BRODERSEN

simplifying systems

IEC61850 Server in RTU32 Series

Presentation

IEC61850

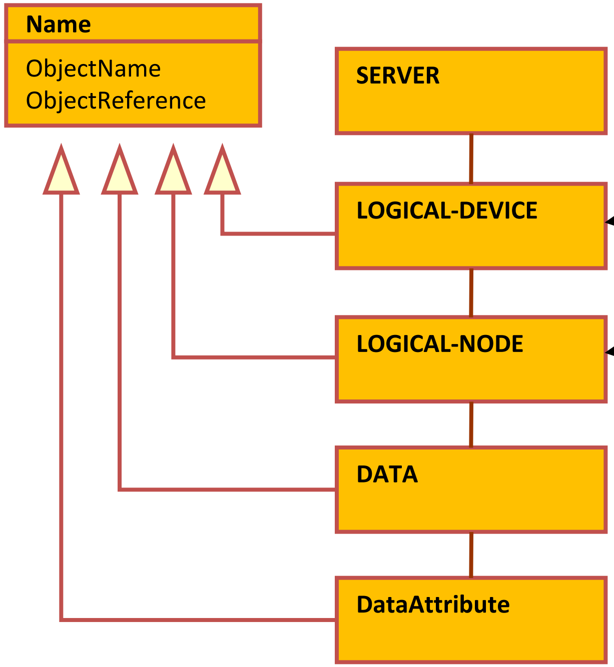
General Introduction

IEC61850 General Introduction and Overview

IEC61850 in general

- Evolution of the EN/IEC60870
- Type object oriented model
- Identification through Object Name
- World wide standard

IEC61850 Class Model

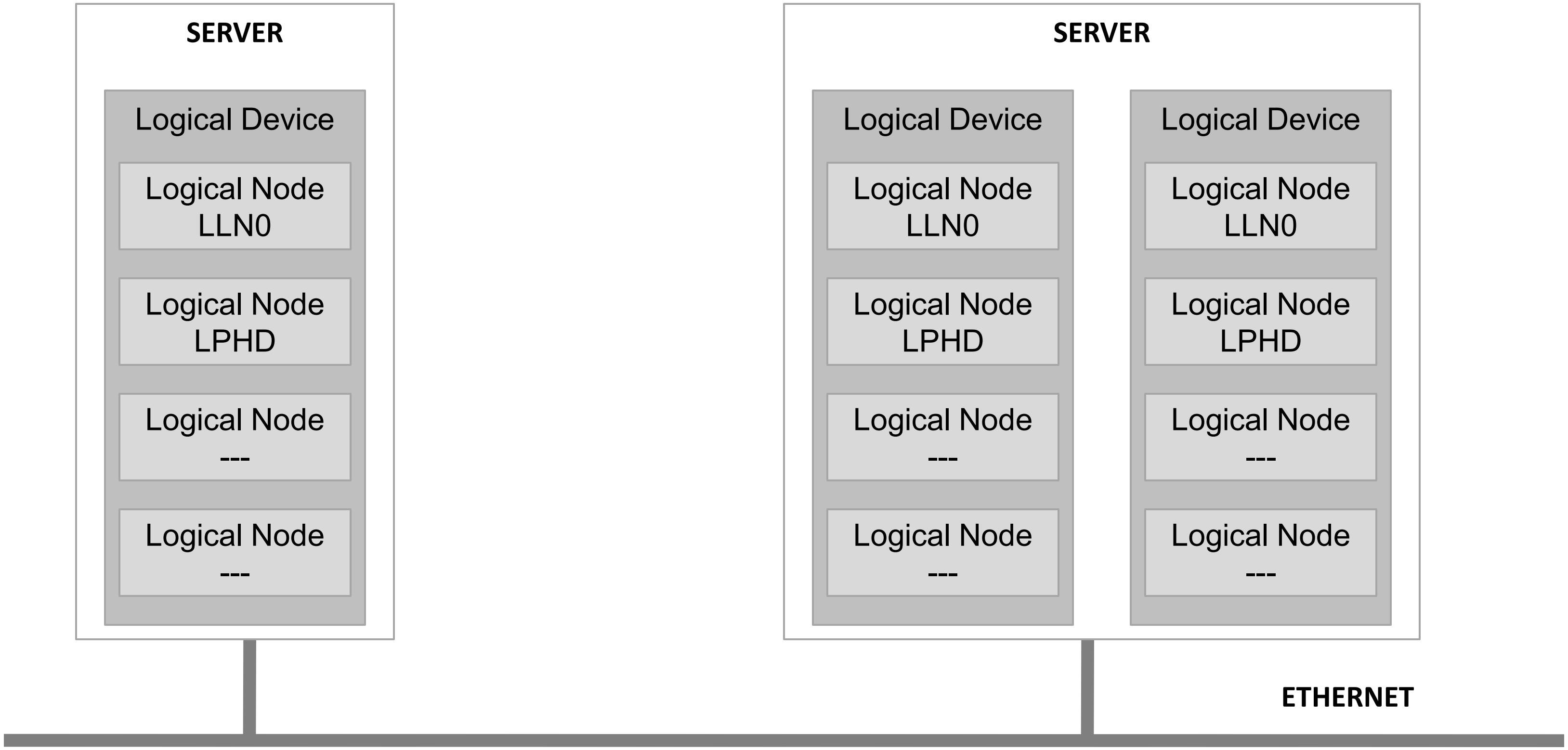


Physical Device: access by network address

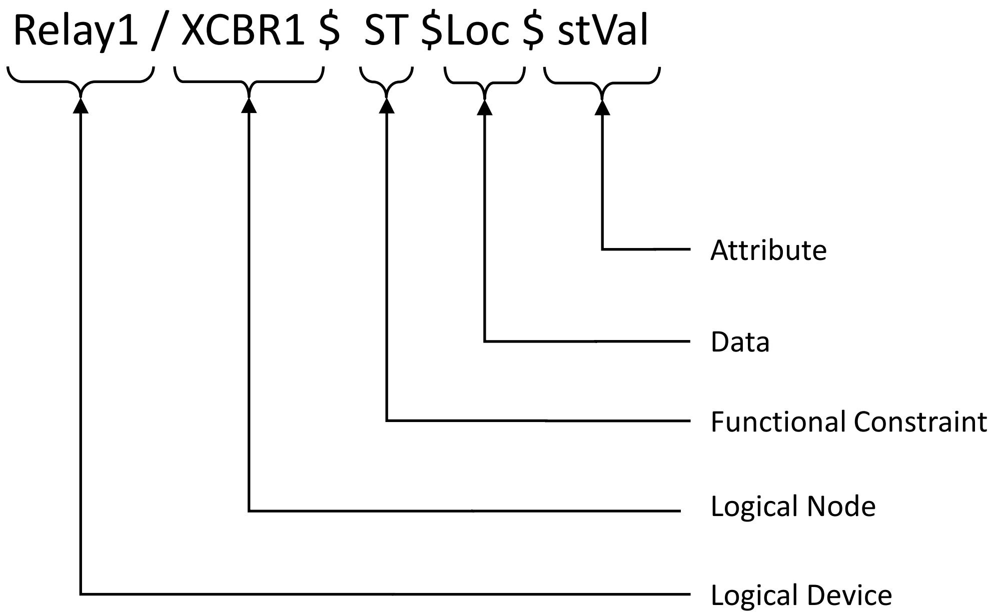
Enables data from multiple devices to be aggregated into a single physical device (data concentrator)

IEC61850 Architecture

- A logical Device describes one or more IEDs (Intelligent Electrical Device)
- A logical Node describes an IEC61850 Object



IEC61850 Object Name Structure



IEC61850 type of Logical Nodes

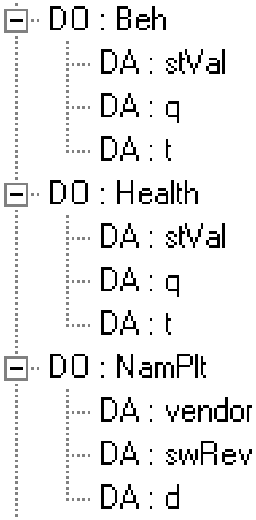
Name	Description
Axxx	Automatic Control (4). ATCC (tap changer), AVCO (volt. ctrl.), etc.
Cxxx	Supervisory Control (5). CILO (Interlocking), CSWI (switch ctrl), etc.
Gxxx	Generic Functions (3). GGIO (generic I/O), etc.
Ixxx	Interfacing/Archiving (4). IARC (archive), IHMI (HMI), etc.
Lxxx	System Logical Nodes (2). LLN0 (common), LPHD (Physical Device)
Mxxx	Metering & Measurement (8). MMXU (meas.), MMTR (meter.), etc.
Pxxx	Protection (28). PDIF, PIOC, PDIS, PTOV, PTOH, PTOC, etc.
Rxxx	Protection Related (10). RREC (auto reclosing), RDRE (disturbance)..
Sxxx	Sensors, Monitoring (4). SARC (archs), SPDC (partial discharge), etc.
Txxx	Instrument Transformer (2). TCTR (current), TVTR (voltage)
Xxxx	Switchgear (2). XCBR (breaker), XCSW (switch)
Yxxx	Power Transformer (4). YPTR (transformer), YPSH (shunt), etc.
Zxxx	Other Equipment (15). ZCAP (cap ctrl), ZMOT (motor), etc.
Wxxx	Wind (Set aside for other standards)
Oxxx	Solar (Set aside for other standards)
Hxxx	Hydropower (Set aside for other standards)
Nxxx	Power Plant (Set aside for other standards)
Bxxx	Battery (Set aside for other standards)
Fxxx	Fuel Cells (Set aside for other standards)

As of the flexible implementation of IEC61850 in RTU32 – special Logical Nodes are also supported!

IEC61850 General Introduction and Overview

Logical Node

- A Logical Node contains:
    - The common Logical Node information
    - Status information
    - Settings
    - Measured values
        - Value (stVal)
        - Quality (q)
        - Time and Date stamp (t)
    - Control (clVal)
        - Value (stVal)
        - Quality (q)
        - Time and Date stamp (t)



```
⊟ DO : Beh
    DA : stVal
    DA : q
    DA : t
⊟ DO : Health
    DA : stVal
    DA : q
    DA : t
⊟ DO : NamPlt
    DA : vendor
    DA : swRev
    DA : d
```

IEC61850 Description file types and Interoperability

Complete System or Sub-systems are descriped in the IEC61850 Substation Configuration Language (SCL). The descriptions includes;

- **SSD**: System Specification Description - XML description of the entire system
- **SCD**: Substation Configuration Description - XML description of a single substation
- **ICD**: IED Capability Description - XML description of items supported by an IED
- **CID**: Configured IED Description - XML configuration for a specific IED

Abstract Communications Service Interface (ACSI) – the IEC61850 type of Interoperability – define what is supported by the IED, RTU, Substation or any other device part of a IEC61850 system.

The ACSI defines;

- A set of objects
- A set of Services to manipulate and access those objects
- A base set of data types for describing objects

IEC61850 General Introduction and Overview

Data Set

- Defined as a group of data objects and/or data attributes. In other terms it is a group of named variables and their values.

- The purpose is to:
  - Create Report Control Block (for SCADA –PLC/RTU communication)
  - Create GOOSE communication (for PLC/RTU – PLC/RTU Data Set communication)

Report Control Block (RCP)

RCP is an abstract for:

URCB (unbuffered report control blocks)

- The unbuffered are sent to the client and destroyed immediately by the server after sending without any acknowledgment.
- The server sends a block immediately after value or quality change.

BRCB (buffered report control blocks)

- The buffered are sent to the client till the reception of the acknowledgment from the client.
- They are resent as long as the client accepts them.
- They are stored (up to the specified limit with the actual server) in case the communication between server and client fails.
- The client asks for the buffered reports since a given number only if he detects a connection failure or (some) lost reports, otherwise the BRCBs act like URCBs and the server sends a block immediately after value or quality change.

GOOSE

What about GOOSE communication ?

- Generic Oriented Object Substation Events
- A fast communication protocol between IEC61850 Servers.
- The Ethernet frames can be tagged with a priority to allow some switches process higher priority frames faster.

Features and how to configure the RTU32 IEC61850 Server

IEC61850 General Introduction and Overview

RTU32 IEC61850 facts

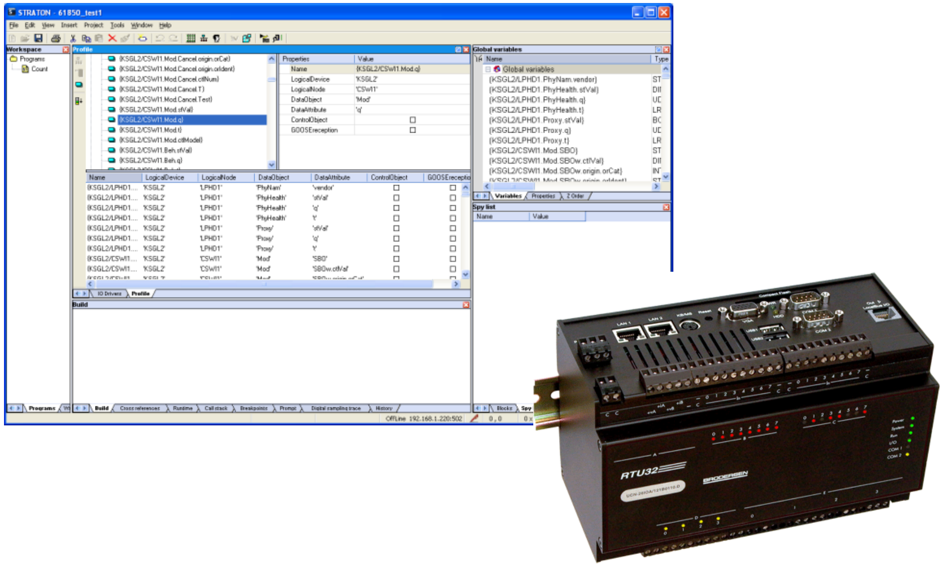
- Server driver is integrated in the RTU32 PLC – and configured in STRATON
- All details of Logical Devices and Logical Nodes are defined in an ICD file (SCL file) created in the SCL File Editor in STRATON.
- Based on the SCL file, the driver is automatically generated with all nessesary profiles and variables
- You can freely adjust the configuration and add your own application
- STRATON Programming environment online Help provide all nessesary details

RTU32 IEC61850 Server features

- ICD (SCL) support
- Report Control Blocks (RCB)
  - Predefined
  - Dynamic
- GOOSE / GSSE
- Unbuffered reporting
- Buffered reporting

IEC61850 Server in RTU32 PLC & STRATON

How to configure IEC61850 Server in RTU32 PLC / STRATON



STRATON - 61850_test1

Workspace

- Programs
  - Count

Profile

- (KSGL2/CSWI1.Mod.Cancel.origin.orCat)
- (KSGL2/CSWI1.Mod.Cancel.origin.orIdent)
- (KSGL2/CSWI1.Mod.Cancel.ctlNum)
- (KSGL2/CSWI1.Mod.Cancel.T)
- (KSGL2/CSWI1.Mod.Cancel.Test)
- (KSGL2/CSWI1.Mod.stVal)
- (KSGL2/CSWI1.Mod.q)
- (KSGL2/CSWI1.Mod.t)
- (KSGL2/CSWI1.Mod.ctlModel)
- (KSGL2/CSWI1.Beh.stVal)
- (KSGL2/CSWI1.Beh.q)

Properties	Value
Name	(KSGL2/CSWI1.Mod.q)
LogicalDevice	'KSGL2'
LogicalNode	'CSWI1'
DataObject	'Mod'
DataAttribute	'q'
ControlObject	□
GOOSEreception	□

Name	LogicalDevice	LogicalNode	DataObject	DataAttribute	ControlObject	GOOSEreceptio
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'PhyNam'	'vendor'	□	□
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'PhyHealth'	'stVal'	□	□
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'PhyHealth'	'q'	□	□
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'PhyHealth'	't'	□	□
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'Proxy'	'stVal'	□	□
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'Proxy'	'q'	□	□
(KSGL2/LPHD1....	'KSGL2'	'LPHD1'	'Proxy'	't'	□	□
(KSGL2/CSWI1....	'KSGL2'	'CSWI1'	'Mod'	'SBO'	□	□
(KSGL2/CSWI1....	'KSGL2'	'CSWI1'	'Mod'	'SBOw.ctlVal'	□	□

Global variables

Name	Type
Global variables	
(KSGL2/LPHD1.PhyNam.vendor)	ST
(KSGL2/LPHD1.PhyHealth.stVal)	DI
(KSGL2/LPHD1.PhyHealth.q)	UD
(KSGL2/LPHD1.PhyHealth.t)	LR
(KSGL2/LPHD1.Proxy.stVal)	BO
(KSGL2/LPHD1.Proxy.q)	UD
(KSGL2/LPHD1.Proxy.t)	LR
(KSGL2/CSWI1.Mod.SBO)	ST
(KSGL2/CSWI1.Mod.SBOw.ctlVal)	DI
(KSGL2/CSWI1.Mod.SBOw.origin.orCat)	IN

Spy list

Name	Value

Build

OffLine 192.168.1.220:502

IEC61850 Server Driver configuration in RTU32 Series

The IEC61850 Server Driver configuration in RTU32 Series are done in the follow steps

- Design a SCL file according to your requirements for the RTU32 IEC61850 Server. You might need the RTU32 to represent some switchgear, protection equipment or just some general purpose I/O.

- Open the STRATON Fieldbus Configurator and add a IEC61850 Server

- Import/read the SCL file and select the data you want to use in your communication configuration and select ok

- Now your complete driver is configured and all variables are created.

IEC61850 Server Driver configuration in RTU32 Series

Create the SCL file

- STRATON includes in standard version a complete SCL file editor. The SCL Editor is designed to create new ICD or CID files.
- Features supported:

  Insert Items / IEC61850

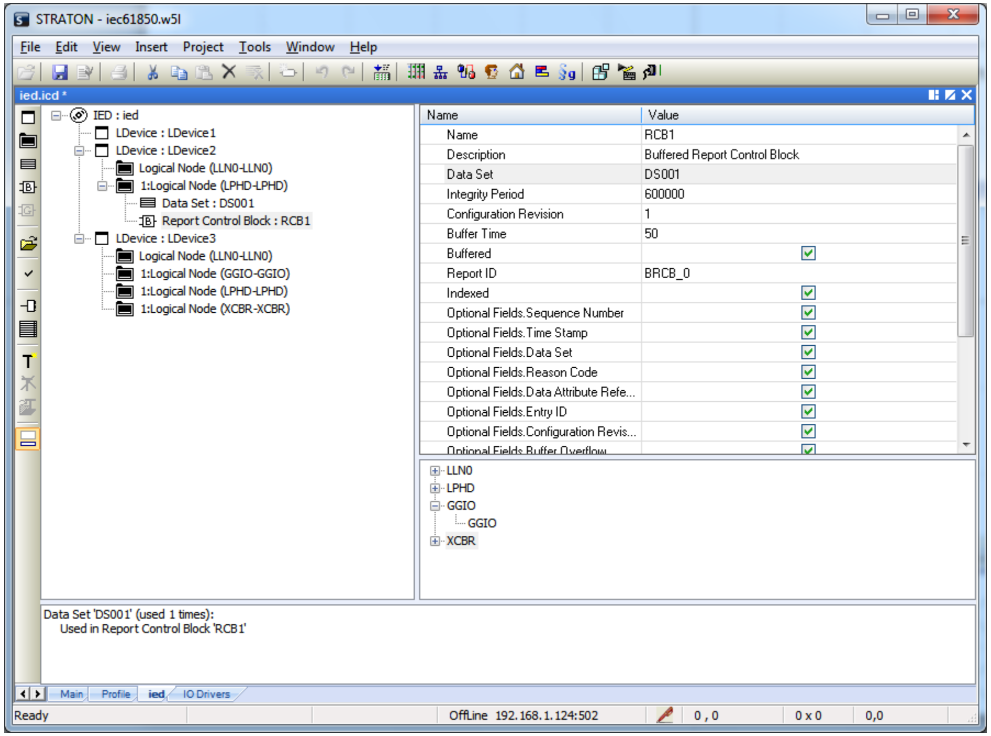
  Insert Logical Devices

  Import/Create Logical Node Types

  Create DataSets

  Create Bufffered and Unbuffered RCB

  Create GOOSE



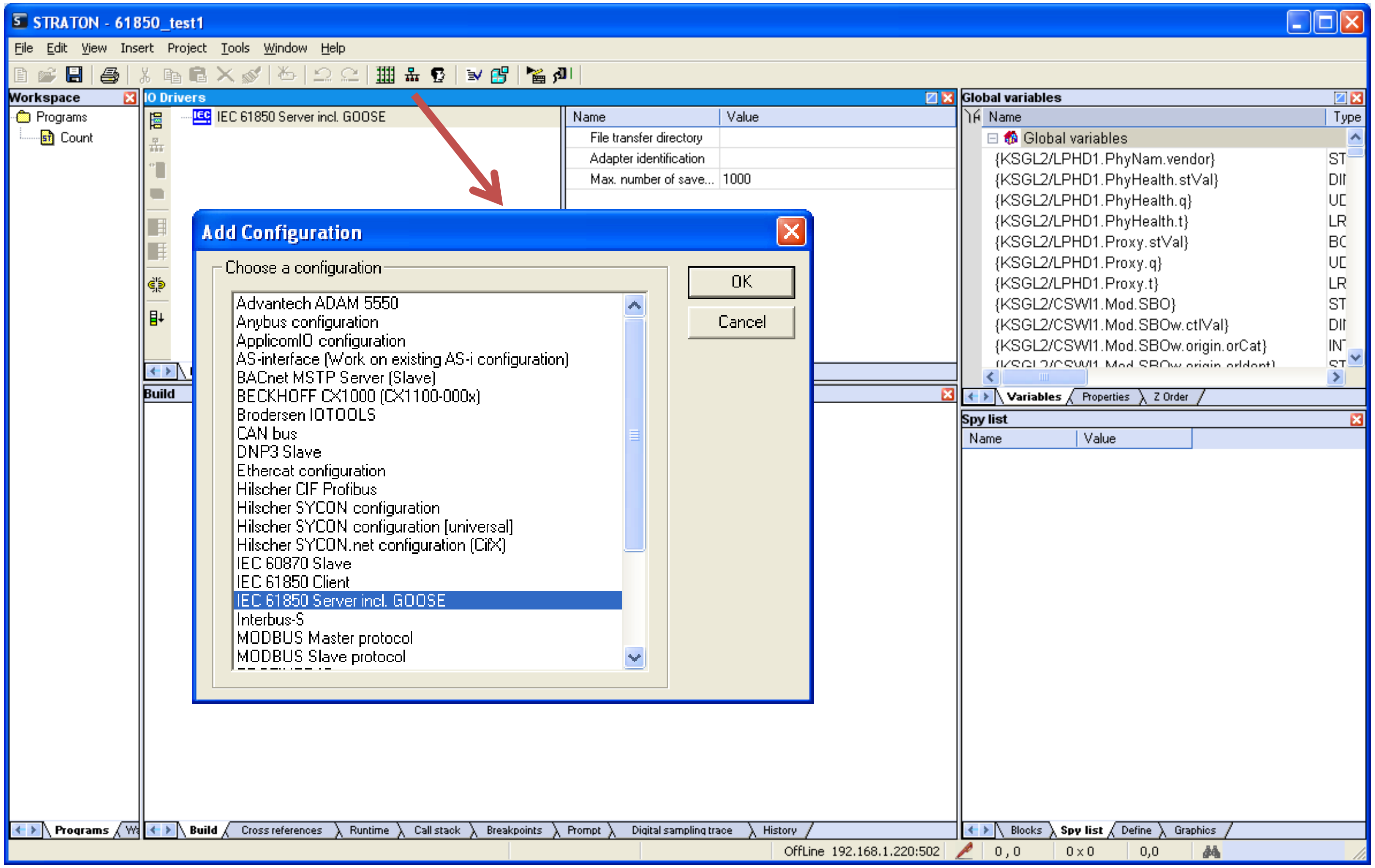
Name	Value
Name	RCB1
Description	Buffered Report Control Block
Data Set	DS001
Integrity Period	600000
Configuration Revision	1
Buffer Time	50
Buffered	☑
Report ID	BRCB_0
Indexed	☑
Optional Fields.Sequence Number	☑
Optional Fields.Time Stamp	☑
Optional Fields.Data Set	☑
Optional Fields.Reason Code	☑
Optional Fields.Data Attribute Refe...	☑
Optional Fields.Entry ID	☑
Optional Fields.Configuration Revis...	☑
Optional Fields.Buffer Overflow	☑

Data Set 'DS001' (used 1 times):
Used in Report Control Block 'RCB1'

IEC61850 Server Driver configuration in RTU32

Add the IEC61850 Server driver to your Project

- Choose IEC61850 Server incl. GOOSE in the STRATON Fieldbus Configurator


STRATON - 61850_test1
File Edit View Insert Project Tools Window Help
Workspace
Programs
Count
IO Drivers
IEC 61850 Server incl. GOOSE
Build
Add Configuration
Choose a configuration
OK
Cancel
Global variables
Variables Properties Z Order
Spy list
Name Value
Programs Build Cross references Runtime Call stack Breakpoints Prompt Digital sampling trace History
Blocks Spy list Define Graphics
OffLine 192.168.1.220:502
0 , 0
0 x 0
0,0

Name	Value
File transfer directory	
Adapter identification	
Max. number of save...	1000

Add Configuration – Choose a configuration:

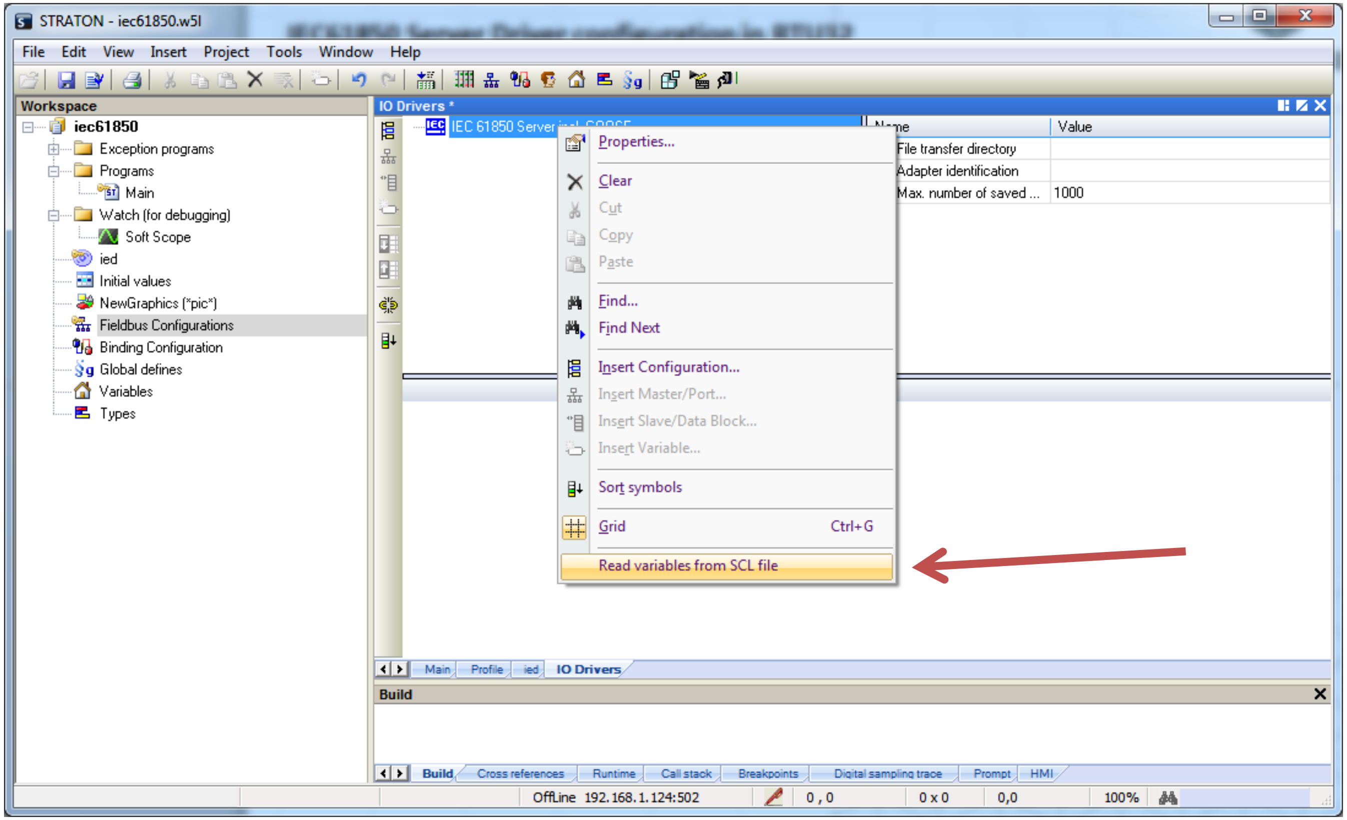
- Advantech ADAM 5550
- Anybus configuration
- ApplicomIO configuration
- AS-interface (Work on existing AS-i configuration)
- BACnet MSTP Server (Slave)
- BECKHOFF CX1000 (CX1100-000x)
- Brodersen IOTOOLS
- CAN bus
- DNP3 Slave
- Ethercat configuration
- Hilscher CIF Profibus
- Hilscher SYCON configuration
- Hilscher SYCON configuration (universal)
- Hilscher SYCON.net configuration (CifX)
- IEC 60870 Slave
- IEC 61850 Client
- IEC 61850 Server incl. GOOSE
- Interbus-S
- MODBUS Master protocol
- MODBUS Slave protocol

Global variables

Name	Type
{KSGL2/LPHD1.PhyNam.vendor}	ST
{KSGL2/LPHD1.PhyHealth.stVal}	DII
{KSGL2/LPHD1.PhyHealth.q}	UD
{KSGL2/LPHD1.PhyHealth.t}	LR
{KSGL2/LPHD1.Proxy.stVal}	BC
{KSGL2/LPHD1.Proxy.q}	UD
{KSGL2/LPHD1.Proxy.t}	LR
{KSGL2/CSWI1.Mod.SBO}	ST
{KSGL2/CSWI1.Mod.SBOw.ctlVal}	DII
{KSGL2/CSWI1.Mod.SBOw.origin.orCat}	IN

IEC61850 Server Driver configuration in RTU32

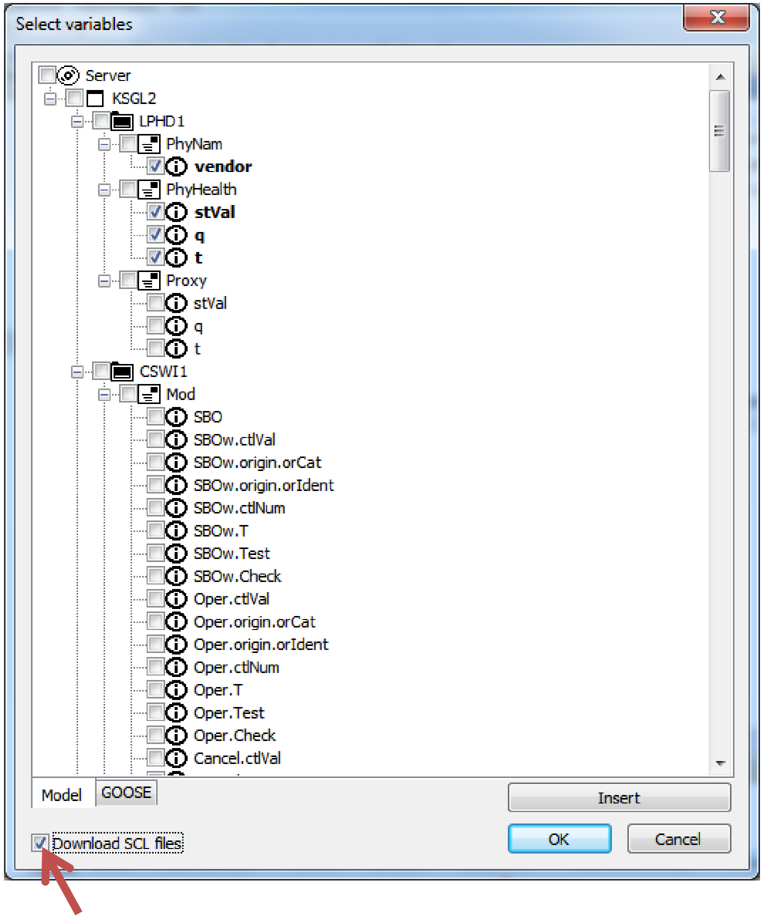
Import/Read the configuration from the SCL file



Name	Value
File transfer directory	
Adapter identification	
Max. number of saved ...	1000

IEC61850 Server Driver configuration in RTU32

Now you select the data types/variables that are RELEVANT for your application



- ☐ Server
  - ☐ KSGL2
    - ☐ LPHD1
      - ☐ PhyNam
        - ☑ **vendor**
      - ☐ PhyHealth
        - ☑ **stVal**
        - ☑ **q**
        - ☑ **t**
      - ☐ Proxy
        - ☐ stVal
        - ☐ q
        - ☐ t
    - ☐ CSWI1
      - ☐ Mod
        - ☐ SBO
        - ☐ SBOw.ctlVal
        - ☐ SBOw.origin.orCat
        - ☐ SBOw.origin.orIdent
        - ☐ SBOw.ctlNum
        - ☐ SBOw.T
        - ☐ SBOw.Test
        - ☐ SBOw.Check
        - ☐ Oper.ctlVal
        - ☐ Oper.origin.orCat
        - ☐ Oper.origin.orIdent
        - ☐ Oper.ctlNum
        - ☐ Oper.T
        - ☐ Oper.Test
        - ☐ Oper.Check
        - ☐ Cancel.ctlVal

☑ Download SCL files

Only select data types required that they will be refelcted in the driver model used.

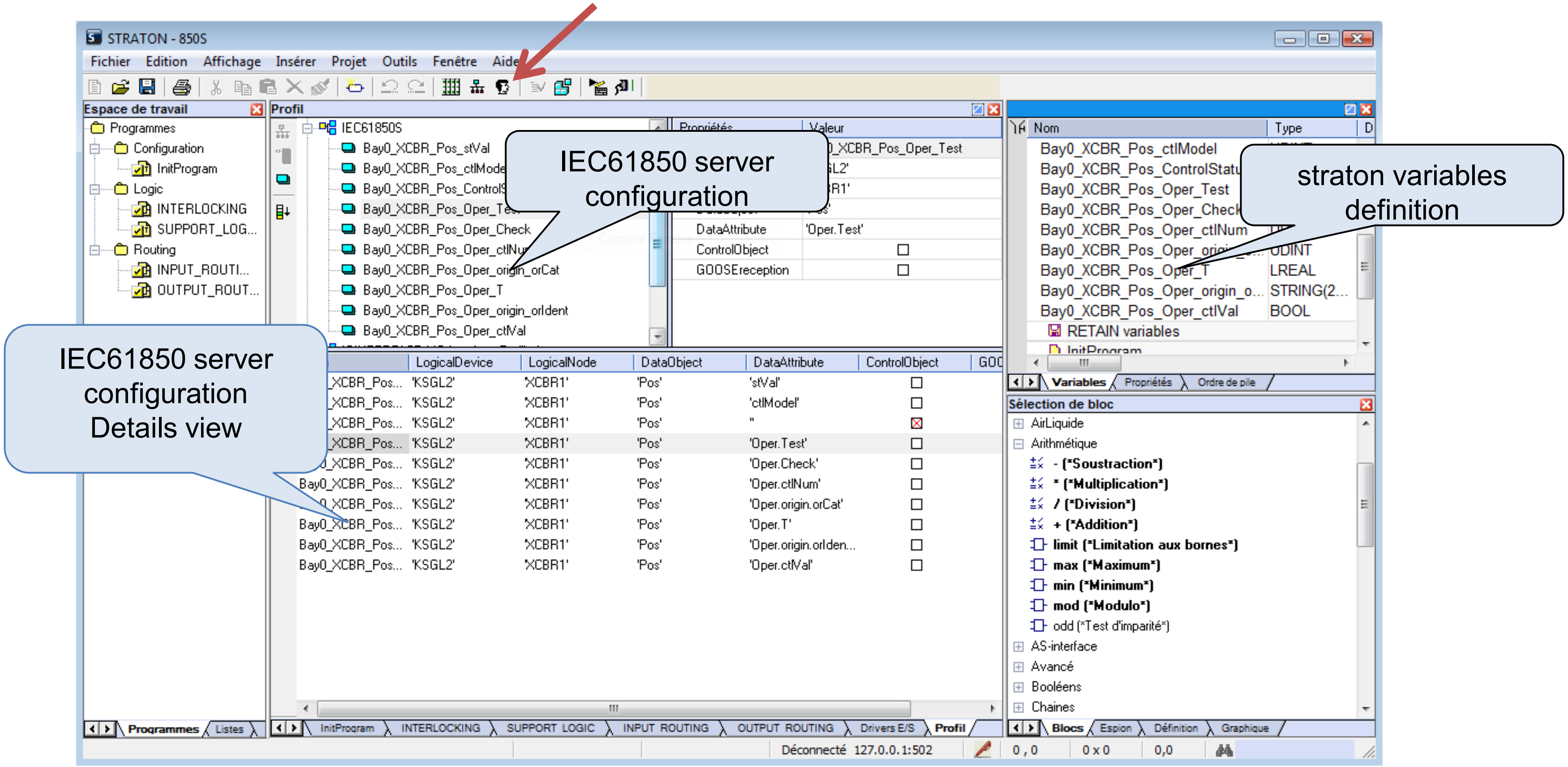
Remember to tick on ”Download SCL files” – so the actual SCL file (*.ICD) are moved to the RTU32. Used when connecting the IEC61850 Client.

Say OK when all is configured correctly.

IEC61850 Server Driver configuration in RTU32

Now the complete driver is configured and the driver is ready for use

- Use Profile Editor to monitor the complete imported Data Set



Propriétés	Valeur
	_XCBR_Pos_Oper_Test
	GL2'
	R1'
	'os'
DataAttribute	'Oper.Test'
ControlObject	□
GOOSEreception	□

Nom	Type	D
Bay0_XCBR_Pos_ctlModel		
Bay0_XCBR_Pos_ControlStatu		
Bay0_XCBR_Pos_Oper_Test		
Bay0_XCBR_Pos_Oper_Check		
Bay0_XCBR_Pos_Oper_ctlNum		
Bay0_XCBR_Pos_Oper_origi...	UDINT	
Bay0_XCBR_Pos_Oper_T	LREAL	
Bay0_XCBR_Pos_Oper_origin_o...	STRING(2...	
Bay0_XCBR_Pos_Oper_ctlVal	BOOL	

	LogicalDevice	LogicalNode	DataObject	DataAttribute	ControlObject	GOO
_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'stVal'	□	
_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'ctlModel'	□	
_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	''	☒	
_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.Test'	□	
0_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.Check'	□	
Bay0_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.ctlNum'	□	
0_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.origin.orCat'	□	
Bay0_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.T'	□	
Bay0_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.origin.orIden...	□	
Bay0_XCBR_Pos...	'KSGL2'	'XCBR1'	'Pos'	'Oper.ctlVal'	□	

IEC61850 server configuration

straton variables definition

IEC61850 server configuration Details view

IEC61850 Server Driver configuration in RTU32

After configuration of the IEC61850 Server Driver you can:

- Link variables directly to physical I/Os
- Link variables to your own designed User Defined Function Blocks – that could be often used blocks or parts of your application
- Link variables to PLC programs where you have manipulated the data after your own requirements

Note that:

- You can find details of setup and configuration in the STRATON HELP
- It requires detailed knowledge about IEC61850 to understand all the parameteres and functions in the driver
- Details of supported functions – ACSI Conformance Statement are also found in STRATON Help
- The RTU32 PLC/RTU is the ultimate Gateway as you can:
  - Run several drivers parallel incl. IEC60870, DNP3, Modbus, ProfiBus etc.
  - Freely exchange and manipulate data as all are available as STRATON PLC variables
- IEC61850 Client is also supported