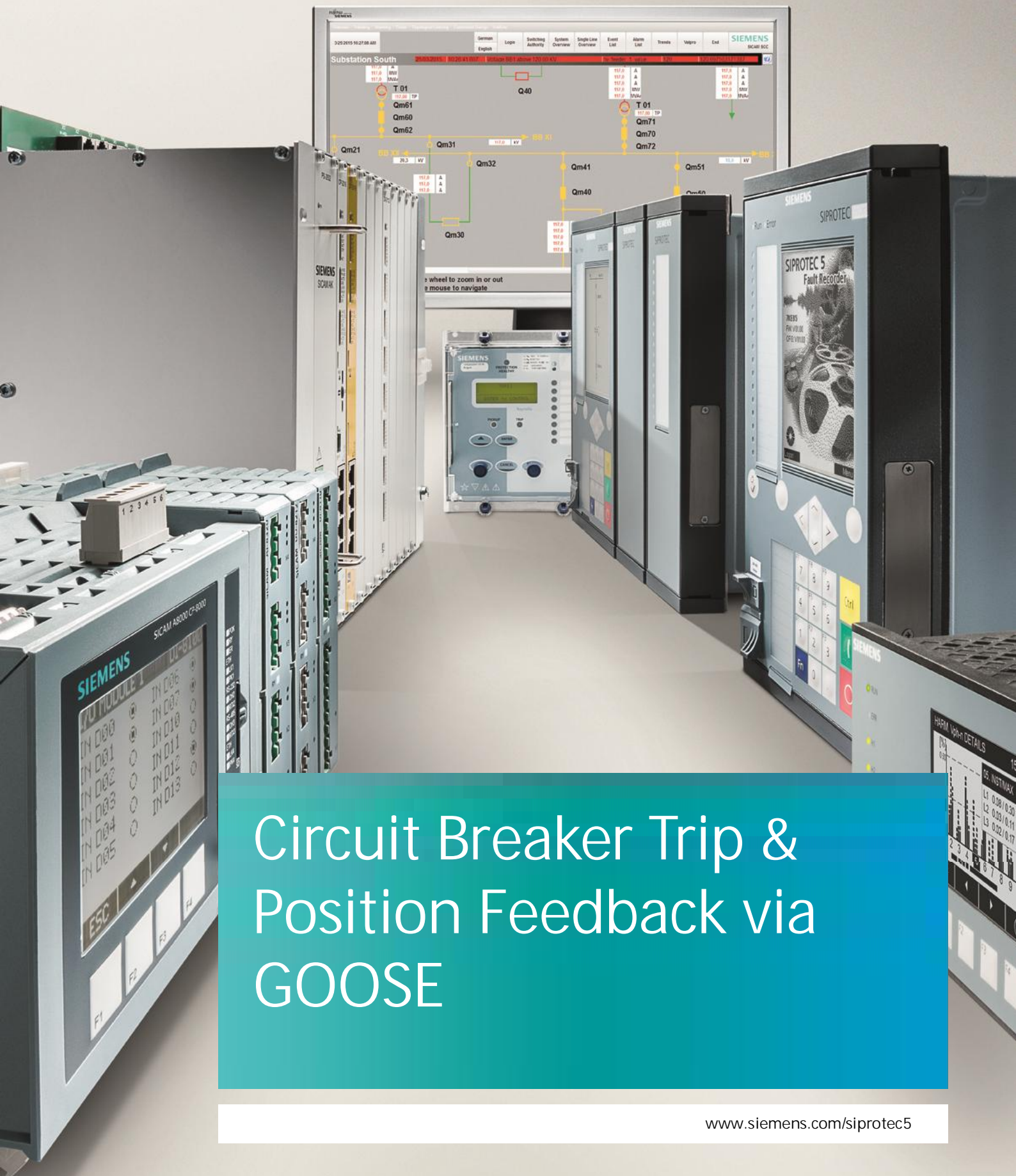


SIEMENS

Ingenuity for life



Circuit Breaker Trip & Position Feedback via GOOSE

SIPROTEC Application

Process bus – Circuit Breaker Trip & Position Feedback via GOOSE

SIPROTEC Application

Process bus – Circuit Breaker Trip & Position Feedback via GOOSE

APN-049, Edition 1

Content

1	Process bus – Circuit Breaker Trip & Position Feedback via GOOSE.....	3
1.1	Introduction.....	3
1.2	Data structure.....	3
1.3	Merging Unit 6MU805.....	4
1.4	SIPROTEC 4.....	5
1.5	IEC 61850 System Configurator.....	8
1.6	Additional notes.....	10
1.7	Summary.....	10

1 Process bus – Circuit Breaker Trip & Position Feedback via GOOSE

1.1 Introduction

With the digitalization of the process bus, where the wiring from the yard to the control room is to be minimized, both binary and analog signals are aimed to be transmitted via optical Ethernet networks.

The signals are collected by an intelligent electronic device installed on the yard which forwards the information to one or more protection relays and bay control units, normally located in the control room. The transmission of the analog information takes place based on the IEC 61850-9-2 Standard while the binary information is exchanged using the IEC 61850-8-1, as extendedly used in the station bus.

Usually for the primary disconnection elements such as circuit breakers, disconnectors and earthing switches have been used a couple of binary inputs for the position information and a couple of binary outputs for the switching commands. These binary inputs and outputs are integrated inside a unique signal of the type DPC (Double point Controllable) which also correlates internally the position of the equipment as a feedback of a previous command.

With the process bus technology the physical inputs and outputs actually used are not in the same device which manages the corresponding data information, but remotely located in one or more devices installed on the yard. In consequence, it is necessary the use of GOOSE messages to exchange the information and CFCs logics to interconnect them.

This application note explains how to deal with this procedure using a merging unit 6MU805 as acquisition device and a SIPROTEC 5 as protection relay.

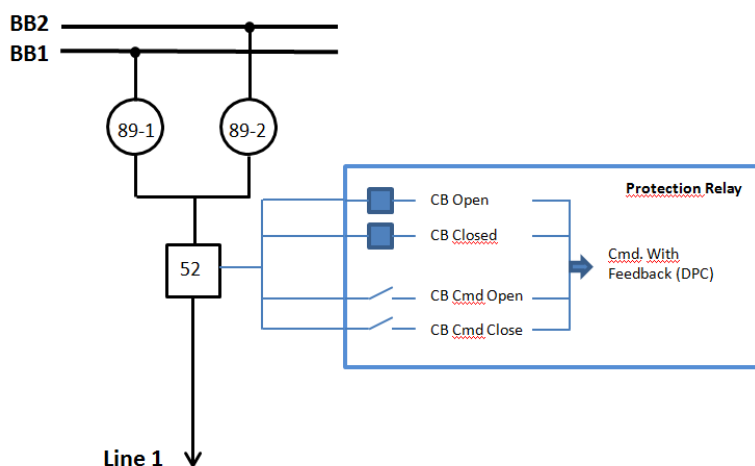
1.2 Data structure

For the monitoring and automation of electrical substations is typical the use of the so called data structures which contain two or more basic data types. Specifically for the management of primary disconnection elements it is common the use of the SDPS structure which allows the processing of double-point indications of signals of the type DPC (Double point Controllable).

Individual Structure Elements of the data structure SDPS are:

Name	Data Type	Explanation
DP	WORD	Indication value
Q	WORD	Quality

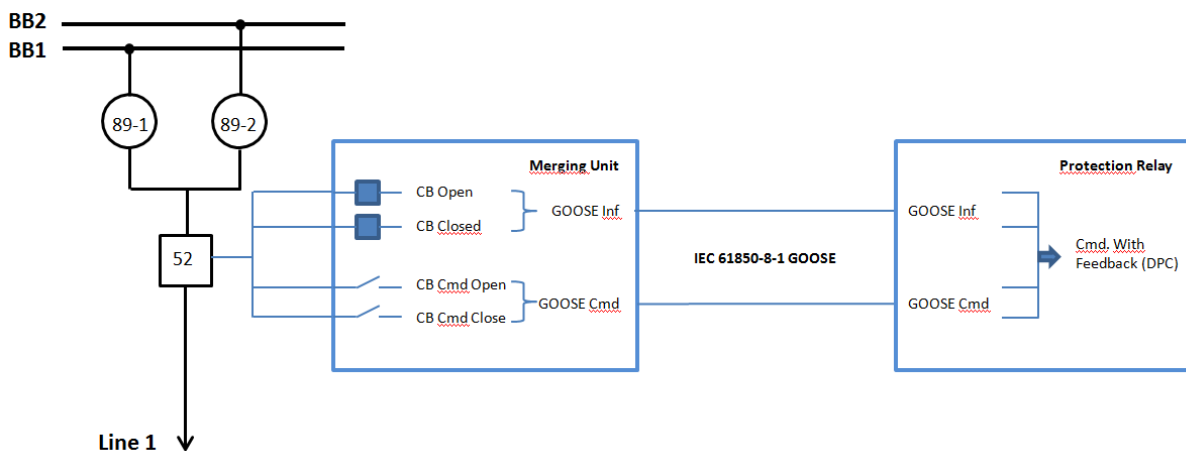
Such a data structure internally correlates several binary inputs and outputs in order to combine command and position information in a unique signal as shown below.



SIPROTEC Application

Process bus – Circuit Breaker Trip & Position Feedback via GOOSE

The scheme using the process bus technology therefore looks a bit different:



In a comparable way, the trip signals originated by a protection function are not executed by binary outputs of the protection relay itself, but sent via GOOSE messages to the merging unit, and this unit is the responsible for the actual trip of the circuit breaker.

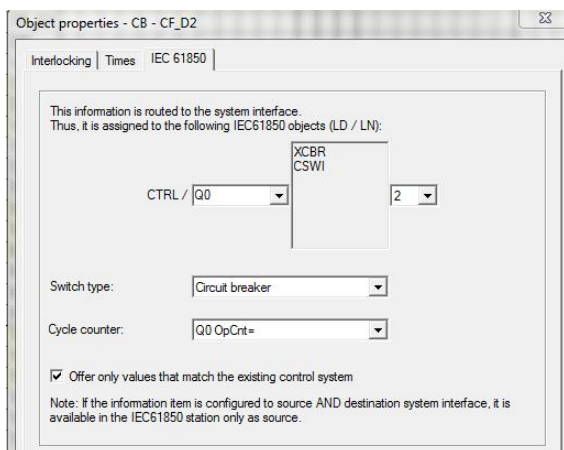
Thus a proper assignation of signals and exchange of GOOSE messages has to be granted in order to provide a clean and failure-free operation of the system.

In the following chapters it will be shown how to create the corresponding data structure and signals in DIGSI and how to assign the GOOSE messages in the System Configurator for the circuit breaker information. Disconnectors and Earthing Switches are to be handled in a similar way although obviating the trip signals.

1.3 Merging Unit 6MU805

When the merging unit is created in DIGSI 4, the software automatically generates a circuit breaker, a disconnector and an earthing switch. If the type of signal corresponds with your use case you can use them in your parameterization. If not, you can delete them and create new signals. For that you need the Masking I/O (Configuration Matrix) editor.

Simply, in the group Control Device right click and select "Insert Information". For the Circuit breaker for example, select *Control with Feedback / Double Control (DF) 1 Trip 1 Close / Double Point 0 0 not valid (CF_D2)*, or the type you want to use in your application. After that you shall assign the corresponding inputs and outputs and select as source of the command and destination of the feedback the System Interface (S). The object Properties Window will be displayed and you should edit the IEC information:



For the trip you need to create an External *Single Point ON/OFF (ExSP)*, assign a binary output as destination and the System Interface (S) as Source.

In case you have one pole operation, you will need to create three additional *ExSP* for the trip of each pole and three additional SP Signals for the corresponding positions. Once again, assign for trips the corresponding binary output as destination and the System Interface (S) as Source. And for the position the binary input as source and the System Interface (S) as destination.

Device	Number	Display text	Information Long text	Type	Source											Destination																							
					BI											F	S	C	BO								LE	B	O	S	X	C	D	C					
					1	2	3	4	5	6	7	8	9	1	1				1	2	3	4	5	6	7	8													
EN100-Modul 1																																							
P.System Data 1																																							
P.System Data 2						*	*																																
Control Authority																																							
Control Device		CB	CB	CF_D2																																			
		CB	CB	DP	X	X												X	T	Cl																			
		CB Pole A	CB Pole A	SP			H																																
		CB Pole B	CB Pole B	SP				H																															
		CB Pole C	CB Pole C	SP					H																														
		Trip 3Phas	Trip 3Phase	ExSP														X	U																				
		Trip PoleA	Trip PoleA	ExSP														X		U																			
		Trip PoleB	Trip PoleB	ExSP														X			U																		
		Trip PoleC	Trip PoleC	ExSP														X				U																	

Now you can save and close the offline configuration and go to DIGSI Manager, and update the changes in the IEC 61850 Station.

1.4 SIPROTEC 4

In DIGSI 5 you will need to generate some signals and CFC Charts. In the example it will be used the “late binding” option for GOOSE Signals, available from the DIGSI 5 and DDDs version V7.50.

Trips and commands will be sent to the Merging unit via GOOSE while the positions will be published by the Merging Unit and subscribed by the SIPROTEC 5 device.

1.4.1 Information Routing Matrix

Under the Circuit Breaker Function Group, create a User Defined Function Block by dragging it from the global library. Rename it to “MU Exchange”, for instance. Inside this group, you need now to generate a DPS signal for the double point signal of the circuit breaker position and three SPS signals for the positions of pole A, B and C.

MU Exchange	301.6361		
Mode (controllable)	301.6361.51	ENC	
Behavior	301.6361.52	ENS	
Health	301.6361.53	ENS	
CB Pos MU		DPS	
CB PA MU		SPS	
CB PB MU		SPS	
CB PC MU		SPS	

Those signals are meant to receive the information acquired by the binary inputs of the merging unit (CB, CB Pole A, CB Pole B and CB Pole C in the DIGSI 4 Configuration Matrix).

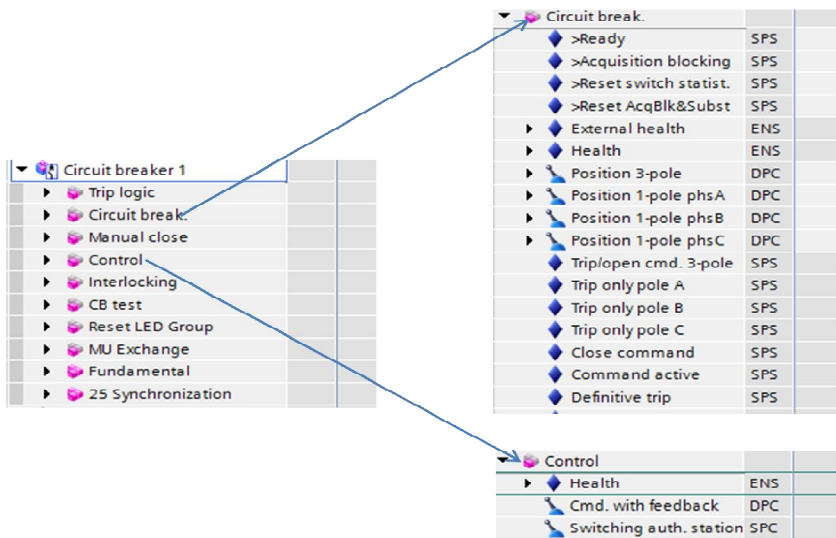
For additional Circuit breakers you can easily copy and paste the MU Exchange Function Block.

1.4.2 Charts

With the help of a function chart you can prepare the way to receive the information coming from the merging unit via GOOSE messages and connect it to the internal default signals used by the FG Circuit Breaker.

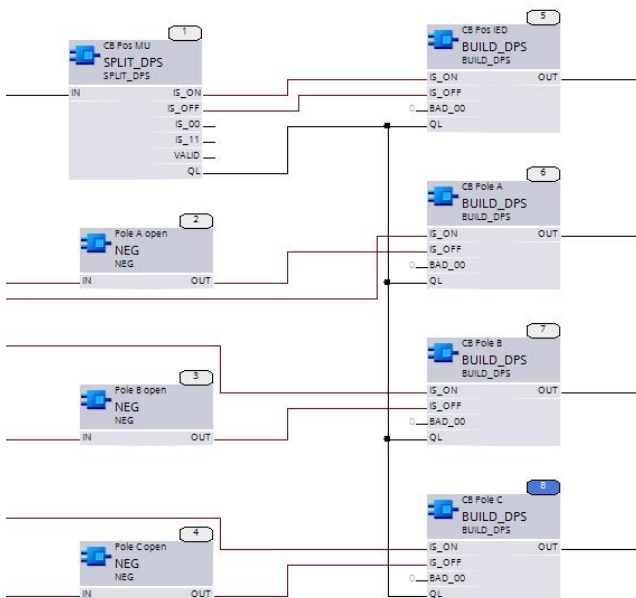
SIPROTEC Application

Process bus – Circuit Breaker Trip & Position Feedback via GOOSE



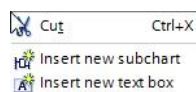
In the Function Group Circuit Breaker the position of the circuit breaker as well as the position of each pole is handled as DPC signal. On the other *side* those signals are commonly wired as DP in the case of the circuit breaker position (using two binary inputs) and as SP in the case of the poles positions (one binary input each).

In order to properly correlate the information you need to build a CFC logic as shown below:

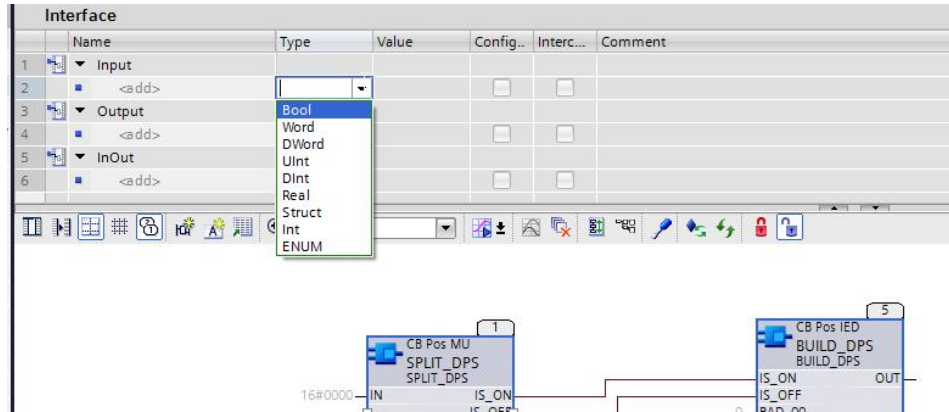


Here you have two options:

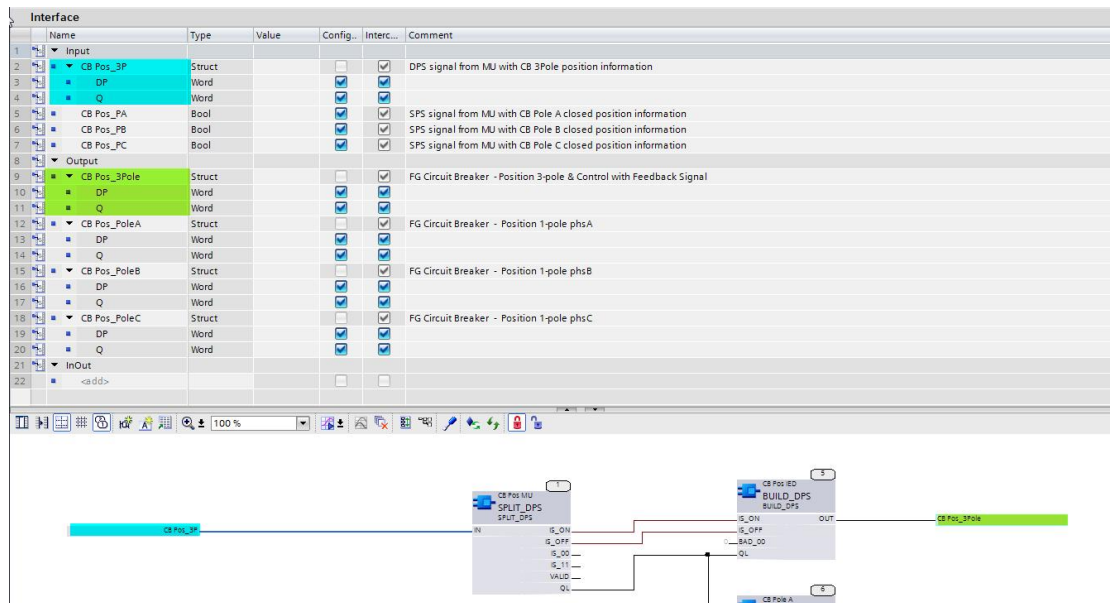
1. You copy and paste the blocks and reassign the Inputs and Outputs for every Circuit Breaker in every device
 2. You create right away a subchart and save the logic as a block under the global library. The second one will reduce the engineering effort; therefore it would be the best option and as such described below.
- On an empty CFC right-click and select "Insert new subchart"




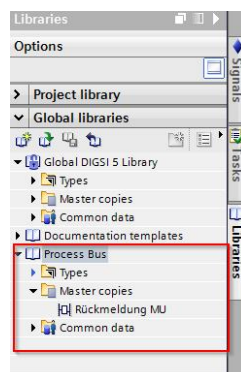
- Add the needed blocks and realize the interconnections
- Open the Interface editor on the top of the CFC and create the required inputs and outputs



- After that, assign the inputs and outputs of the blocks to the corresponding inputs and outputs in the interface editor



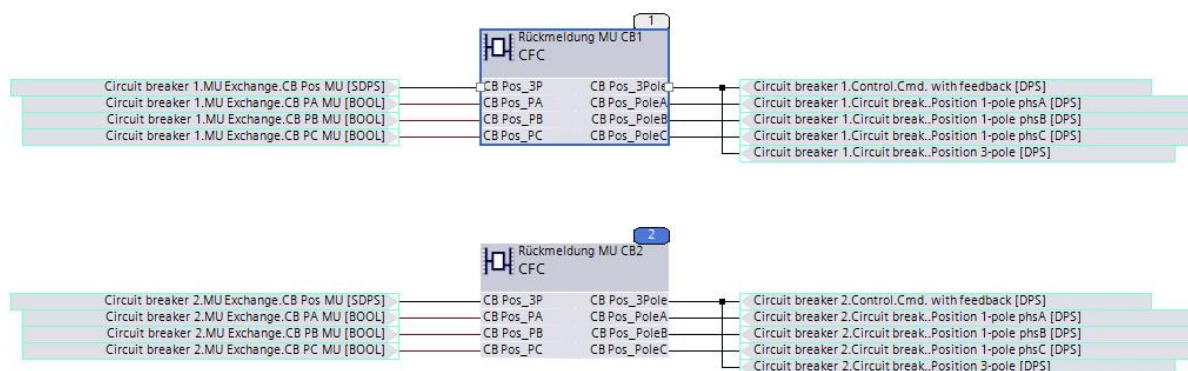
- Compile the CFC to verify that neither errors nor warnings are present
- To save the subchart open the *Libraries* Catalog (on the right side of the screen and under Global Libraries create a new global library by clicking on the following button 
- Give it a name and drag the subchart to the Master copies



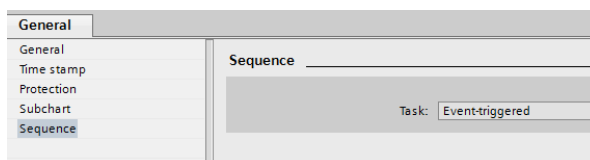
SIPROTEC Application

Process bus – Circuit Breaker Trip & Position Feedback via GOOSE

- Now you can use the subchart by dragging it and dropping it in an open CFC Chart, and assigning the signals to the corresponding inputs and outputs.



- To ensure the execution of the subchart, both subchart and new CFC Chart must use the same task



1.5 IEC 61850 System Configurator

In a Process Bus project both IEC 61850 Stations in DIGSI 4 and DIGSI 5 have to be connected to the same *.scd file.

The IEC 61850 System Configurator can be run by:

- directly from the programs menu in Windows
- double-clicking on the IEC61850 station in DIGSI 4
- While exporting changes of the IEC 61850 Station in DIGSI 5

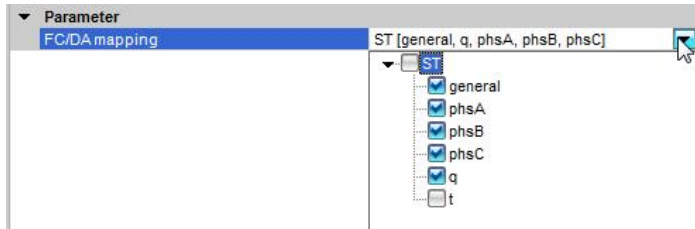
For the scope of the present application note we'll only consider the GOOSE Editor.

- Create a new GOOSE Application and drag from the source catalog the signals you want to publish from the Merging Unit
- From the destination catalog drag the signals to be subscribed in the SIPROTEC 5 relay and drop in on the corresponding source signal

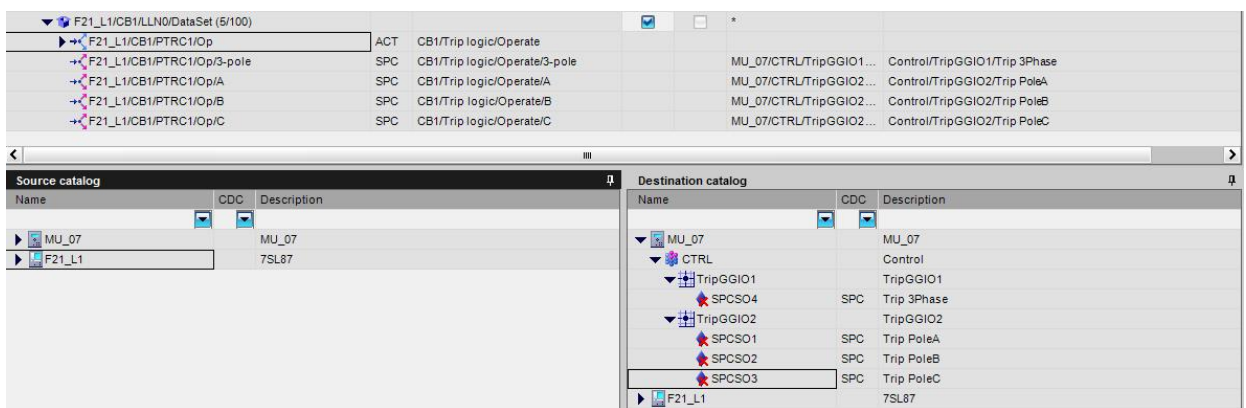
Source	Destination	Task	Source Signal	Destination Signal
MU_07/CTRL/LLN0/DataSet (12/30)				*
MU_07/CTRL/Q0XCBR2/Pos	DPC	Control/CBXCBR/Position		*
MU_07/CTRL/Q0XCBR2/Pos/Status value	DPC	Control/CBXCBR/Position/Status v...	F21_L1/CB1/USER1/CB...	CB1/MU Exchange/CB Pos MU
MU_07/CTRL/Q0GGIO1/SPCSO1	SPC	Control/Q0GGIO1/CB Pole A		
MU_07/CTRL/Q0GGIO1/SPCSO1/Status value	SPC	Control/Q0GGIO1/CB Pole A/Statu...	F21_L1/CB1/USER1/CBp...	CB1/MU Exchange/CB PA MU
MU_07/CTRL/Q0GGIO1/SPCSO2	SPC	Control/Q0GGIO1/CB Pole B		
MU_07/CTRL/Q0GGIO1/SPCSO2/Status value	SPC	Control/Q0GGIO1/CB Pole B/Statu...	F21_L1/CB1/USER1/CBp...	CB1/MU Exchange/CB PB MU
MU_07/CTRL/Q0GGIO1/SPCSO3	SPC	Control/Q0GGIO1/CB Pole C		
MU_07/CTRL/Q0GGIO1/SPCSO3/Status value	SPC	Control/Q0GGIO1/CB Pole C/Statu...	F21_L1/CB1/USER1/CBp...	CB1/MU Exchange/CB PC MU
MU_07/EXT/pdGGIO485/SPCSO53	SPC	Extended/pdGGIO485/Holdover tim...		
MU_07/EXT/pdGGIO485/SPCSO53/Status value	SPC	Extended/pdGGIO485/Holdover tim...	F21_L1/Application/LLND...	Application/General/Holdover Runs
MU_07/EXT/pdGGIO485/SPCSO37	SPC	Extended/pdGGIO485/PPS lost		
MU_07/EXT/pdGGIO485/SPCSO37/Status value	SPC	Extended/pdGGIO485/PPS lost/Sta...	F21_L1/Application/LLND...	Application/General/PPS Lost

- Create a new GOOSE Application and drag from the source catalog the trips you want to publish from the protection device; normally the Op (operate signal) contained in the PTRC1 logical node. If your operation should be per pole,

click on the parameter FC/DA Mapping under properties on the right side of the screen and select additional to the general trip, the phases A, B and C.



- Now you can assign the corresponding ExSPs signals created in the merging unit. It will look as shown below:



The links will be shown below the set of available FC/DA Mapping but the assignment per pole will be still clear

Name	CDC	Description			
F21_Lab/CB1/PTRC1/Op	ACT	CB1/Trip logic/Operate			
3-pole	SPC				
A	SPC				
B	SPC				
C	SPC				
→ F21_Lab/CB1/PTRC1/Op/3-pole	SPC	CB1/Trip logic/Operate/3-pole	MU_07/CTRL/TripGGIO1...	Control/TripGGIO1/Trip 3Phase	
→ F21_Lab/CB1/PTRC1/Op/A	SPC	CB1/Trip logic/Operate/A	MU_07/CTRL/TripGGIO2...	Control/TripGGIO2/Trip PoleA	
→ F21_Lab/CB1/PTRC1/Op/B	SPC	CB1/Trip logic/Operate/B	MU_07/CTRL/TripGGIO2...	Control/TripGGIO2/Trip PoleB	
→ F21_Lab/CB1/PTRC1/Op/C	SPC	CB1/Trip logic/Operate/C	MU_07/CTRL/TripGGIO2...	Control/TripGGIO2/Trip PoleC	

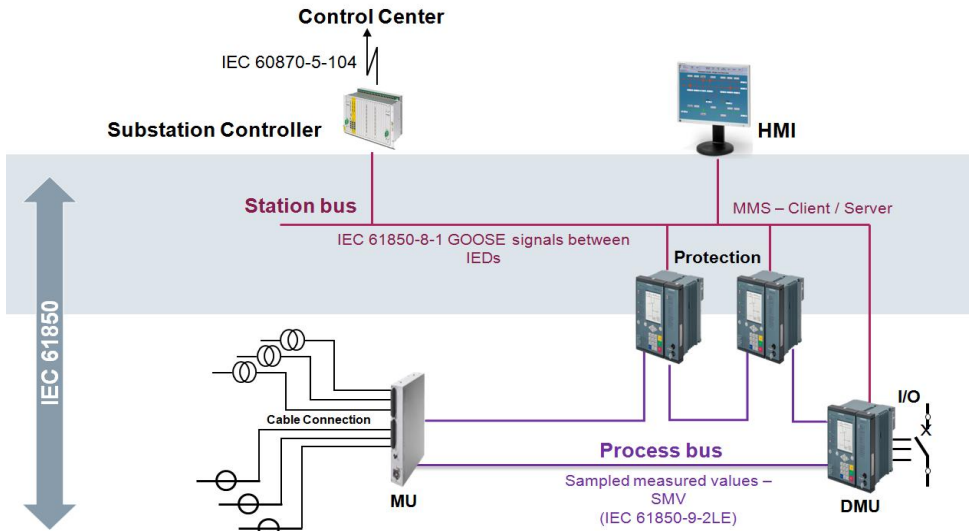
- Save the *.scd station and import changes in both DIGSI 4 and DIGSI 5. Save and download changes into the corresponding devices.

SIPROTEC Application

Process bus – Circuit Breaker Trip & Position Feedback via GOOSE

1.6 Additional notes

Depending on the architecture defined for a specific process bus project, it is also possible to realize the supervision and control of the primary devices by an additional unit, normally called DMU - Digital Merging Unit.



In this case, the exchange of information will be similar to the description in this document but using two different SIPROTEC 5 devices.

1.7 Summary

A digital substation can take advantage of the complete information exchange scope of the IEC 61850 standard. MMS, GOOSE and SV transmission can be properly combined in order to optimize the data flow in the station and process buses achieving also the main goal of minimizing the use of hardwiring.

Published by
Siemens AG 2018
Energy Management Division
Digital Grid
Automation Products
Humboldtstr. 59
90459 Nuremberg, Germany

www.siemens.com/siprotec

For more information,
please contact our
Customer Support Center.

Tel.: +49 180 524 70 00

Fax: +49 180 524 24 71

(Charges depending on provider)

Email: support.energy@siemens.com

© 2016 Siemens. Subject to changes and errors.
The information given in this document only contains
general descriptions and/or performance features which
may not always specifically reflect those described, or
which may undergo modification in the course of further
development of the products. The requested performance
features are binding only when they are expressly agreed
upon in the concluded contract.

For all products using security features of OpenSSL, the
following shall apply:
This product includes software developed by the OpenSSL
Project for use in the OpenSSL Toolkit.
(<http://www.openssl.org/>)
This product includes cryptographic software written by
Eric Young (eay@cryptsoft.com)
This product includes software written by Tim Hudson
(tjh@cryptsoft.com)
This product includes software developed by Bodo Moeller.