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## R-GOOSE/R-SV Test Cases and Setup

Purpose: The ED2.1 CDs of IEC 61850-8-1 and IEC 61850-9-2 provide updates to the protocol elements of IEC TR 61850-90-5. There have been additional changes to the security protocols (e.g. KDC). However, since there is currently no known available KDC that fulfills the current IEC 62351-9 CDV, testing of the KDC functionality will be out-of-scope of this test campaign.

Besides the IED testing, infrastructure testing is also in scope in order to test IGMPv3, IGMP Snooping, and Firewall functionality.

There are two architectures for testing:

* Non-routed environment
* Routed and Firewalled environment

For the general environment, the R-GOOSE/R-SV applications will publish on VLAN ID = 7. The subnet masks will be 255.255.255.0 for the applications. Applications will publish into two different multicast address ranges based upon being R-GOOSE or R-SV:

* R-GOOSE: Applications will publish into the multicast address range of 224.0.1.1 – 224.0.1.254.  
    
  Each vendor will be allocated a group of 16 consecutive multicast addresses.
* R-SV: Applications will publish into the multicast address range of 224.0.2.1 – 224.0.2.254.  
    
  Each vendor will be allocated a group of 16 consecutive multicast addresses.

Additionally, each vendor will be allocated host IP addresses. There will be two class “c” addresses allocated for R-GOOSE and R-SV. Vendors will be assigned a specific range in one of the address ranges.

|  |  |  |
| --- | --- | --- |
| Protocol | Host Address Range 1 (A range) | Host Address Range 1 (B range) |
| R-GOOSE | 192.168.10.2-192.168.10.127 | 192.168.11.2-192.168.11.127 |
| R-SV | 192.168.10.129-192.168.10.254 | 192.168.11.129-192.168.11.254 |

An SCT shall be utilized to configure all subscribers to subscribe to all publishers of the same protocol. The configuration of subscriptions shall be done through SCL.

## Non-Routed Network Test Cases

A switched network will be provided but is not the target of the testing.

### GOOSE

#### SCL

The publishing participants were required to provide either Xfactor (e.g. ED.1 CID files) or IID SCL files containing the GOOSE configuration information. These files were used to configure the subscribers. Unlike the structured SCL tests, no SCD was required for the configuration, although allowed.

The SCL files should provide a minimum of 2 GOOSE control blocks. One Dataset for a GOCB should contain FCDAs while the other contains DataSet members that are FCDs:

* The FCDA DataSet should contain:  
  + single point status: stVal and q
  + double point status: stVal and q
  + double point: stVal and q
  + a measurement value: mag.f and q
* The FCDA DataSet should contain:
  + A DataSet member that has a functional constraint of ST
  + A DataSet member that has a functional constraint of MX

There is an optional test for a DataSet whose contents are both FCDA and FCD based.

#### Exchange a GOOSE with FCDAs

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | Procedure:  A publisher shall publish a DataSet whose members are FCDA. The dataset should contain as many information types as possible from the definitions above. |
| Expected Result: | Subscriber provides confirmation that the GOOSE was received and that the information was properly interpreted.  The mechanism to provide this verification for the witness observation is subscriber specific. |

#### Exchange a GOOSE with a combination FCD and FCDA

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | Procedure:  A publisher shall publish a DataSet whose members contain at least one FCD and one FCDA. The FCDA shall not be contained in the FCD. The dataset should contain as many information types as possible from the definitions above... |
| Expected Result: | Subscriber provides confirmation that the GOOSE was received and that the information was properly interpreted.  The mechanism to provide this verification for the witness observation is subscriber specific |

#### GOOSE Test Bit

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | No test description was provided  Procedure: |
| Expected Result: | A GOOSE test bit was present |

#### Detection of TAL Expiration

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | It is a local issue on how to accomplish this (e.g. pulling the publisher’s cable or setting the Enable to false).  Procedure:  The transmission of the published GOOSE is interrupted. |
| Expected Result: | The subscribing IED detects TAL expiration and gives some local indication. |

#### Simulation Bit

##### Ability to process data with simulation bit true

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | This involves the test set and is a precondition for the following tests.  Procedure:   1. The GOOSE publisher is publishing data. 2. The GOOSE publisher simulation flag is changed to indicate the GOOSE telegram is being published by a test device. |
| Expected Result: | The GOOSE data is examined using Wireshark and the GOOSE telegram should have the 8th octet set in Reserved 1... |

##### Ability to ignore data with simulation bit true

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | Procedure:   1. The publisher and GOOSE subscriber are functioning properly. 2. The GOOSE subscriber uses the GOOSE telegram indications should be LGOS1.St.stVal=true, LGOS1.SimSt.StVal=false 3. The GOOSE subscriber is put into LPHD1.St.Sim.stVal=true 4. The GOOSE subscriber continues using the GOOSE telegram, indications should be LGOS1.St.stVal=true, LGOS1.SimSt.StVal=false 5. A second identical GOOSE telegram is published by a test device and the simulation flag is set “true” 6. The GOOSE subscriber now will use the test GOOSE telegram, indication should be LGOS1.St.stVal=true, LGOS1.SimSt.StVal=true (The GOOSE subscriber will now only use GOOSE telegrams with the simulation flag set true) 7. Subscriber to provide sim status per implementation. |
| Expected Result: | The test set is publishing GOOSE telegrams with the Simulation flag set “true”. The subscriber shall decode the simulated telegrams.  Subscriber to provide sim status per implementation.  The mechanism to provide this verification for the witness observation is subscriber specific. |

## Routed Network Test Cases

A Routed Network will be provided. The network will consist of the following architecture:



The routed domain will utilize VLAN 8 as it is typical of utilities to use VLANs to segment routed domains.

### GOOSE

#### SCL

The publishing participants were required to provide either Xfactor (e.g. ED.1 CID files) or IID SCL files containing the GOOSE configuration information. These files were used to configure the subscribers. Unlike the structured SCL tests, no SCD was required for the configuration, although allowed.

The SCL files should provide a minimum of 2 GOOSE control blocks. One Dataset for a GOCB should contain FCDAs while the other contains DataSet members that are FCDs:

* The FCDA DataSet should contain:  
  + single point status: stVal and q
  + double point status: stVal and q
  + double point: stVal and q
  + a measurement value: mag.f and q
* The FCDA DataSet should contain:
  + A DataSet member that has a functional constraint of ST
  + A DataSet member that has a functional constraint of MX

There is an optional test for a DataSet whose contents are both FCDA and FCD based.

#### Exchange a GOOSE with FCDAs

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | Procedure:  A publisher shall publish a DataSet whose members are FCDA. The dataset should contain as many information types as possible from the definitions above. |
| Expected Result: | Subscriber provides confirmation that the GOOSE was received and that the information was properly interpreted.  The mechanism to provide this verification for the witness observation is subscriber specific. |

#### Exchange a GOOSE with a combination FCD and FCDA

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | Procedure:  A publisher shall publish a DataSet whose members contain at least one FCD and one FCDA. The FCDA shall not be contained in the FCD. The dataset should contain as many information types as possible from the definitions above... |
| Expected Result: | Subscriber provides confirmation that the GOOSE was received and that the information was properly interpreted.  The mechanism to provide this verification for the witness observation is subscriber specific |

#### GOOSE Test Bit

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | No test description was provided  Procedure: |
| Expected Result: | A GOOSE test bit was present |

#### Detection of TAL Expiration

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | It is a local issue on how to accomplish this (e.g. pulling the publisher’s cable or setting the Enable to false).  Procedure:  The transmission of the published GOOSE is interrupted. |
| Expected Result: | The subscribing IED detects TAL expiration and gives some local indication. |

#### Simulation Bit

##### Ability to process data with simulation bit true

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | This involves the test set and is a precondition for the following tests.  Procedure:   1. The GOOSE publisher is publishing data. 2. The GOOSE publisher simulation flag is changed to indicate the GOOSE telegram is being published by a test device. |
| Expected Result: | The GOOSE data is examined using Wireshark and the GOOSE telegram should have the 8th octet set in Reserved 1... |

##### Ability to ignore data with simulation bit true

This section contains a brief description of the test case, expected result, and the actual results.

|  |  |
| --- | --- |
| Test Case Description: | Procedure:   1. The publisher and GOOSE subscriber are functioning properly. 2. The GOOSE subscriber uses the GOOSE telegram indications should be LGOS1.St.stVal=true, LGOS1.SimSt.StVal=false 3. The GOOSE subscriber is put into LPHD1.St.Sim.stVal=true 4. The GOOSE subscriber continues using the GOOSE telegram, indications should be LGOS1.St.stVal=true, LGOS1.SimSt.StVal=false 5. A second identical GOOSE telegram is published by a test device and the simulation flag is set “true” 6. The GOOSE subscriber now will use the test GOOSE telegram, indication should be LGOS1.St.stVal=true, LGOS1.SimSt.StVal=true (The GOOSE subscriber will now only use GOOSE telegrams with the simulation flag set true) 7. Subscriber to provide sim status per implementation. |
| Expected Result: | The test set is publishing GOOSE telegrams with the Simulation flag set “true”. The subscriber shall decode the simulated telegrams.  Subscriber to provide sim status per implementation.  The mechanism to provide this verification for the witness observation is subscriber specific. |

## Infrastructure Testing

### IGMPv3 Testing of Routers

The infrastructure testing will utilize R-GOOSE.

#### LAN A

|  |  |
| --- | --- |
| Test Case Description: | 1. To verify that the routed infrastructure does not route traffic that is not a source specific subscription.  Add a new IED/Application that publishes to the same destination multicast address as one of the existing IEDs on LAN A. It shall have the same IED Name and configuration. It will have a different/unused host IP address. 2. A network sniffer on LAN B should be connected and monitoring the destination multicast address. 3. The IED whose destination multicast address is being published by the new IED shall be disconnected. |
| Expected Result: | The IEDs on LAN B should indicate an TAL timeout and the network sniffer should not show any packets being delivered to LAN B. |

#### LAN B

|  |  |
| --- | --- |
| Test Case Description: | 1. To verify that the routed infrastructure does not route traffic that is not a source specific subscription.  Add a new IED/Application that publishes to the same destination multicast address as one of the existing IEDs on LAN B. It shall have the same IED Name and configuration. It will have a different/unused host IP address. 2. A network sniffer on LAN A should be connected and monitoring the destination multicast address. 3. The IED whose destination multicast address is being published by the new IED shall be disconnected. |
| Expected Result: | The IEDs on LAN A should indicate an TAL timeout and the network sniffer should not show any packets being delivered to LAN A. |

### IGMP Snooping Testing of Switches

The infrastructure testing will utilize R-GOOSE.

|  |  |
| --- | --- |
| Test Case Description: | To verify that the switch properly supports IGMP snooping.   1. Add a new IED/Application that publishes to the different destination multicast address as one of any of the LAN A or LAN B. It shall have a different IED Name and configuration. It will have a different/unused host IP address. 2. Add a PC that is a GOOSE subscriber and has a network sniffer. The subscriber should subscribe to at least one GOOSE, but not the one of the new IED/Application. 3. The publisher should publish. |
| Expected Result: | The network sniffer should not show any packets being delivered to the PC’s subscriber. |

### Firewall

To be determined. Need input from Firewall vendors.