Jemena Electricity Networks (Vic) Ltd

JEN OEM Technical Guide Handbook

Client onboarding technical guide to Jemena's Utility Server (Staging and Production)

Version 1.0

Jemena
bringing energy to life

An appropriate citation for this paper is:

JEN OEM Technical Handbook

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Table of contents

Glossary

Terms	Definition
CA	Certificate Authority
CEC	Clean Energy Council
Client	Client is Original Equipment Manufacturer (OEM). These can be considered an aggregator, gateway or direct-connected manufacturer
CSIP	Common Smart Inverter Profile
CSIP-AUS	Common Smart Inverter Profile for Australia. The Common Smart Inverter Profile for Australia, an implementation guide for IEEE 2030.5 applicable to Australia. The CSIP-AUS can be downloaded from the ARENA DEIP interoperability steering committee website
CSR	Certificate Signing Request
Digicert	A company Jemena uses for PKI certificate generation
IANA	Internet Assigned Numbers Authority
IEEE 2030.5:2018	IEEE Standard for Smart Energy Profile Application Protocol
JEN CEDT	Jemena Electricity Network (JEN) Connections – Electricity Distribution Team
Jemena Utility Server	A computer server that allows orchestration of End Devices using CSIP-Aus communication protocols. There are 2 environments available to OEM. Staging is Jemena's non-production used to do initial verification with test inverters. Production is a live system where client will be added once all required onboarding activities are successfully completed.
LFDI	Long Form Device Identifier
MCA	Manufacture Certificate Authority
MICA	Manufacture Issuing Certificate Authority
OEM	Original Equipment Manufacturer
PEN	Private Enterprise Number
PKI	Public Key Infrastructure
SERCA	Smart Energy Root Certificate Authority
SCC	Software Communication Client is IEEE 2030.5 client to receive commands and send measurements
SME	Subject Matter Expert

1. Purpose and Scope

1.1 Purpose

The purposes of this document are:

- to ensure there is a consistent procedure for the inverter Original Equipment Manufacturer (OEM) to test their CSIP-AUS communication software clients; and
- to validate successful interoperability between Jemena Electricity Network (JEN) Utility Server and inverter OEM CSIP-AUS software communication clients (SCC) for inverters listed under CEC website: Inverters | Clean Energy Council.

This document serves as a supplementary document alongside IEEE 2030.5:2018, SA HB-218:2023, CSIP and CSIP-AUS communications client test procedures v1.0 to assist with interfacing with JEN Utility Server. It will be reviewed regularly and amended as required to reflect changes in standards, the application of new technologies, changes to procedures and field experience, among other things.

1.2 Scope

The scope of this document is limited to the testing of CEC listed inverters with software communication clients that are compliant to IEEE 2030.5 CSIP-Aus, either hosted locally on the inverter or a gateway device or via a certified cloud connection to JEN Utility Server.

1.3 Intended Audience

Original Equipment Manufacturer

1.4 Responsibilities

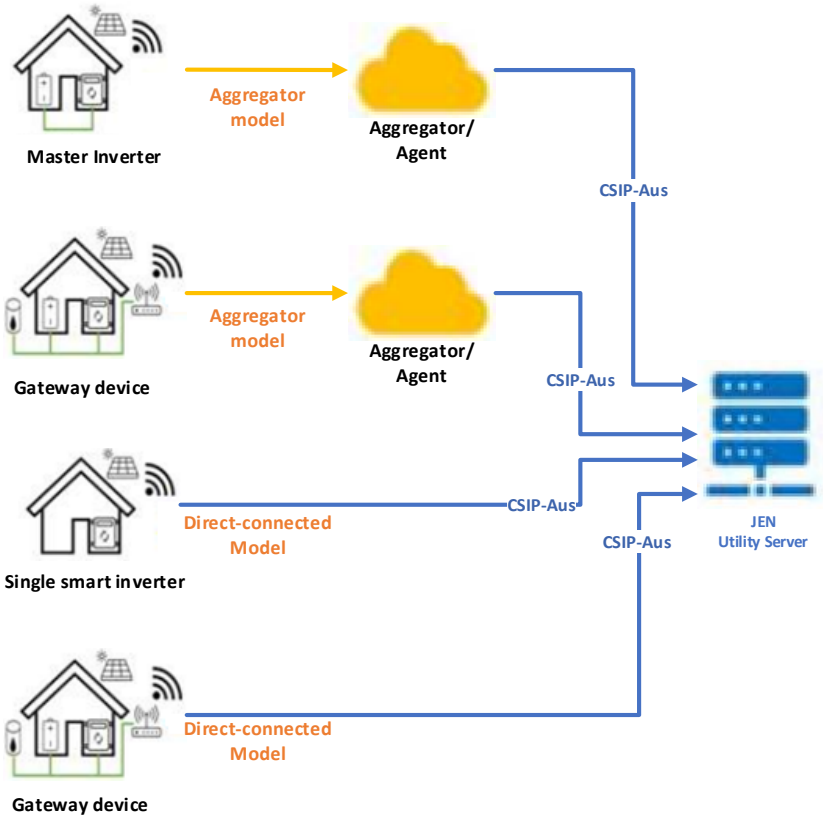
Role	Responsibility
JEN	• Provides test Utility Server for OEM • Provides testing requirements and criteria (this document) • Witness and record test outcomes • Administer communication software clients and inverters that passes or fails the test • Technical support and resolve dispute
OEM	• Sets up any bench testing and equipment required at the OEM's laboratory to perform the validation test as documented in this document • Ensure connectivity with Utility Server established prior to execution of the tests with JEN • Conduct test with JEN's representative to witness and record test outcomes • Document outcomes of test for JEN to sign off

2. IEEE 2030.5 Communications Pathways

The CSIP-AUS protocol is the basis for JEN's communication to small and medium Embedded Generation (EG) installations and to Virtual Power Plant (VPP) Aggregators--via gateways, third-party cloud platforms or natively direct to the inverter.

CSIP-AUS enables control (trip, restore, setpoint) and monitoring capabilities over the public internet, allowing JEN to communicate, directly or indirectly with EGs via the new JEN CSIP-AUS Utility Server.

The various types of communications arrangements are outlined in below.



2.1 Aggregator model

The aggregator platform acts as the communications software client, communicating with the JEN utility server. The aggregator platform then communicates with a combination of a gateway(s) and end devices.

The end devices do not need to be located within one electrical site and can be distributed across a large geographic area but aggregated together by a single entity. The utility server must be able to identify each individual end device as an IEEE 2030.5 end device so that each can be monitored and controlled individually.

2.2 Direct-connected device model

The inverter is CSIP-AUS compliant and has a built-in communications software client enabling direct communications between the utility server and the solar system

The gateway can be used in conjunction, is CSIP-AUS compliant and collects data from and controls the end devices. It may appear as a single device to the utility server.

3. JEN Utility Server Details

Environment name	URL
JEN Staging	https://sep2-e2e.aws.jemena.com.au:8444
JEN production	https://sep2.aws.jemena.com.au:8443

4. General JEN Utility Server Operating Guideline

<table>
<tr><th>#</th><th>Topic</th><th>Information</th></tr>
<tr><td>1</td><td>Poll and post rates</td><td>Clients must send 5mins poll and post rate for the following resources under normal operation as per CSIP standard. Failure to do so will present underlying issues to the system interoperability.

<table>
<tr><th>Resource</th><th>Type</th><th>Value (secs)</th></tr>
<tr><td>DeviceCapability</td><td>Poll</td><td>300</td></tr>
<tr><td>EndDeviceList</td><td>Poll</td><td>300</td></tr>
<tr><td>FunctionSetAssignmentsList</td><td>Poll</td><td>300</td></tr>
<tr><td>DERProgramList</td><td>Poll</td><td>300</td></tr>
<tr><td>MirrorUsagePoint</td><td>Post</td><td>300</td></tr>
<tr><td>DERList
- DERStatus
- DERSettings
- DERCapability</td><td>Post</td><td>300</td></tr>
</table>

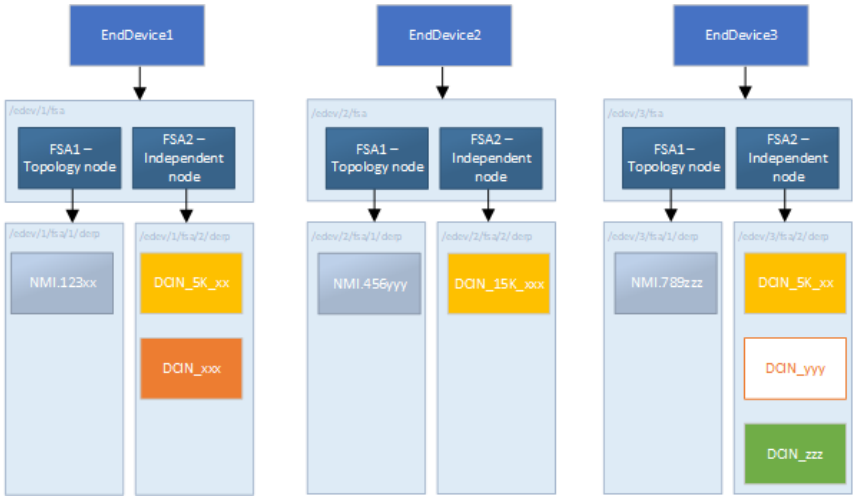
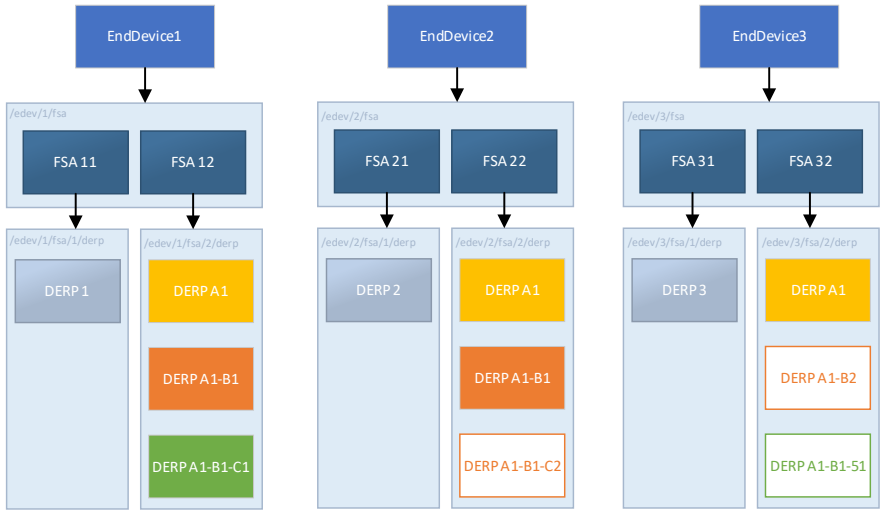
Warning: Any more frequent post and poll rate than this will cause performance issues to Utility Server. It adds significant, excess traffic to the server which leads to increased errors, longer response time and delays in processing the required resources.

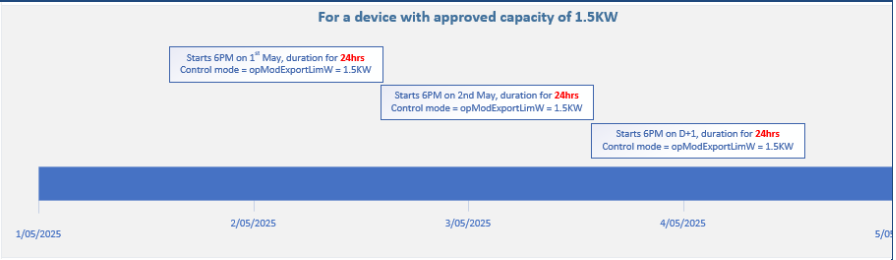
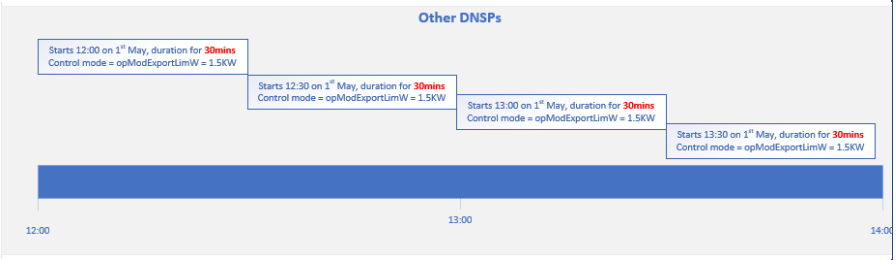
Client should support 1 min rate to efficiently perform the capability test during device commission. Otherwise, a longer capability testing time is expected for the given devices. JEN Utility Server will utilise the following poll and post rates during capability test to gain quicker polling of controls and posting of telemetry.

<table>
<tr><th>Resource</th><th>Type</th><th>Value (secs)</th></tr>
<tr><td>DeviceCapability</td><td>Poll</td><td>300</td></tr>
<tr><td>EndDeviceList</td><td>Poll</td><td>300</td></tr>
<tr><td>FunctionSetAssignmentsList</td><td>Poll</td><td>300</td></tr>
<tr><td>DERProgramList</td><td>Poll</td><td>60</td></tr>
<tr><td>MirrorUsagePoint</td><td>Post</td><td>60</td></tr>
<tr><td>DERList
- DERStatus
- DERSettings
- DERCapability</td><td>Post</td><td>60</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Timestamp</td><td>All timestamps should be in Unix epoch seconds.</td></tr>
<tr><td>3</td><td>Control Acknowledgement</td><td>When a control event is sent by the Utility server, each related device is expected to send an acknowledgement back, indicating they have received, started or completed the event.

<table>
<tr><th><status>
Enumeration Value</th><th>Description</th></tr>
<tr><td>1</td><td>Event Received</td></tr>
<tr><td>2</td><td>Event Started</td></tr>
<tr><td>3</td><td>Event Completed</td></tr>
<tr><td>6</td><td>The event has been cancelled</td></tr>
<tr><td>7</td><td>The event has been superseded</td></tr>
</table>
</td></tr>
</table>

#	Topic	Information
		Sample of the expected response from Client to JEN Utility Server where status 1 = received. <DERControlResponse xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus="https://csipaus.org/ns"> <createdDateTime>1748321935</createdDateTime> <endDeviceLFDI>11EE5B6D6F3E1A9618B2659F5D4630917AC447D9</endDevice <status>1</status> <subject>7A1FC1AB8AC07489F6F9D61400009182</subject> </DERControlResponse>
4	<Version> tag	JEN Utility Server **does not** currently include the version tag to any of the responses. **Recommended:** Client is advised not check for <version> field. Instead, please poll and check each field for data difference. **Alternate 1** – Poll and store the data from Get /edev call. Impacted endpoints: **GET FunctionSetAsignmentsList** **GET** /sep2/fsagrp/134/fsa?s=0&l=255 **POST MirrorMeterReading** POST /sep2/mup **GET MeterReading** GET /sep2/upt/646930/mr/123456 **GET DERProgramList** GET /sep2/grp/28524/derp?s=0&l=255 **GET DefaultDerControl** GET /sep2/derp/28523/dderc **GET DERControlList** GET/sep2/derp/28523/derc?s=0&l=100
5	FunctionSetAssignmentsList structure	JEN Utility Server manage groups of devices using topology and non-topology Groups. Devices can be enrolled in the **same** FSA and DERProgram and EndDevices can be mapped to FSAs in a **many-many** relationship. **Recommended:** Client is expected to support multiple DER FSA lists and relevant primacy, more specifically, adhering to JEN structure

#	Topic	Information
		JEN Utility Server – FSA structure  Other DNSPs 
6	JEN ongoing operating controls	Jemena sends daily controls to all commissioned inverters. Site export limit (opModExpLimW) = Inverter's approved capacity, daily starts 6 PM with duration 24hr. Jemena operational controls will be scheduled as a series of seven successive one-day controls. Accordingly, the randomizeDuration and randomizeStart parameters will be used. Please ensure that for successive events, clients use the effective end time of the earlier event as the effective start time of the next event and not report these as superseded. JEN Utility Server – BAU daily controls example

#	Topic	Information
		 Other DNSP example:  Note: In the future, JEN Utility Server intend to send periodic controls similar to other DNSPs.
7	Failsafe	Aggregator model must implement at each site fail-safe operating modes, so that in event of failures of the aggregator or gateway platform, the fail-safe export limits will operate.
8	In-band registration support	Jemena **only** support in-band registration for aggregator model client. Jemena is in progress of testing this feature and will engage with OEMs on the rollout plan. JEN will require client to run through additional tests to verify the in-band registration function as part of JEN onboarding process prior to production use.
9	*Must Include MirrorMeterReadings under MUP.*	JEN Utility Server **requires** Client to include **MirrorMeterReadings** under *MirrorUsagePoint.* Client **must** provide the MirrorMeterReadings under MirrorUsagePoint, otherwise, failures to do so will result in 400 error response. **Post MirrorUsagePoint** Post /sep2/mup

#	Topic	Information
		<MirrorUsagePoint xmlns="urn:ieee:std:2030.5:ns"> <mRID>5509D69F8B3535950000000000009182</mRID> <description>DER [Inverter A]</description> <roleFlags>49</roleFlags> <serviceCategoryKind>0</serviceCategoryKind > <status>1</status> <deviceLFDI>12a4a4b406ad102e7421019135ffa2805235a21c</deviceLFDI> <MirrorMeterReading> <mRID>5509D69F8B3535950001000000009182</mRID> <description>Real Power(W) Set</description> <ReadingType> <accumulationBehaviour>4</accumulationBehaviour> <dataQualifier>2</dataQualifier> <intervalLength>300</intervalLength> <powerOfTenMultiplier>0</powerOfTenMultiplier> <uom>38</uom> </ReadingType> </MirrorMeterReading> </MirrorUsagePoint> • Note: *Other DNSPs may not require MirrorMeterReadings under MUP.*
10	*MirrorUsagePoint* recommendation	JEN recommends all clients to use the POST **MirrorMeterReading** or **MirrorMeterReadingList** to send **multiple** MirrorMeterReadings instead of calling one post for each MirrorMeterReading. That means, 2 POST calls with MirrorMeterReading for 6+ readings. This is the most efficient optimal method for client and Jemena to process the MirrorMeterReadings.

#	Topic	Information

		Example:
		- a single POST for (3x) DER Readings for *roleFlags = 0003*
		
		`<MirrorUsagePoint xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus=https://csipaus.org/ns>`
		`<mRID>00000000</mRID>`
		`<description>SITEUSAGE</description>`
		`<roleFlags>0003</roleFlags>`
		`<serviceCategoryKind>0</serviceCategoryKind>`
		`<status>1</status>`
		`<deviceLFDI>11111111111111111111111111111111111111111</deviceLFDI>`
		`<MirrorMeterReading>`
		`<mRID>11111111</mRID>`
		`<description>SiteReal(Active)Power</description>`
		`<ReadingType>`
		`<dataQualifier>2</dataQualifier>`
		`<kind>37</kind>`
		`<powerOfTenMultiplier>-3</powerOfTenMultiplier>`
		`<uom>38</uom>`
		`</ReadingType>`
		`</MirrorMeterReading>`
		`<MirrorMeterReading>`
		`<mRID>2222222</mRID>`
		`<description>SiteReactivePower</description>`
		`<ReadingType>`
		`<dataQualifier>2</dataQualifier>`
		`<kind>37</kind>`
		`<powerOfTenMultiplier>-3</powerOfTenMultiplier>`
		`<uom>63</uom>`
		`</ReadingType>`
		`</MirrorMeterReading>`
		`<MirrorMeterReading>`
		`<mRID>333333333</mRID>`
		`<description>SiteVoltage(SinglePhase)</description>`
		`<ReadingType>`
		`<accumulationBehaviour>0</accumulationBehaviour>`
		`<commodity>1</commodity>`
		`<dataQualifier>2</dataQualifier>`
		`<kind>0</kind>`
		`<phase>65</phase>`
		`<powerOfTenMultiplier>-3</powerOfTenMultiplier>`
		`<uom>29</uom>`
		`</ReadingType>`
		`</MirrorMeterReading>`

<table>
<tr><th>#</th><th>Topic</th><th>Information</th></tr>
<tr><td></td><td></td><td>- a single POST for (4x) DER Readings for roleFlags = 0049

<pre>
<MirrorUsagePoint xmlns="urn:ieee:std:2030.5:ns"
xmlns:csipaus=https://csipaus.org/ns>
    <mRID>10000000</mRID>
    <description>DERUSAGE</description>
    <roleFlags>0049</roleFlags>
    <serviceCategoryKind>0</serviceCategoryKind>
    <status>1</status>
    <deviceLFDI>11111111111111111111111111111111111111111
       </deviceLFDI>
    <MirrorMeterReading>
        <mRID>444444444</mRID>
        <description>DERReal(Active)Power</description>
        <ReadingType>
            <dataQualifier>2</dataQualifier>
            <kind>37</kind>
            <powerOfTenMultiplier>-3</powerOfTenMultiplier>
            <uom>38</uom>
        </ReadingType>
    </MirrorMeterReading>
    <MirrorMeterReading>
        <mRID>5555555555</mRID>
        <description>DERReactivePower</description>
        <ReadingType>
            <dataQualifier>2</dataQualifier>
            <kind>37</kind>
            <powerOfTenMultiplier>-3</powerOfTenMultiplier>
            <uom>63</uom>
        </ReadingType>
    </MirrorMeterReading>
    <MirrorMeterReading>
        <mRID>66666666</mRID>
        <description>DERVoltage(SinglePhase)</description>
        <ReadingType>
          <accumulationBehaviour>0</accumulationBehaviour>
          <commodity>1</commodity>
          <dataQualifier>2</dataQualifier>
          <kind>0</kind>
          <phase>65</phase>
          <powerOfTenMultiplier>-3</powerOfTenMultiplier>
          <uom>29</uom>
        </ReadingType>
    </MirrorMeterReading>
</pre></td></tr>
<tr><td>11</td><td>Notifications/subscription</td><td>Post /ntfy is not supported by JEN Utility Server</td></tr>
<tr><td>12</td><td>Multiple inverters setup support</td><td>A subset of the test procedure must be repeated with a multiple-inverters test setup to validate a software communication client’s capability to support multiple downstream devices.

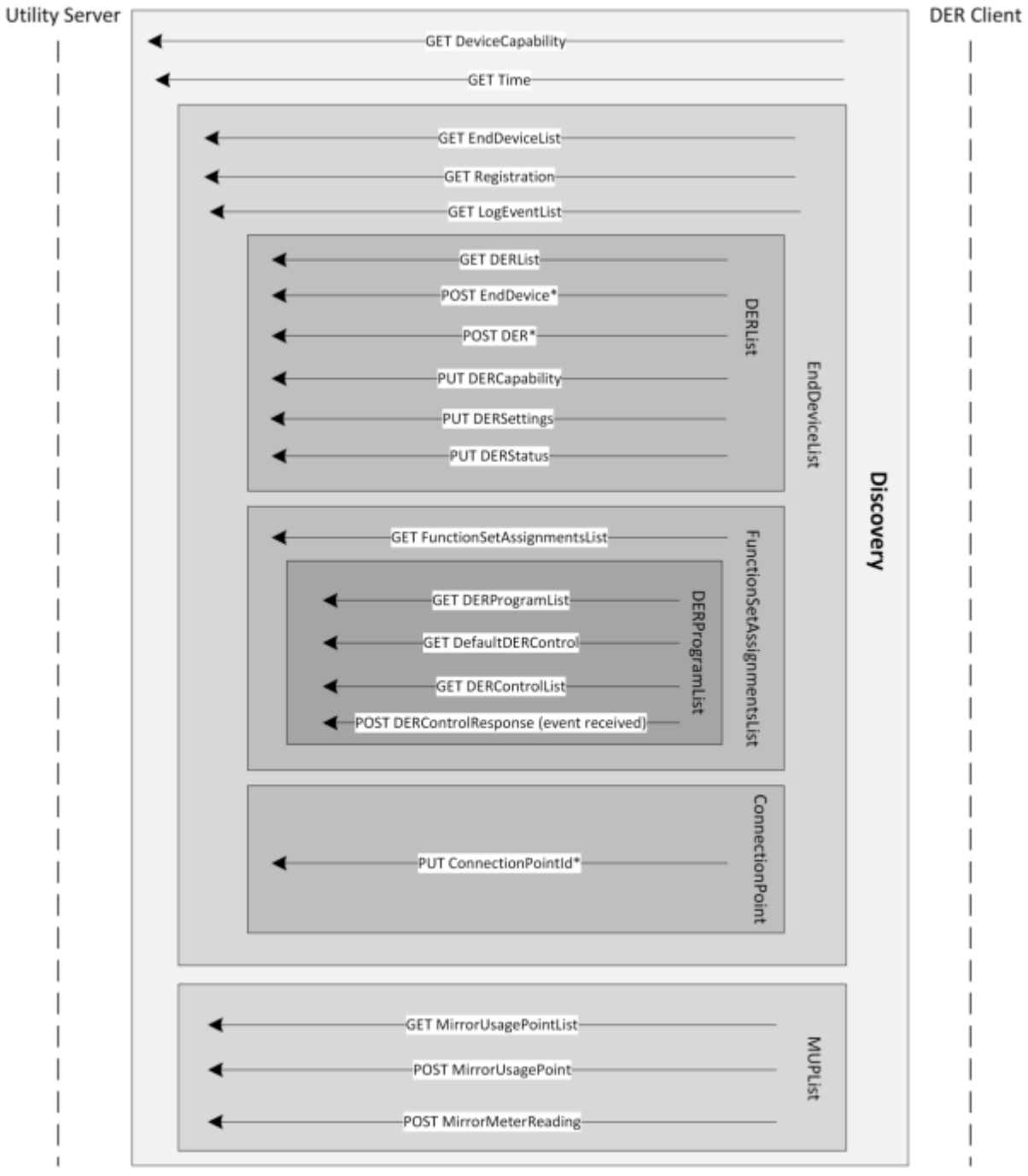
Compliance to these tests will be validated with a JEN representative to witness and record outcomes of each test.

Communication clients that intend to support management of multiple DER simultaneously shall be tested controlling at least two DERs.</td></tr>
</table>

#	Topic	Information
		The following tests must be repeated with multiple inverters present to achieve certification for multiple inverter support: • Discovery • Export Limit (DefaultDERControl & DERControl) Generation Limit (DERControl)
13	Software/firmware upgrade and any impacting changes.	If you anticipate a firmware update or any impacting change, provide 2 weeks' advance notice and liaise with JEN to ensure there is no impact to current operation. Method: emergency.backstop@jemena.com.au Similarly, JEN will notify external counterparts of any impacting changes within 2 weeks' notice. JEN would like start establishing co-testing environment for pre-production regression testings with OEM to ensure reliable and stable interoperability. Please reach out to start the conversation with us.

5. Flow of Communication Interactions

Diagram below illustrates the communication interactions for the initial device connection and discovery.



**Request only supported for In-Band registration workflow*

Figure 13: DER Client-Server Interactions - Discovery

Diagram below illustrates the ongoing communication interactions, worth noting the DER Control responses, DERSettings and DERCapability are posted on change only.

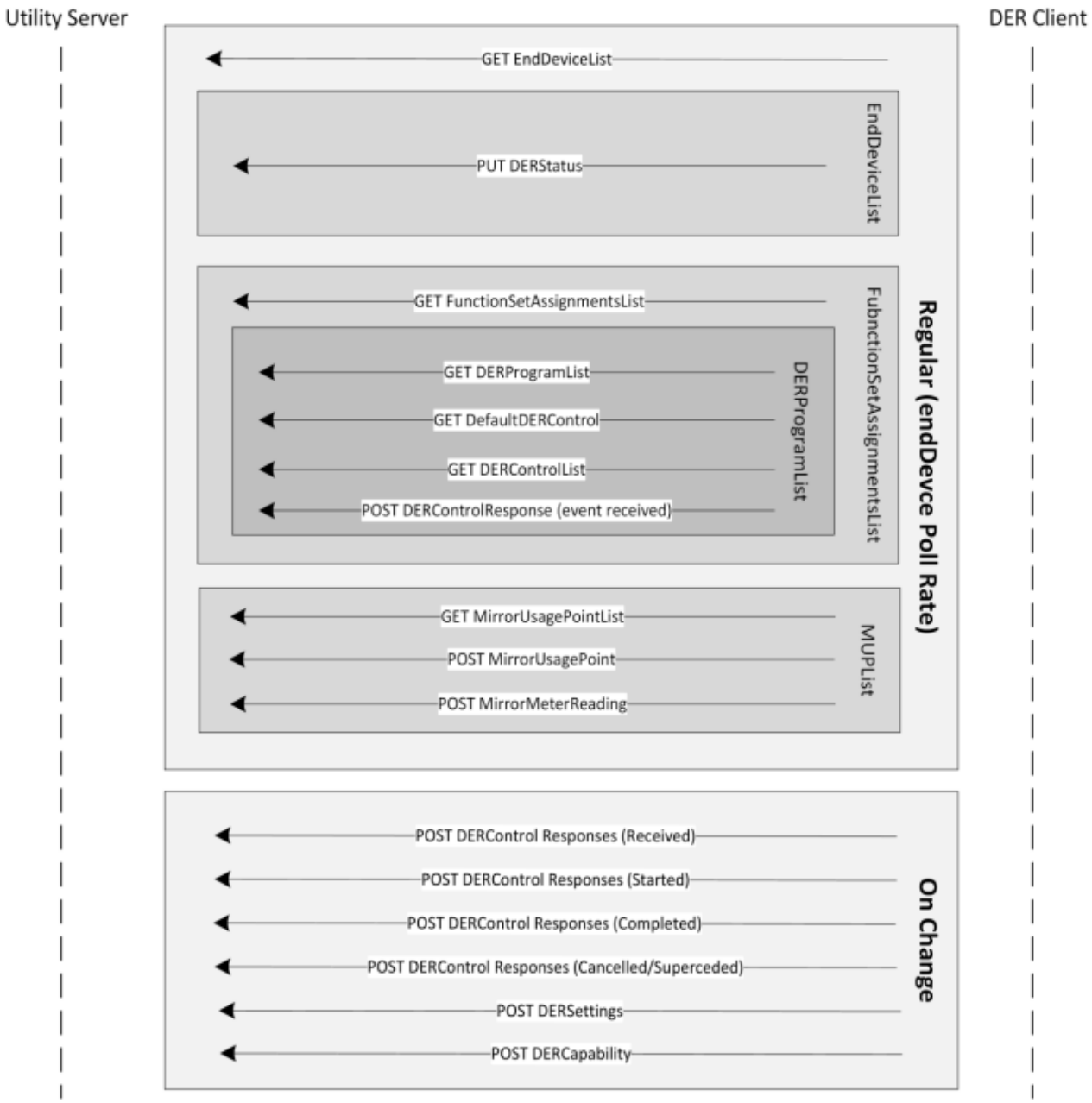


Figure 14: Client-Server interactions - Ongoing

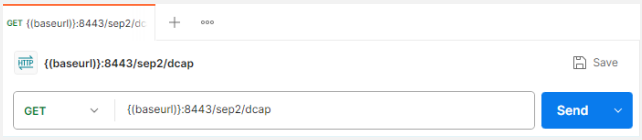
6. Sample requests and responses

6.1 Initial Device Connectivity / Discovery

Resource: Get Device Capability

Endpoint: GET https://sep2-e2e.aws.jemena.com.au:8444/sep2/dcap

Sample:



Expected response:

200 OK

```
<DeviceCapability href="/sep2/dcap"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <ResponseSetListLink href="/sep2/grp/1/rsps" all="1"/>
    <TimeLink href="/sep2/tm"/>
    <UsagePointListLink href="/sep2/upt" all="4"/>
    <EndDeviceListLink href="/sep2/edev" all="25"/>
    <MirrorUsagePointListLink href="/sep2/mup" all="4"/>
</DeviceCapability>
```

Resource: Get MirrorUsagePoint

Endpoint: GET /sep2/mup

Expected response:

200 OK

```
<MirrorUsagePointList href="/sep2/mup" pollRate="300" all="2" results="2"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <MirrorUsagePoint href="/sep2/mup/1939">
        <mRID>01F60015F000A2</mRID>
        <description>SITE MUP</description>
        <roleFlags>03</roleFlags>
        <serviceCategoryKind>0</serviceCategoryKind>
        <status>1</status>
        <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
        <postRate>300</postRate>
    </MirrorUsagePoint>
    <MirrorUsagePoint href="/sep2/mup/1737">
        <mRID>01F60015F000A1</mRID>
        <description>DER MUP</description>
        <roleFlags>49</roleFlags>
        <serviceCategoryKind>0</serviceCategoryKind>
        <status>1</status>
        <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
        <postRate>300</postRate>
    </MirrorUsagePoint>
</MirrorUsagePointList>
```

Resource: Get Time

Endpoint: GET /sep2/tm

Expected response:

200 OK

```
<Time href="/sep2/tm"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <currentTime>1748517048</currentTime>
    <dstEndTime>0</dstEndTime>
    <dstOffset>0</dstOffset>
    <dstStartTime>0</dstStartTime>
    <localTime>1748517048</localTime>
    <quality>7</quality>
    <tzOffset>0</tzOffset>
</Time>
```

Resource: Get device list

Endpoint: GET /sep2/edev

Expected response:

200 OK

```
<EndDeviceList href="/sep2/edev" subscribable="1" pollRate="300" all="25" results="25"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <EndDevice href="/sep2/edev/169" subscribable="1">
        <DERListLink href="/sep2/edev/169/der" all="1"/>
        <DeviceInformationLink href="/sep2/edev/169/di"/>
        <lFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</lFDI>
        <LogEventListLink href="/sep2/edev/169/lel" all="0"/>
        <sFDI>84221680595</sFDI>
        <changedTime>1747726701</changedTime>
        <FunctionSetAssignmentsListLink href="/sep2/fsagrp/134/fsa" all="2"/>
        <postRate>300</postRate>
        <RegistrationLink href="/sep2/edev/169/rg"/>
        <csipaus:ConnectionPointLink href="/sep2/edev/169/cp"/>
    </EndDevice>
..
..(23 more)
..
    <EndDevice href="/sep2/edev/332" subscribable="1">
        <DERListLink href="/sep2/edev/332/der" all="1"/>
        <DeviceInformationLink href="/sep2/edev/332/di"/>
        <lFDI>1F000199B6BA60CAE6D3E733D230A92C6410E3D7</lFDI>
        <LogEventListLink href="/sep2/edev/332/lel" all="0"/>
        <sFDI>83215056910</sFDI>
        <changedTime>1730854441</changedTime>
        <FunctionSetAssignmentsListLink href="/sep2/fsagrp/295/fsa" all="0"/>
        <RegistrationLink href="/sep2/edev/332/rg"/>
        <csipaus:ConnectionPointLink href="/sep2/edev/332/cp"/>
    </EndDevice>
</EndDeviceList>
```

Additional note: Different OEM types will find different pre-registered devices (aka edevs).

- Aggregator-based OEMs: You'll see two pre-registered edevs: an Aggregator endDevice (representing the Aggregator instance) and an Aggregator mediated DER endDevice (representing a managed DER).
- Direct device OEMs: You'll find a single pre-registered directly connected DER endDevice.

Resource: Get **FunctionSetAsignmentsList**

Endpoint: GET /sep2/fsagrp/134/fsa?s=0&l=255

Where, s = the start index and the l = limit to retrieve are optional parameters to filter data. This example brings back the first record up to 255 records.

Expected response:

200 OK

```
<FunctionSetAssignmentsList href="/sep2/fsagrp/134/fsa" subscribable="1" all="2" results="2"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <FunctionSetAssignments href="/sep2/fsa/28523">
        <DERProgramListLink href="/sep2/grp/28524/derp" all="1"/>
        <TimeLink href="/sep2/tm"/>
        <mRID>FAAC42A3A9B8B8D2B3C3B82700009182</mRID>
        <description>WillsTest_IndepNode01</description>
    </FunctionSetAssignments>
    <FunctionSetAssignments href="/sep2/fsa/14547">
        <DERProgramListLink href="/sep2/grp/14548/derp" all="2"/>
        <TimeLink href="/sep2/tm"/>
        <mRID>BC565251823B2E269F1AC6A800009182</mRID>
        <description>PremiseNMI</description>
    </FunctionSetAssignments>
</FunctionSetAssignmentsList>
```

6.2 Send DER Connection Status, Operational Mode & Capabilities and Settings

Resource: Get DER Device links

Endpoint: GET /sep2/edev/{x}/der

Expected response:

200 OK

```
<DERList href="/sep2/edev/169/der" all="1" results="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <DER href="/sep2/der/112" subscribable="1">
        <DERAvailabilityLink href="/sep2/der/112/dera"/>
        <DERCapabilityLink href="/sep2/der/112/dercap"/>
        <DERSettingsLink href="/sep2/der/112/derg"/>
        <DERStatusLink href="/sep2/der/112/ders"/>
    </DER>
</DERList>
```

Resource: Send DER status: Connection status & Operational mode

Endpoint: PUT /sep2/der/112/ders

Body:

```
<DERStatus
    xmlns="urn:ieee:std:2030.5:ns">
    <readingTime>1748756605</readingTime>
    <operationalModeStatus>
        <dateTime>1748756605</dateTime>
        <value>2</value>
    </operationalModeStatus>
    <genConnectStatus>
        <dateTime>1748756605</dateTime>
        <value>01</value>
    </genConnectStatus>
</DERStatus>
```

Expected response:

204 OK

Resource: Send DER Capabilities

Endpoint: PUT /sep2/der/{x}/dercap

```
<DERCapability mlns="urn:ieee:std:2030.5:ns" mlns:ns2="https://csipaus.org/ns">
    <ns2:doeModesSupported>00000005</ns2:doeModesSupported>
    <modesSupported>10000C</modesSupported>
    <type>4</type>
    <rtgMaxVA>
        <multiplier>0</multiplier>
        <value>5000</value>
    </rtgMaxVA>
    <rtgMaxVar>
        <multiplier>-1</multiplier>
        <value>29999</value>
    </rtgMaxVar>
    <rtgMaxW>
        <multiplier>0</multiplier>
        <value>5000</value>
    </rtgMaxW>
    /
    <rtgVNom>
        <multiplier>2</multiplier>
        <value>25</value>
    </rtgVNom>
</DERCapability>
```

Expected response:

204 OK

Resource: Send DER Settings

Endpoint: PUT /sep2/der/{x}/derg

PUT /sep2/der/112/derg

```
<DERSettings
    xmlns="urn:ieee:std:2030.5:ns">
    <doeModesEnabled>05</doeModesEnabled>
    <modesEnabled>10000C</modesEnabled>
    <setGradW>1666</setGradW>
    <setMaxVA>
        <multiplier>0</multiplier>
        <value>3000</value>
    </setMaxVA>
    <setMaxVar>
        <multiplier>0</multiplier>
        <value>3000</value>
    </setMaxVar>
    <setMaxVarNeg>
        <multiplier>0</multiplier>
        <value>0</value>
    </setMaxVarNeg>
    <setMaxW>
        <multiplier>0</multiplier>
        <value>3000</value>
    </setMaxW>
    <updatedTime>1748760109</updatedTime>
</DERSettings>
```

Expected response:

204 OK

Resource: Send DER availability

Endpoint: PUT /sep2/der/112/dera

```
<DERAvailability
    xmlns="urn:ieee:std:2030.5:ns">
    <readingTime>1748817197</readingTime>
</DERAvailability>
```

Expected response:

204 OK

6.3 Send DER Telemetry

Resource: Get MirrorUsagePointList

Endpoint: GET /sep2/mup?s=0&l=255

Where, s = the start index and the l = limit to retrieve are optional parameters to filter data. This example brings back the first record up to 255 records.

Expected response:

200 OK

```
<MirrorUsagePointList href="/sep2/mup" pollRate="300" all="2" results="2"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <MirrorUsagePoint href="/sep2/mup/1939">
        <mRID>01F60015F000A2</mRID>
        <description>SITE MUP</description>
        <roleFlags>03</roleFlags>
        <serviceCategoryKind>0</serviceCategoryKind>
        <status>1</status>
        <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
        <postRate>300</postRate>
    </MirrorUsagePoint>
    <MirrorUsagePoint href="/sep2/mup/1737">
        <mRID>01F60015F000A1</mRID>
        <description>DER MUP</description>
        <roleFlags>49</roleFlags>
        <serviceCategoryKind>0</serviceCategoryKind>
        <status>1</status>
        <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
        <postRate>300</postRate>
    </MirrorUsagePoint>
</MirrorUsagePointList>
```

Resource: Get MirrorUsagePoint details

Endpoint: GET /sep2/mup/1737

Expected response:

204 OK

```
<MirrorUsagePoint href="/sep2/mup/1737"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <mRID>01F60015F000A1</mRID>
    <description>DER MUP</description>
    <roleFlags>49</roleFlags>
    <serviceCategoryKind>0</serviceCategoryKind>
    <status>1</status>
    <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
    <postRate>300</postRate>
</MirrorUsagePoint>
```

Resource: Send MirrorMeterReading

Endpoint: POST /sep2/mup/1737

```
<MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns">
    <mRID>E51282AE5C506CAC389CC5492123CC48</mRID>
    <description>Real Power(W) DER</description>
    <ReadingType>
            <accumulationBehaviour>12</accumulationBehaviour>
            <commodity>1</commodity>
            <dataQualifier>2</dataQualifier>
            <flowDirection>1</flowDirection>
            <kind>37</kind>
            <phase>0</phase>
            <powerOfTenMultiplier>0</powerOfTenMultiplier>
            <uom>63</uom>
        </ReadingType>
</MirrorMeterReading>
```

Content-Type: application/sep+xml

Expected response:

204 OK

Resource: Send MirrorMeterReading

Endpoint: POST /sep2/mup/1737

Content-Type: application/sep+xml

```
<MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns">
    <mRID>E51282AE5C506CAC389CC5492123CC48</mRID>
    <description>Real Power(W) DER</description>
    <Reading>
        <value>2</value>
        <timePeriod>
            <duration>300</duration>
            <start>1748761376</start>
        </timePeriod>
    </Reading>
</MirrorMeterReading>
```

Expected response:

204 OK

Response: Location /sep2/mr/2732

Resource: Get MeterReading

Endpoint: GET /sep2/mr/2732

Content-Type: application/sep+xml

Expected response:

200 OK

```
<MeterReading href="/sep2/mr/2732"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <mRID>01F60015F00012</mRID>
    <description>Real Power(W) DER</description>
    <ReadingLink href="/sep2/mr/2732/read"/>
    <ReadingTypeLink href="/sep2/mr/2732/rt"/>
</MeterReading>
```

6.4 Receiving and responding to DERControls

Resource: Get FunctionSetAssignmentList

Endpoint: GET /sep2/fsagrp/134/fsa?s=0&l=255

Where, s = the start index and the l = limit to retrieve are optional parameters to filter data. This example brings back the first record up to 255 records.

Expected response:

200 OK

```
<FunctionSetAssignmentsList href="/sep2/fsagrp/134/fsa" subscribable="1" all="2" results
    ="2"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <FunctionSetAssignments href="/sep2/fsa/28523">
        <DERProgramListLink href="/sep2/grp/28524/derp" all="1"/>
        <TimeLink href="/sep2/tm"/>
        <mRID>FAAC42A3A9B8B8D2B3C3B82700009182</mRID>
        <description>WillTest_IndepNode01</description>
    </FunctionSetAssignments>
    <FunctionSetAssignments href="/sep2/fsa/14547">
        <DERProgramListLink href="/sep2/grp/14548/derp" all="2"/>
        <TimeLink href="/sep2/tm"/>
        <mRID>BC565251823B2E269F1AC6A800009182</mRID>
        <description>PremiseNMI</description>
    </FunctionSetAssignments>
</FunctionSetAssignmentsList>
```

Resource: Get DERProgramList

Endpoint: GET /sep2/grp/28524/derp?s=0&l=255

Expected response:

200 OK

```
<DERProgramList href="/sep2/grp/28524/derp" subscribable="1" pollRate="300" all="1"
    results="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <DERProgram href="/sep2/derp/28523" subscribable="1">
        <mRID>31672E25FD3F83086FAF0B9F00009182</mRID>
        <description>WillTest_IndepNode01</description>
        <ActiveDERControlListLink href="/sep2/derp/28523/aderc" all="0"/>
        <DefaultDERControlLink href="/sep2/derp/28523/dderc"/>
        <DERControlListLink href="/sep2/derp/28523/derc" all="0"/>
        <DERCurveListLink href="/sep2/derp/28523/dc" all="0"/>
        <primacy>100</primacy>
    </DERProgram>
</DERProgramList>
```

Resource: Get DefaultDerControl

Endpoint: GET /sep2/derp/28523/dderc

Expected response:

200 OK

```
<DefaultDERControl href="/sep2/derp/28523/dderc" subscribable="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <mRID>385D63045DE8B43197E7A2FA00009182</mRID>
    <description>Test default control</description>
    <DERControlBase>
        <csipaus:opModGenLimW>
            <multiplier>2</multiplier>
            <value>5</value>
        </csipaus:opModGenLimW>
    </DERControlBase>
</DefaultDERControl>
```

Resource: Get DERControlList

Endpoint: GET sep2/derp/28523/derc?s=0&l=255

Where, s = the start index and the l = limit to retrieve are optional parameters to filter data. This example brings back the first record up to 255 records.

Expected response:

200 OK


```
<DERControlList href="/sep2/derp/28523/derc" subscribable="1" all="1" results="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <DERControl href="/sep2/derc/29377" replyTo="/sep2/rsps/1/rsp" responseRequired="07"
        subscribable="1">
        <mRID>9B5008817AE07281A9F00BE900009182</mRID>
        <description>Test control</description>
        <creationTime>1748762345</creationTime>
        <EventStatus>
            <currentStatus>1</currentStatus>
            <dateTime>1748762337</dateTime>
            <potentiallySuperseded>false</potentiallySuperseded>
        </EventStatus>
        <interval>
            <duration>900</duration>
            <start>1748762319</start>
        </interval>
        <DERControlBase>
            <csipaus:opModGenLimW>
                <multiplier>0</multiplier>
                <value>345</value>
            </csipaus:opModGenLimW>
        </DERControlBase>
    </DERControl>
</DERControlList>
```

Resource: Post DERControlResponse

Endpoint: POST /sep2/rsps/1/rsp

Content-Type: application/sep+xml

Below DERControlResponse submits a DERControlResponse.status = 1. This denotes “Event received”.

```
<DERControlResponse xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus="https://csipaus.org/ns">
  <createdDateTime>1748762508</createdDateTime>
  <endDeviceLFDI>111321240100060CAE6D3E733D230A92C6411226</endDeviceLFDI>
  <status>1</status>
  <subject>9B5008817AE07281A9F00BE900009182</subject>
</DERControlResponse>
```

Below DERControlResponse submits a DERControlResponse.status = 2. This denotes “Event started”.

```
<DERControlResponse xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus="https://csipaus.org/ns">
  <createdDateTime>1748762508</createdDateTime>
  <endDeviceLFDI>111321240100060CAE6D3E733D230A92C6411226</endDeviceLFDI>
  <status>2</status>
  <subject>9B5008817AE07281A9F00BE900009182</subject>
</DERControlResponse>
```

Below DERControlResponse submits a DERControlResponse.status = 3. This denotes “Event completed”.

```
<DERControlResponse xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus="https://csipaus.org/ns">
  <createdDateTime>1748762508</createdDateTime>
  <endDeviceLFDI>111321240100060CAE6D3E733D230A92C6411226</endDeviceLFDI>
  <status>3</status>
  <subject>9B5008817AE07281A9F00BE900009182</subject>
</DERControlResponse>
```

Expected response:

200 OK

7. Client Onboard Key Activities

Step 1: In JEN staging environment:

- Section 7.1 - Request a test certificate
  Certificate *is signed and issued by JEN*
  Client IP whitelisting
- Section 7.2 - Connectivity test
  Verify ***connectivity*** *is established between client and JEN Utility Server*
- Section 7.3 - Register a test device
  Out-of-band registration
  In-band registration
- Section 7.4 - Discovery test in Staging
  Verify inverter is able to send ***DER device and monitoring information***
- Section 7.5 - Functional test
  Verify inverter complies with the ***CSIP-AUS functional tests***

Step 2 : In JEN production environment:

- Section 7.6 – Onboard to Production environment
  Repeat steps in Section 7.1-7.4

Step 3: Client onboard completes

- Section 7.7 Client successfully onboarded with JEN.
  Jemena will add the client to approved OEM list on the public website.

7.1 Request a test certificate to JEN staging environment

JEN has different requirements and procedure for issuing PKI certificate depending on your communication pathway. Please check Section 2 IEEE 2030.5 Communications Pathways if you are unsure.

For more information on PKI, please refer to Section 10 Certificate Public Key Infrastructure (PKI).

7.1.1 Requesting a certificate: Aggregator model

Warning:

Client must keep their Private Key and JEN issued Certificate in a safe place. If it is lost, client must notify JEN to reapply for the certificate. Additional cost will incurred here, up to $3000 USD. The client is responsible for this fee.

Step#	Description	Supporting material
1	Client generates a Private Key	

2	Client submits the following to JEN 1. Certificate Signing Request (CSR) 2. and IP address to whitelist **Methods:** Email **<u>or</u>** file share to emergency.backstop@jemena.com.au	Refer to Section C1.1 Native IEEE 2030.5 Root Ca Device Certificate Profile JEN Utility Server has implemented IPs access restriction in non-production/staging environment for the purpose of onboard testing. If Client anticipates IPs change, please provide JEN 7 business days advance notice via emergency.backstop@jemena.com.au to avoid delays.
3	JEN will send the signed certificate and registration details to client. 1. Signed certificate (CSR signed) 2. Aggregator LFDI 3. Registration PIN 4. Additional Information on determining an LFDI for a Virtual End Device (Refer to Section 8.3.2)	Registration PIN for non-production is 111115 and production is 536367.

.

7.1.2 Requesting a certificate: Direct-device model

Warning:

Client must keep their Private Key and JEN issued Certificate in a safe place. If it is lost, client must notify JEN to reapply for the certificate. Additional cost will incurred here, up to $3000 USD. The client is responsible for this fee.

Step#	Description	Supporting material
1	Client generates a Private Key.	
2	Client submits the followings to JEN: 1. A Manufacture Certificate Authority (MCA) Certificate Signing Request (CSR) and 2. “Manufacture Certificate Authority (MCA) - Certificate Authority (CA) Naming Form” **Methods:** Email **<u>or</u>** file share to emergency.backstop@jemena.com.au	Refer to Section C1.2 Intermediate CA Certificate Profile (MCA) The client is responsible for ensuring that the CSR exactly matches the CA Naming Form—for example, the Issuer Distinguished Name (DN) and the Subject DN must be identical. Any discrepancies will render the MCA unusable and require a new certificate application. In such cases, the client will be responsible for a re-signing fee of $3,000 USD..

3	JEN will send the certificate and registration details to client. • Signed MCA Certificate • Registration PIN	Registration PIN for non-production is 111115 and production is 536367.

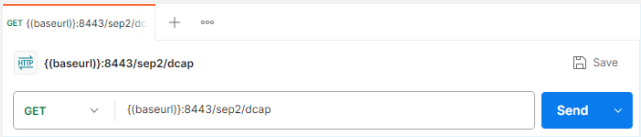
7.2 Connectivity Test in staging environment

This test is intended to validate the client's ability to perform connectivity against JEN Utility Server and to establish basic IEEE 2030.5- based communications.

Note:

1. Client must use their issued certificate for all requests to JEN Utility Server.
2. If an error is returned, please check FAQ 8.78.7 to understand the likely issue and possible resolution.

Step#	Description	Supporting material

1	Client queries JEN Utility Server for DeviceCapability resource.	**Resource:** Get Device Capability
		
		Endpoint: GET /sep2/dcap
		
		Sample:
		
		 
		
		Expected response:
		
		200 OK
		
		`<DeviceCapability href="/sep2/dcap"`
		`xmlns="urn:ieee:std:2030.5:ns"`
		`xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"`
		`xmlns:csipaus="https://csipaus.org/ns">`
		`<ResponseSetListLink href="/sep2/grp/1/rsps" all="1"/>`
		`<TimeLink href="/sep2/tm"/>`
		`<UsagePointListLink href="/sep2/upt" all="4"/>`
		`<EndDeviceListLink href="/sep2/edev" all="24"/>`
		`<MirrorUsagePointListLink href="/sep2/mup" all="4"/>`
		`</DeviceCapability>`
		
		Errors:
		
		Check out the Troubleshooting and FAQs – Section 8.7.

2	Client emails the test evidence including result to JEN **Methods:** Email emergency.backstop@jemena.com.au	

7.3 Register a test device in staging environment

7.3.1 Out of Band registration

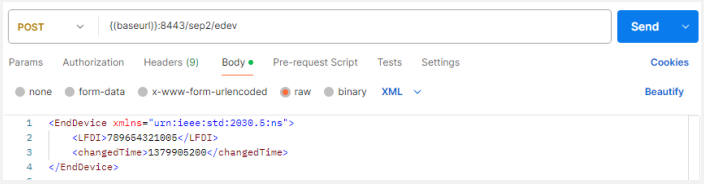
Step#	Description	Supporting material
1	Generate the device LDFI.	Refer to Section 8.3.2 for more info on how to generate a device LDFI.
2	Client emails the test device's **LDFI**. **Methods:** Email emergency.backstop@jemena.com.au	Refer to Section 9.3 for more info on the LDFI data object requirement
3	JEN sends a confirmation once the device is successfully registered with JEN Utility Server.	

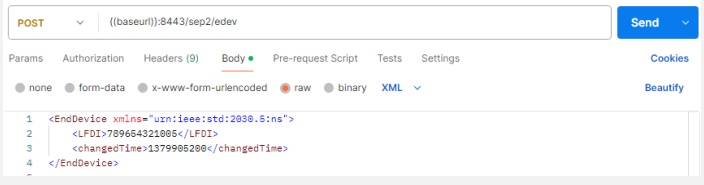
7.3.2 In-Band registration

Note:

- JEN only support in-band registration for aggregator model client.
- JEN is in progress of testing this feature and will engage with OEMs on the rollout plan.

Step#	Description	Supporting material
1	Generate the device LDFI.	Refer to Section 8.3.2 for more info on how to generate a device LDFI.
2	Client notifies JEN the intention to commence the in-band registration and provide the test device's LFDI. Wait for JEN to reply with a NMI to use as the device's ConnectionPointID.	Refer to Section 9.3 for more info on the LDFI data object requirement Refer to Section 9.2 for more info on the ConnectionPointID data object requirement
3	Client sends a request to JEN Utility Server to create a test device	**Resource:** Create a DER device **Endpoint:** POST /sep2/edev

	• Include device LFDI	Content-Type: application/sep+xml
		
		Body:
		
		`<EndDevice xmlns="urn:ieee:std:2030.5:ns">`
		`  <LFDI>789654321005</LFDI>`
		`</EndDevice>`
		
		Sample:
		
		 
		
		Expected response:
		
		201 Created
		
		Location: /sep2/edev/{x}
		
		Errors:
		
		Check out the Troubleshooting and FAQs - Section 8.7
		
		<u>Additional note:</u> A subsequent call to the GET /edev/ endpoint will return a list containing the newly created resource.

4	Client sends a request to JEN Utility Server to update the location of the device on the network with the ConnectionPointID (as shared in step 2) by JEN)
	
	• ConnectionPointID e.g. 6001234567
		Resource: Update the ConnectionPointID of the DER device
		
		Endpoint: PUT /sep2/edev/{x}/cp
		
		Content-Type: application/sep+xml
		
		Body:
		
		`<csipaus:ConnectionPoint`
		`xmlns:csipaus="https://csipaus.org/ns">`
		`  <connectionPointId>6001234567</connectionPointId>`
		`</csipaus:ConnectionPoint>`
		
		Sample:
		
		 
		
		Expected response:
		
		201 Created
		
		Location: /sep2/edev/{x}

		Errors: **403 – Unauthorised** **For device undefined.** If an invalid connectionPointID was supplied, a 403 error code is returned and the device will be deleted in JEN Utility Server. Client is expected to call step3 again to recreate the device again (POST /sep2/edev).

7.4 Discovery Test in staging environment

This test is intended to validate the client's ability to perform discovery against the Utility Server and to establish basic IEEE 2030.5- based communications.

Note:

1. Client must use their issued certificate for all requests to JEN Utility Server.
2. If an error is returned, please check FAQ 8.7 All about response errors to understand the likely issue and possible resolution.

Step#	Description	Supporting material
1	On JEN's request, Client sends request to the following endpoints. 1. /sep2/tm 2. /sep2/mup 3. /sep2/edev 4. /sep2/dderc 5. /sep2/derc Confirm all endpoints above are responding as specified here.	**1. Resource:** Get Time **Endpoint:** GET /sep2/tm **Expected response:** 200 OK `<Time href="/sep2/tm" xmlns="urn:ieee:std:2030.5:ns" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:csipaus="https://csipaus.org/ns"> <currentTime>1749628236</currentTime> <dstEndTime>0</dstEndTime> <dstOffset>0</dstOffset> <dstStartTime>0</dstStartTime> <localTime>1749628236</localTime> <quality>7</quality> <tzOffset>0</tzOffset> </Time>`

2. Resource: Get MirrorUsagePoint

Endpoint: GET /sep2/mup?s=0&l=255

Expected response:

200 OK

```
<MirrorUsagePointList href="/sep2/mup" pollRate="300" all="2" results="2"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <MirrorUsagePoint href="/sep2/mup/5947">
        <mRID>E3113790B6DBC1FCB80BAF0300005151</mRID>
        <description>MUP1 Site</description>
        <roleFlags>03</roleFlags>
        <serviceCategoryKind>0</serviceCategoryKind>
        <status>1</status>
        <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
        <postRate>300</postRate>
    </MirrorUsagePoint>
    <MirrorUsagePoint href="/sep2/mup/5940">
        <mRID>DA923F1CFADB595381B4544900005151</mRID>
        <description>MUP2 DER</description>
        <roleFlags>49</roleFlags>
        <serviceCategoryKind>0</serviceCategoryKind>
        <status>1</status>
        <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
        <postRate>300</postRate>
    </MirrorUsagePoint>
</MirrorUsagePointList>
```

3. Resource: Get device list

Endpoint: GET /sep2/edev

Expected response:

200 OK

```
<EndDeviceList href="/sep2/edev" subscribable="1" pollRate="300" all="25" results="25"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <EndDevice href="/sep2/edev/169" subscribable="1">
        <DERListLink href="/sep2/edev/169/der" all="1"/>
        <DeviceInformationLink href="/sep2/edev/169/di"/>
        <lFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</lFDI>
        <LogEventListLink href="/sep2/edev/169/lel" all="0"/>
        <sFDI>84221680595</sFDI>
        <changedTime>1747726701</changedTime>
        <FunctionSetAssignmentsListLink href="/sep2/fsagrp/134/fsa" all="2"/>
        <postRate>300</postRate>
        <RegistrationLink href="/sep2/edev/169/rg"/>
        <csipaus:ConnectionPointLink href="/sep2/edev/169/cp"/>
    </EndDevice>
..
..(23 more)
..
    <EndDevice href="/sep2/edev/332" subscribable="1">
        <DERListLink href="/sep2/edev/332/der" all="1"/>
        <DeviceInformationLink href="/sep2/edev/332/di"/>
        <lFDI>1F000199B6BA60CAE6D3E733D230A92C6410E3D7</lFDI>
        <LogEventListLink href="/sep2/edev/332/lel" all="0"/>
        <sFDI>83215056910</sFDI>
        <changedTime>1730854441</changedTime>
        <FunctionSetAssignmentsListLink href="/sep2/fsagrp/295/fsa" all="0"/>
        <RegistrationLink href="/sep2/edev/332/rg"/>
        <csipaus:ConnectionPointLink href="/sep2/edev/332/cp"/>
    </EndDevice>
</EndDeviceList>
```

4. Resource: Get default DER Control

Endpoint: GET /sep2/derp/{x}/dderc

Expected response:

200 OK

```
<DefaultDERControl href="/sep2/derp/28523/dderc" subscribable="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <mRID>385D63045DE8B43197E7A2FA00009182</mRID>
    <description>Test default control</description>
    <DERControlBase>
        <csipaus:opModGenLimW>
            <multiplier>2</multiplier>
            <value>5</value>
        </csipaus:opModGenLimW>
    </DERControlBase>
</DefaultDERControl>
```

5. Resource: Get active DER Control

Endpoint: GET /sep2/derp/{x}/derc

Expected response:

200 OK

```
<DERControlList href="/sep2/derp/28523/derc" subscribable="1" all="1" results="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <DERControl href="/sep2/derc/29377" replyTo="/sep2/rsps/1/rsp" responseRequired="07"
        subscribable="1">
        <mRID>9B5008817AE07281A9F00BE900009182</mRID>
        <description>Test control</description>
        <creationTime>1748762345</creationTime>
        <EventStatus>
            <currentStatus>1</currentStatus>
            <dateTime>1748762337</dateTime>
            <potentiallySuperseded>false</potentiallySuperseded>
        </EventStatus>
        <interval>
            <duration>900</duration>
            <start>1748762319</start>
        </interval>
        <DERControlBase>
            <csipaus:opModGenLimW>
                <multiplier>0</multiplier>
                <value>345</value>
            </csipaus:opModGenLimW>
        </DERControlBase>
    </DERControl>
</DERControlList>
```

Client sends

1. connection status & operational mode,
2. DER compatibility
3. DER settings
4. DER availability

Resource: Get DER Device links

Endpoint: GET /sep2/edev/{x}/der

Expected response:

200 OK

```
<DERList href="/sep2/edev/169/der" all="1" results="1"
    xmlns="urn:ieee:std:2030.5:ns"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:csipaus="https://csipaus.org/ns">
    <DER href="/sep2/der/112" subscribable="1">
        <DERAvailabilityLink href="/sep2/der/112/dera"/>
        <DERCapabilityLink href="/sep2/der/112/dercap"/>
        <DERSettingsLink href="/sep2/der/112/derg"/>
        <DERStatusLink href="/sep2/der/112/ders"/>
    </DER>
</DERList>
```

1. **Resource:** Send DER status: Connection status & Operational mode

Endpoint: PUT /sep2/der/{x}/ders

Content-Type: application/sep+xml

Body:

```
<DERStatus
      xmlns="urn:ieee:std:2030.5:ns">
      <readingTime>1748756605</readingTime>
      <operationalModeStatus>
            <dateTime>1748756605</dateTime>
            <value>2</value>
      </operationalModeStatus>
      <genConnectStatus>
            <dateTime>1748756605</dateTime>
            <value>01</value>
      </genConnectStatus>
</DERStatus>
```

Expected response:

204 OK

2. **Resource:** Send DER Capabilities

Endpoint: PUT /sep2/der/{x}/dercap

Content-Type: application/sep+xml

Body:

```
<DERCapability href="/sep2/der/1547/dercap"
xmlns="urn:ieee:std:2030.5:ns"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:csipaus="https://csipaus.org/ns">
        <modesSupported>08</modesSupported>
        <rtgMaxVA>
                <multiplier>0</multiplier>
                <value>3705</value>
        </rtgMaxVA>
        <rtgMaxVar>
                <multiplier>0</multiplier>
                <value>-1492</value>
        </rtgMaxVar>
        <rtgMaxVarNeg>
                <multiplier>0</multiplier>
                <value>-1492</value>
        </rtgMaxVarNeg>
        <rtgMaxW>
                <multiplier>0</multiplier>
                <value>5000</value>
        </rtgMaxW>
        <rtgMaxWh>
                <multiplier>0</multiplier>
                <value>0</value>
        </rtgMaxWh>
        <type>83</type>

<csipaus:doeModesSupported>01</csipaus:doeModesSupported>
</DERCapability>
```

Expected response:

204 OK

3. **Resource:** Send DER Settings

Endpoint: PUT /sep2/der/{x}/derg

Content-Type: application/sep+xml

Body:

		<DERSettings xmlns="urn:ieee:std:2030.5:ns"> <doeModesEnabled>05</doeModesEnabled> <modesEnabled>10000C</modesEnabled> <setGradW>1666</setGradW> <setMaxVA> <multiplier>0</multiplier> <value>3000</value> </setMaxVA> <setMaxVar> <multiplier>0</multiplier> <value>3000</value> </setMaxVar> <setMaxVarNeg> <multiplier>0</multiplier> <value>0</value> </setMaxVarNeg> <setMaxW> <multiplier>0</multiplier> <value>3000</value> </setMaxW> <updatedTime>1748760109</updatedTime> </DERSettings> **Expected response:** 204 OK **Resource:** Send DER availability **Endpoint:** PUT /sep2/der/112/dera Content-Type: application/sep+xml **Body:** <DERAvailability xmlns="urn:ieee:std:2030.5:ns"> <readingTime>1748817197</readingTime> </DERAvailability> **Expected response:** 204 OK
4	Client powers up the device, informs JEN and provide test evidence to steps 2&3.	**Jemena will validate the following device data, refer to Section A1.2 for further information.** The following telemetry readings through the Metering Mirror function set: • Site Real Power (kW)

		• Site Reactive Power (kVAr) • Site Voltage (V) • Gross Inverter Real Power (kW) • Gross Inverter Reactive Power (kVAr) • Inverter Voltage (V) The Status Information will capture attributes under: • DERCapability • DERSettings • DERStatus • DERAvailability (Optional)
5	JEN will send a confirmation of the verification.	If fail, it is expected that Client reviews the feedback and provide a resolution. For further assistance, please email emergency.backstop@jemena.com.au.

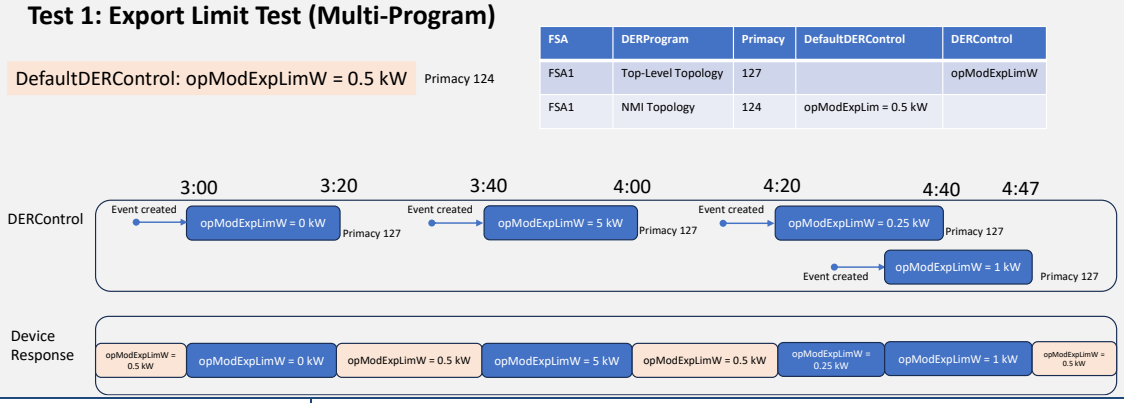
7.5 Functional Test in Staging Environment (out-of-band)

Jemena will perform 8 tests to verify the functionality of the client Software Communication Client and inverter.

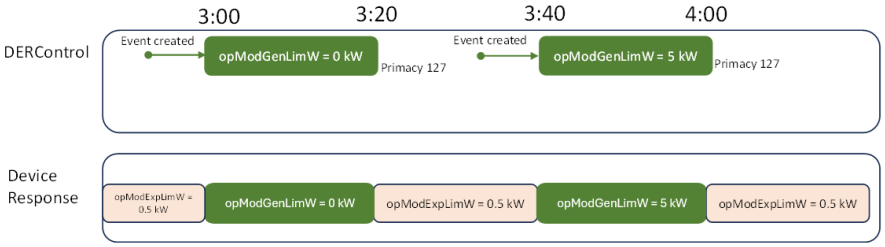
Prior to testing, JEN requires the client to satisfy the following conditions so that JEN can verify the functional tests.

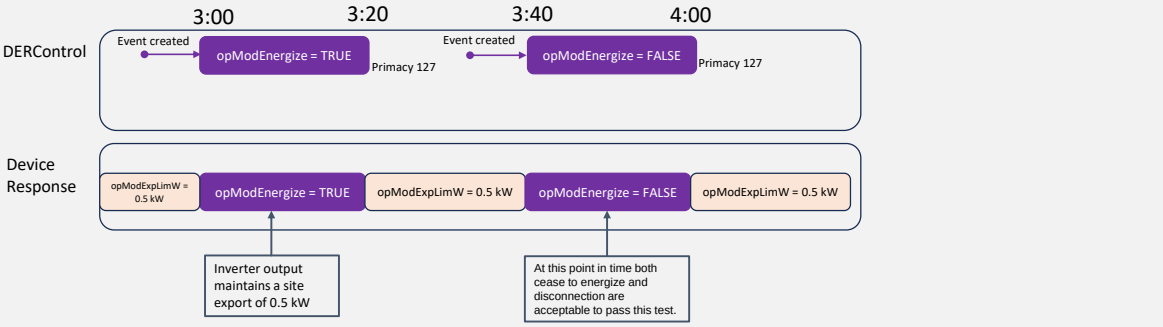
- A physical inverter with reliable PV simulator or DC source.
- The test inverter should have minimum load of 0.5kW.
- Client is advised to review the below JEN test cases and ensure your inverter is exhibit the expected behaviours as documented here.

Step #	Description	Supporting material
0	Client books a session with JEN for the functional test.	Provide JEN: • an UI to JEN so JEN can monitor the device responses • what model of the inverter and Software Communication Client
1A	Test Export Limit Requested DER Info Post Rate = 60 s Requested Meter Data Post Rate = 60 s	JEN test details: This test is intended to validate default export limit and active control export limit functions.

		1. Set the default OpModExpLimW = 0.5kW at NMI node (Primacy 124) and expect site active power and generation are correct 2. Set the active OpModExpLimW = 0kW at Top Level node (Primacy 127) and expect site active power limit reduces to 0KW 3. Set the active OpModExpLimW = 5kW at Top Level node (Primacy 127) and expect site active power limit increases to 5KW 4. Expect at the end of the scheduled control that site export returns to 0.5kW. **Overlap of two control commands test** This test is intended to understand whether the first control command will be cancelled when the second control command initiates. 1. Set 1st active OpModExpLimW = 0.25kW for Tstart=0 and Tend = 20 minutes 2. Set 2nd active OpModExpLimW = 1.0kW for Tstart=14 and Tend = 27 minutes (event needs to be created once 1st active control has started) 3. Expect at end of scheduled control that site export limit returns to 0.5 kW.
	Expected outcome **Test 1: Export Limit Test (Multi-Program)** DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124  	
1B	Test Generation Limit This test is intended to validate active control generation limit function.	JEN test details: 1. Set an active OpModGenLimW = 0kW at Top Level node (Primacy 127) and expect inverter active power limit reduces to 0kW 2. Set an active OpModGenLimW = 5kW at Top Level node (Primacy 127) and expect inverter active power limit increases to 5kW
	Expected outcome	

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	Top-Level Topology	127		opModExpLimW
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	

<table>
<tr><td></td><td colspan="2">
Test 1: Generation Limit Test (Multi-Program)
DefaultDERControl: opModExpLim = 0.5 kW Primacy 124
<table>
<tr><th>FSA</th><th>DERProgram</th><th>Primacy</th><th>DefaultDERControl</th><th>DERControl</th></tr>
<tr><td>FSA1</td><td>Top-Level Topology</td><td>127</td><td></td><td>opModGenLimW</td></tr>
<tr><td>FSA1</td><td>NMI Topology</td><td>124</td><td>opModExpLim = 0.5 kW</td><td></td></tr>
</table>


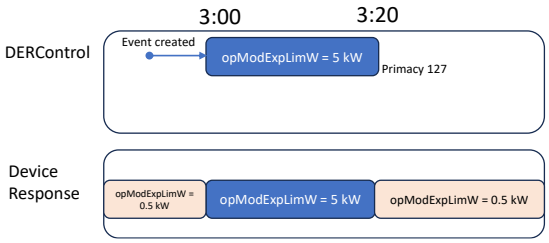
Note: Generation output is expected to increase and not be restricted by any default export limit control during the active generation limit control duration.
</td></tr>
<tr><td>1C</td><td>Test JEN sends De-energize control</td><td><u>JEN test details:</u>
1. Send OpModEnergize = False at Top Level node (Primacy 127) and confirm connection status</td></tr>
<tr><td></td><td colspan="2">
Test 1: Energize Test (Multi-Program)
DefaultDERControl: opModExpLim = 0.5 kW Primacy 124
<table>
<tr><th>FSA</th><th>DERProgram</th><th>Primacy</th><th>DefaultDERControl</th><th>DERControl</th></tr>
<tr><td>FSA1</td><td>Top-Level Topology</td><td>127</td><td></td><td>opModEnergize</td></tr>
<tr><td>FSA1</td><td>NMI Topology</td><td>124</td><td>opModExpLim = 0.5 kW</td><td></td></tr>
</table>


</td></tr>
<tr><td>2</td><td>Test Tests ongoing Site Export Control via an Independent Node.</td><td><u>JEN test details:</u>
1. Set an active OpModExpLimW = 5kW on Independent Node (Primacy 127) and expect site active power limit increases to 5kW.
2. Expect at end of scheduled control that site export limit returns to 0.5 kW.</td></tr>
</table>

Test 2 (Multi-FSA)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA2	Non-Topology	127		opModExpLimW

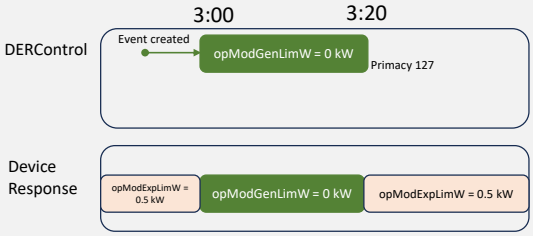


3	Test ongoing Site **Generation** Control via an *Independent* Node.	JEN test details: 1. Set an active OpModGenLimW = 0kW on Independent Node (Primacy 127) and expect inverter active power limit reduces to 0kW 2. Expect at end of scheduled control that site export limit returns to 0.5 kW.

Test 3 (Multi-FSA)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA2	Non-Topology	127		opModGenLimW

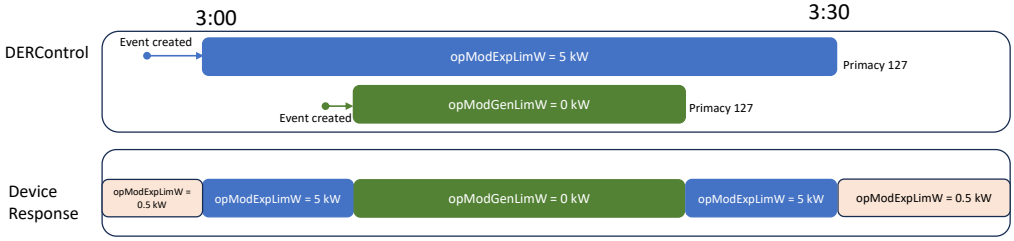


4	Test ongoing Site Export Control via an Independent Node and Overriding by the MSL event at the Top-Level Topology Node.	JEN test details: 1. Set an **Independent Node** active OpModExpLimW = 5 kW on **"Testing Node"** (Primacy 127) for 30 Minutes or (6x poll rate) and expect site active power limit increases to 5 kW. 2. After 10 minutes or (1x poll rate), set an active OpModGenLimW on Top-Level Topology Node = 0 kW (Primacy 127) for 10 minutes or (2x poll rate) and expect inverter active power limit decreases to 0 kW 3. Expect at end of scheduled control that site export limit returns to 0.5 kW.

Test 4 (Multi-FSA, Multi-Program, Multi-Controls)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA1	Top-Level Topology	127		opModGenLimW
FSA2	Non-Topology	127		opModExpLimW



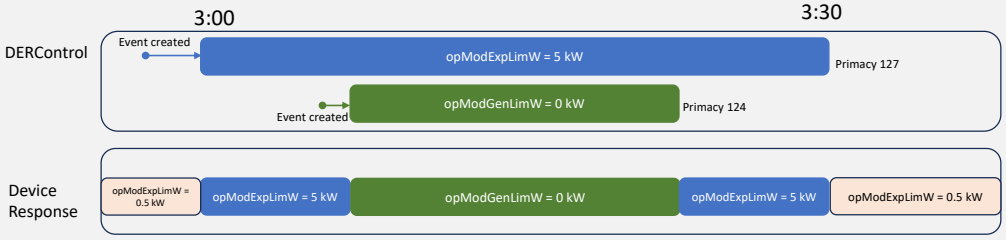
t) For DERControls, differing controls (e.g., opModTargetVar, opModTargetW) within DERControl *Events* are independent and are allowed to overlap or nest without superseding. If multiple controls are identified for a DERControl *Event*, future DERControl *Events* for an individual control (or a subset of the original *Event*) that cause an *Overlapping Event* will supersede the original *Event* strictly for that control (or a subset of the original *Event*). Note: Rule f) applies to all *Overlapping Events*.

5	Test ongoing Site Export Control via an Independent Node and Overriding by a Lower Primacy at the NMI Topology Node	<u>JEN test details:</u> 1. Set an **Independent Node** active OpModExpLimW = 5 kW on **"Testing Node"** (Primacy 127) for 30 Minutes or (6x poll rate) and expect site active power limit increases to 5 kW. 2. After 10 minutes or (1x poll rate), set an active OpModGenLimW on NMI Topology Node = 0 kW (Primacy 124) for 10 minutes or (2x poll rate) and expect inverter active power limit decreases to 0 kW 3. Expect at end of scheduled control that site export limit returns to 0.5 kW.

Test 5 (Multi-FSA, Multi-Controls)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	opModGenLimW
FSA2	Non-Topology	127		opModExpLimW



t) For DERControls, differing controls (e.g., opModTargetVar, opModTargetW) within DERControl *Events* are independent and are allowed to overlap or nest without superseding. If multiple controls are identified for a DERControl *Event*, future DERControl *Events* for an individual control (or a subset of the original *Event*) that cause an *Overlapping Event* will supersede the original *Event* strictly for that control (or a subset of the original *Event*). Note: Rule f) applies to all *Overlapping Events*.

6	Test ongoing Site Export Control via an Independent Node and Overriding by the MSL event at the Top-Level	<u>JEN test details:</u> 1. Set an **Independent Node** active OpModExpLimW = 5 kW on **"Testing Node"** (Primacy 127) for 30 Minutes or (6x poll rate) and expect site active power limit increases to 5 kW.

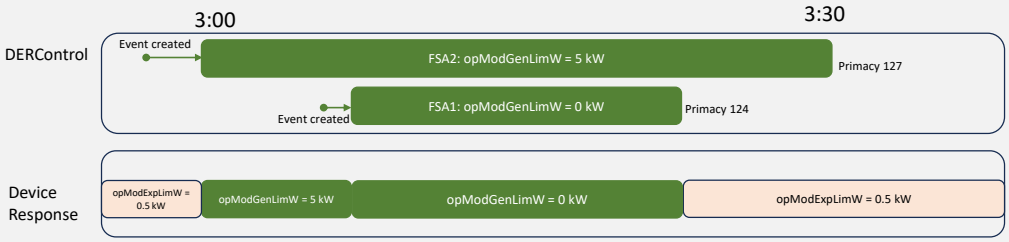
	Topology Node for active control OpModExpLimW	2. After 10 minutes or (1x poll rate), set an active OpModExpLimW on Top-Level Topology Node = 0 kW (Primacy 127) for 10 minutes or (2x poll rate) and expect site active power limit decreases to 0 kW 3. Expect at end of scheduled control that site export limit returns to 0.5 kW.
	Test 6 (Multi-FSA, Multi-Program, Same Control) DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124 3:00 3:30 DERControl: Event created, FSA2: opModExpLimW = 5 kW, Primacy 127; Event created, FSA1: opModExpLimW = 0 kW, Primacy 127 Device Response: opModExpLimW = 0.5 kW; opModExpLimW = 5 kW; opModExpLimW = 0 kW; opModExpLimW = 0.5 kW e) A client SHALL consider the current *Event* complete if a superseding *Event* is started. f) When comparing two *Nested Events* or *Overlapping Events* from servers with the same primacy, the creationTime element SHALL be used to determine which *Event* is newer and therefore supersedes the older. The *Event* with the larger (e.g., more recent) creationTime is the newer *Event*.	
7	Test ongoing Site Generation Control via an Independent Node and Overriding by a Lower Primacy at the NMI Topology Node for active control OpModGenLimW	JEN test details: 1. Set an **Independent Node** active OpModGenLimW = 5 kW on **"Testing Node"** (Primacy 127) for 30 Minutes or (6x poll rate) and expect inverter active power limit increases to 5 kW. 2. After 10 minutes or (1x poll rate), set an active OpModGenLimW on NMI Topology Node = 0 kW (Primacy 124) for 10 minutes or (2x poll rate) and expect inverter active power limit decreases to 0 kW 3. Expect at end of scheduled control that site export limit returns to 0.5 kW.

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA1	Top-Level Topology	127		opModExpLimW
FSA2	Non-Topology	127		opModExpLimW

Test 7 (Multi-FSA, Same Control)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	opModGenLimW
FSA2	Non-Topology	127		opModGenLimW



e) A client SHALL consider the current *Event* complete if a superseding *Event* is started.

f) When comparing two *Nested Events* or *Overlapping Events* from servers with the same primacy, the creationTime element SHALL be used to determine which *Event* is newer and therefore supersedes the older. The *Event* with the larger (e.g., more recent) creationTime is the newer *Event*.

Clients SHALL determine the primacy of DRLC and DER Control based on the following in order of precedence:

a) Servers SHALL indicate their primacy in the primacy element of the function set instance. See schema (IEEE Std 2030.5 supplemental material) definition of PrimacyType for possible values.

b) Clients SHALL prioritize execution of DRLC and DER function set *Events* with different PrimacyType attributes using the following guidelines:

1) 0 supersedes 1
2) 1 supersedes 2
3) 2 supersedes 3
4) If two instances are received with the same priority, then normal Event Rules and Guidelines apply (e.g., superseding based on scheduling).

8 Test moving Device from one Independent node (with Primacy set to 127) to another Independent node (also with Primacy set to 127) and validating that Device DOES NOT subscribe to any new controls on it is previous independent node

JEN test details:

1. Assign the device to an Independent Node **"Test_OEM_Validation_Ind"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node).
2. Set an active OpModExpLimW = 0 kW on **"Test_OEM_Validation_Ind"** for 30 Minutes or (6x poll rate) and expect site active power limit decreases to 0 kW.

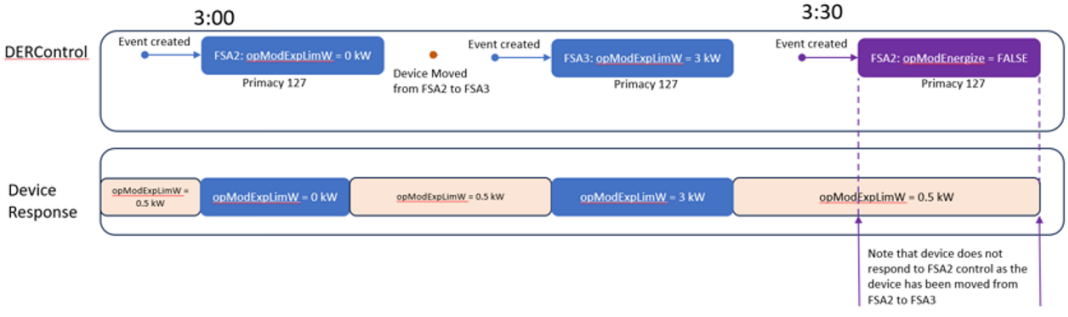
   Expect at end of scheduled control that site export limit returns to 0.5 kW.
3. Create a new Independent Node **"Test_MV_Ind_Node_2"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node). Have an Active control OpModExpLimW = **3 kW** assigned to the node.
4. Move device from **"Test_OEM_Validation_Ind"** to "**Test_MV_Ind_Node_2**" and expect site active power limit increases to 3kW
5. Set an active control OpModEnergise = False on **"Test_OEM_Validation_Ind"** for 10 Minutes

   Expect Device now under "**Test_MV_Ind_Node_2**" Node DOES NOT receive this control

Test 8 (Multi-FSA, Multi-Program)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA2 (Old)	Non-Topology (Test_OEM_Validation_Ind)	127		opModExpLimW opModEnergize
FSA3 (new)	Non-Topology (Test_MV_Ind_Node_2)	127		opModExpLimW



7.6 Onboard client to Production environment

Note: Whitelist is not required in Production environment.

Repeat steps in Section 7.1 to 7.4 for production environment access and testing.

Note:

- Whitelist is not required in Production environment.
- Functional test is not required in Production environment.
- It is **recommended** to use a real inverter on a real NMI
- Post successful connectivity & discovery testing, the device will to be deleted from Jemena Utility Server after pass the final production tests.

The following two tests serve as the final validation step before a new OEM is onboarded into production. These tests are designed to simulate the two critical stages that an inverter from a customer will undergo once the OEM onboarded in production. This ensures that the inverter can successfully pass our capability test and, subsequently, respond correctly to our business-as-usual (BAU) controls—specifically, exporting 5kW per phase.

Step#	Description	Supporting material
1	**Capability Test (20–40 minutes)**	**This test requires two inverters** on the same independent node to pass our capability test for commissioning. It helps detect FSA logic issues (some OEMs have different FSA logic from us) and make sure the issues identified in the staging environment has been fixed. Depending on real-world conditions—such as using an actual inverter for testing when solar irradiation is insufficient for export limit testing—one or two tests will be selected from the list below: 1. Set an active **OpModExpLimW = 1.5 kW** for 10 to 15 minutes. Once the export limit control period ends, the inverter should automatically revert to the default OpModExpLimW = 0.5 kW 2. Set an active **OpModGenLimW = 0kW** for 10 to 15 minutes. Once the generation limit control period ends, the inverter should automatically revert to the default OpModExpLimW = 0.5 kW For details on FSA logic, please refer to Section 4.
2	BAU Test	For testing purposes, the inverter needs to be powered on twice on separate days, with a total runtime of approximately 20–30 minutes (e.g., once at 4:00 PM today and again at 11:00 AM the following day). For a real inverter this test will go through 4:00PM to the next day morning (e.g., 11:00AM).

		This test involves scheduling seven consecutive 24-hour control periods, each running from 6:00 PM to 6:00 PM the following day. To pass, the inverter must demonstrate the ability to handle extended and successive control commands. For details on successive control, please refer to Section 4.

7.7 Client onboard completes

When all the required tests have successfully passed, the onboarding process completes. JEN will add the client to JEN's approved OEM list and publish the data to our website.

8. Troubleshooting and FAQs

8.1 Why am I getting connectivity issues when trying to connect to the JEN Utility Server?

Please follow the below steps to troubleshoot your issue.

1. Telnet test

Use telnet test to verify JEN Utility Server is open and reachable.

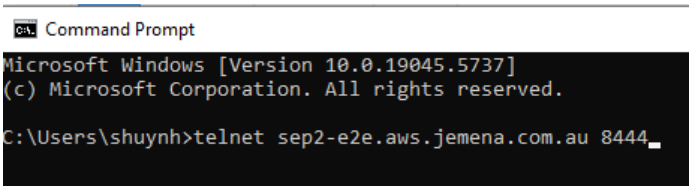
a) Open command prompt/terminal

On Windows, open the command prompt (Start > search "cmd" and press Enter). On macOS or Linux, open a terminal.

b) Enter the following command

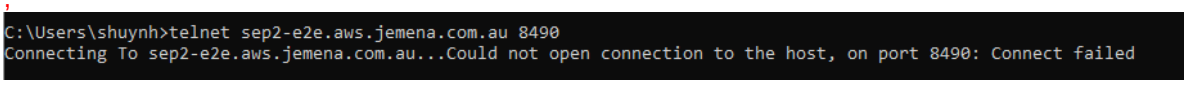
{For staging environment}	**Telnet sep2-e2e.aws.jemena.com.au 8444**
{For production environment}	**Telnet sep2.aws.jemena.com.au 8443**

c) Enter the following command

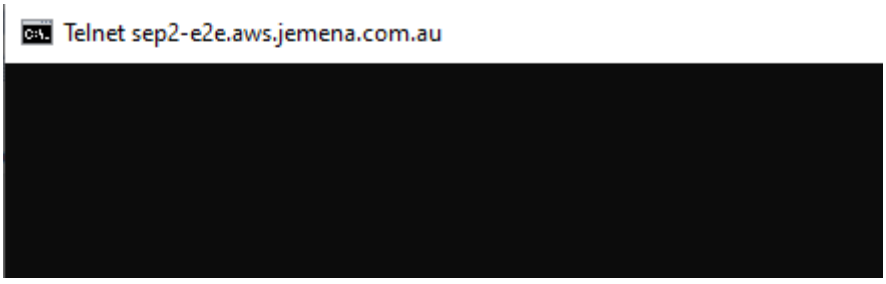


If telnet is unsuccessful, it may indicate the source IP has not be whitelisted properly. Please share the source IP to JEN.

,



If telnet is successful (below sample), this confirms that network and IP connectivity to JEN Utility Server. Please proceed to step 2.



2. CURL Command for GET /DCAP request

```
curl -v \
--cert test_device.pem \
--key test-20305-key.pem \
--cacert test_ca.pem \
'https://sep2-e2e.aws.jemena.com.au:8444/sep2/dcap' \
-X GET -s -k  -H "Content-Type: application/xml"
```

8.2 Why is the Utility Server not responding to pings?

The JEN Utility Server does not respond to pings.

8.3 How to generate client LFDI?

LFDI must be generated as a hash of the device's X.509 certificate.

8.3.1 Direct-connected device and Aggregators Client

The LFDI for a given device certificate can be generated with the following openssl command:

```
1.  openssl x509 -outform der -in client-cert.pem | sha256sum | head -c 40 | tr '[a-f]' '[A-F]'
```

Alternatively, the LFDI for a given device certificate can be generated with the following PowerShell commands:

```
openssl x509 -outform der -in client-cert.pem -out client-cert.der

Get-FileHash client-cert.der
```

8.3.2 How generate a device LFDI?

8.3.2.1 Determining a Device LFDI For Aggregators Model

Aggregators and software clients can represent multiple downstream sites or devices while communicating to the Utility Server as a single communicating client. These aggregators require a single certificate regardless of how many downstream devices it might represent. However, all downstream devices require their own LFDI to identify each site.

Aggregators generating virtual Device LFDIs, must follow the recommended pattern for the 40 Hex digits Virtual LFDI:

The first 32 hex digits of a unique identifier.

Each LFDI and its associated SFDI must be unique.

The last 8 hex digits must be the provider's Private Enterprise Number (PEN) with leading zeros (if PEN is less than 8 characters).

These downstream devices LFDIs are generated by the aggregator using the aggregator manufacturer's Private Enterprise Number (PEN). The PEN shall be used as the last 8 digits of the LFDI with leading zeroes.

Note: Private Enterprise Number (PEN) are managed by Internet Assigned Numbers Authority (IANA https://www.iana.org/). If your organization does not have a PEN, you can request on for free from IANA.

8.3.2.2 Determining a Device LFDI For Direct Device Model

The Device LFDI **shall** be the certificate fingerprint left-truncated to 160 bits (20 octets). For display purposes, this shall be expressed as 40 hexadecimal (base 16) digits in groups of four.

8.4 What is JEN Utility Server registration PIN?

Registration PIN is *optional*.

If used, please ensure that the Registration PIN associated with the Device matches:

Staging environment PIN - 111115

Production environment PIN – 536367

8.5 Why am I getting JSON instead of XML?

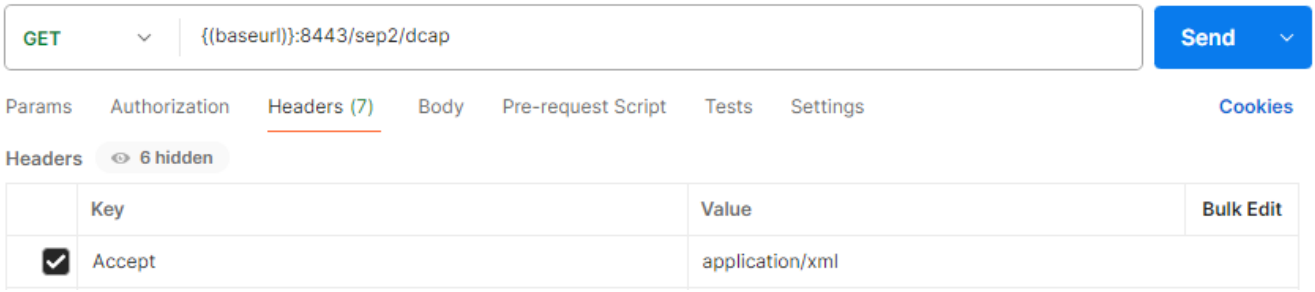
Info: IEEE 2030.5 resources are defined in the IEEE 2030.5 XML schema and access methods are defined in the Web Application Description Language (WADL).

Likely root cause:

In the request, the key "Accept" may be missing or not set correctly.

Suggestion to Client:

Ensure the request contains a key "**Accept**" and value set to **"application/xml".**



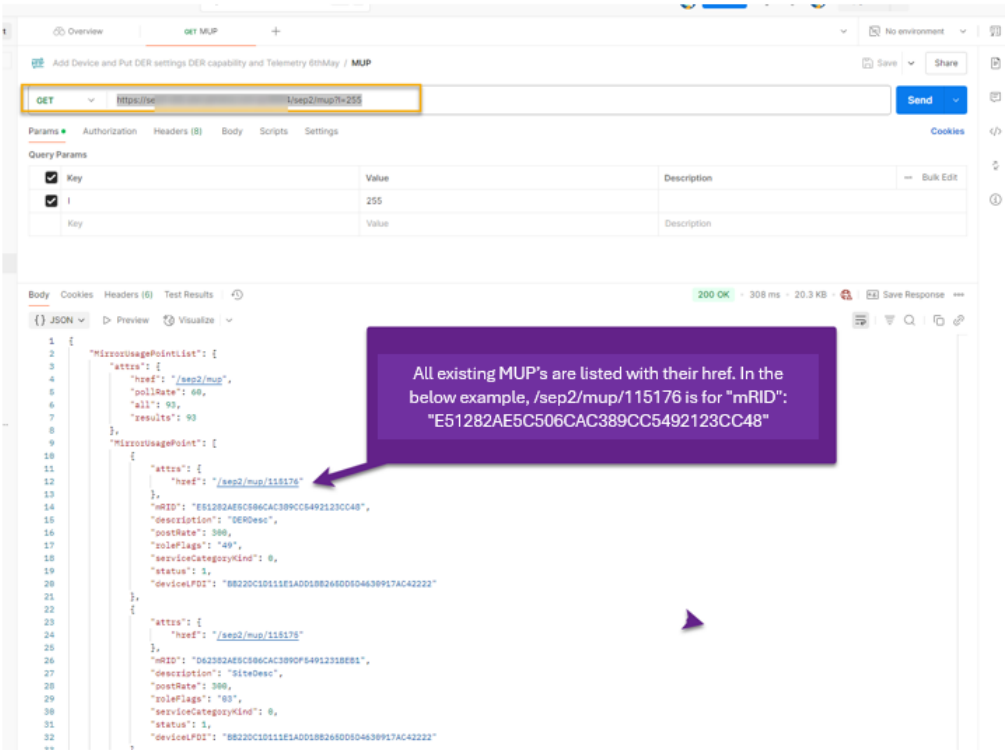
8.6 How to correct the DataQualifier?

The expected DataQualifier is documented in Section A1.2.1 Monitoring. To correct any DataQualifier, delete (refer to steps below) or update the mup data.

Note: Do not post a new one this create duplicate record without deleting one first.

Step1. Query the existing list of MUPs

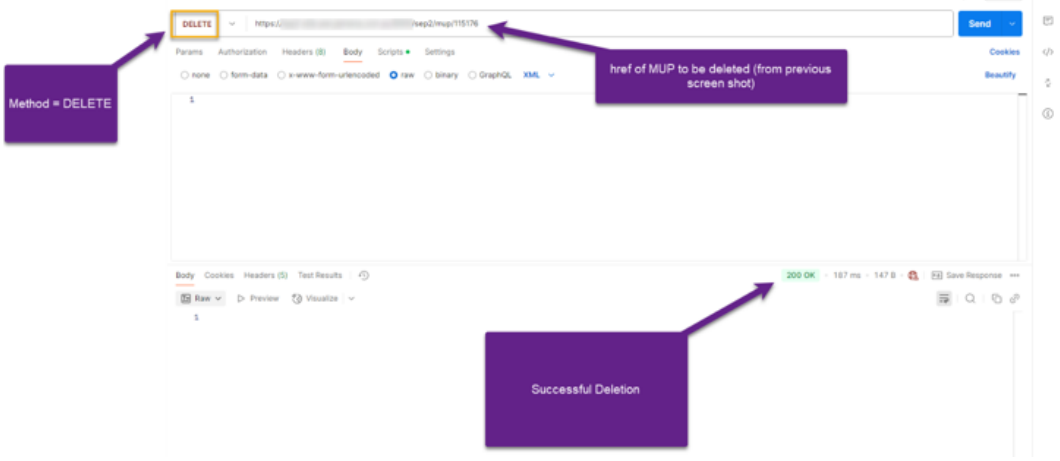
Endpoint: GET /sep2/mup?l=255



Step2. Delete the MUP

This example is to delete a Single MUP: "mRID": "E51282AE5C506CAC389CC5492123CC48",

Endpoint: DELETE /sep2/mup/115176



Step3. Create new MUP using the same (deleted) mRID id as before (sample below) or new MUP ID.

Endpoint: POST /sep2/mup/

Body:

```
<MirrorUsagePoint xmlns="urn:ieee:std:2030.5:ns">
    <mRID>E51282AE5C506CAC389CC5492123CC48</mRID>
    <description>DER Wills Inverter MUP2</description>
    <roleFlags>49</roleFlags>
    <serviceCategoryKind>0</serviceCategoryKind >
    <status>1</status>
    <deviceLFDI>1F60015FB6BA60CAE6D3E733D230A92C6410E3D7</deviceLFDI>
    <MirrorMeterReading>
        <mRID>01230015F002A1</mRID>
        <description>Reactive Power(VAR) DER</description>
        <ReadingType>
            <accumulationBehaviour>12</accumulationBehaviour>
            <commodity>1</commodity>
            <dataQualifier>2</dataQualifier>
            <flowDirection>1</flowDirection>
            <kind>37</kind>
            <phase>0</phase>
            <powerOfTenMultiplier>0</powerOfTenMultiplier>
            <uom>63</uom>
        </ReadingType>
    </MirrorMeterReading>
</MirrorUsagePoint>
```

8.7 All about response errors

8.7.1 Why am I getting not getting any error – the remote end closed connection without response error?

Info: A request was ended and connection closed without response error from JEN Utility Server

Likely root cause:

The request did not include a valid PKI certificate

Suggestion to Client

Please review to ensure the PKI certificate is valid and supplied in the request.

8.7.2 400 Bad Request?

Info: The Utility Server enforces validation on all mandatory fields and specific sequence order according to XSD:sequence attributes as denoted by IEEE2030.5 and CSIP-Aus.

Likely root cause:

a) Mandatory field(s) is missing

b) Field(s) is not in the expected order

Suggestion to Client

It is recommended to validate all Bodys against IEEE2030.5 and CSIP-AUS XSDs.

XSD schema validation files are available in:

- https://csipaus.org/ns/
- https://github.com/epri-dev/IEEE-2030.5-Client/blob/master/sep.xsdhttps://github.com/epri-dev/IEEE-2030.5-Client/blob/master/sep.xsd

8.7.3 Why am I getting 404 (Not Found) error for valid endpoint URL?

Info: The Utility Server returns a 404 (Not Found) error code for both non-existent resources and/or existence confirmation is withheld.

Likely root cause:

An unexpected 404 error most likely indicates a certificate issues associated with the requested resource such as invalid certificate or certificate is not authorised.

Suggestion to Client

Review the certificate used to ensure it is valid.

8.7.4 Why am I getting 404 (Not Found) error newly created resource?

Info: A resource is recently created and client is receiving 404 when requesting the resource

Likely root cause:

The newly created resource may take a time for the resources to be available.

Suggestion to Client

Client should retry after a few seconds.

8.7.5 Why am I getting 403 Forbidden?

Info: The Utility Server returns 403 to indicate issue with access to the requested resource.

Likely root cause:

LFDI may be mismatch

Suggestion to Client

Check to ensure that the LFDI meets the Utility Server requirements for LFDI generation in section 9.3. LFDI Requirements

8.7.6 Why am I getting a 415 (Unsupported Media Type) error?

The Utility Server requires a specific header in all PUT and POST requests. This header, called "Content-Type", value must be set to "application/sep+xml".

Likely root cause:

Header key "Content-Type" may be missing.

Suggestion to Client

Check all PUT and POST requests to ensure it has the required header and the expected value.

8.7.7 What does a 429 Client Error: Too Many Requests error mean?

The server is experiencing too many simultaneous requests. Client is advised to send requests based on the 5mins poll and post rate recommendation, and to be capable of exponentially reducing requests/retry when hit with this error codes after a short duration time.

8.8 Why am I having issues with in-band registration?

Note: The below guidance only applies to client that use the "**GET/edev/{x}/rg**" API call. For client that does not use the "**GET/edev/{x}/rg**" API call there will be no response from Jemena's Utility Server.

Issue: I received a "**204**" No Content Response to the "**GET/edev/{x}/rg**" API call

Likely root cause:

The Device Registration PIN will not be provided in the Registration Resource Link's body (specifically **the Registration PIN is either Null, Blank, or Empty**):

Suggestion to Client

Client should disregard the Registration Resource Link and proceed with completing a successful In-Band Registration process without performing PIN-based validation.

Note: If client is unable to support the suggestion here, then Jemena recommends client to continue with Out-Of-Band Registration.

8.9 Help, I still have issue.

Contact 1300xxxx or emergency.backstop@jemena.com.au for further assistance

9. Data Objects

9.1 EndDevice Data Object

#	Field	Name	Description	Data type	Format	Mandatory?
1	LFDI	Long Form Device Identifier	The Long Form Device Identifier (LFDI) is used to identify a site and is calculated based on the device certificate. Rule to generate this data, please refer to Section 9.3 LFDI Requirements	String(40)	Alphanumeric only. Hex string [2..40] characters ^[a-zA-Z0-9]*$ No special characters allowed.	Yes
2	SFDI	Short Form Device Identifier	The IEEE 2030.5 standard uses SFDI to uniquely identify DER devices.	String(12)	Numeric only. No special characters allowed.	Yes
3	changedTime	-	Time of request or time of change, in EPOCH time. *Example*, 1747889552 = Thursday, 22 May 2025 2:52:32 PM GMT+10:00	Time	Number	Yes
4	enabled	-	Resource status. By default, this field should be set to “true”.	Boolean	true/false	Yes

9.2 ConnectionPoint Data Object

#	Field	Name	Description	Data type	Format	Mandatory?
1	ConnectionPointID	-	This field represents the NMI DER is connected to. NMI has 10 digits plus 1 checksum. 10 digits is recommended to be passed, and validated against JEN NMI database. Any additional numbers will be stripped from the NMI	String(11)	Numeric only. String [0 .. 32] characters.	Yes

			when submitting the ConnectionPointLink.			

9.3 LFDI Requirements

Refer to Section 9.3 for instruction to generate LDFI.

#	Field	Name	Description	Data type	Format	Mandatory?
1	LFDI	Long Form Device Identifier	The Long Form Device Identifier (LFDI) is used to identify a site and is calculated based on the device certificate.	String(40)	Alphanumeric only. 40 Hexadecimal characters ^[a-zA-Z0-9]*$ No special characters allowed.	Yes

10. Certificate Public Key Infrastructure (PKI)

All client communication to JEN Utility Server require a certified PKI certificate to securely authenticate and identify clients. Clients are required to apply for a digital identity certificate in order to connect to Jemena Utility Server.

The device certificate is used to generate unique identifiers in the form of a LFDI and SFDI via hashing.

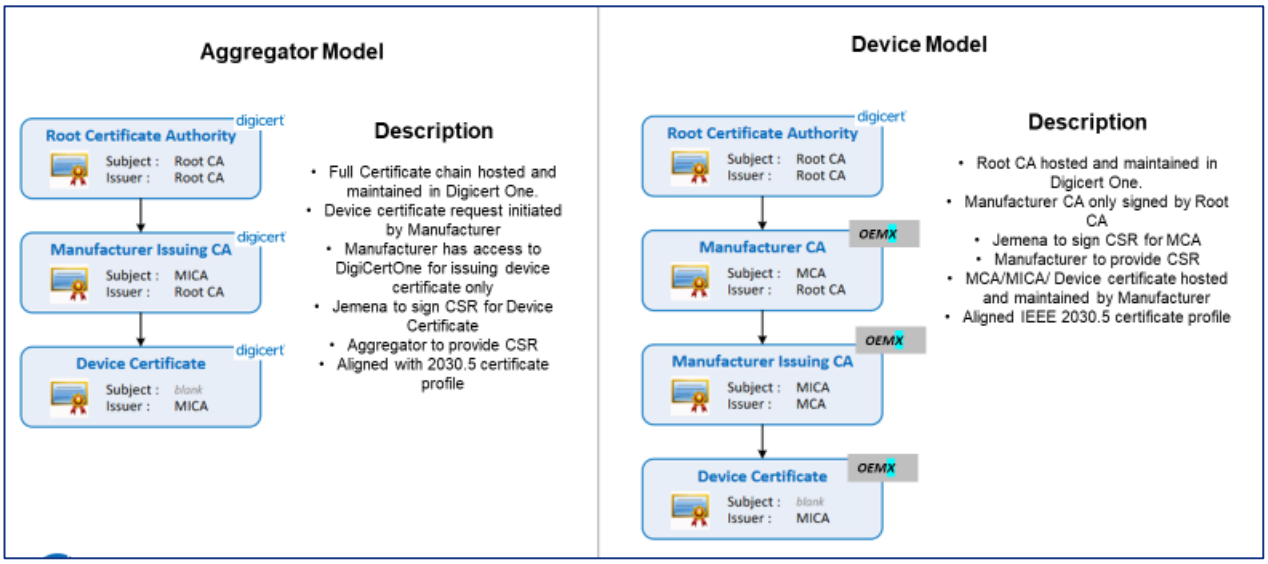
10.1.1 PKI Structure

Below illustrates the PKI structure based on the communication model.

Key call outs:

Certificate is unique to a client and respective Jemena Utility Server environment; staging and production.

Figure 10-1: High-level process of Certificate Signing Request



A1 Connectivity test in Staging Environment

A1.1 Connectivity test

A1.1.1 Criteria used to determine pass or fails

The following criteria shall be used to determine pass or fail.

Test	Expected Result	Failure Criteria	Implementation notes
Discovery – Monitoring Capability	Client communications with the Utility Server are initialised as appropriate by the client. Utility Server captures EndDevice information. Utility Server captures monitoring as per CSIP-Aus mapping through the Metering Mirror Function. Utility Server captures Status Information: - Ratings (DERCapability) - Settings (DERSettings) - Operational Status (DERStatus) - Availability (DERAvailability) [Optional] - Alarms (DERStatus) The Client is time synced with the Utility Server.	Client does not perform discovery against the Utility Server. Client does not access the necessary function set or device capability. Client becomes unsynchronised with the Utility Server.	Required monitoring data shall be 5-minute average and the inverter must be capable of sending this every 5-minutes. Arbitrary monitoring PostRates shall be supported to a minimum interval of 60s in alignment with the CSIP-AUS. This functionality may be utilised by the Utility Server during testing and the capability test. Where a client manages multiple DER under a single device, for the Meter Mirror Function the posted values shall be an aggregation of the DER under a device. Where a client manages multiple DER under a single device, for DERCapability, the posted values shall be a summation of the total controllable capacities of the DER under a device. Where a client manages multiple DER under a single device, for DERSettings, the posted values shall be a summation of the total controllable capacities of the DER under a device.

A1.2 Discovery – Monitoring Capability

Further details of the monitoring and status attributes are presented below.

A1.2.1 Monitoring

Under any scenario (aggregator-mediated or otherwise), EndDevices shall be able to report the following monitoring information. This information shall be reported for the connection point. The following average readings are required through the Mirror Metering function set:

Monitoring Data	Description	Role Flags	UOM	Phase Code	Data Qualifier	Reported
Site Real (Active) Power	Site real power at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	38 – W		2 – Average	M
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Site Reactive Power	Site reactive power at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	63 – Var		2 – Average	M
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Real (Active) Power	Gross DER/inverter real power generation	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	38 – W		2 – Average	M
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Reactive Power	Gross DER/inverter reactive power generation	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	63 – Var		2 – Average	M
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Site Voltage (Single Phase)	Site voltage at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	29 – V	129 – AN	2 – Average	M
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Site Voltage (3 phase) Line to Neutral	Site voltage at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	29 – V	129 – AN 65 – BN 33 – CN	2 – Average	M
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Voltage (Single phase)	DER/inverter voltage	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	29 – V	129 – AN	2 – Average	O
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Voltage (3 phase) Line to Neutral	DER/inverter voltage	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	29 – V	129 – AN 65 – BN 33 – CN	2 – Average	O
					12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Frequency		0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	33 – Hz		2 – Average 12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O

M – Mandatory
O – Optional

Where applicable, data intervals shall be aligned to regular boundaries (for example, 1/5/30 minute boundaries). By default, EndDevices shall report monitoring information every 5 minutes (aligned to 5-minute boundaries). Devices shall support reporting intervals up to 1 minute.

A1.2.2 Status information

Aggregators acting for its DERs and DER Clients shall be able to report the following information.

A1.2.2.1 DERCapability

The required DERCapability Objects that are required:

DER Information	Nameplate Mapping	Reported	Multiple Inverter Sites Implementation
Max apparent power	rtgMaxVA	M	Total aggregated for all DERs
Max reactive power delivered by DER	rtgMaxVar	O	Total aggregated for all DERs
Max reactive power received by DER	rtgMaxVarNeg	O	Total aggregated for all DERs
Max active power output	rtgMaxW	M	Total aggregated for all DERs

A1.2.2.2 DERSettings

The required DERSettings Objects that are required:

DER Information	Nameplate Mapping	Reported	Multiple Inverter Sites Implementation
Max apparent power	setMaxVA	M	Total aggregated for all DERs
Max reactive power delivered by DER	setMaxVar	O	Total aggregated for all DERs
Max reactive power received by DER	setMaxVarNeg	O	Total aggregated for all DERs
Max active power output	setMaxW	M	Total aggregated for all DERs
Max energy storage capacity	rtgMaxWh	M – if applicable	Total aggregated for all DERs

A1.2.2.3 DERStatus

The required DERStatus Objects that are required:

Operational Status Information	DERStatus Mapping	Reported	Values
Operational State	operationalModeStatus	M	0 = Not applicable/Unknown; 1 = Off; 2 = Operational mode; 3 = Test mode
Inverter State	inverterStatus	O	
Connection Status	genConnectStatus	M	0 = Connected; 1 = Available; 2 = Operating; 3 = Test; 4 = Fault/Error
Alarm Status	alarmStatus	M if available	
Connection Status for storage DER	storConnectStatus	Required for communications software communication clients that can control energy storage	
Operational Energy Storage Capacity	stateOfChargeStatus	Required for communications software communication clients that can control energy storage	

B1.1.2.4 DERAvailability

The required DERAvailability Objects that are optional and only required if the communications software communication clients can control energy storage:

Reserve Generation Status	DERStatus Mapping	Reported
Discharge duration availability	availabilityDuration	Optional if available
Charge duration availability	maxChargeDuration	Optional if available
Charge rate availability	reserveChargePercent	Optional if available
Discharge rate availability	reservePercent	Optional if available

B1 Functional Testing in Staging Environment

B1.1 Criteria used to determine pass or fails

The following criteria shall be used to determine pass or fail.

Test	Expected Result	Failure Criteria	Implementation notes
Export Limit	The utility server configures an active DERControl: OpModExpLimW. On the next poll of the Utility Server, the client receives and starts the updated active DERControl: OpModExpLimW. Following the completion of the active DERControl, the device reverts back to the DefaultDERControl: OpModExpLimW.	The device does not change export power to the scheduled active DERControl. The device does not revert to the DefaultDERControl once the scheduled active DERControl is complete.	Where a client manages multiple DER under a single device, , the export limit control is the total site export, and the client shall portion this across the DER downstream of the controllable device to comply with the control.
Generation Limit	The utility server configures an active DERControl: OpModGenLimW. On the next poll of the Utility Server, the client receives and starts the updated active DERControl: OpModGenLimW. Following the completion of the active DERControl, the device reverts back to the DefaultDERControl: OpModExpLimW.	The device does not change the generator power to the scheduled active DERControl. The device does not revert to the DefaultDERControl once the scheduled active DERControl is complete.	Where a client manages multiple DER under a single device, the generation limit control is the aggregated generation, and the client shall portion this across the DER downstream of the controllable device.
Energize	The utility sever configures an active DERControl: opModEnergize. On the next poll of the Utility Server, the client receives and starts the updated active DERControl: opModEnergize and updates DERStatus to confirm the status of the device. Following the completion of the active DERControl the device updates the	The device does not de-energise and re-energise the device. The device status is not updated. At this point in time both cease to energize and disconnection are acceptable to pass this test.	Where a client manages multiple DER under a single device, all managed DER are expected to energise / re-energise when instructed.

	DERStatus to confirm the status of the device.		

B1.2 Test setup

Each DER or Device Under Test (DUT) is enrolled in 3 x DERPrograms to emulate our go-live design:

FSA	DERProgram	Primacy
1 (topology)	NMI-Level	124
1 (topology)	Top-Level	127
2 (non-topology)	Independent	127

C1 Certificate Additional Information

C1.1 Native IEEE 2030.5 Root Ca Device Certificate Profile

Certificate Details

Version	v3
Serial number	Unique Positive Integer assigned by the CA
Subject DN	C=<Country> O=<Manufacturing Org> CN=IEEE 2030.5 Root serialNumber=<001>
Issuer DN	O=SunSpec Alliance CN=IEEE 2030.5 Root serialNumber=<001>
notBefore	<Issuing Date>
notAfter	Dec 31, 9999 23:59:59Z [99991231235959Z]
Signature Algorithm	Sha256
Key size and type	ECC 256 (secp256r1)

Certificate Extensions

Extension Identifier	OID	Criticality	Value
keyUsage	{id-ce 15}	TRUE	
keyCertSign			Set
basicContraints	{id-ce 19}	TRUE	
cA			Set (TRUE)
pathLenConstraint			Set (0)
authorityKeyIdentifier	{id-ce 35}	FALSE	
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
subjectKeyIdentifier	{id-ce 14}	FALSE	OPTIONAL
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
certificatePolicies	{id-ce 32}	TRUE	
policyIdentifier			<At Least One IEEE 2030.5 Device Type Identifier>
policyQualifiers			Not Set

C1.2 Intermediate CA Certificate Profile (MCA)

Certificate Details

Version	v3
Serial number	Unique Positive Integer assigned by the CA
Subject DN	C=<Country> O=<Manufacturing Org> CN=IEEE 2030.5 Root serialNumber=<001>
Issuer DN	O=SunSpec Alliance CN=IEEE 2030.5 Root serialNumber=<001>
notBefore	<Issuing Date>
notAfter	Dec 31, 9999 23:59:59Z [99991231235959Z]
Signature Algorithm	Sha256
Key size and type	ECC 256 (secp256r1)

Certificate Extensions

Extension Identifier	OID	Criticality	Value
keyUsage	{id-ce 15}	TRUE	
keyCertSign		Set	
basicContraints	{id-ce 19}	TRUE	
cA		Set (TRUE)	
pathLenConstraint			Set (1)
authorityKeyIdentifier {id-ce 35}	FALSE		
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
subjectKeyIdentifier {id-ce 14}	FALSE	OPTIONAL	
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
certificatePolicies {id-ce 32}	TRUE		
policyIdentifier			<At Least One IEEE 2030.5 Device Type Identifier>
policyQualifiers		Not Set	

C1.3 Intermediate CA Certificate Profile (MICA)

Certificate Details

Version	v3
Serial number	Unique Positive Integer assigned by the CA
Subject DN	C=<Country> O=<Manufacturing Org> CN=IEEE 2030.5 Root serialNumber=<001>
Issuer DN	O=SunSpec Alliance CN=IEEE 2030.5 Root serialNumber=<001>
notBefore	<Issuing Date>
notAfter	Dec 31, 9999 23:59:59Z [99991231235959Z]
Signature Algorithm	Sha256
Key size and type	ECC 256 (secp256r1)

Certificate Extensions

Extension Identifier		OID	Criticality	Value
keyUsage		{id-ce 15}	TRUE	
keyCertSign			Set	
basicContraints		{id-ce 19}	TRUE	
cA			Set (TRUE)	
pathLenConstraint				Set (0)
authorityKeyIdentifier	{id-ce 35}	FALSE		
keyIdentifier				Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
subjectKeyIdentifier	{id-ce 14}	FALSE	OPTIONAL	
keyIdentifier				Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
certificatePolicies	{id-ce 32}	TRUE		
policyIdentifier				<At Least One IEEE 2030.5 Device Type Identifier>
policyQualifiers			Not Set	

C1.4 Device Certificate Profile

Certificate Details

Version	v3
Serial number	Unique Positive Integer assigned by the CA
Subject DN	Not Set
Issuer DN	<Issuing CA: MCA or MICA>
notBefore	<Issuing Date>
notAfter	Dec 31, 9999 23:59:59Z [99991231235959Z]
Signature Algorithm	Sha256
Key size and type	ECC 256 (secp256r1)

Certificate Extensions

Extension Identifier	OID	Criticality	Value
keyUsage	{id-ce 15}	TRUE	
keyAgreement			Set
digitalSignature			Set
subjectKeyIdentifier	{id-ce 14}	FALSE	OPTIONAL
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
authorityKeyIdentifier	{id-ce 35}	FALSE	
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
certificatePolicies	{id-ce 32}	TRUE	
policyIdentifier			<Exactly One IEEE 2030.5 Device Type Identifier>
policyQualifiers			Not Set
subjectAltName	{id-ce 17}	TRUE	
otherName: HardwareModuleName: hwType hwSerialNum			Set (<OID VALUE>) Set (<OCTET STRING VALUE>)