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# **Protocol Implementation eXtra Information for Testing (PIXIT) for IEC 61850 for the SEL-3505 Automation Controllers**

**February 22, 2013**



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# 1 INTRODUCTION

This document specifies the Protocol Implementation eXtra Information for Testing (PIXIT) of the IEC 61850 interface for the SEL-3505 Automation Controllers.

This document applies specifically to the following models and firmware versions.

Model	Firmware Version
SEL-3505 RTAC	SEL-3505-R122-V0-Z001001-D20121121

Together with the PICS, the PIXIT forms the basis for a conformance test according to IEC 61850-10.

## 1.1 Contents of This Document

Each section specifies the PIXIT for each applicable ACSI service model as structured in IEC 61850-10.

## 2 PIXIT FOR ASSOCIATION MODEL

Not applicable.

## 3 PIXIT FOR SERVER MODEL

Not applicable.

## 4 PIXIT FOR DATA SET MODEL

Not applicable.

## 5 PIXIT FOR SUBSTITUTION MODEL

Not applicable.

## 6 PIXIT FOR SETTING GROUP CONTROL MODEL

Not applicable.

## 7 PIXIT FOR REPORTING MODEL

Not applicable.

## 8 PIXIT FOR LOGGING MODEL

Not applicable.



## 9 PIXIT FOR GENERIC SUBSTATION EVENTS MODEL

Description	Value/Clarification		
<p>What elements of a subscribed GOOSE header does the RTAC check to decide whether the message is valid and to accept allData values?</p> <p>Ignored = the RTAC accepts the message without checking the element value.</p> <p>SCL match = the element value should match the configuration, or the RTAC ignores the GOOSE message.</p>	No	src. MAC address	= ignored
	Yes	dest. MAC address	= SCL match
	Yes	VLAN id	= ignored if absent
	Yes	VLAN priority	= ignored if absent
	Yes	Ethertype	= 0x88B8
	Yes	APPID	= SCL match
	Yes	gocbRef	= SCL match
	No	timeAllowedtoLive	= see below
	Yes	datSet	= SCL match
	Yes	goID	= SCL match
	No	t	= ignored
	No	stNum	= see below
	No	sqNum	= see below
	No	test	= false (true will be ignored)
	Yes	confRev	= SCL match
No	ndsCom	= false (true will be ignored)	
Yes	numDatSetEntries	= SCL match	
Can you obtain more details, as necessary, about the conditions for checked GOOSE header elements?	<p>The RTAC validates the 16-bit APPID value from the header with the value in the SCL.</p> <p>The ACSELERATOR RTAC® software permits you to use logic to access any header information (timeAllowedtoLive, stNum, sqNum, test, and ndsCom).</p>		
Can you turn the test flag in the published GOOSE on/off?	Yes. You can use logic to set the value of the test flag.		

Description	Value/Clarification
How does the RTAC behave when the GOOSE publish configuration is incorrect?	<p>The RTAC refuses to transmit a GOOSE message under the following conditions:</p> <ul style="list-style-type: none"> <li>• The GOOSE message has the same destination MAC address and APPID pair as another GOOSE message, published or subscribed by the RTAC.</li> <li>• The GOOSE message has the broadcast address (FF-FF-FF-FF-FF-FF) as its destination MAC address.</li> <li>• The GOOSE message has a multicast address that starts with something other than the OUI (01-0C-CD) assigned to the standard.</li> <li>• The GOOSE message lacks a configured dataset or contains unsupported data attribute types.</li> <li>• The GOOSE message encoding would exceed the capacity of an Ethernet frame.</li> </ul> <p>If the RTAC refuses to transmit a GOOSE message, it asserts an ndsCom tag that is available to user logic.</p> <p>The RTAC can transmit a GOOSE message with ndsCom=true under the following additional conditions:</p> <ul style="list-style-type: none"> <li>• The APPID is set to 0. The standard reserves this value to indicate a lack of configuration.</li> <li>• User logic has set the Force_Needs_Commissioning tag for the message to true.</li> </ul> <p>If the RTAC is transmitting a GOOSE message with ndsCom=true, it asserts an ndsCom tag that is available to user logic.</p>
When does the RTAC mark a subscribed GOOSE as lost? (TAL = time allowed to live value from the last received GOOSE message)	The RTAC asserts the Offline tag corresponding to the subscription if the message does not arrive prior to TAL.
How does the RTAC behave when it fails to receive one or more subscribed GOOSE messages, or it receives a message that is syntactically incorrect (missing GOOSE)?	<p>If a subscribed GOOSE message does not arrive AND the last TAL value indicates that one should have been received, then the RTAC asserts the Offline tag corresponding to the subscription.</p> <p>A GOOSE message that can be matched to a subscription, but which fails additional decoding (such as allData), causes the RTAC to assert the ASN_Decode_Failure tag corresponding to the subscription.</p>
What happens when a subscribed GOOSE message is out of order?	The RTAC asserts the Sequence_Error tag corresponding to the subscription.
What happens in the case of a duplicate subscribed GOOSE message?	<p>If stNum did not increment, then no new data were expected and allData will be ignored.</p> <p>If sqNum did not change, then the RTAC asserts the Sequence_Error tag corresponding to the subscription.</p>



Description	Value/Clarification												
Does the device subscribe to GOOSE messages with/without the VLAN tag?	Yes, the RTAC subscribes to GOOSE messages with <i>AND</i> without the VLAN tag.												
Can the GOOSE data set contain the following: <ul style="list-style-type: none"><li>structured data objects (FCD)</li><li>TimeStamp data attributes</li><li>Quality data attributes</li></ul> Note: data attributes (FCDA) are mandatory	<table><tr><td></td><td>Subscribed</td><td>Published</td></tr><tr><td>FCD</td><td>Yes</td><td>Yes</td></tr><tr><td>TimeStamp</td><td>Yes</td><td>Yes</td></tr><tr><td>Quality</td><td>Yes</td><td>Yes</td></tr></table>		Subscribed	Published	FCD	Yes	Yes	TimeStamp	Yes	Yes	Quality	Yes	Yes
	Subscribed	Published											
FCD	Yes	Yes											
TimeStamp	Yes	Yes											
Quality	Yes	Yes											
Published FCD-supported common data classes and data types are:	Published GOOSE messages may contain any of the following common data classes: INS, CMV, MV and SPS. Published GOOSE messages may contain any of the following data attribute types: BOOLEAN, INT32, FLOAT32, TimeStamp, and Quality.												
Subscribed FCD supported common data classes/data types include the following:	Subscribed GOOSE messages may contain any common data class. You can use logic to access common data attributes having one of the following types: BOOLEAN, INT32, FLOAT32, Dbpos, TimeStamp, and Quality.												
What is the slow retransmission time, and is it fixed or configurable?	The value of the MaxTime child of the GSE element within the SCL definition of the GOOSE message determines the maximum retransmit interval. You can use ACSELERATOR Architect® software to configure this value. The RTAC has a configurable processing interval. You can derive the maximum retransmit interval by rounding the MaxTime value up to the nearest integer multiple of the processing interval. When the RTAC transmits at this slow rate, the TAL value in the published message will be twice the retransmit interval.												
What are the minimum and maximum supported retransmission times, and are these times fixed or configurable?	You can set MinTime to a minimum of 4 ms. MaxTime is limited to a 32-bit value. You can use SCL to configure MinTime and MaxTime.												
Can you use SetGoCBValues(GoEna) to turn the GOOSE publish on/off?	The RTAC does not support the SetGoCBValues service. However, you can use custom logic to turn GOOSE publish on or off on a per-message basis.												



Description	Value/Clarification
Additional Information	
How many GOOSE subscriptions does the RTAC allow?	150
How many GOOSE messages can you publish?	150
Which quality bits can you set in published data sets?	<p>You can use logic to set the states of all quality bits GOOSE publisher transmits.</p> <p>Validity:</p> <p><b>Yes</b> Good</p> <p><b>Yes</b> Invalid</p> <p><b>Yes</b> Reserved</p> <p><b>Yes</b> Questionable</p> <p><b>Yes</b> Overflow</p> <p><b>Yes</b> OutofRange</p> <p><b>Yes</b> BadReference</p> <p><b>Yes</b> Oscillatory</p> <p><b>Yes</b> Failure</p> <p><b>Yes</b> OldData</p> <p><b>Yes</b> Inconsistent</p> <p><b>Yes</b> Inaccurate</p> <p>Source:</p> <p><b>Yes</b> Process</p> <p><b>Yes</b> Substituted</p> <p><b>Yes</b> Test</p> <p><b>Yes</b> OperatorBlocked</p>



Description	Value/Clarification
Which quality bits can you access from subscribed GOOSE message datasets?	<p>The states of all quality bits are available to user logic.</p> <p>Validity:</p> <p><b>Yes</b> Good*</p> <p><b>Yes</b> Invalid</p> <p><b>Yes</b> Reserved</p> <p><b>Yes</b> Questionable*</p> <p><b>Yes</b> Overflow</p> <p><b>Yes</b> OutofRange*</p> <p><b>Yes</b> BadReference</p> <p><b>Yes</b> Oscillatory</p> <p><b>Yes</b> Failure</p> <p><b>Yes</b>OldData</p> <p><b>Yes</b> Inconsistent</p> <p><b>Yes</b> Inaccurate</p> <p>Source:</p> <p><b>Yes</b> Process</p> <p><b>Yes</b> Substituted</p> <p><b>Yes</b> Test</p> <p><b>Yes</b> OperatorBlocked</p> <p>* Internal range processing can override the state (i.e., if limits set in the RTAC are more restrictive than limits set in the publisher).</p>

## 10 PIXIT FOR CONTROL MODEL

Not applicable.





## 11 PIXIT FOR TIME AND TIME-SYNCHRONIZATION MODEL

NOTE: The RTAC can act as a client or server for purposes of time synchronization.

Description	Value/Clarification
How do you view internal time and quality or expose the time-stamp value and time-stamp quality via the IEC 61850 interface?	You can view time-stamp value and time-quality information from ACSELERATOR RTAC software, when it is online. View the internal time and time quality by examining the state of the System_Time_Control tags.
What time quality bits are supported?	<b>No</b> LeapSecondsKnown <b>Yes</b> ClockFailure <b>Yes</b> ClockNotSynchronized
How does the RTAC behave for lost time synchronization signal/messages?	See the following.
When is the quality bit Clock failure set?	The ClockFailure bit is always false.
When is the quality bit Clock not synchronized set?	<p>The RTAC supports multiple time sources—IRIG, NTP, IEC 61850, and DNP 3.0.</p> <p>The management of the ClockNotSynchronized bit depends on the RTAC time sources.</p> <p>If the RTAC receives time via an IRIG source that does not contain a time accuracy figure, or if the value is undefined, the RTAC sets the ClockNotSynchronized time quality bit to true.</p> <p>If the RTAC receives time via an NTP or IEC 61850 time source, the RTAC assumes this source to be a time-synchronized source. The RTAC therefore sets the ClockNotSynchronized time quality bit to true in the case of lost synchronization.</p> <p>If the RTAC receives time via a DNP time source, the RTAC assumes this source to not be a time-synchronized source. The ClockNotSynchronized time quality bit will therefore always be set to true.</p>

## 12 PIXIT FOR FILE TRANSFER MODEL

Not applicable.