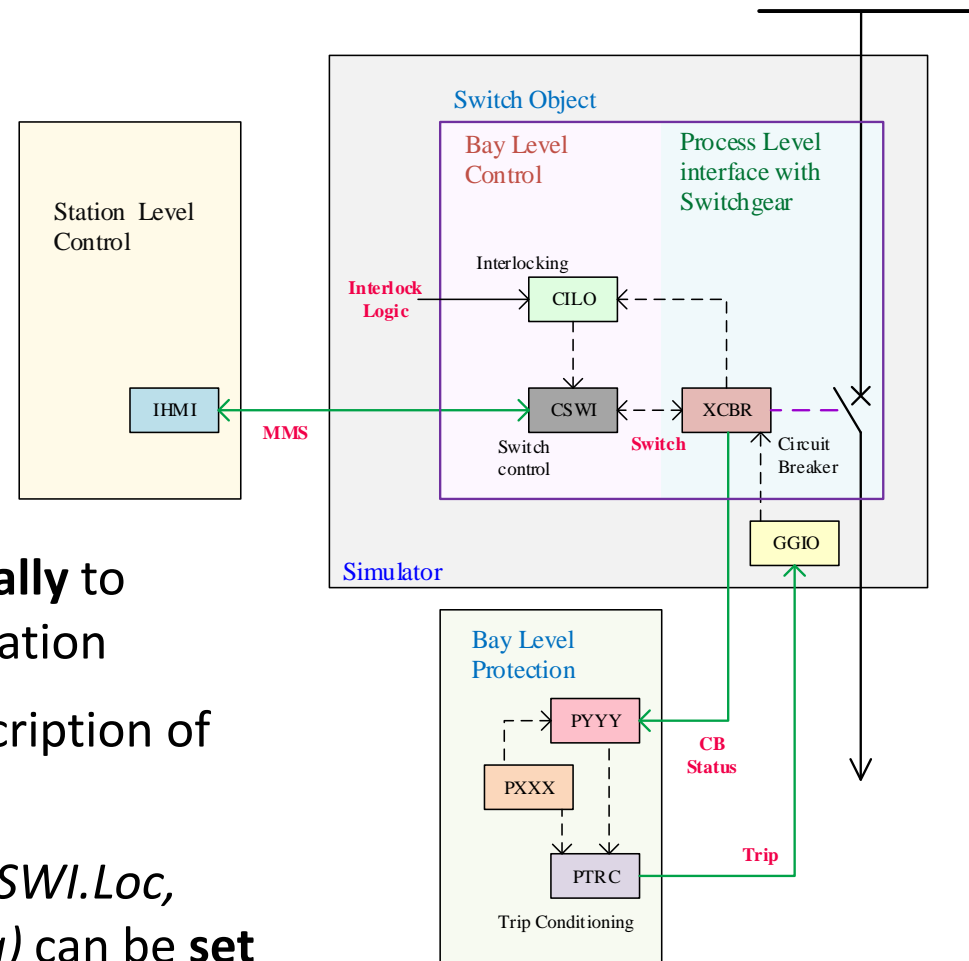
Command

AA = Always Allowed

NA = Not Allowed

Implementations in GTNET-GSE

- An instance each of **CSWI** and **CILO** LNs exist for every **XCBR/XSWI** LN instance
- This combination is considered as a **switch object**
- Information flow between XCBR/XSWI, CSWI, CILO LNs are internal
- XCBR/ XSWI LNs are **mapped internally** to corresponding switches in the simulation
- A GGIO LN instance is used for subscription of trip signals
- All four control parameters (*XCBR/XSWI.Loc*, *LLNO.MltLev*, *CSWI.Loc*, *CSWI.LocSta*) can be **set dynamically** in the simulation



Initialization of Switch Objects

- All four control models are implemented with an added “**status only**” option in GTNET-GSE version 6
- Control model type is chosen when LN instances are first created using the **SCD Editor** (the IED configurator for GTNET-GSE)
- Type of the switch (XCBR or XSWI) is also chosen at this point
- All **three LN instances** (XCBR/XSWI, CSWI, CILO) are locally interlinked and created simultaneously

Edit LD CSWI_XCBR

CSWI Entries				
Add	Inst	ctlModel	Type	Del
	InClass="CSWI" inst="1"	sbo-with-normal-security	XSWI	
	InClass="CSWI" inst="2"	status-only	XCBR	
	InClass="CSWI" inst="3"	direct-with-normal-security	XSWI	
	InClass="CSWI" inst="4"	sbo-with-normal-security	XSWI	
	InClass="CSWI" inst="5"	direct-with-enhanced-security	XSWI	
	InClass="CSWI" inst="5"	sbo-with-enhanced-security	XSWI	

Available Information

- Each GTNET-GSE v6 component can model a maximum of **32 independent circuit switches**
- All related LN instances are grouped in to a separate **Logical Device (LD)**
- A **dataset** each for **MMS** and **GOOSE** communication, with the following information available for a single switch object

MMS Dataset	GOOSE Dataset
CSWI.Pos.StVal	XCBR/XSWI.Pos.StVal
CSWI.Loc.StVal	XCBR/XSWI.Pos.q
CSWI.LocSta.StVal	
CILO.EnaOpn.StVal	
CILO.EnaCls.StVal	
XCBR/XSWI.Pos.StVal	
XCBR/XSWI.OpCnt.StVal	

Related Configurations

- All configurable parameters related to the “**XCBR/XSWI logical device**” can be set in the SCD editor
- These include the names of the **LD instance**, **GOOSE control block** and **GOOSE dataset** as well as the multicast MAC address, appID, VLAN ID and VLAN priority
- The IP address of the **MMS server** will be the one that is assigned to Ethernet port of the corresponding GTNET hardware module
- This IP address must be correctly configured in the **.scd file** for MMS communication to commence
- A correctly configured **MMS client** should then be able to connect and communicate with the GTNET-GSE MMS server

MMS Client in RSCAD

- RSCAD provides a standalone IEC 61850 client program named the “**61850 MMS Voyageur**”
- It is capable to connect with a server using IEC 61850 MMS communication
- Once connected with a server, the MMS client can;
 - **test** the connection setup with the server device
 - **browse** the data model of the server device
 - **read and write** server data
 - **perform** control operations

MMS Client in RSCAD (cont.)

61850 MMS Voyageur - C:\RTDS_USER\MMS\serverDatabase.txt

File Server Help

GTNETV6 [172.24.9.111]

GTNETV6 [172.24.9.111] *

Name	Value	FC
Pos		
SBO		CO
ctfModel	sbo-with-enhanced-security	CF
sboTimeout	30000	CF
sboClass	operate-once	CF
SBOw		
Oper		CO
Cancel		CO
stVal	10	ST
q		
t		ST
d		DC
cdcNs		EX
cdcName		EX
dataNs		EX

Parameter	Value
Name	GTNETV6
SCL File [...]	C:\RTDS_USER\fil...
Local AE Qualifier	12
Local Application ID	1.1.1.999
Local Presentation...	00000001
Local Session Sel...	0001
Local Session Tim...	2000
Local Transport Se...	0001
Remote IP address	172.24.9.111
Remote IP port	102
Remote AE Qualifier	12
Remote Applicatio...	1.1.1.999.1
Remote Presentati...	00000001
Remote Session S...	0001

Reference	Name	Value	FC
GTNETV6CSWI_XCBR/Obj2CSWI...	stVal	10	ST

Period (sec): 0.51

New Start Stop

Reports Polled Data

Message Area

Data values updated.
Updating data values...
Data values updated.
Updating data values...
Data values updated.
Updating data values...
Data values updated.
Updating data values...
Data values updated.
'GTNETV6' disconnected from server.
Associating to 'GTNETV6'...
Association to server is complete! 'GTNETV6 [172.24.9.111]'.
Updating data values...
Data values updated.

Copy Clear

MMS Client in RSCAD (cont.)

- In this work, the focus is only on **performing control operations** on the server device
- Control operations enable the client to **change the state** of an internal or external process of the server device
- A “**Command Control Dialog**” can be opened for a selected “**control object**”
- Parameters such as the **control value**, **originator category** and **command (service) type** can be chosen from this window
- It **supports** all standard originator categories therefore, can emulate any originator in a test
- The **logging area** displays a summary of the information exchanged between the client and the server

Command Control Dialog

The screenshot shows a dialog box with the following sections and annotations:

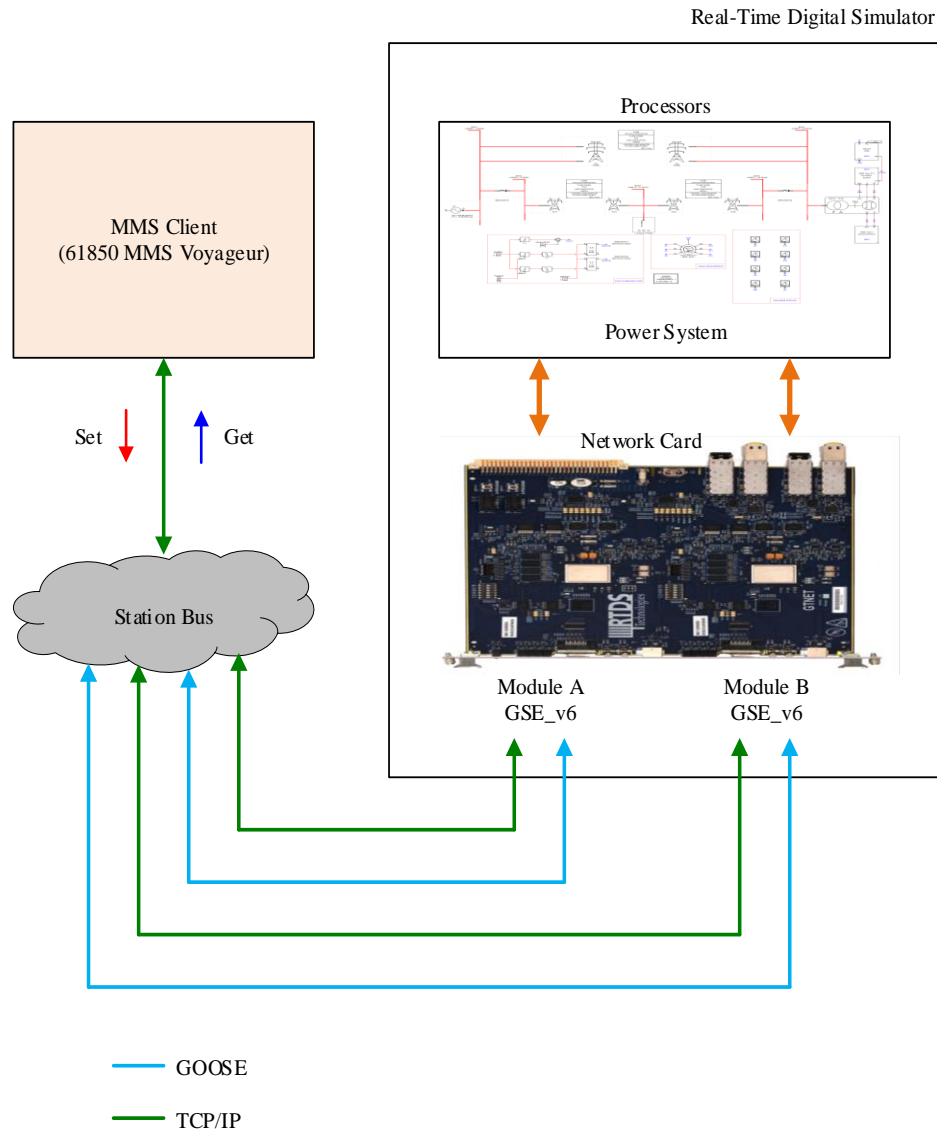
- Status:** Fields for Value, Quality, Time Stamp, and Originator (Category, Id).
- Control:** A red box highlights the 'Value' dropdown (set to 'on (TRUE)') and the 'Ctrl Num' field (set to 0). Another red box highlights the 'Originator' section, including 'Category' (set to 'remote-control'), 'Id' (set to '172.24.2.21'), and a 'TEXT' dropdown.
- Check:** Checkboxes for 'Synchro Check', 'Interlock Check', and 'Test'.
- Dialog commands:** A red box highlights the 'Select', 'Select with Value', 'Operate', and 'Cancel' buttons.
- Log:** A red box highlights a table with the following data:

Time	Service	Msg. Type	Status	Details
19:51:22.677	SelectWithValue	Request		ctlVal=True
19:51:25.746	SelectWithValue	Response	+	
19:51:22.677	Operate	Request		ctlVal=True
19:51:27.915	Operate	Response	+	

Annotations on the left side of the dialog:

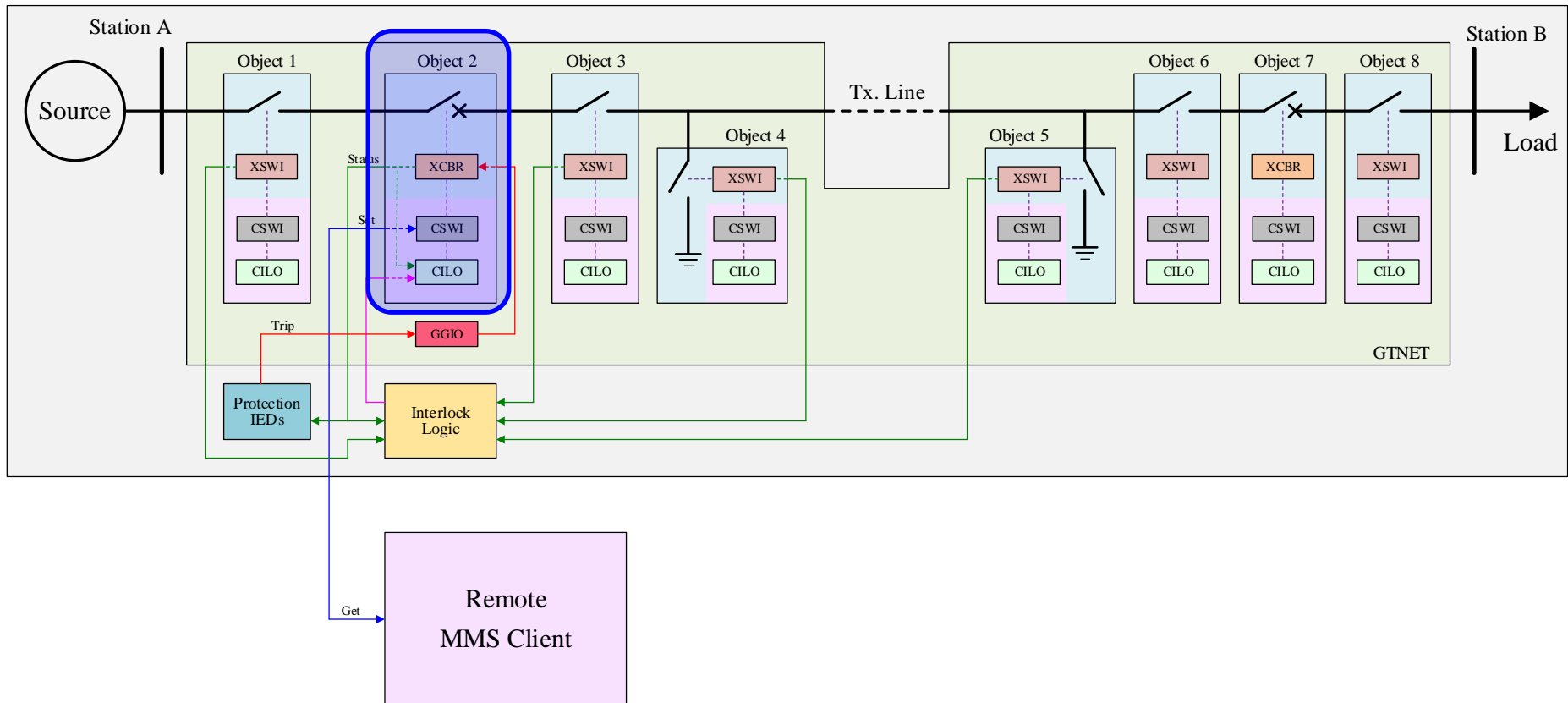
- Value:** Points to the 'Value' dropdown in the Control section.
- Originator Category:** Points to the 'Category' dropdown in the Originator section.
- Dialog commands:** Points to the 'Select' button.
- Log:** Points to the Log table.

Test Setup



Example Test Case

Real-Time Simulator



Manual Testing

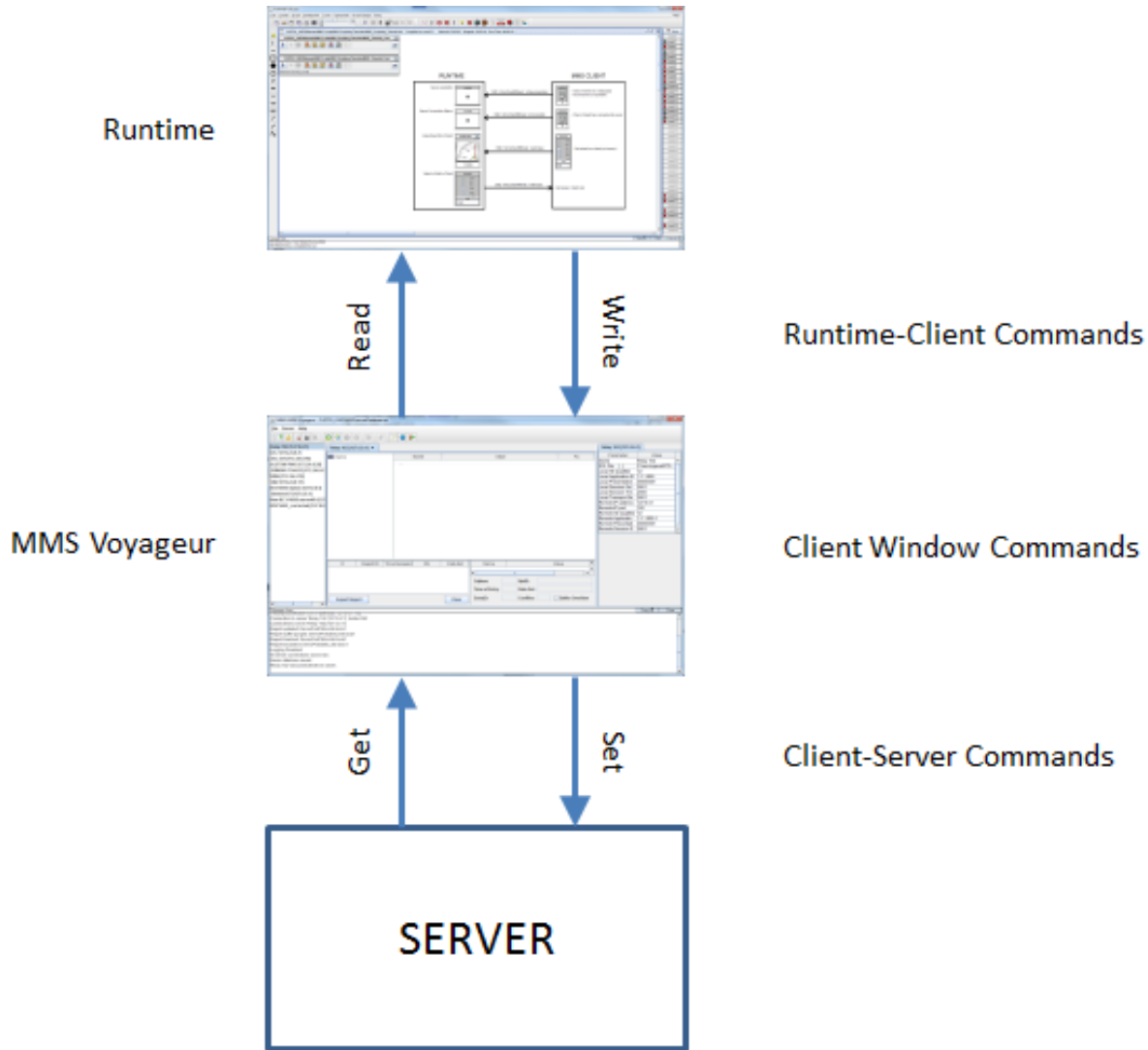
The screenshot displays the RSCAD 5.004 interface. The left pane shows a project tree for 'sachintha' with a sub-project 'CEATI 5th annual P&C Conference' containing various files like 'GTNETV6.sib'. The main workspace shows a network diagram with a 'Source' connected to 'Bus 1' (132.9). Four circuit breakers (CSWI1, CSWI2, CSWI3, CSWI4) are shown with their respective disconnector (DS) and circuit breaker (CB) components. Below the diagram are three status panels: 'XCBR/XSWI.Loc', 'CSWI.Loc', and 'CSWI.LocSta', each with 8 indicator lights. A legend indicates 0 for Disable and 1 for Enable. A 'PosA' panel and a 'Subsystem #1' table are also visible.

	IBURF	IBURB	IBURC
1			
0.83333			
0.66667			
0.5			
0.33333			

Automated Testing with Scripting

- MMS Voyager supports the **scripting capability** of “RSCAD Runtime”
- This enables users to **automate testing** and effectively test a large number of scenarios with different settings
- Here, all cases described in IEC 61850-7-4 are tested for three scenarios,
 - With interlock check bypassed
 - With interlocks checked, but violated
 - With interlocks checked, and satisfied
- In total, **24 cases** and **72 switching operations** are performed

Automated Testing with Scripting (cont.)



Automated Testing

The image displays the RSCAD software interface. On the left is a project tree for 'sachintha', showing a hierarchy of folders including 'Development', 'Internal_Training', 'Research', 'Inst_Pow', 'MultiMass', and 'Papers'. Under 'Papers', there is a folder 'CEATI 5th annual P&C Conference' containing a sub-folder '2' with files like 'AutomatedXCBRTesting.scr' and 'GTNETV6.dft.1'. The main window shows a network diagram with a 'Source' connected to 'Station A' (Bus 1, 137.4). The network includes switches CSW1, CSW2, CSW3, and CSW4, with various ports (DS1Op, DS1CI, DS2Op, DS2CI, CB1Op, CB1CI, ES1, ES1Op, ES1CI) and a ground symbol. Below the diagram are three control panels: 'XCBR/XSWI.Loc', 'CSWI.Loc', and 'CSWI.LocSta', each with a row of 8 indicator lights (labeled 8-1) and an 'ON/OFF' label. To the right of these panels are 'LLNO.MitLev' (set to 1) and a 'POSA' control panel. At the bottom right, a 'Subsystem #1' window shows a table with columns 'IBURA', 'IBURB', and 'IBURC' and a y-axis labeled 'Amplitude' ranging from 0.33333 to 1.0.

Test Results

- Above script only tests a **single circuit breaker**
- Its control model is **SBO with enhanced security**
- Operations for all 4 control models are tested in a similar manner
- Then, $72 \times 4 = \mathbf{288}$ control operations are performed for a single switch object

Test Results

Scenario 1: With interlock check **bypassed**

	Switch	Bay control parameters			Command from (OrCat)					
					Bay		Station		NCC	
Case	XCBR.Loc XSWI.Loc	LLNO.MitLev	CSWI.Loc	CSWI.LocSta	Intended operation	Result	Intended operation	Result	Intended operation	Result
1	T	F	n.a.	n.a.	NA	✓	NA	✓	NA	✓
2	F	F	T	n.a.	AA	✓	NA	✓	NA	✓
3	F	F	F	T	NA	✓	AA	✓	NA	✓
4	F	F	F	F	NA	✓	NA	✓	AA	✓
5	T	T	n.a.	n.a.	NA	✓	NA	✓	NA	✓
6	F	T	T	n.a.	AA	✓	NA	✓	NA	✓
7	F	T	F	T	AA	✓	AA	✓	NA	✓
8	F	T	F	F	AA	✓	AA	✓	AA	✓

Loc Status

T = True
 F = False
 n.a. = not applicable

Command

AA = Always Allowed
 NA = Not Allowed

Result

✓ - Expected Result
 ✗ - Unexpected Result

Test Results (cont.)

Scenario 2: With interlocks checked, but **violated**

Case	Switch XCBR.Loc XSWI.Loc	Bay control parameters LLNO.MltLev CSWI.Loc CSWI.LocSta			Command from (OrCat)					
					Bay		Station		NCC	
					Intended operation	Result	Intended operation	Result	Intended operation	Result
1	T	F	n.a.	n.a.	NA	✓	NA	✓	NA	✓
2	F	F	T	n.a.	NA	✓	NA	✓	NA	✓
3	F	F	F	T	NA	✓	NA	✓	NA	✓
4	F	F	F	F	NA	✓	NA	✓	NA	✓
5	T	T	n.a.	n.a.	NA	✓	NA	✓	NA	✓
6	F	T	T	n.a.	NA	✓	NA	✓	NA	✓
7	F	T	F	T	NA	✓	NA	✓	NA	✓
8	F	T	F	F	NA	✓	NA	✓	NA	✓

Loc Status

T = True
F = False
n.a. = not applicable

Command

AA = Always Allowed
NA = Not Allowed

Result

✓ - Expected Result
✗ - Unexpected Result

Test Results

Scenario 3: With interlocks checked, and **satisfied**

Case	Switch XCBR.Loc XSWI.Loc	Bay control parameters LLNO.MitLev CSWI.Loc CSWI.LocSta			Command from (OrCat)					
					Bay		Station		NCC	
					Intended operation	Result	Intended operation	Result	Intended operation	Result
1	T	F	n.a.	n.a.	NA	✓	NA	✓	NA	✓
2	F	F	T	n.a.	AA	✓	NA	✓	NA	✓
3	F	F	F	T	NA	✓	AA	✓	NA	✓
4	F	F	F	F	NA	✓	NA	✓	AA	✓
5	T	T	n.a.	n.a.	NA	✓	NA	✓	NA	✓
6	F	T	T	n.a.	AA	✓	NA	✓	NA	✓
7	F	T	F	T	AA	✓	AA	✓	NA	✓
8	F	T	F	F	AA	✓	AA	✓	AA	✓

Loc Status

T = True
F = False
n.a. = not applicable

Command

AA = Always Allowed
NA = Not Allowed

Result

✓ - Expected Result
✗ - Unexpected Result

RTDS P&A Suite IEC 61850 Analyzer

RTDS P&A Suite IEC 61850 Analyzer

File Edit Clear Help Publisher 10/16 captured GOOSE messages

Capture Open Clear Analyze Show Messages Auto Clear Messages Show Re-Transmitted Messages

No.	Time	stNum	sqNum	test	TATL
1	2019-09-11 11:15:06.993482	101	12	false	4000
2	2019-09-11 11:15:24.656604	102	0	false	8
3	2019-09-11 11:15:24.659675	102	1	false	16
4	2019-09-11 11:15:24.667641	102	2	false	32
5	2019-09-11 11:15:24.683653	102	3	false	64
6	2019-09-11 11:15:24.707699	103	0	false	8
7	2019-09-11 11:15:24.708671	104	0	false	8
8	2019-09-11 11:15:24.711669	104	1	false	16
9	2019-09-11 11:15:24.719662	104	2	false	32
10	2019-09-11 11:15:24.735660	104	3	false	64
11	2019-09-11 11:15:24.767902	104	4	false	128
12	2019-09-11 11:15:24.831672	104	5	false	256
13	2019-09-11 11:15:24.959652	104	6	false	512
14	2019-09-11 11:15:25.215663	104	7	false	1024
15	2019-09-11 11:15:25.727661	104	8	false	2048
16	2019-09-11 11:15:26.751767	104	9	false	4000

PN51ProtCtrl/LLN0\$GOSP_GCB

- GOOSE details
- Data details
- Last received GOOSE information
- Activity/Errors

Time	Type	Details
2019-09-11 11:15:06.993482	GSE	State Number has changed 0 to 101
2019-09-11 11:15:24.656604	GSE	State Number has changed 101 to 102
2019-09-11 11:15:24.707699	GSE	State Number has changed 102 to 103
2019-09-11 11:15:24.708671	GSE	State Number has changed 103 to 104

GOOSE Publishers Pub 1 Pub 2 Pub 3 Pub 4 Pub 5 Pub 6 Pub 7 Pub 8 Pub 9 Pub 10 Pub 11 Pub 12 Pub 13

Selected netIF: Realtek USB NICIP Address: 172.24.2.29
Sniffing the Network for GSE Publishers

GOOSE details

RTDS P&A Suite IEC 61850 Analyzer

File Edit Clear Help Publisher 10/16 captured GOOSE messages

Capture Open Clear Analyze Show Messages Auto Clear Messages Show Re-Transmitted Messages

No.	Time	stNum	sqNum	test	TATL
1	2019-09-11 11:15:06.993482	101	12	false	4000
2	2019-09-11 11:15:24.656604	102	0	false	8
3	2019-09-11 11:15:24.659675	102	1	false	16
4	2019-09-11 11:15:24.667641	102	2	false	32
5	2019-09-11 11:15:24.683653	102	3	false	64
6	2019-09-11 11:15:24.707699	103	0	false	8
7	2019-09-11 11:15:24.708671	104	0	false	8
8	2019-09-11 11:15:24.711669	104	1	false	16
9	2019-09-11 11:15:24.719662	104	2	false	32
10	2019-09-11 11:15:24.735660	104	3	false	64
11	2019-09-11 11:15:24.767902	104	4	false	128
12	2019-09-11 11:15:24.831672	104	5	false	256
13	2019-09-11 11:15:24.959652	104	6	false	512
14	2019-09-11 11:15:25.215663	104	7	false	1024
15	2019-09-11 11:15:25.727661	104	8	false	2048
16	2019-09-11 11:15:26.751767	104	9	false	4000

G PN51ProtCtrl/LLN0\$GOSP_GCB

GOOSE details

Name	Value
Control Block Reference	PN51ProtCtrl/LLN0\$GOSP_GCB
Destination MAC addr...	01:0c:cd:01:01:da
Source MAC address	00:50:c2:4f:9d:cd
Application ID	0x0003
GOOSE ID	AppID
DataSet reference	PN51ProtCtrl/LLN0\$P_GOOSE
PDU Number	
Needs commissioning	false
Configuration revision	1
Simulation/Test	false (0x0000)
Entry time	Sep. 11, 2019 16:15:24.705499947 UTC
Status number (stNum)	102
Sequence number (sq...	3
Time allowed to live (...)	64
Number of DataSet ite...	16

GOOSE Publishers Pub 1 Pub 2 Pub 3 Pub 4 Pub 5 Pub 6 Pub 7 Pub 8 Pub 9 **G Pub 10** Pub 11 Pub 12 Pub 13

Selected netIF: Realtek USB NICIP Address: 172.24.2.29
Sniffing the Network for GSE Publishers

GOOSE data details

RTDS P&A Suite IEC 61850 Analyzer

File Edit Clear Help Publisher 10/16 captured GOOSE messages

Show Messages
 Auto Clear Messages
 Show Re-Transmitted Messages

No.	Time	stNum	sqNum	test	TATL
1	2019-09-11 11:15:06.993482	101	12	false	4000
2	2019-09-11 11:15:24.656604	102	0	false	8
3	2019-09-11 11:15:24.659675	102	1	false	16
4	2019-09-11 11:15:24.667641	102	2	false	32
5	2019-09-11 11:15:24.683653	102	3	false	64
6	2019-09-11 11:15:24.707699	103	0	false	8
7	2019-09-11 11:15:24.708671	104	0	false	8
8	2019-09-11 11:15:24.711669	104	1	false	16
9	2019-09-11 11:15:24.719662	104	2	false	32
10	2019-09-11 11:15:24.735660	104	3	false	64
11	2019-09-11 11:15:24.767902	104	4	false	128
12	2019-09-11 11:15:24.831672	104	5	false	256
13	2019-09-11 11:15:24.959652	104	6	false	512
14	2019-09-11 11:15:25.215663	104	7	false	1024
15	2019-09-11 11:15:25.727661	104	8	false	2048
16	2019-09-11 11:15:26.751767	104	9	false	4000

PN51ProtCtrl/LLN0\$GOSP_GCB

GOOSE details

Data details

Attribute	Value	Type	FC
stVal	true	BOOLEAN	ST
Quality	00000000000000	Quality	ST
Validity	good	ENUM	ST
Overflow	false	BOOLEAN	ST
OutOfRange	false	BOOLEAN	ST
BadReference	false	BOOLEAN	ST
Oscillatory	false	BOOLEAN	ST
Failure	false	BOOLEAN	ST
OldData	false	BOOLEAN	ST
Inconsistent	false	BOOLEAN	ST
Inaccurate	false	BOOLEAN	ST
Source	process	ENUM	ST
Test	false	BOOLEAN	ST
OperatorBlocked	false	BOOLEAN	ST
stVal	false	BOOLEAN	ST
Quality	00000000000000	Quality	ST

Last received GOOSE information

Activity/Errors

GOOSE Publishers Pub 1 Pub 2 Pub 3 Pub 4 Pub 5 Pub 6 Pub 7 Pub 8 Pub 9 **Pub 10** Pub 11 Pub 12 Pub 13

Selected netIF: Realtek USB NICIP Address: 172.24.2.29
Sniffing the Network for GSE Publishers

GOOSE last received message

RTDS P&A Suite IEC 61850 Analyzer

File Edit Clear Help Publisher 10/16 captured GOOSE messages

Capture Open Clear Analyze Show Messages Auto Clear Messages Show Re-Transmitted Messages

No.	Time	stNum	sqNum	test	TATL
1	2019-09-11 11:15:06.993482	101	12	false	4000
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PN51ProtCtrl/LLN0\$GOSP_GCB

- GOOSE details
- Data details
- Last received GOOSE information

Name	Value
Source MAC address	00:50:c2:4f:9d:cd
Simulation/Test	false (0x0000)
Entry time	Sep. 11, 2019 16:15:24.756749927 UTC
PDU number (SPDU)	
Status number (stNum)	104
Sequence number (sqNum)	179
Time allowed to live (ms)	4000
Remaining time to live (ms)	3601
Number of DataSet items	16

Activity/Errors

GOOSE Publishers Pub 1 Pub 2 Pub 3 Pub 4 Pub 5 Pub 6 Pub 7 Pub 8 Pub 9 Pub 10 Pub 11 Pub 12 Pub 13

Selected netIF: Realtek USB NICIP Address: 172.24.2.29
Sniffing the Network for GSE Publishers

Conclusions

- Standard IEC 61850 models are created to represent switchgear in real-time simulations
- Related implementation details and configuration procedures are explained
- A standalone client program is used to validate the MMS server operations related to switchgear implementations
- A number of scenarios are tested and results are presented

Thank you

Q & A