



RTAC R151 Technical Note

With the addition of firmware version R151-V0 to the RTAC product line, the following are some notes and additional comments about new additions or changes in the firmware. These items are compiled from the release notes found in *Appendix A: Firmware and Manual Versions* of the ACSELERATOR RTAC® SEL-5033 Software Instruction Manual. Please note that this document does not discuss each release note, but rather just those with additional context or conversation points. This information can also be found in the SEL-5033 instruction manual in the appropriate sections for the new or modified behavior.

Some new features or enhancements to existing features in R151-V0 include the following:

- Added support for 3U SEL-3350 automation controller hardware.
- Added OPC UA client protocol.
- Enhanced the Connected IED tools in the web interface to add an online protocol dissector for debugging serial or Ethernet communications to client and server devices.
- Enhanced the Sequence of Events log to store 500,000 records.
- Enhancements to the Check IED configuration functionality provided by SEL protocol clients and servers.
- Increased the Recording Group custom channel limit from 128 to 512 BOOL quantities.
- Improved the frequency tracking step response performance on voltage input startup for SEL-2245-42 AC protection modules.
- [Cybersecurity Enhancement] Support for a Restricted BIOS with a reduced set of functionality that provides an enhanced security posture.
- [Cybersecurity Enhancement] Removed support for TLSv1.1 for SSL/TLS connections established by protocols, HTTPS connections to the web interface, and connections on TCP port 5432.

A collection of IEC 61850 enhancements is also included with R151-V0, including the following changes:

- Added support for functional naming for MMS client and GOOSE receive.
- Added support for LGOS logical nodes for GOOSE receive messages.
- Enhanced MMS client to support collection of DPL, LPL, and VSS common data classes.
- Enhanced MMS client to support the set point functional constraint for common data classes CUG, ENG, ING, ORG, SPG, and TSG.
- Enhanced MMS server to support the set point functional constraint for common data classes ASG, CUG, ENG, ING, ORG, SPG, and TSG.
- Enhanced MMS server to support LTIM and LTMS logical nodes.
- Enhanced MMS server to support local-remote functionality.
- Enhanced GOOSE to support simulation mode.

ACCELERATOR RTAC enhancements include the following:

- Added Modification Type column to main menu.
- Added support for logging of ACD, ACT, and ENS tag types in the Tag Processor.
- Added support for IIoT libraries supporting MQTT, HTTP, and Web Socket communications supported by XML and JSON formatting.

The following are additional comments on new features and changes in the RTAC product line.

Addition of OPC UA Client Protocol

Firmware version R150-V0 added support for OPC UA (Open Platform Communications, Unified Architecture) server, and with the release of R151-V0, a corresponding OPC UA client protocol is now supported in SEL-3350 and SEL-3555 projects. In these projects, as many as ten OPC UA clients can be added. OPC UA client is a cost-adder option for the SEL-3350, SEL-3555, and SEL-3560 RTACs, and it can be added in the field. Features of the OPC UA client protocol include the following:

- Automatic tag browsing of an OPC UA server that can be communicated to from the ACCELERATOR RTAC installation; no physical RTAC is required for this functionality to operate.
- Following the tag browsing operation, a simple interface to select which tags the RTAC should poll from the server.
- An option to insert OPC UA variables in either structured (a dot-separated tag name representing the entire path to the variable) or unstructured (one single, unified tag name that can be customized to be a far shorter name).

Connected IED Enhancements, Including Online Protocol Dissector

R151 adds a real-time communication status display for client and server devices. A green status indicates successful communications (Offline = FALSE), red status indicates failed communications (Offline = TRUE), and gray indicates a disabled device (ENO = FALSE).

Ethernet Devices						
Actions Capture All Ethernet Traffic						
<input type="checkbox"/> Status	Remote Device	Protocol	Interface	Source IP	Destination IP	Port
<input type="checkbox"/>	Client1_NonStandardPort	DNP Client	Eth_01	127.0.0.1	10.42.92.250	TCP:21000
<input type="checkbox"/>	Client1		Eth_01	10.42.92.250	127.0.0.1	TCP:20001
<input type="checkbox"/>	Client2	DNP Client	Eth_01	10.42.92.250	127.0.0.1	UDP:20000
<input type="checkbox"/>	Client2		Eth_01	127.0.0.1	10.42.92.250	TCP:20011
<input type="checkbox"/>	Client2		Eth_01	10.42.92.250	127.0.0.1	TCP:20000
<input type="checkbox"/>	Client2		Eth_01	10.42.92.250	127.0.0.1	UDP:20011
<input type="checkbox"/>	Client3	Modbus Client	Eth_01	10.42.92.250	127.0.0.1	TCP:1024
<input type="checkbox"/>	Client4	Modbus Client	Eth_01	10.42.92.250	127.0.0.1	TCP:502
<input type="checkbox"/>	Client5	Modbus Client	Eth_01	10.42.92.250	127.0.0.1	TCP:10001
<input type="checkbox"/>	Client8	L&G 8979 Client	Eth_01	10.42.92.250	127.0.0.1	TCP:1025
<input type="checkbox"/>	Iec101_TunneledClient7	IEC 60870 Client	Eth_01	10.42.92.250	127.0.0.1	TCP:15000
<input type="checkbox"/>	Iec101_TunneledServer7	IEC 60870 Server	Eth_01, Eth_02, Eth_10, Eth_07, Eth_08	*	10.42.92.250	TCP:15000
<input type="checkbox"/>	Iec104_Client5	IEC 60870 Client	Eth_01	10.42.92.250	127.0.0.1	TCP:2404
<input type="checkbox"/>	Iec104_NonStandardPort_Client10	IEC 60870 Client	Eth_01	10.42.92.250	127.0.0.1	TCP:12404
<input type="checkbox"/>	Iec104_NonStandardPort_Server10	IEC 60870 Server	Eth_01, Eth_02, Eth_10, Eth_07, Eth_08	*	10.42.92.250	TCP:12404
<input type="checkbox"/>	Iec104_Server6	IEC 60870 Server	Eth_01, Eth_02, Eth_10, Eth_07, Eth_08	*	10.42.92.250	TCP:2404
<input type="checkbox"/>	Server1_NonStandardPort	DNP Server	Eth_01, Eth_02, Eth_10, Eth_07, Eth_08	*	10.42.92.250	TCP:20001
<input type="checkbox"/>			Eth_01, Eth_02, Eth_10, Eth_07, Eth_08	*	10.42.92.250	UDP:20001
<input type="checkbox"/>			Eth_02	*	10.42.92.250	TCP:20001
<input type="checkbox"/>			Eth_02	*	10.42.92.250	UDP:20001

For SEL-3350, SEL-3555, and SEL-3560 RTACs, an online packet dissector is also available from the Connected IEDs page. This tool supports online troubleshooting of device communications by providing real-time decoding of Ethernet and serial variations of devices of the following client/server protocols:

- DNP
- Modbus

- SEL
- IEC 60870-5-101/104
- IEEE C37.118 Synchrophasors
- L&G 8979
- CP2179
- IEC 61850 MMS and GOOSE

The interface allows for application of display filters (matching the same syntax used by Wireshark) as well as facilities to start and stop the capture and to download a pcap file of the traffic for offline troubleshooting.

No.	Time	Source	Destination	Protocol	Length	Info
1	02:34:04.795888	127.0.0.1	127.0.0.1	DNP 3.0	90	Read, Class 123
3	02:34:04.795982	127.0.0.1	127.0.0.1	DNP 3.0	99	Response
5	02:34:04.796075	127.0.0.1	127.0.0.1	DNP 3.0	81	Confirm
7	02:34:09.795838	127.0.0.1	127.0.0.1	DNP 3.0	90	Read, Class 123
9	02:34:09.795945	127.0.0.1	127.0.0.1	DNP 3.0	99	Response
11	02:34:09.796011	127.0.0.1	127.0.0.1	DNP 3.0	81	Confirm
13	02:34:14.795850	127.0.0.1	127.0.0.1	DNP 3.0	90	Read, Class 123
15	02:34:14.795976	127.0.0.1	127.0.0.1	DNP 3.0	99	Response
17	02:34:14.796067	127.0.0.1	127.0.0.1	DNP 3.0	81	Confirm

Filter: dnp3

318.6 KIB / 10.0 MiB

Frame 3: 99 bytes on wire (792 bits), 99 bytes captured (792 bits)

Ethernet II, Src: 00:00:00:00:00:00, Dst: 00:00:00:00:00:00

Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 20000, Dst Port: 56056, Seq: 1, Ack: 25, Len: 33

Distributed Network Protocol 3.0

Data Link Layer, Len: 24, From: 2, To: 0, PRM, Unconfirmed User Data

Transport Control: 0xccc, Final, First(FIR, FIN, Sequence 12)

Data Chunks

1 DNP 3.0 AL Fragment (18 bytes): #3(18)

Application Layer: (FIR, FIN, CON, Sequence 12, Response)

Application Control: 0xccc, First, Final, Confirm(FIR, FIN, CON, Sequence 12)

Function Code: Response (0xB1)

Internal Indications: 0x0000

RESPONSE Data Objects

Object(s): 16-Bit Analog Change Event with Time (Obj:32, Var:04) (0x2004), 1 point

Qualifier Field, Prefix: 1-Octet Index Prefix, Range: 8-bit Single Field Quantity

Number of Items: 1

Point Number 0 (Quality: Online), Value: 425, Timestamp: Nov 2, 2022 02:34:04.296000000

Sequence of Events Log Stores 500,000 Records

On the SEL-3350, SEL-3555 and SEL-3560 RTACs, an enhancement was made to the SOE logging capabilities to increase the maximum number of stored events from 30,000 to 500,000. This allows for far more capable historical context in the SOE log and IED SER collection capabilities of the RTAC platform.

SEL Protocol Check IED Configuration Enhancements

The Check IED configuration features supported by SEL clients have been enhanced to provide some basic historical logging of previously detected changes as well as automatic notification of newly detected changes via an SEL server connection to a monitoring application. If a change in an IED's settings is detected by an SEL client, it will now write that event to a report file in the RTAC's file manager, storing time stamps and SHA256 hashes of the last ten change events.

[Cybersecurity Enhancement] Restricted BIOS for Improved Security

When R151-V0 (or one of the associated point releases of R148-V6, R149-V3 or R150-V2) is loaded onto an SEL-3555-2 or SEL-3350 RTAC, a BIOS update will occur (the update can take as long as 10 minutes). The new updated Restricted BIOS has several features removed (such as remote management on the SEL-3555-2) in the name of improving security and reducing the need for future BIOS updates as vulnerabilities are discovered in those unused features. Of addi-

tional note with the Restricted BIOS is that it contains no user settings and cannot be entered by an end user via a key press at startup. Version 12.5.49152.260 is the updated version for the SEL-3555-2/SEL-3560-2 and version 11.2.49152.139 is the update for the SEL-3350.

[Cybersecurity Enhancement] Removal of TLSv1.1 for SSL/TSL Connections

TLSv1.1 has been deprecated. The RTAC platforms support the TLS v1.2 standard. The removal of this encrypted communications method from the RTAC enhances the security posture of the product. External applications using TLS connections to the RTAC (ACSELERATOR Team[®] SEL-5045 Software, ACSELERATOR Diagram Builder[™] SEL-5035 Software, SEL Blueframe[™], the Data Management and Automation (DMA) application suite, etc.) may require updates to preserve compatibility with R151 firmware.

IEC 61850 Enhancements

R151-V0 includes a variety of IEC 61850 enhancements. For additional details on these features, see *Section 2: Communications* in the SEL-5033 Instruction Manual. New functionality includes support for the following:

- Automatic generation and updating of LGOS logical nodes for received GOOSE messages. The statistics are consistent with LGOS statistics available from SEL relays. To have ACSELERATOR Architect[®] SEL-5032 Software automatically generate LGOS nodes, use CID class file version 8 or later.
- Simulation mode for GOOSE receive messages. The CFG.LPHD.Sim data object (which enables or disables simulation mode) can be managed via the logic engine or the MMS server interface to turn simulation mode on or off. Simulation mode is available if the CFG.LPHD.Sim data object exists in the server data model regardless of the CID class file version. CID class file version 8 will be the first CID file to automatically include CFG.LPHD.Sim in the RTAC data model by default.
- Automatic generation of LTIM and LTMS logical nodes, which provide status information about the RTAC system clock and synchronization status. These data will only be automatically populated when LTIM and LTMS are included in the CFG logical device. CID class file version 8 will be the first CID file to automatically include LTIM and LTMS in the RTAC data model by default.
- Support for local/remote control. This functionality will consider the orcat value received by the MMS server when the logical node or logical device is in local mode.
- Support for the set point functional constraint in both the MMS server and client. This adds support for tags with data types ASG, CUG, ENG, ING, ORG, SPG, and TSG. There is no dependency on elements or attributes in the CID file or CID class file version.
- Support for functional naming in MMS client and GOOSE receive. Functional naming will be used when the supportsLdName attribute in the client services element in the RTAC's CID file is set to True. When this attribute is set to True, MMS clients will create functionally named tags if functionally named data is in the server's CID file. If the server contains no functionally named data, product naming will be used. For GOOSE receive when functional naming is enabled

and the publishing device has functionally named data, the functional name will be used in the ACSELERATOR RTAC. If the publishing device does not have functionally named data, product naming will be used instead of the index-based naming used prior to R151. Functional naming is disabled by default in CID class file version 8.

SEL-3505-3 Firmware Compatibility Updates

SEL-3505-3 units manufactured after November 11, 2022, are only compatible with firmware revisions R148-V6, R149-V3, R150-V2, and R151-V0 or later. This is because a hardware component change in the SEL-3505-3 that requires updated firmware to run the new hardware port. Customers with firmware locks on the SEL-3505-3 must update their special specs to allow ordering of new SEL-3505-3 hardware.

Cybersecurity Fixes to RTAC Web Interface

R151-V0, along with all associated point releases (R147-V6, R148-V7, R149-V4, and R150-V2), includes a collection of bug fixes to resolve vulnerabilities in the RTAC web interface. These corrections prevent an authenticated attacker from possibly exploiting various web functions that could cause information leakage (user credentials, operating system files, etc.).

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SCHWEITZER ENGINEERING LABORATORIES, INC.

2350 NE Hopkins Court • Pullman, WA 99163-5603 U.S.A.

Tel: +1.509.332.1890 • Fax: +1.509.332.7990

selinc.com • info@selinc.com

