Common Smart Inverter Profile – Australia

Contents

1 Introduction

This guide aims to assist organisations involved in the Australian electricity network specifically with the deployment, monitoring and orchestration/active management of Distributed Energy Resources (DER), via the creation of a standardised minimum communication protocol to assist in their operation in Australia.

Australia is experiencing an ever-increasing uptake of DER – leading the world in rates of household solar and an emerging uptake of newer resources like energy storage and electric vehicles. The opportunity presents to use the interoperability capabilities of modern technology to harness the full value of these devices to benefit consumers, electricity networks and the broader power system. More parties are becoming interested in using these resources for a broad range of uses, from increasing network visibility to providing local network services that can allow consumers to engage in new markets and maximise their investment in DER.

This guide is focussed on the visibility (both static and near-real-time) of DER and their active management through the provision of dynamic (real power) import and export limits[1]. This will enable a consistent approach to the active management of DER relevant to the Australian context, by ensuring DER, DER operators and related parties operate in a consistent and understood manner that is essential for network management and that will enable the integration across different Australian jurisdictions as seamlessly as possible, as well as making operations in other countries possible with minimal alteration (where those relevant standards have been chosen).

This 'Common Smart Inverter Profile – Australia' is developed by the DER Integration API Technical Working Group (DERIAPITWG)[2]. This working group formed in 2019 as a collaboration of Australian energy sector businesses from across the supply chain, including numerous distribution networks, retailers, equipment manufacturers and aggregators. The group determined that the most appropriate starting point to promote interoperability amongst DER and DNSPs in Australia was to leverage existing

---

[1] The technical working group identified these as priority use cases for the standardisation of communication and behaviour of DER, given the current state of maturity of active DER management in Australia. Other identified use cases may be incorporated at a later stage, and can be found separately in the DER Use Case document.

[2] For more information on the working group, please contact Tim Moore (timothy.moore1@anu.edu.au).

standards, namely the IEEE 2030.5-2018 specification[3], and the Common Smart Inverter Profile (CSIP)[4]. These standards were chosen principally due to their coverage of relevant data communications, and uptake in related international jurisdictions.

Where the group has determined it necessary to meet Australian requirements, additional extensions or clarifications are proposed to meet these additional requirements.

This does not preclude that other industry standards could be adopted for different use cases but is not the focus of this document.

2   Guiding Principles

We have used the existing principles from CSIP relevant to their use in Australia:

1. All smart distributed energy resources require communications to achieve their full value as distributed energy resources. [CSIP 1]

2. Leverage existing standards and models from both engineering (e.g., AS/NZS 4777.2) and communications (e.g. IEEE 2030.5) standards – The development of a new, stand-alone standard would create additional burden on all parties and only serve to raise costs of both development and maintenance. [CSIP 3]

3. Assume that future revisions will be necessary – The use of DER will continue to evolve and utilities and other DER stakeholders anticipate the emergence of additional use cases in both the immediate future and longer term . Attempting to anticipate all future use cases will add complexity to the specification without commensurate value. As such, extensibility of the specification through future revisions is required. [CSIP 4]

4. Create a minimal specification – A simple interface serves to lower costs and improve quality. [CSIP 6]

In addition to the considerations common to CSIP and the Australian context, the following principles have also been determined:

---

[3] https://standards.ieee.org/standard/2030_5-2018.html

[4] https://sunspec.org/common-smart-inverter-profile-csip/

5. Focus on core, common use cases with significant immediate uptake that will create the greatest value across the Australian electricity sector.

6. Take a pragmatic approach to any implementation that requires additional data flows not explicitly covered within the guide.

   The guide should describe a set of principles for implementing additional functionality. This will allow the communication interface to be extended under a framework that it is consistent with the approaches detailed in the guide, in turn providing a pathway that allows additional use cases to be incorporated in future versions of the guide once a need for standardisation has been established.

7. Where possible, the CSIP-AUS should align as closely as possible with existing implementations (e.g. CSIP), and be explicit about where changes or additions have been made.

8. The functionality described within this guide shall not, where possible, overlap with functionality that is covered by existing standards (e.g. AS/NZS 4777).

This guide will clearly differentiate between functionality that is covered within existing standards or regulations and that which is enabled through this guide.

2.1 Scope

This guide is to be read in conjunction with, and references, both CSIP and the IEEE 2030.5-2018 standard. This guide includes changes, clarifications or additions required to meet use cases identified in the Australian context. Over time, the version of CSIP and 2030.5 referenced in this guide will change, and it is expected that features of the profile described in this document may change to reflect this. Where possible, backwards compatibility will be maintained; however in cases where this is in conflict with changes in CSIP or 2030.5, this will be clearly identified within the document.

The versions of CSIP and IEEE 2030.5 that form the basis for this document are:

Reference	Abbreviation
IEEE Std 2030.5:2018 (Revision of IEEE Std 2030.5-2013)	SEP2
Common Smart Inverter Profile v2.003-02-2018	CSIP
AS/NZS 4777.2:2020	AS/NZS 4777
AS/NZS 4755 (all parts)	AS/NZS 4755

For the remainder of this document, these will be referred to by the abbreviations listed.

System Types

The guide has been developed with the intention to be applied to residential and small commercial and industrial resources. While it is intended that this profile may be applied to the growing number of small-scale customers, the guide is not prescriptive in determining size limits. Australian networks have implemented (or are implementing) subsets of the described functionality on both connected and isolated networks, and in some instances are considering adoption for commercial (up to 1500 kW) generators[5].

This guide covers the technical implementation of standards-based protocols to transmit information between two or more parties. In doing so, it specifically excludes (or only references where necessary) a number of considerations that should be determined in conjunction with the implementation of this guide:

Contractual Arrangements

The technical implementation of data collection and communication processes discussed in this guide does not confer any contractual requirements or mandates for this data to be collected and disseminated to any organisation. Commercial arrangements or policy mandates should be considered separately to this guide. Any contractual arrangements between organisations (commercial or otherwise) is outside the scope of this guide.

User Consent and Data Privacy

For the purposes of this guide, the collection, communication and storage of information is assumed to comply with all legislation and national privacy principles (including user consent and data privacy) relevant to these processes. The guide makes no determination as to the appropriate handling and use of this data - it is incumbent on the organisations involved to ensure their compliance.

Cybersecurity

Cybersecurity is a critical aspect of the implementation of secure protocols for communication between DER, aggregators and DNSPs. Similarly to CSIP and SEP2, this document does cover some aspects of a cybersecurity implementation, but this is not to be treated as a comprehensive guide to a complete cybersecurity implementation. In this guide, cybersecurity is referenced only in the context of the implementation of secure protocols within the applicable standards, between the parties specified.

---

[5] https://www.talkingenergy.com.au/dynamicder

Other communication links (for example, between an aggregator and a device) are not covered in this guide.

Australia's Distributed Energy Integration Program, a collaboration of market and industry stakeholder peak bodies, along with the Commonwealth Government is considering how best to advance minimum levels of cyber security capability across the DER ecosystem.

Until this work is progressed and finalised it is expected that parties involved in the DER ecosystem will determine and implement cyber security practices across all their devices, communication interfaces and systems, where such requirements are not stipulated in this guide.

Testing and conformance

A test procedure will be developed and made available to assist in the development and testing of compliant server and client implementations. These resources do not replace commercial testing and compliance suites, but are intended to assist in the development of systems in adherence with this guide.

Certification

Systems communicating using the SEP2 protocol are expected to comply with the standard to the extent possible given the required functionality for a particular use case. Certification is not required for organisations to use and implement against this guide. Certification approaches and requirements will be defined by a suitable certification body in the future.

Physical Response

The validation of the physical response of devices to any signal from the utility server is not considered in this version of the guide. The testing and conformance of devices will be developed in a subsequent version, potentially by reference to standards that deliver such requirements. In the interim, DNSPs may provide alternate requirements to validate the physical device response prior to, or during their operation on the network.

Notes on interpreting this document

From this point forward, this document is to be read as a companion piece to the Common Smart Inverter Profile, with differences in application described in this document. The following sections follow the numbering convention of CSIP, and highlight only deviations with CSIP. Omitted sections are assumed to be in accordance with CSIP.

Any example references to other engineering standards are to be read as references to Australian equivalents (particularly AS/NZS 4777.2 2015 for inverter response). Any references to itself (*CSIP*) are to be treated as references to the Australian version (*CSIP-AUS*). **For clarity, deviations from CSIP are shown in bold.**

3 Communications Architecture Overview

3.2 Scenarios

Lines 177-183

Note that the notion of a DER in CSIP is logical concept generally thought of as one or more physical inverters organized and operating as a single system with a common point of aggregation behind a single point of common coupling (PCC) with the utility. This allows the management of a plant/system possessing a single PCC regardless of whether it is composed of a single inverter or many. It is the responsibility of the management system to manage the underlying inverters to meet the requirements of the settings provided by the utility server.

A DER client at each site must be able to control and measure the site power export at the PCC. DERs on a site behind the point of common coupling may be controlled independently, however only one DER on a site SHALL be used to control and measure the import and export power to the grid.

4 General CSIP Requirements

4.2 Registration and Identification of DERs

Lines 209-216

The registration of DER may be performed by an in-band or out-of-band process. The registration process may result in the delivery of a globally unique identifier (GUID) associated with a particular DER. The GUID provides a shared name between the utility and the other party to ensure that operations and data are routed appropriately. The GUID is used to guarantee its authenticity and uniqueness within the scope of a single utility's CSIP server. For DER Clients that have an IEEE 2030.5 certificate, the GUID SHALL be derived from this certificate (see section 5.2.1.2).

For aggregator DER Clients the GUID SHALL be derived by the aggregator operator in accordance with the procedure outlined within the utility's interconnection handbook.

DER or aggregators MAY provide a network connection point identifier as part of the registration process. Refer to Annex E for implementation details on the optional connection point registration extension.

4.4   DER Control Events and Settings

Lines 274-283

The DefaultDERControl will be in effect until it is changed or a DERControl event occurs. **The utility server will utilise the DefaultDERControl to control the desired failsafe behaviour of the DER client.**

For DER that needs to be actively managed, the DER utility server can continuously update one or more active DERControls to the DER during normal operation.

4.4.2   Requirements

Lines 285-292

All DERs and related communications will support the Autonomous and Advanced functionality and controls as shown below.

The autonomous functions should be configured per existing national standards or comply with jurisdictional requirements.

The following advanced functions SHALL be supported:

Advanced Function
Grid Import/Export Limit
Connect/Disconnect
Monitor Key Data including Alarms, DER Status and Output
Limit Maximum Active Power Mode

Default settings or modes for Autonomous Functions SHALL not be changeable via IEEE 2030.5.

Lines 302-306

The DefaultDERControl will be used as a mechanism for the utility DER server to update the failsafe controls that will be applied when no active DERControl event is in place. The DefaultDERControl SHALL be applied when there is no DERControl in place and the active DERControl has completed (eg. when the DER loses communication with the Utility Server).

During connection or reconnection to the electricity network, the DER SHALL follow the AS/NZS 4777.2 *Connection and Reconnection Procedure*, except as specified below:

Upon reconnection or 'startup' of the DER Client, after previous communication with the utility server, the DefaultDERControl SHALL be applied prior to communications being established with the utility server and receipt of an active DERControl event.

To achieve this, the DER Client will need to store the DefaultDERControl settings between communication and electrical network interruptions.

4.5   Communication Interactions

Lines 330-336

Unless specified in each utility's InterconnectionHandbook or programs/contracts, default polling and posting rates SHALL be as follows:

- Polling of DERControls and DefaultDERControls (Direct DER Communication)– **every 5 minutes**
- Posting monitoring information (Direct and Aggregator Mediated Communications)– every 5 minutes

Lines 335-340

For DERs with an external SMCU, the SMCU SHALL transfer the DER control to the DER within **1 minute** of receiving the control from the server.

For DERs with a GFEMS, the GFEMS SHALL transfer the DER control to the DERs within **1 minute** of receiving the control from the server.

For DERs mediated by Aggregators, the Aggregator SHALL transfer the DER control to the DERs within **5 minutes** of receiving the control from the server.

4.6.1 Monitor Data

Lines 348-353

Refer to Annex A for details on expected monitoring data, attributes and data qualifiers.

4.6.2 Status Information

4.6.2.2   Operational Status Information

Lines 366-368

Aggregators acting for its DERs and DER Clients SHALL have the capability to report the dynamic Operational Status Information shown in Table 5. **Operational status SHALL be reported on change and at the EndDevice postRate.**

4.6.3 Alarms

Lines 373-380

Aggregators acting for its DERs and DER Clients SHALL have the capability to report the alarm data shown in Table 6 as they occur. **The alarm status MAY be reported on change and at the EndDevice postRate.**

Alarms
Overcurrent
Over/Under Voltage
Over/Under Frequency

5.1.2 Resources and Function Sets

Line 410 – Table 7

Function Set	Utility Server	Aggregator	DER Client
Time	MUST	MUST	MUST
Device Capability	MUST	MUST	MUST
End Device	MUST	MUST	MUST
FSA	MUST	MUST	MUST
DER	MUST	MUST	MUST
Response	MAY	MUST	MUST
Meter/Mirror Meter	MAY	MUST	MUST
Log Event	**MAY**	**MAY**	**MAY**

Subscription/Notification	MUST	MUST	MAY
Security	MUST	MUST	MUST

5.2.2 Commissioning and Identification of DER Requirements

Lines 555-565

In the Aggregator scenario, the DERs under the management of the Aggregator may not be IEEE 2030.5 devices – that is, they may not have a device certificate. In this case, the **Aggregator will** produce the LFDI (see section 5.2.1.2). In all cases, this identity and the associated LFDI are returned to the Aggregator for their uses in ensuring communications are routed correctly.

In the rare event that an LFDI collision is detected (i.e. two unique certificates or IDs hash to the same LFDI value), the certificates or IDs of the offending DERs will need to be **replaced or re-generated**. This may require returning the DERs to the manufacturer for certificate replacement. Note that the probability of a LFDI collision is infinitesimally small. It is much more likely the collision was caused by an accidental duplication of the certificate or ID.

5.2.4 DER Controls and DER Default Control Requirements

Line 601 – Table 9

Grid DER Support Functions	IEEE 2030.5 DERControls	IEEE 2030.5 DefaultDERControls
Ramp Rate Setting		setGradW
		setSoftGradW
Connect/Disconnect	opModEnergize	opModEnergize
Real Power Output Limit Control	opModMaxLimW	opModMaxLimW
Site Export Limit (in Watts)	**opModExpLimW**	**opModExpLimW**
Site Import Limit (in Watts)	**opModImpLimW**	**opModImpLimW**
Max generation limit	**opModGenLimW**	**opModGenLimW**
Max load limit	**opModLoadLimW**	**opModLoadLimW**

Refer to Annex B for further specification of the four DER management envelope extensions.

Lines 602-604

The Ramp Rate Setting function is used to control the ramp rate of the DefaultDERControl controls and is used to manage the rate of application of the failsafe controls.

The DER Client will need to store the DefaultDERControl settings between communication and electrical network interruptions.

5.2.4.1   Scheduling of Controls

Lines 606-607

DERControls are IEEE 2030.5 events and SHALL conform to all the event rules in Section **10.2.3** of IEEE 2030.5-2018.

5.2.5.1   Monitor Data

Lines 651-652 Tables 10 – 11

Refer to Annex A for details on expected monitoring data, attributes and data qualifiers.

6.1   Utility Server Operation

6.1.4   In-Band DER Registration

Lines 758-762

In the in-band registration model, the utility server has a list of authorized devices **or a mechanism for determining authorized devices as they initiate communication with the server. For example, a utility may receive a list of devices from an aggregator through an out-of-band process, or it may only authorize an** *EndDevice* **when that device is POSTed to the** *EndDevice* **endpoint.**

6.2   Aggregator Operations

6.2.1 Host and Service Discovery

Lines 858-861

For this section, discovery is the process whereby the Aggregator obtains enough information to get the utility server's DeviceCapability resource. There are many methods for the Aggregator to get this information, and the exact method to use is determined by the utility. **One out-of-band method is presented used by mutual consent of the utility and Aggregator.**

Lines 870-874

<Removed>

6.3.1.2   Unicast-DNS and DNS-SD

Lines 977-980

<Removed>

Annex A - Reporting DER Data

DER Monitoring Data

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, and (subject to interconnection handbook agreement) may be reported for the DER.

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.

Monitoring Data	RoleFlags	UOM	Phase Code	Kind	Data Qualifier	Req'd
Site Real (Active) Power^	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	38 – W		37	2 – Average	M
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Site Reactive Power^	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	63 – Var		37	2 – Average	M
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Real (Active) Power^^	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	38 – W		37	2 – Average	M
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Reactive Power^^	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	63 – Var		37	2 – Average	M
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O

Frequency	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	33 – Hz		37	2 – Average 12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Site Voltage (Single Phase)	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	29 – V	129 - AN	37	2 – Average	M*
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Site Voltage (3 Phase) Line to Neutral	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	29 – V	129 - AN 65 - BN 33 - CN	37	2 – Average	M**
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Voltage (Single Phase)	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	29 – V	129 - AN	37	2 – Average	M*
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O
Voltage (3 Phase) Line to Neutral	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	29 – V	129 - AN 65 - BN 33 - CN	37	2 – Average	M**
					12 – Normal (Instantaneous) 8 – Maximum 9 - Minimum	O

Table 1 Mandatory (M) and optional (O) data reporting requirements.

* At least one of site or device voltage must be reported. Where site voltage is available, it must be reported.

** multi-phase readings are mandatory for a multi-phase installation.

^ Load convention applies to site readings – positive for import from the grid.

^^ For data reporting purposes, device readings are assumed to be the aggregation of DER under a device.

Annex B - DER Management Envelope Extensions

Support for Dynamic Operating Envelopes communicated through the protocol is enabled by the Australian Smart Inverter Profile extensions. This set of extensions shall be supported by conforming equipment to manage site- and device-level operating envelopes.

Using these extensions, a device shall report its capabilities according to DERCapability::doeModesSupported according to the following bit positions:

Bit Position	Mode
0	*opModExpLimW*
1	*opModImpLimW*
2	*opModGenLimW*
3	*opModLoadLimW*

Note: This attribute (and bit positions) corresponds to the new setting DERSetting::doeModesEnabled.

Note: As per the conventions specified in IEEE 2030.5 Resources all extensions defined in this guide are placed in a new namespace "https://csipaus.org/ns". The XML examples provided in this guide use the prefix "csipaus:" to represent this namespace; when no prefix is specified the default SEP2 namespace applies.

These modes refer to the following additional attributes of DERControlBase:

csipaus:opModImpLimW attribute *(ActivePower) [0..1]*
 This is the constraint on the imported active power at the connection point.

csipaus:opModExpLimW attribute *(ActivePower) [0..1]*
This is the constraint on the exported active power at the connection point.

csipaus:opModGenLimW attribute *(ActivePower) [0..1]*
 This is a constraint on the maximum allowable discharge rate, in Watts, specifically for a single physical device (or aggregation of devices, excluding uncontrolled devices) such as an EV charge station.

csipaus:opModLoadLimW attribute *(ActivePower) [0..1]*
This is a constraint on the maximum allowable charge rate, in Watts, specifically for a single physical device (or aggregation of devices, excluding uncontrolled devices) such as an EV charge station.

Note: charge and discharge limits apply to bi-directional resources (such as a battery, that can act as a load and generator). In the case of a pure load or generator (e.g. solar system, hot water system),

support for this extension requires that the charge or discharge limit be interpreted in the same manner as *opModMaxLimW*. If both values are present, the most restrictive value is to be used. Where both site and resource limits are specified within a single DERControlBase and are in conflict with each other, the EndDevice may ignore the opModLoadLimW and opModGenLimW values in favour of opModExpLimW and opModImpLimW settings.

Example - Envelope Communication

Step	Description
1	The client discovers a server of its EndDevice instance and GETs its FunctionSetAssignments (FSA). Through its FSA the client discovers it is enrolled in a DERProgram (enrollment occurs out of band). The client registers with the specified DERProgram server if a secure connection is required.

2	Client GETs the DERProgramList specified in its FSA. Client sends the following request, in this case indicating that it can accept either EXI or XML:
	
	`GET /derp HTTP/1.1`
	`Host: {hostname}`
	`Accept: application/sep+xml; level=+S1`

3	The DER server responds with the requested DERProgramList, for example:
	
	`HTTP/1.1 200 OK`
	`Content-Type: application/sep+xml`
	`Content-Length: {contentLength}`
	
	`<DERProgramList all="1" href="/derp"`
	`results="1" xmlns="urn:ieee:std:2030.5:ns">`
	`  <DERProgram href="/derp/0">`
	`  <mRID>01BE7A7E57</mRID>`
	`  <description>Example DER Program</description>`
	`  <DERControlListLink all="2" href="/derp/0/derc"/>`
	`  <primacy>2</primacy>`
	`  </DERProgram>`
	`</DERProgramList>`

4	The client locates or creates a local Notification resource that can be used to receive notification of changes to the DERControlList.

5	The client POSTs the URI of the Notification resource, together with the DERControlListLink it read from the DERProgram, to the subscription list of its EndDevice instance on the DER server.
	
	`POST /edev/0/sub HTTP/1.1`
	`Host: {hostname}`
	`Content-Type: application/sep+xml`
	`Content-Length: {contentLength}`
	
	`<subscription xmlns="urn:ieee:std:2030.5:ns">`

```
<subscribedResource>http://server.example.com/derp/0/derc</subscribedResource>
   <encoding>0</encoding>
   <level>+S1</level>
   <limit>0</limit>
   <notificationURI>http://client.example.com/ntfy</notificationURI>
</subscription>
```

| 6 | The DER server responds with Status 201 Created. In the future, the DER server will "push" DERControlList updates to the client.

```
HTTP/1.1 201 Created
Location: /edev/0/sub/1
Content-Length: 0
```
|
| 7 | Client GETs the list of DERControls from the DER server. Client sends the below request, in this case asking for the first element of the list. N.B. Lists are ordered according to:
     1. DERControl.Interval.start (ascending)
     2. DERControl.creationTime (descending)
     3. DERControl.mRID (descending)

GET /derp/0/derc?s=0&l=1 HTTP/1.1
Host: {hostname}
Accept: application/sep+xml |
| 8 | DER server responds with the first DERControl on the list.
Server sends the following response:

HTTP/1.1 200 OK
Content-Type: application/sep+xml
Content-Length: {contentLength}

```
<DERControlList all="2" href="/derp/0/derc" results="1" xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus="https://csipaus.org/ns">
    <DERControl>
        <mRID> ABCDEF0123456789 </mRID>
        <description>Example DERControl 1</description>
        <interval>
            <duration>86400</duration>
            <start> 1605621600 </start>
        </interval>
        <DERControlBase>
            <csipaus:opModImpLimW>
                <multiplier>0</multiplier>
                <value>20000</value>
            </csipaus:opModImpLimW>
            <csipaus:opModExpLimW>
``` |

```
                <multiplier>0</multiplier>
                <value>5000</value>
            </csipaus:opModExpLimW>
            <csipaus:opModGenLimW>
                <multiplier>0</multiplier>
                <value>5000</value>
            </csipaus:opModGenLimW>
            <csipaus:opModLoadLimW>
                <multiplier>0</multiplier>
                <value>20000</value>
            </csipaus:opModLoadLimW>
        </DERControlBase>
    </DERControl>
</DERControlList>
```

| 9 | For each DERControl with ResponseRequired Bit 0 set, the Client POSTs a response with a status of "Message Received" to the response resource specified by the replyTo field in the DERControl. Client sends the following: |

```
POST /rsp HTTP/1.1
Host: {hostname}
Content-Type: application/sep+xml
Content-Length: {contentLength}

<DERControlResponse xmlns="urn:ieee:std:2030.5:ns">
  <createdDateTime>1341507000</createdDateTime>
  <endDeviceLFDI>C0FFEE00</endDeviceLFDI>
  <status>1</status>
  <subject>02BE7A7E5
</DERControlResponse>
```

Annex C - DRED Communications

This guide has chosen to treat DRED as a DER EndDevice and utilise the existing DERControl function set and map AS/NZS 4755 DRM controls for appliance DRED to the DERControl properties used for BESS control.

The DRED EndDevice will be treated as a load that can be reduced by applying a DRM control percentage (as listed in Table C1 below).

The following is an outline for design of DRED Load Control:

1) Handle DRED as a DER EndDevice similar to BESS
2) Utilise the DERControl property to control DRED:
   - opModFixedW – where the percentage is mapped to the AS/NZS 4755 DRM (refer to Table C.1)
3) No DefaultDERControl resource required. The failsafe command is assumed to be 100% (i.e. uncontrolled)
4) Utilise the DERCapability properties to be reported by the DRED EndDevice:
   - modesSupported – 'opModFixedW' bit set
   - DERType- utilise DeviceCategoryType bitmap on the associated EndDevice. For e.g. A/C use '7 – Smart Appliance', HWS '3 – Water Heater', Pool Pump Controllers '4 – Pool Pump', EV Charge Equipment - '17 – Electric vehicle supply equipment (EVSE)'
5) Utilise the DERSettings property to be reported by the DRED EndDevice:
   - modesEnabled – 'opModFixedW' bit set when control mode active
6) Utilise the DERStatus properties to be reported by the DRED EndDevice:
   - alarmStatus – '0'
   - operationalModeStatus – report current DRM in operation based on DRMs mapped to the following enumeration (as detailed in Table C.2). Where there is no DRM mode applied then the 'OperationalModeStatus' will be removed from the DER Status message.
   - GenConnectStatus – report connection status for the DRED and used as a mechanism to report on device error. GenConnectStatus = '1' when connected and '0' when not connected.

Table C1 - DRED EndDevice reduced by applying a DRM control percentage

AS4755 Operating Instruction	AS4755 DRM	Operational Mode Status	DERControl Property	DERControl Property Value	Lower Limit	Upper Limit
OI 0	DRM 0	100	opModConnect	False	-	-
OI 1	DRM 1	101	opModFixedW	0 %	-30.00	-0.01
OI 2	DRM 2	102	opModFixedW	-50 %	-60.00	-30.01
OI 3	DRM 3	103	opModFixedW	-75 %	-90.00	-60.01
OI 4	DRM 4	104	opModFixedW	-100 %	-100.00	-90.01
OI 5	DRM 5	105	opModFixedW	0 %	0.00	30.99
OI 6	DRM 6	106	opModFixedW	50 %	31.00	60.99
OI 7	DRM 7	107	opModFixedW	75 %	61.00	90.99
OI 8	DRM 8	108	opModFixedW	100 %	91.00	100.00

Table C2 – Operational Mode Status to report current DRM in operation based on DRMs mapped to the following enumeration operationalModeStatus

operationalModeStatus	DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
100	1	0	0	0	0	0	0	0	0
101	0	1	0	0	0	0	0	0	0
102	0	0	1	0	0	0	0	0	0
154	0	1	1	0	0	0	0	0	0
103	0	0	0	1	0	0	0	0	0
116	0	1	0	1	0	0	0	0	0
124	0	0	1	1	0	0	0	0	0
136	0	1	1	1	0	0	0	0	0
104	0	0	0	0	1	0	0	0	0
109	0	1	0	0	1	0	0	0	0
110	0	0	1	0	1	0	0	0	0
111	0	1	1	0	1	0	0	0	0
112	0	0	0	1	1	0	0	0	0
113	0	1	0	1	1	0	0	0	0
114	0	0	1	1	1	0	0	0	0
115	0	1	1	1	1	0	0	0	0
105	0	0	0	0	0	1	0	0	0
117	0	0	1	0	0	1	0	0	0
118	0	0	0	1	0	1	0	0	0
119	0	0	1	1	0	1	0	0	0
120	0	0	0	0	1	1	0	0	0
121	0	0	1	0	1	1	0	0	0
122	0	0	0	1	1	1	0	0	0
123	0	0	1	1	1	1	0	0	0
106	0	0	0	0	0	0	1	0	0

operationalModeStatus	DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
125	0	1	0	0	0	0	1	0	0
126	0	0	0	1	0	0	1	0	0
127	0	1	0	1	0	0	1	0	0
128	0	0	0	0	1	0	1	0	0
129	0	1	0	0	1	0	1	0	0
130	0	0	0	1	1	0	1	0	0
131	0	1	0	1	1	0	1	0	0
132	0	0	0	0	0	1	1	0	0
133	0	0	0	1	0	1	1	0	0
134	0	0	0	0	1	1	1	0	0
135	0	0	0	1	1	1	1	0	0
107	0	0	0	0	0	0	0	1	0
137	0	1	0	0	0	0	0	1	0
138	0	0	1	0	0	0	0	1	0
139	0	1	1	0	0	0	0	1	0
140	0	0	0	0	1	0	0	1	0
141	0	1	0	0	1	0	0	1	0
142	0	0	1	0	1	0	0	1	0
143	0	1	1	0	1	0	0	1	0
144	0	0	0	0	0	1	0	1	0
145	0	0	1	0	0	1	0	1	0
146	0	0	0	0	1	1	0	1	0
147	0	0	1	0	1	1	0	1	0
148	0	0	0	0	0	0	1	1	0
149	0	1	0	0	0	0	1	1	0
150	0	0	0	0	1	0	1	1	0
151	0	1	0	0	1	0	1	1	0
152	0	0	0	0	0	1	1	1	0
153	0	0	0	0	1	1	1	1	0
108	0	0	0	0	0	0	0	0	1
155	0	1	0	0	0	0	0	0	1
156	0	0	1	0	0	0	0	0	1
157	0	1	1	0	0	0	0	0	1
158	0	0	0	1	0	0	0	0	1
159	0	1	0	1	0	0	0	0	1
160	0	0	1	1	0	0	0	0	1
161	0	1	1	1	0	0	0	0	1
162	0	0	0	0	0	1	0	0	1
163	0	0	1	0	0	1	0	0	1
164	0	0	0	1	0	1	0	0	1
165	0	0	1	1	0	1	0	0	1
166	0	0	0	0	0	0	1	0	1
167	0	1	0	0	0	0	1	0	1
168	0	0	0	1	0	0	1	0	1
169	0	1	0	1	0	0	1	0	1
170	0	0	0	0	0	1	1	0	1
171	0	0	0	1	0	1	1	0	1
172	0	0	0	0	0	0	0	1	1
173	0	1	0	0	0	0	0	1	1

operationalModeStatus	DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
174	0	0	1	0	0	0	0	1	1
175	0	1	1	0	0	0	0	1	1
176	0	0	0	0	0	1	0	1	1
177	0	0	1	0	0	1	0	1	1
178	0	0	0	0	0	0	1	1	1
179	0	1	0	0	0	0	1	1	1
180	0	0	0	0	0	1	1	1	1

Annex D – DERIAPITWG Member Organisations

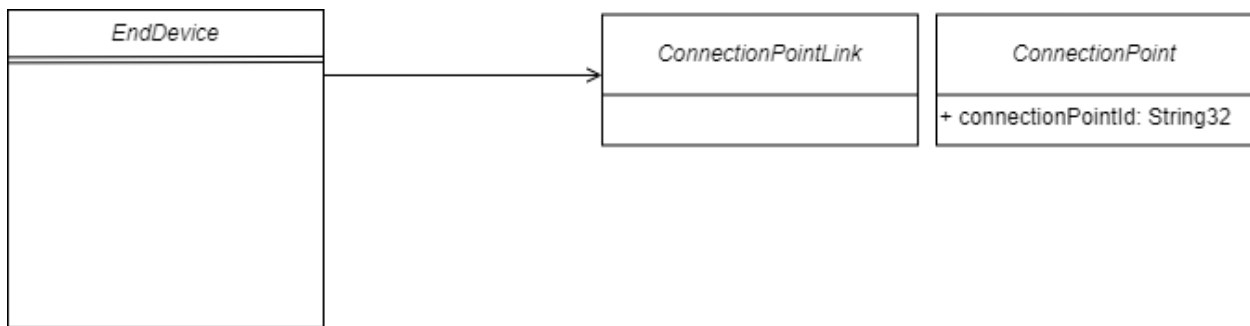| |
|---|
| AEMO |
| AGL |
| Ausgrid |
| AusNet Services |
| Australian National University |
| CitiPower, Powercor, United Energy |
| Combined Energy |
| Dept of Environment, Land and Water Planning |
| Energy Queensland |
| FIMER Australia |
| Fronius |
| Greensync |
| Horizon Power |
| Mondo |
| Redback Technologies |
| Rheem |
| SA Power Networks |
| SwitchDin |
| TasNetworks |
| Watt Watchers |
| Western Power |

Annex E – Connection Point Registration Extension

The intent of the Connection Point registration extension is to provide the capability for SEP2 servers to offer a consistent mechanism to provide additional information about the existence and location of a newly registered device on the network.

ConnectionPoint package

ConnectionPoint object (Resource)

Contains identification information related to the network location at which the *EndDevice* is installed.

connectionPointId attribute (String32)

The ConnectionPoint identifier. By default, the National Metering Identifier (NMI) is used to identify the network location of the device in this attribute.

ConnectionPointLink object (Link)

SHALL contain a Link to an instance of *ConnectionPoint*.

Web-application description language

ConnectionPoint resource extension

Sample URI: /edev/{id1}/cp

Request representation: ConnectionPoint

Response representation: ConnectionPoint

Methods: GET/HEAD: Mandatory, PUT: Mandatory, POST: Error, DELETE: Error

Implementation

The implementation of this extension includes a change to the CSIP operating procedures and an additional endpoint that is exposed by the server.

Validation

The server may validate that the supplied information matches installation details provided in separate processes (for example, through network connection applications). Where the server determines that the supplied ConnectionPoint id is invalid, the server shall return a HTTP 400 response with

reasonCode = 1 (invalid request value), for example:

```
<Error xmlns="urn:ieee:std:2030.5:ns">
  <reasonCode>1</reasonCode>
</Error>
```

Updates

Where this extension is used, the server shall support updates to ConnectionPoint identifier through a PUT request. This may be used, for instance, to correct an incorrectly entered identifier.

Step	Description
1-8	Follow the same procedure as Table C.1 of CSIP, steps 1-8

9	Client GETs its EndDeviceList from Server as configured (or as returned in DNS-SD Discovery).
	
	 Client sends the following request:
	
	 `GET /edev HTTP/1.1`
	`Host: {hostname}`
	`Accept: application/sep+xml`

10	Server responds with the *EndDeviceList* resource. The response contains a list of *EndDevices* registered by this client, with the first entry being the aggregator *EndDevice*. Server sends the following response: ``` HTTP/1.1 200 OK Content-Type: application/sep+xml Content-Length: {contentLength} <EndDevicelist href= "/sep2/edev" subscribable="1" all="3" results="3" xmlns="urn:ieee:std:2030.5:ns" xmlns:csipaus="https://csipaus.org/ns" > <EndDevice href "/sep2/edev/1000"> <LFDI> 9dfdd56f6128cdc894ale42c698cab197184aBe9</1 FDI> <LogEventListLink href="/sep2/edev/ 1000/1og" all="0"/> <sFDI>424105305561</sFDI> <changedTime>1514837000 </changedTime> <enabled>1</enabled> <RegistrationLink href "/sep2/edev/1008/rg"/> <SubscriptionListLink href="/sep2/edev/1000/ sub" all="0"/> </EndDevice> <EndDevice href "/sep2/edev/1"> <csipaus:ConnectionPointLink href="/edev/1/cp"/> <DERListLink href="/sep2/edev/1/der" all="0"/> <LFDI>12a4a4b406ad102e7421019135ffa2805235a21c</1FDI» <LogEventlistlink href-"/sep2/edev/ 1/log" all- "9"/> <sFDI>050044792964</sFDI> <changedTime>1514836800 </changedTime> <enabled>1</enabled> <FunctionSetAssignmentsListLink href="/sep2/edev/1/fs a" all="2"/> RegistrationLink href-"/sep2/edev/1/re"/> </EndDevice> <EndDevice href="/sep2/edev/2"> <csipaus:ConnectionPointLink href="/edev/2/cp"/> <DERListLink href="/sep2/edev/2/der" all="e"/> ```

	``` <LFDI>5509d69f8b353595206ad71b47e27906318ea367</LFDI> <LogEventListlink href="/sep2/edev/2/log" all="0"/> <sFDI> 228273300409</sFDI> <changedTime>1514836800 </changedTime> <enabled>1</enabled> <FunctionsetAss ignmentsListlink href="/sep2/edev/2/fsa" all="2/> <RegistrationLink href="/sep2/edev/2/rg"/> </EndDevice> </EndDevicelist> ```
11	The client then POSTs to Device Registration endpoint information on the device to be registered, for which the aggregator will be communicating on behalf of: ``` POST /edev/ HTTP/1.1 Host: {hostname} Content-Type: application/sep+xml Content-Length: {contentLength} <EndDevice xmlns="urn:ieee:std:2030.5:ns"> <sFDI>789654321005</sFDI> <changedTime>1379905200</changedTime> </EndDevice> ```
12	Server indicates the EndDevice record was created with the following: If a new EndDevice entry is created, the server would respond with the following where Location indicates the path to the newly created EndDevice resource: *HTTP/1.1 201 Created* *Location: /edev/4* A subsequent call to the GET /edev/ endpoint will return a list containing the newly created resource.
	Optional Extension

13	To inform the network of the location of the device on the network with respect to its connection point, the aggregator PUTs to /edev/{edevLocation}/cp.
| | ```
PUT /edev/4/cp HTTP/1.1
Host: {hostname}
Content-Type: application/sep+xml Content-Length:
{contentLength}


<csipaus:ConnectionPoint
xmlns:csipaus="https://csipaus.org/ns">
  <csipaus:connectionPointId>1234567890
</csipaus:connectionPointId>
</csipaus:ConnectionPoint>
``` |