UK Power Networks Dispatch API Specification

V1.0

REVISION RECORD

Version	Date	Description
V 1.0	02/02/2023	A guidance document created for the Flexibility Service Providers and all other relevant parties to integrate with UK Power Networks' Dispatch Platform through an Application Programming Interface (API).

CONTENTS

TERMINOLOGY

This section describes the terminology used within this document.

Term	Definition
Absolute	Absolute or Absolute Setpoint is a dispatch instruction type that defines the absolute power value to be imported or exported by the relevant Flexible Unit
API	Application Programming Interface
Cease	End of any service request in the context of MW Dispatch where a setpoint with power value matching the contractual capacity of a DER is issued.
CIM	Common Information Model
DCE	Distributed Computing Environment
Delta	Delta or Delta Setpoint is a dispatch instruction type that defines the change in power value to be imported or exported by the relevant Flexible Unit.
DER	Distributed Energy Resource
DUI	Dispatch Unique Identifier
ESO	Electricity System Operator
HTTP/S	Hyper Text Transfer Protocol / Secure
FSP	Flexibility Service Provider – The responsible party for the Flexible Units that has contracted with UK Power Networks to provide Flexibility Services.
FU	Flexible Unit or Flex Unit – An aggregation of physical assets on the electricity network that the FSP controls to deliver the contracted Flexibility Services.
NCS	Network Computing System
OSF	Open Software Foundation
RDP	Regional Development Programme
REST	Representational State Transfer
Schedule	A time series of Power Setpoints for a Flexible Unit to adhere to.
Setpoint	Instruction defining the power value at which a Flexible Unit should adhere.
UKPN	UK Power Networks
UTC	Coordinated Universal Time
UUID	Universally Unique Identifier – referred to as “MRID” in some requests.

1 INTRODUCTION

This document provides guidance to the Flexibility Service Providers (FSP) and all other relevant parties to carry out the design of their systems to integrate with UK Power Networks' cloud-based Dispatch Platform through an Application Programming Interface (API).

This document covers the requirements associated with operational exchanges through the Dispatch Platform for the below services. It clarifies responsibilities and demarcations, and where relevant refers to industry standards or good practices. For more details on the services please refer to service specific guidance.

- Flexibility Services
- Megawatt (MW) Dispatch Service to the Electricity System Operator (ESO)

Where the Distributed Energy Resource (DER) is providing the above services whilst subject to other schemes not contained in this document, such as Flexible Connection schemes, UK Power Networks will advise of the relevant operational procedures.

The term Flexible Unit (FU) as used for Flexibility Services refers to a single dispatchable unit made up of one or more DER. For the purpose of this document, Flexible Unit is also used to refer to the same under MW Dispatch, albeit under MW Dispatch the Flexible Unit can only consist of one DER.

2 INTEGRATION PROCESS

The integration process connects an FSP to the Dispatch Platform. It broadly consists of the below sequential steps. Commercial onboarding is beyond the scope of this documentation, please seek further guidance from the service specific documentation.

- **Configuration and Development:** Processes to configure, implement, and complete internal testing of FSP and UK Power Network' systems.

- **Integration testing:** This includes the execution and completion of the following testing in the pre-production environment:

    - Connectivity Testing: Involves tests to verify the connectivity between the UK Power Networks Dispatch platform and the FSP system. This focuses on testing the FSP's implementation of APIs in accordance with the API specifications outlined in this document, ensuring consistency on both ends.

    - Systems' Integration Testing: Involves tests to ensure that the End-to-End system operates as required, including functional and non-functional testing. These tests will be driven by mock input data.

- **Commissioning:** This involves processes as well as a set of tests executed and completed in the production environment:

    - Migration to Production: Involves processes followed by the FSP to migrate their system from pre-production to the production environment.

    - Commissioning Testing: Involves tests used to demonstrate that the FSP fully complies with expected behaviour in the production environment.

After commissioning testing has been completed, the FSP is deemed as being ready to have a production instance connected to the UK Power Networks' production Dispatch Solution and ready for further stages.

More detailed information on the steps involved in the End-to-End integration process, including responsibilities for both the FSP and UK Power Networks, is provided in Figure 1 and Appendix I.

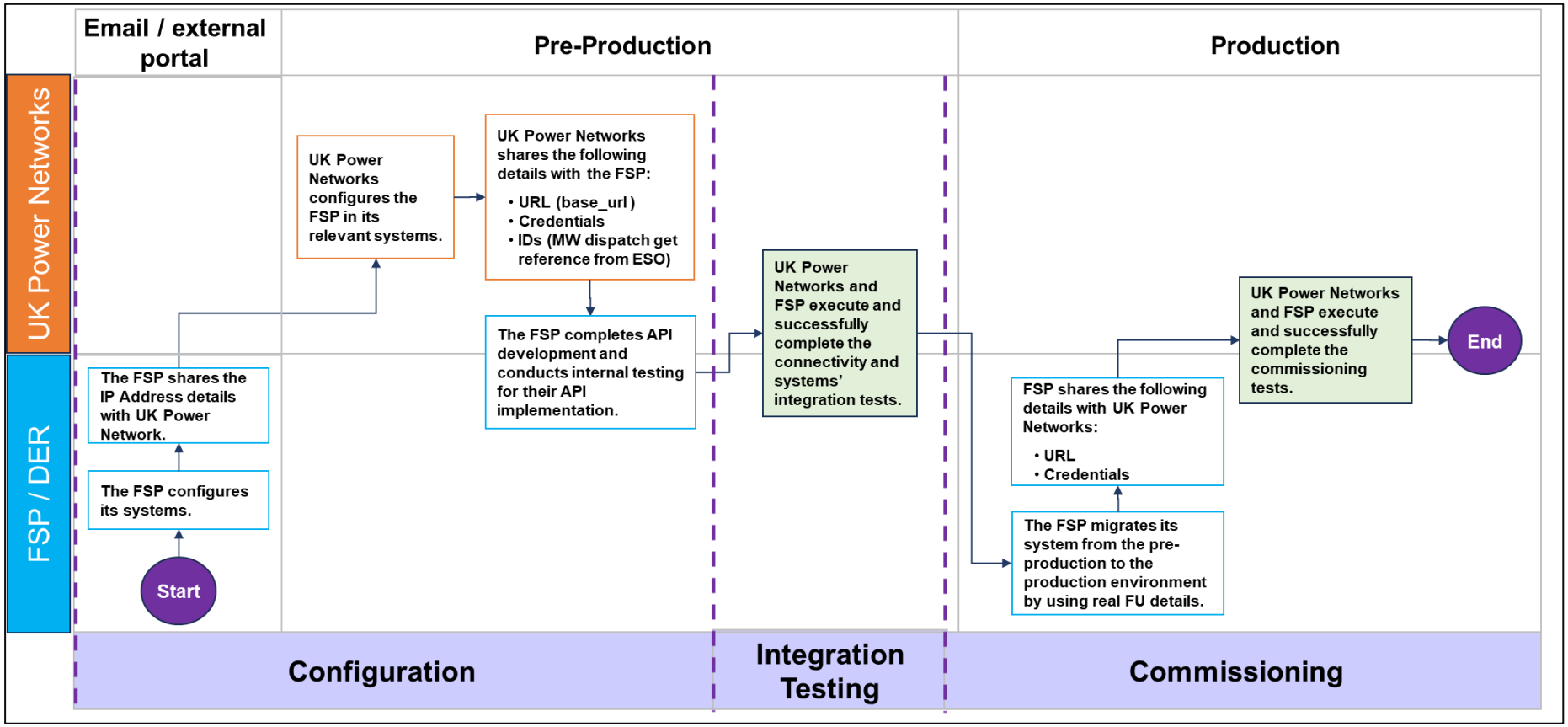

Figure 1: End-to-End integration process

3 SYSTEM INTERFACE SUMMARY

This section provides an overview of the interactions between UK Power Networks Systems, Dispatch Platform and the FSP Systems. The following sections define each of the interfaces used by the Dispatch Platform. Figure 2 provides a high-level overview of these interactions. The interfaces are named and numbered – the following sections reference the numbered interfaces in this diagram.

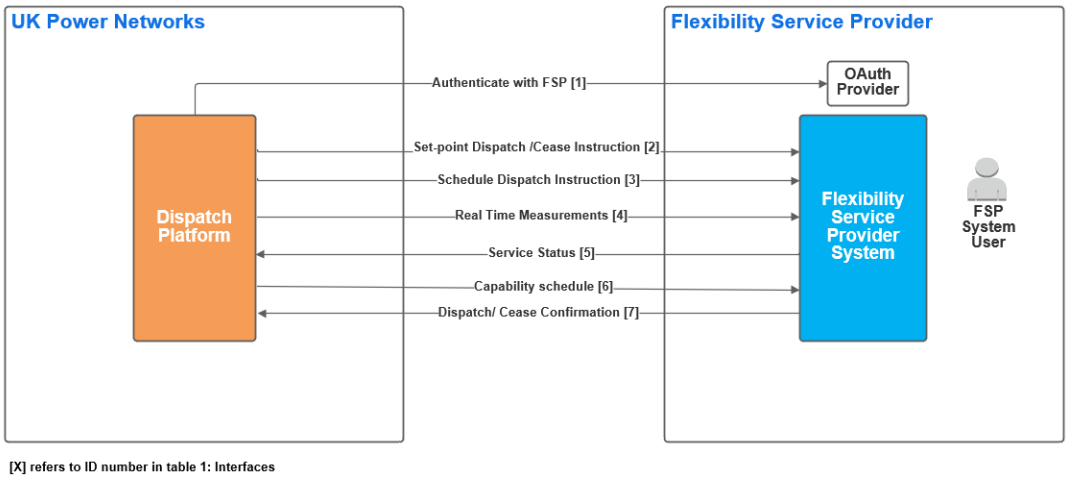

Figure 2: Flexibility Service Interactions

Dispatch Platform: This is a UK Power Networks managed cloud-based platform hosted in Microsoft Azure. It includes interfaces to all relevant systems within UK Power Networks' distribution network and is responsible for management, control, and monitoring of FUs or DERs through FSPs.

FSP System: FSP owned control equipment that interfaces with UK Power Networks Dispatch Platform. It is responsible for fulfilling the service requirements. FSP System interfaces with all the associated DER systems and is responsible for management, control, and monitoring of FUs. The interfaces between the FSP and the DER is beyond the scope of this document.

Communication links: The Dispatch Platform interfaces with FSPs using a cloud API as detailed in section 3.1.

3.1 Interfaces

Table 1 summarises the data exchange between FSP and the Dispatch Platform. The type of data (Mandatory or Optional) is specified for both UK Power Networks' Flexibility Services and ESO MW Dispatch Service.

Table 1: Interfaces

ID	Purpose	From	To	Information Flow	Functional Description	Product Usage		API Description
						Flexibility Services	MW Dispatch	
1	Authenticate with FSP	Dispatch Platform	FSP System	Authentication Token	Used by the Dispatch Platform to authenticate with the FSP.	Mandatory	Mandatory	Section 4.4.2 FSP Authentication
2	Set-point Dispatch /Cease Instruction	Dispatch Platform	FSP System	Power value (W), Time	Dispatch/Cease instruction with the real power value (W) in near real time, within the limits of the agreed contract.	Mandatory (intra-day dispatch) • Power value is a delta change. • A zero-power value ends any service.	Mandatory • Power value is absolute limit, FU should not export above this limit. • FU alters operating point to match power value. • Power value matching the contractual capacity ends any service request meaning the FU can ramp up to previous/new export level.	Section 4.5.1 Setpoint Dispatch/Cease Instruction
3	Schedule Market Period Dispatch Instruction	Dispatch Platform	FSP System	Power value (W)	Dispatch instruction with the real power value for each market period during the day (15 minute or 30-minute periods).	Mandatory (Day-Ahead dispatch) • Power value is a delta change	Not Applicable	Section 4.5.2 Scheduled Market Period Dispatch

ID	Purpose	From	To	Information Flow	Functional Description	Product Usage		API Description
						Flexibility Services	MW Dispatch	
4	Real Time Measurements	FSP System	Dispatch Platform	Demand measurement (W), every minute.	Analogue measurement values (W) in real time sent once every minute.	Optional	Mandatory • Measurements are used to inter communication health to sites (Heartbeat), if no measurements are received for a pre-defined period, then the site is assumed to be un-responsive and will not be utilised for this service until measurements restart. • The metering data value itself does not need to be genuine DER metering output but can be dummy data for the purpose of link monitoring. • In case of DER sending their real time metering data, UK Power Networks will not utilise them for commercial or operational purposes unless there is an agreement with FSP in the commercial domain.	Section 4.6.1 Real-time Measurements

ID	Purpose	From	To	Information Flow	Functional Description	Product Usage		API Description
						Flexibility Services	MW Dispatch	
5	Service Status	FSP System	Dispatch Platform	True, False	Service status (true= available, false= unavailable) sent in real time whenever the service status changes (i.e. unit become unavailable due to FSP's internal systems failure), or every minute.	Optional	Optional	Section 4.6.2 Service Status
6	Capability Schedule Submission	FSP System	Dispatch Platform	Three schedules of values for each market period (forward scheduled demand (W), flexible capacity offered delta (W), utilisation fee (£))	Three schedules submitted day ahead or ad hoc using standard market periods (30 minutes or 15 minutes). Schedule will contain forward scheduled demand (W), flexible capacity offered (W), utilisation fee (£).	Optional	Not Applicable	Section 4.6.3 Capability Schedule Submission
7	Dispatch/ Cease Confirmation	FSP System	Dispatch Platform	Confirmation status of instruction, Error codes	Confirmation signal representing final status of the dispatch/ Cease instruction – this will be uniquely tied to a dispatch/ cease instruction through the Dispatch Unique Identifier (DUI).	Not Applicable	Mandatory	Section 4.6.4 Dispatch/ Cease Confirmation

4 SYSTEM DESIGN INTERFACE

4.1 Architectural Pattern

Message exchange between the Dispatch Platform and the FSP System will adopt a RESTful request-response design pattern using the HTTPS protocol. The format of all payloads for RESTful interfaces is JSON.

4.2 Flexible Unit Unique Identifier

4.2.1 Distribution Flexibility Service

Each FU will be assigned a unique identifier which will be inherited from the UK Power Networks market system. A universally unique identifier (UUID) is used to uniquely identify a Flexible Unit between all systems. The format of this ID is text, or String, given it is usually a combination of characters, numbers and hyphens e.g. 00fc4ba4-2007-11ea-978f-2e728ce88125.

A more detailed UUID description is included in Appendix II.

4.2.2 MW Dispatch Service

For upstream communications the FU UUID is also called the “unitID”.

For Flexible Units participating in the MW Dispatch service then unique identifiers are inherited from the ESO registration process and will take the form:

UKPN-XXX

Where ‘X’ is a numeric value from 0-9.

4.3 Power Values & Polarity

The different services issue real power-based instructions in different ways, this section aims to define how the power values should be interpreted for each service.

Generally, the polarity of power signals should be interpreted such that:

- Positive values indicate:
    - Absolute Values: Exporting to grid.
    - Delta Values: Change in the export direction i.e., increased generation or decreased demand.
- Negative values indicate:
    - Absolute Values: Importing from grid.
    - Delta Values: Change in the import direction i.e., increased demand or decreased generation.

This is graphically represented in Figure 3.

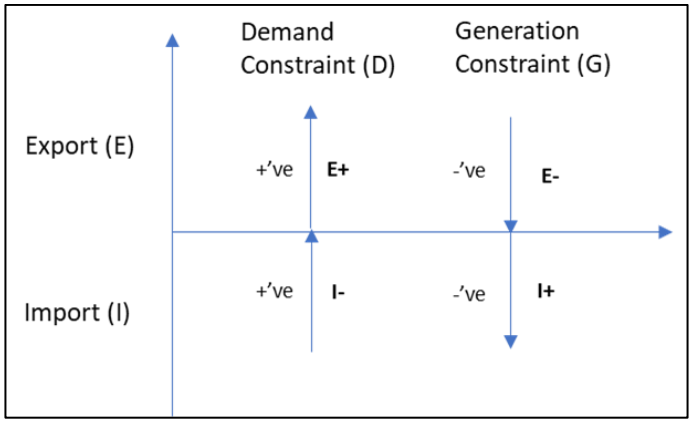

Figure 3: Power Value Polarity

4.3.1 Flexibility Services

As per Table 1, the mandatory signals for Flexibility Services are listed below:

- Authenticate with FSP
- Set-point Dispatch /Cease Instruction (intra-day dispatch)
- Schedule Dispatch Instruction (Day-Ahead dispatch)

For Flexibility Services, power values represent a delta change which the FU is expected to make from its baseline. For example:

- A +500kW power value means that an export FU should increase export by 500kW or an import FU should decrease its demand by 500kW.
- A -400kW power value means that an export FU should decrease its export by 400kW or an import FU should increase its demand by 400kW.

The time provided with a power value is the time from which the instruction is valid. For start instructions the time should be interpreted as the time by which the response is required. i.e., ramp up prior to the time. However, for stop instructions the time should be interpreted as the time after which no response is required. The baseline methodology will be service and contract dependent, please refer to service specific guidance.

4.3.2 MW Dispatch Service

As per Table 1, the mandatory signals for MW Dispatch service are listed below:

- Authenticate with FSP
- Set-point Dispatch /Cease Instruction
- Real Time Measurements (i.e. dummy value to monitor the link)
- Dispatch/ Cease Confirmation

For the MW Dispatch service all power values are absolute values. For example:

- A +500kW value instructs that the FU that it should be exporting 500kW.
- A 0kW value instructs the FU that it should not be importing or exporting.

The time provided with a power value is the time from which the instruction is valid – instructions will be issued very close to instantaneously, so all instructions should be actioned immediately.

4.4 Authentication

4.4.1 Dispatch Platform Web Services

For each incoming https request to the Dispatch Platform, a **Basic Authentication Header** will be required to be provided, which should contain the username and password for the system user that has been configured to allow access to a component on the Dispatch Platform.

4.4.2 FSP Authentication

For each FSP that provides an API for dispatch, there should also be a separate API provided for initial Authentication following the OAuth2.0 Client Credential flow for generating bearer tokens. The assumption is that one service account will be used for all RESTful requests to FSPs.

Authentication APIs are summarized in Table 2.

Table 2: Authentication APIs provided by FSPs

<table>
<tr><td>Source</td><td>Dispatch Platform</td></tr>
<tr><td>Destination</td><td>FSP System</td></tr>
<tr><td>Protocol</td><td>https POST</td></tr>
<tr><td>URL</td><td>Defined by the FSP</td></tr>
<tr><td>Operational Trigger & frequency</td><td>• On Initial interaction with the API to authenticate and retrieve Bearer Token.
• When the Bearer Token has expired, and another is required.</td></tr>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data item</th><th>Type</th><th>Description</th></tr>
<tr><td>URL</td><td>String</td><td>The URL for passing the user credentials to</td></tr>
<tr><td>Header</td><td>String</td><td>'Content-Type: application/x-www-form-urlencoded'

Will include base64 encoded Auth header with basic clientid:clientsecret</td></tr>
</table>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>200</td><td>Authenticated successfully</td></tr>
<tr><td>400</td><td>Data validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden - Authentication error</td></tr>
<tr><td>401</td><td>Unauthorised – No correct permissions</td></tr>
</table>
</td></tr>
</table>

4.5 Dispatch Platform to FSP System

4.5.1 Setpoint Dispatch/Cease Instruction

Table 3: Setpoint Dispatch/Cease Instruction API details

Source	Dispatch Platform
Destination	FSP System
Protocol	https POST
URL	Defined by the FSP and includes the UUID of the Flexible Unit.

Operational Trigger & frequency	The power signal must be interpreted differently depending on the service being provided:
	• **Flexibility Services**: Power values represent the delta the FSP is expected to implement with respect to its baseline export/import.
	  ○ For a FU providing generation turn up services and a delta of 5000W the site would be expected to increase export by 5000W.
	  ○ For a FU providing demand turn down services and a delta of 5000W the site would be expected to decrease its import by 5000W.
	  ○ A non-zero power value is the equivalent of a start instruction, and a zero-power value is the equivalent of a stop instruction.
	  ○ The time provided with a power value is the time from which the instruction is valid. For start instructions the time should be interpreted as the time by which the response is required. i.e., ramp up prior to the time. However, for stop instructions the time should be interpreted as the time after which no response is required, i.e., ramp down after the time.
	• **MW Dispatch**: Power values represent an absolute operating point which the FU should operate at.
	  ○ A zero power value is the equivalent of a start instruction and a power value matching the contractual capacity is the equivalent of a stop instruction. For MW dispatch, the stop instructions mean a Cease instruction.
	  ○ The time provided with a power value is the time from which the instruction is valid – instructions will be issued very close to instantaneously, so all instructions should be actions immediately.

Parameters	None

<table>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data item</th><th>Type</th><th>Description</th></tr>
<tr><td>Time</td><td>ISO8601 formatted date-time string (UTC)</td><td>The start time from which the instructed power value is valid – this is inclusive.</td></tr>
<tr><td>power</td><td>Float</td><td>Power value is Watts</td></tr>
<tr><td>Dui</td><td>string</td><td>Only Mandatory for FU’s providing MW Dispatch Service. Unique identifier for dispatch instruction</td></tr>
</table>
</td></tr>
<tr><td>Example Payload</td><td>{
"time":"2020-11-25T18:15:00Z",
"power":10000.0,
“dui”:”DUIjkghdf87620”
}</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>200</td><td>Received successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be message detailing the validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden - Authentication error</td></tr>
<tr><td>401</td><td>Unauthorised – No correct permissions</td></tr>
<tr><td>404</td><td>Not Found – Device UUID does not exist</td></tr>
</table>
</td></tr>
</table>

4.5.2 Scheduled Market Period Dispatch Instruction

Table 4: Schedule Market Period Dispatch Instruction API details

Source	Dispatch Platform
Destination	FSP System
Protocol	https POST
URL	Defined by the FSP and includes the UUID of the Flexible Unit.
Operational Trigger & frequency	• For the Flexibility Service within the agreed timeframes the Dispatch Platform sends a dispatch schedule for all market periods of the next day, midnight to midnight. • Set Point delta values can be positive and negative and represent the change in Power value the device should observe. ○ For a FU providing generation turn up services and a delta of 5000W the site would be expected to increase export by 5000W.

<table>
<tr><td></td><td>

For a FU providing demand turn down services and a delta of 5000W the site would be expected to decrease its import by 5000W.
A non-zero power value is the equivalent of a start instruction, and a zero-power value is the equivalent of a stop instruction.
The time provided with a power value is the time from which the FU should be ready to seamlessly export at the requested power value. The FU should continue to export at the required power value until the end of the required period.

</td></tr>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data item</th><th>Type</th><th>Description</th></tr>
<tr><td>market period</td><td>Tuple containing start and end time of the market period</td><td>Discrete time period for dispatch</td></tr>
<tr><td>start</td><td>ISO8601 formatted date-time string (UTC)</td><td>Start time of the market period - Inclusive</td></tr>
<tr><td>end</td><td>ISO8601 formatted date-time string (UTC)</td><td>End time of the market period - Exclusive</td></tr>
<tr><td>power</td><td>Float</td><td>The set point, in Watts, which the FU is expected to operate at – expected to a single decimal place.</td></tr>
</table>
</td></tr>
<tr><td>Example Payload for Dynamic with step size of 30 mins over 24-hour period</td><td>
<pre>
[
  {
    "marketPeriod": {
      "start": "2020-11-25T00:00:00Z",
      "end": "2020-11-25T00:30:00Z"
    },
    "power": 10000.0
  },
  {
    "marketPeriod": {
      "start": "2020-11-25T00:30:00Z",
      "end": "2020-11-25T01:00:00Z"
    },
    "power": 15000.0
  },
…
  {
</pre>
</td></tr>
</table>

<table>
<tr><td></td><td>
<pre>
"marketPeriod": {
"start": "2020-11-25T23:00:00Z",
"end": "2020-11-25T23:30:00Z"
},
"power": 5000.0
},
{
"marketPeriod": {
"start": "2020-11-25T23:30:00Z",
"end": "2020-11-26T00:00:00Z"
},
"power": 5000.0
}

]
</pre>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>200</td><td>Received successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be a message detailing the validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden - Authentication error</td></tr>
<tr><td>401</td><td>Unauthorised – No correct permissions</td></tr>
<tr><td>404</td><td>Not Found – Device UUID does not exist</td></tr>
</table>
</td></tr>
</table>

4.6 FSP System to Dispatch Platform

4.6.1 Real-time Measurements

Table 5: Real Time Measurements API details

Source	FSP
Destination	Dispatch Platform
Protocol	https POST
URL	https://{base_url}/services/esg-interface/measurements/{Device_uuid}

<table>
<tr><td>Operational Trigger & frequency</td><td>

Frequency on change of the live measurement value.
Live analogue measurement value can be sent once every minute.
A zero value is interpreted as the Device is alive but not producing or consuming energy

</td></tr>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data Item</th><th>Type</th><th>Unit/Value</th></tr>
<tr><td>Unit Symbol</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitSymbol</td><td>W</td></tr>
<tr><td>Unit Multiplier</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitMultiplier</td><td>K</td></tr>
<tr><td>AnalogueMeasurementType</td><td>String</td><td>“measuredRealPower”</td></tr>
<tr><td>Value (Real Power)</td><td>Integer</td><td></td></tr>
<tr><td>Measurement Quality Value</td><td>String</td><td>“Good” – measurement is known to be good quality
“Bad” – measurement known to be bad quality.</td></tr>
<tr><td>Timestamp</td><td>ISO8601 formatted date-time string (UTC)</td><td></td></tr>
</table>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>200</td><td>Received successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be a message detailing the validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden – Device does not exist, or user does not have correct permissions to access it.</td></tr>
<tr><td>401</td><td>Unauthorised – Authentication failed.</td></tr>
</table>
</td></tr>
</table>

Example Payloads	{
	"typeName":"ch.iec.tc57cim.iec61970.base.core.Equipment",
	"name":"measurement",
	"measurements":[
	{
	"typeName":"ch.iec.tc57cim.iec61970.base.meas.Analog",
	"unitSymbol":"Wh",
	"unitMultiplier":"k",
	"measurementType":"realEnergy",
	"analogValues":[
	{
	"typeName":"ch.iec.tc57cim.iec61970.base.meas.AnalogValue",
	"value":12345.678,
	"measurementValueQuality": {
	"typeName":"ch.iec.tc57cim.iec61970.base.meas.MeasurementValueQuality",
	"validity": "GOOD" or "INVALID"
	}
	"timeStamp":"2020-02-24T17:35:40"
	}
	]
	}
	],
	"mrid":"5d0b8674acd94b10b325b38b7dca29c6",
	"typeName": "string"
	}

4.6.2 Service Status

Table 6: Service Status API details

Source	FSP
Destination	Dispatch Platform
Protocol	https POST
URL	https://{base_url}/services/esg-interface/measurements/{Device_uuid}
Operational Trigger & frequency	Digital Service Status of true or false can be sent whenever the service status changes at the asset, or every minute. • Value = true means Device is IN SERVICE • Value = false means Device is OUT OF SERVICE

<table>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data Item</th><th>Type</th><th>Unit/Value</th></tr>
<tr><td>measurementType</td><td>String</td><td>“serviceStatus”</td></tr>
<tr><td>value</td><td>boolean</td><td>true = Available
false = Unavailable</td></tr>
<tr><td>Measurement Quality Value</td><td>String</td><td>“Good” – measurement is known to be good quality
“Bad” – measurement known to be bad quality.</td></tr>
<tr><td>Timestamp</td><td>ISO8601 formatted date-time string (UTC)</td><td></td></tr>
</table>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>200</td><td>Received successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be a message detailing the validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden – Device does not exist, or user does not have correct permissions to access it.</td></tr>
<tr><td>401</td><td>Unauthorised – Authentication failed.</td></tr>
</table>
</td></tr>
</table>

Example Payloads	{
	"name": "serviceStatus",
	"measurements": [
	{
	"typeName": "ch.iec.tc57cim.iec61970.base.meas.Digital",
	"mRID": "G1",
	"name": "Service Status",
	"measurementType": "serviceStatus",
	"digitalValues": [
	{
	"typeName": "ch.iec.tc57cim.iec61970.base.meas.DigitalValue",
	"timeStamp": "2021-06-19T11:35:39.309Z",
	"measurementValueQuality": {
	"validity": "Good",
	"typeName": "String"
	},
	"value": true
	}
	]
	}
	],
	"mrid": "0c94a9db-f232-43bc-8248-b32b5478bb2c",
	"typeName": "String"
	}

4.6.3 Capability Schedule Submission

The Dispatch Platform provides a common interface allowing the submission of time series data in the form of schedules. This section defines some of the ways in which this interface is used when exchanging information about Flexibility Services.

4.6.3.1 Scheduled Demand

Table 7: Scheduled Demand API details

Source	FSP
Destination	Dispatch Platform
Protocol	https POST
URL	https://{base_url}/services/schedules-service/schedules/{scheduleBucketUuid}

<table>
<tr><td>Operational Trigger & frequency</td><td>

Schedule of power values (W) per market period representing the forward scheduled demand.
Set Point values can be positive and negative and represent the instantaneous Power value the device should observed at point of connection. A Positive value indicates that the Flexible Unit should be exporting to the grid and a negative value indicates that the Flexible Unit should be importing. For Flexibility Service this is submitted daily.
For Dynamic Service this is submitted before gate closure
UUID of the Schedule will be sent back as part of success response.

</td></tr>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data item</th><th>Type</th><th>Unit / Value</th></tr>
<tr><td>data</td><td>Array of Doubles</td><td>The array of set points per step size</td></tr>
<tr><td>description</td><td>String</td><td>Free form text</td></tr>
<tr><td>scheduleBucketUuid</td><td>String</td><td>The UUID for parent Schedule</td></tr>
<tr><td>name</td><td>String</td><td>Free form text</td></tr>
<tr><td>startTime</td><td>ISO8601 formatted date-time string (UTC)</td><td></td></tr>
<tr><td>multiplier</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitMultiplier</td><td>“k” or “M”</td></tr>
<tr><td>symbol</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitSymbol</td><td>“W” or “Var”</td></tr>
</table>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>201</td><td>Created successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be message detailing the validation error such as demand greater than site capacity, invalid json, or missing elements.</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden – No correct permissions or Schedule Bucket Uuid does not exist</td></tr>
<tr><td>401</td><td>Unauthorised - Authentication error</td></tr>
</table>
</td></tr>
</table>

Example Payloads	{
	
	"data": {
	"stepSize": 1800,
	"points": [
	0,
	1,
	2,
	3,
	4,
	…
	]
	},
	"description": "Schedule Description",
	"name": "Schedule Name",
	"scheduleBucketMrid": "0c94a9db-f232-43bc-8248-b32b5478bb2c",
	"startTime": "2020-03-13T00:00:00Z",
	"value1Unit": {
	"multiplier": "k",
	"symbol": "w"
	}
	}

4.6.3.2 Schedule of Available Delta

Table 8: Schedule of Available Delta API details

Source	FSP
Destination	Dispatch Platform
Protocol	https POST
URL	https://{base_url}/services/schedules-service/schedules/{scheduleBucketUuid}

<table>
<tr><td>Operational Trigger & frequency</td><td>

Schedule of power values (W) per market period representing the schedule of available delta.
Set Point values are always positive, and represent the instantaneous Power value the device should be running at
For Dynamic Service this is submitted before gate closure
UUID of the Schedule will be sent back as part of success response.

</td></tr>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data item</th><th>Type</th><th>Unit / Value</th></tr>
<tr><td>data</td><td>Array of Doubles</td><td>The array of set points per step size</td></tr>
<tr><td>description</td><td>String</td><td>Free form text</td></tr>
<tr><td>scheduleBucketUuid</td><td>String</td><td>The UUID for parent Schedule</td></tr>
<tr><td>name</td><td>String</td><td>Free form text</td></tr>
<tr><td>startTime</td><td>ISO8601 formatted date-time string (UTC)</td><td></td></tr>
<tr><td>multiplier</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitMultiplier</td><td>“k” or “M”</td></tr>
<tr><td>symbol</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitSymbol</td><td>“W” or “Var”</td></tr>
</table>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>201</td><td>Created successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be message detailing the validation error such as invalid json, or missing elements.</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden - No correct permissions or Schedule Bucket Uuid does not exist</td></tr>
<tr><td>401</td><td>Unauthorised - Authentication error</td></tr>
</table>
</td></tr>
</table>

Example Payloads	{
	
	"data": {
	"stepSize": 1800,
	"points": [
	0,
	1,
	2,
	3,
	4,
	…
	]
	},
	"description": "Schedule Description",
	"name": "Schedule Name",
	"scheduleBucketMrid": "0c94a9db-f232-43bc-8248-b32b5478bb2c",
	"startTime": "2020-03-13T00:00:00Z",
	"value1Unit": {
	"multiplier": "k",
	"symbol": "w"
	}
	}

4.6.3.3 Schedule of Utilisation Price

Table 9: Schedule of Utilisation Price API details

Source	FSP
Destination	Dispatch Platform
Protocol	https POST
URL	https://{base_url}/services/schedules-service/schedules/{scheduleBucketUuid}
Operational Trigger & frequency	• Schedule of values £/MWh per market period representing the schedule of prices for utilisation of available delta. • For Dynamic Service this is submitted before gate closure • UUID of the Schedule will be sent back as part of success response.

<table>
<tr><td>Parameters</td><td>None</td></tr>
<tr><td>Data Items</td><td>
<table>
<tr><th>Data item</th><th>Type</th><th>Unit / Value</th></tr>
<tr><td>data</td><td>Array of BigDecimal</td><td>The array of values of Prices per step size</td></tr>
<tr><td>description</td><td>String</td><td>Free form text</td></tr>
<tr><td>scheduleBucketUuid</td><td>String</td><td>The UUID for parent Schedule</td></tr>
<tr><td>name</td><td>String</td><td>Free form text</td></tr>
<tr><td>startTime</td><td>ISO8601 formatted date-time string (UTC)</td><td></td></tr>
<tr><td>multiplier</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitMultiplier</td><td>“none”
n.b. units in request are specified as “none” but values should be in £/MWh.</td></tr>
<tr><td>symbol</td><td>ch.iec.tc57cim.iec61970.base.domain.UnitSymbol</td><td>“none”</td></tr>
</table>
</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>201</td><td>Created successfully</td></tr>
<tr><td>400</td><td>Data validation error – there will be message detailing the validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden - No correct permissions or Schedule Bucket Uuid does not exist</td></tr>
<tr><td>401</td><td>Unauthorised - Authentication error</td></tr>
</table>
</td></tr>
<tr><td>Example Payloads</td><td>
<pre>{
  "stepSize": 1800,
  "data": {
    "points": [
      0,
      1,
      2,
      3,
      4,
      …
    ]
  },
  "description": "Schedule Description",
  "name": "Schedule Name",</pre>
</td></tr>
</table>

```
  "scheduleBucketMrid": "0c94a9db-f232-43bc-8248-b32b5478bb2c",
  "startTime": "2020-03-13T00:00:00Z",
  "value1Unit": {
    "multiplier": "none",
    "symbol": "none"
  }
}
```


4.6.4 Dispatch/ Cease Confirmation

Table 10: Dispatch/Cease Confirmation API details

Source	Flexible Service Provider
Destination	Flexibility Service System
Protocol	https POST
URL	https://{base_url}/services/mw-dispatch/confirmation
Operational Trigger & frequency	• Triggered by Flexible Unit in response to a start or stop instruction from the Flexibility Service System. The ResponseCode should be set based on whether the Flexible Unit can provide the requested service. • Confirmation should be issued within 60 seconds of receiving the instruction.
Parameters	None
Data Items	See below

Data item	Type	Description
unitID	String	Unique identifier for Flexible Unit to be dispatched. Referred to as UUID elsewhere in document.
dui	String	Unique Identifier for dispatch / cease instruction pair. Must match the dui for associated start instruction.
responseCode	Enumeration	Code to communicate status of dispatch instruction. Possible values: • ACCEPTED • REJECTED
dateTimeStamp	ISO8601 formatted date-time string (UTC)	Time instruction was sent by Flexible Unit..

<table>
<tr><td>Example Payload</td><td>{
“ unitID “:”UKPN-123”,
“ dui “:”DUIjkghdf87620”,
“responseCode”:”ACCEPTED”
“ dateTimeStamp “:2020-11-25T18:15:00Z,
}</td></tr>
<tr><td>Response Scenarios & codes</td><td>
<table>
<tr><th>Http Response Code</th><th>Meaning</th></tr>
<tr><td>200</td><td>Received successfully</td></tr>
<tr><td>400</td><td>Data validation error– there will be message detailing the validation error</td></tr>
<tr><td>500</td><td>Internal Server Error – Service is down</td></tr>
<tr><td>403</td><td>Forbidden - Authentication error</td></tr>
<tr><td>401</td><td>Unauthorised – No correct permissions</td></tr>
<tr><td>404</td><td>Not Found – Device UUID does not exist</td></tr>
</table>
</td></tr>
</table>

5 APPENDIX I - END-TO-END INTEGRATION PROCESS

Step	No	Description	Who is involved	Environment
1- Configuration and Development	1.1	The FSP configures its systems and shares the following details with UK Power Networks: • IP Address	FSP	Email / external portal
	1.2	UK Power Networks configures the FSP in its relevant systems and shares the following details with the FSP: • URL (base_url) • Credentials • IDs (MW dispatch get reference from ESO)	UKPN	Pre-Production
	1.3	The FSP completes API development and conducts internal testing for their API implementation.	FSP and UKPN	Pre-Production
2- Integration Testing	2.1	UK Power Networks and FSP execute and successfully complete the connectivity and systems' integration tests.	FSP and UKPN	Pre-Production
3- Commissioning	3.1	The FSP migrates its system from the pre-production to the production environment by: • Using real FU details	FSP	Production
	3.2	FSP shares the following details with UK Power Networks: • URL • Credentials	FSP	Production
	3.3	UK Power Networks and FSP execute and successfully complete the commissioning tests.	FSP and UKPN	Production

6 APPENDIX II - UUID

A universally unique identifier (UUID) is a 128-bit number that identifies unique Internet objects or data. It is generated by an algorithm with values that are based on a machine's network address.

The UUID was created in the Network Computing System (NCS), which later became a part of the Distributed Computing Environment (DCE) standardized by the Open Software Foundation (OSF).

A UUID is typically denoted by 32 hexadecimal digits displayed in five-character groups individually separated by hyphens.

Different mechanisms are used to generate UUIDs to determine and compare UUID uniqueness levels. Based on the type of mechanism used, the generated UUID will be either completely or practically different from other generated UUIDs. UUIDs are made up of combined components; therefore, some kind of uniqueness is always present in any generated UUID.

A guaranteed unique identifier includes a reference to the network address of the UUID generating host, a time stamp and an arbitrary component. Because network addresses for each computer vary, the time stamp is also different for each generated UUID. Thus, two different host machines exhibit sufficient levels of uniqueness. The randomly created arbitrary component is added for enhanced security.