

2020

Proof-of-Concept report

DREM – DSO ROLE IN ELECTRICITY MARKET
D6.2 REPORT

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<i>Document no.:</i>	DREM-D6.2 Proof-of-Concept report
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<i>Last revision date:</i>	2020-04-02

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1 Introduction and scope

The DREM project is a R&D project partly funded by the partners and the EUDP program.

DREM stands for – **D**istributed system operators **R**ole in the **E**nergy **M**arket

Partners in the project are: Radius Elnet (project leader), HOFOR, DTU, Markedskraft and EURISCO

The objective of the DREM project is to investigate specific problems faced by DSOs in a future energy system where power system balancing services are provided by flexibility assets, connected at the distribution level.

Large scale use of flexibility assets may cause congestion problems as well as market conflicts between operators, and the overall socio-economic objectives may be hampered by private financial objectives.

DREM will investigate how the DSO could provide a service in a form of a *Trade Permission System (TPS)* to secure that trade on electricity markets is not causing congesting problems in the distribution system.

The communication scheme that forms the basic instrument in TPS is expected to utilize and further develop the communication protocol developed and tested in another R&D project called CHPCOM (Combined Heat and Power Communication - www.chpcom.dk) where congestion issues from the DSOs point of view, was not investigated completely.

CHPCOM developed and tested a standardized communication platform¹ primary for the CHP, which is facilitating easy and safe communication between energy assets in general. The perspective of the CHPCOM project was precisely to enable such communication used further in a smart energy future and in this way, facilitate market models and smooth competition.

1.1 The scope of this document

- ✓ This document will focus on the ICT implementation for the data communication platform, based on the WP5.1, WP6.1 requirement specification.
- ✓ Basic ICT architecture for the TPS platform
- ✓ Basic MADES² network and technologies
- ✓ Meta data documentation for TPS platform message exchange

¹ CHPCOM used IEC 61850, which is generally agreed to be the international standard. Energinet.dk has in Regulations since 2007 recommended this standard.

² ENTSO-E's Market Data Exchange Standard (MADES)

1.2 Introduction to the ‘Proof-of-Concept’

Development of a Proof-of-Concept (PoC) involves a broad spectrum of elements, from conceptual ideas to requirements specification and implementation – before the PoC can be tested in laboratory or real-life field-test.

All this was done in DREM and the illustration below, shows the basic steps it involved.

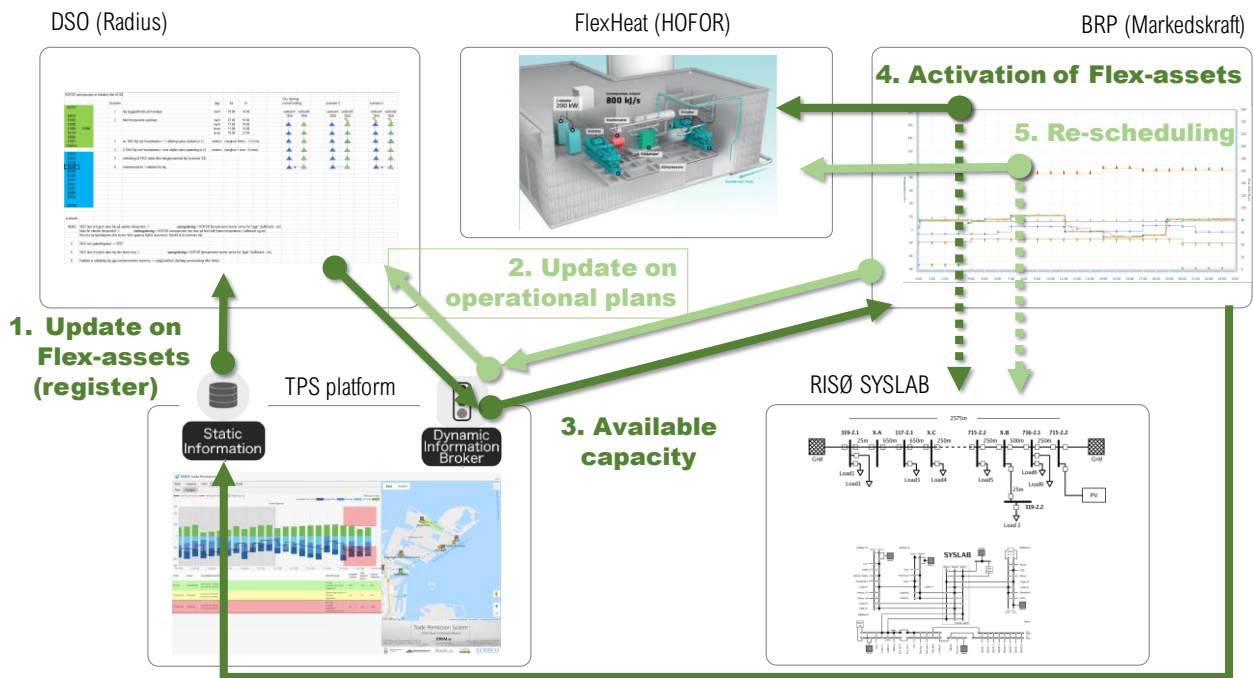


Figure 1: Proof-of-Concept overview

The report DREM D6.3 will focus more on the actual test and evaluation results, the description of the steps involved in the PoC and some of the challenges and results gained from the PoC process.

An important part of the PoC was the DREM TPS platform and this D6.2 report will document the ICT architecture and data exchange developed during this project.

2 Architecture

2.1 Basic architecture of the TPS platform

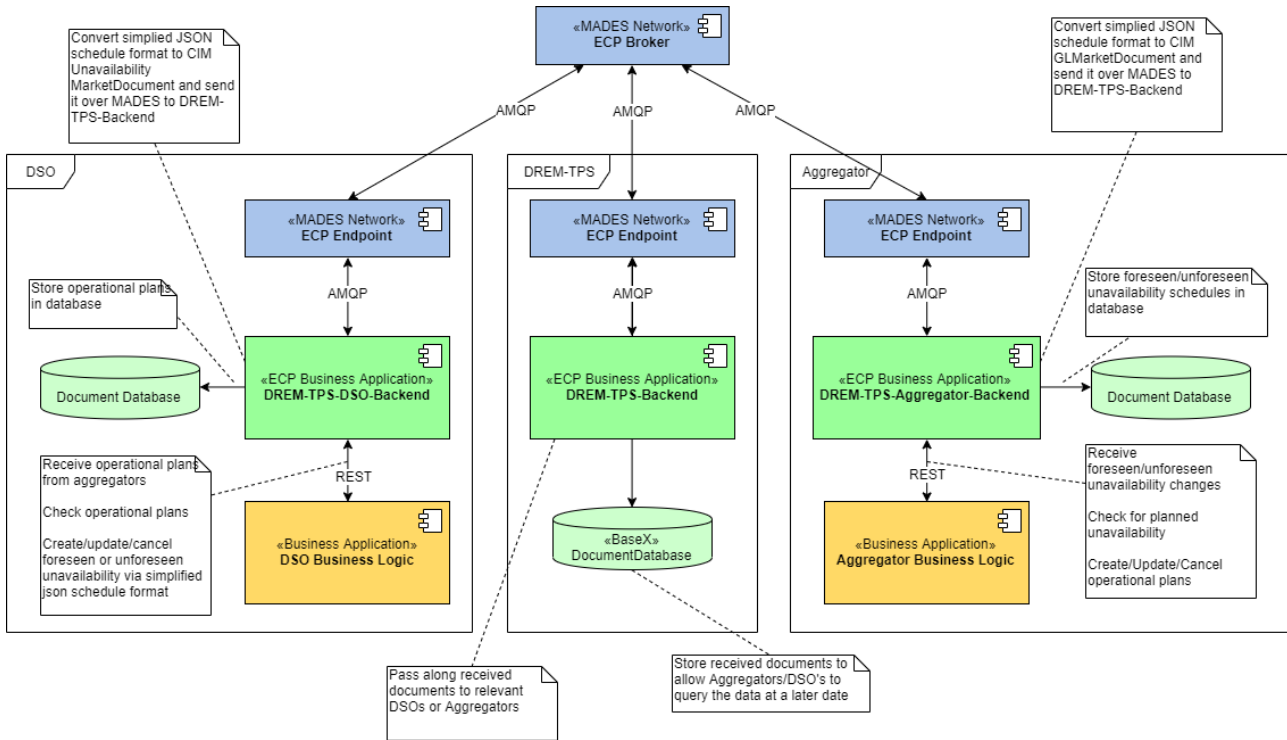


Figure 2: Basic architecture diagram of the TPS platform

The TPS platform can be segmented into three basic groups; DREM-TPS, Aggregator and DSO, each with their distinct responsibilities as seen in Figure 2: Basic architecture diagram of the TPS platform.

For the purpose of simplifying the communication paths in the diagram, the central MADES Network component named “ECP Component Directory” has been left out.

The DSO and Aggregator communicate with each other by sending data to the DREM-TPS backend, using their respective ECP Endpoint. The DREM-TPS backend is then responsible for distributing the received CIM documents to all relevant parties. This prevents any one party from attempting to game the system by selectively sending data to individual actors unfairly as specified in requirement “F1 – Standardized communication”

Once a CIM document is received, it can be directly processed by an AGR/BRP or DSO’s business application, if connected directly to the ECP Endpoint, or it can be pre-processed by their respective backend application, which stores and converts the received/sent CIM documents into a simplified JSON format that can freely be translated to and from its equivalent CIM format. The data is then exposed using a REST/HTTP web interface.

2.2 The MADES Network

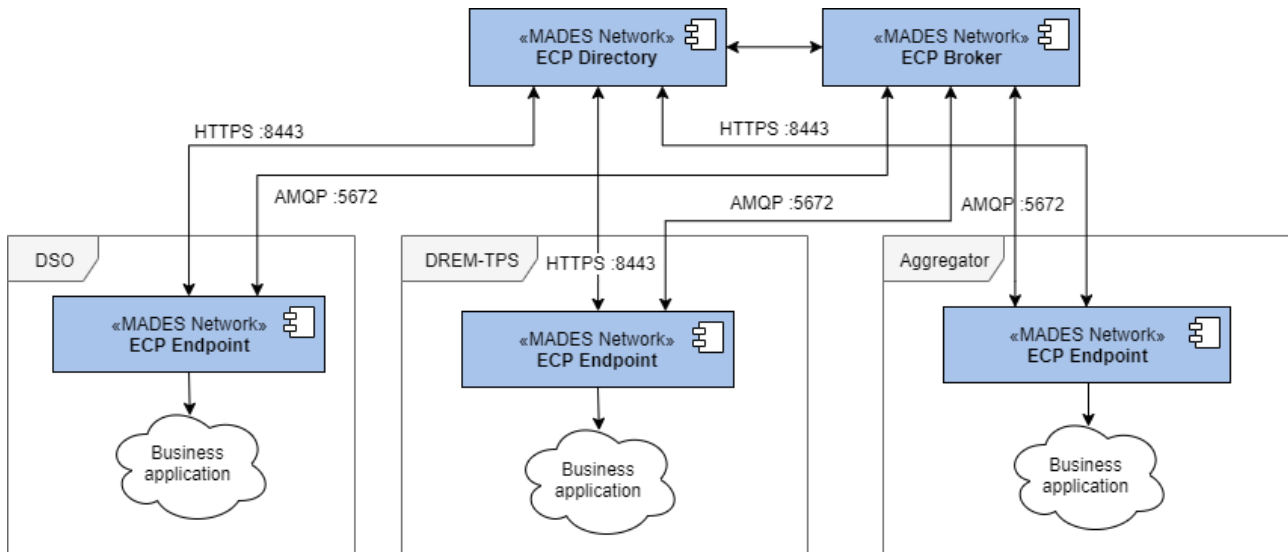


Figure 3 - MADES architecture diagram

IEC-62351-503 specification, otherwise known as MADES (Market Data Exchange Standard) is a communication standard developed by ENTSO-E for reliable transportation of data between parties in the energy sector.

MADES is to be used to facilitate all communication between DREM-TPS modules, as specified by requirement “F1 – Standardized communication”

Simplified, the MADES network is an AMQP 1.0 network with additional components to allow for easy and standardized discoverability of other endpoints along with automatic exchange and renewal of X509 certificates.

AMQP 1.0 is an open standard message-oriented middleware protocol, used in MADES to routes messages between endpoints either via direct point-to-point communication or using a publish-subscribe pattern to abstract from who the message is going to be sent to.

MADES was specifically designed with the intent of sending standardized CIM XML documents, though it technically supports the transmission of any binary data. For the scope of this project, only CIM XML documents are transferred over the MADES network as specified in requirement “F1 – Standardized communication”.

2.2.1 MADES Network c2.2.1.1omponents

2.2.1.2 ECP Component Directory

The ECP Component directory is responsible for authorizing connected endpoints by signing and distributing X.509 certificates used by the connected endpoints and brokers.

The ECP Component Directory provides a HTTPS secured web interface for all communication between it and connected endpoints & brokers.

When an endpoint or a broker wishes to become a part of a MADES network, a request is sent to the Component Directory with a signing request for a client generated X.509 certificate. Once the Component directory administrator approves the registration request, the Component Directory signs the client

generated X.509 certificate and distributes the public certificate to all connected endpoints & brokers, signaling that it is now a part of the network.

2.2.1.3 ECP Broker

At its core, the ECP Broker is an AMQP broker, responsible for indirectly routing data between connected ECP Endpoints using AMQPS. The differentiating feature of the ECP broker compared to an AMQP broker, is that the ECP broker automatically retrieves certificates from the connected ECP Component Directory.

Multiple brokers can exist in the same network to ensure a high availability of data sent over the MADES Network.

2.2.1.4 ECP Endpoint

The ECP Endpoint is a component in the MADES network responsible for receiving and sending data over the MADES network by routing it using the components contained in the connected ECP Component Directory

All data is encrypted End-to-End between endpoints, using the endpoint generated certificate, which has subsequently been signed and distributed by the ECP Component Directory. This prevents any broker from gaining knowledge of what is being sent over the network, outside who the sender and receiver is.

The ECP Endpoint provides multiple interfaces for sending and receiving data, however for the scope of DREM-TPS, only the standardized AMQP interface has been used, which has the additional benefit of reducing overhead, as less components are needed for AMQP -> AMQP communication.

2.2.1.5 Business application

The business application is the sender/receiver connected to its respective ECP Endpoint. These are left abstract in Figure 3 - MADES architecture diagram, as it isn't necessary for the visualization of how the MADES network operates, See Figure 2: Basic architecture diagram of the TPS platform for which business applications connect to their respective ECP endpoints.

3 Design

3.1 MADES network

As MADES is a standard developed by ENTSO-E, ENTSO-E has also funded development of working implementations of the components in the MADES network. Developed by UNICORN and owned & distributed by ENTSO-E, their implementation of the ECP-Endpoint, ECP Broker & ECP Component Directory has been used in this project to greatly reduce development cost & time, that would otherwise had been needed for developing a working MADES network implementation.

Version 4.3 was used in this project; newer versions has since become available, though the underlying functionality should be working the same way.

3.2 CIM Documents

All data exchanged is using the CIM document standard as specified in requirement “F1 – Standardized communication” and the purpose of each CIM document used, is described in the following sections

3.2.1 Unavailability Market Document

The Unavailability market document, is created by a DSO and sent to all AGR/BRP’s who are managing flexibility assets, effected by the unavailability.

To support the Action information from unforeseen unavailability’s as specified in “F6 – Sending capacity limit” an additional Timeseries is added to the document, with the Business Type of Z1 to indicate, that this is a non-standardized Timeseries. The metadata for the foreseen and unforeseen versions of the unavailability market document, can be seen in appendix 4.1.2 GL_MarketDocument Metadata

3.2.2 GL Market Document

The Generation/Load market document is created by an AGR/BRP for all flexibility assets, operated by the AGR/BRP and sent to all DSO’s who needs to be aware of the production/consumption of the flexibility asset. The document contained an operational plan for one or more flexibility assets operated by an AGR/BRP. This is used by the DSO to predict potential issues that may arise, in case of limited availability of the grid, which can be a result of a foreseen or unforeseen problem.

No additional extensions have been made to the document and the used metadata can be seen in appendix 4.1.2 GL_MarketDocument Metadata

3.2.3 Ref Market Document

The Generation/Load market document is created by an AGR/BRP for all flexibility assets, operated by the AGR/BRP and sent to all DSO’s. The document contains metadata for a flexibility asset, informing what kind of flexibility asset it is, who operates it, which grid it is connected to and what it is capable of, in the form of max production & consumption. This is used both by the DSO to know what kind of flexibility assets are connected to their grid and what their capabilities are, along with informing the DREM-TPS backend, where data should be routed, when it receives outage information, that has to be routed to the affected flexibility assets AGR/BRP operator

No additional extensions have been made to the document and the used metadata can be seen in appendix 4.1.4 Ref_MarketDocument Metadata

3.2.4 Status Request Market Document

The status request market document can be created both by the AGR/BRP and the DSO and is used to retrieve CIM documents from the DREM-TPS backend. The AGR/BRP uses it to retrieve historical & future

unavailability documents that are affecting flexibility assets operated by the AGR/BRP, from the DREM-TPS platform. The DSO uses it to retrieve historical & future operational plans for one or more flexibility assets connected to the DSO's grid.

No additional extensions have been made to the document and the used metadata can be seen in appendix 3.2.4 Status Request Market Document

3.2.5 Acknowledgement Market Document

Every receiver of a CIM document, should respond with an Acknowledgment document, once the document has been processed. The Acknowledgement document should then specify if the received CIM document could be processed correctly, or if an error occurred while doing so, potentially providing additional information about what went wrong. The acknowledgement can additionally be in the form of a disagreement/conflict, where e.g. an AGR/BRP informs the DSO that they are unable to comply with the limits defined in an unavailability market document.

This document is used to confirm that a sent CIM document has not only been received, but also understood, as a simple receipt confirmation is already handled by the MADES network protocol.

No additional extensions have been made to the document and the used metadata can be seen in appendix 3.2.5 Acknowledgement Market Document

3.3 DREM-TPS Modules

The DREM-TPS modules are developed specifically to facilitate the communication of outages and operational plans only between relevant DSO's and Aggregators as described by non-functional requirement "NF3 – Platform privacy"

3.3.1 DREM-TPS Backend

A business application connecting to the DREM-TPS-Backend ECP Endpoint using AMQP. The purpose of the DREM-TPS Backend is to route outages and operational plans between DSO's and Aggregator's, without the involved parties being able to unfairly include or exclude who is affected by a DSO outage.

Responsibilities

- Parse incoming CIM operational plans and route the contained flexibility asset operational plans to the relevant DSO's that are responsible for the distribution network, the flexibility asset is connected to.
- Parse incoming CIM outages and route them to all Aggregators that own one or more of the flexibility assets affected by the outage

3.4 DSO Modules

3.4.1 ECP Endpoint

The ECP Endpoint is a standard ECP Endpoint deployment from ENTSO-E running version 4.3 and configured to connect to the DREM-TPS ECP Component Directory. It is responsible for routing sent/received CIM documents between the DSO and the DREM-TPS backend

3.4.2 DSO Backend

A business application connecting to the DSO ECP Endpoint using AMQP, built to simplify the integration process for the DSO by providing storage of XML CIM documents along with providing a simplified format

for reading CIM operational plans and creation, updating & cancelation of foreseen and unforeseen outages.

Responsibilities

- Receive incoming CIM operational plans and store them in an XML database
- Send outgoing CIM foreseen/unforeseen outages and store them in an XML database
- REST server
 - Convert CIM documents to and from simplified JSON format
 - Add/update/cancel foreseen and unforeseen outages using simplified json model of CIM outages
 - Provide new/updated/canceled operational plans to listeners using long lived requests using simplified json model of CIM operational plans

3.5 Aggregator Modules

The Aggregator modules help AGR/BRP's in integrating with the DREM-TPS platform by providing two endpoints for sending/receiving data to relevant DSO's

The first and most native method, is by directly connecting a business application to the ECP endpoint module and communicate using standardized CIM document, which the AGR/BRP potentially already generates for other purposes.

The second method is by using the provided Web API to send & receive JSON formatted CIM documents, where any static information has been hidden or otherwise simplified. This has the advantage of greatly reducing the complexity of handling CIM document generation and version control, along with providing a persistent document storage that can be queried when needed.

3.5.1 ECP Endpoint

The ECP Endpoint is a standard ECP Endpoint deployment from ENTSO-E running version 4.3 and configured to connect to the DREM-TPS ECP Component Directory and is responsible for routing sent/received CIM documents between the AGR/BRP and the DREM-TPS backend

3.5.2 Aggregator Backend

The purpose of the Aggregator backend is to provide access to the stored CIM documents in the document database, along with converting received CIM documents to a simplified JSON format and sent JSON documents, after converting them to their related CIM document type. By doing this, an AGR/BRP can work entirely in the simplified JSON format, without losing any functionality, while greatly reducing complexity.

The Aggregator backend is implemented in Java and connects as a business application to the Aggregator ECP Endpoint using AMQP.

Responsibilities

- Receive incoming CIM operational plans and store them in an XML document database
- Send outgoing CIM foreseen/unforeseen outages and store them in an XML database
- REST/HTTP web interface
 - Convert CIM documents to and from simplified JSON format

- Add/update/cancel foreseen and unforeseen outages using simplified json model of CIM outages
- Provide new/updated/canceled operational plans to listeners using long lived requests using simplified json model of CIM operational plans

REST/HTTP web interface endpoints

Method	Path	Description
GET	/ping	Simply ping endpoint for checking if the Web API is available
GET	/unavailability/foreseen	Fetch a list of foreseen unavailability's that match the provided search criteria.
GET	/unavailability/foreseen/updates	A long polling request that returns a response, once new foreseen unavailability's are available, or returns a 408 – request timeout response, to indicate that the requester should send a new request.
GET	/unavailability/unforeseen	Fetch a list of unforeseen unavailability's that match the provided search criteria.
GET	/unavailability/unforeseen/updates	A long polling request that returns a response, once new unforeseen unavailability's are available, or returns a 408 – request timeout response, to indicate that the requester should send a new request.
PUT	/flexibility asset	Register a new flexibility asset with the DREM-TPS backend
GET	/flexibility asset	Fetch a list of stored flexibility assets that match the provided search criteria
POST	/flexibility asset/ {FLEXIBILITY ASSET_MRID}	Modify an existing flexibility asset registered in the DREM-TPS backend
PUT	/flexibility asset/plan	Send a new operational plan to the DREM-TPS backend, for subsequent distribution to relevant DSO's
GET	/flexibility asset/plan	Fetch a list of stored flexibility asset operational plans that match the provided search criteria
POST	/flexibility asset/plan/{PLAN_MRID}	Modify an existing operational plan in the DREM-TPS backend

3.5.3 Document Database

The document database is a BaseX XML database responsible for storing created and received CIM XML documents for the purpose of providing a record of received outage plans.

Documents created by the REST/HTTP Web interface is also stored, for the purpose of supporting creation of revisions of already created documents, which cannot be done without storing some of the information contained in the original document, as they are randomly generated at the time of creation.

3.5.4 Aggregator Business Application

The Aggregator Business Application is the AGR/BRP specific implementation, that connects either directly to the ECP Endpoint and communicate using CIM documents or connects to the Aggregator Backend and communicate using the simplified CIM equivalent JSON format.

3.6 Detailed architecture diagram of demo setup

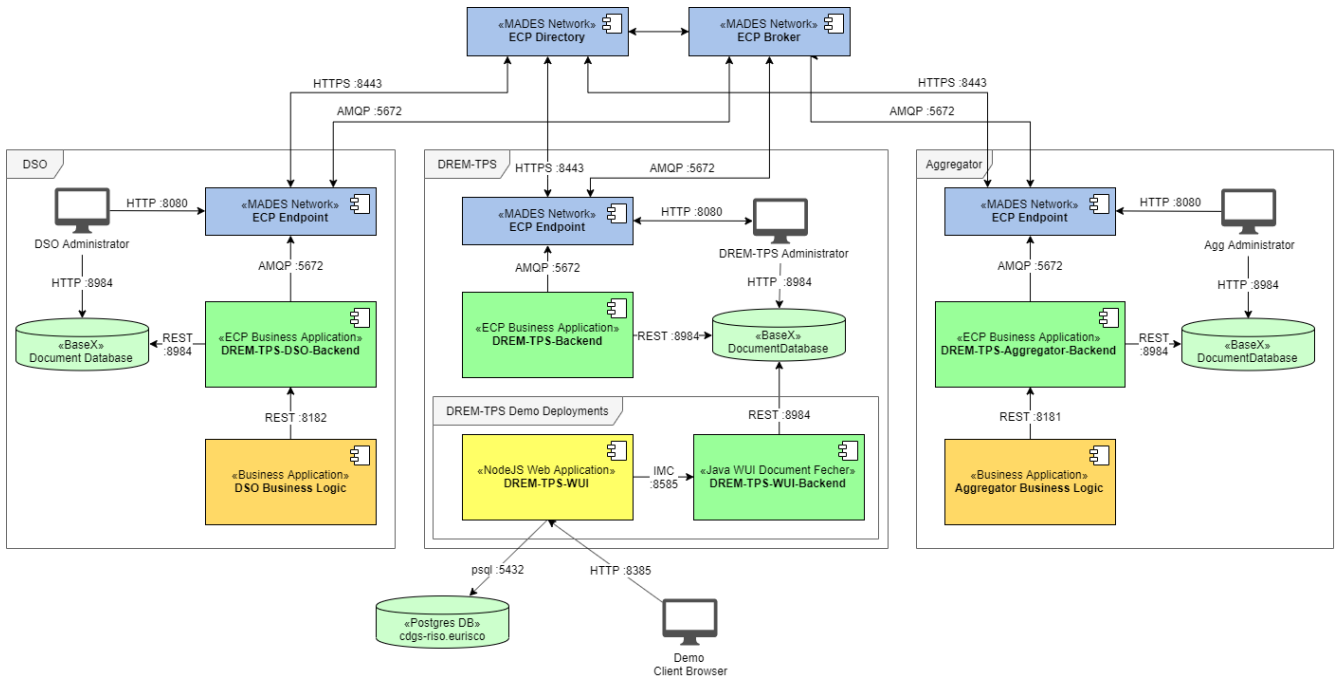


Figure 4: Detailed architecture diagram of demo setup

3.7 Components developed for demonstration purposes

3.7.1 DREM-TPS WUI

The TPS user interfaces that have been developed for the Proof-of-Concept demonstration, are described in the DREM-D63 report.

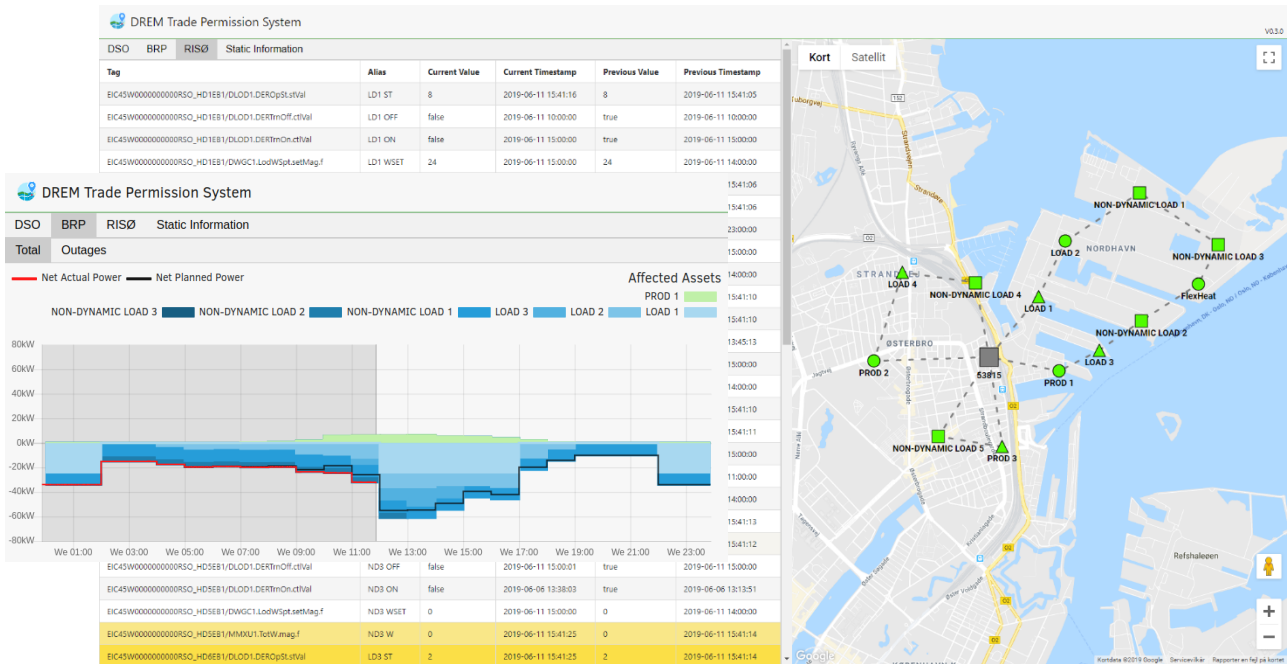


Figure 5: Screenshot to illustrate some of the user interfaces develop for the TPS platform

4 Annex

4.1 CIM Documents

4.1.1 Unavailability_MarketDocument Metadata

Unavailability_MarketDocument		v4.0		
Ref.				
Process				
mRID	ID_String	The unique identification of the document being exchanged within a business process flow.	0	[1..1]
revisionNumber	ESMPVersion_String	The identification of the version that distinguishes one evolution of a document from another.	1	[1..1]
type	MessageKind_String	The coded type of a document. The document type describes the principal characteristic of the document.	2	[1..1]
process Type	ProcessKind_String	The identification of the nature of process that the document addresses. --- The process dealt with in the document.	3	[1..1]
sender_MarketParticipant.mRID	PartyID_String	The identification of a party in the energy market. --- Document owner.	4	[1..1]
sender_MarketParticipant.market Role. type	MarketRoleKind_String	The identification of the role played by a market player. --- Document owner. --- The role associated with a MarketParticipant.	5	[1..1]
receiver_MarketParticipant.mRID	PartyID_String	The identification of a party in the energy market. --- Document recipient.	6	[1..1]

1a	1a
Foreseen Unavailability	Unforeseen Unavailability
Senders Unique Identification	Senders Unique Identification
Senders unique version (incremented with each transmission of the same document)	Senders unique version (incremented with each transmission of the same document)
A26=Capacity document	A04=System Operator area schedule
A26=Outage information	A26=Outage information
DREM-TPS=XXXXXXXXXXXXXXXXXXXX "DSO Identification codingScheme='A01' A01=EIC"	DREM-TPS=XXXXXXXXXXXXXXXXXXXX "DSO Identification codingScheme='A01' A01=EIC"
A04=System Operator A32=Market Information Aggregator	A04=System Operator A32=Market Information Aggregator
DREM-TPS=XXXXXXXXXXXXXXXXXXXX "Aggregator Identification	DREM-TPS=XXXXXXXXXXXXXXXXXXXX "Aggregator Identification

receiver_MarketParticipant.marketRole.type	MarketRoleKind_String	The identification of the role played by a market player. --- Document recipient. --- The role associated with a MarketParticipant.	7	[1..1]
createdDateTime	ESMP_DateTime	The date and time of the creation of the document.	8	[1..1]
unavailability_Time_Period.timeInterval	ESMP_DateTimeInterval	The start and end date and time for a given interval. --- This information provides the start and end date and time of the schedule time interval. All time intervals for the time series in the document shall be within the total time interval for the schedule. The receiver will discard any time intervals outside the schedule period.	9	[1..1]
TimeSeries	TimeSeries	Repeating element	10	[0..*]
Reason	Reason	Repeating element	11	[0..*]

codingScheme='A01' A01=EIC"	codingScheme='A01' A01=EIC"
A20=Party Connected to the Grid A32=Market Information Aggregator	A20=Party Connected to the Grid A32=Market Information Aggregator
Creation date/time of the document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z	Creation date/time of the document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z
<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>	<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>
Repeating element (n times)	Repeating element (n times)
Repeating element Not used	Repeating element Not used

TimeSeries				
mRID	ID_String	A unique identification of the time series.	0	[1..1]

Foreseen Unavailability Capacity	Unforeseen Unavailability Capacity	Unforeseen Unavailability Action
Unique Identification of Time series within document	Unique Identification of Time series within document	Unique Identification of Time series within document

business Type	BusinessKind_String	The identification of the nature of the time series.	1	[1..1]
biddingZone_Domain.mRID	ArealD_String	The identification of the bidding zone for which the unavailability information is being provided. A bidding zone cannot vary within an Outage Document	2	[0..1]
in_Domain.mRID	ArealD_String	The unique identification of the domain. --- The area where the product is being delivered.	3	[0..1]
out_Domain.mRID	ArealD_String	The unique identification of the domain. --- The area where the product is being extracted.	4	[0..1]
quantity_Measure_Unit.name	MeasurementUnitKind_String	The identification of the formal code for a measurement unit (UNECE Recommendation 20). --- The unit of measurement used for the quantities expressed within the time series.	5	[1..1]

A53=Planned maintenance	A54=Force unavailability	Z01=Action request (Name will probably change)
NOT USED	NOT USED	NOT USED
NOT USED	NOT USED	NOT USED
NOT USED	NOT USED	NOT USED
KWT for Kilo Watt	KWT for Kilo Watt	NOT USED

start_DateAndOrTime.date	Date	This identifies the date of the start of the unavailability being described in the time series.	6	[1..1]
start_DateAndOrTime.time	Time	This identifies the time of the start of the unavailability being described in the time series.	7	[1..1]
end_DateAndOrTime.date	Date	This identifies the date of the end of the unavailability being described in the time series.	8	[1..1]
end_DateAndOrTime.time	Time	This identifies the time of the end of the unavailability being described in the time series.	9	[1..1]
curveType	CurveType_String	The identification of the coded representation of the type of curve being described.	10	[1..1]
Flexibility asset	Flexibility asset_RegisteredResource	Repeating element	11	[1..*]
Period	Series_Period	Repeating element	12	[1..*]

YYYY-MM-DD	YYYY-MM-DD	YYYY-MM-DD
HH:MM:SSZ	HH:MM:SSZ	HH:MM:SSZ
YYYY-MM-DD	YYYY-MM-DD	YYYY-MM-DD
HH:MM:SSZ	HH:MM:SSZ	HH:MM:SSZ
A03 = Variable Sized Blocks	A03 = Variable Sized Blocks	A03 = Variable Sized Blocks
Single element	Single element	Single element
Single element	Single element	Single element

Period				
timeInterval	ESMP_DateTimeInterval	The start and end time of the period.	0	[1..1]
resolution	Duration	The definition of the number of units of time that compose an individual step within a period.	1	[1..1]
Point	Point	Repeating element	2	[1..*]

<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>	<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>	<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>
PT5M=5 minute contracts (5 min.)	PT5M=5 minute contracts (5 min.)	PT5M=5 minute contracts (5 min.)
Repeating element (n times)	Repeating element (n times)	Repeating element (n times)

Point				
position	Position_Integer	A sequential value representing the relative position within a given time interval.	0	[1..1]
quantity	Decimal	The principal quantity identified for a point.	1	[1..1]
Reason	Reason	Repeating element	2	[0..*]

Sequential value beginning with 1	Sequential value beginning with 1	Sequential value beginning with 1
Capacity of distribution network	Capacity of distribution network	[Action enum] 0=STOP_LOAD_OR_PRODUCION 1=MAINTAIN_CURRENT_LOAD_OR_PRODUCION 2=INCREASE_LOAD_OR_PRODUCTION
Repeating element not used	Repeating element not used	Repeating element not used

Flexibility asset				

mRID	ID_String	A unique identification of the flexibility asset	0	[1..1]
name	String	Name of the flexibility asset	1	[0..1]
flexibility asset_PSRType.psrType	PsrType_String	This represents the coded identification of the type of flexibility asset being described.	2	[0..1]
location.name	String	The name of the location of the flexibility asset for which the unavailability information is being provided.	3	[0..1]
Reason	Reason	Repeating element	4	[0..*]

Unique flexibility asset identifier formatted as EIC=A01, CGM=A02 or GS1=A10	Unique flexibility asset identifier formatted as EIC=A01, CGM=A02 or GS1=A10	Unique flexibility asset identifier formatted as EIC=A01, CGM=A02 or GS1=A10
Any free human readable and possibly non unique text naming the object	Any free human readable and possibly non unique text naming the object	Any free human readable and possibly non unique text naming the object
A04=Generation A05=Load	A04=Generation A05=Load	A04=Generation A05=Load
Any free human readable and possibly non unique text naming the object.	Any free human readable and possibly non unique text naming the object.	Any free human readable and possibly non unique text naming the object.
Repeating element not used	Repeating element not used	Repeating element not used

Reason				
code	ReasonCode_String	The motivation of an act in coded form.	0	[1..1]
text	ReasonText_String	The textual explanation corresponding to the reason code.	1	[0..1]

NOT USED		
NOT USED	NOT USED	NOT USED
NOT USED	NOT USED	NOT USED

4.1.2 GL_MarketDocument Metadata

GL_MarketDocument	v4.0			
Ref.				
Process				
mRID	ID_String	The unique identification of the document being exchanged within a business process flow.	0	[1..1]
revisionNumber	ESMPVersion_String	The identification of the version that distinguishes one evolution of a document from another.	1	[1..1]
type	MessageKind_String	The coded type of a document. The document type describes the principal characteristic of the document.	2	[1..1]
process.processType	ProcessKind_String	The identification of the nature of process that the document addresses. --- The process dealt with in the document.	3	[1..1]
sender_MarketParticipant.mRID	PartyID_String	The identification of a party in the energy market. --- Document owner.	4	[1..1]
sender_MarketParticipant.markedRole.type	MarketRoleKind_String	The identification of the role played by a market player. --- Document owner. --- The role associated with a MarketParticipant.	5	[1..1]
receiver_MarketParticipant.mRID	PartyID_String	The identification of a party in the energy market. --- Document recipient.	6	[1..1]

1a
Operational Plan
Senders Unique Identification
Senders unique version (incremented with each transmission of the same document)
A01=Balance responsible schedule
A01=Day ahead A02=Intra day incremental
DREM-TPS=XXXXXXXXXXXXXXXXXXXXX "Aggregator Identification codingScheme='A01' A01=EIC"
A20=Party Connected to the Grid A32=Market Information Aggregator
DREM-TPS=XXXXXXXXXXXXXXXXXXXXX "DSO Identification codingScheme='A01' A01=EIC"

receiver_MarketParticipant.markedRole.type	MarketRoleKind_String	The identification of the role played by a market player. --- Document recipient. --- The role associated with a MarketParticipant.	7	[1..1]
createdDateTime	ESMP_DateTime	The date and time of the creation of the document.	8	[1..1]
time_Periode.timeInterval	ESMP_DateTimeInterval	The start and end date and time for a given interval. --- This information provides the start and end date and time of the schedule time interval. All time intervals for the time series in the document shall be within the total time interval for the schedule. The receiver will discard any time intervals outside the schedule period.	9	[1..1]
TimeSeries	TimeSeries	Repeating element	10	[0..*]
Reason	Reason	Repeating element	11	[0..*]

A04=System Operator A32=Market Information Aggregator
Creation date/time of the document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z
<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>
Repeating element (n times)
Repeating element Not used

TimeSeries				
mRID	ID_String	A unique identification of the time series.	0	[1..1]
business Type	BusinessKind_String	The identification of the nature of the time series.	1	[1..1]
objectAggregation	ObjectAggregationKind_String	The identification of the domain that is the common dominator used to aggregate a time series.	2	[0..1]

Production plan	Consumption plan
Unique Identification of Time series within document	Unique Identification of Time series within document
A01=Production	A04=Consumption
A06 = Resource Object	A06 = Resource Object

inBiddingZone_Domain.mRID	ArealD_String	The unique identification of the domain. --- The area where the product is being delivered.	3	[0..1]
outBiddingZone_Domain.mRID	ArealD_String	The unique identification of the domain. --- The area where the product is being extracted.	4	[0..1]
quantity_Measure_Unit.name	MeasurementUnitKind_String	The identification of the formal code for a measurement unit (UN/ECE Recommendation 20). --- The unit of measurement used for the quantities expressed within the time series.	5	[1..1]
registeredResource.mRID	Date:ResourceID_String	The identification of the production unit for which the generation information is being provided.	6	[0..1]
registeredResource.name	String	The Name of the production unit for which the generation information is being provided.	7	[0..1]
curveType	CurveType_String	The identification of the coded representation of the type of curve being described.	8	[1..1]
PowerSystemResource	MktPSRType	Repeating element	9	[1..1]
Period	Series_Period	Repeating element	10	[1..*]

NOT USED	NOT USED
NOT USED	NOT USED
NOT USED	NOT USED
NOT USED	NOT USED
NOT USED	NOT USED
A03 = Variable Sized Blocks	A03 = Variable Sized Blocks
Single element	Single element
Repeating element (n time)	Repeating element (n time)

Period				
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timeInterval	ESMP_DateTimeInterval	The start and end time of the period.	0	[1..1]
resolution	Duration	The definition of the number of units of time that compose an individual step within a period.	1	[1..1]
Point	Point	Repeating element	2	[1..*]

<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>	<period.timeInterval> <start>2018-05-31T22:00Z</start> <end>2015-05-31T22:00Z</end> </period.timeInterval>
PT5M=5 minute contracts (5 min.)	PT5M=5 minute contracts (5 min.)
Repeating element (n times)	Repeating element (n times)

Point				
position	Position_Integer	A sequential value representing the relative position within a given time interval.	0	[1..1]
quantity	Decimal	The principal quantity identified for a point.	1	[1..1]
Reason	Reason	Repeating element	2	[0..*]

Sequential value beginning with 1	Sequential value beginning with 1
Total energy production of units in timeseries	Total energy consumption of units in timeseries
Repeating element not used	Repeating element not used

PowerSystemResource				
psrType	PsrType_String	Represents the coded identification of the type of resource being described	1	[0..1]
voltage_PowerSystemResources.highVoltageLimit	ESMP_Voltage	Represents the voltage connection level of the production unit being described. This value shall always be provided in KVT.	2	[0..1]

A04=Generation	A05=Load
NOT USED	NOT USED

GeneratingUnit	MktGeneratingUnit	Repeating element	3	[0..*]
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Repeating element (1 time)	Repeating element (1 time)
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GeneratingUnit				
mRID	ResourceID_String	This represents the coded identification of the type of unit being described.	0	[1..1]
Name	String	Represents the name of the generation unit.	1	[1..1]
NominalP	ESMP_ActivePower	The principal quantity identified for a point.	2	[1..1]

Unique flexibility asset identifier formatted as EIC=A01, CGM=A02 or GS1=A10	Unique flexibility asset identifier formatted as EIC=A01, CGM=A02 or GS1=A10
Any free human readable and possibly non unique text naming the object.	Any free human readable and possibly non unique text naming the object.
Nominal energy production in KVT for the unit	Nominal energy consumption in KVT for the unit

Reason				
code	ReasonCode_String	The motivation of an act in coded form.	0	[1..1]
text	ReasonText_String	The textual explanation corresponding to the reason code.	1	[0..1]

NOT USED	NOT USED
NOT USED	NOT USED

4.1.3 StatusRequest_MarketDocument Metadata

StatusRequest_MarketDocument	v8.0			
mRID	ID_String	Sender's Unique Identification	0	[1..1]
type	MessageKind_String	The coded type of a document. The document type describes the principal characteristic of the document	1	[1..1]
createdDateTime	ESMP_DateTime	The date and time of the creation of the document	2	[1..1]
Attribute	AttributeInstanceComponent	Repeating element	3	[1..*]

Attribute				
attribute	String	Name of attribute to match when searching for relevant documents	0	[1..1]
attributeValue	AttributeValue_String	Value of the requested attribute	1	[1..1]

Attribute				
attribute	String	Name of attribute to match when searching for relevant documents	0	[1..1]
attributeValue	AttributeValue_String	Value of the requested attribute	1	[1..1]

Attribute				
attribute	String	Name of attribute to match when searching for relevant documents	0	[1..1]

Get Operational Plans
Sender's Unique Identification
A67=Resource Provider Schedule for production/consumption
Creation date/time of the document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z
Repeating element (n times)

ProcessType
A01=Day ahead A02=Intra day incremental

BusinessType
A01=Production A04=Consumption

Resource

attributeValue	AttributeValue_String	Value of the requested attribute	1	[1..1]
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Unique EIC of requested resource

4.1.4 Ref_MarketDocument Metadata

Ref_MarketDocument		v1.0			
Ref.					1a
Process					Update Flexibility asset
mRID	ID_String	The unique identification of the document being exchanged within a business process flow.	0	[1..1]	Senders Unique Identification
type	MessageKind_String	The coded type of a document. The document type describes the principal characteristic of the document.	1	[1..1]	A95=Configuration Document
process.processType	ProcessKind_String	The identification of the nature of process that the document addresses. --- The process dealt with in the document.	2	[1..1]	A36=Creation A37=Modification A38=Deactivation process A39=Synchronisation process
sender_MarketParticipant.mRID	PartyID_String	The identification of a party in the energy market. --- Document owner.	3	[1..1]	Aggregator Identification A01=EIC
sender_MarketParticipant.markedRole.type	MarketRoleKind_String	The identification of the role played by a market player. --- Document owner. --- The role associated with a MarketParticipant.	4	[1..1]	A20=Party Connected to the Grid
receiver_MarketParticipant.mRID	PartyID_String	The identification of a party in the energy market. --- Document recipient.	5	[1..1]	DREM-TPS=XXXXXXXXXXXXXXXXXXXXX A01=EIC

receiver_MarketParticipant.markedRole. type	MarketRoleKind_String	The identification of the role played by a market player. -- Document recipient. -- The role associated with a MarketParticipant.	6	[1..1]	A32=Market Information Aggregator
createdDateTime	ESMP_DateTime	The date and time of the creation of the document.	7	[1..1]	Creation date/time of the document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z
TimeSeries	TimeSeries	Repeating element	8	[0..*]	Repeating element (n times)

TimeSeries					Production plan
registeredResource.mRID	ResourceID_String	The unique identification of a resource	0	[1..1]	EIC coded unique id of resource A01=EIC
registeredResource.name	String	The name of the resource	1	[1..1]	Any free human readable and possibly non unique text naming the object
registeredResource.location.name	Characters200_String	The name of the location of the resource	3	[0..1]	Any free human readable and possibly non unique text naming the object.
registeredResource.pSRType.psrType	PsrType_String		3	[1..1]	A04=Generation A05=Load
registeredResource.pSRType.powerSystemResources.highVoltageLimit	ESMP_Voltage		4	[1..1]	NOT USED
registeredResource.pSRType.powerSystemResources.lowVoltageLimit	ESMP_Voltage		5	[0..1]	NOT USED
CancelledTS	ESMPBoolean_String	Cancellation status of resource	6	[0..1]	An indicator stating that the TimeSeries, identified by the mRID, is withdrawn as well as all the values sent in a previous version of the TimeSeries in a previous document

description	String	The description is a free human readable text describing or naming the object	7	[0..1]	Human readable description of the flexibility asset
owner_MarketParticipant.mRID	PartyID_String		8	[1..1]	Aggregator identification A01=EIC
startLifetime_DateAndOrTime.date	Date	The date when the network element was put in service	9	[1..1]	YYYY-MM-DD
endLifetime_DateAndOrTime.date	Date	The date when the network element will be withdrawn of service	10	[0..1]	YYYY-MM-DD
implementation_DateAndOrTime.date	Date	This identifies the date of the effective implementation of the information provided in the time series	11	[0..1]	YYYY-MM-DD
active_Measurement_Unit.name	MeasurementUnitKind_String	The unit for active generation or consumption	12	[0..1]	KWT for Kilo Watt
installedGeneration_Quantity.quantity	Decimal		13	[0..1]	Generation quantity of resource
installedConsumption_Quantity.quantity	Decimal		14	[0..1]	Consumption quantity of resource
installedReactive_Quantity.quantity	Decimal		15	[0..1]	Reactive quantity of resource
reactive_Measurement_Unit.name	MeasurementUnitKind_String		16	[0..1]	KWT for Kilo Watt
Multipod_RegistredResource.mRID	ResourceID_String		17	[0..1]	NOT USED
Domain	Domain	Repeating element	18	[1..*]	NOT USED
Coordination_MarketParticipant	Other_MarketParticipant	Repeating element	19	[0..*]	NOT USED
Interested_MarketParticipant	Other_MarketParticipant	Repeating element	20	[0..*]	NOT USED
RegisteredResource	Specific_RegisteredResource	Repeating element	21	[0..*]	NOT USED

Domain					
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mRID	AreaID_String	The unique identification of the domain	0	[1..1]	NOT USED
Coordination_MarketParticipant					
mRID	PartyID_String	The identification of a party in the energy market	0	[1..1]	NOT USED
Interested_MarketParticipant					
mRID	PartyID_String	The identification of a party in the energy market	0	[1..1]	NOT USED
Specific_RegisteredResource					
mRID	ResourceID_String	The unique identification of a resource	0	[1..1]	NOT USED

4.1.5 Acknowledgement_MarketDocument Metadata

Acknowledgement_MarketDocument	v8.0			Accepted	Incomplete
ID_String	Sender's Unique Identification	0	[1..1]	Sender's Unique Identification	Sender's Unique Identification
ESMP_DateTime	Date and time of creation of the acknowledgement (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z	1	[1..1]	Date and time of creation of the acknowledgement (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z	Date and time of creation of the acknowledgement (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z
PartyID_String	EIC code of the document sender (Receiver of the original document)	2	[1..1]	Identification codingScheme=A01	Identification codingScheme=A01
MarketRoleKind_String	ReceiverRole of the original document	3	[1..1]	For DREM-TPS: A32=Market Information Aggregator For DSO: A04=System Operator For Aggregator: A20=Party Connected to the Grid	For DREM-TPS: A32=Market Information Aggregator For DSO: A04=System Operator For Aggregator: A20=Party Connected to the Grid
PartyID_String	EIC code of the document receiver (Sender of the original document)	4	[1..1]	Identification codingScheme=A01	Identification codingScheme=A01
MarketRoleKind_String	SenderRole of the original document	5	[0..1]	For DREM-TPS: A32=Market Information Aggregator For DSO: A04=System Operator For Aggregator: A20=Party Connected to the Grid	For DREM-TPS: A32=Market Information Aggregator For DSO: A04=System Operator For Aggregator: A20=Party Connected to the Grid
ID_String	Unique identification of the document being acknowledged	6	[0..1]	mRID of received document	mRID of received document
ESMPVersion_String	Version of the document being acknowledged	7	[0..1]	revisionNumber of received document	revisionNumber of received document
MessageKind_String	Type of the document being acknowledged	8	[0..1]	type of received document	type of received document
PayloadId_String	The identification of the name of the file or the payload that has been transmitted	9	[0..1]	<i>Not used</i>	<i>Not used</i>

ESMP_DateTime	Date and time of reception of the electronic document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z	10	[0..1]	Date and time of reception of the electronic document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z	Date and time of reception of the electronic document (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:00Z
Reason	Repeating element	12	[0..*]	Single element	Repeating element (n times)
TimeSeries	Repeating element	11	[0..*]	NOT USED	Repeating element (n times)
Time_Period	Repeating element	13	[0..*]	NOT USED	Repeating element (n times)

	code providing the acknowledgement status A01 - Fully Accepted A02 - Fully Rejected B01 - Incomplete document	0	[1..1]	A01	B01
	string containing the textual description of a rejection	1	[0..1]	NOT USED	Optional clarifying text

ID_String	A unique identification of the time series	0	[1..1]	NOT USED	mRid of rejected TimeSeries
ESMPVersion_String	The identification of the version of the time series	1	[0..1]	NOT USED	Version of rejected TimeSeries
Time_Period	Repeating element	2	[0..*]	NOT USED	Repeating element (n times)
Reason	Repeating element	3	[0..*]	NOT USED	Repeating element (n times)

ESMP_DateTimeInterval	The start and end date and time for a given interval	0	[1..1]	NOT USED	timeInterval of rejected Time_Period
Reason	Repeating element	1	[0..*]	NOT USED	Repeating element (n times)

