

Project FUSION -

Specification of communication protocols between market participants

SP Energy Networks



Date of first issue: 10-11-2020





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4. This document can be cross-referenced with our publications USEF Due Diligence Report, USEF Consultation Report and FUSION USEF Implementation Plan on the FUSION Webpage.

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About this document

Document Title: Project FUSION - Specification of communication protocols between market participants
Date of issue: 10/11/2020
Date of last revision: 10/11/2020

Revision History

Revision	Issue Date	Comments
V1.0	22/04/2020	Draft for review
V2.0	01/05/2020	Final draft
V3.0	29/05/2020	Final version
V4.0	10/11/2020	Revised final version

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1 INTRODUCTION

1.1 Overview of Project FUSION

Project FUSION is funded under Ofgem's 2017 Network Innovation Competition (NIC), to be delivered by SP Energy Networks in partnership with seven project partners: DNV GL, Origami Energy, PassivSystems, Imperial College London (academic partner), SAC Consulting, The University of St. Andrews, and Fife Council.

Project FUSION represents a key element of SP Energy Network's transition to becoming a Distribution System Operator (DSO), taking a step towards a **clean, smart and efficient energy system**. As the electricity system changes from a centralised to decentralised model, it enables a smarter and more flexible network to function. Project FUSION is trialling the use of commoditised local demand-side flexibility through a structured and competitive market, based on a **universal, standardised market-based framework; the Universal Smart Energy Framework (USEF)**. USEF provides a standardised framework that defines products, market roles, processes and agreements, as well as specifying data exchange, interfaces and control features. The purpose of USEF is to accelerate the transition to a smart, flexible energy system to maximise benefits for current and future customers. Section 1.2 provides a brief overview of USEF.

Project FUSION will also inform wider policy development around flexibility markets and the DNO-DSO transition through the development and testing of standardised industry specifications, processes, and requirements for transparent information exchange between market participants accessing market-based flexibility services. Ultimately, Project FUSION will contribute to Distribution Network Operators and all market actors unlocking the potential and value of local network flexibility in a competitive and transparent manner. In doing so, Project FUSION aims to contribute to addressing the energy trilemma by making the energy system more secure, more affordable and more sustainable.

1.2 USEF Overview

The USEF framework aims to facilitate effective coordination across all the different actors involved in the electricity market by providing a common standardised roles model and market design while describing communication requirements and interactions between market roles. USEF turns flexible energy use into a tradeable commodity available for all energy market participants, separated from (but in coordination with) the traditional electricity supply chain, to optimise the use of resources. USEF focuses on explicit demand-side flexibility, in which prosumers are contracted by the aggregator to provide specific flexibility services using Active Demand and Supply (ADS) assets. USEF acknowledges, but does not provide detailed considerations for implicit demand-side flexibility or peer-to-peer energy trading.

To facilitate the transition towards a cost-effective and scalable model, the framework provides the essential tools and mechanisms which redefine existing energy market roles, add new roles and specify interactions and communications between them. In addition, the USEF standard ensures that all technologies and projects will be compatible and connectable to the energy system, facilitating project interconnection, hence fostering innovation and accelerating the smart energy transition. By delivering a common standard to build on, USEF connects people, technologies, projects and energy markets in a cost-effective manner. Its market-based mechanism defines the rules required to optimise the whole system, ensuring that energy is produced, delivered and managed at lowest cost for the whole system and effectively for the end-user.

The USEF framework provides:

- a **standardised common framework** designed to be implemented on top of current energy markets such as wholesale, retail and capacity markets.

- a description of the **flexibility value chain** (FVC) involving new and existing market players and giving a central role to the aggregator in facilitating flexibility transactions.
- a **roles model** and an **interaction model** to enable the implementation of different business models and interactions between actors.
- a market design described by the **Market Coordination Mechanism (MCM)** which sets out the phases and interaction requirements for flexibility transactions. The MCM provides all stakeholders with equal access to a smart energy system. To this end, it facilitates the delivery of value propositions (i.e. marketable services) to various market parties without imposing limitations on the diversity and customisation of those propositions.
- detailed **communication and market access requirements** taking into consideration privacy and cybersecurity issues.

Appendix A provides glossary containing definitions for roles and key terminology used in USEF.

1.3 Introduction to the USEF Communication Protocol

The USEF Communication Protocol, formally referred to as the USEF Flex Trading Protocol (UFTP), describes the interactions and communication exchange between Aggregators and DSOs to resolve grid constraints at distribution level. The UFTP covers all phases in the USEF Market Coordination Mechanism (contract, plan, validate, operate and settle) and is designed to be used as a stand-alone protocol for flexibility forecasting, offering, ordering and settlement processes.

The UFTP Specifications¹ describe:

- The detailed communication exchange between DSO, Aggregator and Common References Operator (CRO) as well as UFTP use cases² descriptions derived from the MCM;
- The USEF message descriptions, defining the attributes contained in each Extensible Markup Language (XML) message; and
- The USEF message transport mechanism.

To complement the UFTP Specifications, the USEF Foundation has made available a GitHub page containing the UFTP XSD (XML Schema Definition) files.³

1.4 Purpose of this Document

This document sets out the minimum requirements for implementing the USEF Flex Trading Protocol (UFTP). The UFTP will form the basis for the communication protocol to be adopted in the FUSION trial.

This report can be used by GB flexibility providers as a guide to the process and technical requirements to participate in the FUSION trial.


This document should be read in conjunction with the FUSION USEF Implementation Plan document, published on the [FUSION website](#), which provides a more detailed description of USEF elements deployed in the FUSION trial.

The current document:

¹ https://www.usef.energy/download-the-framework/#popup_overlay1

² The use cases are separate activities that require interaction between DSO and Aggregator, each containing multiple messages in both directions. These are derived from the Market Coordination Mechanism phases.

³ <https://github.com/USEF-Foundation/UFTP>

- 
- sets out USEF roles and market participants and their relation to the FUSION trial and the UFTP;
 - describes the detailed information flow between DSO, Common Reference Operator CRO and flexibility service providers according to the UFTP;
 - presents the USEF message guide and description of message attributes;
 - explains the USEF message transport mechanism;
 - describes the UFTP governance, backward compatibility and foreseen developments; and
 - sets out the specific requirements for FUSION trial participants.

This document is not intended to provide an exhaustive specification of the communications requirements for aggregators wishing to participate in Project FUSION. The communications protocol described in this document represents the USEF Flexibility Trading Protocol (UFTP), which will form the basis for the communications protocol to be adopted in FUSION. Any aggregator expressing an interest in participating in FUSION will be invited to enter into further discussions with SPEN to agree upon the finer details of the communications requirements specified in this document. These discussions will explore specific communications requirements in more detail including, for example, the provision of appropriate cyber security and data protection.

2 USEF ROLES AND MARKET PARTICIPANTS

Table 1 lists the USEF roles that will be performed during the FUSION trial. It describes which roles are included in the UFTP, and how they relate to GB market participants. The colour coding describes whether the USEF role fully matches, partially matches, or does not match the GB arrangements.

Note that the capitalisation of the first letter is used to differentiate between USEF role and non-USEF role. For example: "Aggregator" refers to the USEF role, whereas "aggregator" refers to the GB market party.

Table 1: USEF roles in UFTP and in the FUSION trial

Legend:

Role exists in USEF and GB the arrangements but with slightly different responsibilities or names

Role matches USEF and GB arrangements

Role is exclusive to USEF

USEF Role included in the FUSION trial	Included in UFTP	Relation to GB market participants
Distribution System Operator (DSO) <i>Role responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area.</i>	YES	This role will be performed by SP Energy Networks (SPEN) and the UFTP will govern the communication with market participants.
Active Demand Supply (ADS) <i>Energy consuming or producing devices that can be actively controlled.</i>	NO	This role refers to the flexible assets that are managed by the Aggregator. The interaction between the Aggregator and its ADS is out of scope of the UFTP.
Aggregator <i>A service provider that contracts, monitors, aggregates, dispatches and remunerates flexible assets at the customer side. Aggregators buy flexibility from Prosumers and sell it to Flexibility Service Providers.</i>	YES	The USEF <i>role definition</i> for Aggregator differs from the <i>market party</i> aggregator. In FUSION, the Aggregator role can be performed by any party that manages a portfolio of flexible assets, for example, aggregators or suppliers.
Constraint Management Service Provider (CMSP) <i>A provider of constraints management services to a DSO or the ESO.</i>	YES	This role provides flexibility to the DSO for constraint management, therefore, unlike the Aggregator, the CMSP is market facing. In the FUSION trial, the CMSP role can be performed by any market party that offers flexibility services, for example, aggregators.
Common Reference Operator (CRO) <i>Role responsible for operating the Common Reference. The Common Reference as a repository which contains detailed information on network congestion points, their associated connections and active aggregators in the electricity network.</i>	YES	This role will be performed by SPEN and the UFTP will govern the communication between CRO, DSO and market participants.

<p>Meter Data Company (MDC)</p> <p><i>Role designating a company responsible for the acquisition and validation of meter data and to facilitate the flexibility and balancing settlement processes by making accurate and valid data available to market agents.</i></p>	<p>NO</p>	<p>This role will be performed by SPEN, but it's outside of scope of the UFTP.</p>
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Figure 1 below shows the flexibility chain in the FUSION trial expressed in USEF roles. While the Aggregator is responsible for managing the flexibility from their portfolio, the CMSP is facing the market and offers the flexibility to the DSO. Although the roles of Aggregator and CMSP are most likely to be combined under the same market party, they can also be carried out by different actors. For the latter, the interactions between Aggregator and CMSP are out of the scope of USEF and the UFTP.

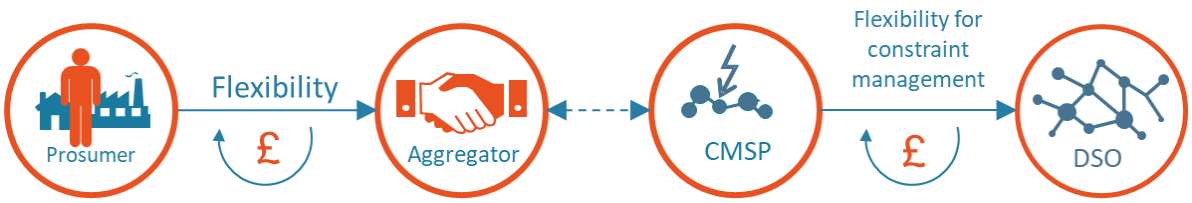


Figure 1: Flexibility value chain in the FUSION trial

The implementation of the UFTP, described in the following sections, is a prerequisite for potential parties looking to provide flexibility services to SP Energy Networks (as DSO) as part of the FUSION trial.

3 DETAILED INFORMATION FLOW IN MARKET COORDINATION MECHANISM PHASES

The Market Coordination Mechanism (MCM) is designed to facilitate and standardise the interactions of market participants; and to enable the optimisation of power, capacity and flexibility transactions from contract to settlement (see Figure 2). This section describes the information exchange between DSO and Aggregator during the 5 phases of the USEF MCM. For each phase, we present the information flow and which interactions are done via the UFTP.

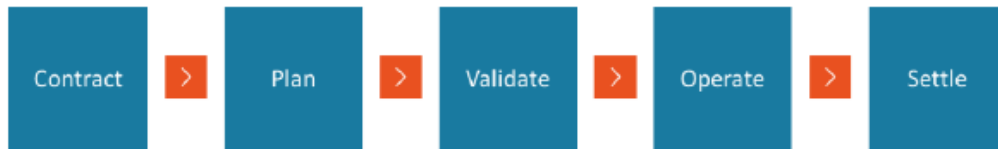


Figure 2: USEF Market Coordination Mechanism phases

Following the reasoning from the previous section, the interactions should be between DSO and CMSP. However, we use the term Aggregator (AGR) to encompass both the roles of, Aggregator and any intermediate CMSP.

3.1 Contract Phase

During the Contract phase, the Aggregator (AGR) and the DSO begin interaction. Figure 3 shows the information exchange that takes place during this phase, which consists of:

- Pre-qualification process (outside of UFTP);
- Negotiation of bilateral flexibility contract (outside of UFTP); and
- Publication of the Aggregator connections in the Common Reference (CR).

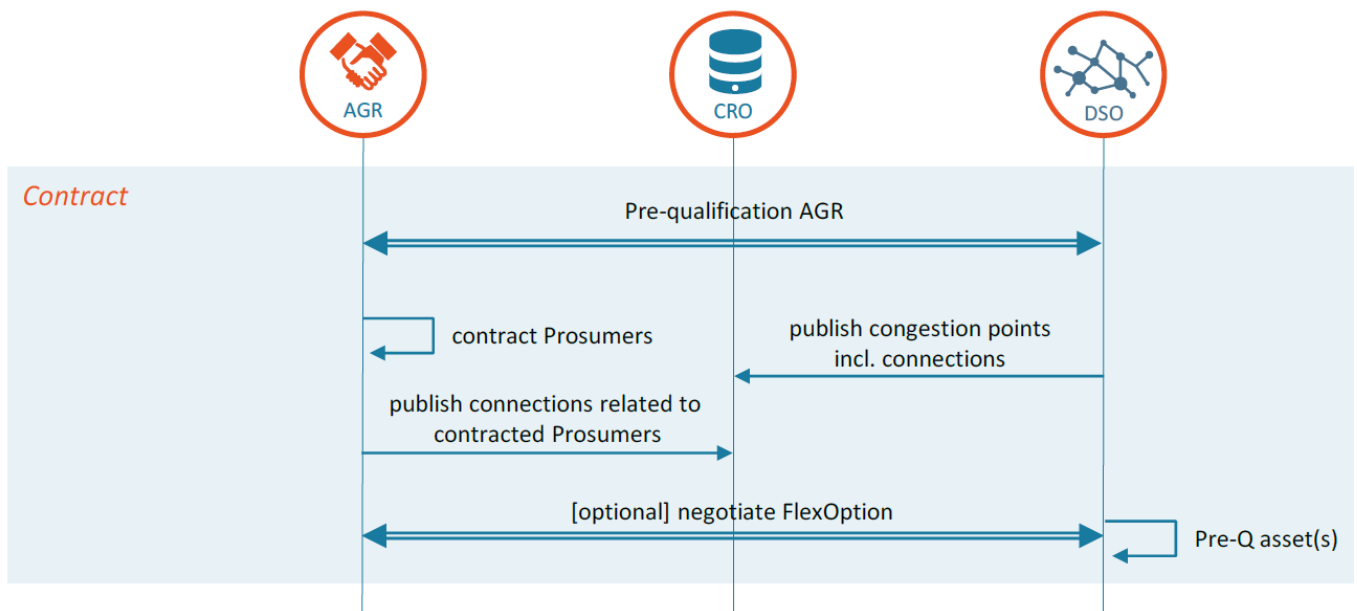


Figure 3: General information flow in the Contract phase

The CR contains a list of connection identifiers (for example MPANs) for each congestion point, as registered by the DSO, as well as a list of the Aggregator connections. The DSO and Aggregators exchange information with the Common Reference Operator (CRO) to publish congestion points and connections, respectively. The UFTP covers this communication flow through XML messages. The CR can be operated in open or closed mode. When operating in

open mode, the CRO will accept updates from any USEF-compliant Aggregators. In closed mode, Aggregators will need to be pre-configured in order for updates to be accepted, this could be done at the pre-qualification stage. Table 2 presents an overview of the messages between CRO, DSO and Aggregator during the Contract phase.

Table 2: Message exchange for the Contract phase

Name	Direction	Message type
Publish Congestion Points (Long-term)	DSO → CRO	DSOPortfolioUpdate / DSOPortfolioUpdateResponse
Publish Connections	AGR → CRO	AGRPortfolioUpdate / AGRPortfolioUpdateResponse

Regarding the type of contract, USEF introduces two types of options for the DSO to procure flexibility:

- **Long-term flexibility option (“FlexOption”):** The activation and offering of flexibility is pre-arranged in a bilateral contract. The negotiation of the FlexOption contract is not part of the USEF messages.
- **Short-term flexibility options (“free bids”):** The Aggregator does not have a contractual obligation to offer flexibility, but instead decides on a daily basis. For this option, no negotiations are necessary during the contract phase.

3.2 Plan Phase

Figure 4 shows the information flow in the Plan phase. In this phase:

- Aggregators optimize their portfolio across the markets and services in which they are active (outside of UFTP);
- Aggregators retrieve the list of Congestion Points from the CRO (only those that correspond to their connections);
- The DSO retrieves the list of Aggregators active in the congestion points; and
- Optionally, the DSO sends a “FlexReservationUpdate” message to long-term contracted Aggregators to signal whether the contracted amount of flexibility is not (or only partially) needed.

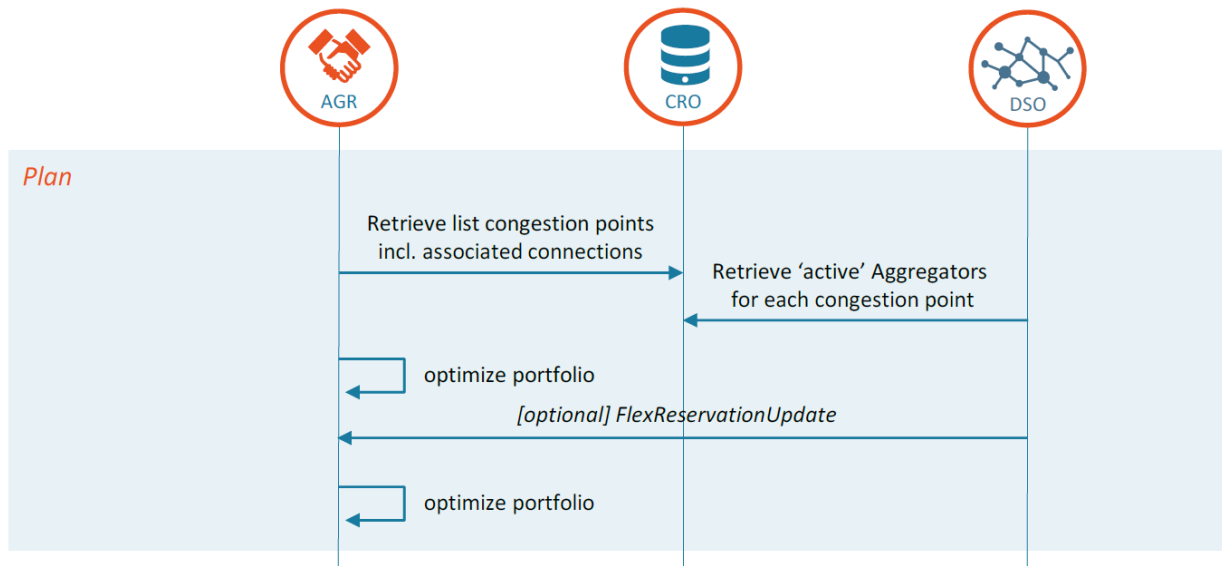


Figure 4: General information flow in Plan phase

The communication between CRO and Aggregators for the retrieval of congestion points is specified in the UFTP through XML messages. In a similar manner, the DSO retrieves the active connections in the congestion point from the CR. Table 3 below presents the overview of Plan phase messages between CRO, DSO and Aggregator.

Table 3: Message exchange for the Plan phase

Name	Direction	Message type
Retrieve Congestion Points	AGR → CRO	AGRPortfolioQuery / AGRPortfolioQueryResponse
Retrieve Active Aggregators	DSO → CRO	DSOPortfolioQuery / DSOPortfolioQueryResponse
Exchange Flexibility Reservation Update	AGR ← DSO	FlexReservationUpdate / FlexReservationUpdateResponse

3.3 Validate Phase

Figure 5 shows the information flow in the Validate phase.

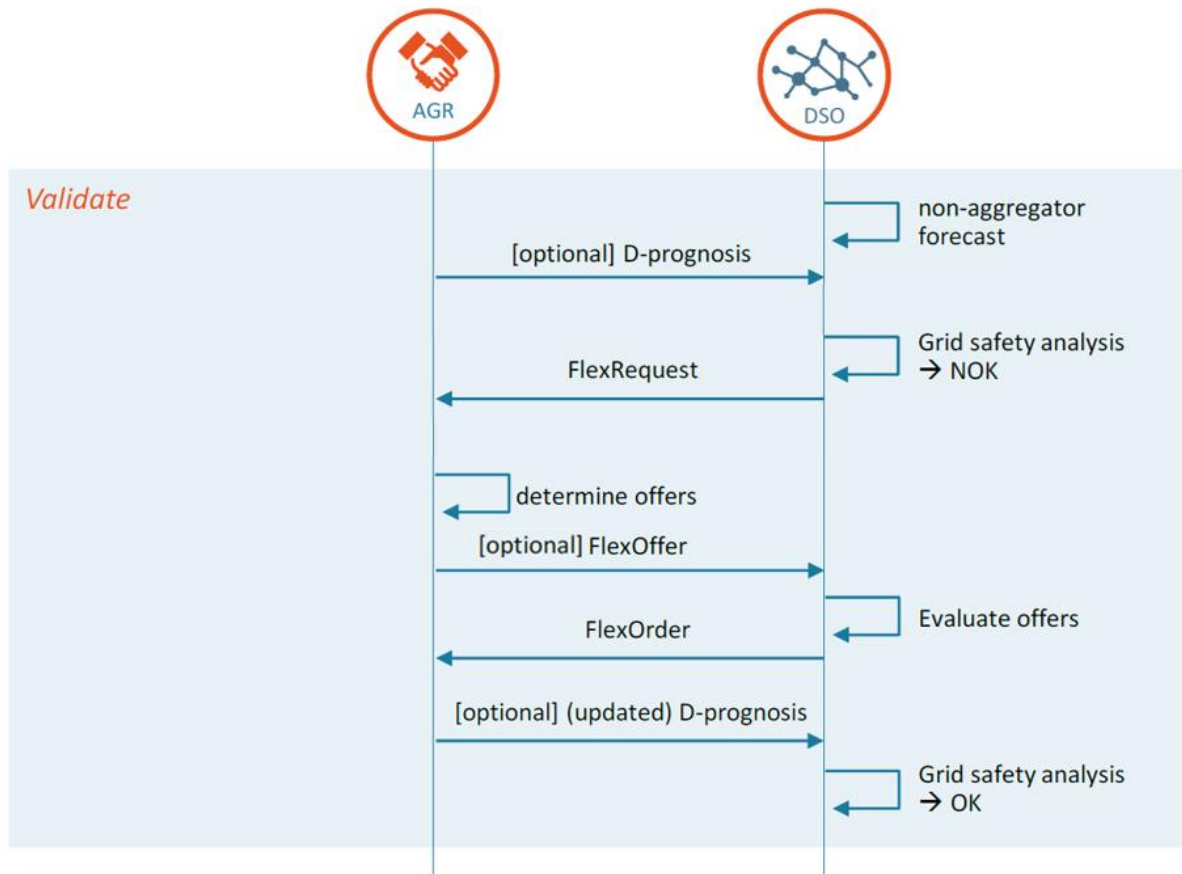


Figure 5: General information flow in Validate phase

During the Validate phase, Aggregators and DSOs iterate the following process until gate closure:

- Aggregators create D-programmes⁴ for each congestion point, based on the optimisation (of the Plan phase), and exchanges them with the DSO (D-programmes are only mandatory when they are used as a baseline to quantify the flexibility delivery. The UFTP allows for other baselining methods);
- The DSO performs a grid safety analysis with their own forecast and the D-programmes from the Aggregators to determine if congestion is expected and, if so, determines how much flexibility is needed (outside of UFTP);
- If needed, the DSO sends flexibility requests to Aggregators;

⁴ D-programmes (or D-prognosis) are a forecast of aggregated load and generation of Aggregator's connections per congestion point per Settlement Period. The creation of D-programmes is outside of the UFTP, however, there are a number of attributes that they must contain to comply with the submission message described in the USEF Flex Trading Protocol Specifications.

- Aggregators with long term contracts need to fulfil their contract obligation and if required send flex offers;
- Other Aggregators who are able and willing to respond to the DSO request, can optionally send flex offers;
- The DSO evaluate the offers (outside of UFTP) and, if the orders are a good fit, the DSO sends a flex order;⁵ and
- Aggregators (after receiving a flex order) return to the Plan phase to re-optimize their portfolio and send an updated D-programme to the DSO reflecting the flexibility ordered.

The communication - for submission of (updated) D-programmes, flex requests, flex offers (revocation) and flex orders – follows the UFTP messaging exchange summarised in Table 4.

Table 4 Message exchange for the Validate phase

Name	Direction	Message type
Exchange D-Prognoses per Congestion Point	AGR → DSO	Prognosis / PrognosisResponse
Exchange Flexibility Requests	AGR ← DSO	FlexRequest / FlexRequestResponse
Exchange Flexibility Offers	AGR → DSO	FlexOffer / FlexOfferResponse
Revocation Flexibility Offer	AGR → DSO	FlexOfferRevocation / FlexOfferRevocationResponse
Exchange Flexibility Orders	AGR ← DSO	FlexOrder / FlexOrderResponse

The UFTP also offers two additional, optional structures for FlexOffer messages:

- A FlexOffer can contain multiple mutually exclusive options.
- A FlexOffer can indicate the capability of partial activation in their offers.

3.4 Operate Phase

Figure 6 shows the information flow in the Operate phase. In this phase:

- The DSO continuously monitors the grid, assessing whether deviations create extra flexibility needs (out of UFTP);
- If needed, the DSO can evaluate the flexibility offers that are still active and send a FlexOrder to the Aggregators;
- The Aggregator continuously monitors that the operation is adhering to the D-programme and flexibility is delivered (out of UFTP);
- If deviations from the D-programme occur, and the Aggregator cannot mitigate them within its portfolio, it's needed to inform the DSO of the changes with an updated D-programme; and
- The Aggregator can revoke flexibility offers if they are no longer feasible.

⁵ If the offered flexibility is not sufficient to resolve the expected congestion or no flexibility is offered, USEF moves to the Orange regime (out of scope of Project FUSION).

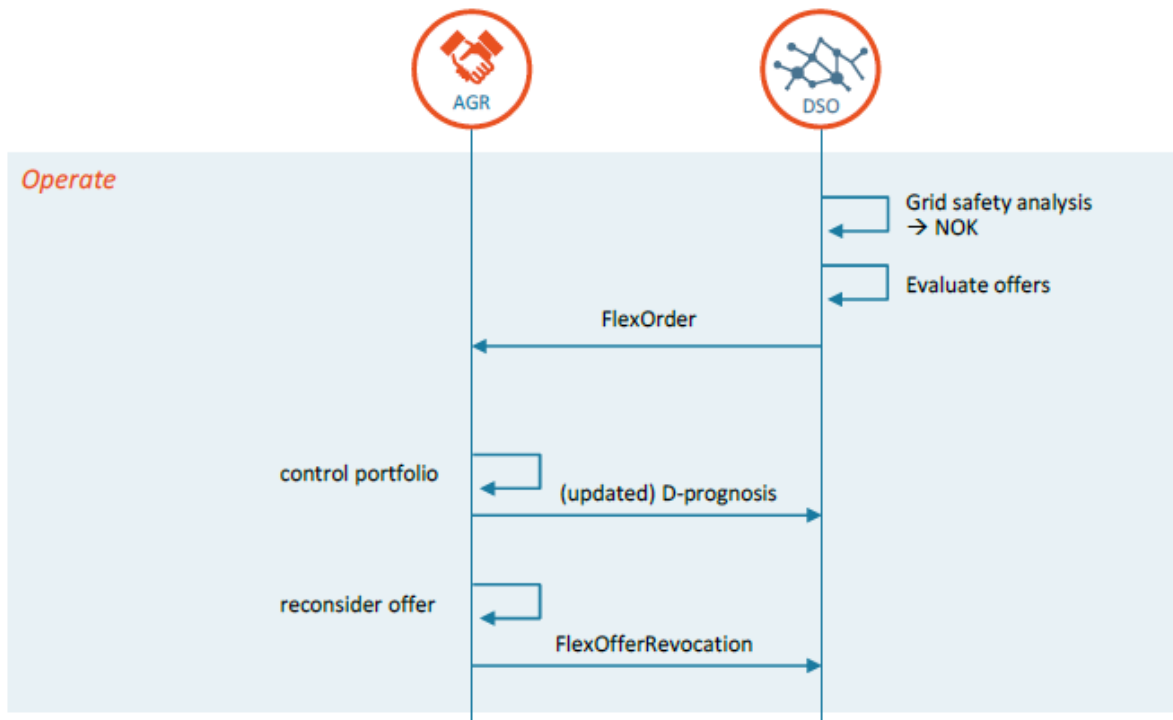


Figure 6 General information flow in Operate phase

The USEF messages related to flexibility trading during the Operate phase are summarised in Table 5.

Table 5 Message exchange for the Operate phase

Name	Direction	Message type
Exchange updated D-Prognoses	AGR → DSO	Prognosis / PrognosisResponse
Revocation Flexibility Offer	AGR → DSO	FlexOfferRevocation / FlexOfferRevocationResponse
Exchange Flexibility Orders	AGR ← DSO	FlexOrder / FlexOrderResponse

3.5 Settle Phase

Figure 7 shows the information flow in the Settle phase. In this phase:

- The DSO collects the meter data (out of UFTP);
- When sub-meters are used, the Aggregator sends the meter data to the DSO (outside of UFTP);
- The DSO calculates the procured flexibility, per Settlement Period, by subtracting the baseline (D-programme) to the actual measurements (out of UFTP);
- The DSO calculates remuneration and penalties based on the flexibility delivery (outside of UFTP);
- The DSO sends settlement to Aggregator; and
- The Aggregator validates the settlement, with their own calculations, and accepts it or disputes it.

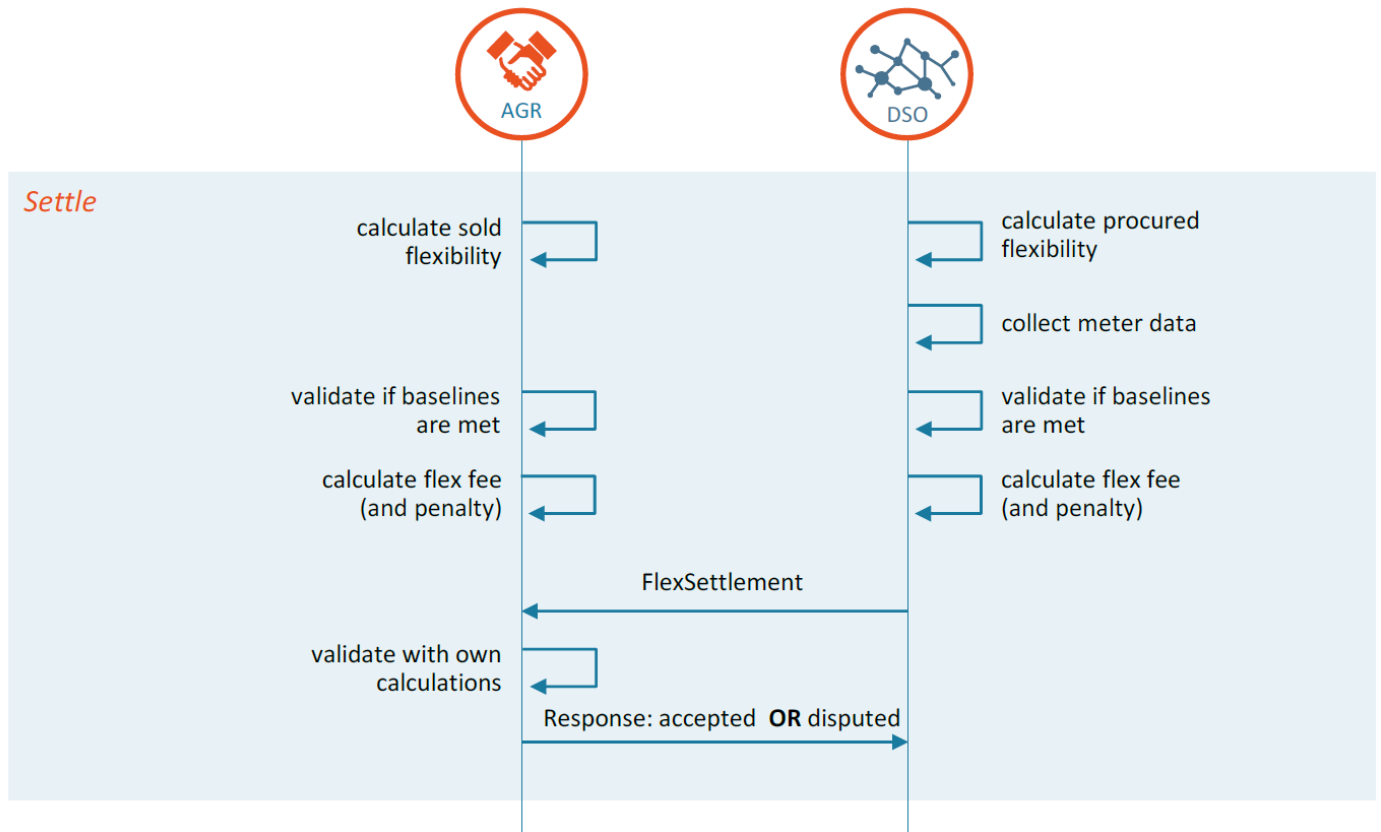


Figure 7: General information flow in Settle phase

The calculation and validation of flexibility delivery is performed out of the UFTP. The DSO and the Aggregator should carry these activities independently and exchange information to share the results, as summarised in Table 6.

Table 6: Message exchange for the Settle phase

Name	Direction	Message type
Process Settlement Items	AGR ← DSO	FlexSettlement/ FlexSettlementResponse

4 USEF MESSAGE DESCRIPTIONS

USEF messages are characterised in XML syntax⁶ and UTF-8 encoding, and they should validate against the USEF schema corresponding to the specification version available at the USEF website.⁷

Table 7 summarises all USEF messages, their description and to which MCM phases they are relevant. Each message must contain specific attributes that are described in Section 4.2 of the USEF Flexibility Trading Protocol Specifications document.⁸ Common to all USEF messages (except for SignedMessage) are the metadata attributes:

- **SenderDomain:** The Internet domain of the USEF participant sending this message.
- **RecipientDomain:** Internet domain of the participant this message is intended for.
- **TimeStamp:** Date and time this message was created.
- **MessageID:** Unique identifier for the message.
- **ConversationID:** Unique identifier used to correlate responses with requests.
- **ISP-Duration:** Time interval indicating the duration of the Settlement Period (in the GB, 30min).
- **TimeZone:** Time zone ID.

Table 7: USEF message catalogue

Message	Phase	Direction	Description
SignedMessage	General	X→X	Secure wrapper used to submit USEF XML messages
TestMessage	Test	X→X	Message for testing purposes
TestMessageResponse	Test	X→X	Response for TestMessageResponse
AGRPortfolioUpdate	Contract	AGR→CRO	AGR connection publications in CRO
AGRPortfolioUpdateResponse	Contract	CRO→AGR	Response for AGRPortfolioUpdate
DSOPortfolioUpdate	Contract	DSO→CRO	DSO congestion point publication
DSOPortfolioUpdateResponse	Contract	CRO→DSO	Response for DSOPortfolioUpdate
AGRPortfolioQuery	Plan	AGR→CRO	Connection retrieval
AGRPortfolioQueryResponse	Plan	CRO→AGR	Response for AGRPortfolioQuery
DSOPortfolioQuery	Plan	DSO→CRO	Retrieval of active AGR in connection points
DSOPortfolioQueryResponse	Plan	CRO→DSO	Response for DSOPortfolioQuery
FlexReservationUpdate	Plan	DSO→AGR	Indication from DSO to AGR on flexibility reservation need
FlexReservationUpdateResponse	Plan	AGR→DSO	Response for FlexReservationUpdate
D-Prognosis	Validate/ Operate	AGR→DSO	D-programme
D-PrognosisResponse	Validate/ Operate	DSO→AGR	Response for D-Prognosis
FlexRequest	Validate	DSO→AGR	Flexibility request per congestion point
FlexRequestResponse	Validate	AGR→DSO	Response for FlexRequest
FlexOffer	Validate	AGR→DSO	Flexibility offer per congestion point
FlexOfferResponse	Validate	DSO→AGR	Response for FlexOffer

⁶ The UFTP does not specify an XML wrapper, but the open source 'message library' software (expected to be freely available by Q3 2020) is planned to include a wrapper. Details of how to access the software will be shared on the FUSION website in due course.

⁷ The current version of this schema, as well as all historic production versions are available for download from the USEF web site, with <https://github.com/USEF-Foundation/UFTP> corresponding to this specification version.

⁸ USEF Flexibility Trading Protocol Specifications https://www.usef.energy/download-the-framework/#popup_overlay1

FlexOfferRevocation	Validate/ Operate	AGR→DSO	Revocation of flexibility offer
FlexOfferRevocationResponse	Validate/ Operate	DSO→AGR	Response for FlexOfferRevocation
FlexOrder	Validate/ Operate	DSO→AGR	Purchase flexibility order in response to a flexibility offer
FlexOrderResponse	Validate/ Operate	AGR→DSO	Response for FlexOrder
FlexSettlement	Settle	DSO→AGR	Order to initiate settlement
FlexSettlementResponse	Settle	AGR→DSO	Response for FlexSettlement

5 MESSAGE TRANSPORT MECHANISM

The UFTP specification defines the content of XML messages between roles. Each message has a unique recipient, identified by the Internet domain and USEF role of the participant. The message transport mechanism enables the sending and receiving of these messages.

UFTP implements asynchronous message exchange by implementing XML over HTTPS. For security reasons, all payload in the exchanged messages is signed. USEF recommends the implementation of service discovery by means of Domain Name Servers (DNS).

Figure 8 shows the end-to-end message exchange. The sender (HTTP client, left part) retrieves the message (step 1) and determines the USEF endpoint of the client via DNS (step 2). Then the message is signed using NaCl private key (step 3). The message is then posted over HTTPS (step 4). The receiver (HTTP server, right part) receives the message and checks against the HTTP protocol (step 1). Errors are signaled via the HTTP synchronous reply.⁹ The XML payload is extracted (step 2) and unsealed (step 3). The result is a valid UFTP XML message. Errors in steps 2 or 3 are signaled via HTTP synchronous reply. In case of errors, the sender may retry or signal to the application (client steps 5-7).

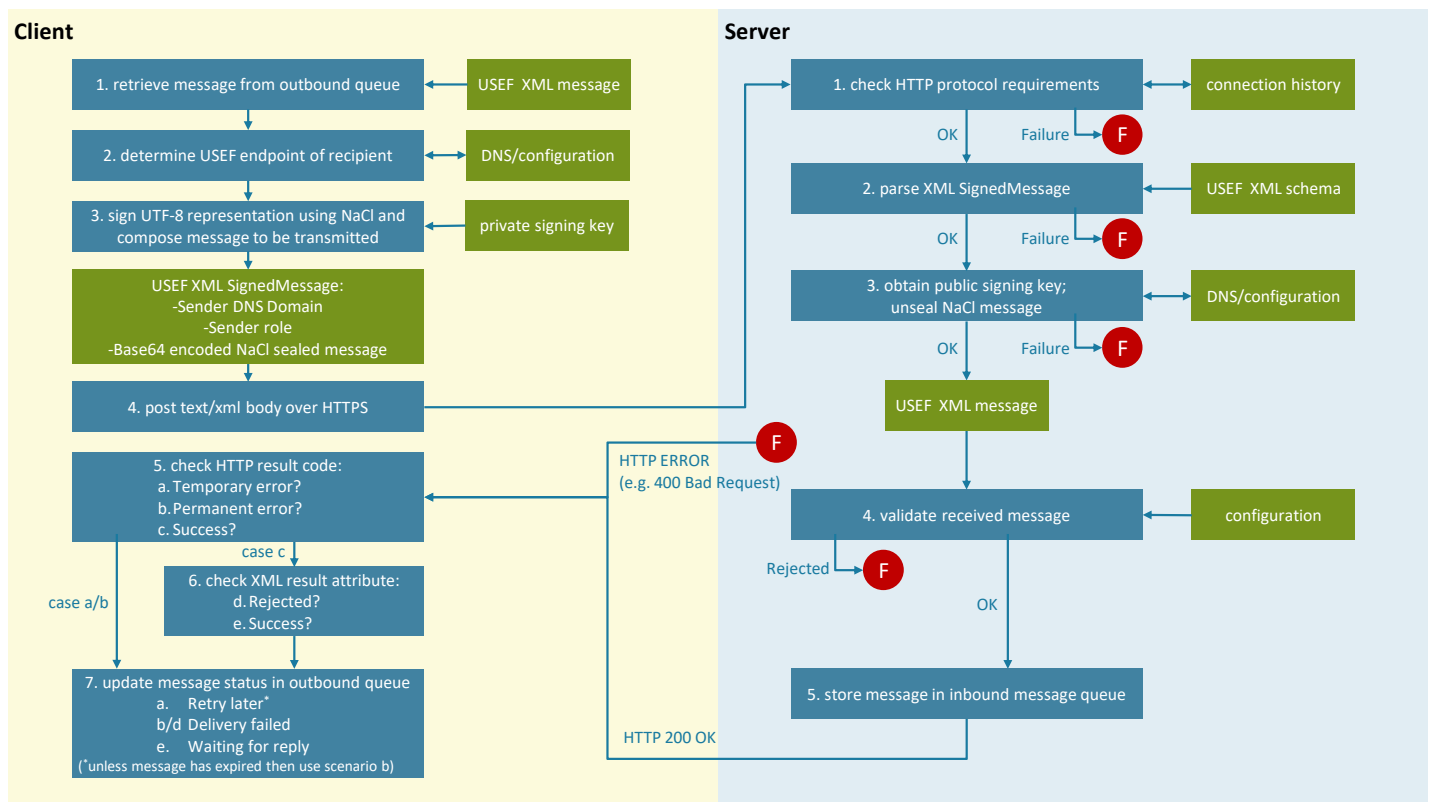


Figure 8: End-to-end UFTP message exchange

5.1 Cryptographic Scheme

The UFTP uses a Cryptographic Scheme Type 1 (CS1). This scheme, based on NaCl,¹⁰ requires participants to generate two public/private key pairs for digital signatures and Authenticated message encryption. While digital signatures are mandatory, message encryption is optional as the basic HTTPS encryption already provides an

⁹ See UFTP Specifications Appendix IV Section 4 for possible errors https://www.usef.energy/download-the-framework/#popup_overlay1

¹⁰ NaCl is a public domain library with high-speed state-of-the-art security features and a purpose-built and straightforward programming interface.

adequate level of security. The two public keys are combined in a single base-64 encoded key string and can be communicated to the counterparty via any channel (e.g. email). In addition, they are published via DNS.

5.2 Service Discovery

In the service discovery stage, DNS¹¹ is used to discover the capabilities as well as the endpoint host name and IP address of the remote participant.

Table 8 shows the required DNS entries for a fictional CRO that provides an UFTP implementation on <https://uftp.common-reference.energy>.

Table 8: Fictional CRO DNS example

Entry	Meaning	Fictional Example
_usef.usef.{domain}	TXT record specifying the version of the USEF specification implemented by this participant where {domain} is the domain name used by the participant.	_usef.usef.common-reference.energy
		2019
_{role}_usef.usef.{domain}	TXT record containing up to two1 space-separated Base-64 encoded public key strings for the specified role where {role} is one of the values agr, dso or cro.	_cro._usef.usef.common-reference.energy
		cs1.St/xFdKeIqTWIKRWBTxFAdaBeUIQ5dIOJBw4206J69w=
http.{role}_usef.usef.{domain}	CNAME record indicating the HTTP endpoint receiving messages for the specified role where {role} is one of the values agr, dso or cro.	_cro._usef.usef.common-reference.energy
		uftp.common-reference.energy

5.3 EA1 addressing scheme

USEF messages often require a unique identity for certain entities. To meet this requirement, USEF defines the Entity Address (EA). Each EA consists of a prefix, indicating the addressing scheme, followed by the actual address. Currently, USEF supports two addressing schemes:

- The European Article Number (EAN): It is commonly used to uniquely identify connection points in the electricity network and therefore a natural identifier to do the same in USEF. An example of an EA using this scheme is: ean.871685900012636543.
- The USEF type 1 entity address (EA1): It is designed to allow participants to generate unique identifiers for themselves and entities managed by them without relying on a central authority.

¹¹ Each USEF participant is responsible for publishing its own endpoint and public key information in a self-managed Domain Name Servers (DNS) zone. To prevent man-in-the-middle interference with the published information, use of DNS System Security Extensions (DNSSEC) is mandatory for such zones.

6 MAINTENANCE OF USEF COMMUNICATION PROTOCOL

This section describes the UFTP governance, backward compatibility and foreseen developments for future versions.

6.1 Governance

UFTP and the USEF Framework are developed, maintained and audited by the USEF Foundation. The USEF User Community is invited to give feedback and collaborate with the USEF Foundation to improve and maintain the UFTP. This process is currently done via email communication, however, the USEF Foundation intends to create a dedicated channel for User Community feedback. Any party interested can join the USEF User Community with no costs involved.¹²

If, under any circumstances, the USEF Foundation is dissolved or is not able to maintain the UFTP, there is a change management process in place that will transfer the UFTP maintenance responsibility to the User USEF community.

6.2 History and Backward Compatibility

The UFTP was created to simplify the original USEF message structure defined in the 2015 Reference Implementation. The USEF Foundation took this decision, based on user feedback, for allowing an easier and a more user-friendly implementation. The modification was only possible by changing the message structure, which ultimately led to backward incompatibility between the original (2015) USEF protocol and the UFTP.

The USEF Foundation seeks to avoid backward and forward incompatibility with future versions. Therefore, the UFTP was designed to allow for more flexibility to accommodate potential changes and extensions. The current message protocol admits, for example, adding optional element or attributes. However, there might be certain changes that do not guarantee compatibility; these will be avoided to the extent possible.

6.3 Foreseen Future Developments

The USEF Foundation intends to continuously improve the UFTP and solve potential issues. The Foundation will address any potential minor changes to ensure the well-functioning of the protocol as promptly as possible. For other improvements that require major modifications or extensions, the USEF Foundation expects to release, at least, a yearly UFTP update.

The foreseen modifications for future versions depend on the User Community feedback. However, there are already some elements that the Foundation seeks to implement in the next version.

¹² To join the USEF User Community, send a request via <https://www.usef.energy/contact/>

7 SPECIFIC REQUIREMENTS FOR FUSION TRIAL PARTICIPANTS

This section describes the specific services that will be tested in the FUSION trial as well as processes in the USEF Market Coordination Mechanism (MCM) phases and associated timings. The section concludes with an overview of requirements for the FUSION trial participants.

7.1 Description of Services to be Trialled in FUSION

Project FUSION will trial three DSO flexibility services in 2021 for forecast overload, pre-fault and post-fault events and will draw on Electricity Networks Association (ENA) Open Networks products: *Sustain*, *Secure* and *Dynamic*. These products fall under USEF's Grid Capacity Management and USEF's Congestion Management categories and have been assigned the following names for FUSION.

- **Sustain Peak Management:** A service to provide the DSO with a planned reduction in demand or increase in generation in advance of forecast capacity constraints at peak time, e.g. to reduce the loading on a transformer during winter tea-time peak.
- **Secure DSO Constraint Management (Pre-Fault):** A service to provide the DSO with an immediate reduction in demand or increase in generation during a planned outage of one or more critical assets or in the event of network disturbances to maintain security standards and avoid any customer minutes lost.
- **Dynamic DSO Constraint Management (Post-Fault):** A service to provide the DSO with an immediate reduction in demand or increase in generation following an unplanned outage of one or more critical assets to maintain security standards and avoid any customer minutes lost.

7.2 Proposed Timing for Implemented USEF Processes with FUSION

USEF does not prescribe the timing and deadlines for completion of the processes contained in the MCM phases, and these will be set at the discretion of Project FUSION. The process timings represented in this document represent those which have been tentatively agreed between Partners during initial trial planning discussions and are included in this document for indicative purposes only. The rationale for selecting these indicative timings included an effort to ensure the trading takes place during working hours to facilitate the participation of flexibility providers.

Due to the different nature of the products described in the section above, during the FUSION trial, the timing of some of the processes will differ from product to product. Figure 9, Figure 10 and Figure 11 show the different timing for Dynamic DSO Constraint Management (Post-Fault), Secure DSO Constraint Management (Pre-Fault) and Sustain Peak Management, respectively, for the Plan, Validate, Operate and Settle phases.

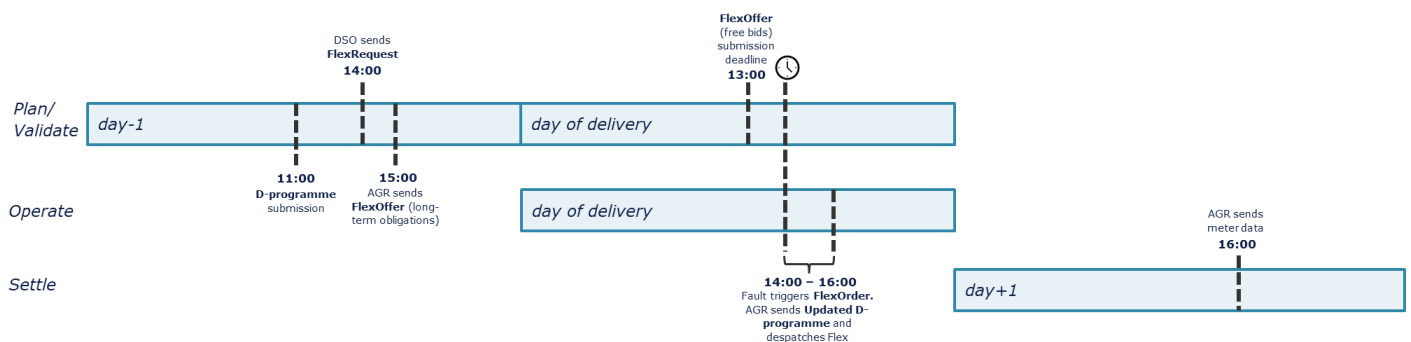


Figure 9: Indicative FUSION trial timing for Dynamic DSO Constraint Management (Post-Fault) product for MCM phases (except Contract)

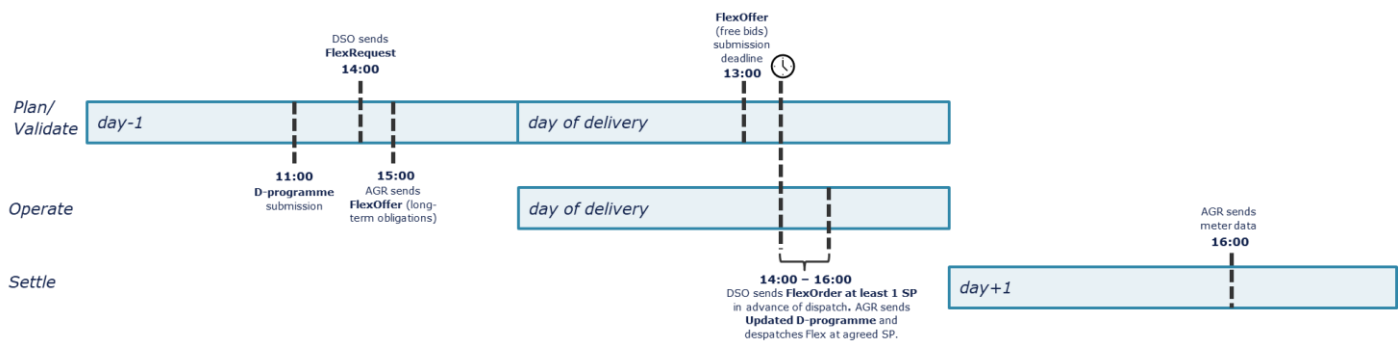


Figure 10: Indicative FUSION trial timing for Secure DSO Constraint Management (Pre-Fault) product for MCM phases (except Contract)

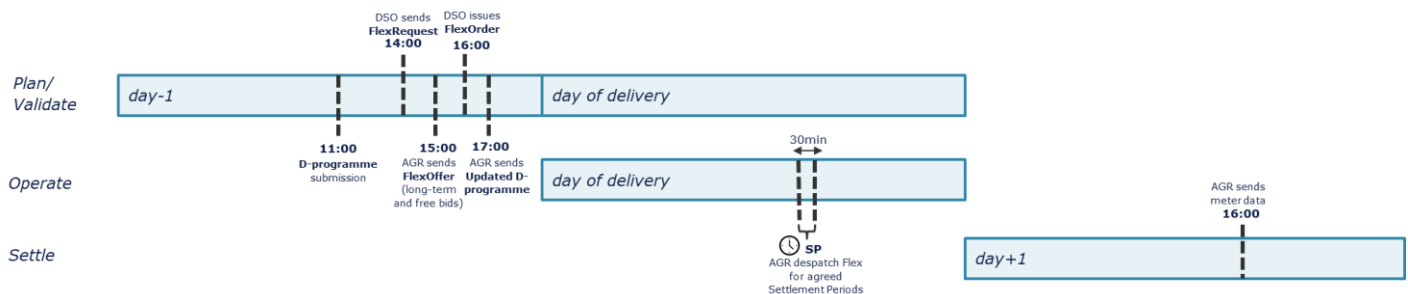


Figure 11: Indicative FUSION trial timing for the Sustain Peak Management product for MCM phases (except Contract)

An overview of the indicative timing per MCM phase:

- **Contract phase:** The contracting, pre-qualification and the publication of connections in the Common Reference (CR) will take place at the very beginning of the trial.
- **Plan phase:** It iterates with the Validate phase during day ahead and intra-day until
 - 13:00 on the delivery day for Dynamic DSO Constraint Management (Post-Fault) and Secure DSO Constraint Management (Pre-Fault) products; and
 - 16:00 day-ahead for Sustain Peak Management product.
- **Validate phase:** The deadline for the submission of D-programmes is 11:00 day-ahead, the DSO will send FlexRequests until 14:00 day-ahead.
 - For the Dynamic DSO Constraint Management (Post-Fault) and Secure DSO Constraint Management (Pre-Fault) products, the Aggregator/CMSP submits the bids corresponding to long-term obligations until 15:00 day-ahead. The deadline for submitting free bids is at 13:00 the day of delivery.
 - For the Secure DSO Constraint Management (Pre-Fault) product, the DSO monitors the grid and if a fault is foreseen, the DSO sends a FlexOrder at least 1 SP period in advance.
 - For the Sustain Peak Management product, the Aggregator/CMSP submits, both, long-term obligations and free bids by 15:00 day-ahead. The DSO issues the FlexOrder by 16:00 day-ahead. Following the FlexOrder, the CMSP/Aggregator should submit the updated D-programme within an hour.

- **Operate phase:** Takes place during each Settlement Period (30 minutes).
 - For the Dynamic DSO Constraint Management (Post-Fault) product, the fault will be simulated within a Settlement Period between 14:00 and 16:00. The fault will automatically trigger a FlexOrder and the CMSP/Aggregator needs to dispatch the offered flexibility, for that Settlement Period, as quickly as specified in the product specifications. Following the FlexOrder, the CMSP/Aggregator must send an updated D-programme to the DSO.
 - For the Secure DSO Constraint Management (Pre-Fault) product, the CMSP/Aggregator will dispatch the flexibility as indicated by the FlexOrder.
 - For the Sustain Peak Management product, the CMSP/Aggregator will dispatch the flexibility as indicated by the FlexOrder the day ahead of delivery.
- **Settle phase:** The CMSP/Aggregator must provide the meter data 1 day after flexibility delivery. The DSO sends the monthly settlement report within 3 working days of the completion of month in question.

7.3 Requirements

7.3.1 List of Functional Requirements

Table 9 shows the functional requirements that are applicable for all FUSION trial participants (FTPs).

Table 9: Functional requirements

ID	Phase	Functional requirement
FR1	All	The FTP shall be able to aggregate information at congestion point level, for forecasting, monitoring and settlement purposes.
FR2	Contract	The FTP shall be able to interact with a central registry (i.e. Common Reference), where it can register all customers within its portfolio (i.e. customers with assets that are under control of the FTP) and unregister customers that have been removed from their portfolio.
FR3	Contract	The FTP shall have long-term forecasting capabilities for the assets that will be used to meet its obligations of each availability contract.
FR4	Contract	The FTP shall be able to register the characteristics of availability contracts (FlexOptions) per DSO per congestion point.
FR5	Plan	The FTP shall be able to interact with a central registry (i.e. Common Reference), and retrieve all congestion points for all DSOs, indicating which of the FTP's connections can participate in the flexibility market per congestion point.
FR6	Plan	The FTP shall be able to process information from the DSO, removing its obligation to participate in the flexibility market as stipulated by the availability contract, for the specified congestion point and date(s).
FR7	Plan	In case the FTP has entered into an availability contract for a specific congestion point, the FTP shall ensure that the contracted flexibility is always available for the DSO to acquire, within the service window agreed.
FR8	Validate	The FTP shall have day-ahead and intraday forecasting capabilities for the assets that will be used for the flexibility trading.

ID	Phase	Functional requirement
FR9	Validate	The FTP shall be able to receive and process flexibility requests from a DSO for a specific congestion point, in the day ahead and intraday timeframe.
FR10	Validate	The FTP shall be able to determine the marginal costs of flexibility activation, and to price a flexibility offer on portfolio (congestion point) level.
FR11	Validate	The FTP shall be able to offer its flexibility to the DSO, responding to the DSO's flexibility request.
FR12	Validate	The FTP shall be able to withdraw an offer before it has been accepted, in case the FTP is no longer able to deliver the offered flexibility.
FR13	Validate	The FTP shall be able to indicate during which times the rebound will occur, in case of time-shifters.
FR14	Validate / Operate	The FTP shall be able to monitor its assets in real-time, and the amount of flexibility they can provide / are providing
FR15	Validate / Operate	The FTP shall be able to optimize its portfolio, e.g. activating additional / other assets in case the initially planned set of assets is unable to deliver the required flexibility.
FR16	Validate / Operate	The FTP shall be able to execute and deliver a flexibility order, from day-ahead to close to real-time.
FR17	Validate / Operate	For rare, unforeseen circumstances, when the FTP is not able to deliver the flexibility according to the flexibility order, the FTP shall be able to inform the DSO as soon as possible.
FR18	Operate	The FTP shall be able to dispatch the flexibility in line with the flexibility order. Depending on product specifications, this should cover both the scheduling of flexibility events, and real-time dispatch.
FR19	Settle	In case sub-meters (local meters) are used for the monitoring and settlement of flexibility, the FTP shall be able to collect the measurement data (latest) the day after activation, and submit the raw (half-hourly) measurement data to the DSO, for all assets within its portfolio, per congestion point.
FR20	Settle	The FTP shall be able to calculate the amount of flexibility it has delivered relative to each flexibility order, by subtracting the measurement data from the baseline (self-generated forecast which was communicated to the DSO prior to the flexibility order) per connection, and aggregating all flexibility quantities per congestion point.
FR21	Settle	The FTP shall be able to validate the flexibility settlement calculations performed by the DSO.

7.3.2 List of Technical Requirements

Table 10 shows the technical requirements that are applicable for all FUSION trial participants (FTPs).

Table 10: Technical requirements

ID	Technical requirement
TR1	All communication between the FTP and the DSO, as well as between the FTP and the CRO, shall be fully UFTP-compliant. All messages defined for these interactions shall be supported.

ID	Technical requirement
TR2	The FTP shall make use of a portfolio management system which automates the flexibility trading processes as much as possible.
TR3	The FTP shall have sub-metering in place for all assets that are deployed for congestion management services, with sufficient accuracy, in line with the product specifications.

7.3.3 List of Security Requirements

Table 11 shows the security requirements that are applicable for all FUSION trial participants (FTPs).

Table 11: Security requirements

ID	Security requirement
SR1	The FTP shall be able to encrypt and securely transmit and authenticate USEF messages.
SR2	The FTP shall not retain personal and personally identifiable data (such as forecasts or meter readings) longer than the trial period, unless strictly required.

7.3.4 List of Other Non-Functional Requirements

Table 12 shows the other non-functional requirements that are applicable for all FUSION trial participants (FTPs).

Table 12: Other non-functional requirements

ID	Non-functional requirement
NF1	The FTP shall have a contract in place for the service received from their prosumers
NF2	The FTP shall store the meter data and all information exchange with the DSO and CRO for the duration of the FUSION trial.
NF3	The FTP shall be willing and capable to share audit and logging information, in order to analyse the complete flexibility chain (DSO to flexible asset) during the trial.
NF4	For auditing purposes, the FTP shall be able to indicate which clocking arrangement has been applied for audit trail and log entries.

APPENDIX A: GLOSSARY

Aggregator (AGR)	A service provider that contracts, monitors, aggregates, dispatches and remunerates flexible assets at the customer side. (USEF terminology)
Common Reference (or congestion point repository)	USEF defines the Common Reference as a repository which contains information about connections and congestions points in the network.
Common Reference Operator (CRO)	In USEF, the CRO is responsible for operating the Common Reference. The CRO's role is to ensure the publication of both the DSO flexibility requirements and the associated flexibility assets in each congested point as well as the standardisation of this publication for all distribution areas.
Congestion Management	The avoidance of the thermal overload of system components by reducing peak loads. The conventional solution to thermal overload is grid reinforcement (e.g. cables, transformers). Congestion management may defer or even avoid the necessity of grid investments.
Constraint Management Service Provider (CMSP)	A provider of constraint management services to a DSO or the TSO. This is a USEF role and is not currently used in GB. This role takes on specific responsibilities in communicating and coordinating flexibility transactions with the ESO and DSOs, to ensure effective deployment of flexibility as well as effective management of network constraints. Responsibilities also involve ensuring efficient dispatch of flexibility to maintain the safety and reliability of the networks.
D-prognosis	Aggregator forecast of the amount of energy to be consumed or produced at a given congestion point.
D-programmes	Aggregator forecasts of planned activations of flexibility (day-ahead and intraday) to be shared with DSOs in congested distribution network areas.
Distribution System Operator (DSO)	As defined in DIRECTIVE 2009/72/EC: A natural or legal entity responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity.
Flexibility	Ability of an asset or a site to purposely deviate from a planned or normal generation or consumption pattern.
Market Coordination Mechanism (MCM)	The Market Coordination Mechanism in USEF includes all the steps of the flexibility trading process, from contractual arrangements to the settlement of flexibility. USEF splits the flexibility trading process in five phases and describes the interactions between market participants and information exchange requirements in each phase of the MCM.
Prosumer	This role refers to end-users who only consume energy, end-users who both consume and produce energy, as well as end-users that only generate (including on-site storage). (USEF terminology)
Settlement Period	The time unit for which imbalance of the balance responsible parties is calculated. In GB is 30 minutes.
Supplier	The role of the Supplier is to source and supply energy to end-users, to manage (hedge) delivery and imbalance risks, and to invoice its customers for energy.
USEF Flexibility Trading Protocol (UFTP)	A protocol that describes the interactions for the exchange of flexibility between Aggregators (or other flexibility service providers) and DSOs.