Substation automation solution with IEC61850

Agenda

- Introduction of Substation Automation System
- General Content of IEC 61850
- IEC 61850 Benefits
- ABB’s SAS Based on IEC 61850
- ABB’s Global References for IEC 61850
SAS as Process Interface to Network Control

All information from process (Power System) are acquired by the Substation Automation system*

All actions on the process (Power System) are performed by the Substation Automation System*

*) protection integral part of SA

Hierarchy of SAS Control Level

Station Level

Station Bus

Bay Level

Process Bus

Process Level

Network Control Center

Substation Automation System

Switchgear/ switchyard
Too many protocols exist in SAS

1. Connection of IEDs and substations

2. Data exchange – Via OPC server & client

Current Standard Requirements for SAS

- Open protocol to cover all communication issue inside the substation
- Assure interoperability between the functions existing inside the substation
- Support all types of architectures used
- Cost reduction
  - By competition
  - By more intelligent functions
  - For investments, operation and maintenance
- Future-proof standard
  - For safe-guarding of investments
  - Regarding suppliers and improving technology
  - For future extensions by bays or functions
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What is IEC 61850?

- IEC 61850 is a global standard for “Communication Networks and Systems in Substations”
- “How to make different devices AND tools from different vendors work together → Interoperability”
IEC 61850 – Interoperability

- Interoperability between different vendors
- Information exchange between two or more devices of similar intelligent
- As preliminary condition for interchangeability.

How to use IEC 61850 for SCADA in Substation

SCADA (Supervisory Control And Data Acquisition)

Station control & monitoring are the basis tasks of a SAS.

This comprises:
- Remote operation of the primary equipment
- Acquisition data of switchgear information and power system measurands
- Handling of events and alarms
How to use IEC 61850 for SCADA in Substation

Vertical Communication

- Vertical communication (bay - station) is based in client-server concept and the following services are used:
  - Read & Write of data
  - Control a device (direct operate / select before operate)
  - Event oriented communication with reporting
    - Group of data – Dataset
    - Report configuration block
    - Including time tag – Time Stamped events (1ms)
  - File transfer for e.g.
    - Parameter and software download
    - Disturbance fault upload
Horizontal communication is based in publisher-subscriber concept. It can significantly replace wiring for:

- Interlocking
- Inter-tripping signal
- Load shedding
- etc..

This method can be used for:

- Interlocking
- Inter-tripping signal
- Load shedding
- etc.
How to use IEC 61850 for Time Critical Info. Exchange

**Service – GOOSE Messaging**

**GOOSE: Generic Object Oriented Substation Event**

- Based on "publisher/subscriber" model where any device can publish data and other subscribe it if needed
- Mission is real-time data transmission– IED to IED < 4ms
- Uses low-level Ethernet layer and priority tagging to get priority in network and devices

**GOOSE Messaging – What?**

- GOOSE = **Generic Object Oriented Substation Event**
  - Generic = Any data
  - Object Oriented = Data from IED 61850 data model
  - Substation = Whole substation
  - Event = Event based sending
- GOOSE is used for transmit data to peer devices in substation
- Ethernet technology offers fast and reliable way to transmit the data
- Similar kind of functionality ABB have in existing LON platform and it is already used for a decade successfully
How to use IEC 61850 for Time Critical Info. Exchange

**GOOSE Messaging – Why?**

- Less expensive – Reduces the amount of copper wiring and relays necessary for implementing protection schemes
- More secure – A copper wire can fail without notice
- Bench tested – Reduce amount of test time necessary in substation
- Faster deployment – Proven protection schemes can be reused in future substations through copy and paste

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**GOOSE Messaging – Priority Tagging**

- Switches to support *Priority Tagging* to allow the GOOSE messages to overtake other messages in the switch.
- Only IEC 61850 takes advantage of the features of the modern 100 Mbit-Ethernet.
How to use IEC 61850 for Process Connection

Full Process Bus Solution

- Logical Device “Merging Unit”
  - LN TVTR
  - LN TCTR

- Logical Device “Breaker IED”
  - LN XCBR

- IEC 61850-9-2
  - Line Protection

How to use IEC 61850 for Process Connection

Service – Sampled Value Transmission

- A method for transmitting sampled measurements from transducers
- Sampled analog values from MU is time coherent
- Benefits are obvious in high voltage transmission substations
- How about medium voltage switchgears?
IEC 61850 Communication Model

3 data access and transfer methods:

- Client Server Communication
- GOOSE
- Sampled Values

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IEC 61850 Benefits

- **Cost savings and improved reliability**
  - Reduction in substation wiring between relays
  - Reduction in communications hardware (gateways, converters)
  - Purchasing variables are reduced to Price, Delivery and Support

- **Interoperability**
  - Customers are no longer locked into a single vendor

- **Ease of use**
  - Object oriented software design approach
  - Reduction of needed technical know-how, i.e. one protocol only vs. many today

- **FAT & SAT**
  - Simulation software for missing switchgear during FAT
  - IEC 61850 standard places integration costs onto vendor

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IEC 61850 Benefits

- **Return on investment**
  - Migrate IED configuration information to future platforms via XML format
  - Long term expandability
  - Ability to integrate better with utility enterprise systems for applications like Asset Management and Equipment Condition Monitoring

- **Support for new type of applications**
  - Standardized high performance communication between bays
  - High performance process bus to connect intelligent sensors reducing system costs
  - Remote parameterization of IEDs
  - Disturbance recording and analysis
  - Time synchronization via Ethernet network (SNTP)
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ABB’s Structured Offering

- **SAS**
  - SAS 600 Series
  - Station level Substation Automation Solutions based on IEC 61850

- **BPS**
  - BPS 600 Series
  - Bay Protection Solutions based on IEC 61850

- **BCS**
  - BCS 600 Series
  - Bay Control Solutions based on IEC 61850
### ABB SAS Solutions Positioning

#### Availability
- Functionality
- Performance
- System Size

### ABB SAS Solutions – Selection Guide

<table>
<thead>
<tr>
<th>System Function</th>
<th>COM 600 Based</th>
<th>SAS 605</th>
<th>SAS 610…690</th>
<th>SAS 635</th>
<th>SAS 690</th>
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</tbody>
</table>

#### System Size
- Number of bay level IEDs:
  - 1…30
  - 1…60
  - 1…150
- Number of remote links:
  - 0…2
  - 1…4
  - 1…40
- Maximum number of IEC61850 Networks:
  - 1
  - 1
  - 1
  - 2
ABB IEC 61850 COM600 Solution

Low Cost Solution

Features

- Communication Gateway COM 6xx
  - Embedded hardware
    - No moving parts - no fans, no hard disks
    - Power supply unit: 19-30 VDC, 110 V AC/DC
    - Protection by enclosure: IP 50
    - Operation -25 to +70 degrees Celsius
    - Storage -40 to +80 degrees Celsius
    - Dimensions: 250 x 100 x 70 mm (W x H x D)
    - Weight: 1.2 kg
  - Interfaces:
    - 4 serial ports
    - Ethernet ports, 100Mbit/s,
    - 4 USB interfaces
    - 1 parallel interface
    - VGA interface
    - keyboard and mouse
ABB IEC 61850 COM600 Solution

Functions

- **HMI**
  - Web Browser based
  - Local and remote
  - Local HMI optional
- **Process Data View and Control**
  - Single Line Diagrams
    - Positions of objects
    - Bus-bar coloring
    - Operations
  - Alarm & Event List
  - Trending & Data Historian
- **Disturbance Record Handling**
  - Fault Analysis
- **Parameter Setting**
  - IED configuration remotely
- **Logical Processor**
  - IEC61131-3 programming
- **Substation Integration**
  - Connectivity to ABB's low voltage motor control center MNS iS

ABB IEC 61850 COM600 Solution

Series

- Station Automation COM600 Series:
  - Control and Monitoring Unit COM605
  - Communication Gateway COM610
  - Station Computer COM615

<table>
<thead>
<tr>
<th>Product</th>
<th>Gateway Functionality</th>
<th>HMI Functionality</th>
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<tbody>
<tr>
<td>COM605</td>
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<td>X</td>
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<tr>
<td>COM610</td>
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<td>X</td>
</tr>
<tr>
<td>COM615</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

- **Limitation:**
  - Not supported redundancy (hot standby)
  - One unit of COM600 can support up to 30-40 IEDs & 250 LV motors
ABB IEC 61850 SAS605 Solution

The Flexible Solution

- **Flexible RTU560** based solutions for distribution and subtransmission applications, refurbishment
- **Main characteristics**
  - Centralized RTU based station computer
  - Direct I/O boards
  - Large numbers of protocols for IED integration and remote communication supported
  - Focus on remote control, optional basic local control

ABB IEC 61850 SAS605 Solution

System Architecture
ABB IEC 61850 SAS605 Solution

System Architecture

Supported Protocols
- IEC61850
- IEC60870-5-101
- IEC60870-5-104
- DNP3.0
- DNP3.0 over LAN/WAN

Applications
- Gateway

Main Features
- Modular design
- Parallel processing architecture
- Multi-protocol support
- Communication rack with CPU modules

Functionality
- Signal routing
- Data conversion
- Alarm Groups
ABB IEC 61850 SAS605 Solution

Functionalities

- Archiving
- Alarm list
- System Diagnostics
- Single line
- Event list
- Secure operation
- User management

ABB IEC 61850 SAS610…690 Solution

The High-End Solution

- High End Solutions for all types of applications
- Main characteristics
  - Distributed station level devices
  - Scalable architecture and functionality:
    - From single to fully redundant system architecture
    - From basic to advanced functions
  - Large systems supported
    - Large numbers of IEDs
    - Highest performance
  - Extremely high flexibility
    - Functionality
    - Communication topology
ABB IEC 61850 SAS 610…690 Series

Main Components – Industrial Type Station PC

Main Features
- Graphical User Interface for local operation at station level
- IEC 61850 Connectivity
- Optional: SYS600 Hot stand-by function for redundant station computer
- Optional: COM 500i software package for remote control function

Applications
- Station HMI
- Optional Integrated Gateway functionality
- SAS 650-V11: Industrial Server with redundant hard disk and power supply

Standard Configuration
- Windows XP or 2003 Server
- MicroSCADA Pro
- LAN Cards for IEC 61850 Communication

Optional Components
- Serial communication ports for remote control
- Redundant Monitor Card
- Windows Terminal Services
ABB IEC 61850 SAS610…690 Solution

Basic Functionalities

- Blocking List
- System Supervision
- Primary equipment supervision
- Measurements
- Alarms
- Sequence of Events
- User Management
- Calendar

Advanced Functionalities

- IED Parameterization
- Disturbance Record upload
- Trip Counter Table
- Disturbance record Analysis
- Automatic Sequences
- Trends
- Measurement Reports
- External Alarming
- Dynamic Busbar Coloring
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Statistics About IEC 61850 Based SA : 2008

- ABB
  - Hundreds of IEC 61850 based substations automation systems ordered or/and delivered
- All suppliers worldwide
  - About 1200 IEC 61850 based substation automation systems delivered
ABB’s Global IEC 61850-Compliant Solutions

Confidential

Project Description

- Interruption-free retrofit: Feeder by feeder
- IEC 61850: Extension of existing Specification
- M1/M2 from different vendors required
- Integration with existing 3rd party Station HMI

References – EGL Laufenburg 380kV Substation
References – DEWA 132/11 kV S/S

- Frame contract for 20 SA systems
- Identical station layouts
- Step-wise introduction of IEC61850
- Rigorous pre-qualification including site visits
- Short order-to-commissioning time

References – PGCIL Maharanibagh 400 kV S/S

- PGCIL’s new substations will be controlled and monitored by IEC 61850-based SA systems
- IED670 One product family for protection and control
- Integration of 3rd party Main 2
- IEDs on IEC 61850 platform
Conclusions

- IEC61850 makes you more competitive through offering interoperability, long term stability, cost effectiveness, and simplicity
- ABB has been fully committed to IEC61850 since the start of the standardization
- IEC61850 is the core technology of ABB’s SA solutions
- ABB is delivering IEC61850 SA systems today

Benefit from our experience!