Project EDGE
Data Specification – Part D
Local Service Exchange (LSE)

Version: June 2023

Important notice

PURPOSE & AUDIENCE

This document describes the data requirements to facilitate participation in the EDGE DER Marketplace operation and to deliver Local Service Exchange. The Australian Energy Market Operator (AEMO) provides this information as a service targeting business and IT staff in participant organisations.

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DOCUMENTS MADE OBSOLETE

Publication of this documents makes *Project EDGE – Local Services Exchange Draft Overview* published on 5th Jan 2022 , obsolete.

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Your feedback is important and helps us improve our services and products. To suggest improvements, please contact AEMO's Support Hub. To contact AEMO's Support Hub use Contact Us on AEMO's website or Phone: 1300 AEMO 00 (1300 236 600) and follow the prompts.

Contents

DATA SPECIFICATION VERSION RELEASE HISTORY

Version	Effective Date	Summary of Changes
June 2023	21/06/2023	Final version of the Data specification for Local Service Exchange This release of the Project EDGE Data Specification consists of publication of Data Specification for Local Service Exchange (LSE) titled "Project EDGE – Data Specification Part D – LSE". And to the existing Part A, Part B and Part C data specification corrections and minor non-breaking updates to the data definition and providing more clarity via additional description and commentary

Version	Effective Date	Summary of Changes
		In Part A: • Updated Sec 2: EDGE Data Specification Overview to add detailed description of the 4 data specification documents (Part A, Part B, Part C and Part D) • In Sec 4: removed reference to Availability Forecast as it no longer required • In Sec 4: Updated data requirements to include OE and Flex OE Desktop Analysis data requirements • Update DOE (Dynamic Operating Envelope) to OE (Operating Envelope) throughout the document. • In Sec 6.5: updated the Introduction to Channel and Topic mapping EDGE • Addition of "Rated Electric Power" attribute in Sec 8.5.5 Aggregator Device Data. This is not a new addition, but this attribute was missed in the previous version of data specification. • Updated FAQs • Added AEMO Copyright statement under Important Notice • Removed Information Classification from Data Characteristics as no longer applicable In Part B: • Removed Availability Forecast data definition as no longer required • Update DOE (Dynamic Operating Envelope) to OE (Operating Envelope) throughout the document. • Added AEMO Copyright statement under Important Notice • Removed Information Classification from Data Characteristics as no longer applicable In Part C: • In Sec 3.2 Boffer Data Characteristics updated the data submission methodology to manual data submission • In Sec 4.2 Telemetry Data replaced the nmiOeSubmissionTimestamp with nmiOEReceivedFlag with data type as Boolean • In Sec 5.1 NMI level Unconstrained Load/Generation Forecast dataChange the data type for uncontrolFcst from 'number' to 'array' with numeric value • In Sec 6 Post DI NMI Operating Envelops Update the NMI level OE data attributes to align to NMI OE v2 (CSIP) for data attribute names. • Update DOE (Dynamic Operating Envelope) to OE (Operating Envelope) throughout the document • Removed Information Classification from Data Characteristics as no longer applicable • Added AEMO Copyright statement under Important Notice

Version	Effective Date	Summary of Changes
		Added Sec 7: Real and Reactive Power Measurement at NMI. This section includes the data definition for the Real (P) & Reactive (Q) Power measurements at NMI level as provided by the DNSP. Part D: Publication of Project EDGE – Data Specification Part D – Local Service Exchange Part D contains the data specification for the Local Support Services as designed and developed for Local Service Exchange (LSE) for trialling viability of DER to deliver local services

1. Glossary

1.1 Abbreviations

Term	**Explanation**
Active Customer	A customer is active when participating in markets through an Aggregator (for example, Mondo).
Active DER	DER that is under active and explicit control of the Aggregator (for example, battery, controllable loads or demand response enabled devices).
Active DER Forecast	Aggregator forecast of consumer DER that they manage for a given time period (Bi-directional offers are a type of active DER forecast).
Actual Performance Data	Aggregated data set at the DUID level of actual performance data.
Aggregator	Role played by Aggregator in EDGE. Manages consumer DER for local DER trade and wholesale energy market participation.
ARENA	The Australian Renewable Energy Agency.
API	Application Programming Interface
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time. Also known as Market Time or NEM time.
Bid	Submitted by controllable load for load increase or decrease.
Bid Type	Category of service for which Bi-directional Offer is submitted (Energy, Ancillary Services, Local DER Service, Network Support Service).
Bi-directional Offer ('Boffer')	An Offer that includes both generation and load. May be referred to as "Boffer".
Bi-directional Unit	An asset or a generating plant that has the capability to both: (a) consume electricity to convert into stored energy; and (b) convert stored energy to produce electricity.
Conformance Monitoring	Monitoring where dispatch targets are not met.
Constrained Bi-directional Offer	DER wholesale market offer that is self-constrained by an Aggregator using limits/constraints communicated by the DNSP through operating envelopes.

Term	**Explanation**
Composite Bi-directional Offer	Aggregation of the multiple Bi-directional Offer(s) from various Aggregator per TNI. Only applies for the Static Nodal Limit target operating model. This is part of the Security Constrained Economic Dispatch function i.e. two step solve.
DMO	Distributed Market Operator. Role played by AEMO in EDGE
DSO	Distribution System Operator. Role played by DNSP which is AusNet Services in EDGE
DOE	Dynamic Operating Envelope
DER	Distributed Energy Resources
DNPS	Distribution Network Service Provider. Owns, maintains and manages the electricity distribution network.
DUID	Dispatchable Unit Identifier, represents wholesale generation or load unit.
Data Exchange Capability	Set of capabilities and functions developed on the Platform to facilitate streamline data exchange between AEMO, DNSP and Aggregator.
DER Compliance	Assessing whether Aggregators are dispatching according to operating envelope limits and / or nodal capacity allocation.
DER Raw Capability	Capabilities that must be tested and verified before DER can be used by an Aggregator to enter a contract for DER Service delivery.
Disaggregated Dispatch	Part of the Nodal constraints operating model. The process by which a Composite dispatch target from the wholesale market is disaggregated and then sent to individual Aggregators.
DER Marketplace	Market frameworks and systems that facilitate the efficient trade of distributed energy services at both the wholesale and local level for the long-term interests of consumers.
Device Standing Data	Device data that changes infrequently, maintained and accessed within internal AEMO systems.
Dispatch Interval	Interval frequency at which service dispatch instructions are sent and the minimum service duration (5 minutes).
Dispatch Target	Issued as part of a dispatch instruction, tells an Aggregator what energy export / import target they much reach by the end of the dispatch interval.
Distributed Energy Services	Energy and non-energy services (such as voltage control) that are delivered by aggregated DER at both the

Term	**Explanation**
	wholesale and local level (within the distribution network).
Distribution Network Limit	Physical limits (for example, voltage, thermal) that apply within the distribution network. The limits can be applied either at NMI or distribution node level. These are applied in the dispatch process to limit the capability of a load or a generating unit such that it is unacceptable to either consume or generate the level of electrical power that would otherwise occur.
Distribution Network Node	A logical grouping of NMIs defined below the TNI within a distribution network hierarchy.
EDGE	Energy Demand and Generation Exchange
EW-DSB	Energy Web – Distributed Service Bus
Firm Bi-Directional Offer	DER wholesale market offer submitted after a nominated cut-off time – the price per band cannot be changed and quantity can change.
Generation Capacity	Capacity (kW) available for power generation/export from DER through the Grid interactive port (that is, terminal of the Inverter) into the distribution network. This refers to the controllable Device capability and not the site capability.
Load Capacity	Capacity (kW) available for power load / import to DER through the Grid interactive port (that is, terminal of the Inverter) into the distribution network. This refers to the controllable Device capability and not the site capability.
Local DER Services	Defined by the DNSP and Aggregators, not traded on wholesale markets.
Local Service Exchange	A component of the Platform for facilitating the posting, procurement and trade of real and reactive power as Local DER Services between DNSP, TNSP and Aggregators, to manage network congestion and increase network limits.
Logical Network Model	Shows the logical distribution network hierarchy down to the NMI.
MC	Market Customer (also referred as Retailer), who purchases electricity from the spot market.
MASP	Market Ancillary Service Provider, is a market participant which provide Frequency Control Ancillary Services (FCAS)
NEM	National Electricity Market, also referred as Market in this document
NER	National Electricity Rules

Term	**Explanation**
NMI	National Meter Identifier, National Metering Identifier, the customer DER connection point to the grid.
NEM Time	Also referred as Market Time. This is the AEST time.
NMI Operating Envelope	Operating Envelope applied to an individual NMI.
NMI Standing Data	Site data that changes infrequently, maintained and accessed within internal AEMO systems.
Nodal Capacity Limits	Nodal capacity limits are thermal limits associated with distribution network nodes (low voltage (LV) circuit up to bulk substation). In Project EDGE, nodal capacity limits may be used to constrain wholesale bi-directional offers as part of the security constrained economic dispatch (SCED) function within the Static Nodal Constraints model.
Offer	Submitted by generators to provide power/energy (power generation).
Operating Envelope	Power export (to grid) & import (from grid) limits provided by DNSP to Aggregators and AEMO.
Operational Forecast	Aggregated data set at the DUID level of anticipated active power flows.
Optimised Operating Envelope	Import/export limit updated with Bi-directional offer and network configuration information at a greater frequency than static Operating Envelopes.
Participant ID	Unique identifier for a Participant.
Passive DER	DER that is not controllable (that is, Rooftop PV).
Peak Demand	Periods where wholesale demand has reached a peak and local load may need to be curtailed.
Peak Generation	Periods where wholesale generation has reached a peak and local load may need to be increased.
Platform	An off-market, proof-of-concept, technology platform for facilitating trade of DER energy and ancillary services between buyers and sellers at wholesale and local levels. The Platform is common to Project EDGE and Project Symphony.
Reactive Power (Q)	The consumption and export (supply) of Var (for example, over a distribution network for voltage management).
Real Power (P)	The actual amount of power being used, or dissipated, in a circuit (the generation or consumption of Watts).
Scheduled Resource	Assets that, as either net generators or net consumers (load) of electricity, participate in the central dispatch and pricing processes operated by AEMO.

Term	**Explanation**
Security Constrained Economic Dispatch (SCED)	Two-step solve process that is part of the Static Nodal Constraints wholesale target operating model (TOM).
Settlement Simulation	Off-market settlement activity intended to show customer value gain for a given trading period.
Static Network Location Limit	Provided by DNSP with operating envelope for use with static nodal model.
Static Operating Envelope	Import/export limit set through combination of customer connection agreement with DNSP and forecasts.
Technology Type	This refers to the control system and the response available from the Aggregator portfolio. The two types of controllers are as: Variable or Proportional Controller Switch Controller
TNI	Transmission Node Identifier. Bulk substations at the interface between the transmission and distribution networks, used as the connection point for the wholesale spot market.
Trading Interval	This refers to the half hour interval, used in Settlement processes. Note within this interval there will likely need to be 5 min energy dispatch intervals in this demonstration.
TSO	Transmission System Operator; AEMO's function outside of these demonstration projects.
VPP	Virtual Power Plant
Value Stacking	Value stacking means having the capability to perform and capture the commercial value of multiple energy services at the same time.
Wholesale Integration	Set of capabilities and functions developed on the Platform to facilitate Aggregator and DNSP participation in wholesale services/Local DER Services.
Wholesale Clearing Price Comparison	Comparison of DER Bi-directional Offers and Composite offers to the wholesale spot clearing price to prepare a merit order and determine which offers are cleared for dispatch.
WTD	Willingness to Deliver
WTP	Willingness to Pay

1.2 Key Concepts

Term	Explanation
DHF (Demand High Firmness)	Demand High Firmness – A long term, CapEx deferral mechanism providing firm capability for resolving network issues
DLF (Demand Low Firmness)	Demand Low Firmness – A short term, OpEx mechanism providing fast assistance for network issues at short notice
VHF (Voltage High Firmness)	Voltage High Firmness – A mechanism where Volt-VAR curves are applied to DER assets to help manage voltage issues

2. EDGE Data Specification Overview

EDGE Data Specification is published to provide Aggregators and interested parties with detailed overview of the integration to EDGE Marketplace, data obligations for participating in Project EDGE.

Its contents are for the purpose of facilitating the research activities of Project EDGE and **are not intended to set a precedent to be adopted within current or future market arrangements**. The project intends to gather evidence to inform future market arrangements that would occur through appropriate consultation processes.

For ease of consumption the EDGE Data Specification is presented in a four-part document as described below:

2.1 Part A: Introduction to Data Exchange, Data Obligations and Participant Enrolment

Part A covers the introduction to Project EDGE and data exchange, followed by overview of the data obligations for participation into trial and enrolments and on-boarding specific data requirements for Aggregator and DNSP.

Part A contains following sections:

- Glossary of terms and key concepts
- Introduction
- Project EDGE data requirements
- Data Exchange Overview
- Message Acknowledgement
- Participant On-boarding and Enrolment Data requirements
- Appendix

2.2 Part B: Market Participation & Operational Visibility Data Requirements

Part B covers the Project EDGE data requirements for market participation; provision of Dynamic Operating Envelopes (DOE) for enforcing distribution level constraints, provision of Bi-directional Offers for Energy (Boffer) – providing Aggregator intent, pre-dispatch price forecast as a input to Boffers and AEMO dispatch instructions.

Part B also covers data requirements for Operational Visibility of the Aggregators portfolio to AEMO. This includes DUID Telemetry data, Operational forecasts (provided via Boffer).

Please note: for the purpose of the Project EDGE, AEMO will treat the Boffer submitted by Aggregator every 5 mins covering 48 hrs as the Aggregators operational forecasts. No separate Operational Forecast data feed is required.

- Market Data requirements in
  - Bi-directional Offer (Boffer) [also used as Operational Forecast]
  - NMI Operating Envelopes (OE) v1
  - NMI Operating Envelopes (OE) v2 aligned to the CSIP AUS
  - Dispatch Instructions
- Operational Visibility data requirements in
  - DUID Telemetry Data
- Pre-Dispatch Price Forecast (5 min & 30 min)

Please refer to the Project EDGE Data Specification Part B: Market Participation & Operational Visibility Data Requirements document.

2.3 Part C: OE Economic Optimisation and Flex OE Desktop Analysis Data Requirement

Part C covers the Project EDGE data requirements for OE/Flex OE desktop analysis.

a. By OE Economic Optimisation we mean the Operating Envelopes that considers the Aggregator's NMI level Boffer as an input into the OE calculation
b. By Flex OE we mean the operating envelopes which are applicable to only the aggregation of flexible assets at a site and not at the whole site (excludes customers' uncontrollable/native load).

All data required for the desktop assessment must be provided at NMI level. Aggregators would need to provide NMI level Boffers, Telemetry and Forecasts and DNSPs would provide post-dispatch interval operating envelopes (OE). Data sets for desktop analysis is expected to be provided or shared periodically in batches via a large file transfer capability within the EDGE DER Marketplace platform.

Required Datasets: The datasets to be exchanged are listed below:

From Aggregator

- Unconstrained Boffers
  - Pre-dispatch NMI level Boffer for 'Flex' (i.e. aggregation of all flexible assets at the site)
  - Post-dispatch NMI level Boffer at 'NMI' (i.e. measure at the NMI - net of site)
- NMI Telemetry Data
  - NMI level Telemetry data including reference to DOE applied during that interval
- Forecast Data

- Pre-dispatch Uncontrolled Load or Generation forecast at NMI level

From DNSP

- Operating Envelope:
  - Post-Dispatch DOE containing with reference to objective function
- Real & Reactive Power Data
  - Instantaneous measurements of real and reactive power at NMI level for NMIs in DNSP portfolio

What is meant by Pre-dispatch/Post-dispatch?

- Pre-dispatch: for the dispatch interval prior to the start of the subject dispatch interval.
- Post-dispatch: for the dispatch interval immediately after the completion of the subject dispatch interval.

For example:

For DI 10:00 AM – DI start time is 09:55 and DI end time is 10:00

Pre-dispatch will be calculated before 09:55 and post-dispatch will be calculated after 10:00

2.4 Part D: Local Service Exchange and Local Services Data Requirement

This document forms the Part D: Local Service Exchange and Local Services Data requirement. This document covers the data requirements for local service exchange and local services. This document must be read in conjunction with the Project EDGE – Local Service Exchange High Level design document available on Project EDGE Technical Specification webpage.

Part D provides the data definition including sample JSON structures for all message or transaction types for the demand and voltage services tested with the DNSP and Aggregator. For the services this document provides:

a. Demand Low Firmness (DLF) covers the messages exchanged for this service, including:
   - Offer
   - Service Need
   - Service Agreement
   - Arming / Disarming Signal
   - Notice Signal
   - Signal Acknowledgements

- Unavailability Signal

b. Demand Low Firmness (DLF) covers the messages exchanged for this service, including:
    - Service Need
    - Offer
    - Service Agreement
    - Notice Signal
    - Signal Acknowledgements

Please note in EDGE Voltage High Firmness (VHF) service and all interactions were tested manually off-platform, therefore there is no data specifications for this service.

3. Demand High Firmness

For details and explanation on the Demand High Firmness please refer to the Project EDGE - Local Service Exchange High Level Design document.

3.1 Service Need Data Definition

ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
SN_1	submission_time	string	date-time		Creation datetime of the message, rendered as UTC+10	Y	N
SN_2	service_need_id	string	uuid		UUID for traceability purposes	Y	N
SN_3	service_need_name	string			Name of the service need	Y	N
SN_4	service_classification	string		DEMAND VOLTAGE	Classification of the service as either demand or voltage	Y	N
SN_5	service_type	string		INCREASE, DECREASE	Identification of the service type as either increase or decrease	Y	N
SN_6	Firmness	string		HIGH MEDIUM LOW	Identification of the firmness (delivery certainty) level as high, med or low	Y	N
SN_7	Aggregator	string			Name of Aggregator sending the message	Y	N
SN_8	location_id	string			Location where the network constraint needs to be alleviated	Y	N
SN_9	bidding_open	string	date-time		"Outlines the start time for bidding window, rendered as UTC+10"	N	Y

ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
SN_10	bidding_close	string	date-time		"Outlines the end time for bidding window, rendered as UTC+10"	N	Y
SN_11	contract_quantity_cap	number			Annual Network Support Allowance (in MWh)	N	N
SN_12	contract_payment	number			Annual network support payment	N	N
SN_13	availability_price	number			Availability Ceiling Price per kW/h	N	N
SN_14	activation_price	number			Utilization Ceiling Price per kWh	N	N
SN_15	contract_period	array-object				Y	N
SN_16	contract_period.contract_startdate	string	date		Start date of the Contract Period	Y	N
SN_17	contract_period.contract_enddate	string	date		End date of the Contract Period	Y	N
SN_18	contract_period.availability	array-object				Y	N
SN_19	contract_period.availability.availability_start	string	time		Start time of the Availability Period	N	N
SN_20	contract_period.availability.availability_end	string	time		End time of the Availability Period	N	N
SN_21	contract_period.availability.day_type	string		WEEKDAY, WEEKEND_PUBLIC_HOLIDAY, ALL		Y	N
SN_24	contract_period.availability.baseline	number			Baseline quantity in KW	Y	N
SN_25	contract_period.availability.quantity	number			Dispatch Quantity Cap in KW	Y	N
SN_26	contract_period.availability.mode			MAX_DEMAND_INCREASE, MAX_DEMAND_DECREASE		N	N

3.2 Service Need JSON

- A Service Need is produced by the DSO and sent to an Aggregator


```
{
  "submission_time": "2021-08-25T23:00:00.000+10:00",
  "service_need_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
  "service_need_name": "",
  "service_classification": "DEMAND",
  "service_type": "INCREASE",
  "firmness": "LOW",
  "aggregator": "aggIdentifier",
  "location_id": "WOTS_1",
  "bidding_open": "2021-08-25T23:00:00.000+10:00",
  "bidding_close": "2021-08-25T23:00:00.000+10:00",
  "contract_quantity_cap": 456.10,
  "contract_payment" : 100,
  "availability_price": 25.75,
  "activation_price": 123.99,
  "contract_period": [
    {
      "contract_startdate": "2021-08-25",
      "contract_enddate": "2021-08-25",
      "availability": [
      {
          "availability_start": "16:00:00",
          "availability_end": "18:00:00",
          "day_type": "WEEKDAY",
          "baseline" : 1.0,
          "quantity": 15.5,
          "mode" : "MAX_DEMAND_INCREASE"
        }
      ]
    }
  ]
}
```

3.3 Offer Data Definition

Offer							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
O_1	submission_time	string	date-time		Creation datetime of the message, rendered as UTC+10	Y	N
O_2	service_need_id	string	uuid		UUID for traceability purposes	Y	N
O_3	service_need_name	string			Name of the service need that the Aggregator is responding to	Y	N
O_4	offer_id	string	uuid		UUID for traceability purposes	Y	N
O_5	aggregator	string			Name of Aggregator sending the message	Y	N
O_6	location_id	string			"Location where the network constraint needs to be alleviated"	Y	N
O_7	Baseline	number			Baseline quantity in KW"	N	N
O_8	Quantity	number			Dispatch quantity cap in kW, noting that the formula for dispatch verification will be baseline +/- quantity	N	N
O_9	Mode	string		MAX_DEMAND_INCREASE, MAX_DEMAND_DECREASE		N	N
O_10	availability_price	number			Availability Ceiling Price per kWh	N	N
O_11	activation_price	number			Utilization Ceiling Price per kWh	N	N

3.4 Offer JSON

- An Offer is produced by the Aggregator and sent to the DSO

```
{
    "submission_time": "2022-03-22T23:59:59.000+10:00",
    "service_need_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
    "service_need_name": "DHF Site A",
    "offer_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
    "aggregator": "aggIdentifier",
    "location_id": "Site A",
    "baseline": 15.5,
    "quantity": 0.00,
    "mode" : "MAX_DEMAND_INCREASE"
    "availability_price": 0.00,
    "activation_price": 0.00,
}

```

3.5 Service Agreement Data Definition

Service Agreement							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
SA_1	submission_time	string	date-time			Y	N
SA_2	aggregator	string			Name of Aggregator sending the message	Y	N
SA_3	service_need_id	string	uuid		Y	N	
SA_4	service_agreement_id	string	uuid			Y	N
SA_5	offer_id	string	uuid			Y	N
SA_6	status	boolean				Y	N
SA_7	rejection_reason	string				N	N

3.6 Service Agreement JSON

- A Service Agreement is produced by the DSO and sent to an Aggregator

```
{
  "submission_time": "2021-08-25T23:00:00.000+10:00",
  "aggregator": "aggIdentifier",
  "service_need_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
  "service_agreement_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
  "offer_id" : "91b7d6ab-5595-4abc-addf-efe5d903dd88",
  "status": true,
  "rejection_reason": "something went wrong"
}

```

3.7 Arming / Disarming Signal Data Definition

Arming / Disarming Signal							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
A_1	submission_time	string	date-time			Y	N
A_2	event_id	string	uuid		UUID for traceability purposes	Y	N
A_3	signal_type	string	enum	ARM, DISARM		Y	N
A_4	signal_id	string	uuid		UUID for traceability purposes	Y	N
A_5	service_need_id	string	uuid		UUID of the Service Request for traceability purposes	Y	N
A_6	service_need_name	string			Name of the service need	Y	N
A_7	aggregator	string			Name of Aggregator sending the message	Y	N
A_8	location_id	string			Location where the network constraint needs to be alleviated"	Y	N
A_9	availability_start	string	date-time		Contractually fixed availability but added as FYI for Aggregator, rendered as UTC+10"	Y	Y
A_10	availability_end	string	date-time		Contractually fixed availability but added as FYI for Aggregator, rendered as UTC+10"	Y	Y
A_11	activation_start	string	date-time		Network event start datetime, rendered as UTC+10	Y	N
A_12	activation_end	string	date-time		Network event end datetime, rendered as UTC+10	Y	N
A_13	service_classification	string		DEMAND, VOLTAGE	Classification of the service as either demand or voltage	Y	N
A_14	service_type	string		INCREASE, DECREASE	Identification of the service type as either increase or decrease	Y	N

Arming / Disarming Signal							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
A_15	firmness	string		HIGH, MEDIUM, LOW	Identification of the firmness (delivery certainty) level as high, med or low	Y	N
A_16	baseline	array				Y	N
A_17	baseline.start	string	date-time		Baseline start time/s for the event (used to populate event signals - can be single or profile)	Y	N
A_18	baseline.value_kW	number			Baseline value/s for the event in KW (used to populate event signals - can be single or profile)	Y	N
A_19	quantity_kW	number			Quantity in KW	Y	N
A_20	availability_price	number			Availability Ceiling Price per kW/h	N	N
A_21	activation_price	number			Utilization Ceiling Price per kWh	N	N
A_22	required_response_datetime	string	date-time		Datetime by which Aggregator needs to confirm availability, rendered as UTC+10	N	Y

3.8 Arming / Disarming Signal JSON

- An Arming & Disarming Signal is produced by the DSO and sent to an Aggregator


```
{
    "submission_time": "2021-08-25T23:00:00.000+10:00",
    "event_id": "91b7d6ab-5595-4abc-addf-efe5d903dd90",
    "signal_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
    "signal_type": "ARM",
    "service_need_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
    "service_need_name": "DHF Site A",
    "aggregator": "aggIdentifier",
    "location_id": "WOTS_1",
    "availability_start": "2021-08-27T05:00:00.000+10:00",
    "availability_end": "2021-08-27T08:00:00.000+10:00",
    "activation_start": "2021-08-27T05:00:00.000+10:00",
    "activation_end": "2021-08-27T08:00:00.000+10:00",
    "service_classification": "DEMAND",
    "service_type": "DECREASE",
    "firmness": "HIGH",
    "baseline": [
        {
            "start": "2022-08-04T18:00:00+10:00",
            "value_kW": 60
        }
    ],
    "quantity_kW": 15.5,
    "availability_price": 25.75,
    "activation_price": 20.25,
    "required_response_datetime": "2021-08-26T01:00:00.000+10:00"
}
```

3.9 Notice Signal Data Definition

Notice Signal							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
N_1	submission_time	string	date-time		Creation datetime of the message, rendered as UTC+10	Y	N
N_2	event_id	string	uuid		UUID for traceability purposes	Y	N
N_3	signal_type	string		NOTICE		Y	N
N_4	signal_id	string	uuid		UUID for traceability purposes	Y	N
N_5	service_need_id	string	uuid		UUID of the Service Request for traceability purposes	Y	N
N_6	service_need_name	string			Name of the service need that the notice signal is being sent for	Y	N
N_7	aggregator	string			Name of Aggregator sending the message	Y	N
N_8	location_id	string			Location where the network constraint needs to be alleviated	Y	N
N_9	activation_start	string	date-time		Network event start datetime, rendered as UTC+10	Y	N
N_10	activation_end	string	date-time		Network event end datetime, rendered as UTC+10	Y	N
N_11	service_classification	string		DEMAND, VOLTAGE		Y	N
N_12	service_type	string		INCREASE, DECREASE		Y	N
N_13	firmness	string		HIGH, MEDIUM, LOW		Y	N
N_14	baseline	array				Y (If firmness = HIGH)	N
N_15	baseline.start	string	date-time		Baseline start time/s for the event (used to populate event signals - can be single or profile)	Y	N

Notice Signal							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
N_16	baseline.value_kW	number				Y	N
N_17	quantity_kW	number			Quantity in KW	Y (If firmness = HIGH)	N
N_18	mode	string		MAX_DEMAND_INCREASE, MAX_DEMAND_DECREASE		N	N
N_19	availability_price	number			Availability Ceiling Price per kW/h	N	Y
N_20	activation_price	number			Utilization Ceiling Price per kWh	N	Y

3.10 Notice Signal JSON

- A Notice Signal is produced by the DSO and sent to an Aggregator

```
{
  "submission_time": "2021-08-25T23:13:15.819+10:00",
  "event_id" : "91b7d6ab-5595-4abc-addf-efe5d903dd98",
  "signal_type" : "NOTICE",
  "signal_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
  "service_need_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
  "service_need_name":"DHF Site A, C,D",
  "aggregator": "aggIdentifier",
  "location_id": "WOTS_1",
  "activation_start": "2021-08-25T23:13:15.819+10:00",
  "activation_end": "2021-08-25T23:13:15.819+10:00",
  "service_classification": "DEMAND",
  "service_type" : "INCREASE",
  "firmness": "HIGH",
  "baseline": [
        {
            "start": "2022-08-04T18:00:00+10:00",
            "value_kW": 60
        }
    ],
  "quantity_kW": 15.5,
  "mode" : "MAX_DEMAND_INCREASE",
  "availability_price": 25.75,
  "activation_price": 20.25
}

```

3.11 Unavailability Signal Data Definition

Unavailability Signal							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
U_1	submission_time	string	date-time		Creation datetime of the message, rendered as UTC+10	Y	N
U_2	Aggregator	string			Name of Aggregator sending the message	Y	N
U_3	event_id	string	uuid		UUID for traceability purposes	Y	N
U_4	signal_type	string		UNAVAILABLE		Y	N
U_5	signal_id	string	uuid		UUID for traceability purposes	Y	N
U_6	Reason	string			Aggregator providing information to DSO regarding their unavailability	Y	N

3.12 Unavailability Signal JSON

- An Unavailability Signal is produced by the Aggregator and sent to the DSO

```
{
    "submission_time": "2021-08-25T23:13:15.819+10:00",
    "aggregator": "aggIdentifier",
    "event_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
    "signal_type": "UNAVAILABLE",
    "signal_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
    "reason" : "free text"
}

```

3.13 Signal Acknowledgements Data Definition

Acknowledgement							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
ACK_1	Data	array-object				Y	N
ACK_2	data.submission_time	string	date-time			Y	N
ACK_3	data.signal_type	string		ARM, DISARM , NOTICE, UNAVAILABLE		Y	N
ACK_4	data.signal_id	string	guid			Y	N
ACK_5	data.service_need_id	string	guid			Y	N
ACK_6	data.service_need_name	string				Y	N
ACK_7	Acknowledgements	array-object				Y	N
ACK_8	acknowledgements.code	string		ACCEPT, REJECT, INVALID		Y	N
ACK_9	acknowledgements.title	string				Y	N
ACK_10	acknowledgements.detail	string				Y	N
ACK_11	acknowledgements.source	string				Y	N
ACK_12	Warnings	array-object				N	N
ACK_13	warnings.code	string				Y	N
ACK_14	warnings.title	string				Y	N
ACK_15	warnings.detail	string				Y	N
ACK_16	warnings.source	string				Y	N
ACK_17	Errors	array - object				N	N
ACK_18	Errors.code	String		INVALID_SIGNAL, INVALID_SUBMISSION_TIME, INVALID_LOCATION, INVALID_AVAILABILITY_START, INVALID_AVAILABILITY_END,		Y	Y

Acknowledgement							
ID	Attribute Name	Data Type	Format	Enum	Description	Is Mandatory	Is Nullable
				INVALID_ACTIVATION_START, INVALID_ACTIVATION_END, INVALID_QUANTITY, INVALID_REQUIRED_RESPONSE_DATETIME			
ACK_19	errors.title	string				Y	N
ACK_20	errors.detail	string				Y	N
ACK_21	errors.source	string				Y	N

3.14 Signal Acknowledgements JSON

- The Acknowledgement schema is used to communicate business validations by both the DSO and Aggregator


```
{
    "data": {
        "submission_time": "2021-08-25T23:13:15.819+10:00",
        "signal_type" : "ARM",
        "signal_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
        "service_need_id": "91b7d6ab-5595-4abc-addf-efe5d903dd88",
        "service_need_name":"DHF Site A,C,D"
    },
    "acknowledgements": [
        {
            "code": "REJECT",
            "title": "",
            "detail": "string",
            "source": "string"
        }
    ] ,
    "errors": [
        {
            "code": "INVALID_SIGNAL",
            "title": "",
            "detail": "string",
            "source": "string"
        }
    ],
    "warnings": [
        {
            "code": "",
            "title": "",
            "detail": "string",
            "source": "string"
        }
    ]
}

```

3.15 Business Validations for Demand High Firmness

- The following business validations are applied by the Aggregator or DSO when receiving a signal for LSE DHF
  - Aggregators validates the Arming/Disarming & Notice Signal
  - DSO validates the Unavailability Signal

Business validations – DHF						
No.	Error code	Reason	ARM	DISARM	NOTICE	UNAVAILABLE
1	INVALID_SUBMISSION_TIME	Submission time cannot be past date	Y	Y	Y	Y
2	INVALID_SUBMISSION_TIME	Submission time must be in NEM time	Y	Y	Y	Y
3	INVALID_SUBMISSION_TIME	Submission time is < arming signal		Y	Y	
4	INVALID_EVENT_ID	Event id not associated with an active arming signal		Y	Y	Y
5	INVALID_LOCATION	Location does not exist in LSE	Y	Y	Y	
6	INVALID_AVAILABILITY_START	Availability start <> contracted availability start	Y			
7	INVALID_AVAILABILITY_END	Availability end <> contracted availability end	Y			
8	INVALID_AVAILABILITY_END	Availability end must be in NEM time	Y			
9	INVALID_ACTIVATION_START	Activation start < Service need availability start time	Y		Y	
10	INVALID_ACTIVATION_END	Activation end > Service need availability end time	Y		Y	
11	INVALID_ACTIVATION_END	Activation end must be in NEM time	Y			
12	INVALID_BASELINE_START	The first baseline.start list item <> activation.start	Y		Y	
13	INVALID_BASELINE_START	baseline.start >= activation.end	Y		Y	
14	INVALID_REQUIRED_RESPONSE_DATETIME	Required response datetime cannot be <= submission time	Y		Y	
15	INVALID_REQUIRED_RESPONSE_DATETIME	Required response datetime must be in NEM time	Y		Y	
16	INVALID_QUANTITY	Quantity is greater than the dispatch quantity cap	Y			

4. Demand Low Firmness

4.1 Signals

Signals used for Demand Low Firmness (DLF) are a subset of Demand High Firmness (DHF) signals, the schema remains the same. However, business validations for DLF are different.

Signals used for DLF are:

c. Service Need – see 3.1 Service Need
d. Offer - see 3.2 Offer
e. Service Agreement – see 3.3 Service Agreement
f. Notice Signal - see 3.5 Notice Signal
g. Signal Acknowledgements - see 3.7 Signal Acknowledgements

4.2 Business Validations for Demand Low Firmness

- The following business validations are applied by the Aggregator when receiving a Notice Signal for LSE DLF

Business validations – DLF			
No.	Error code	Reason	NOTICE
1	INVALID_SUBMISSION_TIME	Submission time cannot be past date	Y
2	INVALID_SUBMISSION_TIME	Submission time must be in NEM time	Y
3	INVALID_LOCATION	Location does not exist in LSE	Y
4	INVALID_ACTIVATION_START	Activation start < Service need availability start time	Y
5	INVALID_ACTIVATION_END	Activation end > Service need availability end time	Y
6	INVALID_BASELINE_START	The first baseline.start list item <> activation.start	Y
7	INVALID_BASELINE_START	baseline.start >= activation.end	Y
8	INVALID_REQUIRED_RESPONSE_DATETIME	Required response datetime cannot be <= submission time	Y
9	INVALID_REQUIRED_RESPONSE_DATETIME	Required response datetime must be in NEM time	Y
10	TBC	Baseline & quantity = blank & mode = blank	Y

5. Voltage High Firmness

The EDGE project is testing Voltage High Firmness (VHF) off platform manually, therefore there is no data specifications for this service.