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## NovaTech Substation Automation Solutions for IEC 61850

This document summarizes NovaTech OrionLX<sup>™</sup> and Bitronics<sup>®</sup> products and solutions for IEC 61850. The focus is on how these products can be applied in electrical substations with both non-IEC 61850 legacy technology and the latest IEC 61850 technology. NovaTech products for IEC 61850 are summarized below.









#### OrionLX<sup>™</sup> and OrionLXm Substation Automation Platforms

Applied as RTU, Security Gateway, Communications Processor, Logic Processor, Substation HMI, Alarm Annunciator, SOE Recorder, and DA Controller.

#### Bitronics<sup>®</sup> 878 High Density I/O (HDIO)

Up to 48 I/O in combinations of discrete inputs, discrete outputs, and transducer inputs. Boolean logic on board.

#### **Bitronics 70 Series Distributed Recording IEDs**

Provides distributed recording in a modular M870 Family with up to 48 I/O. The M871 Model provides a single set of PTs/CTs for monitoring a single feeder, line or bus. The M872 Model provides dual PTs/CTs for monitoring dual feeders, buses, or transformer. The split core CT option reduces installation time. Software for record retrieval and analysis available.

#### **Bitronics 60 Series SCADA Panel Meter**

Provides accurate measurements and bright, user-defined alphanumeric display. One model can be set up for 2-element, 2 ½-element, or 3-element systems. All configuration through front panel or through webpages.

#### **Bitronics PowerPlex II Automation Transducer**

Provides the measurements and features of the 60 Series meter, plus additional features for automation applications: discrete inputs and outputs, serial communications, synchronizing PT input, and flexible mounting.

## Automation Terminology



Figure 1 – Diagram showing the names of the devices referenced in this document

## Automation with Mixed Legacy Technology and IEC 61850 Technology

The OrionLX<sup>™</sup> Automation Platform is designed to bridge the latest IEC 61850 technologies with legacy technologies using configuration tools to convert protocols and create object models.

Figure 2 below illustrates integration possibilities:



Figure 2 – Diagram showing the OrionLX as a bridge between IEC 61850 technologies and legacy technologies

# IEC 61850 Applications with NovaTech Products

#### IEC 61850 IED → Legacy SCADA Gateway

Example:

- 1. OrionLX<sup>™</sup> accesses data from Bitronics<sup>®</sup> IEC 61850 IEDs.
- 2. Orion converts IEC 61850 objects into IEC 60870-5-104 data points or DNP3 data points.
- 3. SCADA reads data from OrionLX using IEC 60870-5-104 protocol or DNP3 protocol.



SCADA System

In the OrionLX<sup>™</sup> configuration program (NovaTech Configuration Director or "NCD") users define which points are to be acquired from the IED, and which points are to be presented to data clients, typically SCADA, HMI screen, Math and Logic, external databases, email clients, etc. Figure 4 below shows the points selected to be read from the Bitronics<sup>®</sup> M871 Recording IED. In this case, 149 input points have been selected from the 2503 points available. A search function and "MX" and "ST" point filter simplify data management in large applications.



Figure 4 – IEC 61850 Point Selection Screen in OrionLX Configuration Software (NCD)

Figure 5 below shows another NCD configuration screen showing the selected IEC 61850 points to be presented to a IEC 60870-4-104 SCADA Master. The selected points include the points obtained from the Bitronics M871 IED (using IEC 61850) and also diagnostic OrionLX points.



Figure 5 – IEC 60870-5-104 SCADA Point Selection Screen in OrionLX configuration software (NCD)

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#### Legacy IED → IEC 61850 Client Gateway

- 1. OrionLX<sup>™</sup> accesses data from IEDs using DNP3, Modbus, IEC-870-5-103, and vendor-specific protocols such as SEL<sup>®</sup> protocol or others.
- 2. The Orion "Model Builder" creates IEC 61850 object models from the data accessed from IEDs. Model Builder is described on the next page of this document.
- 3. An IEC 61850 Client, such as an HMI, accesses data from Orion.



Figure 6 – Diagram showing connections and data flow for the "Legacy IED to IEC 61850 Client Gateway" application

#### Using Orion Model Builder to Create User-Specific Device Models

The Orion Model Builder feature in NCD enables fast creation of user-specific Server Device Models. Logical Devices can be set up any way the user desires. An "IED Device" approach and "Substation Apparatus" approach are illustrated in Figure 8 below. Each Logical Device is populated by one or more Logical Nodes (measurement, protection, control, etc), then Data Objects and Data Attributes. Any point in the Orion real-time database can be dragged and dropped into these Logical Devices. The IEC 61850 user can define Logical Devices based on IEDs, substation apparatus, or any other way that best supports user practices.

IED Approach t	o Defining Logical Devices:
OrionLX™ Server (a physical device with an IP address)	
	Logical Device (line 1 meter)
	Logical Nodes and Data
	Logical Device (line 1 primary 1 relay)
	Logical Nodes and Data
	Logical Device (line 1 primary 2 relay)
	Logical Nodes and Data
	Logical Device (line 1 PMU)
	Logical Nodes and Data
	Logical Device (line 1 breaker monitor)
	Logical Nodes and Data
	Logical Device (line 2 meter)
	Logical Nodes and Data
	Logical Device (line 2 primary 1 relay)
	Logical Nodes and Data
	Logical Device (line 2 primary 2 relay)
	Logical Nodes and Data
	Logical Device (line 2 PMU)
	Logical Nodes and Data
	Logical Device (line 2 breaker monitor)
	Logical Nodes and Data

#### Substation Apparatus Approach to Defining Logical Devices:

OrionLX Server (a physical device with an IP address) Logical Device (line 1 breaker) Logical Nodes and Data Logical Device (line 2 breaker) Logical Nodes and Data Logical Device (transformer #1) Logical Nodes and Data Logical Device (transformer #2) Logical Nodes and Data

Figure 8 – Illustration of two approaches to defining Logical Devices. The Orion Model Builder can support the creation of any model desired by the user.

#### Legacy IED → IEC 61850 IED Data Transfer

Example 1:

- 1. OrionLX<sup>™</sup> receives (subscribes to) GOOSE message sent (published) by Bitronics<sup>®</sup> IED indicating ON state.
- 2. OrionLX forces Remote Bit ON in SEL® relay using SEL protocol.

Example 2:

- 3. OrionLX reads input status ON from SEL relay using SEL protocol.
- 4. OrionLX publishes GOOSE message to IEC 61850 protective relay. Relay subscribes to GOOSE message and implements control.



Figure 7 – Diagram showing data flow for the "Legacy IED to IEC 61850 IED Data Transfer" application

#### **OrionLX HMI Visualization in IEC 61850 Systems**

- 1. OrionLX<sup>™</sup> accesses data from IEDs using IEC 61850 and legacy protocols. Alarm and SOE points are written to non-volatile SQL database.
- 2. On a VGA terminal, operator browses web pages served up by Orion using a browser hosted by Orion.



Figure 9 – Diagram showing connections and data flow for the "OrionLX HMI Visualization" application

#### **Bitronics GOOSE Cross Triggering (for Recording)**

- 1. A 70 Series Bitronics<sup>®</sup> Recorder, monitoring an HV line, triggers on fault condition and starts recording.
- 2. This Bitronics Recorder sends (publishes) GOOSE message to other networked Bitronics Recorders (e.g. on bus or transformer). Each of these Bitronics Recorders subscribe to GOOSE and are configured to start recording when receiving the GOOSE message "trigger". This eliminates hard-wiring in distributed recording applications.



Figure 10 – Diagram showing connections and data flow for the "Bitronics GOOSE Cross Triggering (for Recording)" application

#### **Bitronics Fast GOOSE-based Control in IEC 61850 Systems**

#### Example:

- 1. Bitronics<sup>®</sup> IEDs send (publish) GOOSE message containing input status and other real-time conditions.
- 2. OrionLX<sup>™</sup> receives (subscribes to) GOOSE messages and processes control logic; IEC 61131-3 can be used, or the .lua-based Advanced Math and Logic for faster schemes.

OrionLX contains all other real-time conditions reported by other IEDs, enabling it to make control decisions based on a complete "world view".

3. OrionLX sends (publishes) GOOSE messages which are received by (subscribed by) Bitronics IEDs and processed as a physical control output.



Figure 11 – Diagram showing connections and data flow for the "Fast GOOSE-based Control" application

#### **OrionLX Security Gateway in IEC 61850 Systems**

OrionLX<sup>™</sup> provides the following substation security features:

- 1. Encrypted SCADA protocols (e.g. DNP3 Secure) or an OpenVPN channel for non-secure SCADA protocols.
- 2. Encrypted protocols for engineering access: SFTP, SSH, HTTPS, etc.
- 3. Firewall.
- 4. Passthrough access to IEDs only to users with proper sign-on credentials.
- 5. Options for OrionLX to interact with a Remote Authentication Server (RAS) to simplify password management.
- 6. Options to secure HMI operations: proper user privileges required for sign-on, for controlling substation devices, for adding or removing control tags, for acknowledging alarms, etc.



Figure 12 - Diagram showing connections and data flow for the "Security Gateway" application

#### **OrionLX Time Manager in IEC 61850 Systems**

- 1. OrionLX<sup>™</sup> receives time in either IRIG-B or SNTP format from either GPS receiver or networked time server (OrionLX will support ptp 1588 in the 2017 OrionLX+ model).
- 2. OrionLX serves out SNTP to networked IEDs.
- 3. OrionLX sends out IRIG-B to SEL relays (over serial connection).
- 4. OrionLX sends out DNP3 time or IEC 60870-5-103 time to non-IEC 61850 IEDs that do not support SNTP, or do not require IRIG-B accuracy.



Figure 13 – Diagram showing connections and data flow for the "Orion Time Manager" application



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