



Transforming the world of energy using open standards

SISCO IEC 61850 Products Overview

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About SISCO

- Founded in 1983
- Standards:
 - » IEC 61850
 - » ICCP-TASE.2 (IEC 60870-6)
 - » CIM (IEC 61970/61968)
 - » COMTRADE (IEEE C37.111)
- Focus:
 - » Helping users extract value from open interoperable standards by providing solutions based on knowledge, experience and innovation.



SISCO Committed to Standards

- IEC Technical Committee 57 (TC57)
 - » WG07/19 – IEC60870-6 TASE.2 (ICCP)
 - » WG10 – IEC 61850 (power system automation communications)
 - » WG13 – IEC 61970 for EMS (CIM modeling and model exchange)
 - » WG14 – IEC 61968 for DMS (CIM modeling and messaging)
 - » WG15 – IEC 62351 Communications Security
 - » WG17 – IEC 61850-420 and 8-2 Distributed Energy Resources
 - » WG19 – Interoperability and Harmonization with TC57
- IEEE
 - » Power System Relaying Committee (PSRC)
 - » CIM Task Force
- UCA International Users Group
 - » Founding Member
 - » CIM Users Group
 - » IEC 61850 Users Group
- ISO
 - » TC 184 - ISO 9506 (MMS)
- Smart Electric Power Association (SEPA)
 - » Founding Member of SGIP 2.0
 - » OpenFMB

SISCO Technology

- ❑ Communication Protocol Software and Tools for:
 - » Control Center-Control Center and Control Center-Power Plant communications
 - Intercontrol Center Communications Protocol (ICCP) IEC 60870-6 TASE.2
 - » Power System Automation Communications
 - IEC 61850
- ❑ Common Information Model
 - » CIM based messaging for model-driven application integration
 - » Adapter and tools to apply CIM to data and tag name management for operational systems.
- ❑ COMTRADE Utility for PI
 - » Enterprise level power system disturbance file management system for PI
- ❑ Unified Analytic Platform
 - » A high-speed analytic platform for processing real-time data streams such as GOOSE and IEC TR 61850-90-5 (Routable GOOSE) for wide area protection, measurement and control.
- ❑ Training, adapter/application development, consulting, and systems integration services to assist our customers in the exploiting benefits of model-driven integration based on these open international standards.

IEC 61850 Products

- AX-S4 61850: Complete IEC 61850 Interface for Windows Applications
 - IEC 61850 Client
 - IEC 61850 GOOSE publisher and subscriber
 - IEC 61850 Server
- GOOSE Blaster
 - » Testing tool to simulate GOOSE and R-GOOSE messaging
- R-GOOSE Gateway
 - » Transforms GOOSE \leftrightarrow R-GOOSE
- MMS-EASE Lite: Portable IEC 61850 Source code
 - » Commonly used for IEDs of many different types and functions
- Unified Analytic Platform (UAP)
 - » Real-time processing of high-speed field data for wide area protection and centralized remedial action systems (C-RAS)



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AX-S4 61850

ACCESS FOR...

Features, Architecture, and Applications

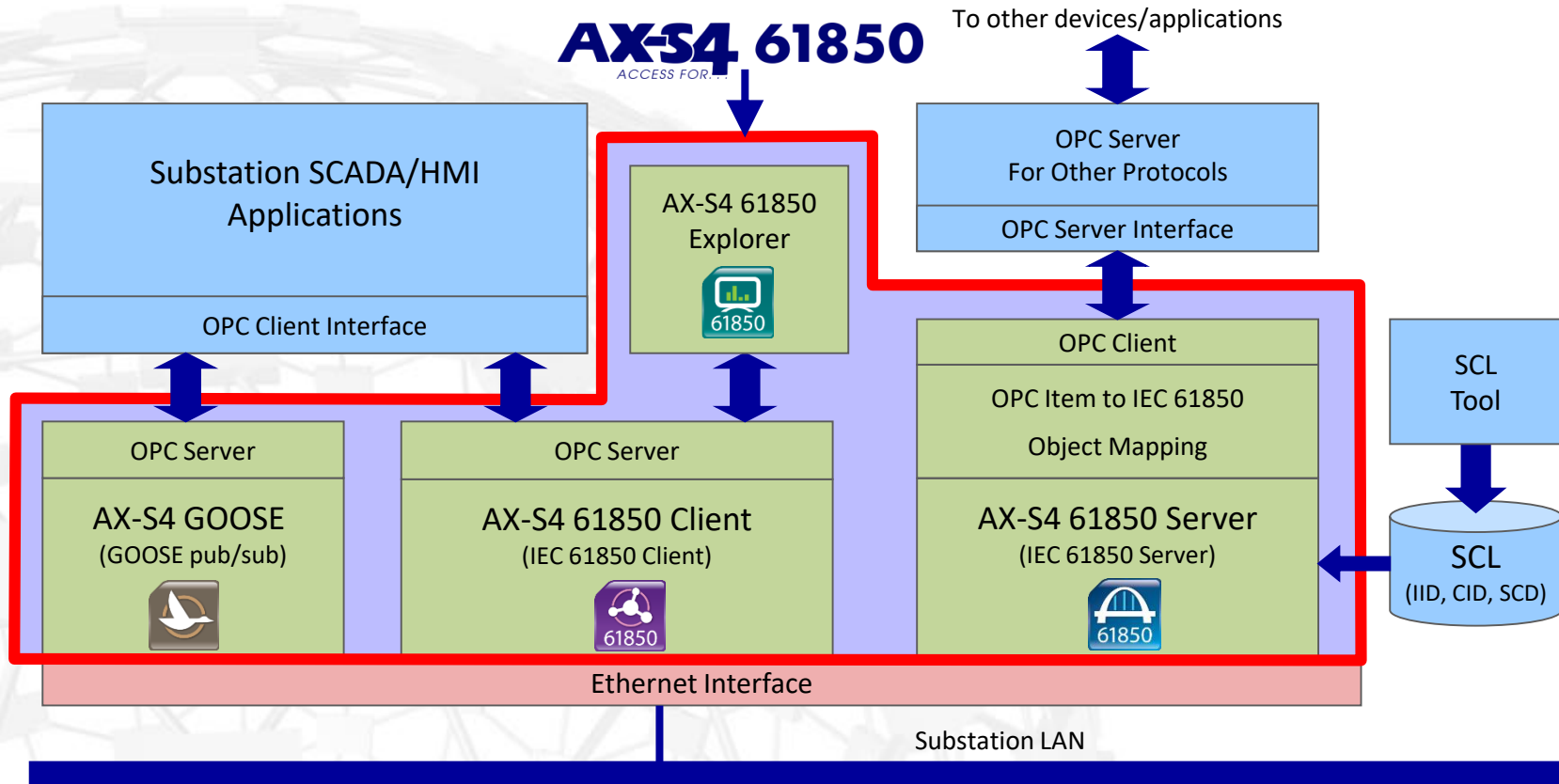
AX-S4 61850 Description

ACCESS FOR...

- Complete “*Access For IEC 61850*” interface for Windows applications
 - » IEC 61850 Client to access data in IEC 61850 devices
 - » IEC 61850 Server for gateways, concentrators, and proxies.
 - » IEC 61850 GOOSE publisher and subscriber
- Standardized interface to applications:
 - » OPC Data Access (DA) V3.0 (see <http://www.opcfoundation.org>)
 - » Backward Compatible to OPC DA V2.05

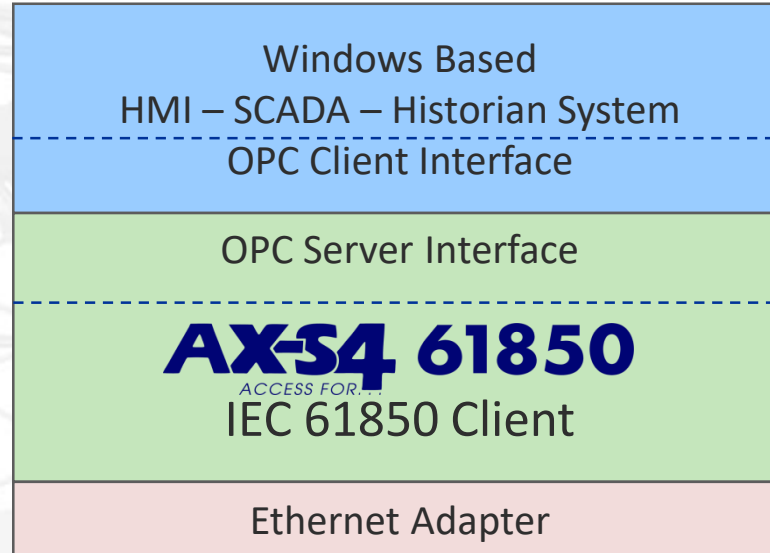
AX-S4 61850 Complete Architecture

ACCESS FOR...



AX-S4 61850 Basic Application

ACCESS FOR...



IEC 61850
Devices
(servers)



AX-S4 61850 Client Features

ACCESS FOR...

- IEC 61850 Ed.1 and Ed.2 Client functions supported (OPC Server):
 - Object discovery and automatic configuration of data using ACSI services
 - SCL (IEC 61850-6-1) import to configure client for remote devices
 - › Can import individual devices via ICD, IID and CID Files
 - › Can import an entire substations in a single operation via SCD files
 - Transparent and Automatic Handling of Buffered and Unbuffered Reporting
 - Read/Write of any IEC 61850 Object
 - Automated Controls (with Normal or Enhanced Security)
 - Logs
 - File Transfer client
 - OPC DA V3.0 Server
 - IEC 62351 secure communications supported:
 - › TLS 1.2 for server level authentication and encryption
 - › X.509 Digital certificates for strong application level authentication
- Includes interactive object explorer for device object visualization, debug, testing, configuration, and control

AX-S4 61850 Explorer – Interactive Access

ACCESS FOR...

Configuration functions available via integrated explorer interface.

Object pane shows available devices. Click on the device to access or expand the data. Right-click to bring up supported functions.

Automatic reporting is configurable interactively or via XML file import.

Monitor pane displays reports and data from multiple devices

Status line displays activity messages.

The screenshot shows the AX-S4 61850 Explorer application window. The interface is divided into several panes:

- Object Pane (Left):** A tree view showing the hierarchy of physical devices. Under 'Relay_1', the 'MMTR1' object is selected and highlighted in blue.
- Detail Pane (Top Right):** Displays the hierarchical structure and values for the selected 'MMTR1' object. The 'Object' column lists various sub-objects like 'Mod', 'Beh', 'Health', 'SupVWh', etc., and the 'Value' column shows their corresponding data values.
- Monitor Pane (Bottom):** Displays a table of data reports. The first row shows a data value of '010000>Data' with a reason code of '010000>Data'. The second row shows a timestamped data value: '2010-08-17T22:00:46.930995941Z[qual=1.0,1,31]'. The third row shows an integrity check result: '000010:Integrity,{{(60},{60},000000000000,2010-08-03T19:16:11.180545807Z[qual=1.0,1,31]}}'. The fourth row shows another data value: '010000>Data,{{{(366778.9),{-171.522}},{{(366778.9),{-171.522}},000000000000,2010-08-03T19:16:11.180545807Z[qual=1.0,1,31]}}'. The fifth row shows another integrity check result: '000010:Integrity,{{{(0.2591435),(104.9213)},{{(0},{0}),000000000000,2010-08-03T19:16:11.180545807Z[qual=1.0,1,31]}}}'.
- Status Line (Bottom):** Displays the message: '8/17/2010 4:24:17 PM - AX-S4 61850 Explorer has been started'.

Detail Pane displays object info, enables writing values, and copy-paste function for creating hot-links to IEC 61850 data.

Report data received and reason codes are highlighted.



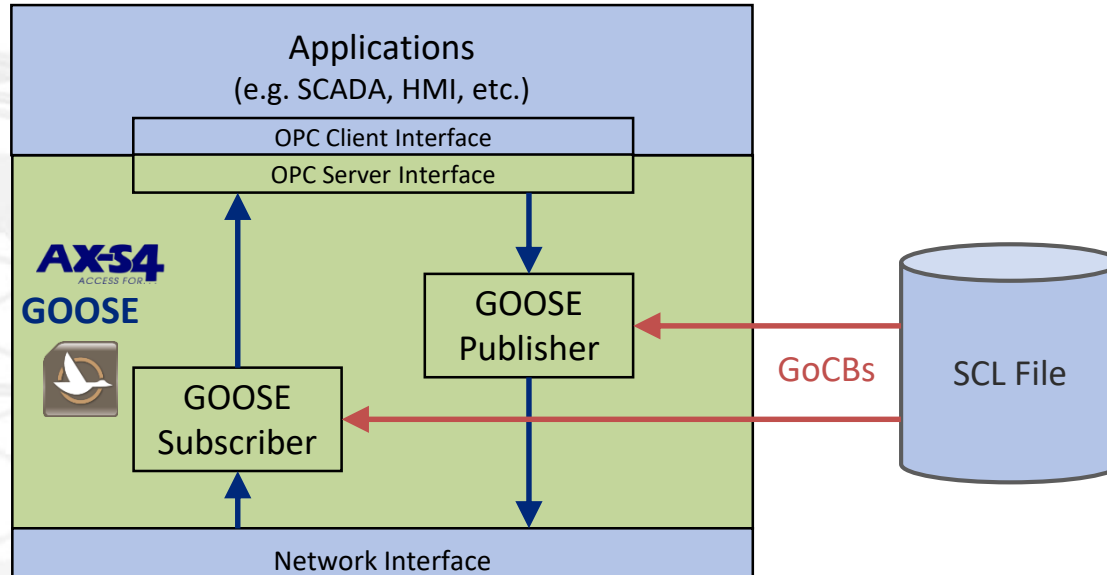
AX-S4 GOOSE Features

ACCESS FOR...

- IEC 61850 Publisher and Subscriber (OPC Server DA V3.0 interface):
 - Configuration of GOOSE control blocks via SCL (IEC 61850-6-1)
 - › Can represent single or several IEDs and GoCBs from SCL file
 - Enable and disable GOOSE control blocks via OPC interactions
 - Configurable retransmission curves
 - Automated timestamp, quality, state, sequence number and time allowed to live processing
 - Writing changed data to AX-S4 GOOSE triggers outgoing GOOSE and increments state number
 - OPC items updated as GOOSE messages arrived
 - High performance architecture provides reliable processing
 - OPC DA V3.0 Server

AX-S4 GOOSE Application

ACCESS FOR...



AX-S4 61850 Server Features

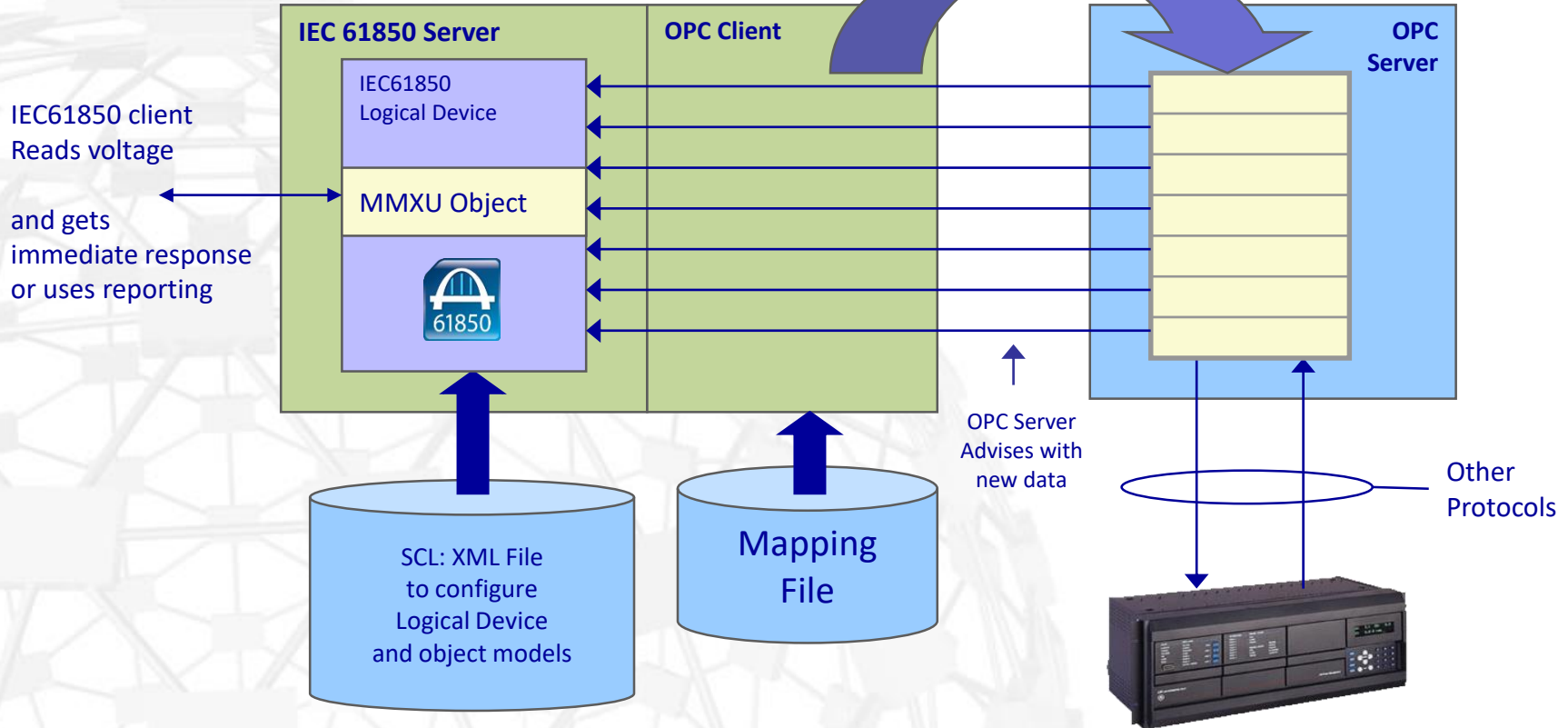
ACCESS FOR...

- IEC 61850 Server functions:
 - Configuration of IEC 61850 server via SCL (IEC 61850-6)
 - Mapping of IEC 61850 objects to external OPC server for dynamic data
 - Fixed value initialization via SCL or mapping file for static data.
 - Read/Write of any IEC 61850 Object
 - Buffered and Unbuffered Reporting
 - Controls (Direct and SBO via Normal Security)
 - Full support for object discovery using ACSI services
 - IEC 61850 file server functions
 - OPC DA V3.0 Client
 - IEC 62351 secure communications supported:
 - › TLS 1.2 for server level authentication and encryption
 - › X.509 Digital certificates for strong application level authentication

AX-S4 61850 Server

ACCESS FOR...

OPC Client Creates Groups



Example Mapping File: IEC 61850 gateway to Modbus Device

Mapped to AX-S4 61850 GOOSE publisher

| | | | | | |
|------|------------------------------------|------------------------|------------------------------------|----------------|--------------------|
| CTRL | AlmGGIO1\$ST\$Beh\$stVal | KEPware.KEPServerEx.V4 | Simulated.User.beh_stVal | ReadOnlyDyn | |
| CTRL | AlmGGIO1\$ST\$Health\$stVal | KEPware.KEPServerEx.V4 | Simulated.User.Health_stVal | ReadOnlyDyn | |
| CTRL | AlmGGIO1\$ST\$SPCSO1\$stVal | SISCO.AXS4GOOSE.1 | Local.SISCO_IED1CTRL/SPSCO1\$stVal | ReadWriteDyn | |
| CTRL | AlmGGIO1\$CF\$Mod\$ctlModel | KEPware.KEPServerEx.V4 | Simulated.User.ctlModel | ReadOnlyStatic | |
| CTRL | AlmGGIO1\$CF\$SPCSO1\$ctlModel | KEPware.KEPServerEx.V4 | Simulated.User.ctlModel | ReadOnlyStatic | |
| CTRL | AlmGGIO1\$DC\$NamPlt\$vendor | KEPware.KEPServerEx.V4 | Simulated.User.vendorSISCO | ReadOnlyStatic | |
| CTRL | AlmGGIO1\$DC\$NamPlt\$swRev | KEPware.KEPServerEx.V4 | Simulated.User.swRev | ReadOnlyStatic | |
| CTRL | AlmGGIO1\$DC\$NamPlt\$d | KEPware.KEPServerEx.V4 | Simulated.User.namPltSISCO | ReadOnlyStatic | |
| CTRL | AlmGGIO1\$DC\$NamPlt\$configRev | KEPware.KEPServerEx.V4 | Simulated.User.configRev | ReadOnlyStatic | |
| CTRL | AlmGGIO1\$EX\$NamPlt\$InNs | dummy_opcserver | dummy_opcitem | ReadOnlyStatic | IEC 61850-7-4:2003 |
| CTRL | MMXU1\$MX\$Hz\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.HzMagf | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$PhV\$phsA\$cVal\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsA_V_Mag | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$PhV\$phsA\$cVal\$ang\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsA_V_Ang | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$PhV\$phsB\$cVal\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsB_V_Mag | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$PhV\$phsB\$cVal\$ang\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsB_V_Ang | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$PhV\$phsC\$cVal\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsC_V_Mag | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$PhV\$phsC\$cVal\$ang\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsC_V_Ang | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$A\$phsA\$cVal\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsA_A_Mag | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$A\$phsA\$cVal\$ang\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsA_A_Ang | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$A\$phsB\$cVal\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsB_A_Mag | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$A\$phsB\$cVal\$ang\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsB_A_Ang | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$A\$phsC\$cVal\$mag\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsC_A_Mag | ReadOnlyDyn | |
| CTRL | MMXU1\$MX\$A\$phsC\$cVal\$ang\$f | KEPware.KEPServerEx.V4 | MODBUS.GEUR.PhsC_A_Ang | ReadOnlyDyn | |

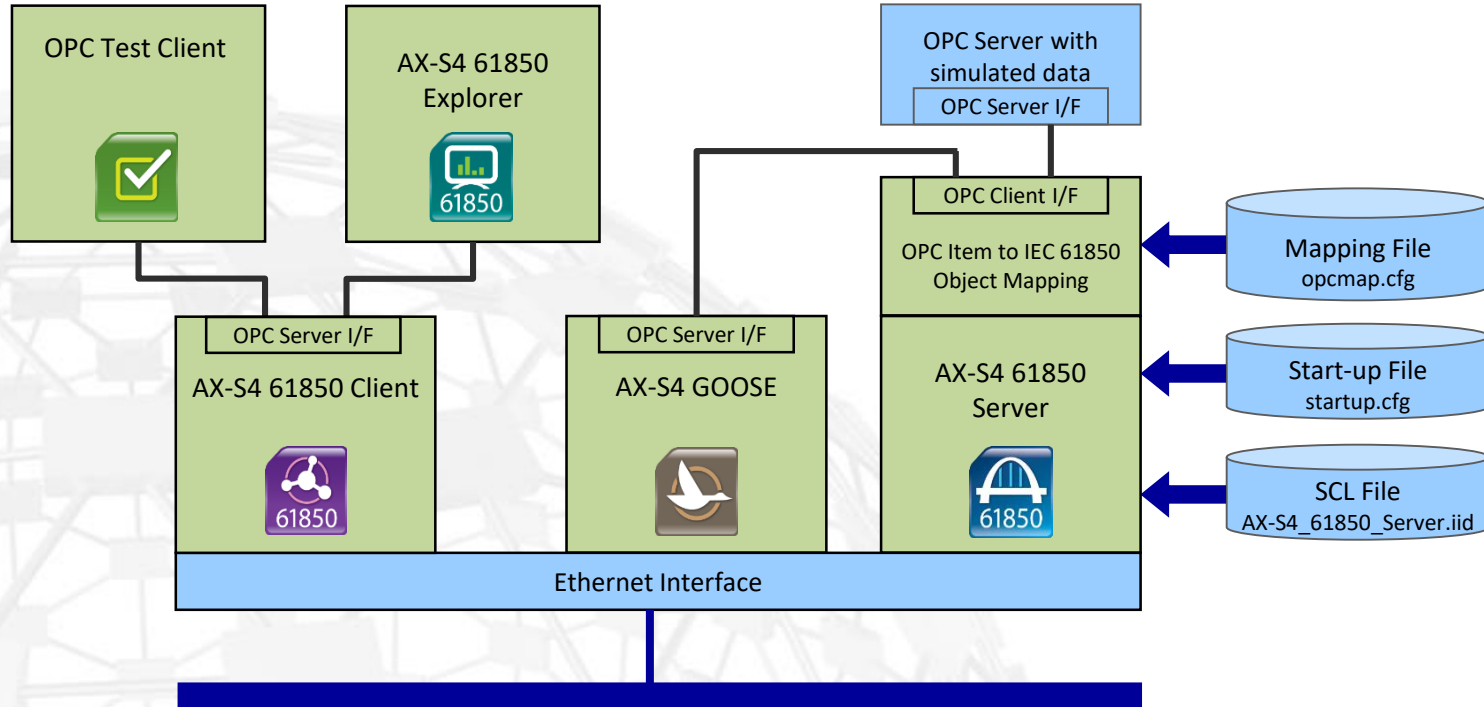
Unmapped item with initial value

Mapped to Modbus OPC Server for device data (for example)

Logical Device IEC 61850 Item OPC Server from which to read/write data OPC Item OPC Group defined in IOCLASS.CFG Initial Value



AX-S4 61850 “Out-of-the-Box” and Ready to Run System



After installation there is a pre-configured IEC 61850 server (based on the AX-S4 61850 Server) supporting ACSI and GOOSE with simulated data that can be accessed via the AX-S4 61850 client or other networked ACSI clients and GOOSE devices. Useful for application testing or illustrating configuration and setup concepts.

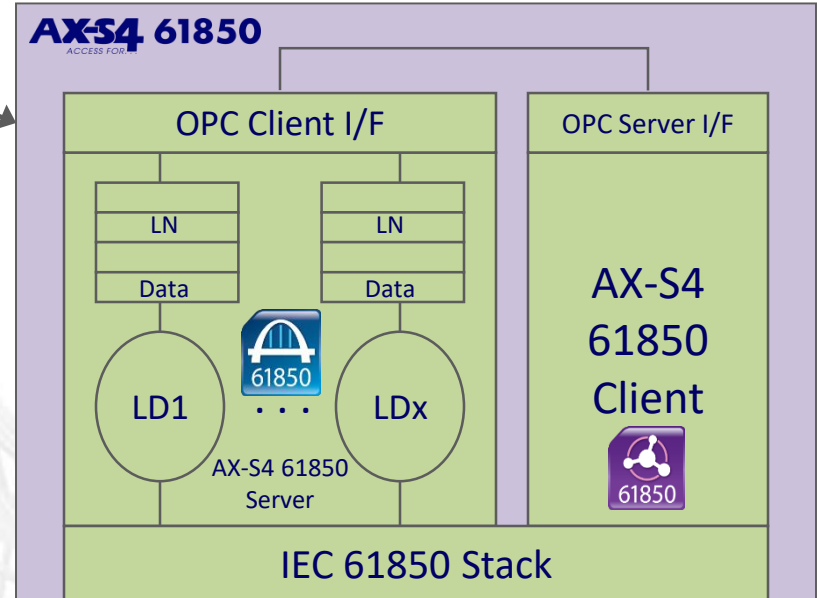
AX-S4 61850 as an IEC 61850 Proxy

ACCESS FOR...

“Proxy Server”

IEC 61850 clients access the AX-S4 61850 proxy server instead of individual devices. Enables multiple clients to share a single application association to the device.

IEC 61850 Clients



IEC 61850 Devices

LD1

LD2

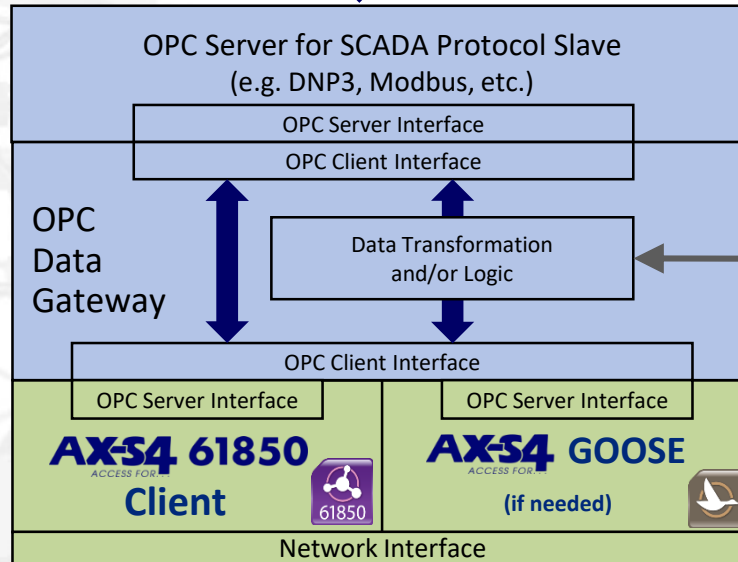
LDx

AX-S4 61850 SCADA Protocol Gateway

ACCESS FOR...



SCADA Master
(protocol master)



May be needed to transform incompatible data types (e.g. double point status to/from boolean, float to/from integer, scaling, etc.) or control processing



IEC61850 Devices

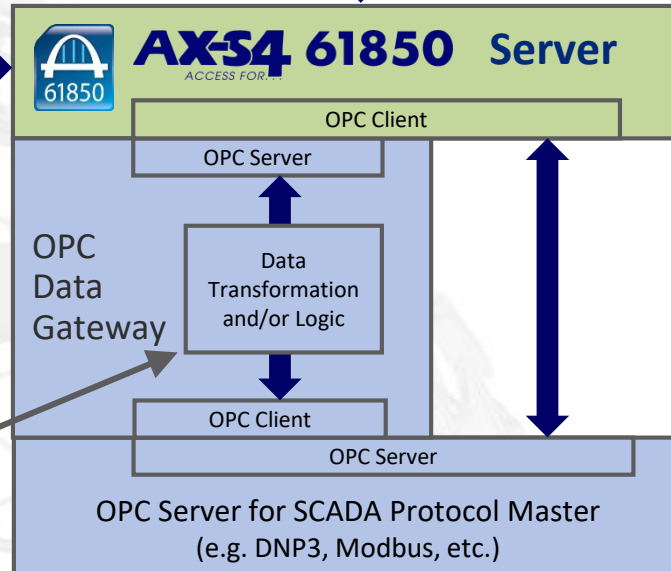
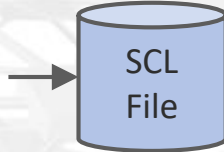
AX-S4 61850 Data Concentrator

ACCESS FOR...



SCADA Master
(IEC 61850 Client)

Each device is represented as a separate logical device in the SCL file



May be needed to transform incompatible data types (e.g. double point status to/from boolean, float to/from integer, scaling, etc.) or control processing



Devices

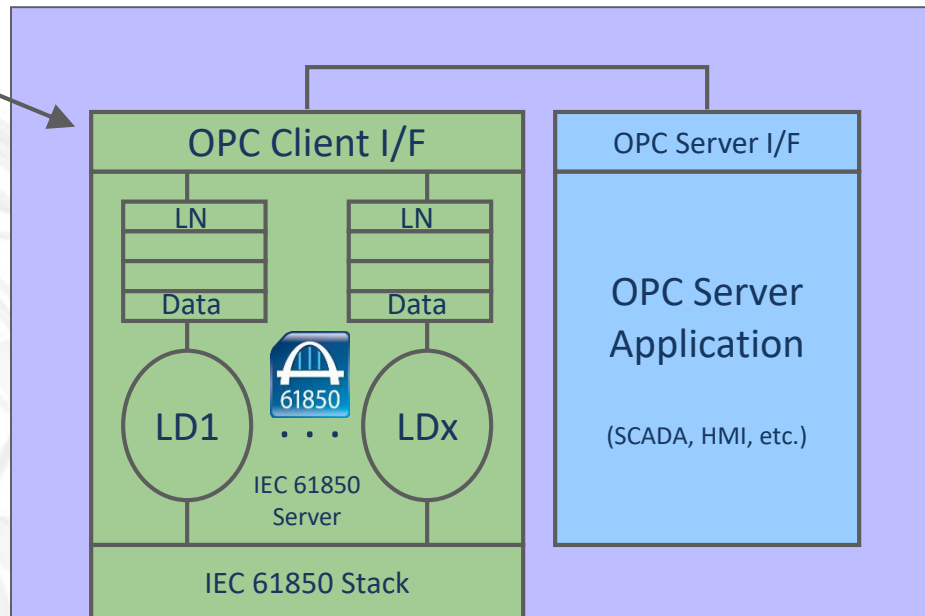


AX-S4 61850 ACCESS FOR... to Expose OPC server data to IEC 61850 clients

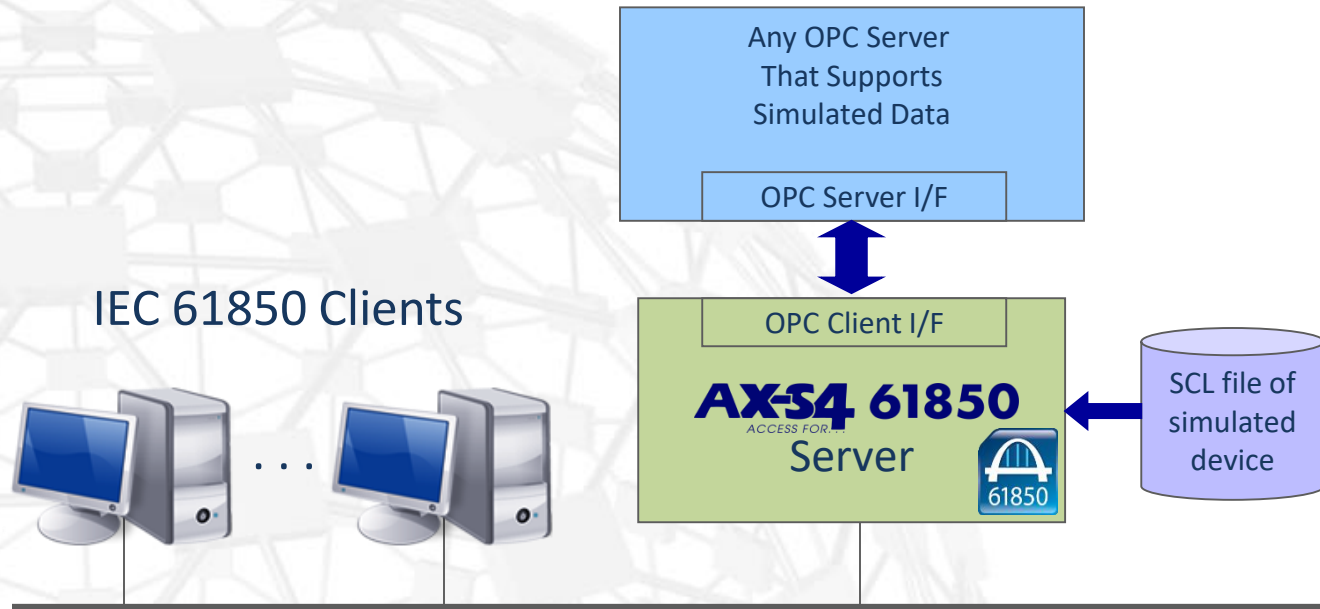
AX-S4 61850 Server

IEC 61850 clients access the data stored in the OPC server via the AX-S4 61850 server.

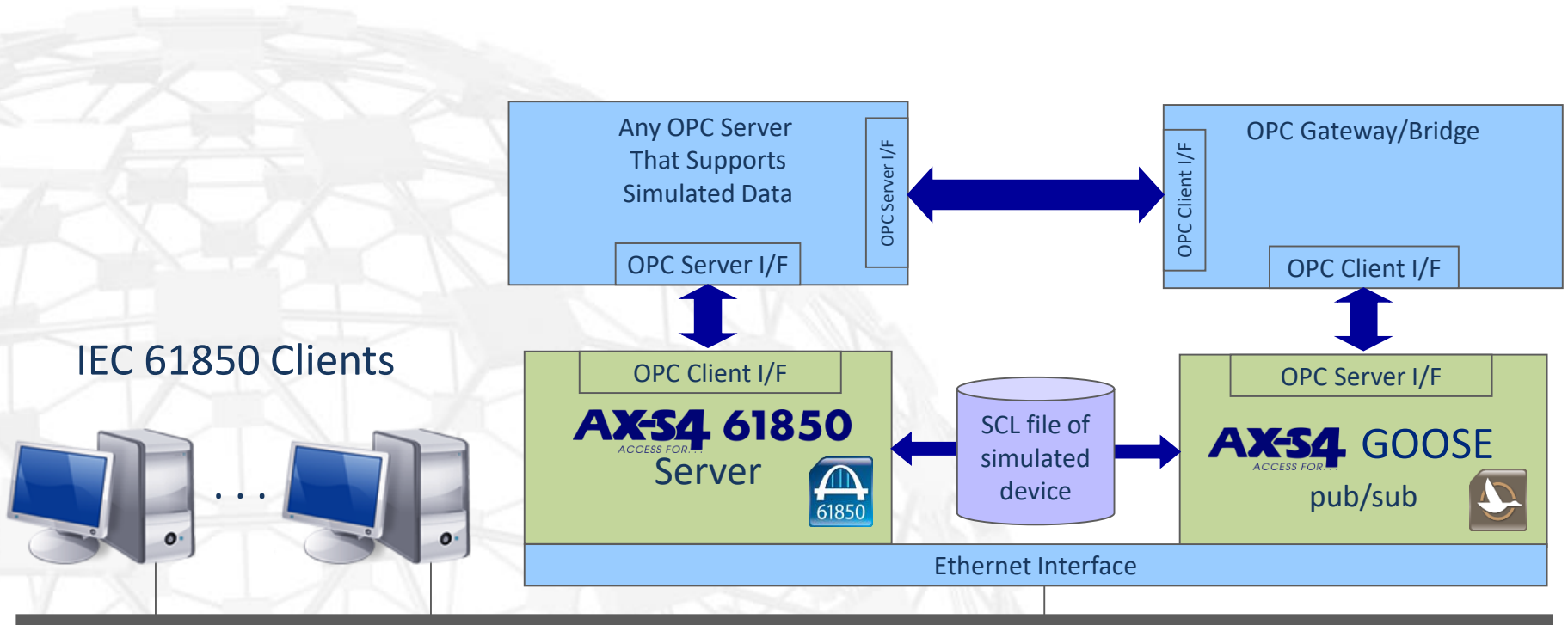
IEC 61850 Clients



AX-S4 61850 as an IEC 61850 Device Simulator

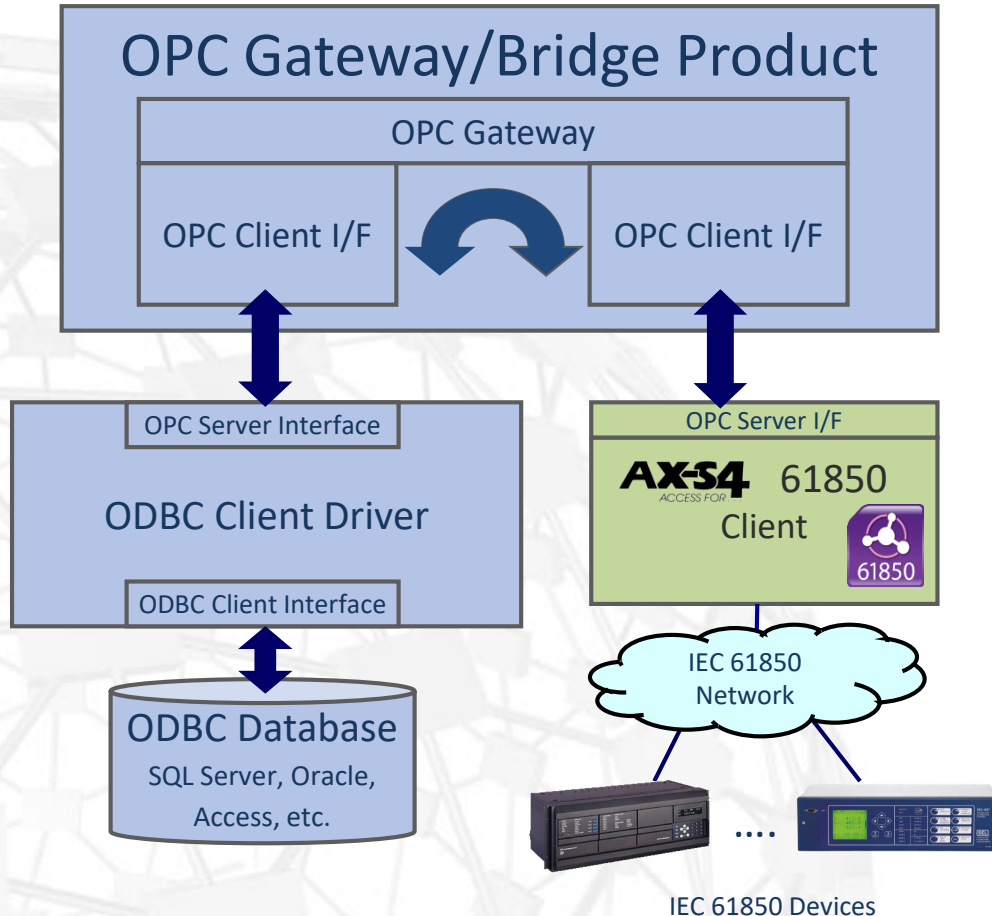


AX-S4 61850 IEC 61850 Device Simulator with GOOSE



AX-S4 61850 Interface to ODBC

ACCESS FOR...





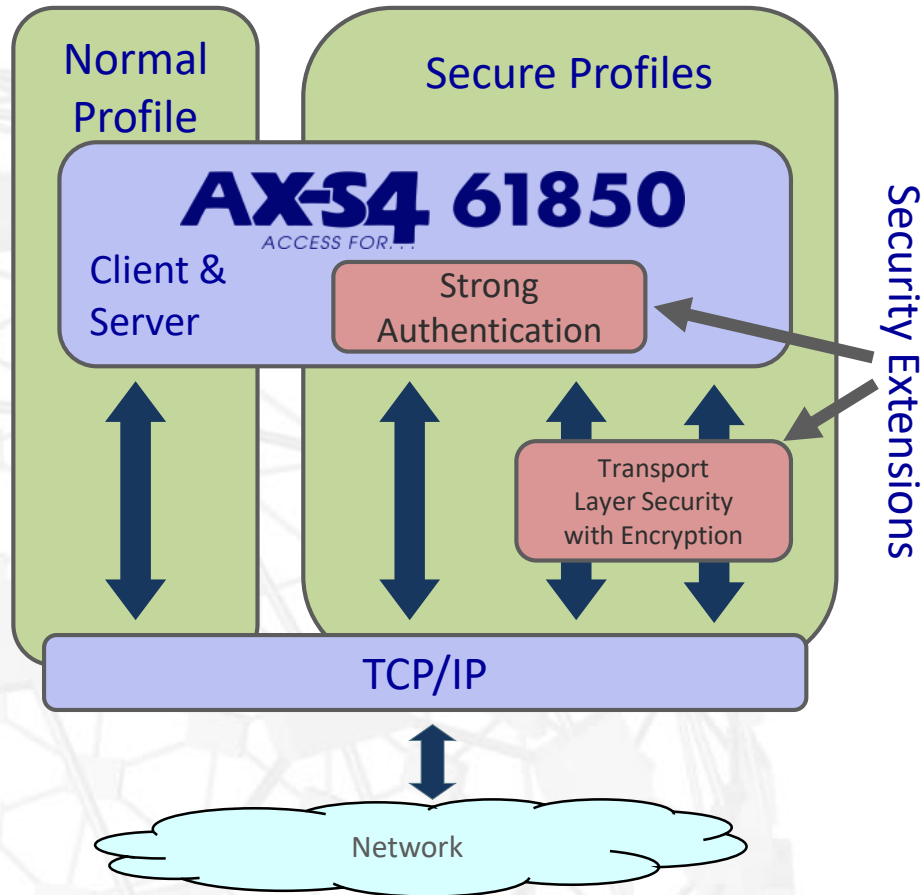
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IEC 62351-4 Security Extensions for AX-S4 61850

AX-S4 61850 Security Extensions

- Incorporates Support for IEC 62351-4 to provide
 - Application level authentication using digital certificates
 - Transport Layer Security (TLS) for encryption
- 1024/2048 bit asymmetrical keys for authentication and connection establishment and 256-bit symmetrical keys for encryption
- Encryption is periodically rekeyed to eliminate brute force breaking of encryption
- Connect requests are time stamped and signed to avoid playback and spoofing
- Supports simultaneous use with or without security functions on a link by link basis
- Security extensions are included with AX-S4 61850 at no additional cost
- Supports both AX-S4 61850 Client and AX-S4 61850 Server
- AX-S4 61850 Security Extensions are subject to governmental export restrictions

AX-S4 61850 Security Extensions





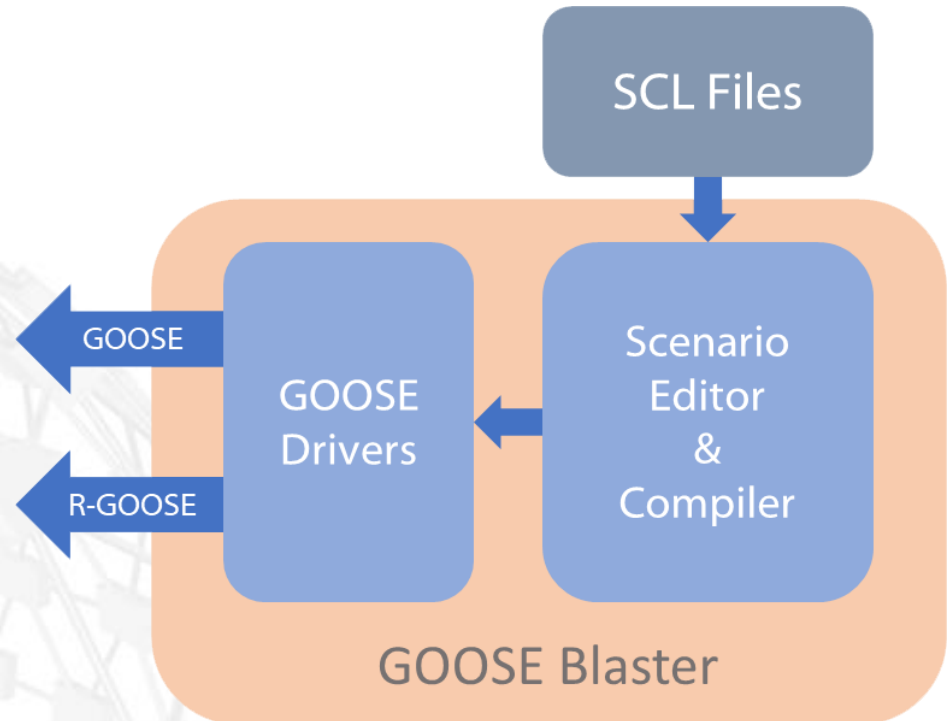
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GOOSE Blaster

Simulate GOOSE and R-GOOSE Messaging for Testing

GOOSE Blaster

- Simulates GOOSE and R-GOOSE messaging
- Capable of supporting large scale simulations of many devices including
 - » Critical state changes
 - » Out of sequence and missing message scenarios
 - » Good/bad quality/timestamps
 - » Many realistic and anomalous conditions can be simulated
- Supports execution of multiple scenarios simultaneously



GOOSE Blaster Scenario

| GOOSE Blaster Control [herb1] | | | | | | | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| GOOSE | Initial Values | 00.000 | 02.000 | 04.000 | 06.000 | 08.000 | 10.000 | 12.000 | 14.000 | 16.000 | 18.000 | 20.000 | 22.000 | 24.000 |
| herb1 | 1 | 9 | 9 | 9 | 9 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Events | | | | | | | | | | | | | | |
| Power Up | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Disconnect | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Connect | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Parameters | | | | | | | | | | | | | | |
| Ethernet Parameters | | | | | | | | | | | | | | |
| DstAddr | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 | 01 00 00 00 01 01 |
| SrcAddr | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 | 00 00 00 00 00 01 |
| VLAN-ID | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VLAN-PRI | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| GOOSE Parameters | | | | | | | | | | | | | | |
| APPID | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| GocbRef | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... |
| DatSet | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... | IED1Device1/LL... |
| GoID | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo | SISCOBkrkDemo |
| SINum | | | | | | | | | | | | | | |
| SqNum | | | | | | | | | | | | | | |
| Test | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ConfRev | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| NdsCom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Data Values | (10.0000000000... | (10.0000000000... | (10.0000000000... | (01.0000000000... | (10.0000000000... | (01.0000000000... | (01.0000000000... | (10.0000000000... | (01.0000000000... | (10.0000000000... | (01.0000000000... | (10.0000000000... | (01.0000000000... | (10.0000000000... |
| CSW11\$ST\$Pos\$Val(B\$sting2) | 10 | 10 | 10 | 01 | 10 | 01 | 01 | 10 | 01 | 10 | 01 | 10 | 01 | 10 |
| CSW11\$ST\$Pos\$Val(V\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| CSW11\$ST\$OpCls\$General(Bool) | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| CSW11\$ST\$OpCls\$Val(B\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| CSW12\$ST\$Pos\$Val(B\$sting2) | 01 | 01 | 10 | 01 | 10 | 01 | 10 | 01 | 10 | 01 | 10 | 01 | 10 | 01 |
| CSW12\$ST\$Pos\$Val(V\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| XCBR1\$ST\$Pos\$Val(B\$sting2) | 10 | 10 | 10 | 01 | 10 | 01 | 01 | 10 | 01 | 10 | 01 | 10 | 01 | 10 |
| XCBR1\$ST\$Pos\$Val(V\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| XCBR2\$ST\$Pos\$Val(B\$sting2) | 01 | 01 | 10 | 01 | 10 | 01 | 01 | 10 | 01 | 10 | 01 | 10 | 01 | 10 |
| XCBR2\$ST\$Pos\$Val(V\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| RBRF1\$ST\$OpEx\$General(Bool) | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| RBRF1\$ST\$OpEx\$Val(B\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| PTRC1\$ST\$TId\$General(Bool) | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| PTRC1\$ST\$TId\$Val(B\$sting13) | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 | 00000000000000 |
| IED1.IED1Device1/LLN0\$GO\$gocbInrFault | 1 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| IED2.IED2Device2/LLN0\$GO\$gocbInrFault | 1 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| IED3.IED3Device3/LLN0\$GO\$gocbInrFault | 1 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| IED4.IED4Device4/LLN0\$GO\$gocbInrFault | 1 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| IED5.IED5Device5/LLN0\$GO\$gocbInrFault | 1 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| IED6.IED6Device6/LLN0\$GO\$gocbInrFault | 1 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| IED7.IED7Device7/LLN0\$GO\$gocbInrFault | 1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| IED8.IED8Device8/LLN0\$GO\$gocbInrFault | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| IED9.IED9Device9/LLN0\$GO\$gocbInrFault | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| IED10.IED10Device10/LLN0\$GO\$gocbInrFault | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

2018-04-19 14:11:38.747 GOOSE Blaster Control started with privileges : SISCO UAP Managers, SISCO GOOSE Blaster Managers





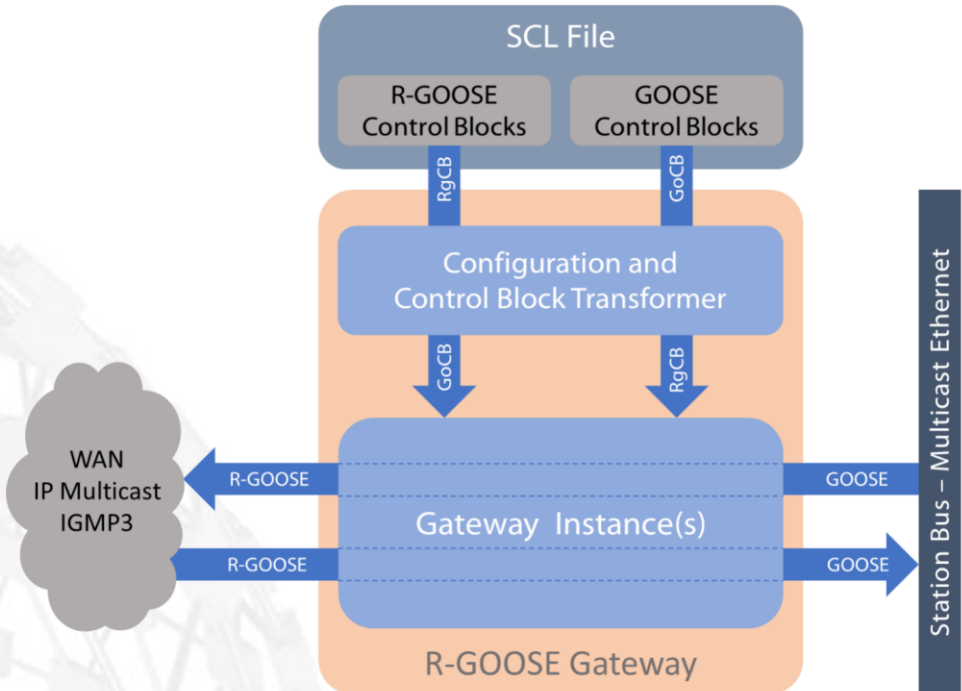
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R-GOOSE Gateway

Interconnect GOOSE and R-GOOSE Systems

R-GOOSE Gateway

- Translates Ethernet Multicast GOOSE messaging to/from IP Multicast GOOSE (R-GOOSE) with minimal latency
- Configures with SCL and autogenerates the necessary GoCB and RgCBs needed on either end of the gateway
- Supports execution of multiple gateway instances and multiple network interfaces





Transforming the world of energy using open standards

MMS *Lite*

IEC 61850 Portable Source Code for Embedded Systems
and Other Applications

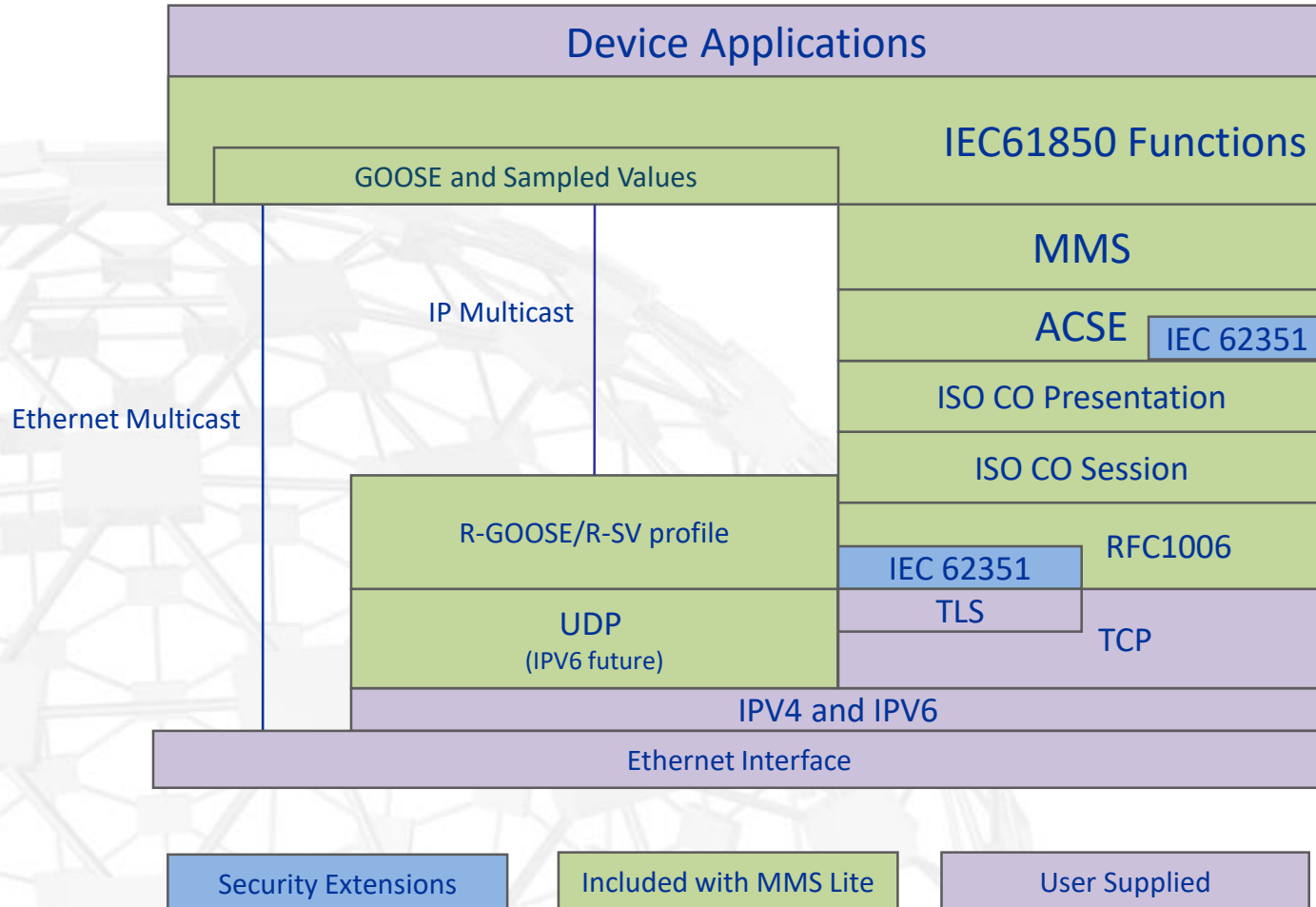
MMS *Lite*

- Source code implementation helps you get IEC 61850 products to the market fast using robust field-proven technology
- Designed specifically for resource constrained embedded systems yet suitable for host system development
- Portable to any computing platform
- Used in protection relays, RTUs, PQ meters, wind turbine controllers, transformer monitoring, host applications, etc.
 - » Over 450 device manufacturers using MMS *Lite* world-wide
 - » Hundreds of devices using MMS *Lite* have passed UCAIug certified conformance testing
 - » Millions of devices installed and operational world-wide using MMS *Lite*
- Flexible licensing options minimize initial cost while providing upgrade path as needs grow
- ICCP-TASE.2 Extensions Available (Optional)
- IEC 62351-4 Security Extensions Available (Optional)

MMS *Lite* Features

- Resource Efficient in both RAM and ROM
- Portable to any O/S supporting ANSI C
- Flexible memory management:
 - User managed memory pool; or
 - Dynamic memory allocation
- Uses well defined interfaces to:
 - Ethernet
 - TCP/IP
 - Memory management
 - Activity logging for debug
 - O/S calls

MMS Lite Profiles



Current IEC 61850 Support

- IEC61850 Edition 1 and Edition 2 Client and Server in one implementation
- Supports All ACSI Services and Objects parts 6, 7-2, 7-3, 7-4, 7-410, 7-420, 8-1, 61400-25-2 and more.
 - » Buffered and Unbuffered Reporting
 - » Controls (all options)
 - » Settings
 - » Logs
 - » GOOSE Ethernet Multicast
 - » 9-2 Process Bus
 - » Routable GOOSE and SV per IEC TR 61850-90-5* for IP Multicast (excluding GDOI)
 - » IEC 62351 security extensions available as an option
- Supports both IPV4 and IPV6 for client/server communications
- Run Time Definition of Objects via SCL per IEC 61850-6

* - IEC TR 61850-90-5 will become part of Ed 2.1 in 2018.

MMS *Lite* Portability

- Portable to any OS and CPU supporting ANSI C compiler
- Customers have also ported to:
 - pSOS
 - VxWorks
 - RTXc
 - LynxOS
 - ThreadX
 - Home-Grown
 - Many many others
- Portation services are available if needed.
- Most customers port MMS Lite to their platform with minimal (if any) assistance from SISCO and typically without informing SISCO. **MMS *Lite* is truly platform independent.**

MMS *Lite* Porting

- Sample application provided to assist in testing the ported software
- Ready to compile “out of the box” on:
 - RedHat Linux
 - Win32
- Portable to **any** platform supporting ANSI C.
- Accommodates any byte alignment or ordering (big/little endian) system
- Lower layer provider code isolates interfaces to TCP and Ethernet to minimize impact for non-Linux/Win32 systems
- O/S specific functions controlled via #define and isolated into specific modules to improve portability

MMS *Lite* Licensing Options

- Source Code is licensed to a single location
 - » Temporary access allowed for outside contractors
- Flexible licensing enables low cost entry and preserves investment as needs and volumes increase.
 - » All source code license fees paid can be credited towards purchase of an upgraded license
- Per Copy Based Licenses
 - » Lower source code fees to get started
 - » License fee per unit of end product
- Paid-Up License
 - » Higher source code fees
 - » No per unit license fees for high-volume devices
- License Options
 - » Corporate Licensing
 - » Product Restricted
 - » Academic Research

MMS *Lite* Security Extensions

- Incorporates Support for the IEC 62351-4 subset of IEC 62351-6 to provide
 - Application level authentication using digital certificates
 - Transport Layer Security (TLS) for encryption
- 1024/2048 bit asymmetrical keys for authentication and connection establishment and 256-bit symmetrical keys for encryption
- Encryption is periodically rekeyed to eliminate brute force breaking of encryption
- Connect requests are time stamped and signed to avoid playback and spoofing
- Supports simultaneous use with or without security functions on a link by link basis
- Internal data structure support for holding role/privilege information in support of IEC 6235-8 Role Based Access Control (RBAC)
- Security extensions are available separately as a one-time purchase for any existing MMS *Lite* license



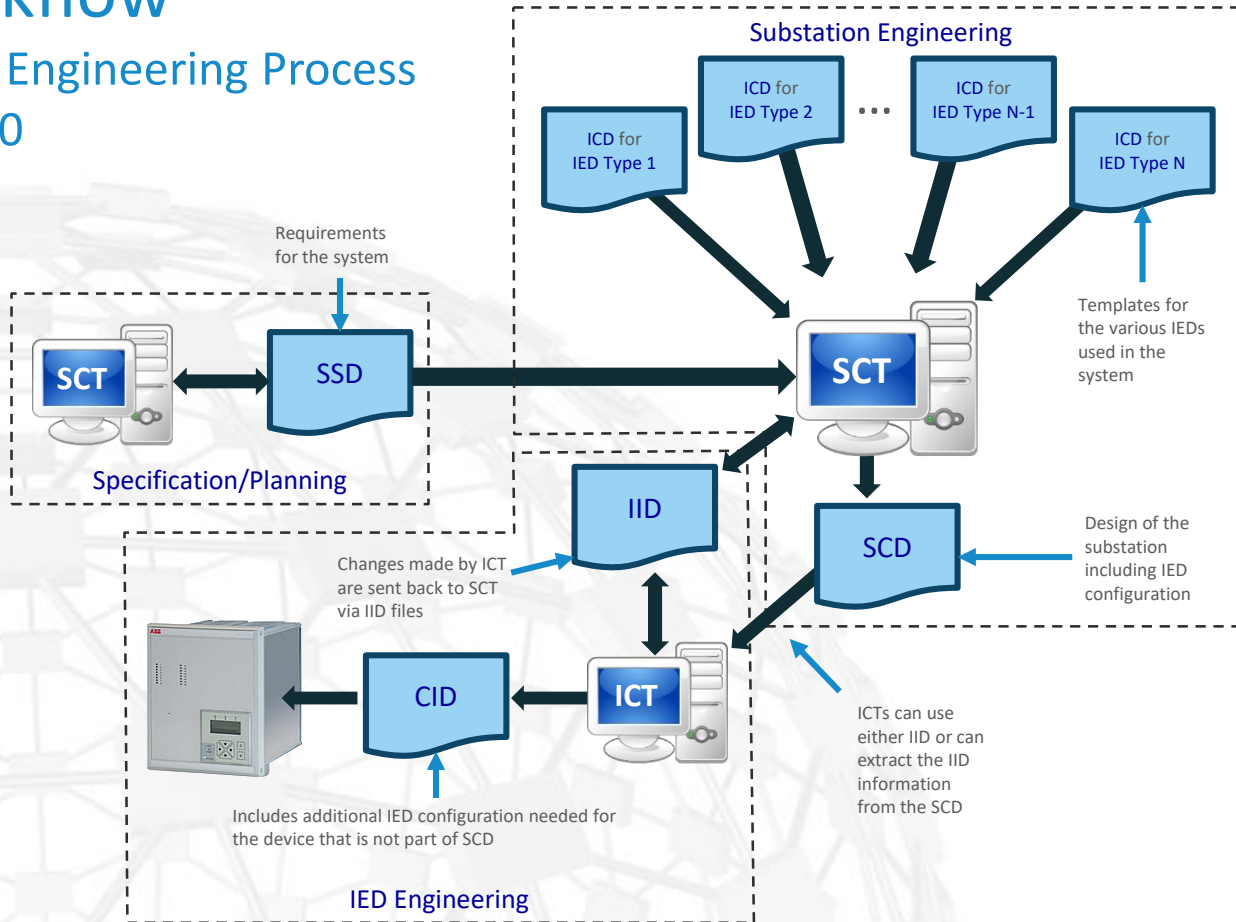
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Future IEC 61850 Products

SCL Toolkit
GOOSE Monitor

SCL Workflow

“Top-Down” Engineering Process
per IEC 61850



SCL File Types

- **SSD: System Specification Description**

XML description of a system. A specification for what is needed without specific IEDs assigned to power system functions.

- **SCD: Substation Config. Description**

XML description of a single substation. A description of the substation and IEDs in it that is generated by a Substation Configuration Tool (SCT).

- **IID: Instantiated IED Description**

XML description of a device that is used in the substation design of an SCD but may not be completely configured.

- **CID: Configured IED Description**

XML configuration for a specific IED that has been completely configured. An IED Configuration Tool (ICT) uses an IID or SCD as input and generates the CID.

- **SED: System Exchange Description**

Subset of a SCD file that specifies responsibilities between entities implementing different parts of a project

- **ICD: IED Capability Description**

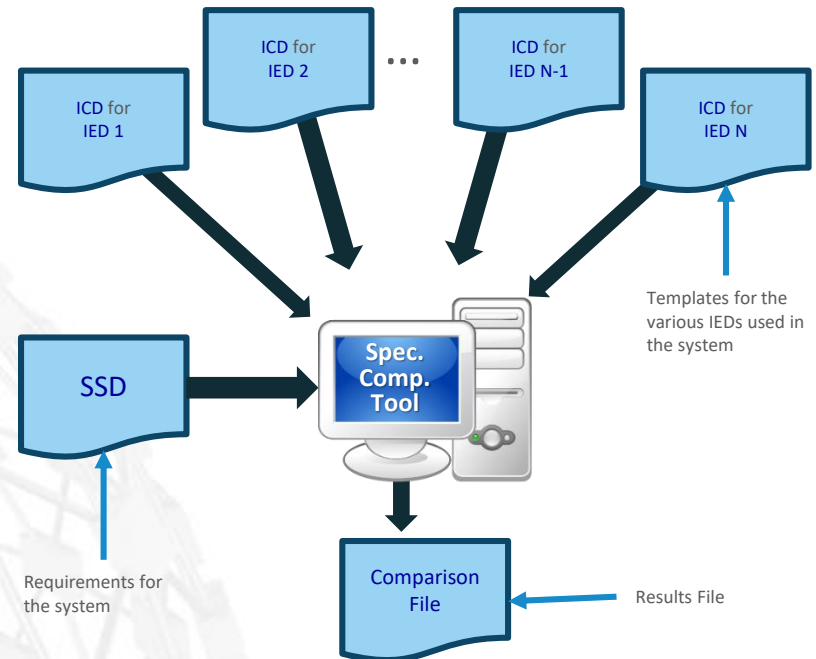
XML description of what is supported by an IED. A template for a given type of product that is provided by the IED supplier. Used by a SCT to select devices for the design of the substation.

SCL Toolkit

- A set of utilities to assist users in implementing the IEC 61850 “Top-Down” engineering process
 - » Specification Comparison Tool – IED selection utility
 - » Workflow Comparison Tool – Evaluates changes in SCL files
 - » LN Definition Browser – Provides access to IEC 61850 object definitions
 - » SCD to CID Extractor – Extracts CID/IID information from an SCD
 - » SCL to CIM Converter – Converts IEC 61850 SCL to IEC 61970 CIM
 - » DNP3 ICD Creator and Mapping – Enables use of DNP3 devices with the IEC 61850 engineering process
 - » IEC 61850 UML – UML for Enterprise Architect for use in Enterprise Semantic Modeling (ESM) and Application Integration activities

Specification Comparison Tool

- Compares the requirements of a System Specification Description (SSD) file to determine which IEDs are the best functional fit for that project
- Inputs:
 - » SSD file for the project (or SCD)
 - » IED Capability Description (ICD) (or CID/IID) files for all the devices being considered
- Output:
 - » Microsoft Word File with tables illustrating the comparison results



Specification Comparison Tool Demo

The screenshot displays the SCL Requirement Comparison Tool interface. The main window shows the 'Specification File' and 'Files to Compare' sections. The 'Found Vendors' and 'Vendor Filters for Report' sections are visible, along with a 'Create Report' button. An 'IED Comparison and Report Options' dialog box is open, showing settings for 'IED Options' (Weighting for Services Matching: 5.0, Enforce Single Access Point: checked, etc.), 'Logical Node Weighting Factors' (Missing Data Objects: 4.0, etc.), and 'Returned Results' (Number of Results: 3, Include All Details: checked).

Summary Results for Specification IED: GEDevice

| Item | Spec | Best match 1 | Best match 2 | Best match 3 |
|------------------|----------------------|---------------------|--------------------|--------------------|
| IEDName | GEDevice | P642 | TMWBayCrttDemo | |
| Vendor | GE Multilin - Europe | SCHNEIDER ELECTRIC | TMW | |
| IED Type | GE Multilin - Europe | F650 Bay Controller | P642 | ? |
| Metric | | 1381.77 | 227.82 | 190.04 |
| Price | | Unknown | Unknown | Unknown |
| Filename | TMWBayCrttDemo.cid | TMWBayCrttDemo.cid | TMWBayCrttDemo.cid | TMWBayCrttDemo.cid |
| SCL Version | 2007 | 2007 | 2007 | 2007 |
| SCL Revision | 8 | 8 | 8 | 8 |
| Num APs | 1 | 1 | 1 | 1 |
| Service Mismatch | | 0 | 62.5 | 156.25 |
| Metric | | | | |
| Num LNClass | 21 | 21 | 19 | 7 |
| Num LNInst | 178 | 178 | 129 | 7 |
| Num LNTypes | 49 | 49 | 42 | 7 |

1.1.3.1.1 Logical Node Comparison Details

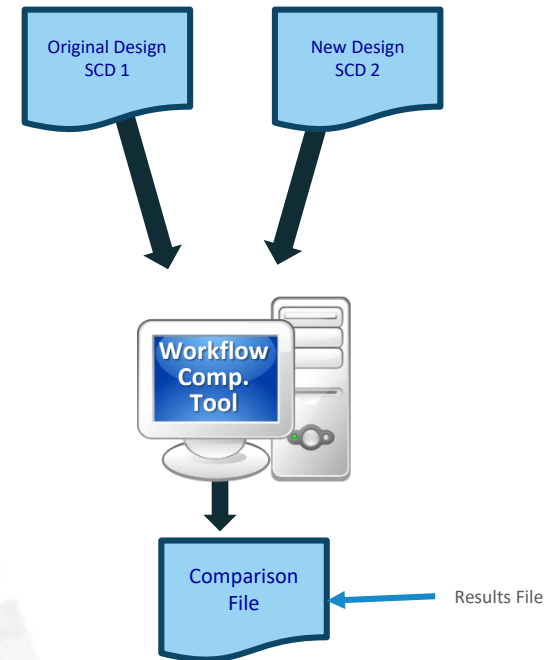
The following table shows the number of specified instances versus the number of Logical Node instances available in the IEDs that were selected as the best fit for the specified IED

| LNClass | Spec Inst | IED Match 1 Inst | IED Match 2 Inst | IED Match 3 Inst |
|---------|-----------|------------------|------------------|------------------|
| CILO | 16 | 16 | | |
| CSWI | 16 | 16 | | |
| GGIO | 9 | 9 | 15 | 1 |
| LGOS | 24 | 24 | | |
| LPHD | 1 | 1 | 4 | 1 |
| MMTR | 1 | 1 | 1 | |
| MMMU | 1 | 1 | 1 | |

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Workflow Analysis Tool

- Used to determine the work required to migrate a substation from one design to another
- Compares the contents of 2 SCD files and identifies the changes that need to be implemented to an existing system in order to accommodate the new substation design
- Input:
 - Original SCD file
 - New SCD file
- Output:
 - Word document identifying the changes required



Workflow Analysis Tool Demo

SISCO SCL Workflow Tool

File MatchTypes Logging

Previous SCD File: C:\Users\valph\Desktop\SCL Toolkit\SCL Toolkit Files\IntegratedApplicationHV12. ... Generate Work Report

Current SCD File: C:\Users\valph\Desktop\SCL Toolkit\SCL Toolkit Files\IntegratedApplicationHV12. ...

Report Control: LN found with mismatched ReportControls: Siemens_7UT85_TxA_P2Application/LN0
 Report Control: ReportControl Blocks mismatched in LD: Siemens_7UT85_TxA_P2Application
 Data Set: DataSets mismatched in LD: Siemens_7UT85_TxA_P2CB2
 GOOSE Control: Mismatched DataSet Members detected Siemens_7UT85_TxA_P2CB2/LN0 name= gcb1
 GOOSE Control: GOOSE Control Block Mismatch detected Siemens_7UT85_TxA_P2CB2/LN0 name= gcb1
 GOOSE Control: Control Blocks mismatched in LD: Siemens_7UT85_TxA_P2CB2
 ExtRef: Data Set "" does not match in Extref: <ExtRef daName="stVal" doName="Pos" iedName="GE_C264_INC_A_BCU" IInst="CONTROL" InClass="XCBR" InInst="1" ser
 ExtRef: Data Set "" does not match in Extref: <ExtRef daName="q" doName="Pos" iedName="GE_C264_JNC_A_BCU" IInst="CONTROL" InClass="XCBR" InInst="1" ser
 CreateReport: Create Report
 CreateReport: Report File: C:\Users\valph\Desktop\SCL Toolkit\SCL Toolkit Files\WorkResults2.docx

Work Planning for ICTs based upon SCL Differences 4/20/2018 9:39:30 AM

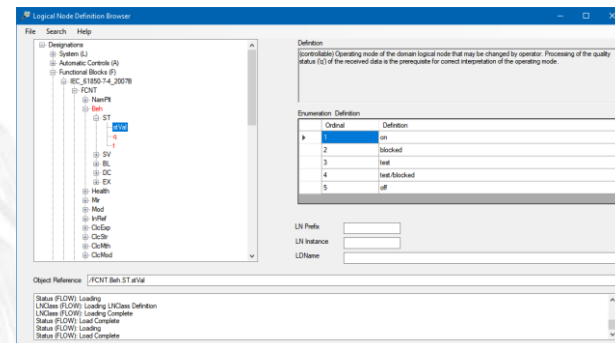
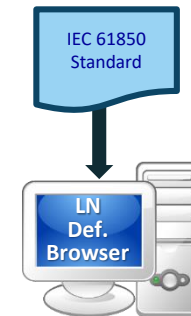
| IED Name | Manufacturer | Must Update | May Update | Changes |
|----------------------|--------------|-------------|------------|--|
| SEL_421_7S_Line1_BC | SEL | Yes | | GOOSE Controls Subscriptions DataSets RPT Controls GOOSE Controls |
| SIE_IncA_MU01 | SIEMENS | Yes | | Subscriptions DataSets SMV Controls |
| SIE_TxA_MU01 | SIEMENS | Yes | | Subscriptions Extref DataSets GOOSE Controls SMV Controls Communication |
| Siemens_7UT85_TxA_P2 | SIEMENS | Yes | | Subscriptions Extref DataSets RPT Controls |

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Logical Node (LN) Definition Browser

- Provide the user with easy electronic access to the standardized IEC 61850 object models
- Displays detailed definitions of IEC 61850 Logical Nodes
- Users can browse the LN definitions in supported IEC 61850 standards:
 - » IEC 61850-7-4
 - » IEC 61850-7-410 (Hydro Power)
 - » IEC 61850-7-420 (Distributed Energy Resources)
- Search for references to specific CDCs
- Display mandatory/optional objects
- Create object references and copy to clipboard



Logical Node (LN) Definition Browser Demo

The screenshot displays the Logical Node Definition Browser interface. On the left, a tree view shows the hierarchy of Logical Nodes, including IEC_61850-7-4_2007B and its sub-nodes like KVLV. The main area shows the definition for LN: Valve control Name: KVLV. Below this, an enumeration table lists values for the KVLV node:

| Ordinal | Definition |
|---------|--------------|
| 1 | on |
| 2 | blocked |
| 3 | test |
| 4 | test/blocked |
| 5 | off |

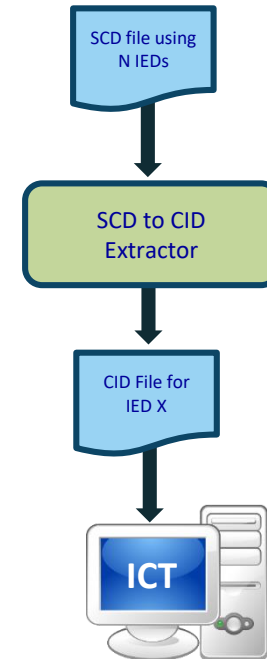
Below the table, fields for LN Prefix (myIED), LN Instance (04), and LDName (Q1C1L1Doble6150) are visible. A search for CDCs window is overlaid on the right, showing a list of CDCs with DPC selected:

| CDCName | Definition |
|---------|---|
| DEL | <<statistics>> Phase to phase related measured values of a three-phase system (DEL) |
| DPC | Controllable double point (DPC) |
| DPL | Device name plate (DPL) |
| DPS | Double point status (DPS) |
| ENC | <<abstract>> Controllable enumerated status (ENC) |
| ENG | Enumerated status setting (FC-SP)/ENG_SP) |

The search results also show the number of CDCs searched (2030) and found (26).

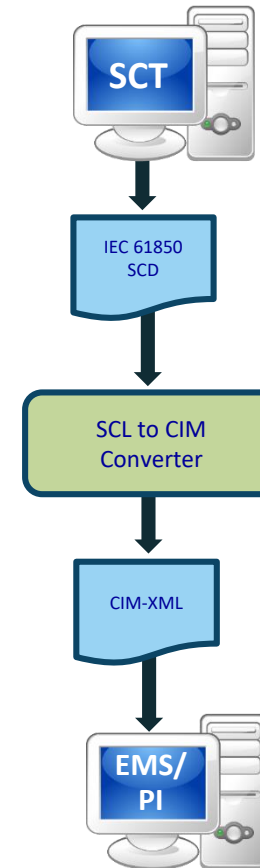
SCD – CID Extractor

- Extracts individual CID files from an IEC 61850 SCD file.
- Useful for situations where the device vendor does not have an IED Configuration Tool (ICT) that supports IEC 61850



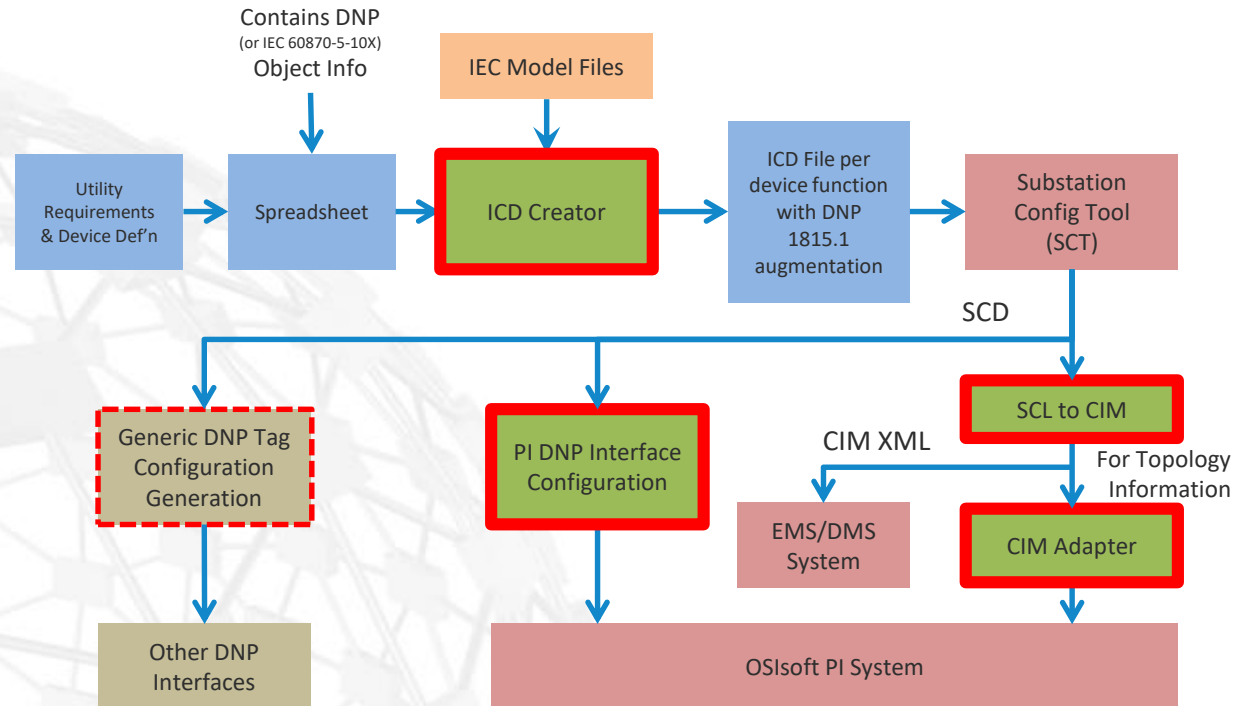
SCL – CIM Converter

- Converts IEC 61850 SCD file into IEC 61970 Common Information Model (CIM) files for import into EMS, DMS, PI, etc.
- Enables the substation semantic information created during the substation design process to be used for configuration of other systems including:
 - » Substation power system topology and connectivity
 - » Attribute/tag naming
 - » Settings
 - » Subscriptions for SCADA clients



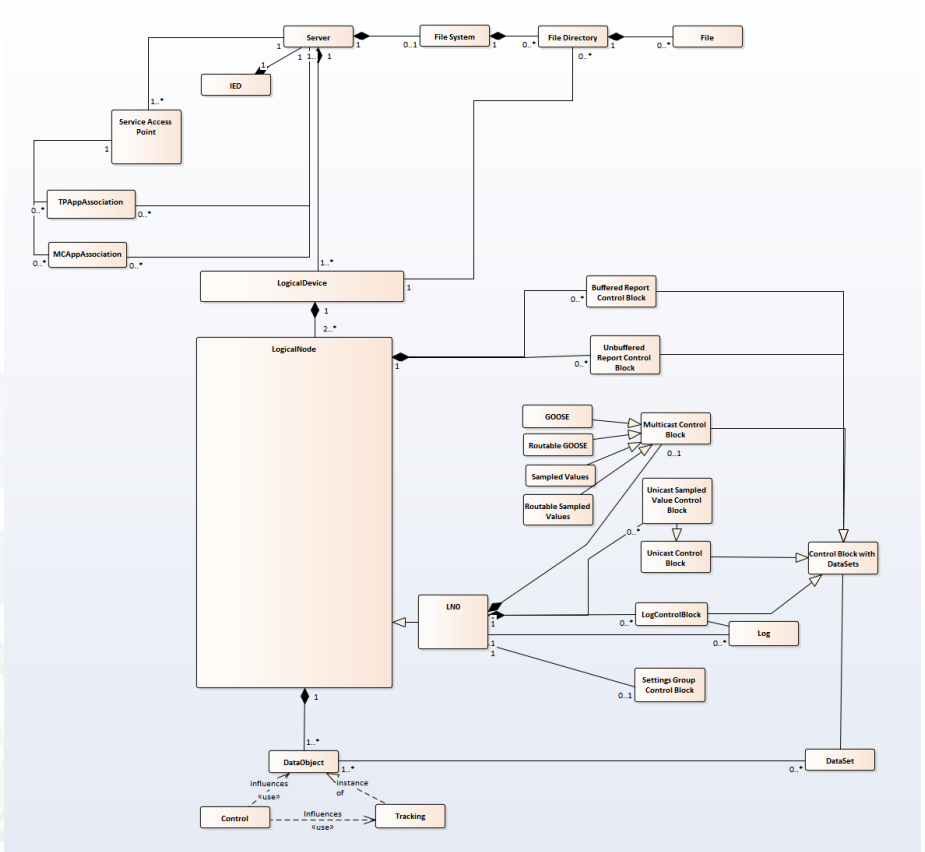
DNP3 ICD Creator and Mapping Tool

- Enables application of the IEC 61850 engineering process to DNP3 based systems
- Simplifies configuration via automated tag name generation and mapping



IEC 61850 UML

- Conversion of IEC 61850 Code Components to Unified Modeling Language (UML) in Enterprise Architect (EA)
- UML can be used for Enterprise Semantic Modeling (ESM) for analytic management and model-driven integration
- UML enables harmonization with CIM power system models to create combined CIM-IEC 61850 Models
- Currently available under Apache OSS license. Will be included in SCL Toolkit under commercial internal use license.



SCL Toolkit Packaging

- All SCL Toolkit components will be packaged together in a bundle
- A “Launcher” will provide a central app from which any of the individual tools can be invoked
- As new tools are released they can be added to an existing system under maintenance.



Transforming the world of energy using open standards

SISCO GOOSE Monitor

The Challenge of GOOSE

- IEC 61850 GOOSE Messaging uses multicast technology for station level time-critical protection and automation messaging
- Each device is typically publishing multiple GOOSE control blocks and subscribing to multiple GOOSE control blocks from other devices in the substation
- In large substations there are many hundreds of publish-subscribe relationships between devices
- With messages being transmitted as fast as 5-10 ms per message it can be very difficult for the substation engineer to debug these systems using traditional network monitoring or by monitoring a single device

The GOOSE Monitor Solution

- The GOOSE Monitor is designed to provide an intuitive visualization of the real-time GOOSE messaging occurring on station bus that enables the engineer to quickly identify what is working and what is not working
- Allows the engineer to cut through the complexity and focus their attention on where the problems are

GOOSE Monitor Provides Answers

- Are GOOSE messages being published as expected?
- Are GOOSE messages being received by the IEDs as expected?
- Are there unexpected GOOSE messages on the network?
- What data is being published in each GOOSE message?
- Is the flow of GOOSE messages as expected?
- Are there simulated GOOSE messages on the network?

GOOSE Monitor Features

- Provides an intuitive and simplified view of network relationships and GOOSE traffic status to help the engineer focus on what is important
- GOOSE configuration is automatically generated from SCD file:
 - » Graph diagram
 - Nodes represent state of GOOSE subscriptions via LGOS
 - Connections between nodes represent GOOSE messaging
 - » Addressing
 - » LGOS monitoring
- Beep Mode allows the engineer to follow the publisher and subscriber relationships through the system to track down root causes of problems

GOOSE Monitor Demo

The screenshot displays the GOOSE Monitor application window. On the left, a table lists five IEDs (Index 1-5) with their names and status indicators for Publications and Subscriptions. IED2 is highlighted in blue and marked as 'Not OK'. Below the table, a tree view shows the configuration for IED2, including GOOSE Control Blocks and gossInFault (apName = 'AP1').

| Index | Name | Publications | Subscriptions |
|-------|------|--------------|---------------|
| 1 | IED1 | ● | ● |
| 2 | IED2 | ● | ● |
| 3 | IED3 | ● | ● |
| 4 | IED4 | ● | ● |
| 5 | IED5 | ● | ● |

The main area shows a network diagram with six nodes (1-6) connected by green lines. Node 2 is red, while all other nodes are green. A red arrow points from node 1 to node 2. The status bar at the bottom indicates 'Node States: Not OK, Non-Monitorable, Simulation Being Acted Upon' and 'Good Edge States: Active, Inactive, No Source, Bad Edge States: Active, Inactive, No Source'. A log window at the bottom shows timestamps and messages related to IED2's status.



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Thank You