

TEST REPORT

ReLevENT MQTT interfacing and IEC 61850 Conformance Test

2024-07-31

Test Details

test setup

For the test setup, the FLEDGE ReLevENT docker container is running
(<https://github.com/alliander-opensource/ReLevENT/blob/main/deployments/n61850-smqtt-ubuntu2004/docker-compose.yml>), exposing its IEC 61850 scheduling server on localhost, port 102 and a MQTT broker. The FLEDGE http interface is not used in these tests.

And also the HEDERA-61850-Gateway docker application (<https://github.com/alliander-opensource/ReLevENT/blob/main/hedera-61850-gateway/docker-compose.yml>) needs to be running.

The unit tests initiate the execution on IEC 61850 schedules by utilizing a IEC 61850 client written in Java ("IEC61850bean") and also the HEDERA-61850-Gateway's MQTT interface.

The tests are based on the IEC 61850 spec, especially IEC 61850-90-10:2017 and "Lastenheft Steuerbox: Funktionale und konstruktive Merkmale v1.3".

All tests that do not state differently utilize the IEC 61850 client written in Java to do both, test setup and the actual behaviour testing. The MQTT interface is only used when mentioned.

requirements

Requirements, e.g. 'S01' are references to identifiers to the requirements on Alliander DER Scheduling on github.

For 'S01' means "A set of 10 schedules per logical node must be supported".

For a full overview, visit: <https://github.com/alliander-opensource/der-scheduling/blob/main/REQUIREMENTS.md>

The EmsInterfacingTests are new tests that where not part of the

DER Scheduling and cover more soft requirements that are only available in written form.

tested version <https://github.com/alliander-opensource/ReLevENT/tree/conformance-tests-v0.9>

contact Fraunhofer Institute for Solar Energy Systems ISE
Heidenhofstr. 2
79110 Freiburg, Germany
Team Smart Grid Communication
conformance-test-iec61850@ise.fraunhofer.de

Test Session Summary

Start: Wed Jul 31 15:35:12 2024

End: Wed Jul 31 15:50:42 2024

Duration: 15m 29s

passed: 83 (88.30%)

skipped: 0 (0.00%)

broken: 1 (1.06%)

failed: 10 (10.64%)

unknown: 0 (0.00%)

passed
broken
failed



ValSpsOrValMvlsUpdatedWithCurrentlyRunningSchedule running on/off schedules [0] [broken]

Duration 2s

Requirements LN03

Details

Service error: PARAMETER_VALUE_INCONSISTENT(6) Unable to set
'DER_Scheduler_Control/OnOff_FSCH01.StrTm01.setTm' to '1722433346000'

EnaReq_operating running max power schedules [0] [failed]

Duration 5s

Requirements LN03

Details

expected: <READY> but was: <RUNNING>

EnaReq_operating running on/off schedules [1] [failed]

Duration 22s

Requirements LN03

Details

expected: <READY> but was: <RUNNING>

activeControllerIsUpdated running max power schedules [0] [failed]

Duration	2s
----------	----

Requirements	LN03
	LN02c
	LN02b
	LN02a

Details

expected: <DER_Scheduler_Control/MaxPow_FSCH01> but was:
<DER_Scheduler_Control/MaxPow_Res_FSCH01>

activeControllerIsUpdatedWithScheduleOfHighestPrio running max power schedules [2] [failed]

Duration	1s
----------	----

Requirements	LN03
	E01

Details

expected: <DER_Scheduler_Control/MaxPow_Res_FSCH01> but was:
<DER_Scheduler_Control/MaxPow_FSCH01>

testSamePriosDifferentStartPowerSchedules running active power schedules [0] [failed]

Duration	48s
Description	IEC61850-90-10 ed 2017 Schedule Controller Definitions, section 5.5.3

Details

Array does not match at index 1.

Expected values: [0.0, 10.0, 70.0, 100.0, 70.0, 70.0, 10.0, 100.0, 0.0]

actual values : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]

==> expected: <10.0> but was: <0.0>

testSamePriosDifferentStartPowerSchedules running max power schedules [1] [failed]

Duration	48s
Description	IEC61850-90-10 ed 2017 Schedule Controller Definitions, section 5.5.3

Details

Array does not match at index 1.

Expected values: [0.0, 10.0, 70.0, 100.0, 70.0, 70.0, 10.0, 100.0, 0.0]

actual values : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]

==> expected: <10.0> but was: <0.0>

test_prioritiesPowerSchedules running active power schedules [1] [failed]

Duration 37s

Requirements LN01
S05c
E01
S02
E02
S09

Details

Array does not match at index 1.

Expected values: [0.0, 10.0, 30.0, 70.0, 100.0, 11.0, 31.0, 71.0, 99.0, 12.0, 32.0, 72.0, 98.0, 13.0, 33.0, 73.0, 97.0, 70.0, 90.0, 70.0, 90.0, 70.0, 10.0, 80.0, 100.0, 0.0]

actual values : [0.0, 0.0]

==> expected: <10.0> but was: <0.0>

test_prioritiesPowerSchedules running max power schedules [0] [failed]

Duration 37s

Requirements LN01
S05c
E01
S02
E02

S09

Details

Array does not match at index 1.

Expected values: [0.0, 10.0, 30.0, 70.0, 100.0, 11.0, 31.0, 71.0, 99.0, 12.0, 32.0, 72.0, 98.0, 13.0, 33.0, 73.0, 97.0, 70.0, 90.0, 70.0, 90.0, 70.0, 10.0, 80.0, 100.0, 0.0]

actual values : [0.0, 0.0]

==> expected: <10.0> but was: <0.0>

**test_samePrioAndStartFloatSchedule running active power
schedules [0] [failed]**

Duration	16s
----------	-----

Requirements	S17
--------------	-----

Details

Array does not match at index 1.

Expected values: [0.0, 70.0, 70.0, 100.0, 0.0]

actual values : [0.0, 0.0, 0.0, 0.0, 0.0]

==> expected: <70.0> but was: <0.0>

**test_samePrioAndStartFloatSchedule running max power
schedules [1] [failed]**

Duration	16s
----------	-----

Requirements	S17
--------------	-----

Details

Array does not match at index 1.

Expected values: [0.0, 70.0, 70.0, 100.0, 0.0]

actual values : [0.0, 0.0, 0.0, 0.0, 0.0]

==> expected: <70.0> but was: <0.0>

**ActStrTmlsUpdatedProperly running active power schedules [0]
[passed]**

Duration 47s

Requirements LN03

**ActStrTmlsUpdatedProperly running max power schedules [1]
[passed]**

Duration 47s

Requirements LN03

**ActStrTmlsUpdatedProperly running on/off schedules [2]
[passed]**

Duration 47s

Requirements LN03

DsaReq_operating running active power schedules [0] [passed]

Duration 43s

Requirements LN03

DsaReq_operating running max power schedules [2] [passed]

Duration 43s

Requirements LN03

DsaReq_operating running on/off schedules [1] [passed]

Duration 43s

Requirements LN03

EnaReq_operating running active power schedules [2] [passed]

Duration 22s

Requirements LN03

IEC 61850 Protocol Library version check [passed]

Duration 1ms

Description Checks installed library version of libiec61850. Expects v1.5.2.

IEC 61850 config check [passed]

Duration 1s

Description Reads the IEC 61850 servers name plate and makes sure the correct config version is used

NumEntr_range running active power schedules [1] [passed]

Duration 1s

Requirements LN03

NumEntr_range running max power schedules [0] [passed]

Duration 1s

Requirements LN03

NumEntr_range running on/off schedules [2] [passed]

Duration 1s

Requirements LN03

NxtStrTmlsUpdatedProperly running active power schedules [1] [passed]

Duration 2s

Requirements LN03

NxtStrTmlsUpdatedProperly running max power schedules [2] [passed]

Duration 2s

Requirements LN03

NxtStrTmlsUpdatedProperly running on/off schedules [0] [passed]

Duration 2s

Requirements LN03

SchdEnaErrHoldsMISSING_VALID_SCHDINTVcorrectly running active power schedules [1] [passed]

Duration	4s
Requirements	LN03
	S08

SchdEnaErrHoldsMISSING_VALID_SCHDINTVcorrectly running max power schedules [0] [passed]

Duration	4s
Requirements	LN03
	S08

SchdEnaErrHoldsMISSING_VALID_SCHDINTVcorrectly running on/off schedules [2] [passed]

Duration	4s
Requirements	LN03
	S08

SchdEnaErrHoldsMISSING_VALID_SCHEDULE_VALUEScorrectly running active power schedules [0] [passed]

Duration 4s

Requirements LN03
S08

SchdEnaErrHoldsMISSING_VALID_SCHEDULE_VALUEScorrectly running max power schedules [1] [passed]

Duration 4s

Requirements LN03
S08

SchdEntrIsUpdatedWithCurrentlyRunningScheduleIfPresent running active power schedules [0] [passed]

Duration 42s

Requirements LN03

SchdEntrIsUpdatedWithCurrentlyRunningScheduleIfPresent running max power schedules [1] [passed]

Duration 42s

Requirements LN03

SchdEntrIsUpdatedWithCurrentlyRunningScheduleIfPresent running on/off schedules [2] [passed]

Duration 42s

Requirements LN03

ValEnslsUpdatedWithCurrentlyRunningScheduleIfPresent running active power schedules [2] [passed]

Duration 835ms

Requirements LN03

ValEnslsUpdatedWithCurrentlyRunningScheduleIfPresent running max power schedules [1] [passed]

Duration 834ms

Requirements	LN03
--------------	------

ValEnsisUpdatedWithCurrentlyRunningScheduleIfPresent
running on/off schedules [0] [passed]

Duration	833ms
----------	-------

Requirements	LN03
--------------	------

ValINSIsUpdatedWithCurrentlyRunningScheduleIfPresent
running active power schedules [0] [passed]

Duration	819ms
----------	-------

Requirements	LN03
--------------	------

ValINSIsUpdatedWithCurrentlyRunningScheduleIfPresent
running max power schedules [1] [passed]

Duration	833ms
----------	-------

Requirements	LN03
--------------	------

ValNSIsUpdatedWithCurrentlyRunningScheduleIfPresent running on/off schedules [2] [passed]

Duration 833ms

Requirements LN03

ValSpsOrValMvIsUpdatedWithCurrentlyRunningSchedule running active power schedules [2] [passed]

Duration 40s

Requirements LN03

ValSpsOrValMvIsUpdatedWithCurrentlyRunningSchedule running max power schedules [1] [passed]

Duration 39s

Requirements LN03

absolutePowerValueSchedulesAreSupported() [passed]

Duration 841ms

Requirements S05a

activeControllerIsUpdated running active power schedules [2] [passed]

Duration	4s
----------	----

Requirements	LN03
	LN02c
	LN02b
	LN02a

activeControllerIsUpdated running on/off schedules [1] [passed]

Duration	4s
----------	----

Requirements	LN03
	LN02c
	LN02b
	LN02a

activeControllerIsUpdatedWithScheduleOfHighestPrio running active power schedules [1] [passed]

Duration	3s
----------	----

Requirements	LN03
--------------	------

E01

activeControllerIsUpdatedWithScheduleOfHighestPrio running on/off schedules [0] [passed]

Duration 3s

Requirements LN03
E01

allExpectedSchedulesExist running active power schedules [1] [passed]

Duration 841ms

Requirements LN02c
LN02b
LN02a

allExpectedSchedulesExist running max power schedules [2] [passed]

Duration 838ms

Requirements LN02c
LN02b

LN02a

**allExpectedSchedulesExist running on/off schedules [0]
[passed]**

Duration 838ms

Requirements LN02c
LN02b
LN02a

checkSubnodes running active power schedules [2] [passed]

Duration 839ms

Requirements LN02
LN01
LN03

checkSubnodes running max power schedules [1] [passed]

Duration 834ms

Requirements LN02
LN01
LN03

checkSubnodes running on/off schedules [0] [passed]

Duration 832ms

Requirements LN02
LN01
LN03

commandsAreForwardedJustOnTime() [passed]

Duration 8s

Description Tests that a schedules values are forwarded as a command just in time. Check publishing time, control value and 'SecondsSinceEpoch' payload. Does not check 'FractionOfSecond' of published command. For the test setup, a schedule is created using a IEC 61850 client. Then, the tests are carried out on MQTT messages that are created by FLEDGE. WARNING: this test only works if it is executed first, if the order is switched this is broken. This seems to be related to FLEDEGE. This behaviour is documented in <https://github.com/alliander-opensource/ReLevENT/issues/20>

hasRequiredSubNodes running active power schedules [0] [passed]

Duration 849ms

Requirements	LN01
	LN03

hasRequiredSubNodes running max power schedules [1]
[passed]

Duration	828ms
----------	-------

Requirements	LN01
	LN03

hasRequiredSubNodes running on/off schedules [2] [passed]

Duration	833ms
----------	-------

Requirements	LN01
	LN03

maxPowerValueSchedulesAreSupported() [passed]

Duration	842ms
----------	-------

Requirements	S05b
--------------	------

onOffSchedulesAreSupported() [passed]

Duration 836ms

Requirements S05c

oneDayCanBeCovered() [passed]

Duration 3s

Description Tests that a schedule that covers an entire day can be created and transmitted via MQTT interface. For the test setup, a schedule is written using MQTT. The actual tests are carried out using a IEC 61850 client.

reserveScheduleSupports100values running active power schedules [2] [passed]

Duration 886ms

Requirements S12

reserveScheduleSupports100values running max power schedules [1] [passed]

Duration 838ms

Requirements	S12
--------------	-----

**reserveScheduleSupports100values running on/off schedules [0]
[passed]**

Duration	847ms
----------	-------

Requirements	S12
--------------	-----

**reserveSchedulesCannotBeDeactivated running active power
schedules [2] [passed]**

Duration	1s
----------	----

Requirements	S13
--------------	-----

**reserveSchedulesCannotBeDeactivated running max power
schedules [0] [passed]**

Duration	1s
----------	----

Requirements	S13
--------------	-----

reserveSchedulesCannotBeDeactivated running on/off schedules [1] [passed]

Duration 1s

Requirements S13

reserveSchedulesExist running active power schedules [1] [passed]

Duration 835ms

Requirements S04

reserveSchedulesExist running max power schedules [2] [passed]

Duration 835ms

Requirements S04

reserveSchedulesExist running on/off schedules [0] [passed]

Duration 837ms

Requirements S04

reserveSchedulesHaveFixedPriority running active power schedules [1] [passed]

Duration 843ms

Requirements S14

reserveSchedulesHaveFixedPriority running max power schedules [2] [passed]

Duration 850ms

Requirements S14

reserveSchedulesHaveFixedPriority running on/off schedules [0] [passed]

Duration 855ms

Requirements S14

reserveSchedulesHaveFixedStart running active power schedules [1] [passed]

Duration 864ms

Requirements S15

reserveSchedulesHaveFixedStart running max power schedules [0] [passed]

Duration 866ms

Requirements S15

reserveSchedulesHaveFixedStart running on/off schedules [2] [passed]

Duration 869ms

Requirements S15

schdEnaErr_HoldsMISSING_VALID_NUMENTRcorrectly running active power schedules [0] [passed]

Duration 4s

Requirements	LN03
	S08

**schdEnaErr_HoldsMISSING_VALID_NUMENTRcorrectly running
max power schedules [2] [passed]**

Duration	4s
----------	----

Requirements	LN03
	S08

**schdEnaErr_HoldsMISSING_VALID_NUMENTRcorrectly running
on/off schedules [1] [passed]**

Duration	4s
----------	----

Requirements	LN03
	S08

scheduleSupports100values running active power schedules [1] [passed]

Duration	848ms
----------	-------

Requirements	S10
--------------	-----

scheduleSupports100values running max power schedules [0] [passed]

Duration 841ms

Requirements S10

scheduleSupports100values running on/off schedules [2] [passed]

Duration 840ms

Requirements S10

scheduleSupportsTimebasedScheduling running active power schedules [1] [passed]

Duration 838ms

Requirements S02

scheduleSupportsTimebasedScheduling running max power schedules [2] [passed]

Duration 835ms

Requirements S02

scheduleSupportsTimebasedScheduling running on/off schedules [0] [passed]

Duration 833ms

Requirements S02

schedulesAreForwardedAsIEC61850() [passed]

Duration 3s

Description Tests that a schedule transmitted via MQTT will be forwarded to the IEC 61850 server. Makes sure that schedule values and interval are maintained. Schedule priority is fixed to 20. For the test setup, a schedule is created using a MQTT interface, the actual tests are carried out using a IEC 61850 client.

schedulesAreForwardedInExpectedFormat() [passed]

Duration 5s

Description	This test covers: Schedules are published via MQTT. Publishing interval is 5 seconds. Format of the MQTT JSON payload is as expected. Schedule values and schedule timestamps have the expected values. Does not check 'FractionOfSecond' of published schedule.For the test setup, a schedule is created using a IEC 61850 client. Then, the tests are carried out on MQTT messages that are created by FLEDGE
-------------	---

schedulesArePublishedEvery5Seconds_valuesDoNotDiffer()
[passed]

Duration	14s
Description	Schedules are published via MQTT. Publishing interval is 5 seconds. Schedule values and schedule timestamps have the expected values which do not change over time. Does not check 'FractionOfSecond' of published schedule.For the test setup, a schedule is created using a IEC 61850 client. Then, the tests are carried out on MQTT messages that are created by FLEDGE

tenSchedulesAreSupportedPerType running active power
schedules [2] [passed]

Duration	836ms
Requirements	S01

tenSchedulesAreSupportedPerType running max power schedules [1] [passed]

Duration 829ms

Requirements S01

tenSchedulesAreSupportedPerType running on/off schedules [0] [passed]

Duration 835ms

Requirements S01

testSamePriosDifferentStartOnOffSchedule running on/off schedules [passed]

Duration 11s

Description IEC61850-90-10 ed 2017 Schedule Controller Definitions, section
5.5.3

test_prioritiesOnOffSchedules running on/off schedules [passed]

Duration 18s

Requirements S05c
E01
S02
E02

test_samePrioAndStartOnOffSchedule running on/off schedules [passed]

Duration 16s

Requirements S17

threeReserveSchedulesExist() [passed]

Duration 842ms

Requirements S11