synergy

Utility interconnection handbook

15 April 2025 | Version 1.0

DISCLAIMER

Synergy reserves the right to modify, supplement or revoke this document or any part thereof for any reason, at any time and without notice to users. The user must make and rely on their own inquiries as to the quality, currency, accuracy, completeness and fitness for purpose of any information contained in this document. By using the information in this document, the user acknowledges that they are solely responsible for obtaining professional advice prior to commencing any project, activities or other works. Synergy does not give any warranty or make any representation as to the information provided in this document. To the extent permitted by law, Synergy is not liable in any way for any loss, damage, liability, cost or claim of any kind whatsoever arising directly, indirectly or in connection with the use of, reliance on, or inability to use the information contained in this document.

Refer to Synergy's website for the current version of this document.

CONTACT US

If you have any feedback on this document, please let us know at der-support@synergy.net.au

Synergy acknowledges the Traditional Owners of the Land on which we operate and their continuing connection to the land, water and community. We pay our respects to all Aboriginal and Torres Strait Islander communities, their cultures and to Elders past, present and emerging.

Contents

1 Definitions 4
2 Overview 6
2.1 Background 6
2.2 Purpose and audience 6
2.3 Scope 7
2.4 Related documents 7
3 Testing and listing approach 9
3.1 Testing approach 9
3.2 Listing approach 9
4 Client implementation details 10
4.1 Onboarding 10
4.2 Registration of DER and connection points 10
4.3 Security 11
4.4 Subscriptions 11
5 Hardware requirements 12
5.1 Hardware configuration and combinations 12
5.2 Measurements 13
5.3 Hardware behaviour 14
5.4 Multi-DER configurations 15
6 VPP storage requirements 16
6.1 Background and capabilities 16
6.2 Version management and namespacing 16
6.3 Requirements 16
6.4 Specification 21
7 Additional storage test cases 22
7.1 Individual readings - storage 22
7.2 Capabilities and settings - storage 24
7.3 Storage Control - OpModStorageTargetW 25
7.4 Storage control with export limits – OpModStorageTargetW with OpModExpLimW 28

1 Definitions

Term	Explanation
2030.5	IEEE 2030.5 – 2018
Aggregator (client)	A utility client that provides a proxy communications channel for more than one EndDevice.
API	Application Programming Interface
Testing environment	An instance of Synergy's utility server for purposes of a technology provider to test their solution and have testing outputs verified by Synergy, as a precursor to being provided with access to the production environment.
CSIP	Sunspec's Common Smart Inverter Profile IEEE 2030.5 Implementation Guide for Smart Inverters Version 2.1
SA HB 218	Standards Australia Handbook 218:2023 – Common Smart Inverter Profile - Australia (CSIP-AUS) with Test Procedures.
CSIP-AUS Test Procedures	Standards Australia Handbook 218:2023 – Common Smart Inverter Profile - Australia (CSIP-AUS) with Test Procedures.
DER	Distributed energy resources. The collective term for small scale devices that can either use, generate or store electricity and form a part of the local distribution system. Also referred to as household, business or community energy assets.
Direct client	A utility client that is deployed local to the DER, and only manages a single end device.
EndDevice	A 2030.5 resource that encapsulates and manages bi-directional monitoring and control data to one or more DER.
Export monitoring device	A device that monitors point of connection voltage and active and reactive power flows.
MirrorUsagePoint	A 2030.5 resource created Utility Clients that allows for creation and submission of Mirror Meter Readings.
MirrorMeterReading	A 2030.5 resource created Utility Clients that allows for creation and submission of telemetry readings e.g. site real power, site reactive power.
mTLS	Mutual Transport Layer Security.
OEM	Original equipment manufacturer. An OEM is a company that makes parts or equipment that are sold by another company.
Production environment	An instance of Synergy's utility server for the registration and remote management of Synergy customer systems under the terms of an agreement between Synergy and the customer.
Synergy's *Utility interconnection handbook*	This document.
Technology provider	An organisation that has built and is operating a utility client to allow for remote device management through Synergy's utility server. The OEM may act as the technology provider themselves or have a third party operate as the technology provider.
Utility client	A 2030.5 client that has implemented the required capabilities and functions as defined in SA HB 218.

Utility server	A 2030.5 server that has implemented the required capabilities and functions as defined in the SA HB 218.
VPP	Virtual Power Plant

2 Overview

2.1 Background

Synergy has been developing capability in DER management to meet network security and market objectives. Through a range of projects, trials and production deployments Synergy has progressed its understanding of the landscape and has adopted a preferred position on the remote management of DER.

Synergy's DER functionality requirements document defines requirements for remote management of DER installed in Synergy's network. This specifies the remote management capabilities that must be met by all new and upgraded DER systems[1].

To enable remote management, Synergy has selected CSIP-AUS SA HB 218 as the preferred standard for remote management of all DER (Synergy or third party owned) unless the site infrastructure or project requirements necessitate the use of another technology.

This standard has been selected for the following reasons:

- It allows for centralisation of communication and interaction between Synergy systems and remote DER via technology providers;
- It provides broad coverage of required capabilities for remote management of DER assets;
- It aligns with the national approach, simplifying the process for international technology providers to integrate and connect; and
- It provides a consistent pathway for third party integrators to support Synergy in delivery of market services in the future.

2.2 Purpose and audience

The purpose of this document is to provide technology providers and OEMs with all necessary information to implement and test a compatible hardware and software solution.

The audience of this document is any party that has built or is building a 2030.5 CSIP-AUS utility client and/or associated hardware solutions, with the intention of connecting to Synergy's utility server.

This document includes information on:

1. The high level testing and listing approach – see section 3.
2. Specific requirements and implementation details for utility clients that are connecting to Synergy's utility server – see section 4.
3. Specific requirements and details that relate to hardware behaviour and response as part of a solution – see section 5.

[1] Unless an exemption applies.

4. Information on modifications and extensions, for solutions to participate in specific offers/programs – see section 6.
5. Additional test cases associated with storage extensions – see section 7.

This document is intended to be read in conjunction with SA HB 218 (and associated test procedures), the CSIP and IEEE 2030.5. Where possible, this document references existing documents to minimise duplication and variations and align to a nationally consistent approach.

As the CSIP-AUS and supporting ecosystem documentation (e.g. CSIP-AUS explainer document, security requirements) are developed, updated and published, Synergy will update this document to reduce the scope and reflect and align with the national approach.

2.3 Scope

This handbook describes the requirements for connecting a utility client and hardware solution for remote management by Synergy through its 2030.5 CSIP-AUS utility server.

This document includes all requirements relating to:

- Software interactions between the utility server and the utility client;
- The behaviour of hardware device(s) as part of a system, in response to software interactions from the utility server.

This handbook is applicable to all devices where Synergy has identified that CSIP-AUS is the remote communications channel for API based control as identified in Synergy's DER functionality requirements.

2.4 Related documents

Relevant documentation is included in this section. Where standards are referenced, the version to be applied shall be the most recent version, unless otherwise specified.

Document	Description	Audience
DER functionality requirements DMS# 36454686	Provides Synergy's functional requirements for generating and consuming DER assets in the South West Interconnected System (SWIS).	OEMs and technology providers, installers, equipment retailers and other industry participants.
Installer handbook DM######	Document providing installers with all information required for installation and commissioning of DER assets to connect and operationalise assets in Synergy's CSIP-AUS Server.	Installers

Supported solutions list DM######	Synergy maintained list of supported utility clients and hardware solutions that meet the requirements of Synergy's *Utility interconnection handbook*.	Installers/customers

3 Testing and listing approach

3.1 Testing approach

There is currently no national testing and certification process for utility client and hardware solutions. In the interim, Synergy has developed an approach that aims to minimise the workload for technology providers and facilitate testing, listing and onboarding of technology providers as quickly and efficiently as possible.

Synergy recognises that many technology providers have already tested and listed their solutions with SA Power Networks and the CEC listing (as an output) has been adopted by a number of other network operators across Australia. Synergy's approach maintains consistency with this, utilising the outcomes of this testing as a base and applies a minimum delta of additional test cases. These serve the purpose of minimum integration testing between Synergy's server and technology provider solutions, as well as testing for specific functionalities not covered by SA Power Networks testing.

Technology providers that are seeking to have their solutions test and listed can submit an application through a web form available here. Synergy will subsequently provide the details on the process and activities required to complete testing, achieve listing and be provided with access to production.

3.2 Listing approach

Synergy maintains a *Supported solutions list*. This includes a list of supported utility clients and hardware solutions and the compatibility between those solutions. Synergy is committed to aligning to the national listing approach when this becomes available.

The testing requirements and listing process for devices and solutions will depend on the nature of the listing that a technology provider is seeking.

For technology providers that are seeking for devices and solutions to be utilised for customers connected under DEBS the solution will need to be tested and listed as *DER – Generator*[2].

For technology providers that are seeking for devices and solutions to be utilised in a relevant Synergy Virtual Power Plant (VPP) program, the solution will need to be tested and listed as *DER – Storage*. The requirements and test cases for solutions to be listed as *DER – Storage* include all those for *DER – Generator* and include additional relevant requirements for VPP participation.

Details on the testing requirements for these listing categories will be provided as a part of the onboarding into Synergy's testing environment.

[2] Devices that meet this set of requirements will be eligible for participation in flexible export programs in the future, once made available by Western Power.

4 Client implementation details

This section of Synergy's *Utility interconnection handbook* is intended to be read in conjunction with SA HB 218 and the CSIP. It includes changes, clarification, or additions to operate with Synergy's utility server implementation.

4.1 Onboarding

Synergy will provide each technology provider with all information required to understand Synergy's utility server DeviceCapability resource.

These details will be provided for the testing environment and the production environments separately as part of the onboarding process described in section 3.

4.2 Registration of DER and connection points

Out of band registration

While normal operations will have utility clients register new EndDevices through the inband registration workflow, out of band registration must be supported for edge cases and exception management.

For aggregators, prior to connecting to the utility server for the first time, the utility server will create an EndDevice to represent the aggregator and configure that EndDevice with suitable permissions. When aggregators retrieve their EndDeviceList for the first time it will include a single EndDevice that represents the aggregator client. Once connected aggregator clients will need to have EndDevices registered for each EndDevice that they are managing.

In band registration

All clients will need to submit requests for each EndDevice to be registered and subsequently a ConnectionPoint request to associate a National Metering Identifier (NMI) with the EndDevice (as defined in SA HB 218:2023 section 11). For direct clients this is only required once, for the EndDevice to register itself (and the ConnectionPoint that the EndDevice is associated with). For aggregator clients, this will be required for each EndDevice that that the Aggregator Client is managing.

Clients will not have the ability to remove/delete EndDevices through an in band workflow and should contact Synergy to remove/delete EndDevices through and out of band process.

Connection point registration

ConnectionPoint registrations must be performed immediately following EndDevice registration as the EndDevice will be archived if it is not associated to a ConnectionPoint within a certain duration.

4.3 Security

In addition to the security requirements listed in SA HB 218, the following security requirements shall apply:

1. Aggregator clients shall utilise mTLS to verify the identity of the server as part of authentication.
2. Synergy shall provide a mechanism for issuing signed certificates to direct and aggregator clients on completion of the testing requirements in this *Utility interconnection handbook*.
3. For direct clients, Synergy shall provide a mechanism for clients to request certificates from Synergy that can be loaded onto devices.

Synergy reserves the right to rotate client certificates periodically as part of business-as-usual operations, or without notice revoke certificates as part of a cybersecurity incident response.

4.4 Subscriptions

In addition to SA HB 218 requirements, where aggregators are utilising subscriptions, they shall renew subscriptions every 24 hours.

5 Hardware requirements

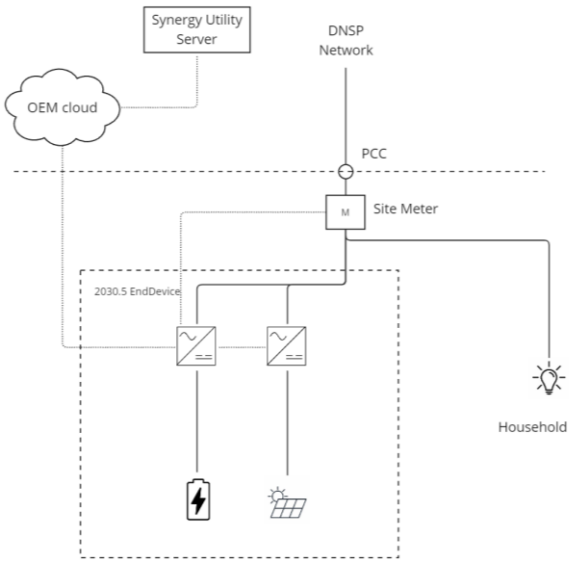
This section describes requirements for hardware and expected response to software interactions to be listed by Synergy.

5.1 Hardware configuration and combinations

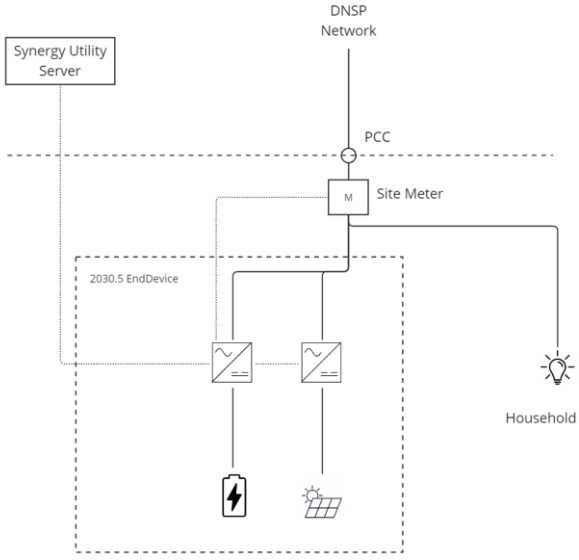
Synergy's approach to hardware configuration is consistent with and aligned to the approach adopted in SA HB 218. Each installation shall have:

1. Remote communications path (communication to utility server or remote system);
2. Energy system controller (either integrated or gateway devices);
3. A DER that may be supplied by a direct current (DC) energy source.

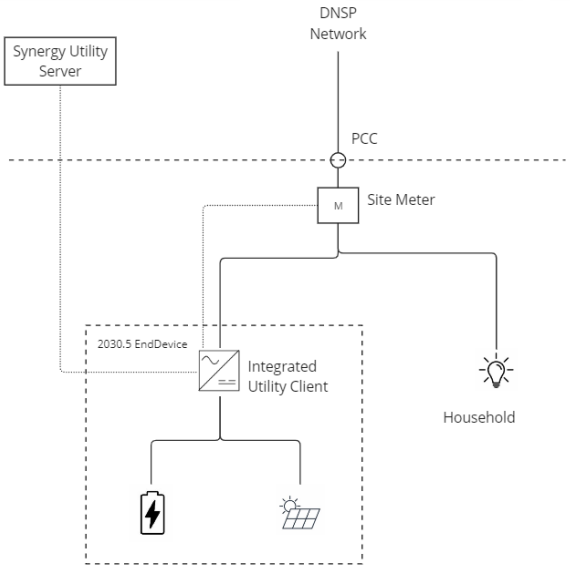
Examples of accepted site and communications configurations support *DER – Generator* and *DER – Storage* requirements are provided below. Other configurations not shown in these examples that comply with all requirements in this handbook may also be considered compliant.



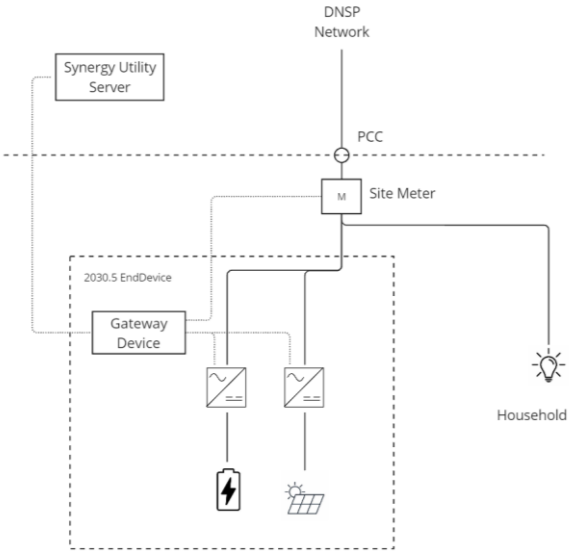
Option 1: Connectivity to Synergy's Server from a centralised cloud hosted utility client.



Option 2: Utility client is implemented on inverter and acts as a master controller for other devices.



Option 3: Directly to individual DER asset/s where each device supports an integrated utility client.



Option 4: A site-based gateway device providing interoperability capability and acting as the site utility client.

Technology providers shall document and make available details on all supported site configurations and solutions for installers.

5.2 Measurements

The client shall create MirrorUsagePoints (MUP) and MirrorMeterReadings (MMR) and submit readings in line with the measurement points and requirements in SA HB 218:2023 section 8.

Post rates for the system will be configured inline with the requirements for the product/service that the customer is participating in.

The measurement aggregation period shall be equal to the MUP post rate specified by the server and aligned to the Coordinated Universal Time (UTC) tick for the relevant post rate. For example, for a five-minute post rate, measurements shall be aligned to the five-minute tick, for a one-minute post rate, measurements shall be aligned to the one-minute tick.

For measurement and calculation of average real and reactive power, Synergy's preferred approach is for the hardware to measure the total energy produced/consumed over the period, and divide that value by the period duration. If this approach cannot be implemented a permissible alternative is to have the values calculated from sampled values across the measurement period. The sampling frequency should be once per 200 ms but shall be at least once per 1 second. For each sample, the value shall be measured using the approach in AS/NZS 4777.2:2020 section 2.13.

Any measurement taken either at the DER or at the site level shall meet the accuracy requirements specified in section 2 of AS/NZS 4777.2:2020 and documented in section 7 of AS/NZS 4777.2:2020.

External measurements

Ability to monitor power flows to and from the connection point is a requirement for all solutions seeking listing as *DER – Generator* or as *DER – Storage*. As a part of testing solutions shall utilise an export monitoring device that meets the measurement requirements in section 5.2.

5.3 Hardware behaviour

Commissioning behaviour

Before an asset is onboarded to Synergy's utility server and commissioned at a site, all new and upgraded DER installations shall be configured with a local hardware export limit in line with Synergy's DER functionality requirements.

As a part of onboarding and commissioning testing with Synergy's utility server, a default limit will be applied that will take priority over this local hardware export limit. Once operational, active limits will be applied that will take priority over the default limit and local hardware limit.

Control priority

Inverters shall implement the prioritisation behaviours in AS/NZS 4777.2:2020 table 2.6, with disturbance withstand limits and operation of the automatic disconnection device prioritised ahead of all remote control interactions.

Where remote control interactions relate to the same behaviours i.e. controls are not orthogonal, remote controls shall be prioritised over local operational controls of the inverter e.g. remote limit controls shall be prioritised over local limits.

Where remote control interactions relate to different behaviours i.e. controls are orthogonal, the local control behaviour shall still be enacted e.g. where a remote limit control is in effect, the system shall still enact specified responses to frequency conditions, voltage conditions and power rate limits.

Where implementing remotely issued controls that relate to multiple devices (AC or DC coupled), Synergy's preferred approach is for the local controller to prioritise these controls in the following order:

1. Control of any other components that are part of the EndDevice e.g. storage or load;
2. Curtailment of solar (partially or fully).

Status

Status information should be reported as per the following definitions:

operationalModeStatus:OperationalModeStatusType

- 1-Off: This status shall be reported whenever the conditions for "Operational mode" are not met.
- 2-Operational mode: This status shall be reported where one or more components of the EndDevice are energised from a DC energy source.

genConnectStatus:ConnectStatusType

- Bit 0 – Connected: This bit shall be asserted where at least one DER with a generation source that is part of the EndDevice has a live AC connection to the grid. This does not necessarily mean that the EndDevice is operating or available.

- Bit 1 – Available: This bit shall be asserted where at least one DER with a generation source that is part of the EndDevice is online, providing telemetry and capable of receiving and responding to controls.
- Bit 2 – Operating: This bit shall be asserted where there are active power flows on either AC-DC or DC-DC circuits on at least one DER with a generation source that is part of the EndDevice.
- Bit 4 – Fault/Error: This bit shall be asserted where any internal fault/error is detected that prevents any DER with a generation source that is part of the EndDevice from responding or being capable of responding to controls, inclusive of communications errors between the asset and utility client.

5.4 Multi-DER configurations

Synergy allows for multiple DER to be installed and configured under a single 2030.5 EndDevice. Where a provider is seeking to support multiple DER, additional implementation requirements must be satisfied.

Hardware behaviour

Where a solution includes more than one DER, there shall be a single EndDevice that is responsible interfacing and coordinating all DER that are included within the EndDevice. The solution shall deliver an aggregate hardware response that is consistent with functional outcomes specified in the CSIP-AUS and in this handbook.

Settings and capabilities

The capabilities and settings for solutions with multiple DER shall reflect the aggregate values of the settings and capabilities reported for all DER that the EndDevice comprises.

Telemetry

The telemetry reporting for solutions with multiple DER shall be aggregate measurements for all DER that the EndDevice comprises. For real and reactive power measurements, this shall be the sum of the real and reactive power values of the DER that it comprises.

6 VPP storage requirements

This section of the document relates to the requirements for technology providers that are seeking to be listed under the category *DER – Storage* by Synergy. All solutions seeking listing as *DER – Storage* must also meet all requirements for the client and hardware behaviour defined in section 4 and section 5.

Test cases for additional storage capabilities are included in section 7.

6.1 Background and capabilities

To enable delivery of market and non-market services, Synergy has been developing capabilities for the remote aggregation and management of DER. To deliver use cases for remote management of storage assets, Synergy has identified capabilities are required, in addition to functionality provided through SA HB 218. These include:

- Ability for a server to understand the presence and capabilities of storage assets within a 2030.5 EndDevice.
- Ability and for a client to send messages that allow a server to understand the state and operation of the energy storage within a 2030.5 EndDevice e.g. stored energy.
- Ability for a client to receive an additional DERControl that instructs an EndDevice to hit a specific set point target.

To deliver these capabilities Synergy has defined implementation details and minimal extensions to 2030.5 and SA HB 218. Field trials have been undertaken to verify these approaches, which inform the requirements in this document.

6.2 Version management and namespacing

At time of publication, Synergy's storage extensions have not been incorporated into the CSIP-AUS. To manage server and client interoperability challenges, Synergy has defined an approach for managing how these storage extensions should be implemented and utilised by clients.

Note: The proposed approach should prevent compatibility issues with existing clients and servers but at time of publication this behaviour has not been tested. These extensions should not be used in production deployments until suitable compatibility testing has been performed.

For any technology provider that is implementing these storage extensions, they can indicate that they will are supporting these by utilising a target namespace of "csipaus.org/ns/v1.3-beta/storage" in all submissions to the server. At time of publication this namespace covers all functionality that is currently in ths csipaus.org/ns/ namespace (corresponding to CSIP-AUS version 1.1a), and also includes the storage extensions defined in this section.

Clients that have not implemented the storage extensions can continue to use the csipaus.org/ns/ namespace and Synergy's server will operate with the base level of functionality defined in sections 3 and 4 of this document and SA HB 218.

6.3 Requirements

Ratings and settings

In addition to the requirements specified in SA HB 218 the client shall submit values for:

- rtgMaxChargeRateW;
- rtgMaxDischargeRateW;
- setMaxChargeRateW;
- setMaxDischargeRateW;
- rtgMaxWh; and
- setMaxWh.

In addition to the definition specified in IEEE 2030.5 – 2018, the following definition shall apply.

rtgMaxChargeRateW and rtgMaxDischargeRateW shall represent the sum of the capabilities of all controllable storage assets that the EndDevice comprises. SetMaxChargeRateW and setMaxDischargeRateW shall represent the sum of the adjusted capabilities of all controllable storage assets that the EndDevice comprises. These values will be less than the total AC output of the EndDevice as represented by rtgMaxW and rtgMaxVA.

rtgMaxWh shall represent the sum of the nameplate value for energy storage assets within the EndDevice.

setMaxWh shall represent the maximum operational value for stored energy in Wh. This is the value of stored energy at which the storage system will not charge above.

Clients shall also submit value for a new parameter not currently specified in IEEE 2030.5 with following definition:

setMinWh attribute (WattHour) [0..1]

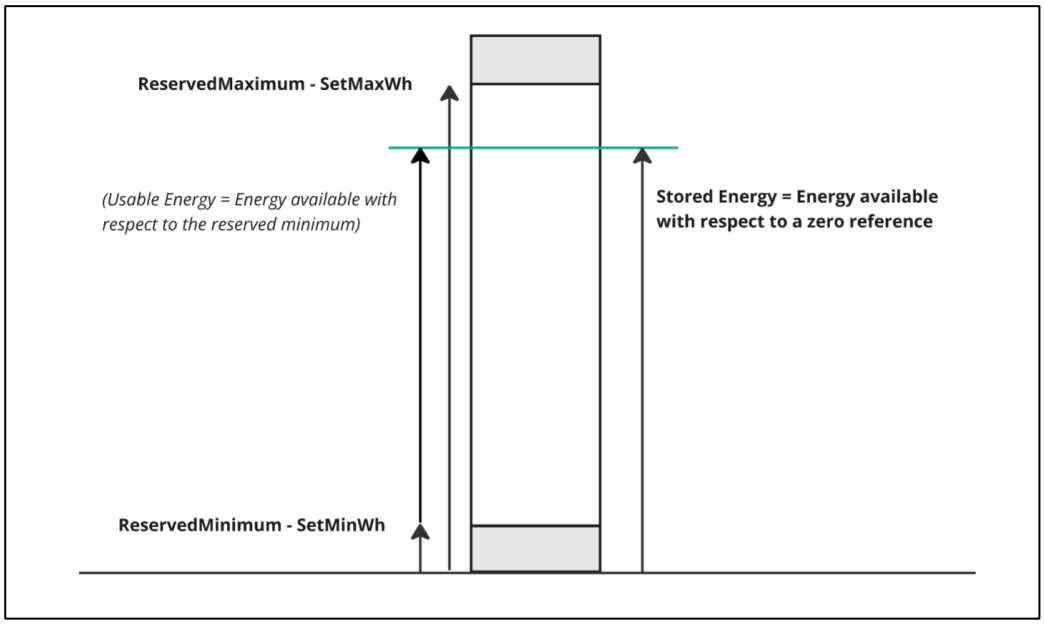
Minimum operational value for stored energy in watt hours. This is the value at which the battery will stop discharging to maintain state of charge above OEM or installer specified reserved minimum.

Stored energy

Clients shall communicate information to the server on the current stored energy in all storage components in the EndDevice via the metering mirror function set.

The client shall create a MUP and MMR that represents the energy stored in the asset in watt-hour baselined from zero energy. By understanding the upper and lower limits for stored energy (as represented by SetMinWh and SetMaxWh), and the current value for stored energy within those bounds, it is possible to form a complete picture of the current state of the asset for service delivery.

Stored energy is distinct from the usable energy, which is the amount of energy that can be discharged before the system reaches the reserved minimum.



Clients shall create a new MUP, and MMR, with the following details to submit readings for stored energy.

MirrorUsagePoint attributes:

- ServiceCategoryKind: 0 - Electricity
- Status: 1 - On
- RoleFlags (asserted)
    - Bit 0 – isMirror
    - Bit 3 – isDER
    - Bit 6 – isSubmeter

MirrorMeterReading/ReadingType attributes:

- AccumulationBehaviour: 12 - Instantaneous
- Commodity: 1 – Electricity
- DataQualifier: 0 – Instantaneous
- IntervalLength: E - Not to be used.
- Kind: 12 - Energy
- NumberOfConsumptionBlocks: E - Not to be provided.
- NumberOfTOUTiers: E - Not to be provided.
- PowerOfTenMultiplier: O - May be provided.
- SubIntervalLength: E - Not to be provided.

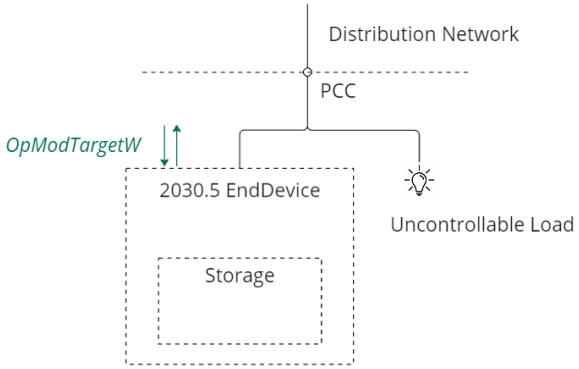
- SupplyLimit: E - Not to be provided.
- TieredConsumptionBlocks: E - Not to be provided.
- UoM: 72 - Wh (real energy in watt-hour).

Set point controls

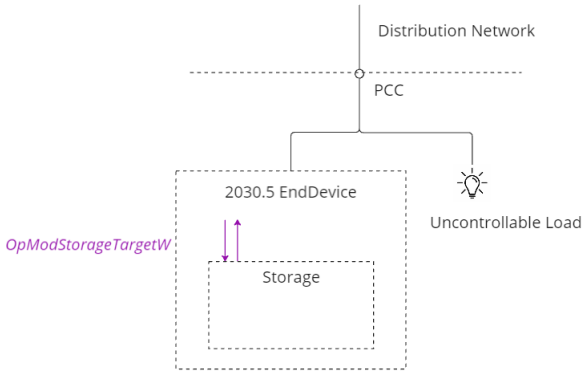
To meet the requirements for *DER – Storage*, solutions shall support one additional control:

- OpModStorageTargetW

For clarity and consistency in implementation a summary of this control is provided with the key differences between this control and the existing 2030.5 control in OpModTargetW. Note: Implementation of OpModTargetW is not required for clients to be tested and listed as *DER – Storage*.



OpModTargetW is a coarser control that does not specify behaviour for storage components but a net outcome from EndDevice that may include other DER.



OpModStorageTargetW is a more granular control that that specifies targets for storage components within the EndDevice. Other components e.g. solar PV within the EndDevice can continue to operate unconstrained.

The enactment of OpModStorageTargetW may be subject to availability of stored energy or other operational constraints. It is the responsibility of the utility server to consider operational constraints when creating these controls.

If the server creates a control that cannot be delivered, for example:

- Where the set point value sits outside the capability of the asset; or
- Where the asset reaches a value of stored energy that prevents it from being able to continue delivering the service

the asset will make best efforts to deliver the service.

Where OpModStorageTargetW controls have been created and overlap with any CSIP-AUS dynamic operating envelope (DOE) extension controls the EndDevice shall attempt to deliver both outcomes (the EndDevice will accept both controls and not mark either as superseded), and the output behaviour shall reflect the more restrictive of the two controls. i.e.

- Where the control would result in violation of a DOE control, the system is set to have the response meet but not exceed the DOE control.

- Where the control would not result in violation of a DOE control, the system is set to have the control meet the setpoint control.

The sign convention for OpModStorageTargetW controls shall be as specified in SA HB 218 and IEEE 2030.5 i.e. generation of power is positive.

OpModStorageTargetW

OpModStorageTargetW is a new attribute in the DERControlBase that may be supported by DER with dispatchable capabilities.

OpModStorageTargetW *(ActivePower) [0..1]*

- This control can only be supported by EndDevices that include storage components (e.g. batteries and electric vehicle supply equipment (EVSE) with bidirectional capabilities).
- OpModStorageTargetW control is a target output at the aggregation of storage assets within an EndDevice in watts and is a signed value.
- The controller for the EndDevice will coordinate controls and behaviour of storage assets to produce a constant aggregate response for those components at the value specified in the OpModStorageTargetW control.
- The controller will ensure the target is maintained at the specified level after accounting for the measurement accuracy as specified in AS/NZS 4777.2:2020 clause 2.13.
- Actions, internal to the dispatchable components to meet this outcome include charging/discharging of any storage assets.
- An OpModStorageTargetW control will not result in interactions with non-storage assets. This means:
    - Any other controlled load within the EndDevice will not be controlled.
    - Any other solar PV as part of the EndDevice will not be curtailed.
- Where there are more than one storage units within the EndDevice, the target setpoint power shall be distributed across storage assets, such that the target value is delivered for at least the duration of the control.

Modes supported

The client shall indicate support for and enablement of OpModStorageTargetW through submissions to DERCapability and DERSettings resources.

Clients shall utilise vppModesSupported and vppModesEnabled to communicate support for and enablement of OpModStorageTargetW.

Clients shall indicate:

1. Support for the DERControlBase OpModStorageTargetW through the DERCapability bitmap DERCapability::vppModesSupported utilising bit position 0.
2. Enablement of the DERControlBase OpModStorageTargetW through the DERSettings bitmap DERSettings::vppModesEnabled utilising bit position 0.

6.4 Specification

Synergy can make available XML schema definition (XSD) files for specifications of these extensions.

7 Additional storage test cases

Additional test cases have been developed to provide coverage for capability that is not currently tested within CSIP-AUS, including storage extensions.

These test cases have been written to provide verification of both the utility client capabilities as well as hardware response to software interactions. This means that all test cases are required to be executed for a utility client to be listed with support for *DER – Storage* and for a compatible hardware to be listed with support for *DER – Storage*.

It is the responsibility of the technology provider to identify and request testing for all relevant asset configurations for storage assets. For example, if the solution is intended to be sold as part of a system with PV generation (AC/DC coupled), testing shall include PV supply, or a DC supply that imitates PV generation. Synergy will work with technology providers to identify what testing is required for hardware combinations/configurations.

7.1 Individual readings - storage

Purpose

This test is intended to validate the client's ability to correctly post average values for the following readings using the MirrorMeterReading POST method:

1. Stored Energy (as defined in section 6).

Precondition

The client has completed the discovery process as defined in the relevant tests in SA HB 218. There is no existing MirrorUsagePoint in place that represents stored energy.

The storage components in the EndDevice have a state of charge between 30% and 70%.

Test procedure

The steps shall be performed as described in the table below and the test results shall be compared against the expected results for both communications clients and the DER.

Step	Manual or utility server step	Expected comms client result	Expected DER result
1	The client completes the discovery process as detailed in test ALL-02 in the CSIP-AUS test procedures including receiving the *MirrorUsagePoint* resource link from the utility server.	Client requests resource information from the utility server's *MirrorUsagePointList* endpoint.	N/A
2	Utility server sends the *MirrorUsagePointList* resource that does not yet contain an entry for the client's *MirrorUsagePoint*, that the client will use for submitting stored energy readings.	The client posts a valid *MirrorUsagePoint* payload to the *MirrorUsagePointList* endpoint on the utility server with the relevant RoleFlag bits asserted[1].	N/A

3	The server returns a HTTP payload confirming that the *MirrorUsagePoint* has been created and its location.	The client again sends a request for its *MirrorUsagePointList* endpoint.	N/A
4	Utility server sends the *MirrorUsagePointList* resource that now contains an entry for the client's *MirrorUsagePoint* including relevant information such as the postRate required for *MirrorMeterReading* posts.	The client posts *MirrorMeterReading* or *MirrorMeterReadingList* payloads for stored energy to the *MirrorUsagePointList* endpoint at the configured interval (default is 60 seconds) at least four times.	N/A
5	The utility server configures an active control with *OpModStorageTargetW* at 5000 W or at the rtgMaxDischargeRateW (whichever is greater).	The storage component of the EndDevice discharges at the specified rate. After the control has started the communications client reports two values for stored energy of the EndDevice. The second value for stored energy shall be less than the first value.	N/A

Criteria

If during testing the client or DER experiences one of the following events the solution is non-conformant with this test case.

a) The client does not post stored energy readings to the utility server in line with the specified definition.

b) The client posts values that do not represent the actual value for stored energy for the EndDevice.

c) The *MirrorMeterReadings*' *mRID* provided by the client does not include the manufacturer's Private Enterprise Number (PEN) as the final 8 digits of the *mRID*.

d) The phase value does not represent the class of client under test e.g. single phase vs. three phase.

e) The timestamps within lastUpdateTime, nextUpdateTime and timePeriod that are reported are aligned with appropriate minute boundaries based on the post rate set. E.g. for a post-rate of 60 seconds the timestamps recorded should be 12:01:00, 12:02:00 etc.

f) After a discharge control takes effect, the stored energy reported does not decrease between subsequent reading submissions.

Notes: This can be a part of the same or separate to the MirrorUsagePoint for the DER Real Power and DER Reactive Power. If using the same MirrorUsagePoint, the MirrorUsagePoint created should also include MirrorMeterReadings for DER real power and DER reactive power.

7.2 Capabilities and settings - storage

Purpose

This test is intended to validate the client's ability to post DER capabilities and settings relevant to the storage components and ability to support OpModStorageTargetW.

Test Procedure

The steps shall be performed as described in the table below and the test results shall be compared against the expected results for both communications clients and the DER.

Step	Manual or utility server step	Expected comms client result	Expected DER result
1	The client completes the discovery process as detailed in test 3.2.1, including receiving the *DERCapability* and *DERSettings* resource links from the utility server.	Client posts *DERCapability* and *DERSettings* payloads to the utility server as required (either on-connection or on-change as specified below).	N/A

Criteria

If during testing the client experiences one of the following events these are considered non-conformances with this requirement:

a) The client posts incorrect or incomplete capabilities values to the utility server, including the specific requirements for storage assets:

- rtgMaxChargeRateW;
- rtgMaxDischargeRateW;
- rtgMaxWh;
- Support for OpModStorageTargetW through vppModesSupported.

b) The client posts incorrect or incomplete settings values to the utility server, including the specific requirements for storage assets:

- setMaxChargeRateW;
- setMaxDischargeRateW;
- setMaxWh;
- setMinWh;
- Enablement of OpModStorageTargetW through vppModesEnabled.

c) The client posts any of the attributes listed above for DERCapability and DERSettings more than once during the test.

Notes: These capabilities and settings shall be submitted to the server in the same request with other DERCapability and DERSettings values as a part of the relevant test in SA HB 218.

7.3 Storage Control - OpModStorageTargetW

Purpose

This test is intended to validate:

- A client's ability to receive an OpModStorageTargetW control from the server and facilitate the execution of that control with a hardware solution.
- A hardware solution's ability to execute the specified control in line with the documented definition.

Note: While this test prescribes specific values for configuration of the system and the duration of scheduled controls, these have not been verified at time of publication. Synergy intends to update these test cases to ensure that the required behaviours are demonstrated, while providing flexibility in the specifics to reduce complexity and duration.

Precondition

A DER incorporating one or more storage assets capable of charging/discharging active power is under the management of the client and idling at ~50% state of charge.

The storage components for the system are configured such that the charge and discharge ratings (rgMaxChargeRateW and rtgMaxDischargeRateW) are equal to the apparent power rating of the inverter that the storage is connected to.

Where testing a configuration that includes PV generation:

- Where DC coupled, a DC supply will be configured controlling to the system which is set at a value of between 30% and 60% of the rated capacity of the hybrid inverter.
- Where AC coupled, the inverter being used to manage the PV generation will be the same rating as the inverter for the storage components. The DC supply for this inverter will be set between 30% and 60% of this inverter's rated output.

The utility has no current active controls in operation and will only create the below controls during the test.

Test procedure

The steps shall be performed as described in the table below and the test results shall be compared against the expected results for both communications clients and the DER.

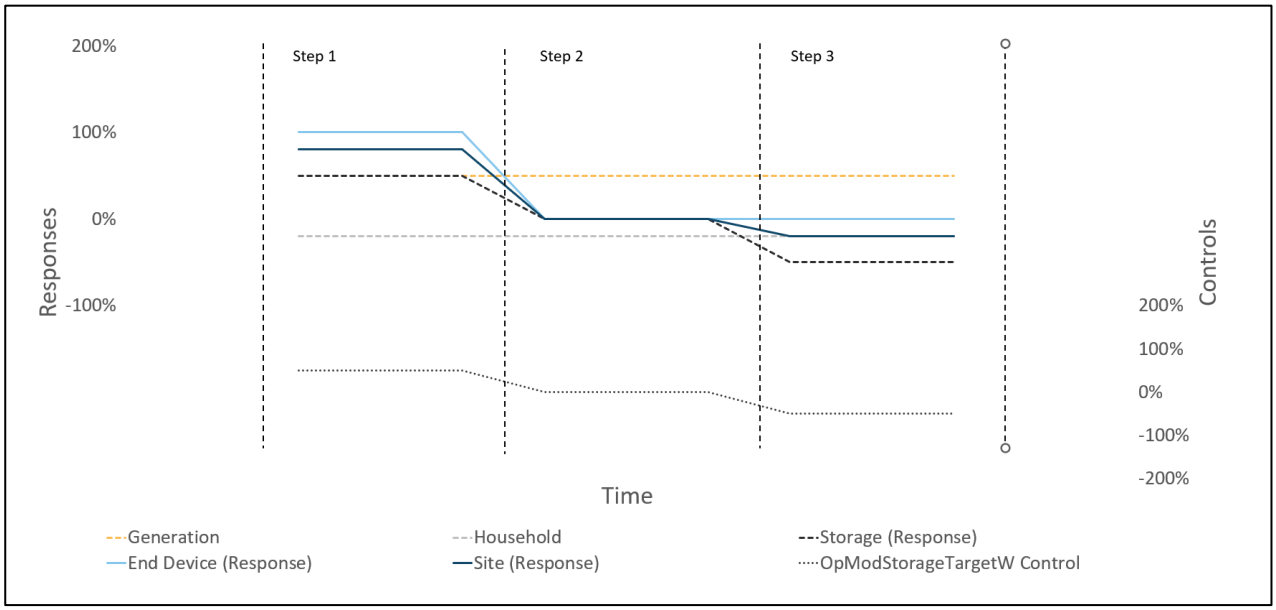
Step	Manual or utility server step	Expected comms client result	Expected DER result
1	The utility server configures an active control with *OpModStorageTargetW* equal to 50% of *rtgMaxDischargeRateW* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with the relevant responses.	The storage component's generation power is adjusted to 50% of *rtgMaxDischargeRateW* after accounting for measurement accuracy requirements. Where the EndDevice includes PV, there is no change to the generation of the PV system.

2	The utility server configures an active control with *OpModStorageTargetW* equal to 0% of *rtgMaxDischargeRateW* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with the relevant responses.	The storage components generation power is adjusted to 0% of *rtgMaxDischargeRateW* after accounting for measurement accuracy requirements. Where the EndDevice includes PV, there is no change to the generation of the PV system.
3	The utility server configures an active control with *OpModStorageTargetW* at a negative value equal to 50% of *rtgMaxChargeRateW* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with the relevant responses.	The consumption power is adjusted to 50% of *rtgMaxChargeRateW* after accounting for measurement accuracy requirements. Where the EndDevice includes PV, there is no change to the generation of the PV system.
4	No further action is taken until the completion of the control.	The client receives and responds to the DERControl with event completed.	The EndDevice reverts to previous behaviour.

Behaviour specification

To improve clarity and consistency in understanding the test steps, a summary table and graphical representation of the test inputs (controls) and outputs (responses) has been developed. All percentage values presented here are percentages of *rtgMaxChargeRateW*/*rtgMaxDischargeRateW.* While the solar (or DC supply simulating solar) can sit between 30% and 60% the table below presents the output values for a solar contribution of 50%.

Input/Output		Input			Output			
Step	**Behaviour description**	**Storage setpoint**	**Export limit**	**House load**	**storage**	**solar**	**EndDevice net**	**Site net**
1	Specified storage produce target	50%	-	-20%	50%	50%	100%	80%
2	Specified hold target	0%	-	-20%	0%	50%	50%	30%
3	Specified consume target	-50%	-	-20%	-50%	50%	0%	-20%



Criteria

If during testing the client experiences one of the following events these are considered non-conformances with this requirement:

a) The storage components do not adjust power to the specified target level in OpModStorageTargetW.

b) The active power generation or load is not sustained for the duration of the control.

c) The target setpoint is not maintained within measurement tolerance specified in section 5.

d) For multiple storage asset configurations, the aggregate power response does not meet the specified target value.

Notes: Completion of response to active load control signals can be expected to occur within 15 seconds to align with response times specified in AS4777.2.

7.4 Storage control with export limits – OpModStorageTargetW with OpModExpLimW

Purpose

This test is intended to validate:

- A client's ability to receive a DERControl containing control modes for:
  - OpModStorageTargetW; and
  - OpModExpLimW

  from the server and facilitate the execution of the control in hardware.
- A hardware solution's ability to execute the specified control behaviour in line with the documented requirements.

Note: While this test prescribes specific values for configuration of the system and the duration of scheduled controls, these have not been verified at time of publication. Synergy intends to update these test cases to ensure that the required behaviours are demonstrated, while providing flexibility in the specifics to reduce complexity and duration.

Precondition

A DER incorporating one or more storage assets capable of charging/discharging active power is under the management of the client and idling at ~50% state of charge.

The storage components for the system are configured such that the charge and discharge ratings (rgMaxChargeRateW and rtgMaxDischargeRateW) are equal to the apparent power rating of the inverter that the storage is connected to.

Where testing a configuration that includes PV generation:

- Where DC coupled, a DC supply will be configured controlling to the system which is set at a value of 30% to 60% of the rated capacity of the hybrid inverter.
- Where AC coupled, the inverter being used to manage the PV generation will be the same rating as the inverter for the storage components. The DC supply for this inverter will be set at a value between 30% and 60% of this inverter's rated output.

A load that is not part of the controllable DER system will be electrically connected to form a part of the site configuration. The load shall be set at a value of 20% of the value of the total rated value of the system (rtgMaxW).

- The utility has a default export limit in effect with a specified value of 1.5 kW.
- The utility has no current active controls in operation and will only create the below controls during the test.

Test Procedure

The steps shall be performed as described in the table below and the test results shall be compared against the expected results for both communications clients and the DER.

Step	Manual or utility server step	Expected comms client result	Expected DER result
1	The utility server configures an active DERControl with an *OpModStorageTargetW* DERControlBase at 100% of *rtgMaxDischargeRateW* and a *OpModExpLimW* DERControlBase at 200% of *rtgMaxDischargeRateW,* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with "received" and "started" responses.	Where a PV system is not connected, the storage power output shall change to rtgMaxDischargeRateW. Where a PV system is connected, there shall be no change to the power generation from the PV system. The storage component's generation power is adjusted to: - 100% of *rtgMaxDischargeRateW,* where the PV and storage components are AC coupled; - Given the value of PV production the greatest value possible, where the PV and storage components are DC coupled.
2	The utility server configures an active DERControl with an *OpModStorageTargetW* DERControlBase at 100% of *rtgMaxDischargeRateW* and a *OpModExpLimW* DERControlBase at 50% of *rtgMaxDischargeRateW,* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with "received" and "started" responses.	Where a PV system is not connected, the storage power output shall change to 70% of *rtgMaxW*, taking the site export to 50% of *rtgMaxW.* Where a PV system is connected, there shall be no change to the power generation from the PV system. The storage component's generation power is adjusted to realise a net site export of 50% of *rtgMaxW*.
3	The utility server configures an active DERControl with a negative value for *OpModStorageTargetW* DERControlBase at 100% of *rtgMaxChargeRateW* and a *OpModExpLimW* DERControlBase at 50% of *rtgMaxDischargeRateW,* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with "received" and "started" responses.	Where a PV system is not connected, the storage power output shall change to a negative value equal to 100% of *rtgMaxChargeRateW*. Where a PV system is connected, there shall be no change to the power generation from the PV system. The storage component's generation power is adjusted to: - A negative value equal to 100% of *rtgMaxChargeRateW,*
4	The utility server configures an active DERControl with a negative value for *OpModStorageTargetW* DERControlBase at 0% of *rtgMaxChargeRateW* and a *OpModExpLimW* DERControlBase at 0% of *rtgMaxDischargeRateW,* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with "received" and "started" responses.	The storage power output shall change to 0% of *rtgMaxDischargeChargeRate*. Where a PV system is connected, the PV system shall be curtailed to ensure that site exports are limited to 0.

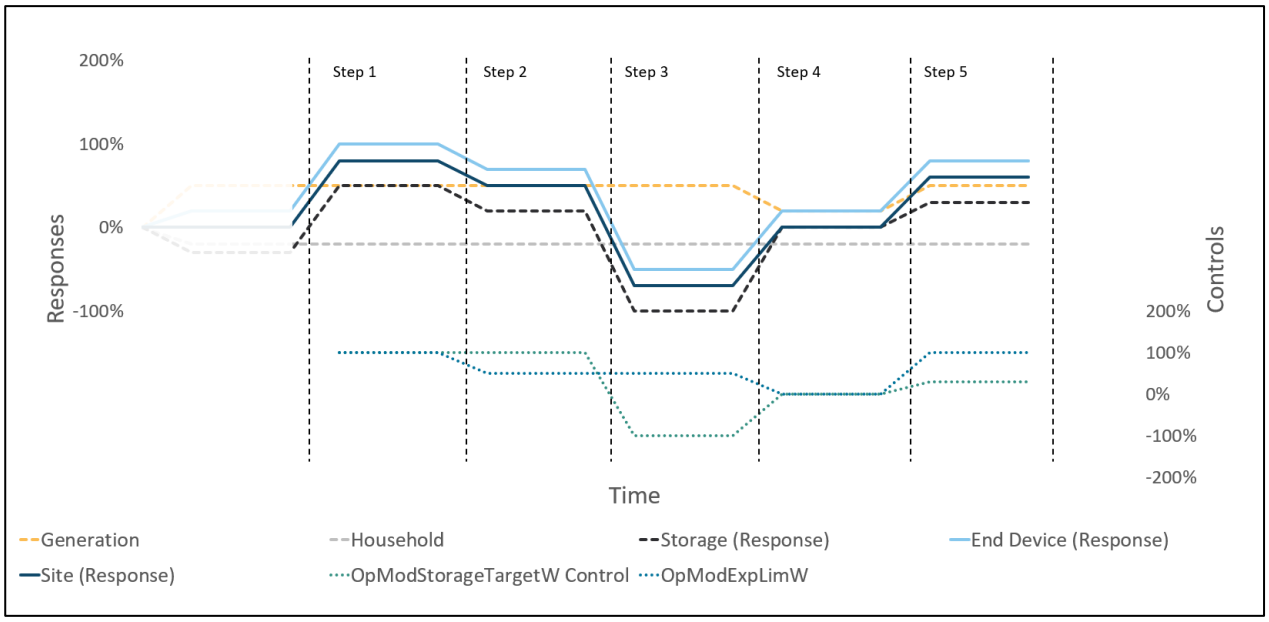
Step	Manual or utility server step	Expected comms client result	Expected DER result
5	The utility server configures an active DERControl with a value for *OpModStorageTargetW* DERControlBase at 30% of *rtgMaxDischargeRateW* and a *OpModExpLimW* DERControlBase at 100% of *rtgMaxDischargeRateW,* that starts 5 minutes in the future with an end time 20 minutes in the future and notifies the client of this control.	The client receives and responds to the active control with "received" and "started" responses.	The storage power output shall change to discharge at 30% of *rtgMaxDischargeChargeRate*. Where a PV system is connected, the PV system shall operate unconstrained.
6	No further action is taken until the completion of the control.	The client receives and responds to the DERControl with event competed.	The EndDevice reverts to previous behaviour.

Behaviour Specification

To improve clarity and consistency in understanding the test steps, a summary table and graphical representation of the test inputs (controls) and outputs (responses) has been developed. All percentage values presented here are percentages of *rtgMaxChargeRateW*/*rtgMaxDischargeRateW.*

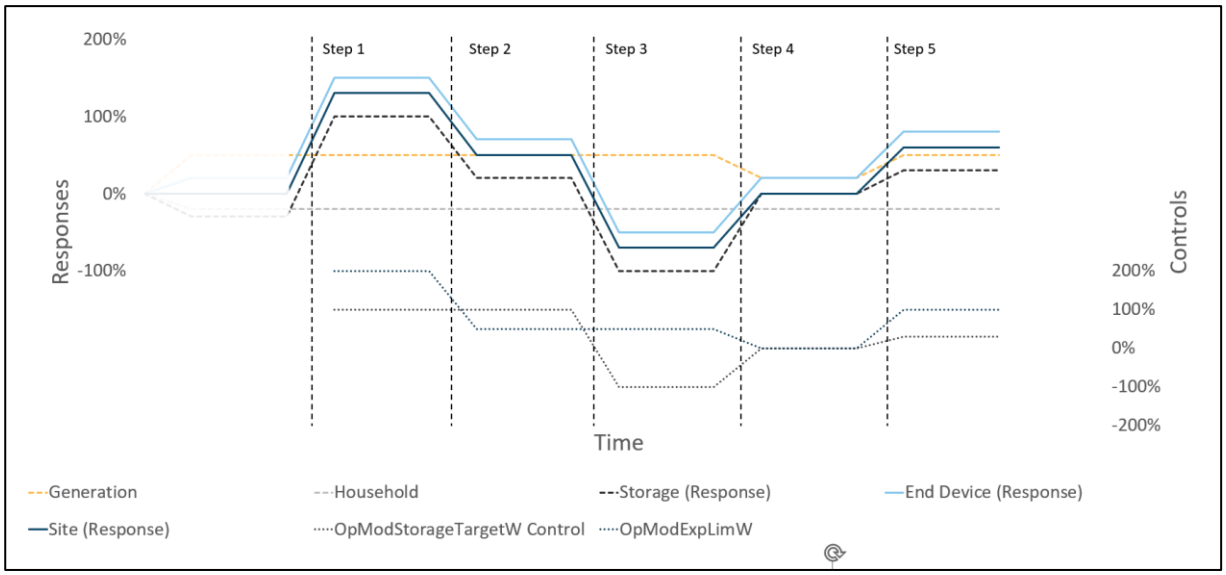
Hybrid systems

Input/Output		Input			Output			
Step	Behaviour description	Storage setpoint	Export limit	House load	Storage	Solar	EndDevice net	Site net
1	Specified storage produce target (under export limit)	100%	200%	-20%	50%	50%	100%	80%
2	Specified storage produce target (over export limit)	100%	50%	-20%	20%	50%	70%	50%
3	Specified storage consume target (under export limit)	-100%	50%	-20%	-100%	50%	-50%	-70%
4	Specified storage hold target (over export limit)	0%	0%	-20%	0%	20%	20%	0%
5	Specified storage produce target (under export limit)	30%	100%	-20%	30%	50%	80%	60%



AC coupled systems

Input/Output		Input			Output			
Step	**Behaviour description**	**Storage setpoint**	**Export limit**	**House load**	**Storage**	**Solar**	**EndDevice net**	**Site net**
1	Specified storage produce target (under export limit)	100%	200%	-20%	100%	50%	150%	130%
2	Specified storage produce target (over export limit)	100%	50%	-20%	20%	50%	70%	50%
3	Specified storage consume target (under export limit)	-100%	50%	-20%	-100%	50%	-50%	-70%
4	Specified storage hold target (over export limit)	0%	0%	-20%	0%	20%	20%	0%
5	Specified storage produce target (under export limit)	30%	100%	-20%	30%	50%	80%	60%



Criteria

If during testing the client experiences one of the following events these are considered non-conformances with this requirement:

a) The storage components do not adjust power to the specified target level in OpModStorageTargetW.

b) The active power generation or load is not sustained for the duration of the control.

c) The target setpoint is not maintained within measurement tolerance specified in section 5.

d) For multiple storage asset configurations, the aggregate power response does not meet the specified target value.

Notes: Completion of response to active load control signals can be expected to occur within 15 seconds to align with response times specified in AS4777.2.

synergy

synergy.net.au