IEC 61850-9-2LE
IEC 61869-9

IEC 61850 is a standard applied to the design of electrical substation automation systems, which defines fast communication of events (GOOSE) or data set samples (Sampled Values) through Ethernet frames. Standard naming and object modeling are based on a Substation Configuration Language (SCL), describing data exchange at device and substation levels.

OUR SOLUTION

Fast transmission and reception of voltage, current and status information between transformers and transducers (CT, PT...) and primary power system equipment. OPAL-RT simulators can be used to emulate merging units or to receive data from real merging units. GPS time synchronization is performed using IEEE 1588, IRIG-B or 1PPS input signals. The protocol supports light edition (LE) and ICD specified IEC 61869-9 Sampled Values and integrates a complete error injection mechanism to emulate cyber-security attacks on the network or erroneous transmission.

IEC 61850-9-2 LE Sampled Values (Light Edition)
The publishing and subscribing of Sampled Values messages are supported in agreement with the document "Implementation guideline for digital interface to instrument transformers using IEC 61850-9-2". The supported sampling rates are (1) 80 samples per cycle, with a nominal frequency of 50 or 60 Hz, and (2) 256 samples per cycle, with 8 samples per frame, with a nominal frequency of 50 or 60 Hz.

IEC 61869-9 Sampled Values
The publishing and subscribing of Sampled Values messages which are defined in an SCL file are supported, as per the IEC 61869-9 standard extending the IEC 61850-9-2 Light Edition.

Performance
The current solution meets or exceeds IEC 61850-9-2LE and IEC 61869-9 requirements. It has been successfully tested with up to 40 SV streams -that the simulator can publish or subscribe to- per simulation core, provided a proper optimization and an adequate number of Ethernet interfaces. The solution is scalable over multiple simulation cores and Ethernet interfaces.

External Synchronization

All types of messages support the use of an external clock with 1PPS, IRIG-B and IEEE1588v2. The precision of the SV compared to the smpCnt within it is plus or minus the time difference between two samples (e.g. 208 µs for 80 samples per cycle at 60 Hz).

IEC 61850 Data Integrity Manipulation

Six different types of manipulations can be performed into the Sampled Values LE solution (output/streamed out of the simulator), each with a configurable trigger:

- Stop transmission: Simulate the loss of packets on the network by stopping the SV publishing during a certain number of frames.
- Delay transmission: Simulate an unwanted delay on the network by delaying the frames for a specified amount of time, in microseconds.
- Duplicate transmission: Simulate a wrong network topology where packets could be sent multiple times by duplicating frames for a certain amount of frames.
- smpCnt manipulation: Simulate an IED clock reset by manipulating the smpCnt of a given frame.
- smpSynch manipulation: Simulate a loss of synchronization by manipulating the smpSynch of a stream for a certain number of frames.
- Quality manipulation: Simulate a change in the IED performance by manipulating the quality of the voltage and current values in a stream.

KEY FEATURES

- **Extraction from SCL/CID/ICD files containing multiple IED/logical nodes**
- **Data Integrity Manipulation interface allowing for a deeper level of IED testing**

- **Connect up to 16 individual 61850-9-2LE messages per license**
- **Synchronization through IRIG-B, 1PPS or IEEE 1588v2 with or without Power Profile**
- **Full control over SV quality bits**

TECHNICAL SPECIFICATIONS

Standards	IEC 61850-9-2LE Sampled Values IEC 61869-9 Sampled Values
Fundamental frequencies	50/60 [Hz]
Special features	IEC 61850 Data Integrity Manipulation
SV sampling rates (Light Edition) **SV sampling rates (IEC 61869-9)**	80/256 samples per cycle User-defined via SCL file
Time synchronization options	IEEE 1588v2 (with Power Profile), 1PPS, IRIG-B

OPAL-RT SOFTWARE COMPATIBILITY

SOFTWARE	IEC 61850-9-2 LIGHT EDITION	IEC 61850 Data Integrity Manipulation	IEC 61869-9
RT-LAB	☑	☑	☑
HYPERSIM	☑	☑	☑

THIRD-PARTY HARDWARE[†]

NAME	SKU	DESCRIPTION
Time synchronisation kit, Oregano Syn1588 PCIe NIC[†]	OP3811 or OP3812	Card required for accurate time synchronization (0.1 ppm oscillator)
Intel Quad-port Ethernet card[†]	EXPI9404PTL	Dispatch Ethernet traffic over multiple ports to increase bandwidth

[†]Prior to ordering and/or installing, check with your local OPAL-RT representative to ensure PCI express and hardware compatibility.