The Orion Automation Platform from NovaTech is being applied in process plants to reduce cost and complexity in the following applications:

1. Protocol conversion and media conversion, primarily conversion from uncommon or proprietary serial protocols to Modbus TCP
2. Integration of large numbers of IEDs (Intelligent Electronics Devices) from substations and load centers
3. 1ms Sequence of Events (SOE) Recording
4. Lower-cost web-based HMI (Human-Machine Interface) and SCADA systems for portions of the plant

This document describes Orion applications in each of these areas and summarizes key Orion features and benefits.

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORION OVERVIEW</td>
<td>3</td>
</tr>
<tr>
<td>PROTOCOL CONVERSION AND MEDIA CONVERSION</td>
<td>6</td>
</tr>
<tr>
<td>Orion polls real-time data from attached IEDs using the native IED protocol and presents data to the DCS in a different protocol.</td>
<td></td>
</tr>
<tr>
<td>INTEGRATION OF LARGE NUMBERS OF INTELLIGENT ELECTRONIC DEVICES</td>
<td>7</td>
</tr>
<tr>
<td>Orion(s) polls IEDs in substations, motor control centers (MCCs) and other process areas and presents scaled and consolidated data to the DCS.</td>
<td></td>
</tr>
<tr>
<td>1ms SEQUENCE OF EVENTS (SOE) RECORDING</td>
<td>12</td>
</tr>
<tr>
<td>Orion Distributed I/O modules time-stamp discrete and analog events to 1ms accuracy. Orion consolidates SOE events and presents to user.</td>
<td></td>
</tr>
<tr>
<td>SMALL WEB-BASED SCADA</td>
<td>15</td>
</tr>
<tr>
<td>Orion polls and archives data from a substation and serves out customized webpages.</td>
<td></td>
</tr>
<tr>
<td>OTHER ORION APPLICATIONS IN PROCESS PLANTS</td>
<td>19</td>
</tr>
</tbody>
</table>
ORION OVERVIEW

What is the Orion Automation Platform?

The Orion Automation Platform is a family of modular hardware platforms and software designed to perform a range of monitoring and control applications.

Originally designed for accessing data from IEDs (Intelligent Electronic Devices) in unconditioned and noisy electrical substations, Orion provides a rugged solution for accessing data from nearly any intelligent serial or Ethernet plant device, plus options to present these data where and how the user desires: to plant control systems, to plant databases, to HMIs (Human-Machine-Interfaces), etc.

OrionLX Physical Overview
How is Orion Applied in Process Plants?

Orion provides real-time data to process control systems and plant databases. These data are accessed from the IEDs in plant process areas and plant substations.

Control commands, such as circuit breaker TRIP/CLOSE, can be sent through Orion either to I/O modules or to the microprocessor protective relay on the breaker.

How Does Orion Access Data?

In this diagram, data flow, from IEDs to plant systems, is represented by bricks. Orion polls a subset of the data available from the IEDs. Plant systems poll all or a portion of the data from Orion.

Note Orion polls data asynchronously to how it is polled (e.g., Orion could poll IEDs every second, while the DCS could poll Orion every two seconds).
Summary of Typical Orion Applications

Protocol Conversion
- Modbus TCP to DNP3 (common utility protocol)
- Modbus TCP to SEL® Protocol (for Schweitzer Relays)
- Modbus TCP to ABB 10-byte (for ABB DPU2000 relays)
- Modbus TCP to Modbus serial (PLCs, most GE motor relays, many starters and drives)
- Modbus TCP to proprietary instrumentation protocols (e.g. SCPI)

Media Conversion
- Serial RS-232 to Ethernet
- Serial RS-485 to Ethernet
- Serial Fiber Optic to Ethernet

“Remote Terminal Unit”
- Report real-time data to SCADA or to DCS
- Accept control commands from SCADA or from DCS
- Can obtain data from IEDs or from Orion I/O modules

Security Gateway
- Secure connections between DCS and IEDs
- Strong password and password rules
- Firewall
- Encryption
- Logging

Human-Machine-Interface (HMI)
- Serve out customized webpages to browsing PC locally or remotely
- Local control and tagging supported
- Direct Video monitor connections to Orion supported (to eliminate browsing PC)

Math and Logic Control
- IEC 61131-3 available for local control tasks
- Rugged Orion I/O modules available

Alarm Annunciation
- Serve out webpages with alarms status
- Acknowledge alarms locally or remotely
- Tile Annunciator available

Sequence of Events (SOE) Recording
- 1ms accuracy
- Works with Orion Distributed I/O
PROTOCOL CONVERSION AND MEDIA CONVERSION

Protocol Conversion and Media Conversion at Southeast US Nuclear Fuel Processing Plant
In a Southeast US nuclear fuel processing plant, Orion Automation Platforms convert data from specialty instruments in their native protocols to the plant NovaTech DCS in Modbus TCP protocol.

Key Orion Features for Protocol Conversion
• Large Orion library of communications protocols – over 50 total including many for Process applications
• NovaTech Engineering can add protocols to Orion for a small one-time fee
• NovaTech “Generic ASCII” protocol enables users to create interfaces to ASCII devices

<table>
<thead>
<tr>
<th>Serial Protocols for Process Applications</th>
<th>Network Protocols for Process Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNP3 Level 2</td>
<td>DNP3 TCP/UDP</td>
</tr>
<tr>
<td>Modbus RTU</td>
<td>Modbus TCP RTU</td>
</tr>
<tr>
<td>SEL * ASCII Protocols</td>
<td>NTP</td>
</tr>
<tr>
<td>SEL2030 Protocol</td>
<td>SNMP</td>
</tr>
<tr>
<td>TransData DTO</td>
<td>FTP / sFTP</td>
</tr>
<tr>
<td>Alstom KITZ (Courier)</td>
<td>HTTP / HTTPS</td>
</tr>
<tr>
<td>GE DLP</td>
<td>telnet / SSH</td>
</tr>
<tr>
<td>ABB DPU and 10-byte</td>
<td>PassThru</td>
</tr>
<tr>
<td>DF1 (Allen Bradley)</td>
<td></td>
</tr>
<tr>
<td>SCPI (Std. Commands for Programmable Inst.)</td>
<td></td>
</tr>
<tr>
<td>Generic ASCII</td>
<td></td>
</tr>
<tr>
<td>IEC60870-5-103</td>
<td></td>
</tr>
<tr>
<td>DQI (Digiquartz)</td>
<td></td>
</tr>
</tbody>
</table>
INTEGRATION OF LARGE NUMBERS OF INTELLIGENT ELECTRONIC DEVICES

Integration of Intelligent Electronic Devices at a Northeast US Cocoa Processing Plant

In a US cocoa processing plant, multiple Orion platforms integrate over 600 motor overload relays, drives and softstarts. Real time data values, including operation status, fault status and measured values, are presented to the plant NovaTech D/3® DCS.

To D/3 PCM using Modbus TCP/IP
Via Ethernet Switch

144 Square D overload relays per Orion
(528 devices total attached to multiple Orions)

RS-485 Modbus

Summary of Cocoa Plant Application

Data Provided:
40408 – MLP II FAULT STATUS BITS
40414 – MLP II OPERATIONAL STATUS BITS
40418 – MLP II Raw Average Current
40422 – MLP II Thermal Capacity Rating

Information to Orion database,
then to D/3 database,
and to TotalVision display screens

528 Square D MotorLogic Plus II (MLP II)
Overload Relays in Square D Motor Control Centers

Orion also accesses data from these IEDs:

**Altivar Drives – 64 Devices**
• 4 read registers, 1 analog write register for speed
• 4 registers to be remapped to contiguous Modbus registers to simplify reading by DCS
• TCP/IP connection to PCM ports via Modbus TCP/IP

**Square D SoftStarts – 13 Devices**
• 4 registers read
• 1 write for settings connections
• TCP/IP connection to PCM ports via Modbus TCP/IP
Integration of Intelligent Electronic Devices at Midwest US Agricultural Product Processing Plant

Eleven Orion Automation Platforms are installed in two substations and nine motor control centers to access real-time data from trip units and protective relays:

- (2) New Substation at Dry Grind Facility
- (1) Dry Grind Medium Voltage
- (1) Mill Motor Control Center
- (1) Feedhouse Motor Control Center
- (1) D/D Motor Control Center
- (1) Utility Motor Control Center
- (1) Elevator Motor Control Center
- (1) DDGS Loadout Motor Control Center
- (1) Alcohol Loadout Motor Control Center
- (1) Waste Treatment Motor Control Center

These data are made available to the plant NovaTech D/3® DCS.

Interface to Eaton MCCs

[Diagram showing interface with Orion5r, Modbus TCP, Modbus Serial RS-485, Proprietary Incon Network, Eaton Digitrip Trip Units on MCCs]
Performance Guidelines: RS-485 Multidrop

Updates from each of the points from each IED can be obtained every 1 to 2 seconds.

Four IEDs on each RS-485 Modbus network
100 data values from each
Key Orion Features for IED Integration

- Up to 16 RS-485 serial ports per Orion; each port able to accommodate up to 31 IEDs
- Large point processing capabilities; up to 20,000 points able to be accessed and presented to DCS
- IED “Point Pick Lists”
- Simple mapping of points from the ports where data is polled by Orion to ports where the DCS will poll data from Orion (no typing)
Orion “Point Pick Lists”

Orion is supplied with over 300 “point pick lists.” These point pick lists contain the names and addresses of all of the points that can be read, or controlled, by Orion. These preformatted lists make configuration possible with minimal typing and scripting.

Point pick lists for many process plant IEDs are provided including:

- Bitronics Meters and Recording IEDs; all models
- GE Protective Relays; “UR” Series, DLP Series, 7xx Series, 469 Series, 269 Series
- GE Meters; PQM Series
- Schweitzer Protective Relays; all models
- Basler and Beckwith Protective Relays; most models
- Square D MLPII Motor Relays
- Eaton DigiTrip IEDs
- Satec, Power Measurement, and Electro-Industries Meters
- Ametek GenStar Meters

The “pick list” in the left column contains all of the 1486 points available in this GE 469 Motor Relay. The middle column shows the 22 points that are selected to be read by Orion. The column at the right displays parameters of selected points. The “Outputs” tab lists all of the points that can be turned ON or OFF by Orion.
1ms SEQUENCE OF EVENTS (SOE) RECORDING

1ms Sequence of Events (SOE) Recording at Midwest Cogeneration Plant
Orions and Distributed SER I/O Modules are applied to place 1ms time stamps on power system events. A redundant architecture, including dual D/3® PCMs and dual RS-485 and Ethernet connections to the I/O modules, assures higher availability.
Sequence of Events Recording with Orion and Distributed I/O
The connections and data flow between Orion and I/O modules in this SOE system are summarized below:

1) Orion I/O monitors field contact state changes.

2) Orion I/O places a time stamp on each switch change. Orion I/O internal clock is synchronized to external source (IRIG-B or NTP).

3) Orion reads all change events using DNP3 protocol. Time stamps are included with all change events.

4) PC running browser reads web pages served out from Orion containing time-stamped event data or event data sent out as .csv file from Orion or event data accessible via SQL queries sent to Orion.
Sequence of Events Recording with Orion and Distributed I/O

Physical Features

- Operates with 48V dc or 125V dc battery-powered systems
  - No converters or interposing relays required

- All input circuits independent and isolated
  - Simplifies retrofits

- Both Ethernet and serial options supported

- Rugged design to survive in harsh environments
  - -25°C to 70°C (156°F)
  - Meets stringent IEEE C37.90 standards for Fast Transients, Electrostatic Discharge and RFI

Software Features

- Internal clock can be synchronized to a precise IRIG-B time signal
  - Facilitates time stamping to an accuracy of one millisecond
  - Network Time Protocol (NTP) also supported when access to NTP server is available

- Individual filters on all discrete input channels to reduce nuisance data
  - ON-state filter
  - De-bounce filter
  - Chattering contact filter

- DNP3 Protocol
  - Supports transfer of timed events in the protocol

- When combined with Orion, presents SOE data in multiple forms to meet specific user requirements
  - Table of SOE events presented on a web page
  - Exported .csv file
  - SQL queries from other databases
SMALL WEB-BASED SCADA

OrionLX-Based WEBserver SCADA at Midwest US Agricultural Product Processing Plant

**Plant Need:**
A monitoring system to identify root causes for power system interruptions.

**Solution:**
- Install Orions and Orion Distributed I/O modules in the substation to access data from IEDs and to capture high-speed (1ms) SOE data
- Provide simple web-based local visualization of power system operation and power system data
- Provide SOE data to utility operators via preconfigured web pages in Orion

---

Automation Equipment Interconnections - WEBserver SCADA Application
Slave OrionLX #2 IED Connections

- Electro Industries CPU 1000 Futura Meter
- Beckwith M-2001C Regulator
- SEL-321 Protective relay
- SEL-501 Protective relay
- SEL-387 Protective relay

Slave OrionLX #3 IED Connections

- (30) GE Multilin 750 Protective Relays
- (6) ABB DPU2000 Protective Relays
- ABB “10-byte” Protocol
- DNP3 Protocol RS-485
Webpages (Screens) Provided in System

OrionLX #1 serves out standard and customized webpages providing specific power system data. These data are used by engineers and operators to identify root causes of power interruptions.

Sequence of Events Screen

![Sequence of Events Screen](image)

Sequence of Events Screen summarizes all logged 1mS time-stamped events in a pre-formatted tabular text.

Alarm Screen

displays power system alarms (in alarm, not acknowledged, in alarm acknowledged, went out of alarm but not acknowledged) in a a pre-formatted color-coded tabular text summary

Communications Screen

a communications screen depicting communication status to and from all power system IEDs connected to Orion.
**One-line Overview Screen**

- **Substation One-line Screen** depicts the three phase electrical system showing conductors, breakers, transformers and other power system components with real-time data superimposed.

**IED Zoom Screen**

- **IED Zoom Screen** detail screen provides more IED data and power system from specific circuits.
- Also presents breaker control options to the user.
OTHER ORION APPLICATIONS IN PROCESS PLANTS

In the electric utility industry, Orion also performs a role in critical Cyber Security, energy management and fast automatic restoration applications. Process plants with challenges in these areas may benefit from the application of Orion.

Security
Where very high communication security is required, the connection between an OrionLX and a remote server, or between a local OrionLX and a remote OrionLX, can be locked down with a VPN (e.g. OpenVPN). Strong passwords in Orion, and the Orion firewall, provide additional levels of security. An unalterable “syslog” records all user access attempts and processes accessed on Orion.

Automatic Restoration
The combination of high-speed math and logic, substation-grade I/O and access to protective relay data make Orion ideal for tie-breaker control in substations.

Energy Management
Orion can provide the real-time energy data from substation IEDs and load center IEDs required for energy management systems, such as the NovaTech Energy and Asset Management System (EAMS).