Infrastructure Portal to a more Reliable Energy Grid.

IEC 61850 Architecture and Applications

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Speaker #1

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20+ Years Experience in Power Systems Modelling, Design and Protection
• LV, MV, and HV Design Architecture
• Customized network solutions
• Engineering studies/ system Modeling (Aspen Oneliner, CYME, ETAP, Easypower, Ecodial, etc.)
• Development of relay protection Settings, schemes and programming
• Control Systems design & Programming
• Development and QC review of One-line, Schematic and Wiring diagrams
• Paralleling Switchgear Design and Implementation
Quality Management
Focus on Quality

Leidos’ quality process focuses on:

- Forming a detailed, up-front approach prior to detailed design
- Establishing a defined design process
- A rigorous challenge before issuance of work products to our clients
Our Mission

Leidos makes the world safer, healthier, and more efficient through technology, engineering, and science.

Our Vision

Become the global leader in the development and application of technology to solve our customers’ most demanding challenges.

Engage, develop, and empower our diverse and valued people to foster a culture of creativity and growth.

Strengthen our communities through volunteerism, sustainable operations, and the advancement of equality.

Values

Integrity

Innovation

Inclusion

Agility

Collaboration

Commitment
IEC 61850 Standard

Overview
IEC 61850 Standard Overview

- 2002-2005 Issued IEC 61850 Ed. 1
- 2009-2012 Issued IEC 61850 Ed. 2

Benefits & Advantages
- Lower cost for installation, configuration and maintenance
- Self Monitoring and Reliability improvement
- Interoperability and Integration
- Fast communication
- Intuitive device and data modeling and naming

Disadvantages
- Additional burden on Network management
- Cyber security overheads: NERC CIP (CIP-002-1 through CIP-009-1)
IEC 61850 Standard Overview

<table>
<thead>
<tr>
<th>Introduction and Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61850-1 :2013</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glossary of Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61850-2 :2003</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61850-3 :2013</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System &amp; Project Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61850-4 :2011</td>
</tr>
</tbody>
</table>

- Abstract Communication Service Interface and Base types (ASCI)
  - IEC 61850-7-2 :2010

- Common Data Class
  - IEC 61850-7-3 :2010

- Compatible Logical Node Classes and Data Classes
  - IEC 61850-7-4 :2010

- Model Concepts
  - IEC 61850-7-5 :2012

<table>
<thead>
<tr>
<th>Communication Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61850-8-1 :2011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sampled Values Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61850-9-2 :2011</td>
</tr>
</tbody>
</table>

Implementation in IEDs and tools

Conformance Testing
- IEC 61850-7-10
IEC 61850 Standard

Development
# IEC 61850 Development

<table>
<thead>
<tr>
<th>Part</th>
<th>Edition 1</th>
<th>Edition 2</th>
<th>Main Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 2: Glossary</td>
<td>2003/42pp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part 3: General Requirements</td>
<td>2002 / 33 pp</td>
<td>2013 / 136 pp</td>
<td>Requirements are in line with other equipment used in same environment (e.g., protection relays)/Addition product safety based on IEC 60255-27/EMC requirements one line and entire with IEC 60255 and IEC 61000-6-5</td>
</tr>
<tr>
<td>Part 4: System and Project Management</td>
<td>2002 / 59 pp</td>
<td>2011 / 74 pp</td>
<td>This second edition constitutes a technical revision to unify document with other IEC 61850 standard parts, in addition extending scope of substation automation systems to all used automation systems.</td>
</tr>
<tr>
<td>Part 5: Communication requirements for functions and device models</td>
<td>2003 / 131 pp</td>
<td>2013 / 306 pp</td>
<td>Extension of automation systems for substation to automation systems used/Interfaces inclusion for substations communication/Communication requirements beyond substation limit.</td>
</tr>
<tr>
<td>Part 6: Configuration language for communication in electrical substations related to IEDs</td>
<td>2004 / 144 pp</td>
<td>2009 / 215 pp</td>
<td>Adding functional extensions based on other parts IEC 61850 changes, especially by IEC 61850-7-2 and IEC 61850-7-3/Adding functional extensions on engineering processes, especially for configuration data exchange between systems configuration tools</td>
</tr>
<tr>
<td>Part</td>
<td>Edition 1</td>
<td>Edition 2</td>
<td>Main Changes</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| Part 7.1: Basic communication structure – Principles and models | 2003 / 110 pp | 2011 / 289 | Information models for specific substation on automatic systems power.  
• Device functions used on process automation.  
• Communication systems to provide interoperability within public energy service places  
compared to first edition, this second edition features:  
• Model for data and statistical historic.  
• Concept Proxies, gateways, hierarchies LD and inputs LN.  
• Time synchronization Models  
• Extension log function. It also clarifies certain items. |
| Part 7.2: Basic communication structure – Abstract communication service interface (ACSI) | 2003 / 171 pp | 2010 / 213 pp | Some types of data not required have been removed.  
• Added logging service for blocks of control.  
• Fixed IEC 62351 series safety. |
| Part 7.3: Basic communication structure – in electrical substations related to IEDs | 2003 / 64 pp | 2010 / 182 pp | This second edition defines new common data classes used by new standards definition models objects based on IEC 61850 for statistical data representation and historical. |
| Part 7.4: Basic communication structure in electrical substations related to IEDs – Common Data Classes | 2003 / 104 pp | 2010 / 179 pp | • Correction and clarification according to technical problems presented by users.  
• Extensions for model historical statistics data.  
• Extensions for new logical nodes for domain quality of energy.  
• Extensions for IEC 61850-90-1.  
• Extensions for new logical nodes for functions monitoring based on IEC 672271.  
• New logical nodes for IEC 61850-7-410 and IEC 61850-7-420 to general interest. |
## IEC 61850 Development

<table>
<thead>
<tr>
<th>Part</th>
<th>Edition 1</th>
<th>Edition 2</th>
<th>Main Changes</th>
</tr>
</thead>
</table>
• Link layer redundancy.  
• Extensions object reference length.  
• Following for mapping service.  
• Second object Reference mapping when is used on tracking or like link.  
• Message GOOSE simulation.  
• SCL erase on control block. |
| Part 9.1: Specific communication service mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link. | 2003 / 29 pp | Replaced by: IEC 61850-9-2:2011 |
• Redefinition “reserved” fields on link layer.  
• Components USVCB and MSVCB evolution.  
• Buffer sampled value transmission encoding evolution. |
• Addition of some test procedures (according to client device, sampled values devices, GOOSE performance). |
IEC 61850 Development

- IEC-61850 is not just a communication protocol, it is a standard for Substation automation design.
- IEC-61850 Ed 2 issued in 2002-2005 improves and wide-ranging features of IEC-61850 Ed 1 issued in 2009-2012. These improvements include tests aspects, new functions inclusion and objects types used in modeling of electrical systems.
- The IEC 61850 Standard is mainly concerned with standardizing specifications so that different suppliers of stations can conform to a common set of provisions for a particular installation, to ensure interoperability.
IEC 61850 Standard
Protocol
## IEC 61850 Protocols

### Definitions

**61850-8-1 GOOSE**
- GOOSE (Generic Object-Oriented Substation Event) communication

**61850-9-2 SMV**
- SMV (Sampled Measured Values) communication.

### Characteristic

**61850-8-1 GOOSE**
- Specifies a method of exchanging time-critical and non-time-critical data through local-area networks
- Event Driven (Circuit Breaker closed, Overcurrent protection operated, Trip Circuit supervision operated …etc.)

**61850-9-2 SMV**
- Streaming (Voltage Sin wave or Current Sin wave)

### Information Transmitted

**61850-8-1 GOOSE**
- BOOLEAN

**61850-9-2 SMV**
- Analog (Sine Wave) Time Stamped

### Update Rate

**61850-8-1 GOOSE**
- On Event Change

**61850-9-2 SMV**
- Continuous Sampling Rate
IEC 61850 Standard
Network Topologies
IEC 61850 Network Topologies

Ethernet communication features

- Ethernet is the communication media for IEC 61850 and other protocols such as Modbus® and DNP3
- Media types: 10/100TX galvanic Ethernet cable with RJ-45 connectors or optical multimode 100FX with LC connectors
- Galvanic Ethernet cables must always be shielded (STP), minimum CAT5e Network topology - either star or ring
IEC 61850 Network Topologies
App (1): Ethernet star topology, galvanic connection (RJ-45) or optical connection (LC)

- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

Ethernet station bus (IEC 61850, Modbus, DNP3)
IEC 61850 Network Topologies
App (2): Ethernet daisy chain topology, galvanic connection (RJ-45) or optical connection (LC)

Ethernet station bus (IEC 61850, Modbus, DNP3)
- Control and events
- Measurements
- Settings and parameterization (IEC 61850)
- Disturbance record upload (IEC 61850, FTP)
- Fault records (IEC 61850, Modbus, DNP)

Note!
The topology can be built totally without switches as the relays have multiple Ethernet ports
IEC 61850 Network Topologies
PRP and HSR redundancy protocols of the IEC62439-3

- Parallel redundancy protocol (PRP) is based on parallel redundant mesh networks (IEC62439-3 Clause 4).
- High availability seamless redundancy (HSR) protocol is based on ring topology with max number of relays 30 relay/ring (IEC62439-3 Clause 5).
- Ethernet Network Configuration With Ring Structure (Switched Mode)
IEC 61850 Network Topologies
Parallel redundancy protocol (PRP) solutions for protective Relays (IEC62439-3 Clause 4)
IEC 61850 Network Topologies
High availability seamless redundancy (HSR) solutions for protective Relays

Sender

HMI
Station computer

GW
to network control center

Receiver

Protection & Control IED

Protection & Control IED

Protection & Control IED

Protection & Control IED

Protection & Control IED
Station communication redundant solutions
HSR to PRP with ABB Protective Relays
IEC 61850
Conventional VS Digital
IEC 61850 Network VS Conventional

Conventional Switchgear
IEC 61850 Network VS Conventional

IEC 61850 Switchgear
IEC 61850 Network VS Conventional

Conventional Cables
IEC 61850 Network VS Conventional

Traditional P&C System | IEC-61850 based P&C System

<table>
<thead>
<tr>
<th>Conventional Cabling</th>
<th>Digital Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cables: 768</td>
<td>256</td>
</tr>
<tr>
<td>Conductors: 4500</td>
<td>1500</td>
</tr>
<tr>
<td>Terminations: 9000</td>
<td>3000</td>
</tr>
</tbody>
</table>
IEC 61850

Characteristics
IEC 61850 Characteristics
IEC 61850 Characteristics

Station Level

Process Level

Bay Level

IEC 61850 MMS
Modbus TCP/IP
DNP 3.0

IEC 61850 GOOSE

LAN A

LAN B
IEC 61850

IEC 61850-8-1 GOOSE Applications
IEC 61850-8-1 GOOSE Applications
Semantic Hierarchical Object Data Model
IEC 61850-8-1 GOOSE Applications
Object Data Model

- IED is a container of three main Logic Devices
  - MAIN01.LD0
  - MAIN01.CTRL
  - MAIN01.DR
IEC 61850-8-1 GOOSE Applications
Object Data Model

- IED is a container of Logic Devices
  - MAIN01.LD0
  - MAIN01.CTRL
  - MAIN01.DR

- Logic Device is a container of Logic Nodes
  - MAIN01.LD0.PHLPTOC1
  - MAIN01.LD0.CMMXU1
  - MAIN01.LD0.PHPTUV1
  - MAIN01.LD0.EFHPTOC1
IEC 61850-8-1 GOOSE Applications
Object Data Model

- IED is a container of **Logic Devices**
  - MAIN01.LD0
  - MAIN01.CTRL
  - MAIN01.DR

- Logic Device is a container of **Logic Nodes**
  - MAIN01.CTRL.CBXCBR1
  - MAIN01.CTRL.CBCSWI1
  - MAIN01.CTRL.DCSXSWI2
IEC 61850-8-1 GOOSE Applications
Object Data Model

- **IED** is a container of **Logic Devices**
  - MAIN01.LD0
  - MAIN01.CTRL
  - MAIN01.DR

- **Logic Device** is a container of **Logic Nodes**
  - MAIN01.LD0.PHLPTOC1
  - MAIN01.LD0.CMMXU1

- **Logic Node** is a container of **Data Objects**
  - MAIN01.LD0.PHLPTOC1.XX.XXX (51P-1)
  - MAIN01.LD0.CMMXU1.XX
    (THREE PH CURRENT VALUE IA, IB, IC)

- **Data Objects** is a container of **Data Attributes**
  - .Op.q
  - .Str.q
  - .Op.general
  - .Str.general
  - Pickup
  - Trip
  - Pickup Quality
  - Trip Quality
  - Signal
  - .A.phsA.instC
  - Val.mag
  - HWrn.q
  - LoAlm.StVal
  - HWrn.StVal
  - High Warning
  - Low Alarm
  - High Warning Quality
  - Phase A current
  - Amplitude
  - 1
  - 2
  - 3
  - 4
  - 51
IEC 61850-8-1 GOOSE Applications
Object Data Model

Logic Node Name
- MAIN01.LD0.CMMXU1.A.phsA.cVal.mag.f

```
ABB= CMMXU1
.A.phsA.instCVal.mag

SEL= METMMXU1
.A.phsA.instCVal.mag.f
```
### IEC 61850-8-1 GOOSE Applications

**GOOSE Message delay**

<table>
<thead>
<tr>
<th>Type</th>
<th>App</th>
<th>Perf. Class</th>
<th>Transmission Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Fast Messages (Trip)</td>
<td>P1</td>
<td>10 mS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P2/P3</td>
<td>3 mS</td>
</tr>
<tr>
<td>1B</td>
<td>Fast Messages (Other)</td>
<td>P1</td>
<td>100 mS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P2/P3</td>
<td>20 mS</td>
</tr>
<tr>
<td>2</td>
<td>Medium Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Low Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Raw Data</td>
<td>P1</td>
<td>10 mS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P2/P3</td>
<td>3 mS</td>
</tr>
<tr>
<td>5</td>
<td>File Transfer</td>
<td></td>
<td>&gt;1000 mS</td>
</tr>
<tr>
<td>6</td>
<td>Time Synchronization</td>
<td>T1 (time)</td>
<td>± 1 (Accuracy)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T2 (time)</td>
<td>± 0.1 (Accuracy)</td>
</tr>
</tbody>
</table>

**Example:** In Case of Under Voltage 27 (f1) operated physical device 1 – what is the Time delay for physical device 2 to initiate operation.

\[ \text{Total Time delay} = t_a + t_b + t_c \]

**Diagram:**

- **Time Synchronization:**
  - \( t_a \)
  - \( t_b \)
  - \( t_c \)
  - GOOSE message

**Physical devices:**
- Physical device 1
- Physical device 2
**IEC 61850-8-1 GOOSE Applications**

**Conventional Automatic Transfer (ATS)**

- **Main Inc 1**
  - (3 VTs)
  - VT A, VT B & VT C
  - CT A, CT B & CT C
  - 52 M1 Circuit Breaker Racked In
  - 52 M1 Circuit Breaker test
  - On Delay Timer
  - 52 M1 NO Contact (52a) Position Open
  - 52 M1 NC Contact (52b) Position Closed
  - M1 Relay trip operated
  - Local Switch – Manual (Close operation)
  - Local Switch – Auto (Close operation)
  - Open Transition Enable (Close operation)

- **Main Inc 2**
  - (3 VTs)
  - VT A, VT B & VT C
  - CT A, CT B & CT C
  - 52 M2 Circuit Breaker Racked In
  - 52 M2 Circuit Breaker Test
  - On Delay Timer
  - 52 M2 NO Contact (52a) Position Open
  - 52 M2 NC Contact (52b) Position Closed
  - M2 Relay trip operated
  - Local Switch – Manual (Close operation)
  - Local Switch – Auto (Close operation)
  - M1 Relay trip operated
  - Local Switch – Manual (Close operation)
  - Local Switch – Auto (Close operation)
  - Open Transition Enable (Close operation)
IEC 61850-8-1 GOOSE Applications
App (1): Automatic Transfer (ATS) using 61850 GOOSE

Main Inc 1

VT A, VT B & VT C
CT A, CT B & CT C
52M1 Circuit Breaker Racked In
52M1 Circuit Breaker test
On Delay Timer
52M1 NO Contact (52a) Position Open
52M1 NC Contact (52b) Position Closed
M1 Relay trip operated
52M2 NO Contact (52a) Position Open
52M2 NC Contact (52b) Position Closed
M2 Relay trip operated
52Tie Contact (52a) Position Open
52Tie Contact (52b) Position Closed
Tie Relay trip operated
Local Switch – Manual (Close operation)
Local Switch – Auto (Close operation)
Open Transition Enable (Close operation)

Main Inc 2

VT A, VT B & VT C
CT A, CT B & CT C
52M2 Circuit Breaker Racked In
52M2 NO Contact (52a) Position Open
52M2 NC Contact (52b) Position Closed
M2 Relay trip operated
52Tie Contact (52a) Position Open
52Tie Contact (52b) Position Closed
Tie Relay trip operated
Local Switch – Manual (Close operation)
Local Switch – Auto (Close operation)
Open Transition Enable (Close operation)
IEC 61850-8-1 GOOSE Applications
App (1A): Loss of Source 1 Open Transition (Non-Std)

Circuit Breaker Opened & De-energized
Circuit Breaker Closed & Energized

M1
F1-1
F1-2
Main Inc 1
(3 VTs)

M2
F2-1
F2-2
Main Inc 2
(3 VTs)

52M1
52TIE
52M2

<table>
<thead>
<tr>
<th></th>
<th>52M1</th>
<th>52TIE</th>
<th>52M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>→ 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>→ 0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0 → 1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1 → 0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
IEC 61850-8-1 GOOSE Applications
App (1B): Loss of Source 1 Closed Transition (Non-Std)

Circuit Breaker Opened & De-energized

Circuit Breaker Closed & Energized

<table>
<thead>
<tr>
<th>52-M1</th>
<th>52-TIE</th>
<th>52-M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 → 1</td>
<td>0</td>
<td>0 → 1</td>
</tr>
<tr>
<td>1 → 0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0 → 1</td>
<td>1</td>
</tr>
</tbody>
</table>

Check Synchronizing 25 OK
IEC 61850-8-1 GOOSE Applications

App (1): Summary

Main Inc 1

(3 VTs)

Main Inc 2

(3 VTs)

Bus Tie

AUTO/
MANUAL

Open Transistion (Non-Std)

<table>
<thead>
<tr>
<th>52M1</th>
<th>52TIE</th>
<th>52M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 → 1</td>
<td>0</td>
<td>0 → 1</td>
</tr>
<tr>
<td>1 → 0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0 → 1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1 → 0</td>
<td>1</td>
</tr>
</tbody>
</table>

Closed Transistion (Non-Std)

<table>
<thead>
<tr>
<th>52-M1</th>
<th>52-TIE</th>
<th>52-M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 → 1</td>
<td>0</td>
<td>0 → 1</td>
</tr>
<tr>
<td>1 → 0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0 → 1</td>
<td>1</td>
</tr>
</tbody>
</table>

Check Synchronizing 25 OK

Keyed Selector Switch
IEC 61850-8-1 GOOSE Applications

App (2): Protection function Blocking using GOOSE 61850 (ZSI) to improve System Arc Flash

March 6, 2023

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No Selectivity

<table>
<thead>
<tr>
<th>CB1</th>
<th>CB2</th>
</tr>
</thead>
</table>

The other feeders are not powered

Full Selectivity

<table>
<thead>
<tr>
<th>CB1</th>
<th>CB2</th>
</tr>
</thead>
</table>

The other feeders are still powered
IEC 61850

IEC 61850-9-2 SMV Applications
### IEC 61850-9-2 SMV Applications

#### Number of hops in network (Ethernet Switches, Red Box, etc.)

<table>
<thead>
<tr>
<th>Number of hops in network (Ethernet Switches, Red Box, etc.)</th>
<th>Internal App Delay (μs)</th>
<th>Theoretical max delay (μs)</th>
<th>Recommended Max Settings (mS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>REX640</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1728 1450</td>
<td>2092 1814</td>
<td>2 2</td>
</tr>
<tr>
<td>5</td>
<td>1728 1450</td>
<td>2638 2360</td>
<td>3 3</td>
</tr>
<tr>
<td>10</td>
<td>1728 1450</td>
<td>3398 3120</td>
<td>5 4</td>
</tr>
<tr>
<td>15</td>
<td>1728 1450</td>
<td>4158 3880</td>
<td>5 4</td>
</tr>
<tr>
<td>20</td>
<td>1728 1450</td>
<td>4918 4640</td>
<td>5 5</td>
</tr>
<tr>
<td>25</td>
<td>1728 1450</td>
<td>5678 5400</td>
<td>6 6</td>
</tr>
<tr>
<td>30</td>
<td>1728 1450</td>
<td>6438 6160</td>
<td>7 6</td>
</tr>
</tbody>
</table>

#### Time Stamped

- 25 Check Synch
- 87B Low Impedence BB
IEC 61850-9-2 SMV Applications
SMV Message delay

- IEC 61850 has five time performance categories – most severe requires +/- 1 µs
- Timestamp requires microsecond resolution
- IEEE 1588 (Precision Time Protocol – PTP) version 2 with Power Profile time synchronization method enabling 1 µs high accuracy time synchronization

Delay measurement
Sync telegram
IEC 61850-9-2 SMV Applications

App (4): Bus Bar Protection System Low impedance using IEC61850 (ABB Relays)
IEC 61850-9-2 SMV Applications
App (5): Bus Bar Protection System High impedance

High Impedance BB Differential
Op. time >20 mS
IEC 61850-9-2 SMV Applications
App (5A): Bus Bar Protection System Low impedance using IEC61850 (SEL Relays)

7 Circuit Breakers

March 6, 2023
IEC 61850-9-2 SMV Applications

App (5B): Bus Bar Protection System Low impedance using IEC61850 (ABB Relays)
IEC 61850

IEC 61850 Working Designs
IEC 61850 Working Designs
App (3B): Paralleling Switchgear
IEC 61850 GOOSE Applications
App (3C): Paralleling Switchgear

RSTP Redundancy

Estimated Time Installation decreased by 60%
## IEC 61850-8-1 GOOSE Applications

App (3C): Paralleling Switchgear

<table>
<thead>
<tr>
<th>Easy Gen Inputs</th>
<th>Easy Gen Outputs</th>
<th>Relay Inputs</th>
<th>Relay Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogue Input from relay Voltage Control (Relay/Axion)</td>
<td>Analogue Output to Generator Voltage Control</td>
<td>Voltage Inputs GEN Side from PT</td>
<td>Analogue output To Easy Gen Voltage Control (Relay/Axion)</td>
</tr>
<tr>
<td>Analogue Input from relay Speed Control from SCADA/Relay/Axion</td>
<td>Analogue Output to Generator Speed Control</td>
<td>Current Inputs BUS Side from CT</td>
<td>Analogue output To Easy Gen Voltage Control (Relay/Axion)</td>
</tr>
<tr>
<td>Can bus Communication RS485</td>
<td>Can bus Communication RS485</td>
<td>Currents Inputs GEN Side from CT</td>
<td>Circuit breaker open</td>
</tr>
<tr>
<td>Voltage Inputs GEN Side from Relay</td>
<td>Engine Start Stop</td>
<td>52a</td>
<td>Circuit breaker Close Command</td>
</tr>
<tr>
<td>Voltage Inputs BUS Side from Relay</td>
<td>Circuit breaker open Command</td>
<td>52b</td>
<td>Circuit breaker Inhibit Close Command</td>
</tr>
<tr>
<td>Currents Inputs GEN Side from Relay</td>
<td>Circuit breaker Close Command through the protection relay</td>
<td>Truck in service</td>
<td>52a</td>
</tr>
<tr>
<td>Digital Input from PB Voltage Control (Raise Lower)</td>
<td>Easy Gen Healthy to SCADA</td>
<td>Truck in test</td>
<td>52b</td>
</tr>
<tr>
<td>Digital Input from PB Speed Control (Raise Lower)</td>
<td>Ready for operation to SCADA</td>
<td></td>
<td>Voltage Inputs GEN Side from Relay/</td>
</tr>
<tr>
<td>Circuit Breaker Position Indication from Relay</td>
<td></td>
<td></td>
<td>Voltage Inputs BUS Side from Relay</td>
</tr>
<tr>
<td>Gen Start Stop</td>
<td></td>
<td></td>
<td>Currents Inputs GEN Side from Relay</td>
</tr>
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IEC 61850-8-1 GOOSE Applications
App (3C): Paralleling Switchgear

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<th>Easy Gen Outputs</th>
<th>Relay Inputs</th>
<th>Relay Outputs</th>
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<tbody>
<tr>
<td>GEN Oil Level Alarm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEN Oil Level Trip</td>
<td></td>
<td></td>
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<tr>
<td>24V DC supply Healthy</td>
<td></td>
<td></td>
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<tr>
<td>Digital Input from PB</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Voltage Control (Raise Lower)</td>
<td></td>
<td></td>
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<tr>
<td>Digital Input from PB</td>
<td></td>
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<tr>
<td>Speed Control (Raise Lower)</td>
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<tr>
<td>Circuit Breaker Position Indication</td>
<td></td>
<td></td>
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<tr>
<td>from Relay</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gen Start Stop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Running</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine stop</td>
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# IEC 61850-8-1 GOOSE Applications

App (3C): Paralleling Switchgear

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<th>Relay Inputs</th>
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<tbody>
<tr>
<td>Manual Mode</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Auto/STBY Mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer to Emergency Mode</td>
<td></td>
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<tr>
<td>Load Management Mode</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>No Load Test Mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility test Mode</td>
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<tr>
<td>Gen Alarm</td>
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</table>
IEC 61850

Evolution and Conclusion
### IEC 61850 Standard Overview

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operating room</td>
</tr>
<tr>
<td></td>
<td>Relay room in GIS</td>
</tr>
<tr>
<td></td>
<td>Relay house in AIS</td>
</tr>
<tr>
<td></td>
<td>Switch yard</td>
</tr>
<tr>
<td></td>
<td>GIS or AIS</td>
</tr>
</tbody>
</table>

#### 1965
- Hardwired SA
  - MMI, Control board
  - Event recording, Protection
  - SCADA-distribution, metering

#### 1985
- Copper cables
  - Bay cubicle
  - GIS

#### 2005
- **Year**