## Solution for Redmine #645

## A4.11a Sampled Values Publish

At least one of the backwards compatible configurations (F4000S1I4U4, F4800S1I4U4, F5760S1I4U4) and at least one of the preferred sample rates specified in IEC 61869-9 shall be supported.

The test lab shall change the applicable SV configuration parameters using the SCT or ICT (when a SmvSettings option is fix), to verify the DUT uses the configured values and not the default values.

The test lab chooses a random or the maximum configuration to perform each test case, with the following exceptions:

* sSvp1 shall be performed using the maximum configuration
* sSvp3 and sSvp5 shall be executed with a preferred configuration and also with a backwards compatible configuration
* sSvp10 and sSvp13 shall be executed with a backwards compatible configuration

Note: The derived quality bit is not specified in IEC 61850-7-3, IEC 61850-9-2 and IEC 61869-9. The derived quality bit will be ignored.

|  |  |
| --- | --- |
| **Test ID** | **Test Case** |
|  | Verify that the maximum delay time from taking the (first, oldest) sample to sending the corresponding message is within the limit of the application class (table 901) and within the limit of LPHD.MaxDl and LPHD.NamMaxDlRtg  |
|  | Verify the format of the link layer: destination MAC, TPID=0x8100, VLAN, Ethertype=0x88BA, APPID, Length* MSVCB01 has APPID = 0x4000, Reserved1=0, Reserved2=0
* MSVCB02 has APPID = 0x4000, Reserved1=0, Reserved2=0
* Other MSVCB has APPID as configured in the SCL, Reserved1=0, Reserved2=0
 |
|  | Verify optional fields, confRev, nofASDU* MSVCB01 has only optional field sampleSynchronized, confRev=1 and nofAsdu=1
* MSVCB02 has only optional fields sampleSynchronized, confRev=1 and nofAsdu=8
* Other MSVCB has optional field sampleSynchronized and optionally synchSourceId, confRev and nofAsdu as configured in the SCL, refresh-time shall be false
 |
|  | Verify the format of the ASDU matches the SCL configuration |
|  | Verify the data set matches the configured/required data set definition* MSVCB01 has data set PhsMeas1 and elements
* MSVCB02 has data set PhsMeas1 and elements
* Other MSVCB have dataset as configured in the SCL, Current values shall precede any voltage values, phase order shall be A-B-C-N, shall not exceed the maximum number of elements
 |
|  | Verify the sample and message rate matches with the MSVCBxx* MSVCB01 samples are transmitted with 80 messages per cycle
* MSVCB02 samples are transmitted with 32 (256/8) messages per cycle
* Other MSVCB samples are transmitted with the configured sample and message rate
 |
|  | Verify that the size for encoding the Length field (TLV) of the variable size elements shall always use minimum length encoding (tissue #1720) |
|  | Verify that the sampled values match with the analogue signals and quality |
| sSvp9 | Verify that when the DUT is synchronised with PTP time source and that in case the PTP signal is lost the SmpSynch in the SV message shall be changed from 2 to 0. "SmpCnt" shall wrap as if a synchronization would be presentVerify that the DUT is synchronised with PTP time source and that in case the GPS signal is lost the SmpSynch in the SV message shall be changed from 2 to 1. "SmpCnt" shall wrap as if a synchronization would be present. |
| sSvp10 | Verify that when the DUT is synchronised with PPS time source and that in case the PPS signal is lost the SmpSynch in the SV message shall be changed from 2 to 0. "SmpCnt" shall wrap as if a synchronization pulse would be present |
| sSvp11 | Verify that after restoring the power the DUT shall publish valid/plausible SV messages within specified time (PIXIT). It is allowed that SmpSynch=0 when DUT is not yet synchronisedCondition: when DUT is not test equipment |
| sSvp12 | If the DUT can produce simulated SV streams verify that in SIMULATION mode the Reserved1 flag Simulate=set (IEC 61850-9-2 $5.3.4.4.4).Note: Simulation is expected to be implemented for test equipment. |
| sSvp13 | Signals that are not measured or calculated shall have the corresponding Quality bit = InvalidCondition: when DUT does measure less then 3 currents and 3 voltages or the DUT supports Quality = invalid |
| sSvp14 | Verify the DUT supports max length MsvID by configuration.* MSVCB01 has MsvID as defined in 9-2LE (max length 32)
* MSVCB02 has MsvID as defined in 9-2LE (max length 32)
* Other MSVCB has MsvID as configured in the SCL (max length 129)
 |
| sSvp15 | Verify that synchSourceId matches the GMC ID. Condition: This test is applicable if PTP is declared. |
| sSvp16 | Verify that in TEST mode the quality.test=set in each sampleCondition: when Mod = Test is supported |
| sSvp17 | When clipping occurs the detailed Quality “out-of-range” is setCondition: This test is applicable if SAMU device |

|  |  |
| --- | --- |
| sSvp20 | Request GetLogicalNodeDirectory(MSVCB) and request GetMSVCBValues (IEC 61850-7-2 Subclause 19.2.2.3) |
| sSvp21 | Request SetMSVCBValues to disable a MSVCB, verify that no SV messages are transmitted anymore (IEC 61850-7-2 Subclause 19.2.2.4) |
| sSvp22 | No attributes of the MSVCB control block can be set except for SvEna. (IEC 61850-9-2 Table 9)  |

Detailed test procedures

|  |  |  |
| --- | --- | --- |
| **sSvp1** | **Verify that the maximum delay time from taking the sample to sending the corresponding message is within the limit** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Table 901, 6.903.2PIXIT Svp1 |
| Expected result2. DUT samples the signals as configured3. DUT sends sampled value messages. The computed delay time shall be less than specified for the application class ms (+0%, -100%). The computed delay time is defined as the fraction of second of the capture time of the message with SmpCnt=0, when SmpCnt is the first, oldest sample in the message. Otherwise add sample time for each additional sample in the message. The maximum delay shall not exceed the value specified in LPHD.NamMaxDlRtg and also LPHD.MaxDl |
| Test descriptionUse the maximum SV configuration, i.e. with the biggest number of quantities that can be configured for a SV stream, without exceeding the sum of quantities limits specified in IEC 61869-9 Clause 6.903.2; in that case, the max configuration will follow: half of channels will be allocated to voltages and half to currents.When PTP is supported1. Configure the DUT with PTP and wait till DUT is synchronized2. Generate current and/or voltage signals3. Capture the sampled values messages for 1 minute4. Repeat step 2 to 3 five times using PTPWhen PTP is not supported:5. Configure the DUT with PPS and wait till DUT is synchronized6. Repeat step 2 to 3 five times using PPS |
| CommentThe maximum measured delay is: - PTP/PPS Configuration X = <max delay>  |

|  |  |  |
| --- | --- | --- |
| **sSvp2** | **Verify the format of the link layer** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-9-2 |
| Expected result3. DUT sends sampled value messages with the following format of the link layer: - destination MAC address = 01-0C-CD-04-xx-xx, as configured  - TPID = 0x8100 - VLAN priority as configured (default = 4) - VLAN ID as configured - Ethertype = 0x88BA  - APPID = 0x4000 for MSVCB01 and MSVCB02, otherwise as configured - reserved 1 = 0x0000 - reserved 2 = 0x0000 |
| Test description1. Configure the DUT with a random configuration, VLAN ID = 0x100 and APPID <> 0x4000 in case of a preferred configuration2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 second |
| CommentTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp3** | **Verify optional fields, confRev and nofAsdu** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.903.11Tissue #1692 |
| Expected result3. DUT sends sampled value messages with- MSVCB01 has only optional field sampleSynchronized, confRev=1 and nofAsdu=1- MSVCB02 has only optional fields sampleSynchronized, confRev=1 and nofAsdu=8- Other MSVCB has optional field sampleSynchronized; optional fields: refreshTime, sampleRate, dataSet and security shall be false; Optional field synchSourceId and confRev as configured in SCL4. The frame contains the synchSourceId service parameter.5. The frame does not contain the synchSourceId service parameter. |
| Test description1. Configure the DUT with a random preferred configuration2. Generate current and/or voltage signals3. Capture the sampled values messages for 1 second4. If PTP is supported, configure synchSourceId to TRUE.5. If PTP is supported, configure synchSourceId to FALSE.6. Repeat the test for a backwards compatible configuration |
| CommentNote: confRev=1 is specified in 9-2LETested with configuration: X and Y  |

|  |  |  |
| --- | --- | --- |
| **sSvp4** | **Verify the format of the ASDU matches the SCL configuration** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-9-2 Clause 8.5, Table 14 |
| Expected result3. DUT sends sampled value messages as configured in SCL |
| Test description1. Configure the DUT with a random configuration2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 second |
| CommentTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp5** | **Verify the ASDU dataset elements** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.903.10 PIXIT Svp4 |
| Expected result3. DUT sends sampled value messages with the correct data set elements matching the variant code under test* MSVCB01 has data set PhsMeas1 and elements
* MSVCB02 has data set PhsMeas1 and elements
* Other MSVCB have dataset as configured in the SCL, Current values shall precede any voltage values, phase order shall be A-AB-B-BC-C-CA-N, shall not exceed the maximum number of elements
 |
| Test description1. Configure the DUT with a random preferred configuration2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 second4. Repeat the test for a backwards compatible configuration  |
| CommentTested with configuration: X and Y |

|  |  |  |
| --- | --- | --- |
| **sSvp6** | **Verify the sample rate**  | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.903.11 |
| Expected result2. DUT samples the signals as configured3. In one minute DUT sends 60 x samples per seconds / numAsdu ±1 sampled value messages * MSVCB01 samples are transmitted with 80 messages per cycle
* MSVCB02 samples are transmitted with 32 (256/8) messages per cycle
* Other MSVCBxx samples are transmitted with the configured sample and message rate
 |
| Test description1. Configure the DUT with a random configuration and the applicable 50 or 60 Hz nominal frequency2. Generate current and/or voltage signals3. Capture the sampled values messages for 1 minute4. Repeat step 1 to 3 five times5. For the preferred variant repeat step 1 to 4 for the other nominal frequency (when supported) |
| CommentNote: * F4000S1I4U4 = 50Hz only
* F4800S1I4U4 and F5760S1I4U4 = 60Hz only
* For the preferred variants the sample rate shall be independent from the nominal frequency.

Tested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp7** | **Verify that the size for encoding the Length field (TLV) of the variable size elements shall always use minimum length encoding** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| Tissue #1720  |
| Expected result2. DUT sends sampled value messages with following length encoding for SV message length, ASDU length, MsvID length and Dataset length:* Length <128: <Type> <Length one byte> <Value>
* Length 128..255: <Type> 0x81 <Length one byte> <Value>
* Length >255: <Type> 0x82 <Length 2 bytes> <Value>
 |
| Test description1. Configure the DUT with a random configuration with small (<127) variable size elements2. Capture the sampled values messages for at least 1 second3. Configure the DUT with a random configuration with large (from 128 to 255) variable size elements4. Capture the sampled values messages for at least 1 second |
| CommentTested with configuration: X and Y |

|  |  |  |
| --- | --- | --- |
| **sSvp8** | **Verify plausibility that the sampled values match with the analogue signals and quality** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.903.9PIXIT: Svp5, Svp12 |
| Expected result3. Voltages* If VN is calculated, check that VN is equal to the magnitude of VA, VB, VC when applying 1 phase voltage and near zero when no signal is applied.
* For measured channels, verify match with signal source

    Currents* If IN is calculated, check that IN is equal to the magnitude of IA, IB, IC (ignoring the sign) when applying 1 phase current and near zero when no signal is applied.
* For measured channels, verify match with signal source

 Quality* The validity is good when the signal is measured or calculated
* The overflow, badReference, oscillatory, oldData, inconsistent and operatorBlocked flags shall be set to false
* The source shall be process
* For backward compatible MSVCB it is permissible to set the “derived” bit (bit 13) when the value is calculated
 |
| Test description1.  Configure the DUT with a random configuration and the correct parameters and frequency2.  Apply current and/or voltage signals to each phase 1 at-a-time for at least 5 seconds each then apply no signal for 10 seconds3.  Capture the sampled values messages |
| CommentThis is a plausibility check not an accuracy test.Tested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp9** | **Verify that the DUT is synchronized with PTP time source** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.904, 6.904.7IEC 61850-9-2 Ed2 Amd1 Clause 9 PIXIT Svp6, Svp7 |
| Expected result3. When PTP is connected DUT sends sampled value messages with SmpSynch = 2 within 30 seconds4. DUT sends sampled value messages with SmpSynch = 1. The maximum processing delay does not change by more than ±100 μs from the value measured during the 1 min synchronized state test (sSvp1).5. Within the maximum resynch time (PIXIT Svp7) the SmpSynch = 26. When DUT has left the hold-over mode it sends messages with SmpSynch = 0.  SmpCnt shall wrap as if a PTP master would be present.  The maximum processing delay does not change by more than ±100 μs from the value measured during the 1 min synchronized state test7. Within the maximum resynch time (PIXIT Svp7) the SmpSynch = 2. The values of SmpCnt and SmpSynch shall in all cases correspond to the time scale and source used for the samples in that ASDU. The sample following a jump have the adjusted values of both SmpCnt and SmpSynch |
| Test description1. Configure the DUT with a preferred configuration and connect PTP grand master2. Generate current and/or voltage signals3. Capture the sampled values messages 4. Force the global PTP master to local (clockClass not 6 and not 7), then wait 30 seconds, by for example disconnecting the GPS antenna5. Restore the PTP grand master from local to global, by for example connecting the GPS antenna, and wait till the samples are synchronized6. Disconnect all PTP grand masters and wait the holdover time (TVTR/TCTR.HoldTmms) plus 30 seconds7. Connect the PTP grand master and wait till the samples are synchronized |
| CommentNote: This test may not be practical for devices with holdover mode exceeding 24 h. Such devices are exempt from step 6 and are expected to ensure compliance by designTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp10** | **Verify that the DUT is synchronized with PPS time source** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.904, 6.904.7PIXIT: Svp6, Svp7 |
| Expected result3. When PPS is connected DUT sends sampled value messages with SmpSynch = 2 within 30 seconds 4. When DUT has left the hold-over mode it sends messages with SmpSynch = 0.  SmpCnt shall wrap as if a synchronization pulse would be present When SmpSynch = 0 the maximum processing delay does not change by more than ±100 μs from the value measured during the 1 min synchronized state test 5. Within the maximum resynch time (PIXIT Svp7) the SmpSynch = 2. The values of SmpCnt and SmpSynch shall in all cases correspond to the time scale and source used for the samples in that ASDU. The sample following a jump have the adjusted values of both SmpCnt and SmpSynch   |
| Test description1. Configure the DUT with a backwards compatible configuration and PPS2. Generate current and/or voltage signals3. Capture the sampled values messages 4. Disconnect the PPS after 10 seconds and wait the holdover time (TCTR/TVTR.HoldTmms) plus 30 seconds5. Connect the PPS |
| CommentNote: This test may not be practical for devices with holdover mode exceeding 24 h. Such devices are exempt from step 4 and are expected to ensure compliance by designTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp11** | **Verify that after restoring the power the DUT shall publish valid 9-2 messages within specified time (PIXIT).** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| PIXIT Svp8, Svp10 |
| Expected result3. DUT sends synchronized and valid sampled value messages within the PIXIT specified time after restoring the power; DUT may send values with validity=invalid during the start-up |
| Test description1. Configure the DUT with a random configuration2. Generate current and/or voltage signals, after 10 seconds disconnect and restore the power supply3. Capture the sampled values messages until valid samples are transmitted |
| CommentTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp12** | **Verify that in SIMULATION the Reserved1.Simulate=set** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-9-2 Clause 5.3.4.4.4PIXIT Svp3 |
| Expected result3. DUT sends sampled value messages with Reserved1.Simulate=set for each message |
| Test description1. Configure the DUT with a random configuration and enable SIMULATION2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 second |
| CommentTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp13** | **Signals that are not measured or calculated shall have the corresponding Quality bit = Invalid (PIXIT)** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.903.9IEC 61850-9-2 Amd1 Table 17, Annex C.3.5PIXIT Svp9 |
| Expected result3. Signals that are not measured or calculated or as specified in the PIXIT shall have the corresponding Quality bit Invalid (0x0002). Any derived values shall have quality bit invalid as well |
| Test description1. Configure the DUT with a backwards compatible configuration as specified in the PIXIT to force quality invalid2. Generate current and/or voltage signals and force quality invalid3. Capture the sampled values messages for at least 1 second |
| CommentIEC 61850-9-2 Ed2 Amd1 Annex C.3.5 states: Servers compliant with the current standard shall not use the formerly “Reserved” value. As such Invalid value 0x0001 is not allowedTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp14** | **Verify minimum & maximum length MsvID** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 6.903.11 |
| Expected result3. DUT sends sampled value messages with maximum length MsvID for each sample5. DUT sends sampled value messages with 4 char length MsvID for each sample |
| Test description1. Configure the DUT with a random configuration and maximum length MsvID (32 char for the backwards compatible and 129 for the preferred configuration)2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 secondFor the preferred variant4. Configure the DUT a preferred configuration and 4 char length MsvID5. Capture the sampled values messages for at least 1 second |
| CommentTested with configuration: X and Y |

|  |  |  |
| --- | --- | --- |
| **sSvp15** | **Verify synchSourceId matches the GMC ID** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-6 Ed2 Amd1 Table 30SCL Services.SMVSettings.synchSrcId=true |
| Expected result3. DUT sends sampled value messages with synchSourceId matching the GMC ID  |
| Test description1. Configure the DUT with a random configuration and enable the optional field synchSourceId and synchronize it to a PTP master clock2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 second |
| CommentNote: not applicable for the backwards compatible ratesTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp16** | **Verify that in TEST mode the quality bit TEST is set for each sample (PIXIT)** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-9-2 Clause 6PIXIT Svp2 |
| Expected result3. DUT sends sampled value messages with quality bit TEST (0x0800) for each sample |
| Test description1. Configure the DUT with a random configuration and set Mod = Test2. Generate current and/or voltage signals3. Capture the sampled values messages for at least 1 second |
| CommentTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp17** | **When clipping occurs the detailed Quality “out-of-range” is set** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 Clause 5.901. 6.903.9, Table 905, Table 907IEC 61850-9-2 Amd1 Table 17, Annex C.3.5PIXIT: Svp13 |
| Expected result4. Some but not all Current and Voltage samples have set detailQuality bit out-of-range and validity questionable.  |
| Test description1. Configure the DUT with a random configuration and to force clipping2. Generate current signals with peak exceeding the clipping limits: TCTR.NamClipRtg, TCTR.Clip 3. Generate voltage signals with peak exceeding the clipping limits: TVTR.NamClipRtg, TVTR.Clip4. Capture the sampled values messages |
| CommentNote: it might be reasonable impossible to force clipping. If so the result is InconclusiveTested with configuration: X |

|  |  |  |
| --- | --- | --- |
| **sSvp20** | **GetLogicalNodeDirectory(MSVCB) and GetMSVCBValues** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-7-2 Subclause 19IEC 61850-9-2 Subclause 8.2.2 |
| Expected result1. DUT sends GetLogicalNodeDirectory(MSVCB) response+ with a list of MSVCB’s. The MSVCB shall be located in LLN0.2. DUT sends GetMSVCBValues response+, the returned values match with the SCL configured values |
| Test description1. For each logical node Client requests GetLogicalNodeDirectory(MSVCB)2. For each MSVCB Client requests GetMSVCBValues |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvp21** | **SetMSVCBValues** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-7-2 Subclause 19IEC 61850-9-2 Table 9 |
| Expected result1. DUT sends SV messages
2. DUT sends a SetMSVCBValues response+ and stops publishing SV messages
3. DUT sends a SetMSVCBValues response+ and initializes/starts publishing SV messages
 |
| Test description1. Configure DUT to publish SV messages
2. Client requests a SetMSVCBValues with SvEna set to FALSE
3. Client requests a SetMSVCBValues with SvEna set to TRUE
 |
| CommentSvEna is the only attribute that may be written according to part 9-2. |

|  |  |  |
| --- | --- | --- |
| **sSvp22** | **Verify that MSVCB attributes are read-only** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61850-7-2 Clause 19.2.3.4IEC 61850-9-2 Table 9 |
| Expected result1. When SetMSVCBValues supported DUT sends a SetMSVCBValues response+ otherwise response-
2. DUT sends a SetMSVCBValues response-
3. DUT sends a SetMSVCBValues response-
4. DUT sends a SetMSVCBValues response-
5. DUT sends a SetMSVCBValues response-
6. When SetMSVCBValues supported DUT sends a SetMSVCBValues response+ otherwise response-
 |
| Test description1. Client requests a SetMSVCBValues to disable SvEna
2. Client requests a SetMSVCBValues with valid MsvID
3. Client requests a SetMSVCBValues with valid DatSet
4. Client requests a SetMSVCBValues with valid DstAddress
5. Client requests a SetMSVCBValues with valid OptFlds
6. Client requests a SetMSVCBValues to enable SvEna
 |
| Comment |

## A4.11b Sampled Values Subscribe

At least one of the backwards compatible configurations (F4000S1I4U4, F4800S1I4U4, F5760S1I4U4) and at least one of the preferred configurations shall be supported.

The starting point for the subscriber communication test is that the SV publishers do conform to the standard, taking into account backwards and forward compability. Negative testing is to verify the behaviour on a mismatching configuration and ethernet network issues (e.g. dropped packets).

The following applicable test cases need to be executed for a random supported configuration, chosen by the test lab, with maximum number of currents (x) and voltages (y) as specified in PIXIT unless specified otherwise in the test case.

Abstract test cases

|  |  |
| --- | --- |
| **Test ID** | **Test Case** |
|  | Verify that the DUT subscribes to one supported SV stream * with a matching VLAN ID and priority
* with a mismatching VLAN ID
* with a mismatching VLAN priority
* without VLAN
* with VLAN ID = 0
* with a MAC-address inside and outside the recommended MAC address range
* with the Reserved1: R>0
 |
|  | Verify that the DUT subscribes to one supported SV stream with and without optional field synchSourceId (preferred variant only) |
|  | When nr of Samples (noASDU) > 1, verify that the DUT subscribes to one supported SV stream with the sample with smpCnt=0 is not first sample in the packet |
|  | Verify that the DUT subscribes to the real SV stream and ignores the simulated SV stream when LPHD.Sim is False or not presentVerify that the DUT subscribes to the simulated SV stream and ignores the real SV stream when LPHD.Sim is TrueVerify LSVS behaviour when supported |
|  | Verify that the DUT ignores the quality derived when set (backwards variant only) |
|  | Verify the DUT subscribes to the specified maximum (SCL ClientServices.maxSMV) number of SV streams  |
|  | Verify the DUT subscribes to the specified maximum (PIXIT) number of dataset elements (volt and current signals) |
|  | Verify that the DUT subscribes to one SV stream with the minimum length SVID (4 chars) and one SV stream with maximum length SVID (129 chars) |
|  | Verify the DUT subscribes to one SV stream with jitter caused by other network traffic; hold SV packets for 1 ms within the maximum delay limit of the supported application class |
|  | Verify the DUT subscribes to one SV stream with maximum delay for the supported application class(this does not include the delay caused by the network) |
|  | Verify the behaviour of the DUT when the quality = INVALID for each sample in one SV stream (PIXIT) |
|  | Verify the logical node LSVS data object attribute values on receiving valid SV messages, no SV messages and SV messages with mismatching ConfRev |
|  | If security is not supported on subscriber, then test that it ignores security and accepts the message. (9-2 Am1 Clause 5.3.3.4.5) |
|  | Verify that SV with future extensions ‘…’ are tolerated |

|  |  |
| --- | --- |
| **Test ID** | **Test Case** |
|  | Verify that the DUT behaves as specified in the PIXIT on a configuration mismatch: * Mismatching MAC address
* Mismatching APPID
* ConfRev+1 and ConfRev-1
* synchSourceId present when not expected, synchSourceId absent when expected
 |
|  | Verify that the DUT behaves as specified in the PIXIT on a mismatching data set element: * extra element(s) with ConfRev+1
* missing last element (s) with ConfRev-1

(preferred variant only) |
|  | Verify that the DUT behaves as specified in the PIXIT on a broken path (“disconnect the cable between 2 switches”, without PRP/HSR) |
|  | Verify that the DUT behaves as specified in the PIXIT when smpSynch is 0, 1 or 5..255 |
|  | Verify that the DUT behaves as specified in the PIXIT when missing 1, 3, 5, 10 consecutive packets |
|  | Verify that the DUT behaves as specified in the PIXIT when the packet with smpCnt=0 is missing  |

Detailed test procedures

|  |  |  |
| --- | --- | --- |
| **sSvs1** | **Verify that the DUT subscribes to one supported SV stream**  | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a |
| Expected result1-6. DUT subscribes to the sampled values and exposes the values according to PIXIT. |
| Test descriptionConfigure the DUT to subscribe to a random SV stream with a recommended destination MAC address 1. SIMULATOR publishes SV stream with matching VLAN ID and priority2. SIMULATOR publishes SV stream with mismatching VLAN ID and mismatching VLAN priority3. SIMULATOR publishes SV stream without VLAN tag4. SIMULATOR publishes SV stream with VLAN ID = 05. SIMULATOR publishes SV stream with Reserved1: R value >0Configure the DUT to subscribe to an SV stream with a destination MAC address outside the recommended range.6. SIMULATOR publishes SV stream with the destination MAC address outside the recommended range  |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs2** | **Verify that the DUT subscribes to one supported SV stream with and without optional field synchSourceId**  | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 ClausePIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values 2. DUT subscribes the sampled values  |
| Test descriptionConfigure the DUT to subscribe to a preferred SV stream with optional field synchSourceId1. SIMULATOR publishes SV stream with synchSourceIdConfigure the DUT to subscribe to a backwards compatible SV stream without optional field synchSourceId 2. SIMULATOR publishes SV stream without synchSourceId  |
| CommentNote: synchSourceID mismatch is tested in sSvsN1 |

|  |  |  |
| --- | --- | --- |
| **sSvs3** | **When nr of Samples (noASDU) > 1, verify that the DUT subscribes to one supported SV stream with the sample with smpCnt=0 is not first sample in the packet** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values 2. DUT subscribes the sampled values  |
| Test descriptionConfigure the DUT to subscribe to a random SV stream with noASDU>11. SIMULATOR publishes SV stream with the sample with smpCnt=0 is the first sample in the packet2. SIMULATOR publishes SV stream with the sample with smpCnt=0 is not the first sample in the packet |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs4** | **Verify that the DUT subscribes to the real SV stream and ignores the simulated SV stream when LPHD.Sim is False or not present and when LPHD.Sim is True** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1b, Svs3 |
| Expected result1. DUT subscribes the real sampled values according to PIXIT, LSVS.St = TRUE, LSVS.SimSt=FALSE2. DUT ignores the simulated sampled values, LSVS.St = TRUE, LSVS.SimSt=FALSE3. DUT indicates loss of SV stream according to PIXIT, LSVS.St changes to FALSE (LSVS.SimSt = FALSE)4. DUT subscribes the real sampled values according to PIXIT, LSVS.St = TRUE, LSVS.SimSt=FALSE5-7. DUT subscribes to the simulated sampled values according to PIXIT, LSVS.SimSt changes to TRUE8. DUT indicates loss of SV stream according to PIXIT, LSVS.St changes to FALSE9. DUT subscribes the real sampled values according to PIXIT, LSVS.St = TRUE, LSVS.SimSt=FALSE |
| Test descriptionConfigure the DUT to subscribe to a random SV streamTest engineer forces LPHD.Sim=False or LPHD.Sim is absent 1. SIMULATOR publishes SV stream with the simulation bit not set2. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set3. SIMULATOR publishes only SV stream with the simulation bit setWhen LPHD.Sim is present, test engineer forces LPHD.Sim=True and perform steps 4-9: 4. SIMULATOR publishes SV stream with the simulation bit not set5. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set6. SIMULATOR publishes only SV stream with the simulation bit set7. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set8. SIMULATOR publishes only SV stream with the simulation bit not setTest engineer forces LPHD.Sim=False 9. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set |
| CommentNote: LSVS is optional and only verified when available. When LSVS is available the LSVS.SimSt is optional |

|  |  |  |
| --- | --- | --- |
| **sSvs5** | **Verify that the DUT ignores the quality derived when set**  | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values 2. DUT subscribes the sampled values  |
| Test descriptionConfigure the DUT to subscribe to a backwards compatible SV stream1. SIMULATOR publishes SV stream with quality derived not set2. SIMULATOR publishes SV stream with quality derived set  |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs6** | **Verify the DUT subscribes to the specified maximum (SCL ClientServices.maxSMV) number of SV streams for this variant** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1bSCL ClientServices.maxSMV |
| Expected result1. DUT subscribes the sampled values of each real SV stream |
| Test descriptionConfigure the DUT to subscribe to the maximum number of SV streams, with at least one preferred stream and at least one backwards compatible stream1. SIMULATOR publishes maximum number of real SV streams plus the same number of simulated streams
 |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs7** | **Verify the DUT subscribes to the specified maximum (PIXIT) number of dataset elements** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs2b |
| Expected result1. DUT subscribes to all the sampled values in the SV stream
 |
| Test descriptionConfigure the DUT to a random SV stream with the maximum number of dataset elements1. SIMULATOR publishes the SV stream with the maximum number of volts and amps
 |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs8** | **Verify that the DUT subscribes to one SV stream with the minimum length SVID (4 chars) and one with maximum length SVID (129 chars)** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values 2. DUT subscribes the sampled values  |
| Test descriptionConfigure the DUT to subscribe to a random SV stream with minimum length SVID (4 chars)1. SIMULATOR publishes SV stream with the SVID as configuredConfigure the DUT to subscribe to a preferred SV stream with maximum length SVID (129 chars)2. SIMULATOR publishes SV stream with the SVID as configured  |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs9** | **Verify the DUT subscribes to one SV stream with jitter caused by other network traffic; hold SV packets for 1 ms**  | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values 2. DUT subscribes the sampled values  |
| Test descriptionConfigure the DUT to subscribe to a random SV stream1. SIMULATOR publishes SV stream with a normal/minimum jitter2. SIMULATOR publishes SV stream and holds (once per second) the samples for 1ms, and then flushes the samples as fast as possible. The total delay shall not exceed the maximum delay limit of the protection application class  |
| CommentNote: the subscriber does not have an application class |

|  |  |  |
| --- | --- | --- |
| **sSvs10** | **Verify the DUT subscribes to one SV stream with maximum delay for the supported application class****(this does not include the delay caused by the network)** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs1a, Svs1b, Svs11 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values3. DUT subscribes the sampled values |
| Test descriptionConfigure the DUT to subscribe to a random SV stream and most precise time synchronization system if supported.1. SIMULATOR publishes SV stream with normal delay2. SIMULATOR publishes SV stream with maximum delay for the supported application class 3. SIMULATOR publishes SV stream with maximum total delay |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs11** | **Verify the behaviour of the DUT when the quality = INVALID for each sample in one SV stream (PIXIT)** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs9 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values and quality according to PIXIT3. DUT subscribes the sampled values and quality according to PIXIT |
| Test descriptionConfigure the DUT to subscribe to a random SV stream1. SIMULATOR publishes SV stream with quality valid2. SIMULATOR publishes SV stream with one value quality invalid3. SIMULATOR publishes SV stream with all values quality invalid |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs12** | **LSVS data object values** | [ ]  Passed[ ]  Failed[ ]  Inconclusive |
| IEC 61869-9PIXIT Svs1a, Svs1b |
| Expected result1. LSVS.St.stVal=TRUE, LSVS.ConfRevNum.stVal (when available), LSVS.RxConfRevNum.stVal (when available) and LSVS.GoCBRef.setSrcRef match with the subscribed GOOSE message
2. LSVS.St.stVal=FALSE
3. LSVS.St.stVal=TRUE
4. LSVS.St.stVal=FALSE; LSVS.RxConfRevNum.stVal (when available) does contain the SV message ConfRev value
 |
| Test descriptionConfigure the DUT to subscribe to a random SV stream1. Publisher sends normal SV messages
2. Publisher stops sending SV messages for one minute
3. Publisher sends normal SV messages without data change
4. Publisher only sends SV messages with a mismatching ConfRev value
 |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs13** | **Subscribe to “secure” SV message** | [ ]  Passed[ ]  Failed[ ]  Inconclusive |
| IEC 61869-9IEC 61850-9-2 Clause 5.3.3.4.5PIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values |
| Test descriptionConfigure the DUT to subscribe to a random SV stream1. Publisher sends SV messages with Reserved1: S=0, R=0, Security bits all 1, Reserved 2 bits all 1 and several tailing non-zero bytes
 |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvs14** | **Subscribe to SV message with future extensions** | [ ]  Passed[ ]  Failed[ ]  Inconclusive |
| IEC 61869-9IEC 61850-9-2 Table 14PIXIT Svs1a, Svs1b |
| Expected result1. DUT subscribes the sampled values |
| Test descriptionConfigure the DUT to subscribe to a random SV stream1. Publisher sends SV messages with an extra fields after “IMPLICIT SEQUENCE OF ASDU” and an extra field after SynchSrcID
 |
| CommentTable 14 indicates ASN.1 “…” in 2 places; this means that the SV message can be extended in a next version and that these tags shall be ignored in the current version |

|  |  |  |
| --- | --- | --- |
| **sSvsN1** | **Verify that the DUT behaves as specified in the PIXIT on a configuration mismatch** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs4 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values according to PIXIT-Svs43. DUT subscribes the sampled values according to PIXIT-Svs44. DUT subscribes the sampled values according to PIXIT-Svs45. DUT subscribes the sampled values according to PIXIT-Svs46. DUT subscribes the sampled values according to PIXIT-Svs47. DUT subscribes the sampled values according to PIXIT-Svs48. DUT subscribes the sampled values9. DUT subscribes the sampled values according to PIXIT-Svs4 |
| Test descriptionConfigure the DUT to subscribe to a backward compatible SV stream without synchSourceId1. SIMULATOR publishes SV stream as configured2. SIMULATOR publishes SV stream with mismatching destination MAC-address3. SIMULATOR publishes SV stream with mismatching APPID4. SIMULATOR publishes SV stream with mismatching SVID5. SIMULATOR publishes SV stream with ConfRev+1 (same dataset)6. SIMULATOR publishes SV stream with ConfRev-1 (not 0, same dataset)7. SIMULATOR publishes SV stream with synchSourceIdConfigure the DUT to subscribe to a preferred SV stream with synchSourceId8. SIMULATOR publishes SV stream as configured9. SIMULATOR publishes SV stream without synchSourceId |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvsN2** | **Verify that the DUT behaves as specified in the PIXIT on a mismatching data set element** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9 6.903.10PIXIT Svs5 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values according to PIXIT-Svs53. DUT subscribes the sampled values according to PIXIT-Svs5 |
| Test descriptionConfigure the DUT to subscribe to a preferred SV stream1. SIMULATOR publishes SV stream with synchSourceId2. SIMULATOR publishes SV stream with ConfRev+1, with an extra dataset element pair at the end3. SIMULATOR publishes SV stream with ConfRev-1, with missing last dataset element pair |
| CommentA pair is the sample plus quality |

|  |  |  |
| --- | --- | --- |
| **sSvsN3** | **Verify that the DUT behaves as specified in the PIXIT on a broken path** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs6 |
| Expected result1. DUT subscribes the sampled values2. DUT behaves as specified in PIXIT-Svs63. DUT subscribes the sampled values  |
| Test descriptionConfigure the DUT to subscribe to a random SV stream (without link redundancy)1. SIMULATOR publishes SV stream2. Disconnect the link between publisher and the subscriber by for example disconnect the ethernet cable between 2 ethernet switches for 10 seconds3. Connect the link between publisher and the subscriber  |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvsN4** | **Verify that the DUT behaves as specified in the PIXIT when smpSynch is 0, 1 or 5..255** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs8 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values according to PIXIT-Svs83. DUT subscribes the sampled values according to PIXIT-Svs84. DUT subscribes the sampled values according to PIXIT-Svs85. DUT subscribes the sampled values according to PIXIT-Svs86. DUT subscribes the sampled values according to PIXIT-Svs8 |
| Test descriptionConfigure the DUT to subscribe to a random SV stream1. SIMULATOR publishes SV stream with smpSynch=22. SIMULATOR publishes SV stream with smpSynch=03. SIMULATOR publishes SV stream with smpSynch=1 with the same synchSourceId4. SIMULATOR publishes SV stream with smpSynch=1 with another synchSourceId5. SIMULATOR publishes SV stream with smpSynch=56. SIMULATOR publishes SV stream with smpSynch=255 |
| CommentNote: in case smpSynch=1 it may have the same or different synchSourceId this is out-of-scope for conformance |

|  |  |  |
| --- | --- | --- |
| **sSvsN5** | **Verify that the DUT behaves as specified in the PIXIT when missing 1, 3, 5, 10 consecutive packets** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs7 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values according to PIXIT-Svs73. DUT subscribes the sampled values according to PIXIT-Svs74. DUT subscribes the sampled values according to PIXIT-Svs75. DUT subscribes the sampled values according to PIXIT-Svs7 |
| Test descriptionConfigure the DUT to subscribe to a random SV stream (without link redundancy)1. SIMULATOR publishes SV stream2. SIMULATOR publishes SV stream with 1 missing packet (not SmpCnt=0)3. SIMULATOR publishes SV stream with missing 3 consecutive packets 4. SIMULATOR publishes SV stream with missing 5 consecutive packets 5. SIMULATOR publishes SV stream with missing 10 consecutive packets  |
| Comment |

|  |  |  |
| --- | --- | --- |
| **sSvsN6** | **Verify that the DUT behaves as specified in the PIXIT when the packet with smpCnt=0 is missing** | **[ ]  Passed****[ ]  Failed****[ ]  Inconclusive** |
| IEC 61869-9PIXIT Svs7 |
| Expected result1. DUT subscribes the sampled values2. DUT subscribes the sampled values according to PIXIT-Svs7 |
| Test descriptionConfigure the DUT to subscribe to a random SV stream (without link redundancy)1. SIMULATOR publishes SV stream2. SIMULATOR publishes SV stream with missing one packet with SmpCnt=0  |
| Comment |

Certificate template

|  |  |
| --- | --- |
| **IEC 61850 Certificate Level A/B1** | No. << certificate number>> |
| Issued to: | For the server product: |
| <TEST INITIATOR><FULL ADDRESS> | <PRODUCT ID and NAME><IEC 61850 software/firmware version: <VERSION>>[Hardware version: xxxxx][S/N: xxxx, yyyy (in case of multiple samples)] |

Issued by: <<test lab>>

**The server product has not been shown to be non-conforming to:**

IEC 61850 Edition 2 Amendment 1 Parts 6, 7-1, 7-2, 7-3, 7-4, 8-1 [and 9-2

and IEC 61869 First Edition Part 9]

**Communication networks and systems for power utility automation**

The conformance test has been performed according to IEC 61850-10, the UCA International Users Group Edition 2 Server Test Procedures version 1.0 with product’s protocol, model and technical issue implementation conformance statements: “<<PICS>>”, “<<MICS>>”, “<<TICS>>” and product’s extra information for testing: “<<PIXIT>>”.

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test):

|  |  |
| --- | --- |
| 1a Basic Exchange (../29)1b Associate with IPv6 (../12)2 Data Sets (../7)2+ Data Set Definition (../24)3 Substitution (../3)4 Setting Group Selection (../4)4+ Setting Group Definition (../13)5 Unbuffered Reporting (../26)6 Buffered Reporting (../36)7 Logging (../14)9a GOOSE Publish (../13)9b GOOSE Subscribe (../26)9c GOOSE Management (../3) | 11a SV publish (,,,,/20)11b SV subscribe (…/20)12a Direct Control (../19)12b SBO Control (../28)12c Enhanced Direct Control (../21)12d Enhanced SBO Control (../29)13a Time Synchronization with SNTP(../8)13b Time Synchronization with PTP (../4)14 File Transfer (../8)15 Service Tracking (../17) |

This certificate includes a summary of the test results as carried out at <<CITY>> in <<COUNTRY>> with <<CLIENT SIMULATOR> <<VERSION>> with test suite <<VERSION>> and <<ANALYZER>> <<VERSION>>. This document has been issued for information purposes only, and the original [paper/archived] copy of the <<TESTLAB>> report: No. <<TESTREPORT NUMBER>> will prevail.

The test has been carried out on the specimen[s] of the product as referred above and submitted to <<TESTLAB>> by <<TEST INITIATOR>>. The manufacturer’s production process has not been assessed. This certificate does not imply that <<TESTLAB>> has certified or approved any product other than the specimen tested.

<<CITY>>, <<DATE>>

<<Manager NAME>> <<Tester NAME>>

<<JOB TITLE>> <<JOB TITLE>>

1 Level A - Independent Test lab with certified [ISO 9001] [ISO/IEC 17025] Quality System

 Level B - Test lab [at least following ISO 9001] [with certified ISO 9001] [with certified ISO/IEC 17025]

****

Applicable Server Test Procedures from the UCA International Users

Group Edition 2 Amendment 1 Server Test Procedures version 1.0

| **Conformance Block** | **Mandatory** | **Conditional**  |
| --- | --- | --- |
| 1a: Basic Exchange | sAss1, sAss2, sAss3, sAss4, sAssN2, sAssN3, sAssN4, sAssN5, sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrv8, sSrvN1abcdf, sSrvN4 | sAss5, sAssN6, sAssN7, sSrv6, sSrv9, sSrv10, sSrv11, sSrv12, sSrv13, sSrv15 sSrvN1e, sSrvN2, sSrvN3  |
| 1b: Associate with IPv6 | sAss61, sAss62, sAss63, sAss64, sAss66, sAss6N2, sAss6N3, sAss6N4, sAss6N5 | sAss65, sAss6N6, sAss6N7 |
| 2: Data Sets | sDs1, sDs10a, sDsN1ae | sDs10b, sDs15, sDsN1b, sDsN13 |
| 2+: Data Set Definition  | sDs2, sDs3, sDs4, sDs5, sDs6, sDs7, sDs8, sDs9, sDs13, sDs14, sDsN1cd, sDsN2, sDsN3, sDsN4, sDsN5, sDsN6, sDsN7, sDsN8, sDsN9, sDsN10 | sDs11, sDs12, sDsN11, sDsN12 |
| 3: Substitution | sSub1, sSub2, sSub3 |  |
| 4: Setting Group Selection | sSg1, sSg3, sSgN1 | sSg11 |
| 4+: Setting Group Definition  | sSg2, sSg4, sSg6, sSg7, sSg8, sSg10, sSg12, sSgN2, sSgN3, sSgN4, sSgN5 | sSg5, sSg9 |
| 5: Unbuffered Reporting | sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp16, sRp23, sRpN1, sRpN2, sRpN3, sRpN4, sRpN5, sRpN7, sRpN8, sRpN9 | sRp6, sRp7, sRp8, sRp10, sRp11, sRp12, sRp13, sRp15, sRp17 |
| 6: Buffered Reporting | sBr1, sBr2, sBr3, sBr4, sBr5, sBr9, sBr14, sBr16, sBr20, sBr21, sBr22, sBr23, sBr24, sBr25, sBr26, sBr27, sBr28, sBr29, sBrN1, sBrN2, sBrN3, sBrN4, sBrN5, sBrN7, sBrN8, sBrN9, sBrN10 | sBr6, sBr7, sBr8, sBr10, sBr11, sBr12, sBr13, sBr15, sBr17  |
| 7: Logging | sLog2, sLog3, sLog4, sLog5, sLog6, sLog7, sLog8, sLog9, sLog11, sLog12, sLog13, sLogN1, sLogN2 | sLog10 |
| 9a: GOOSE publish | sGop2a, sGop3, sGop4, sGop9, sGop10, sGop11, sGop12 | sGop1, sGop2b, sGop5, sGop6, sGopN1, sGopN2 |
| 9b: GOOSE subscribe | sGos1, sGos2, sGos3, sGos5, sGos6a, sGos7, sGos8, sGos9, sGos10, sGos11, sGos12, sGos14, sGos15, sGos20, sGos21, sGos22, sGosN1, sGosN2, sGosN3, sGosN4, sGosN5, sGosN6, sGosN7 | sGos4, sGos6b, sGos13 |
| 9c: GOOSE mngt  | sGom1, sGom2, sGomN1 |  |
| 11a SV Publish | sSvp1, sSvp2, sSvp3, sSvp4, sSvp5, sSvp6, sSvp7, sSvp8, sSvp9, sSvp10, sSvp12, sSvp13, sSvp14, sSvp15 | sSvp11, sSvp16, sSvp17, sSvp20, sSvp21, sSvp22 |
| 11b SV Subscribe | sSvs1, sSvs2, sSvs3, sSvs4, sSvs5, sSvs6, sSvs7, sSvs8, sSvs9, sSvs10, sSvs11, sSvs14, sSvsN1, sSvsN2, sSvsN3, sSvsN4, sSvsN5, sSvsN6 | sSvs12, sSvs13 |
| 12a Direct control | sCtl5, sCtl10, sDOns1, sDOns2 | sCtl2, sCtl3, sCtl7, sCtl13, sCtl15, sCtl16, sCtl17, sCtl18, sCtl21, sCtl23, sCtl24, sCtl28, sCtl29, sDOns4, sDOns5 |
| 12b SBO control | sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25, sSBOns1, sSBOns2, sSBOns6 | sCtl2, sCtl3, sCtl4, sCtl6, sCtl7, sCtl15, sCtl16, sCtl17, sCtl18, sCtl20, sCtl21, sCtl23, sCtl24, sCtl27, sCtl28, sCtl29, sSBOns4, SBOns5, sSBOns7 |
| 12c Enhanced Direct Control | sCtl5, sCtl10, sDOes1, sDOes2 | sCtl2, sCtl3, sCtl7, sCtl13, sCtl14, sCtl15, sCtl16, sCtl17, sCtl18, sCtl21, sCtl23, sCtl24, sCtl26, sCtl28, sCtl29, sDOes4, sDOes5 |
| 12d Enhanced SBO control | sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25, sSBOes1, sSBOes2, sSBOes6, sSBOes8 | sCtl2, sCtl3, sCtl4, sCtl6, sCtl7, sCtl15, sCtl16, sCtl17, sCtl18, sCtl20, sCtl21, sCtl23, sCtl24, sCtl26, sCtl28, sCtl29, sSBOes4, sSBOes5, sSBOes7 |
| 13a Time sync SNTP | sTm1, sTm2, sTmN1 | sTm3, sTm4, sTm5, sTm7, sTmN2 |
| 13b Time sync PTP | sTmP1, sTmP2, sTmPN1 | sTmP5 |
| 14 File transfer | sFt1, sFt2ab, sFt4, sFt5, sFtN1ab | sFt2c, sFt3, sFtN1c |
| 15 Service tracking |  | sTrk1, sTrk2, sTrk3, sTrk4, sTrk5, sTrk6, sTrk7, sTrk8, sTrk9, sTrk10, sTrk11, sTrk12, sTrk13, sTrk14, sTrk15, sTrk16, sTrk17 |

[ All configuration file and data model tests have been successfully performed for the product variants using the same communication hardware and software version:

* << ID and NAME of variant 1>>
* << ID and NAME of variant N>> ]

Test tool limitations: <testcase> <limitation> or None

Changes to table A4.2:

| 11a: SV publish | sSvp1, sSvp2, sSvp3, sSvp4, sSvp5, sSvp6, sSvp7, sSvp8, sSvp12, sSvp13, sSvp14 | PICS/PIXIT-Svp6 PTP: sSvp9PIXIT-Svp6 PPS: sSvp10PIXIT-As9 Not test equipment: sSvp11SCL-SyncSourceID: sSvp15PIXIT-Svp2 Test mode: sSvp16PIXIT-Svp13 SAMU: sSvp17PICS-GetMSVCBValues: sSvp20PICS-SetMSVCBValues: sSvp21 SCL-DynAssociation max>0: sSvp22 |
| --- | --- | --- |
| 11b: SV subscribe | sSvs1, sSvs2, sSvs3, sSvs4, sSvs5, sSvs6, sSvs7, sSvs8, sSvs9, sSvs10, sSvs11, sSvs14, sSvsN1, sSvsN2, sSvsN3, sSvsN4, sSvsN5, sSvsN6 | SCL-LSVS: sSvs12SCL-McSecurity not supported: sSvs13 |