

IEC-61850 Client Communication Protocol

IEC861850 Scada Client implements the part of the standard IEC61850 responsible for ACSI core services, as defined in part 8.1 of IEC861850 standard. It uses encapsulation of the ISO/OSI transport layer into the TCP/IP transport layer. It communicates with IEDs (Intelligent Electronic Devices), RTUs (Remote Terminal Units) and IO devices that support this protocol, acting as the client workstation.

Summary Information

Communication Driver Name : IEC 61850 Client Communication Protocol

Current Version : 2016.2 – 1.3

Implementation DLL : T.ProtocolDriver. IEC61850.dll

Protocol : IEC-61850 Client communication protocol - Edition 2

Interface : TCP/IP

Protocol Options : Timers for protocol control messages

Max number of nodes : User defined

PC Hardware requirements : Standard PC Ethernet interface board



Note

This communication module was rewritten for version an-2016.2 , and uses a library that is different from the one previously used. Changes were made to the configuration procedures of channels, nodes and points. The following section provides notes to aid in the migration of projects that were already using the module from the previous version.

Migration

Scada users of communication module - Issue 1 need to update the channel registration, nodes, and project points. Below are the steps for migrating existing projects to the new issue.

1. Copy all points referring to the nodes of Project Communication Module 61850 to an Excel worksheet.
2. Delete all points referring to the nodes of Project Communication Module 61850.
3. Copy the names of the project nodes and channels to the notebook.
4. Delete all nodes.
5. Delete all channels.
6. Create the channels with the names previously copied in step 3. Configuring each channel according to session 2 - CHANNEL CONFIG – Does not allow copy and paste.
7. Create the nodes with the names previously copied in step 3. Configuring each node according to session 3 - CONFIGURING US (NODE CONFIG) – Does not allow copy and paste.
8. Paste the point definitions previously copied in step 1.
9. When starting the Communication Module, all the Point entries will be validated. If point mistakes occur, they will be recorded in the Log (See section 7.1 - Logs of operations (LOG)) and check how to correct them in session 4 - CONFIGURATION OF POINTS (POINTS CONFIG).

The IEC 61850 Standard

This section aims to briefly present some information on the standard IEC 61850, which directly interferes in the definition and implementation of this communication module.

For more details and a formal description, refer to the standard's texts or documentation of the server IEDs.

The standard is divided into ten parts, listed below.

Chapter Description

1. Introduction and Overview
2. Glossary
3. General Requirements
4. System and Project Management
5. Communication Requirements for Device Functions and Models
6. Configuration of the Description Language for Communication in Substations with IEDs
7. Basic Communication Structures for Substations and Feeders: Principles and Models
 - 7.2 Basic Communication Structures for Substations and Feeders:
 - 7.3 Basic Communication Structures for Substations and Feeders: Common Data Class
 - 7.4 Basic Communication Structures for Substations and Feeds: Classes of Logic Nodes and Compatible Data
8. Mapping for MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and for ISO/IEC8802-3
 - 9.1 Sample Values on One-way Multidrop Point-to-point
 - 9.2 Sample Values for ISO/IEC8802-3
- 10 Conformity Tests

As regards the support for data communication between computers and IEDs, as established by the standard, the types of messages defined are listed below.

Message Description

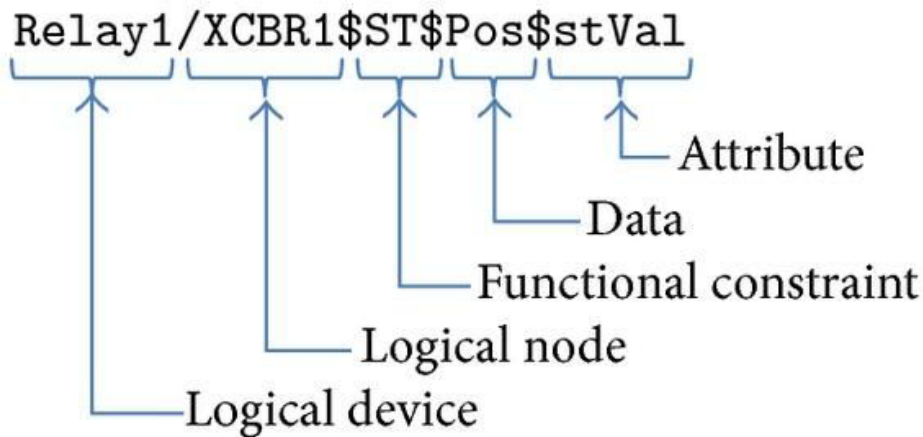
GOOSE Generic Object Oriented Substation - Multicast-type messages that load information between IEDs. They are responsible only for the traffic of messages about the performance of any protection or digital signal.

MMS Manufacturing Message Specification - Unicast-type messages that are used to exchange analog or digital (state) measurement data to indicate the state of the equipment and process.

One of the great advantages introduced by the standard in defining its data communication protocol is the fact that the internal points to an IED do not use numbers for addresses, as in other protocols, but names instead. Each point is considered an object, and its names and formats are standardized by the norm.

Internally to the IEC61850 IEDs there is a map of the objects, arranged in a hierarchical structure. In the communication between a client (for example, SCADA) and the server (for example, a digital-IED relay), these object names (at least when communication is initially established) travel in the protocol messages.

In order to have a general idea of these object's names, the next section briefly presents the structure of the address map hierarchy of the IEC61850.



LD - Logical Devices - These are logical devices within this physical server, which work as function containers (Logical Nodes) or even as gateways between different LD LNs. Generally, IED internal names are used in the initial part of the name (prefixes) and suffixes that indicate the main function of the LD. Examples of suffixes are CTRL, MEAS, etc.

LN - Logical Nodes - Objects that implement the well-defined basic functions within the Logical Device. The names of Logical Nodes are standardized. Each LN contains objects, data sets, Report definitions, Logs, parameter groups, and services that implement objects and functions. For example, a disconnect switch, its state, its control, has the name "Q0CSW1." The LN in this case is the CSWI – "Switch controller." Other examples of LNs would be those that perform measurement functions (MMXU), voltage transformer (TVTR), overcurrent protection (PTOC), thermal protection (PTTR). A complete list of LNs for use in substation IEDs and the rules for forming their names are given in IEC61850-Part 5.

FC - Functional Constraints - The function defined by the LN will contain several objects that are distributed in categories defined as FC-Functional Constraints. These are "CO" that will contain command objects, "ST" that will contain digital signaling objects, "RP" for report-type objects, and "MX" for measurement objects. The list of the following FCs was obtained from IEC61850 Part 7-2-2003 - Table 18. More details about each item can be found in the original table.

ST Status information

Term	Description
MX	Measurements (analog values)
CO	Control DataAttribute will be operated (control model) and read
SP	Setpoint DataAttribute will represent a set-point; value may be controlled and read
SV	Substitution DataAttribute will represent a substitution
CF	Configuration DataAttribute will represent a configuration
DC	Description DataAttribute will represent a description
SG	Setting group logical devices that implement the SGCB class
SE	Setting group
EX	Extended definition
BR	Buffered report
RP	Unbuffered report
LG	Logging Attribute will represent a log control
GO	Goose control
GS	Gsse control Attribute will represent a goose control
MS	Multicast sampled value control
US	Unicast sampled value control

DO - Data objects - Data Objects are objects with standard names that contain the information proper. These objects can be simple, such as the "Pos" object, which provides information on the circuit breaker position. There are more complex "A" objects, which represent a three-phase current. It is made up of four Data Attributes, each of which containing Child Data Attributes with the current information about each phase and a neutral. It has in the latter case multiple levels of Data Attributes in the hierarchy below a Data Object.

Examples of DataObjects are:

Beh - Behavior of LN
 Health - State of the logical node related to HW and SW.
 Loc - Switchover between local and remote operation
 Mod - Mode and behavior: On, Blocked, Test, Test/Blocked, Off
 Pos - Switch position
 A - Current
 neut - Phase neutral
 phsA, phsB, PhsC - Phases A, B and C
 Hz - Frequency
 PPV - Phase to phase voltages
 PhV - Phase to ground voltages for Phases 1, 2, and 3, including Angle

DA - Data Attributes - Each object hierarchically below a Data Object or another Data Attribute, in the case of "ctlNum" or a phase of the stream as "phsC." Examples:
 In the case of "Pos" you can see four Data Attributes:
 stVal - Containing the state of the circuit breaker
 q - The quality of the data
 t - Sampling timestamp
 ctlNum - Data object status change sequence number

In the case of the current "pshC," besides being a Data Attribute itself, it also contains four Data Attributes below it:
 cVal - The current measurement
 instCval - The instantaneous measure of the current at the last acquisition
 q - The quality of the data
 t - Sampling timestamp.

For the end user, the way services are used is transparent. They are only required to know how to set up the user-friendly configuration interfaces for running the IEC61850 SCADA Client.

Communication Module

The communication module consists of two libraries that work together: Communication and Integration.

Communication Library

The communication library is developed in the C ++ programming language and is responsible for the communication between the Communication Module and the equipment. It is designed according to edition 2 of the IEC 61850 standard series.

Supported Objects

The following table provides an overview of supported IEC 61850 objects.

IEC 61850 Objects	MMS Object
SERVER class	Virtual Manufacturing Device (VMD)
LOGICAL DEVICE class	Domain
LOGICAL NODE class	Named Variable
DATA class	Named Variable
DATA-SET class	Named Variable List
SETTING-GROUP-CONTROL-BLOCK class	Named Variable
REPORT-CONTROL-BLOCK class	Named Variable
LOG class	Journal
LOG-CONTROL-BLOCK class	Named Variable
GOOSE-CONTROL-BLOCK class	Named Variable
GSSE-CONTROL-BLOCK class	Named Variable
CONTROL class	Named Variable
Files	Files

Supported Services

The following table provides an overview of supported IEC 61850 Abstract Communication Service Interface (ACSI) services.

IEC 61850 Model	IEC 61850 Services		AA: TP/M C	Client	Server
Server	S1	ServerDirectory	TP	Yes	Yes
Application association	S2	Associate	TP	Yes	Yes
	S3	Abort	TP	Yes	Yes

	S4	Release	TP	Yes	Yes
Logical device	S5	LogicalDeviceDirectory	TP	Yes	Yes
Logical node	S6	LogicalNodeDirectory	TP	Yes	Yes
	S7	GetAllDataValues	TP	Yes	Yes
Data set	S12	GetDataSetValues	TP	Yes	Yes
	S13	SetDataSetValues	TP	Yes	Yes
	S14	CreateDataSet	TP	Yes	Yes
	S15	DeleteDataSet	TP	Yes	Yes
	S16	GetDataSetDirectory	TP	Yes	Yes
Substitution	S17	SetDataValues	TP	Yes	Yes
Setting group control block	S18	SelectActiveSG	TP	Yes	Yes
	S19	SelectEditSG	TP	Yes	Yes
	S20	SetSGValues	TP	Yes	Yes
	S21	ConfirmEditSGValues	TP	Yes	Yes
	S22	GetSGValues	TP	Yes	Yes
	S23	GetSGCBValues	TP	Yes	Yes
Buffered report control block (BRCB)	S24	Report	TP	Yes	Yes
	S24-1	data-change (dchg)	TP	Yes	Yes
	S24-2	qchg-change (qchg)	TP	Yes	Yes
	S24-3	data-update (dupd)	TP	Yes	Yes
	S25	GetBRCBValues	TP	Yes	Yes
	S26	SetBRCBValues	TP	Yes	Yes
Unbuffered report control block (URCB)	S27	Report	TP	Yes	Yes
	S27-1	data-change (dchg)	TP	Yes	Yes
	S27-2	qchg-change (qchg)	TP	Yes	Yes
	S27-3	data-update (dupd)	TP	Yes	Yes
	S28	GetURCBValues	TP	Yes	Yes
	S29	SetURCBValues	TP	Yes	Yes
Log control block	S30	GetLCBValues	TP	Yes	Yes
	S31	SetLCBValues	TP	Yes	Yes
	S32	QueryLogByTime	TP	Yes	Yes
	S33	QueryLogAfter	TP	Yes	Yes
	S34	GetLogStatusValues	TP	Yes	Yes
GOOSE control block	S35	SendGOOSEMessage	MC	Yes	Yes
	S36	GetGoReference	TP		
	S37	GetGOOSEElementNumber	TP		
	S38	GetGoCBValues	TP	Yes	Yes
	S39	SetGoCBValues	TP	Yes	Yes
GSSE control block	S40	SendGSSEMessage	MC		
	S41	GetGsReference	TP		
	S42	GetGSSEElementNumber	TP		
	S43	GetGsCBValues	TP		
	S44	SetGsCBValues	TP		
Multicast SVC	S45	SendMSVMessage	MC		Yes
	S46	GetMSVCBValues	TP	Yes	Yes
	S47	SetMSVCBValues	TP	Yes	Yes

Unicast SVC	S48	SendUSVMessage	TP		Yes
	S49	GetUSVCBValues	TP	Yes	Yes
	S50	SetUSVCBValues	TP	Yes	Yes
Control	S51	Select	TP	Yes	Yes
	S52	SelectWithValue	TP	Yes	Yes
	S53	Cancel	TP	Yes	Yes
	S54	Operate	TP	Yes	Yes
	S55	Command-Termination	TP	Yes	Yes
	S56	TimeActivated-Operate	TP	Yes	Yes
File transfer	S57	GetFile	TP	Yes	Yes
	S58	SetFile	TP	Yes	Yes
	S59	DeleteFile	TP	Yes	Yes
	S60	GetFileAttributeValues	TP	Yes	Yes
Time	T1	Time resolution of internal clock		1ms	1ms
	T2	Time accuracy of internal clock			
	T3	Supported Timestamp resolution		1ms	1ms
AA – Application association					
Legend: TP – Two-party application association (MMS over TCP/IP or Unicast Sampled Value on top of Ethernet) MC – Multicast application association (GOOSE or SV using multicast messages on top of Ethernet) Yes – Supported					

Integration Library

The integration library is developed in the C # programming language and is responsible for the integration between the Communication Module and SCADA. It aims to transact the read and write information between the device and SCADA.

Objects Implemented

The following table provides an overview of implemented IEC 61850 objects. The fields marked with a (?) indicate the implementation of the service.

IEC 61850 Objects	
SERVER class	
LOGICAL DEVICE class	Yes
LOGICAL NODE class	Yes
DATA class	Yes
DATA-SET class	Yes
SETTING-GROUP-CONTROL-BLOCK class	
REPORT-CONTROL-BLOCK class	Yes
LOG class	
LOG-CONTROL-BLOCK class	
GOOSE-CONTROL-BLOCK class	
GSSE-CONTROL-BLOCK class	
CONTROL class	Yes
Files	

Services Implemented

The following table provides an overview of the implemented IEC 61850 Abstract Communication Service Interface (ACSI) services. The fields marked with a (?) indicate the implementation of the service.

Section Header using Heading 2

Sub-Section Header Using Heading 3

It's essential to link from one page to another and to specific sections on a page. You can add any URL to a Confluence page and Confluence will automatically detect it and turn it into a link.

If you paste the URL for another page in your Confluence site, Confluence will display the link text as the page name and turn it into a relative link, meaning if the name of the page changes, Confluence will adjust the link so it doesn't break.

Topic Header using Heading 4

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1. Type `{anchor}` in the editor, select the anchor macro and give your anchor a name
2. Select the text that'll link to the macro and hit `Ctrl+K` (Windows) or `Cmd+K` (Mac) (this opens the link dialog)
3. Choose **Advanced** from the options on the left and type `#` followed by your anchor name

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Adding Images

Be sure when adding images that they are very clear, especially if they contain text, and try to only capture a close up of the important thing you are referencing. You may need to overlay a few screenshots depending on what you are doing. If you need help capturing what you need ask for assistance as a different capture tool may help immensely.

Use the "Insert files and images" tool at the top to insert an image.

Then, be sure to click the "Original" button, and the "Border" button. The Original button will ensure the image is sized as the original, which should have be large enough to read clearly. If needed, you can adjust the size after that, but larger is okay if it helps clarity. The border button will put a box around the image to help delineate it from the white background, which is really useful on some screen shots that also have a lot of white on the edge.

Useful macros

Use [macros](#) when needed to help draw attention to particular information. Here's a few:

Tip, Note, Info, Warning, and Panel Macros

Often when creating documentation, there are elements of a page that you want to highlight or draw the the viewers' attention to. Confluence ships with the [Tip](#), [Info](#), [Warning](#), [Note](#) and [Panel](#) macros, which will help you focus a viewer's attention on a particular part of your content.

Term	Description