European Commission

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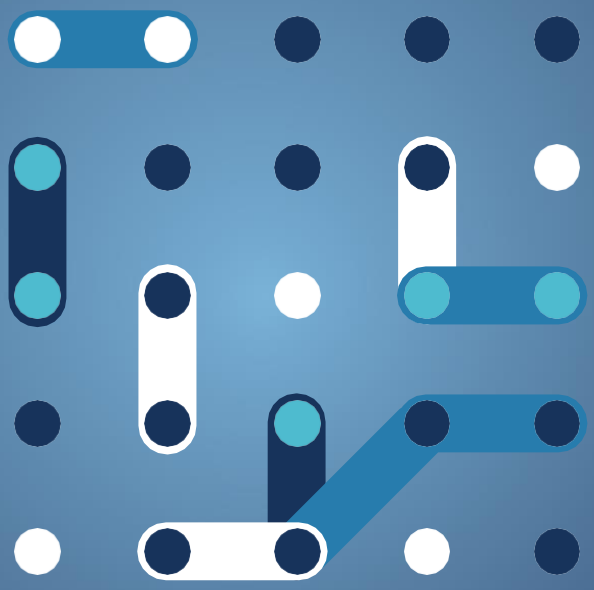
Interoperability of flexibility assets

Data Management Working Group



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bridge

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Bridge WG/TF Chairmanship

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INDEX

Executive Summary

During the BRIDGE General Assembly held on March 11th and 12th 2020 in Brussels, one of the conclusions was to work on the "Interoperability of flexibility assets", with the following objectives:

- Enable interoperability of flexibility assets by maintaining a set of recommendations, best practices and possibly tools.
- Focus on interoperability at function layer (system use-cases, services) and information layer (semantic interoperability, data models …).
- Cover the full flexibility chain, from the bidding/negotiation/activation of flexibility to the control of the flexibility assets on the field.
- Rely on inputs from the BRIDGE projects when it is it the most relevant considering their timeline, e.g. at M12 when the use-cases and the architecture are defined.
- Define and run a stable methodology that will be used during several years to build up results based on the outcomes of the past projects while also integrating the outcomes of the new projects.

This report details the activities performed in 2020 toward these objectives. In particular:

- It defines a methodology (see §2) that allows to analyse the use-cases and system implementation of BRIDGE projects by mapping them to a reference framework (see §3). This common framework allows to perform cross-project analysis and generate outcomes such as a map of standards, a list of identified gaps, etc.
- It defines three Generic Business Processes, as part of its reference framework, covering (1) the provision of flexibility for System Operators through open market (see §3.1.2), (2) the provision of flexibility for System Operators via prior bilateral agreement (see §3.1.3), and (3) the provision of flexibility for Balance Responsible Parties through open market (see §3.1.4). Each Generic Business Process is defined by sequential functions and interactions involving the five business roles: System Operator, Balance Responsible Party, Market Operator, Aggregator and Prosumer.
- It details the analysis of inputs (seven use-cases) provided by four BRIDGE projects (GIFT, FEVER, FLEXIGRID, iELECTRIX) from several perspectives (interfaces, standards, gaps, functions, actors, … see §4.2) leading to first outcomes (see §4.3).

Finally, five main findings and recommendations are enumerated in §5.1:

1. *Methodology to study interoperability of flexibility assets*: this methodology has been demonstrated with first projects and should be extended to more BRIDGE projects. Such contribution from each BRIDGE projects could be made mandatory by Project Officers to strengthen the approach.
2. *Reference framework to study interoperability of flexibility assets*: this framework has been defined based on three Generic Business Processes. Its content should be enhanced, and possibly extended, taking into account the regulatory framework and what is effectively implemented in BRIDGE projects.
3. *Catalogue of relevant solutions/standards for each interface*: a first draft (incomplete) catalogue has been outlined based on the 7 use-cases from 4 projects. It should be further developed based on more BRIDGE projects, and published towards the BRIDGE community (and beyond?).
4. *Functions standardization*: no standard definition of system functions has been identified, preventing to analyse functions as done for interfaces. The way to analyse the interoperability of functions should be further investigated.
5. *Gaps and extensions/modifications of solutions/standards*: several gaps and propositions of extensions/modifications have been listed by the analysed projects. Proper organisation and tools should be set within BRIDGE and with external stakeholders (standardisation bodies, …) to process them.

Based on these conclusions, it is needed to continue work on the interoperability of flexibility assets in 2021, focusing on:

- Collecting inputs from more projects (a first objective could be ~30 use-cases from ~15 projects) – part of this data collection could be done in collaboration with the "BRIDGE Use-case Repository" action;
- Improving the Reference framework by challenging/updating the existing GBPs and, if relevant, adding new GBPs, based on the use-cases effectively implemented by BRIDGE projects;
- Starting discussions with relevant user groups and standardisation bodies to enable BRIDGE to provide feedback based on the projects' experience.

1. Introduction

The Data Management Working Group aims to cover a wide range of aspects ranging from the technical means for exchanging and processing data between interested stakeholders to the definition of rules for exchange, including security issues and responsibility distribution in data handling. Accordingly, the WG has identified 3 areas of collaboration around which mutual exchange of views and discussions have been set:

1. **Communication Infrastructure**, embracing the technical and non-technical aspects of the communication infrastructure needed to exchange data and the related requirements
2. **Cybersecurity and Data Privacy**, entailing data integrity, customer privacy and protection and general security of energy systems
3. **Data Handling**, including the framework for data exchange and related roles / responsibilities, together with the technical issues supporting the exchange of data in a secure and interoperable manner, and the data analytics techniques for data processing

This report fits into the 3nd area "Data Handling" and is covering the topic of "Interoperability of flexibility assets".

This topic of "Interoperability of flexibility assets" has been discussed and its scope defined during the BRIDGE General Assembly held on March 11th and 12th 2020 in Brussels. As a conclusion (see [1]), the following objectives have been listed:

- Enable interoperability of flexibility assets by maintaining a set of recommendations, best practices and possibly tools.
- Focus on interoperability at function layer (system use-cases, services) and information layer (semantic interoperability, data models ...).
- Cover the full flexibility chain, from the bidding/negotiation/activation of flexibility to the control of the flexibility assets on the field.
- Rely on inputs from the BRIDGE projects when it is it the most relevant considering their timeline, e.g. at M12 when the use-cases and the architecture are defined.
- Define and run a stable methodology that will be used during several years to build up results based on the outcomes of the past projects while also integrating the outcomes of the new projects.

Within the BRIDGE Data Management WG, a subgroup has been set to define the methodology. Once the methodology will be set and agreed, some BRIDGE projects will be asked to contribute by providing information about the architecture and solutions being used in their projects.

2. General methodology

The main purpose of this methodology is to share learnings and recommendations from projects to achieve and ensure interoperability of flexibility assets, including standards assessment (adequacy, maturity ...) and gaps identification.

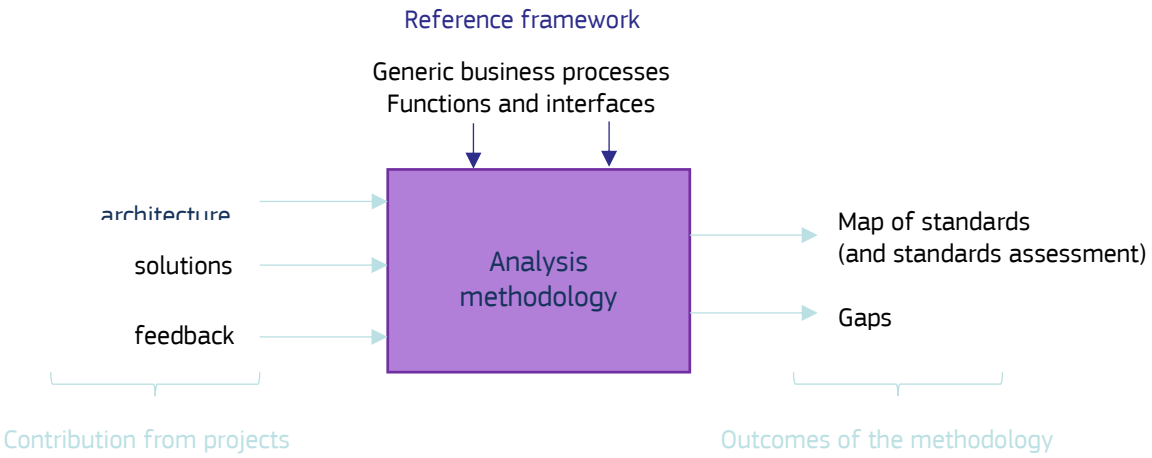
The achievement of these results is facing two main challenges:

- Things are evolving very fast, both from requirements and solutions perspective, meaning that the learnings and recommendations should be updated very often, based on feedback and results from new projects.
- Each of the projects are developing and/or using solutions that might be very different, making very difficult to directly compare and merge results and feedback.

In order to overcome these challenges, the methodology detailed in this section is based on two main principles:

- While the analysis methodology is stable, it relies on a reference framework that will be updated when novel use-cases or market models will appear. Also, the analysis can be run regularly to include results and feedback from new projects.
- As a common denominator between all the projects, the reference framework defines some generic business processes, which are agnostic to any specific technical solution. Each of the projects' specific solutions will be mapped to these generic business processes to enable cross-projects comparison and analysis.

This diagram below depicts how the methodology relies on a reference framework allowing to compare and harmonize the contributions from different projects with different technical solutions, and how it will be used to regularly analyse contributions from new projects to maintain outcomes such as map of standards and assessment and gaps identification.



Color legend: stable – update in case of novel use-cases – regular update to include inputs from new projects

Figure 1: Description of the general methodology to study the interoperability of flexibility assets

2.1 Reference framework to study interoperability of flexibility assets

This reference framework is a common base to compare and harmonize the contributions from different projects with different technical solutions.

It relies on generic business processes, made of functions and interfaces, with which each project's use-cases and architecture can be mapped to identify and assess existing solutions/standards and highlight gaps.

2.1.1 Generic business process

Each generic business process is a description of a process between business roles such as DSO and Aggregator. It is decomposed into subprocesses which are called "functions" (see below). These functions may require information exchange between roles, through interfaces. They may also require external data (e.g. metering data) or external command capabilities (e.g. load control).

Such business process description allows to cover both the function layer and the information layer of the SGAM, which are the focus for the interoperability of flexibility assets. They are called "generic" because they are independent to any technical solution and several use-cases could be mapped to them.

These generic business processes are described with a simple diagram derived from BPMN. Each row refers to a role. Functions are represented as rectangles and interfaces are represented as arrows. In case several path are possible, the alternative path is drawn with dotted lines.

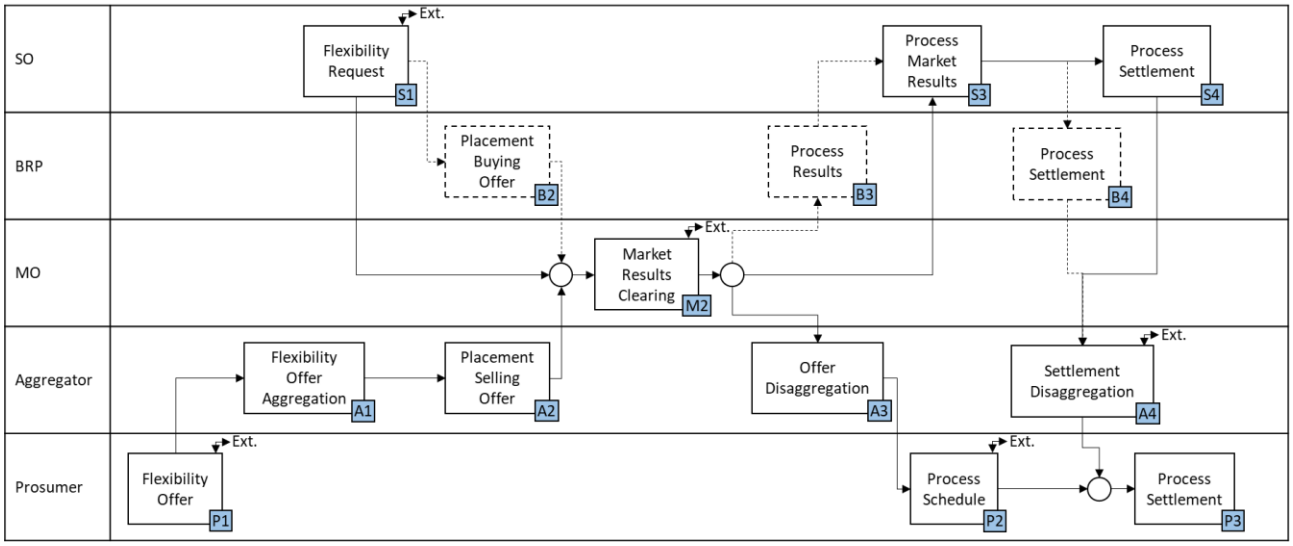


Figure 2: Example of business process diagram

2.1.2 Functions and interfaces

The "functions" represent each of the steps of the business process. They receive inputs from the previous function, use external data or command, and finally provide outputs to the following function. They can be decomposed into "subfunctions", which might be useful for more detailed mapping with some specific architecture.

They are defined with the following table:

X1 / Function name	
Description	This cell describes the purpose of the function, e.g. "the Aggregator collects flexibility offers of all prosumers and calculates the available flexibility for its portfolio"

X1 / Function name	
Inputs	This cell lists the inputs received from the previous function, e.g. "Flexibility offer of prosumer(s)"
Outputs	This cell lists the outputs provided to the following function, e.g. "Aggregated flexibility"
External required data or command	This cell lists the data or commands that are not linked to the previous or following functions but are required to realize the function. An example of external data could be "weather data", "metering data", … An example of command could be "control of flexible loads".
Decomposition into functions/subfunctions	This cell describes the decomposition of the function into subfunctions.

Table 1: Template for function description

The "interfaces" represent the information exchanges between the functions. They are defined with the following table:

X1 → Y1	
Purpose	This cell describes the purpose of the information exchange, e.g. "inform Aggregator about possible flexibility on Prosumer side"
Involved roles	This cell lists the involved roles
List of exchanged data	This cell lists the exchanged data, e.g. "Flexibility offer"

Table 2: Template for interface description

The analysis of the functions allows to study function layer interoperability. The analysis of the interfaces allows to study information layer interoperability.

2.2 Analysis methodology

2.2.1 Principle of the analysis

Each project will provide a description of its system architecture, based on the SGAM model. At least the function and information layers are required.

This architecture will be mapped to the adequate generic business process, depending on the use-case, allowing to make the link e.g. between the data exchanges described in the SGAM information layer and the interfaces defined in the generic business process.

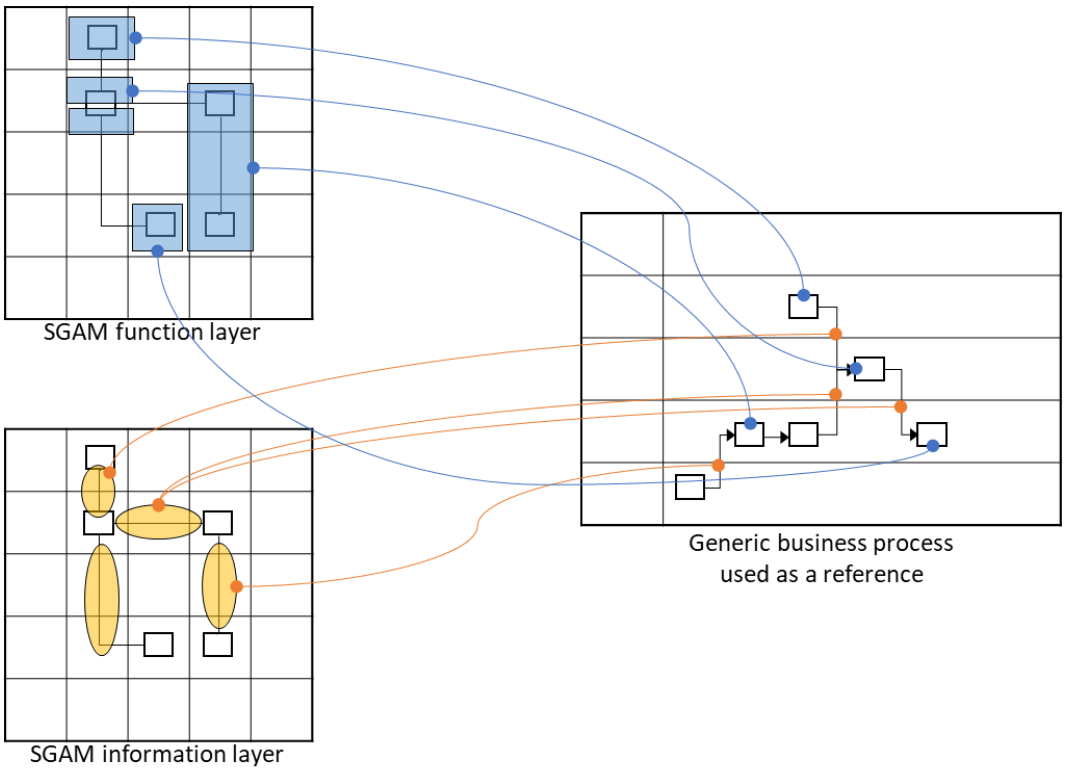


Figure 3: Mapping between a system architecture and the adequate generic business process

For each of the functions and interfaces, the project will describe:

- What solutions/standards are used
  - In case of standard-based solutions, if any extension/modification/deviation to the standard has been required, and why
- If the solutions/standards completely fulfil the needs
  - If not, what is missing
- If some gaps have been identified, e.g. no existing solution for a specific function or interface
  - In such case, what solution has been put in place (proprietary/specific?)

This information will be used to feed:

- The Map of standards, which lists, for each function and interface, the existing solutions and their adequacy
- The list of Gaps, depicting where some solutions are missing, possibly requiring standardization effort (e.g. to extend existing standard or define new standards)

2.2.2 Contribution from projects

The following contributions will be required from projects as an input to the analysis:

- A description of the system architecture, based on the SGAM model. At least the function and information layers are required.
- The list of the solutions/standards being used for each of the functions and interfaces, including for each of them: if any extension/modification/deviation to the standard has been required, and why; if the

solutions/standards completely fulfil the needs; if some gaps have been identified and in such case what has been done.
- A tentative mapping of the system architecture to the relevant generic business processes.

Such information will be requested when it makes the more sense for the project: usually at M12 or M18, when the use-cases and architecture are already defined.

2.2.3 Expected outcomes

As described in §2.2.1, two main outcomes are expected: Map of standards (possibly with standards assessment) and Gaps identification

The purpose of these outcomes is:

- to help new projects (and the industry) to quickly identify which solutions[1]/standards are available to achieve their use-cases, and how much they fulfil the needs;
- to drive future standardization work, e.g. to extend existing standards or define new standards.

2.2.3.1 Map of standards

The map of standards lists, for each of the functions and interfaces, the existing solutions/standards, how they fit to the requirements and if some items are missing.

It can be described with the following table:

Interface	Standard	Provided solution	Missing items
Interface X	Standard A		
	Standard B		
	Standard C		
	Standard D		
	Standard E		

Table 3: Example of standard mapping

Such mapping can be completed with standard assessment, e.g. to assess the maturity of a standard, its future-proofness or its adoption by the industry.

2.2.3.2 Gaps

A list of gaps will be established, detailing for which functions or interfaces the projects are missing proper solutions. A gap could be that there is no existing solution or that the existing solutions are incomplete.

[1] By "solution" we mean non-standardised specifications (e.g. proprietary, open specification, ...)

3. +Reference framework to study interoperability of flexibility assets

In this chapter, the reference framework is described. As defined in §2.1, it is made of generic business processes, functions and interfaces.

In a first step, three generic business process are defined:

- Flexibility for SO through open market
- Flexibility for SO via prior bilateral agreement
- Flexibility for BRP portfolio optimisation

When studying projects and/or when novel use-cases will appear, additional generic business processes might be defined.

3.1 Generic business processes

3.1.1 General assumptions for generic business processes definition

During the GBP definition, several questions were raised. While it was not possible to get clear answers from current active projects, some assumptions were taken and are listed here for reference:

- Q1 (GBP1): is the settlement performed by the parties (DSO, BRP, Prosumer) or by the market operator (MO)? ⇒ It is assumed that the settlement is done by the parties.
- Q2 (GBP1): could the DSO directly go to the market or is it required to have the BRP as an intermediary between the market and the DSO? ⇒ It is assumed that both options are possible.
- Q3 (GBP1): could the Prosumer directly go to the market or is it required to have the Aggregator as an intermediary between the Prosumer and the market? ⇒ it is assumed that the Prosumer must go to market via an Aggregator.
- Q4 (GBP2): is the flexibility offer a static commitment (e.g. between X and Y, whatever the conditions) or a somehow dynamic commitment depending on external conditions (e.g. weather, ...)? ⇒ it is assumed that a flex offer may be a dynamic commitment.
- Q5 (GBP2) if answer to Q4 is “static”, should we add in the process that, in function A6, the Aggregator involves the Prosumers to validate/re-evaluate the possible flex? Or do we simply consider that the commitment from the Prosumer is final and will need to be honoured whatever the conditions? ⇒ as answer to Q4 is “dynamic”, it is assumed that the Aggregator handles Flexibility Requests from SO, in A6, without involving the Prosumer.
- Q6 (GBP2): should we keep the settlement functions (S4 and A4) as the market operator is not involved in this process? ⇒ It is assumed to keep them so far and reassess them when more use-cases from projects will have been analysed.
- Q7 (GBP2): should the regulator or any other regulatory party be involved in the “A5 → S5” interface? ⇒ It is assumed that the regulator is not directly involved.

3.1.2 GBP1 – Flexibility for SO through open market

The generic business process for the case of SOs (i.e. DSO or TSO) utilizing flexibility through open market mechanism - mapping mostly to the case of grid normal operation - is presented in the following figure. The diagram depicts the different subprocesses/functions of each stakeholder in the flexibility lifecycle. In the open market scenario, the process may involve all the relevant stakeholder in the flexibility market:

- System Operator (SO), aiming to optimise the operation of the grid via the use of flexibility. This SO initiates the process of flexibility activation lifecycle (function S1), assesses the flexibility offered by the market (function S3) and handles the settlement process (function S4).
- Balance Responsible Party (BRP), acting as a facilitator for flexibility procurement, placing a buying offer in the flexibility market (function B2), processing the results (function B3) and handling some part of the settlement process (function B4). In some cases, the BRP is skipped and the SO goes directly to the Market.
- Market Operator (MO), enabling the flexibility trading by operating a market (function M2).
- Aggregator, facilitating the pooling of flexibility from various sources (function A1), participating in the market (function A2) and optimally managing its portfolio (function A3) to provide the contracted flexibility. It also provides a settlement function for the utilized flexibility source.
- Prosumer, the source of flexibility, which is offered to the market via the aggregator (function P1), activated taking care modelled preferences and constraints (function P2) and properly remunerated or penalized (function P3).

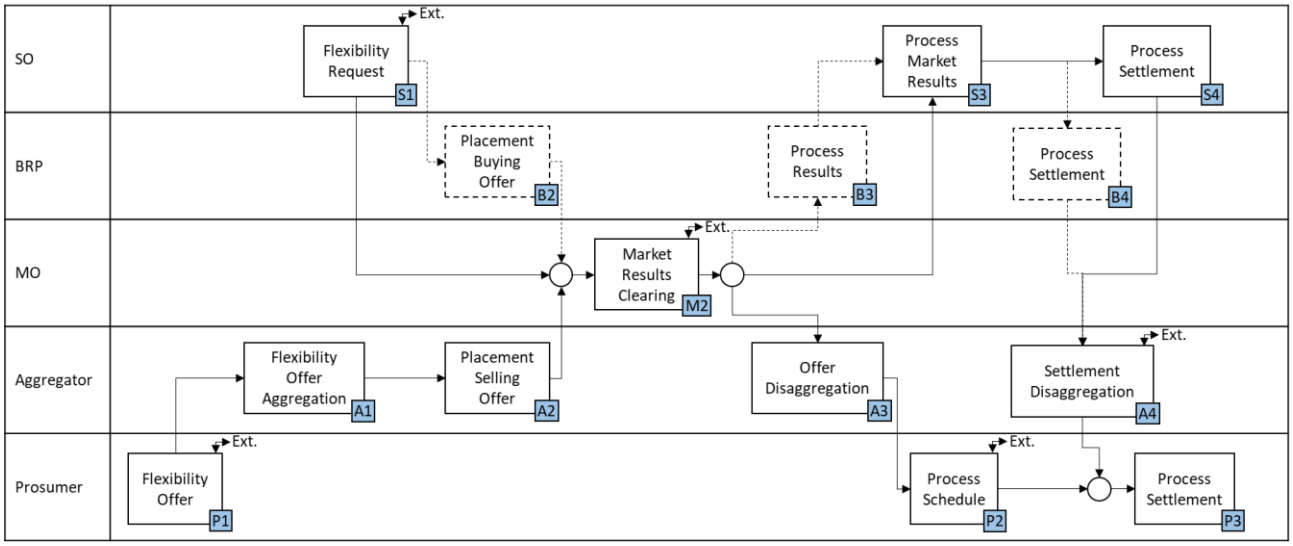


Figure 4 Business process diagram – GBP1 "SO flexibility through open market"

3.1.3 GBP2 – Flexibility for SO via prior bilateral agreement

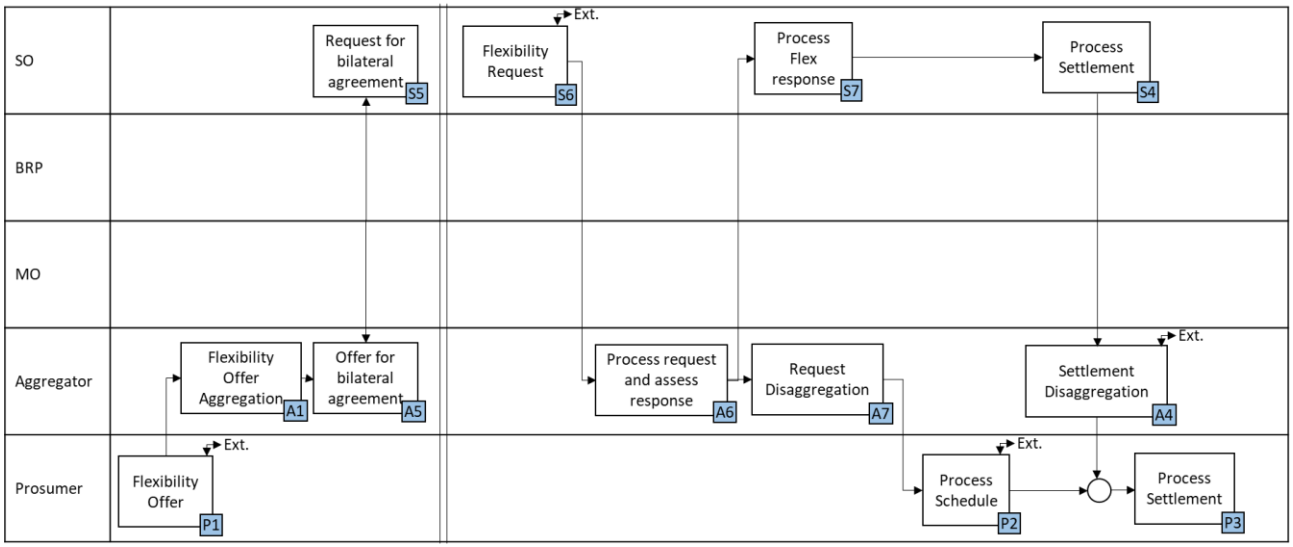
The SO (i.e. DSO or TSO) business process for flexibility via prior bilateral agreement (

Figure 5) is quite different from the one described above, even though flexibility is offered to SO in this case as well. The purpose of this case is to provide near real-time flexibility activation after a SO request, in particular for the SO to deal with an emerging network congestion / load balancing problem. Delivery of flexibility is not expected to be performed through a market, therefore no market operator is involved, in order to simplify and speed up the process. Highest priority must be given due to the emergency status. Therefore, in case there are other flexibility offers and requests available in a market (e.g. Local Flexibility Market), these planned transactions could be temporarily disregarded.

The roles that are involved in this process are the SO, the Aggregator, and the Prosumers. The SO flexibility via prior bilateral agreement process comprises two distinct phases:

- In the first phase, a bilateral agreement between the SO and the Aggregator is made in order to define details as the min. / max amount of flexibility, pricing of the service that Aggregator provides to the SO, and estimated amount of aggregated flexibility that can be provided. The amount of flexibility that can be delivered to SO is determined dynamically by the Aggregator who continuously estimates aggregated flexibility within a rolling horizon T, based on the flexibility offers that are received by the participating prosumers. Flexibility gets updated within T, however it is usually considered fixed for a period defined by a fixed timestep (current time + timestep).

- The second phase is initiated when the SO effectively requires flexibility, for example when detecting or predicting a critical problem in the network, and therefore requests flexibility



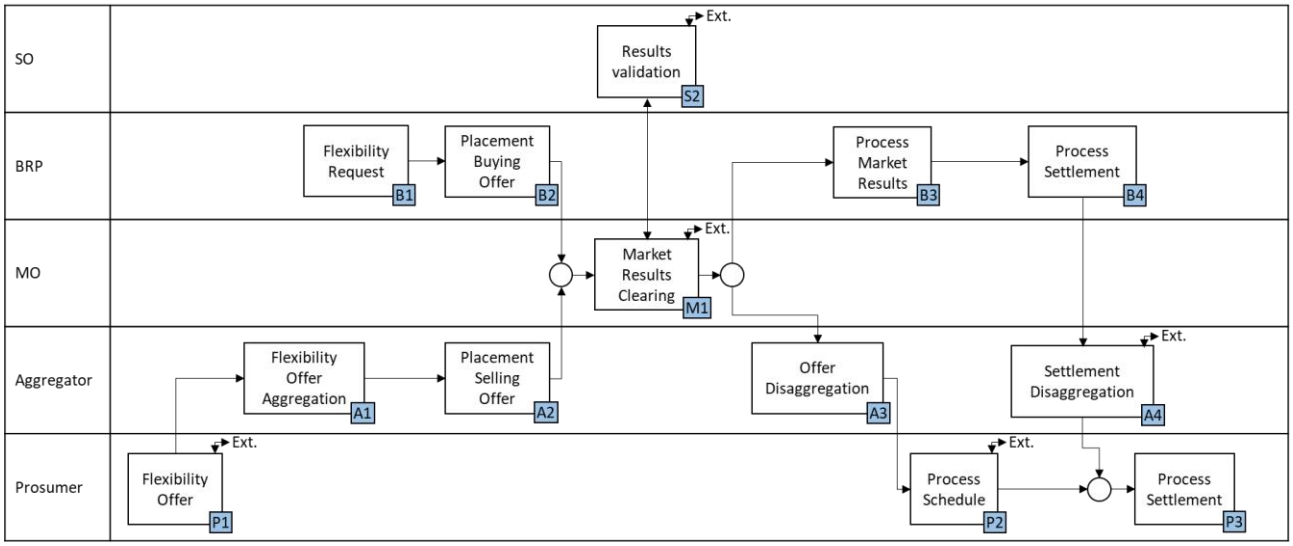
from the Aggregator based on the bilateral agreement. The amount of flexibility that will be provided to SO is calculated dynamically by the Aggregator. Under normal conditions, the whole process ends with the generation of asset control schedules at the prosumers' side, flexibility activation and settlement.

Figure 5: Business process diagram for GBP2 "SO flexibility via prior bilateral agreement"

3.1.4 GBP3 – Flexibility for BRP portfolio optimization

The main objective of balancing markets is to deal with the power system's temporary imbalances to ensure grid stability and security of supply. The flexibility can be used to optimise trading portfolios and reduce balancing cost resulting from deviations between scheduled and actual inflow/off-take. The costs for this balancing mechanism are charged to BRPs with an imbalance in their portfolio. The BRPs optimise their portfolio so that instantaneous deviations between predicted and actual production and consumption are kept as low as possible to avoid imbalance costs and prevent the power system to enter the emergency mode. The flexibility services are offered to energy suppliers/BRP, the aggregator pools the flexibilities services offered by customers or network users to balance the flexibility assets in the grid or energy markets. The responsibility might be carried out by existing bundled roles in the energy market, like energy suppliers with variable prices, aggregators.

It is worth emphasizing that the BRP defines its optimization strategy by undertaking roles of an aggregator and use the received flexibility offer. As well as the BRP can participate in new or existing balancing power markets



and energy services. The difference between the DSO leveraging flexibility through open market and Portfolio optimisation is the market settlement is undertaken by the BRP.

Figure 6: Business process diagram for GBP3 "BRP portfolio optimisation"

3.2 Functions and interfaces

This section describes the functions and interfaces used in the generic business processes.

3.2.1 Functions

3.2.1.1 Summary of relevant functions per Generic Business Process

Function	GBP1	GBP2	GBP3
S1 / Flexibility Request	✓		
S2 / Results validation			✓
S3 / Process Market Results	✓		
S4 / Process Settlement	✓	✓	
S5 / Request for bilateral agreement		✓	
S6 / Flexibility request		✓	
S7 / Process Flex response		✓	
B1 / Flexibility request			✓
B2 / Placement of Buying Offer	(✓)		✓
B3 / Process Results	(✓)		✓
B4 / Process Settlement	(✓)		✓
M1 / Market Results Clearing (BRP)			✓
M2 / Market Results Clearing (SO)	✓		
A1 / Flexibility Offer Aggregation	✓	✓	✓
A2 / Placement Selling Offer	✓		✓

Function	GBP1	GBP2	GBP3
A3 / Flexibility Offer Disaggregation	✓		✓
A4 / Settlement Disaggregation	✓	✓	✓
A5 / Offer for bilateral agreement		✓	
A6 / Process request and assess response		✓	
A7 / Request disaggregation		✓	
P1 / Flexibility offer	✓	✓	✓
P2 / Process schedule	✓	✓	✓
P3 / Process Settlement	✓	✓	✓

3.2.1.2 SO functions

S1 / Flexibility Request	
Description	The SO sends a flexibility request to the market or to the BRP, specifying volume, date(s), location, expiration date (and price in the case of market bid).
Inputs	
Outputs	Flexibility request
External required data	Flexibility pool, Grid Operational Status, Flexibility availability
Decomposition into functions/subfunctions	

S2 / Results validation	
Description	The foreseen result of the market cycle is provided by the MO to the SO, so the SO can validate that the proposed plan is acceptable from the grid perspective.

S2 / Results validation	
Inputs	Flexibility offers and offer results (what, when, where, how much, ...)
Outputs	Acceptance or refusal of the proposed plan
External required data	Grid operational status
Decomposition into functions/subfunctions	

S3 / Process Market Results	
Description	The SO receives information on activated flexibility. It processes the result and in case of inadequate volumes, corrective actions are taken (e.g. new request).
Inputs	Flexibility order
Outputs	Corrective actions
External required data	
Decomposition into functions/subfunctions	

S4 / Process Settlement	
Description	Flexibility transactions are validated via the use of energy measurement data. Payment information for settlement are presented.
Inputs	Energy measurement data, Flexibility order
Outputs	Payment information
External required data	
Decomposition into functions/subfunctions	

S5 / Request for bilateral agreement	
Description	The SO makes a request to the Aggregator to make bilateral agreement regarding the flexibility that can be provided
Inputs	Special flag to indicate an emergency operation scenario Desirable amount of flexibility
Outputs	Start iterative negotiation process with the Aggregator
External required data	
Decomposition into functions/subfunctions	

S6 / Flexibility request	
Description	SO makes a flexibility request to the Aggregator to deal with a predicted grid issue (e.g. emergency situation)
Inputs	
Outputs	Time period Amount of energy Location information
External required data	Grid network area status (emergency state)
Decomposition into functions/subfunctions	

S7 / Process Flex response	
Description	SO processes the flexibility response received.
Inputs	Flexibility response
Outputs	Selected flexibility response

S7 / Process Flex response	
External required data	
Decomposition into functions/subfunctions	

3.2.1.3 BRP functions

B1 / Flexibility request	
Description	BRP places a flexibility bid in the market, specifying volume, date(s), location, expiration date and price.
Inputs	Flexibility request by SO
Outputs	Flexibility request to the market
External required data	
Decomposition into functions/subfunctions	

B2 / Placement of Buying Offer	
Description	BRP places a flexibility bid in the market, specifying volume, date(s), location, expiration date and price.
Inputs	Flexibility request by SO
Outputs	Flexibility request to the market
External required data	
Decomposition into functions/subfunctions	

B3 / Process Results	
Description	BRP receives information on activated flexibility. It forwards relevant information to SO.
Inputs	Flexibility order (s) from market
Outputs	Flexibility order(s) to SO
External required data	
Decomposition into functions/subfunctions	

B4 / Process Settlement	
Description	Flexibility transactions are validated via the use of energy measurement data. Payment information for settlement are presented.
Inputs	Energy measurement data, Flexibility order
Outputs	Payment information
External required data	
Decomposition into functions/subfunctions	

3.2.1.4 Market Operator functions

M1 / Market Results Clearing (BRP)	
Description	Matching of the buying requests and the selling offers from the aggregator
Inputs	Flexibility request from BRP Selling offer(s) from aggregator(s) Validated Results
Outputs	Market Results clearing

M1 / Market Results Clearing (BRP)	
External required data	Flexibility pool
Decomposition into functions/subfunctions	

M2 / Market Results Clearing (SO)	
Description	Matching of the request (buy) and offers (sell) of flexibility.
Inputs	Flexibility request from SO Selling offer(s) from aggregator(s)/BRP(s)
Outputs	Flexibility order(s)
External required data	Flexibility pool
Decomposition into functions/subfunctions	

3.2.1.5 Aggregator

A1 / Flexibility Offer Aggregation	
Description	Aggregator collects flexibility offers of all prosumers and calculates the available flexibility for its portfolio.
Inputs	Flexibility offer of prosumer(s)
Outputs	Aggregated flexibility
External required data	
Decomposition into functions/subfunctions	

A2 / Placement Selling Offer	
Description	Aggregator places a bid of flexibility in the market. The bid has an expiration date and the location of the grid. Location can relate to physical infrastructure (e.g. substation, feeder) or logical segment (area of the grid).
Inputs	Aggregated flexibility
Outputs	Flexibility offer (market level)
External required data	
Decomposition into functions/subfunctions	

A3 / Flexibility Offer Disaggregation	
Description	Aggregator receives flexibility schedule from the market. It activates flexibility of prosumers following internal process of optimisation.
Inputs	Flexibility order from market
Outputs	Flexibility order(s) of prosumer(s)
External required data	
Decomposition into functions/subfunctions	

A4 / Settlement Disaggregation	
Description	Information on transactions of flexibility for settlement at the level of aggregator.
Inputs	Settlement at market level
Outputs	Settlement at prosumer level
External required data	Energy monitoring data, flexibility schedules

A4 / Settlement Disaggregation	
Decomposition into functions/subfunctions	

A5 / Offer for bilateral agreement	
Description	The Aggregator provides an offer for bilateral agreement with the SO
Inputs	Aggregated flexibility (calculated from previous step)
Outputs	Min/Max amount of flexibility that can be used after a SO flexibility request Price per flexibility unit to be paid for providing the service to the Aggregator
External required data	
Decomposition into functions/subfunctions	

A6 / Process request and assess response	
Description	Aggregator receives the flexibility request and checks if it is valid according to the bilateral agreement. If yes, highest priority is given to respond to the flexibility request.
Inputs	Flexibility request information (time period, amount of energy, location)
Outputs	Flexibility schedule returned as response
External required data	
Decomposition into functions/subfunctions	

A7 / Request disaggregation	
Description	Aggregator performs disaggregation of the selected flexibility response to the appropriate prosumers, by applying optimisation methods
Inputs	Flexibility that can be provided to SO after its request
Outputs	Flexibility schedule(s) of prosumer(s)
External required data	
Decomposition into functions/subfunctions	

3.2.1.6 Prosumer

P1 / Flexibility offer	
Description	Prosumer's flexibility is provided to the Aggregator. Prosumer is aware and agrees that provided flexibility can be procured via market transactions or based on bilateral agreement between the DSO and the Aggregator (incentives for prosumer involvement can be provided in the latter case).
Inputs	Flexibility calculation from individual assets: P2H, EV charging, etc. Flexibility time period
Outputs	Flexibility offer
External required data	Any data required for calculating flexibility that can be offered dynamically based on current and forecasted parameters' values: usage patterns, types of devices, set-points preferences, weather data, calendar
Decomposition into functions/subfunctions	

P2 / Process schedule	
Description	Prosumers receives flexibility schedule from the aggregator. Assets are activated following the received schedule.
Inputs	Flexibility order
Outputs	Result of flexibility scheduling
External required data	Control of assets
Decomposition into functions/subfunctions	

P3 / Process Settlement	
Description	Prosumers receives flexibility schedule from the aggregator. Assets are activated following the received schedule.
Inputs	Flexibility order
Outputs	Asset control commands
External required data	
Decomposition into functions/subfunctions	

3.2.2 Arrows (information flows)

3.2.2.1 Summary of relevant interfaces per Generic Business Process

Interface	GBP1	GBP2	GBP3
P1 → A1	✓	✓	✓
A1 → A2	✓		✓
A1 → A5		✓	
A2 → M2	✓		
S1 → B2	(✓)		
B2 → M2	(✓)		
S1 → M2	✓		
M2 → B3	(✓)		
B3 → S3	(✓)		
M2 → S3	✓		
S3 → B4	(✓)		
B4 → A4	(✓)		✓
S3 → S4	✓		
S4 → A4	✓	✓	
M2 → A3	✓		
A3 → P2	✓		✓
P2 → P3	✓	✓	✓
A4 → P3	✓	✓	✓
A5 → S5		✓	

Interface	GBP1	GBP2	GBP3
A6 → S7		✓	
A6 → A7		✓	
A7 → P2		✓	
S7 → S4		✓	
A2 → M1			✓
B1 → B2			✓
B2 → M1			✓
M1 ↔ S2			✓
M1 → B3			✓
B3 → B4			✓
B4 → A4			✓
S1 ↔ Ext	✓		
S2 ↔ Ext			✓
S6 ↔ Ext		✓	
M1 ↔ Ext			✓
M2 ↔ Ext	✓		
A4 ↔ Ext	✓	✓	✓
P1 ↔ Ext	✓	✓	✓
P2 ↔ Ext	✓	✓	✓

S6 → A6		✓	

3.2.2.2 Internal interfaces

P1 → A1	
Purpose	Inform Aggregator about possible flexibility on Prosumer side for the next hour/day/...
Involved roles	Prosumer Aggregator
List of exchanged data	Flexibility offer (what, when, where, how much, ...) Could be: ● A set of Timeseries of flexibility (tolerance) including *baseline* (estimation of desired power consumption considering only prosumer's comfort), *upper bound* (maximum energy that can absorb) *lower bound* (minimum energy required). ● *Granularity* of the timeseries, its *length* (horizon) and *unit* is also contained in message description. ● Location: geographical (latitude and longitude) or grid-related (substation ID or connection point) ● Communication endpoints for central EMS (or individual assets) ● Other information: e.g. flexibility timeseries are valid till are not exploited, once the flexibility is used, Aggregator needs to consider a rate of flexibility adjustment or make frequent queries to get latest updates from prosumer. Or data about rebound effects of storage-like flexibility.

A1 → A2	
Purpose	Inform about aggregated flexibility that can be offered to the market
Involved roles	Aggregator
List of exchanged data	Flexibility offer (what, when, where, how much, ...)

A1 → A5	
Purpose	Communication of the available aggregated flexibility for the horizon of interest, to be processed with an offer optimization function (regarding portfolio of clients, and estimation of the bids/imbalance fees).
Involved roles	Aggregator
List of exchanged data	Aggregated flexibility offers per zone

A2 → M2	
Purpose	Submit flexibility offer to the market
Involved roles	Aggregator MO
List of exchanged data	Flexibility offer (what, when, where, how much, ...)

S1 → M2	

Option 1: through BRP

S1 → B2	
Purpose	Inform about flexibility need that should be placed to the market
Involved roles	SO BRP
List of exchanged data	Flexibility request (what, when, where, how much, ...)
B2 → M2	
Purpose	Place flexibility request
Involved roles	BRP

S1 → M2	
	MO
List of exchanged data	Flexibility request (what, when, where, how much, …)

Option 2: direct

S1 → M2	
Purpose	Place flexibility request
Involved roles	SO MO
List of exchanged data	Flexibility request (what, when, where, how much, …)

M2 → S3

Option 1: through BRP

M2 → B3	
Purpose	Inform about flexibility transaction/agreement
Involved roles	MO BRP
List of exchanged data	Flexibility order (what, when, where, how much, …)

B3 → S3	
Purpose	Inform about flexibility transaction/agreement
Involved roles	BRP

M2 → S3	
	SO
List of exchanged data	Flexibility order (what, when, where, how much, …)

Option 2: direct

M2 → S3	
Purpose	Inform about flexibility transaction/agreement
Involved roles	MO SO
List of exchanged data	Flexibility order (what, when, where, how much, …)

S3 → A4

Option 1: through BRP

S3 → B4	
Purpose	Inform about past flexibility transaction/agreement
Involved roles	SO BRP
List of exchanged data	Flexibility order (what, when, where, how much, …)
B4 → A4	
Purpose	Inform about past flexibility transactions/agreements over a period
Involved roles	BRP

S3 → A4	
	Aggregator
List of exchanged data	List of flexibility orders (what, when, where, how much, …)

Option 2: direct

S3 → S4	
Purpose	Inform about past flexibility transaction/agreement
Involved roles	SO
List of exchanged data	Flexibility order (what, when, where, how much, …)

S4 → A4	
Purpose	Inform about past flexibility transactions/agreements over a period
Involved roles	SO Aggregator
List of exchanged data	List of flexibility orders (what, when, where, how much, …)

M2 → A3	
Purpose	Inform about flexibility transaction/agreement
Involved roles	MO Aggregator
List of exchanged data	Flexibility order (what, when, where, how much, …)

A3 → P2	
Purpose	Inform about flexibility activation to be scheduled
Involved roles	Aggregator Prosumer
List of exchanged data	Flexibility order (what, when, where, how much, ...)

P2 → P3	
Purpose	Inform about past scheduled flexibility activation
Involved roles	Prosumer
List of exchanged data	Flexibility order (what, when, where, how much, ...)

A4 → P3	
Purpose	Inform about past requested flexibility activations
Involved roles	Aggregator Prosumer
List of exchanged data	List of flexibility orders (what, when, where, how much, ...)

A5 → S5	
Purpose	Bid/offer for bilateral agreement (iterative phase) Note: As a prerequisite, bilateral agreements between SO and Aggregator (and/or Prosumer) must be foreseen in the regulation. Involved parties (SO, Aggregator) have to proceed with the bilateral agreement in fully compliance with the regulation dictates.
Involved roles	SO

A5 → S5	
	Aggregator
List of exchanged data	Imbalance Settlement period and its duration. Hourly table of flexibility and corresponding offer Request/bid for flexibility in specific slot(s) of time Validation/refusal message Re-consider offers until all the forecasted energy requirement is safely satisfied. Lead time; Time before the (recurring) flexibility option expires. Problematic point (node) Remuneration scheme Others: ● Maximum number of activations ● Minimum time between activation ● Penalties for deviation from contract

S6 → A6	
Purpose	Flexibility request in operation phase (once the agreements are settled)
Involved roles	SO Aggregator(s)
List of exchanged data	Amount of flexibility and timing Location (geocoding or node specification) of the points in which flexibility is required

A6 → S7	
Purpose	Flexibility response
Involved roles	DSO Aggregator

List of exchanged data	Response; Validation, rejection

A6 → A7	
Purpose	Inform about flexibility agreement
Involved roles	Aggregator
List of exchanged data	Flexibility order (what, when, where, how much, ...)

A7 → P2	
Purpose	Inform about flexibility activation to be scheduled
Involved roles	Aggregator Prosumer
List of exchanged data	Flexibility order (what, when, where, how much, ...)

S7 → S4	
Purpose	Inform about past flexibility transaction/agreement
Involved roles	SO
List of exchanged data	Flexibility order (what, when, where, how much, ...)

A2 → M1	
Purpose	Submit flexibility offer to the market
Involved roles	Aggregator MO

List of exchanged data	Flexibility offer (what, when, where, how much, ...)

B1 → B2	
Purpose	Inform about flexibility need that should be placed to the market
Involved roles	BRP
List of exchanged data	Flexibility request (what, when, where, how much, ...)

B2 → M1	
Purpose	Place flexibility request
Involved roles	MO BRP
List of exchanged data	Flexibility request (what, when, where, how much, ...)

M1 ↔ S2	
Purpose	Exchange between market and SO to ensure a harmless and efficient bid selection from the grid perspective
Involved roles	SO MO
List of exchanged data	Flexibility offers and offer results (what, when, where, how much, ...) Acceptance or refusal of the proposed plan of the MO and/or selection of most relevant offers from SO perspective

M1 → B3	
Purpose	Inform about market results to BRP

M1 → B3	
Involved roles	MO BRP
List of exchanged data	Market results (what, when, where, how much, ...)

B3 → B4	
Purpose	Inform about past flexibility transaction/agreement
Involved roles	BRP
List of exchanged data	Flexibility order (what, when, where, how much, ...)

B4 → A4	
Purpose	Forwarding the market results by the BRP for settlements
Involved roles	BRP, Aggregator
List of exchanged data	Market results(what, when, where, how much, ...)

3.2.2.3 External interfaces

S1 ↔ Ext

S1 ↔ Ext	
Purpose	Exchange data for Flexibility Request
Involved roles	SO, External
List of exchanged data	Flexibility pool, Grid Operational Status, Flexibility availability

S2 ↔ Ext

S2 ↔ Ext	
Purpose	Exchange data for Results validation
Involved roles	SO, External
List of exchanged data	Grid operational status

S6 ↔ Ext

S6 ↔ Ext	
Purpose	Exchange data for Flexibility request
Involved roles	SO, External
List of exchanged data	Grid network area status (emergency state)

M1 ↔ Ext

M1 ↔ Ext	
Purpose	Exchange data for Market Results Clearing (BRP)
Involved roles	MO, External
List of exchanged data	Flexibility pool

M2 ↔ Ext

M2 ↔ Ext	
Purpose	Exchange data for Market Results Clearing (SO)
Involved roles	MO, External
List of exchanged data	Flexibility pool

A4 ↔ Ext

A4 ↔ Ext

Purpose	Exchange data for Settlement Disaggregation
Involved roles	Aggregator, External
List of exchanged data	Energy monitoring data, flexibility schedules

P1 ↔ Ext

P1 ↔ Ext	
Purpose	Exchange data for Flexibility offer
Involved roles	Prosumer, External
List of exchanged data	Any data required for calculating flexibility that can be offered dynamically based on current and forecasted parameters' values: usage patterns, types of devices, set-points preferences, weather data, calendar

P2 ↔ Ext

P2 ↔ Ext	
Purpose	Exchange data for Process Schedule
Involved roles	Prosumer, External
List of exchanged data	Control of assets

4. Interoperability study based on projects

4.1 Inputs from projects

In this section, 7 use-cases have been provided as inputs from projects:

Project	UC #	UC name	Mapped GBP
GIFT	1	Congestion avoidance	1 (SO open market)
FEVER	1	Advanced network congestion management considering DER & grid flexibility	1 (SO open market)
FEVER	14	Form a first example of a regional flexibility exchange model	3 (BRP portfolio optimization)
FLEXIGRID	6	Use case 6	2 (SO bilateral agreement)
FLEXIGRID	8	Use-case 8	1 (SO open market)
iELECTRIX	EDIS	Voltage management	2 (SO bilateral agreement)
iELECTRIX	Güssing	Voltage management	2 (SO bilateral agreement)

4.1.1 Project GIFT – Use case “Congestion avoidance”

4.1.1.1 Summary of the use-case

Scope

Grytøya and Hinnøya form one balance group that is to be monitored and managed to avoid congestion.

Objectives

The main objective is to avoid congestion on the grid for the DSO. Therefore, the objectives are:

Reduce the use of hydrocarbon-based energies

- Allow a high level of penetration of renewable energy
- Avoid congestion in Hinnøya and Grytøya electricity grid
    - Provide observability of the grid

- Develop synergies between energy networks
- Provide flexibility in consumption
- Lower consumption peaks

Actors

Business Role	System Actor	Short Description
DSO	Grid observability system	This actor performs network state estimation in order to allow facilities to define, prepare and optimize the sequence of operations required to solve or mitigate the predicted issues.
	VPS module "Grid operation"	Handles the communication with the Grid
MO	VPS module "Flexibility market"	Offers various flexibility trading options, potentially for the use by BRPs, micro-grids, and third-party flexibility marketers.
Aggregator	VPS module "Flexibility manager"	Allows managing (potentially large) collections of flexible devices in the FO form.
Prosumer	Fish farm	End user of electricity and heat.
	EV station	Automation system located at station level monitoring and controlling the devices in the grid. It can provide interface to network control center.
	E-ferry	End user of electricity and heat.
	Industrial prosumers	A consumer of electricity (including also agriculture users) may also be involved in contract-based Demand/Response.

Short narrative

Avoid congestion in both Hinnøya and Grytøya (Norway) by providing consumption flexibility. In particular, congestion in Grytøya can occur, due to the fact that the transformer capacity on Hinnøya is not adequate for satisfying current needs. Peak-shaving is also considered by the DSO (HLK) to avoid imbalances between production and consumption and therefore congestion.

Four main types of stakeholders who may provide flexibility are combined:

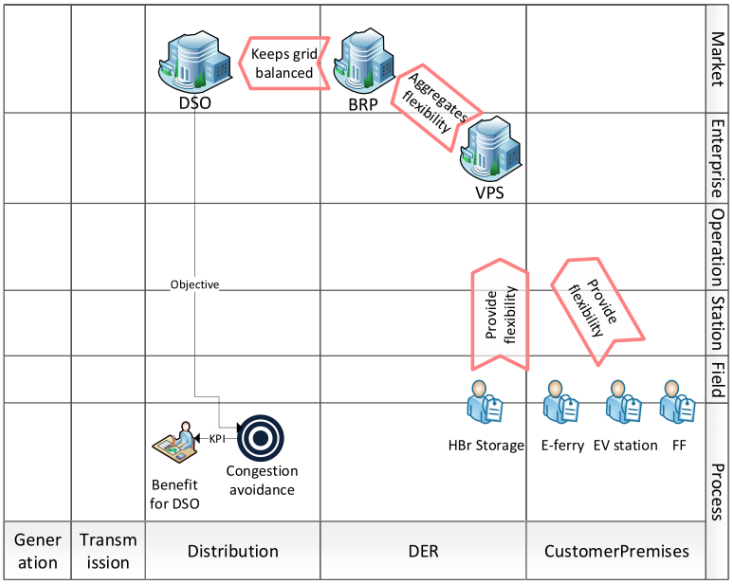
- The Fish farms: may be organized as a cluster, in order to reduce the impact of their connection to the grid (Fish farms LEC UC).
- The EV station: may contribute to the reduction of EV charging load and thus to reduction of the congestion (Smart Harstad UC).

- The E-ferry: as a big consumer, it will use batteries on shore to flatten out its consumption profile Industrial Prosumers: contribute to the reduction of the congestion.
- Other industrial Producers, Consumers and Prosumers: can contribute to the reduction of the congestion.

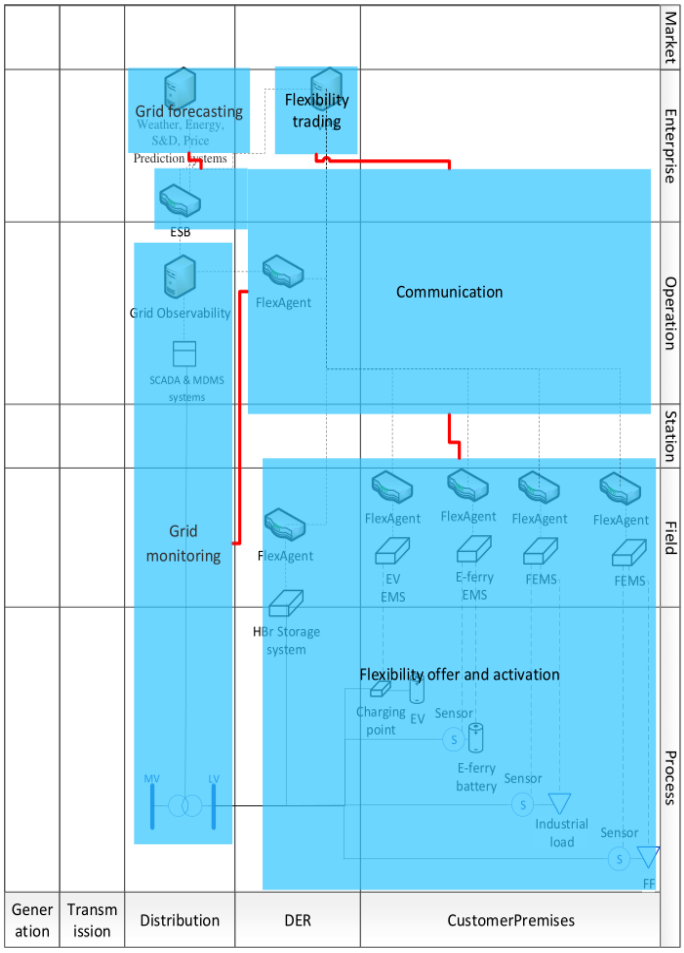
Additionally, a HBr battery system developed will be used for providing flexibility.

4.1.1.2 SGAM of the use-case

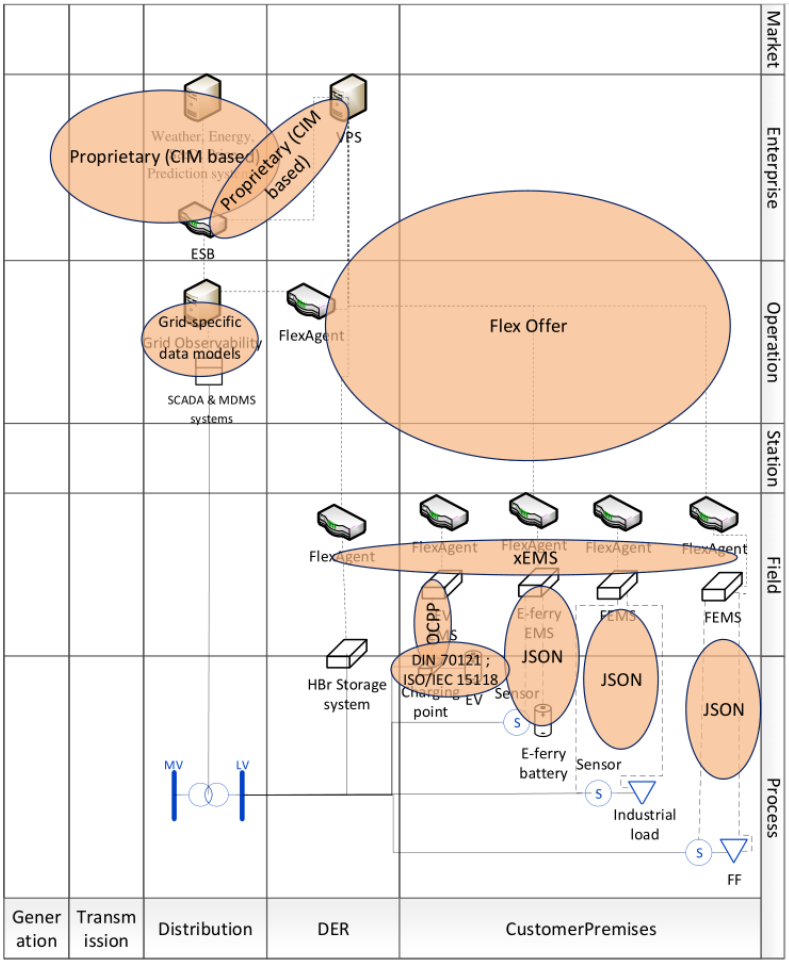
Business layer



Function layer



Information layer



4.1.1.3 Mapping with the generic business process

This use-case is related to "GBP1 – Flexibility for SO through open market".

This mapping is based on Scenario 1 (see below). Other scenarios have similar structure.

Scenario							
Scenario name	Sc.1- Congestion avoidance using Fish farms						
Step No.	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information exchanged (IDs)***	***Requirements, R-IDs***
St.1	Fish farms flexibility offer	Flexibility offer	The Fish farms continuously informs the VPS of their available flexibility.	Report	Fish farms	Inf.7	Req.3
St.2	Fish farms flexibility offer	Communication	The Flex agent manages the communications between the EMS systems and the VPS.	Send	FlexAgent	Inf.7	Req.1, 4, 7
St.3	Imbalance forecast	Forecast	The state of the grid is constantly forecasted in order to try predict imbalances.	Report	Weather, Energy, S&D, Price Predictions	Inf.1, 2, 3, 5	Req.3
St.4	Imbalance forecast	Communication	The ESB manages the communications between the Predictions system and the Grid observability system.	Send	ESB	Inf.1, 2, 3, 4, 5	Req.1, 4, 7

St.5	Imbalance Detection	Grid modeling / observation	The grid behavior is constantly monitored, looking for potential congestion and voltage excursion.	Report	Grid observability system	Inf.4	Req.3
St.6	Flexibility request	Communication	The Flex agent manages the communications from the Grid observability system to the VPS.	Send	FlexAgent	Inf.3, 6	Req.1, 4, 7
St.7	Flexibility request	Virtual power station management	The VPS manages the flexibility available within the grid. When flexibility is needed, it creates requests to the suitable flexibility provider.	Create	VPS Control center	Inf.3, 6	Req.2, 5, 6
St.8	Fish farms flexibility request	Communication	The Flex agent manages the communications between the VPS and the EMS systems.	Send	FlexAgent	Inf.3, 6	Req.1, 4, 7
St.9	Fish farms flexibility provision	Flexibility provision	The fish farms modify their consumption accordingly to the grid needs.	Execute	Fish farms	Inf.8	Req.2

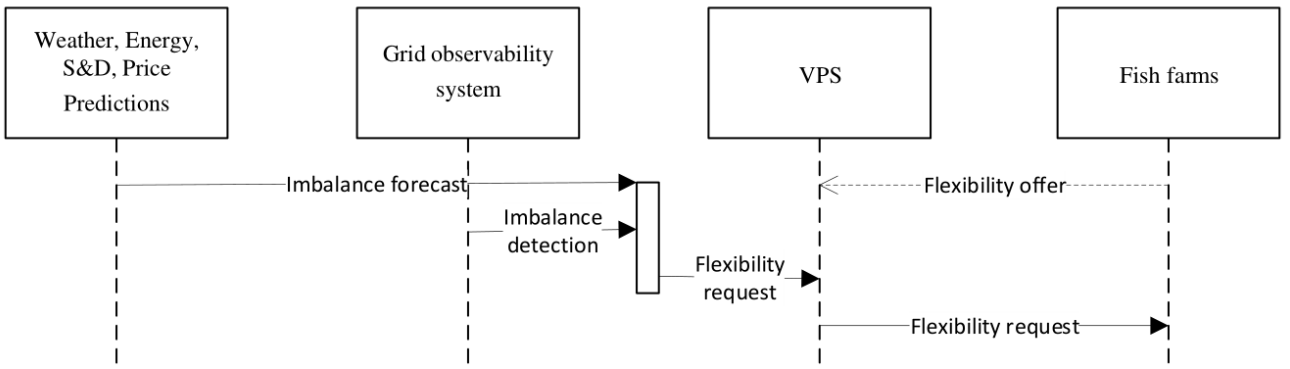
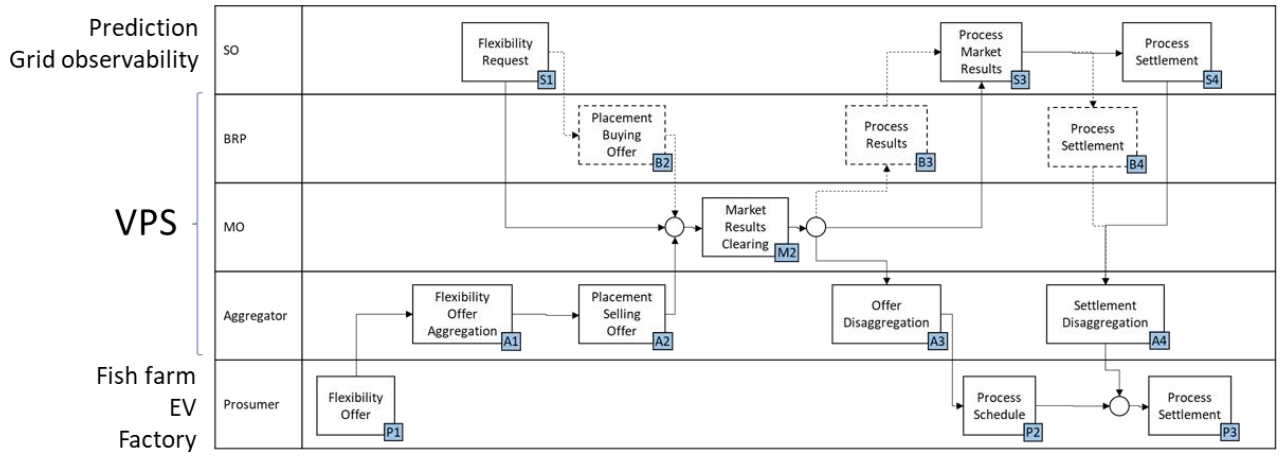


Figure 37:UML sequence diagram of Sc.1 on fish farms

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	Grid observability system + VPS module “Grid operation”	
BRP	–	No BRP
MO	VPS module “Flexibility market”	
Aggregator	VPS module “Flexibility manager”	
Prosumer	xEMS	Fish fams in Sc.1



Mapping between the GBP functions & UC functions

GBP function	Mapped UC function	Comment
S1	St.3 “Forecast” + St.5 “Grid modelling / observation”	
S3		Settlement not described in UC
S4		Settlement not described in UC
B2		No BRP in UC
B3		No BRP in UC
B4		No BRP in UC
M2	St.7 “Virtual Power Station management”	
A1		Done inside the VPS (Flexibility Manager module)
A2		Done inside the VPS (Flexibility Manager module)
A3		Done inside the VPS (Flexibility Manager module)
A4		Settlement not described in UC
P1	St.1 “Flexibility Offer”	
P2	St.9 “Flexibiltiy provision”	

GBP function	Mapped UC function	Comment
P3		Settlement not described in UC

Mapping between the GBP interfaces & UC interfaces

GBP interface	Mapped UC interface	Comment
P1 → A1	St.2 “Fish farm to VPS”	
A1 → A2		Done inside VPS: in “Flexibility Manager” module
A2 → M2		Done inside VPS: between “Flexibility Manager” and “Flexibility Market” modules
S1 → B2		No BRP in UC
B2 → M2		No BRP in UC
S1 → M2	St. 6 “Observability to VPS”	
M2 → B3		No BRP in UC
B3 → S3		No BRP in UC
M2 → S3		Settlement not described in UC
S3 → B4		No BRP in UC
B4 → A4		No BRP in UC
S3 → S4		Settlement not described in UC
S4 → A4		Settlement not described in UC
M2 → A3		Done inside VPS: between “Flexibility Manager” and “Flexibility Market” modules
A3 → P2	St. 8 “VPS to Fish farm”	
P2 → P3		Settlement not described in UC
A4 → P3		Settlement not described in UC

GBP interface	Mapped UC interface	Comment
S1 ↔ Ext	St. 4 “Predictions to VPS”	
M2 ↔ Ext		Not described in UC
A4 ↔ Ext		Not described in UC
P1 ↔ Ext		Not described in UC
P2 ↔ Ext		Not described in UC

4.1.1.4 Solutions/standards being used

Interfaces (information models)

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
P1 → A1	FlexOffer	OS		No standard solution for flexibility offer data exchange ⇒ open solution defined and pushed to community	
A1 → A2	Internal interface	P			
A2 → M2	Internal interface	P			
S1 → B2					
B2 → M2					
S1 → M2	CIM	FS			To be confirmed
M2 → B3					
B3 → S3					
M2 → S3					
S3 → B4					
B4 → A4					

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
S3 → S4					
S4 → A4					
M2 → A3	Internal interface	P			
A3 → P2	FlexOffer			No standard solution for flexibility offer data exchange ⇒ open solution defined and pushed to community	
P2 → P3					
A4 → P3					
S1 ↔ Ext	CIM	MES	Addition of readingQuality to Reading class ReadingType moved from Reading to MeterReading		
M2 ↔ Ext					
A4 ↔ Ext					
P1 ↔ Ext					
P2 ↔ Ext	OCPP Modbus …	FS			

(*) Possible values: “FS” = Fully standard, “MES” = Modified or extended standard”, “OS” = Open Specification, “P” = Proprietary

4.1.2 Project FEVER – Use case: HLUC 01 Advanced network congestion management considering DER & grid flexibility

4.1.2.1 Summary of the use-case

Scope

The scope of this use case is to describe the processes and tools which enable DSOs to identify network overloading issues from planning down to operational time-frame based on forecasted and real network operational data and to setup the remedial mechanisms for maintaining the secure and reliable network operation. Two remedial mechanisms are considered in this use case: grid reconfiguration by properly modifying the network switchgears; and, the procurement of DER active energy flexibility offered by Flexibility Service Providers.

Objectives

The objective of this use case is to prevent network congestion issues at distribution level and consequently minimize/delay network reinforcement costs by combining DSO's conventional network remedial mechanisms with DER flexibility remuneration whenever this is technically and economically viable.

Actors

Business Role	System Actor	Short Description
DSO	DSO Toolbox	A suite of grid-oriented tools complementing DSO's legacy systems enabling more advanced observability and management of the distribution grid. For the scope of this UC includes: ● Critical Event Prevention Application (CEPA) ● Switchgear Dispatch Scheduler (SDS)
	Flexibility Service Consuming Agent (FSCA)	The agent responsible for transforming the flexibility needs of the DSO to a bidding strategy. Could be considered part of the DSOToobox for the scope of this analysis.
	Supervisory Control and Data Acquisition system for Distribution System (DS-SCADA)	SCADA at the level to distribution system, proving network sensing data, grid operational constraints and controllability of grid assets.
	Advanced Metering Infrastructure (AMI)	Advanced Metering Infrastructure providing accessibility to measurement data from smart metering devices.
MO	Flexibility Trading Platform (FTP)	A system responsible for the trading of flexibility among different stakeholders.

Business Role	System Actor	Short Description
Aggregator	Flexibility Management System (FMS)	A system operated by the Flexibility Aggregator to aggregate / disaggregate flexibilities for trading purposes.
Prosumer	Flexibility Service Providing Agent (FSPA)	The agent responsible for transforming the flexibility of the Prosumer to a bidding strategy. Could be considered part of the CEMS for the scope of this analysis.
	Energy Management System (CEMS)	System responsible for monitoring and controlling DER assets at customer level.
External	Weather Forecaster (WF)	Service for providing historic data and meteorological forecasts.

Short Narrative

This use case has the objective of preventing congestion issues in the distribution grid by exploiting network flexibility, i.e. reconfiguration of the network topology in the problematic grid area, and DER flexibility, provided by dispatchable DERs located at distribution level. Congestion management can be considered in different timeframes, i.e. real-time operation, operational planning, and long-term planning. DER flexibility remuneration can be realised via bilateral contracts and/or flexibility markets operated by a third party.

4.1.2.2 SGAM of the use-case

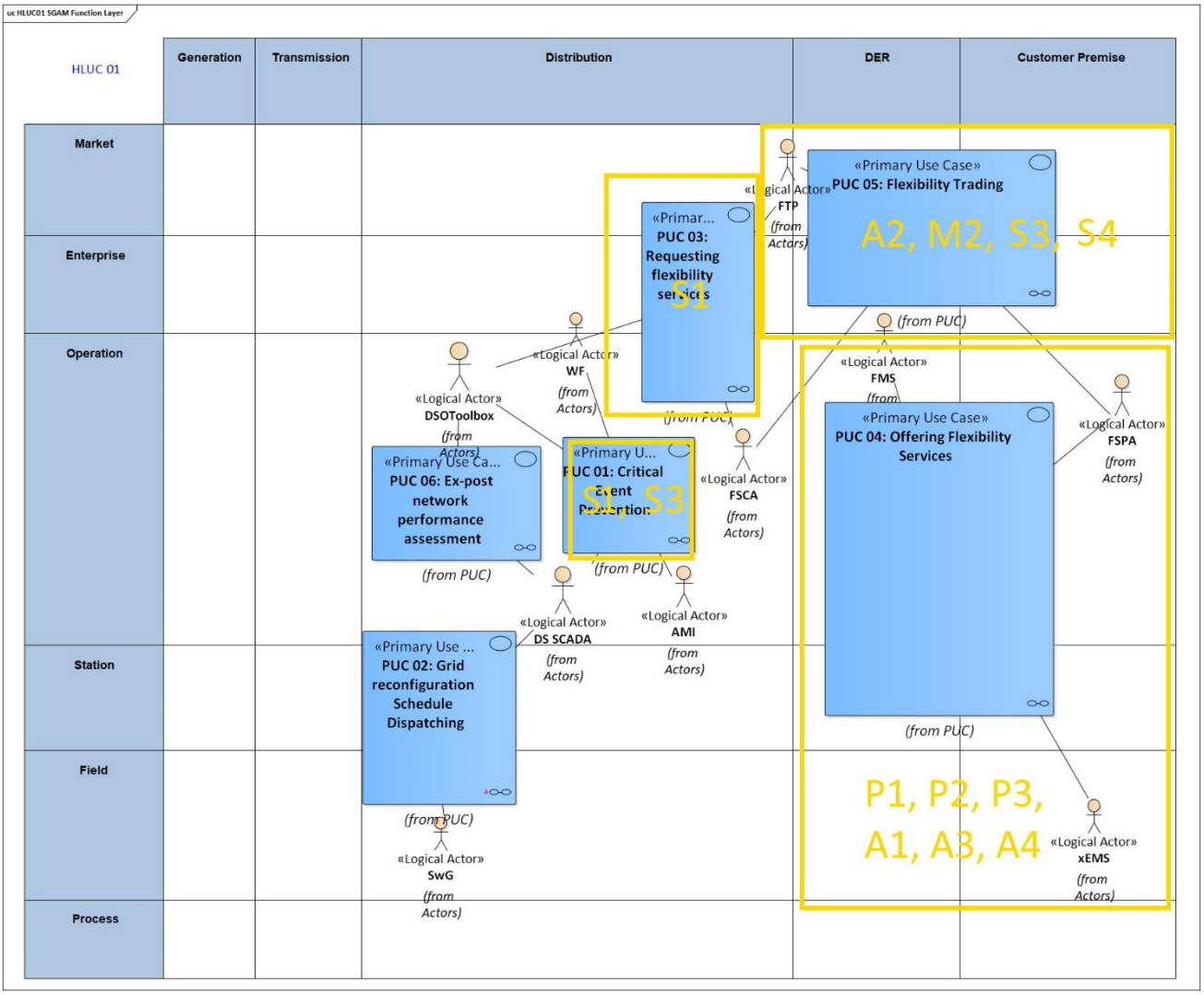


Figure 7: SGAM Function Layer

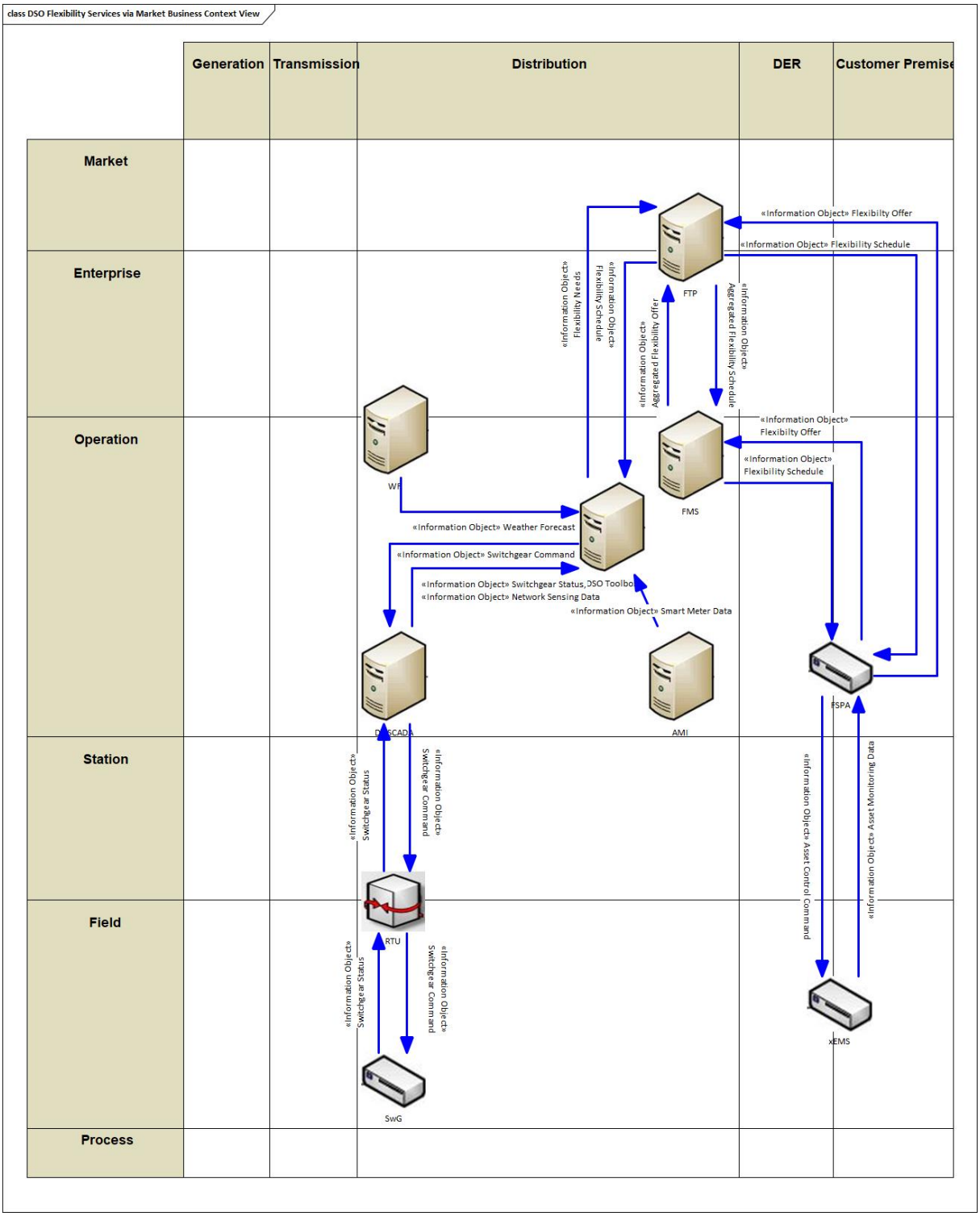


Figure 8: SGAM Information Layer

4.1.2.3 Mapping with the generic business process

This use-case is mapped to GBP1 "SO flexibility through open market".

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	DSO Toolbox	
	Flexibility Service Consuming Agent (FSCA)	
	Supervisory Control and Data Acquisition system for Distribution System (DS-SCADA)	
	Advanced Metering Infrastructure (AMI)	
BRP	–	No BRP
MO	Flexibility Trading Platform (FTP)	
Aggregator	Flexibility Management System (FMS)	
Prosumer	Flexibility Service Providing Agent (FSPA)	
	Energy Management System (CEMS)	
External	Weather Forecaster (WF)	

Mapping between the GBP functions & UC functions

GBP function	Mapped UC function	Comment
P1	PUC04: Offering Flexibility Services	
P2	PUC04: Offering Flexibility Service	This is covered more specifically by SUC 05:Asset Monitoring and Control
P3	PUC04: Offering Flexibility Services	
A1	PUC04: Offering Flexibility Services	
A2	PUC 05: Flexibility Trading	

GBP function	Mapped UC function	Comment
A3	PUC04: Offering Flexibility Services	
A4	PUC04: Offering Flexibility Services	
M2	PUC 05: Flexibility Trading	
B2	-	Not present in this UC
B3	-	Not present in this UC
B4	-	Not present in this UC
S1	PUC01 Critical event prevention actually invokes PUC 03: Requesting flexibility Services	
S3	PUC 05: Flexibility Trading & PUC01 Critical event prevention	
S4	PUC 05: Flexibility Trading	There is a post analysis action modelled as PUC06: Ex-post network performance assessment but settlement is not described.

Mapping between the GBP interfaces & UC interfaces

GBP interface	Mapped UC interface	Comment
P1 ↔ A1	CEMS (FSPA) - FMS	
A1 ↔ A2	FMS	Internal Process
A2 ↔ M2	FMS - FTP	There might be a direct communication among Prosumer and the market but we can disregard it for now.
M2 ↔ A3	FTP - FMS	
A3 ↔ P2	FMS - CEMS (FSPA)	

GBP interface	Mapped UC interface	Comment
P2 ↔ P3	Internal Process	Essentially there is an interaction among FSPA – CEMS. Process relates to existing EMS solution of pilots. No information on this now.
S1 ↔ M2	DSOToolbox(FSCA) - FTP	
M2 ↔ S3	FTP – DSOToolbox(FSCA)	Inform about flexibility transaction/agreement (Flexibility schedule), compute if any actions needed (part of PUC01)
S3 ↔ S4	FTP – DSOToolbox(FSCA)	Settlement information is not yet clarified in the project
S4 ↔ A4	FTP - FMS	Settlement information is not yet clarified in the project
A4 ↔ P3	FMS - CEMS (FSPA)	Settlement information is not yet clarified in the project

4.1.2.4 Solutions/standards being used

Interfaces (information models)

GBP interface	Used solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Comment
P1 ↔ A1	FlexOffer	OS			
A1 ↔ A2	-				Process relates to existing EMS solution. No information on this now
A2 ↔ M2	FlexOffer	OS			Flexibility request
M2 ↔ A3	FlexOffer	OS			Flexibility schedule
A3 ↔ P2	FlexOffer	OS			Flexibility schedule
P2 ↔ P3	-	OS			Internal Process
S1 ↔ External	CIM	FS	?		Smart Meter data from AMI and Network sensing data from SCADA are modelled on CIM, but the work is not

GBP interface	Used solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Comment
					complete yet. Weather data will be also used but data model is not finalised yet as well.
S1 ↔ M2	FlexOffer	OS			Flexibility request
M2 ↔ S3	FlexOffer	OS			Flexibility schedule
S3 ↔ S4	FlexOffer	OS	Needed extension to support settlement information		No sure yet
S4 ↔ A4	FlexOffer	OS	Needed extension to support settlement information		No sure yet
A4 ↔ P3	FlexOffer	OS	Needed extension to support settlement information		No sure yet

(*) Possible values: "FS" = Fully standard, "MES" = Modified or extended standard", "OS" = Open Specification, "P" = Proprietary

4.1.3 Project FEVER – Use case: HLUC 14: Form a first example of a regional flexibility exchange model

4.1.3.1 Summary of the use-case

Scope

The scope of this use case is the development of a regional flexibility exchange market where available flexibility can be traded among different balancing groups represented by the respective BRPs for balancing purposes.

The participation of BRPs in such regional flexibility markets presuppose the internal balancing of the balancing group by the responsible BRP.

Objectives

The objective of this use case is the development of a regional trading mechanisms which will facilitate the trans-regional flexibility trading among BRPs for minimizing their balancing costs.

Actors

Business Role	System Actor	Short Description
BRP	Balancing Responsible Party Management System (BRPMS)	Management System of a Balancing Responsible Party, enabling portfolio management as well as trading of energy and energy flexibility.

Business Role	System Actor	Short Description
		Incorporates flexibility agents (i.e. FSPA/FSCA) for transforming the portfolio flexibility and needs to a bidding strategy
MO	Flexibility Trading Platform (FTP)	A system responsible for the trading of flexibility among different stakeholders.
Aggregator	Flexibility Management System (FMS)	A system operated by the Flexibility Aggregator to aggregate / disaggregate flexibilities for trading purposes.
Prosumer	Flexibility Service Providing Agent (FSPA)	The agent responsible for transforming the flexibility of the Prosumer to a bidding strategy. Could be considered part of the CEMS for the scope of this analysis.
	Energy Management System (CEMS)	System responsible for monitoring and controlling DER assets at customer level.

Short Narrative

The Flexibility Trading Platform (FTP) operated by an independent Market Operator at regional level enables the trading of energy flexibilities among Balancing Groups (BG) coordinated and represented by BRPs.

The initial step for BRP's participation in the regional flexibility market is the internal flexibility management within its balancing group by the BRP Management System (BRP-MS).

In case that the available flexibility pool within the balancing group is not adequate to meet the flexibility needs of the responsible BRP, a second level of flexibility trading among BRPs at regional level is realized. This regional flexibility market facilitates the trading among BRPs with energy flexibility needs which are not fulfilled internally and the BRPs with excess of energy flexibility. The former BRP acts as a flexibility service consumer represented by a Flexibility Service Consuming Agent (FSCA) while the latter acts as Flexibility Service Provider represented by a Flexibility Service Providing Agent (FSPA).

4.1.3.2 SGAM of the use-case

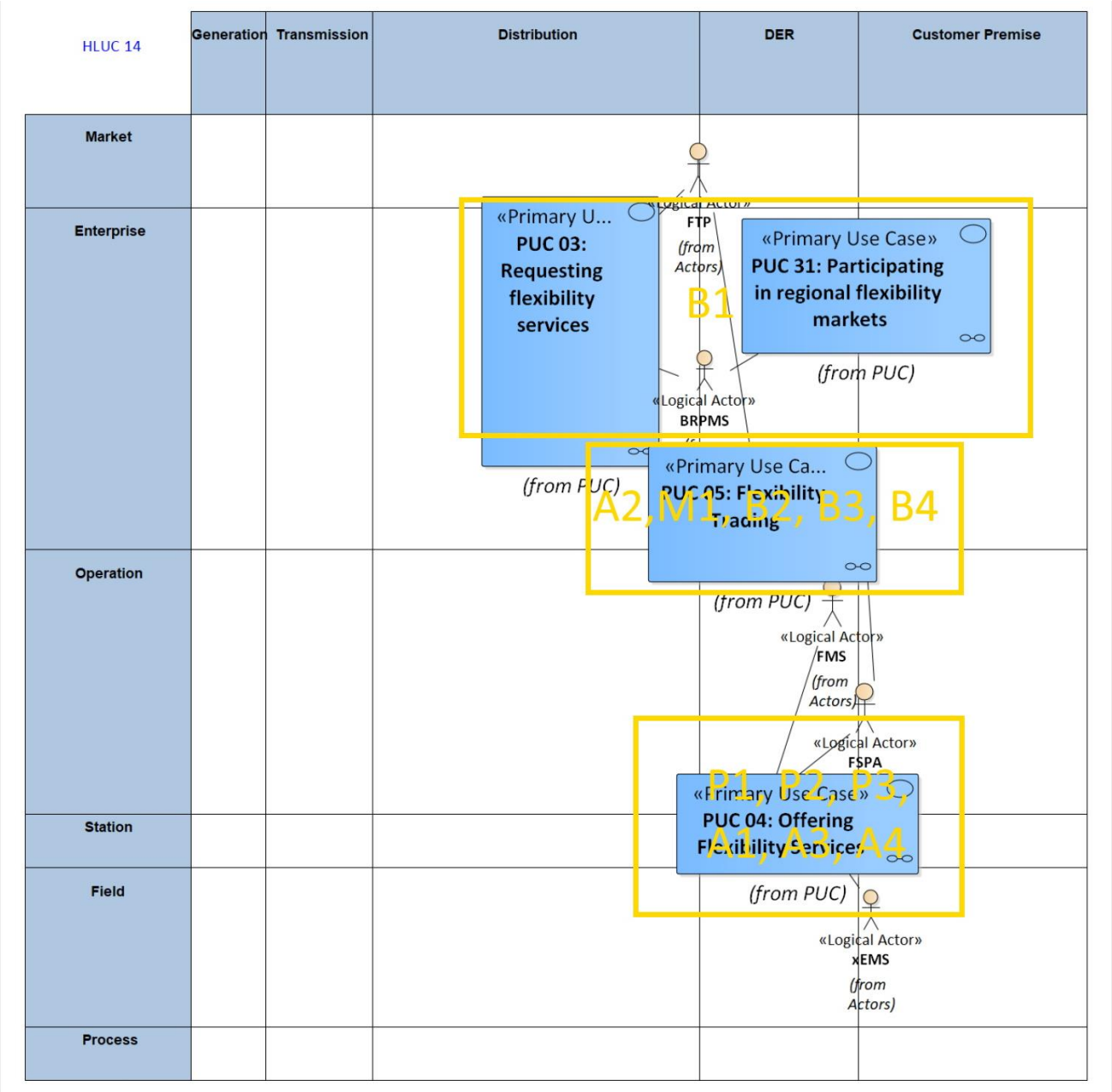


Figure 9: SGAM Function Layer

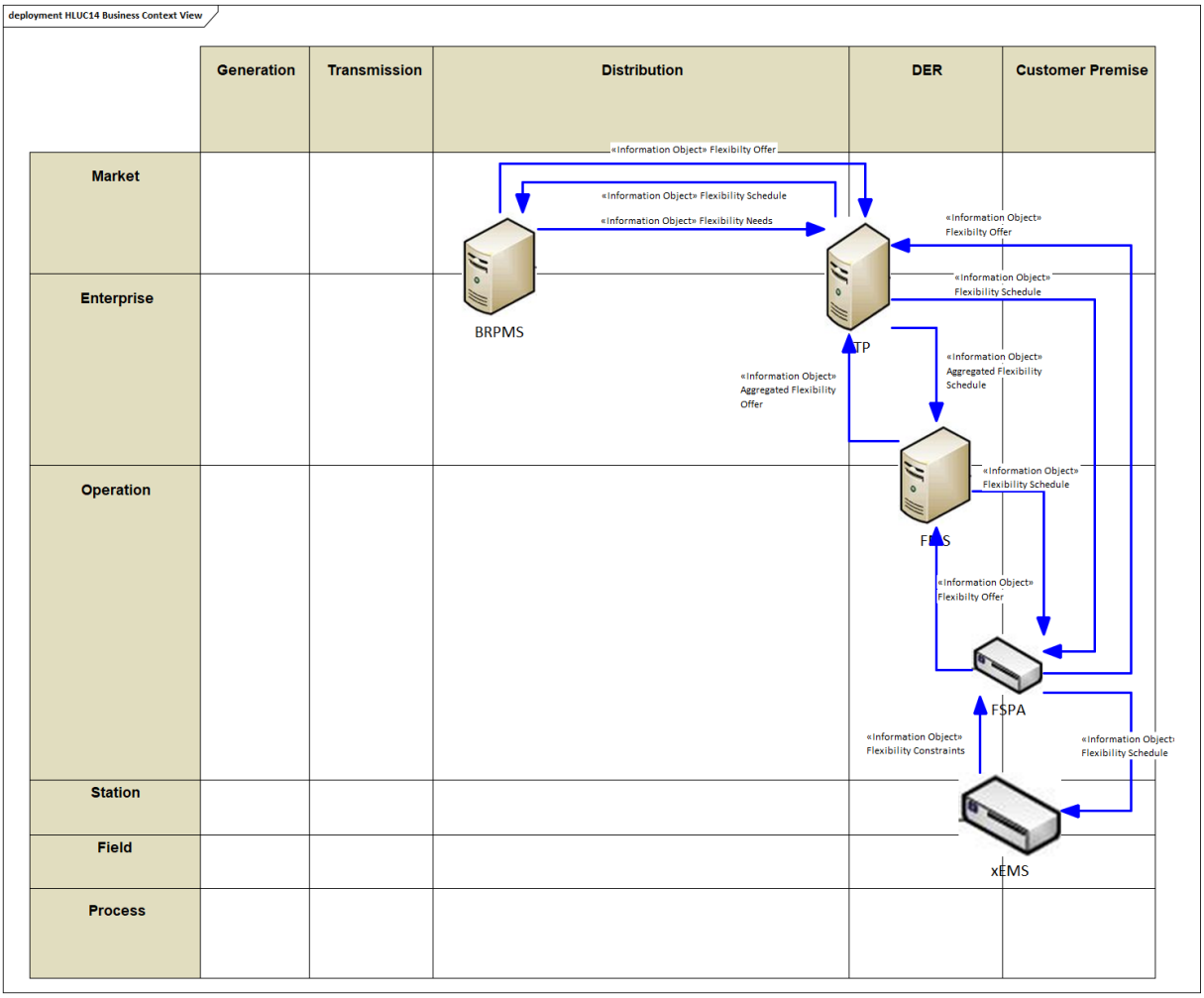


Figure 10: SGAM Information Layer

4.1.3.3 Mapping with the generic business process

This use-case is mapped to GB3 “BRP portfolio optimization”.

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	–	No SO
BRP	Balancing Responsible Party Management System (BRPMS)	
MO	Flexibility Trading Platform (FTP)	
Aggregator	Flexibility Management System (FMS)	
Prosumer	Flexibility Service Providing Agent (FSPA)	

GBP role	Mapped UC actor	Comment
	Energy Management System (CEMS)	

Mapping between the GBP functions & UC functions

GBP function	Mapped UC function	Comment
P1	PUC04: Offering Flexibility Services	
P2	PUC04: Offering Flexibility Service	
P3	PUC04: Offering Flexibility Services	
A1	PUC04: Offering Flexibility Services	
A2	PUC 05: Flexibility Trading	
A3	PUC04: Offering Flexibility Services	
A4	PUC04: Offering Flexibility Services	
M1	PUC 05: Flexibility Trading	
B1	PUC 03: Requesting flexibility Services PUC 31: Participating in regional flexibility markets	
B2		
B3	PUC 05: Flexibility Trading	
B4	PUC 05: Flexibility Trading	
S2	-	Not modelled

Mapping between the GBP interfaces & UC interfaces

GBP interface	Mapped UC interface	Comment
P1 ↔ A1	CEMS (FSPA) - FMS	
A1 ↔ A2	FMS	Internal Process.
A2 ↔ M1	FMS - FTP	
M1 ↔ A3	FTP - FMS	
A3 ↔ P2	FMS - CEMS (FSPA)	
P2 ↔ P3	Internal Process	Essentially there is an interaction among FSPA – CEMS. Process relates to existing EMS solution of pilots. No information on this now.
B2 ↔ M1	BRMS - FTP	
M1 ↔ B3	FTP – BRMS	Inform about flexibility transaction/agreement (Flexibility schedule).
B3 ↔ B4	Internal Process	Settlement information is not yet clarified in the project.
B4 ↔ A4	BRMS - FMS	Settlement information is not yet clarified in the project.
A4 ↔ P3	FMS - CEMS (FSPA)	Settlement information is not yet clarified in the project.

4.1.3.4 Solutions/standards being used

Interfaces (information models)

GBP interface	Used solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Comment
P1 ↔ A1	FlexOffer	OS			
A1 ↔ A2	-				Process relates to existing EMS solution. No information on this now
A2 ↔ M2	FlexOffer	OS			Flexibility request (aggregated)

GBP interface	Used solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Comment
M2 ↔ A3	FlexOffer	OS			Flexibility schedule
A3 ↔ P2	FlexOffer	OS			Flexibility schedule
P2 ↔ P3	-	OS			Internal process
B2 ↔ M1	FlexOffer	OS			Flexibility request
M1 ↔ B3	FlexOffer	OS			Flexibility schedule
B3 ↔ B4	FlexOffer	OS	Needed extension to support settlement information		No sure yet
B4 ↔ A4	FlexOffer	OS	Needed extension to support settlement information		No sure yet
A4 ↔ P3	FlexOffer	OS	Needed extension to support settlement information		No sure yet

(*) Possible values: “FS” = Fully standard, “MES” = Modified or extended standard”, “OS” = Open Specification, “P” = Proprietary

4.1.4 Project FLEXIGRID – Use case 6

4.1.4.1 Summary of the use-case

Scope

Distribution grid congestion management through thermal inertia of the buildings in urban area of Zagreb.

Objectives

The main objective is to avoid congestion on the grid for the DSO. Therefore, the objectives are:

- Avoid grid reinforcement needs through management of flexibility from consumers
  - Larger involvement of end-consumers by reduced prices (dynamic network tariffs).
  - Clarify the business case for energy communities and define optimal arrangements based on various ownership regimes.

Avoid high congestion of the grid due to the presence of DER and/or EV.

Short narrative

Group of residential buildings in urban are of Zagreb, are subjected to install smart devices which accurately learn and estimate comfort level of the residents in term of ambient temperature and need for hot water. This intelligent system is referred known as Virtual Energy Storage (VES) or Building as Battery (BaB), and oversees aggregating

data, runs optimizations for maximizing its portfolio considering constraints/properties
such as capacity of thermal storage, thermal inertia of the building and discharge rates, and computes optimal flexibility offer to the upper layer actor (aggregator or DSO). The flexibility offer consists of a set of timeseries/timetable indicating three quantities per step for a certain horizon of time. The three profiles are:

- lower bound: lowest limit of required power at step t
- baseline consumption: the estimated values for power consumption as if there were no flexibility, only user comfort in the picture step t
- upper bound: the heist power consumer can absorb from the network at step t.

The above-mentioned profiles get updated in a rolling horizon fashion, also based on some rules, e.g., if the flexibility is exploited at a certain time, or when there is abrupt change in climate.

Exploitation of this type of flexibility in Croatian demo falls into Emergency Operation generic business process. Bilateral agreements are to be set between the consumers and DSO, for instance with pre-specified number of activations per year of a price signal from DSO.

Involved roles

UC-6 mainly involves:

- VES: Digital technology and service rendering a set of buildings to Battery as Building (BaB) and Virtual Power Plants (VPP) to provide active services to the system operator such as balance and regulation services.
- Residential buildings: not necessarily energy producer but contributing in a VPP enabled by VES technology.
- DSO: over taking role of real market and aggregator to current date

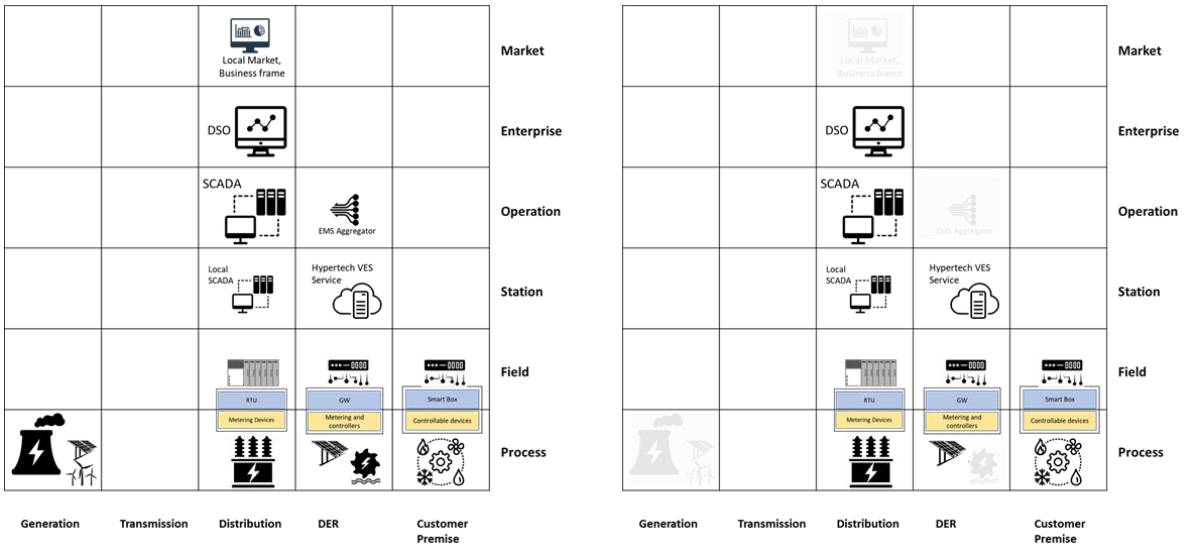


Figure 11: Actors' view

4.1.4.2 SGAM of the use-case

Function Layer (mapping with GBP2 “SO flexibility via prior bilateral agreement”)

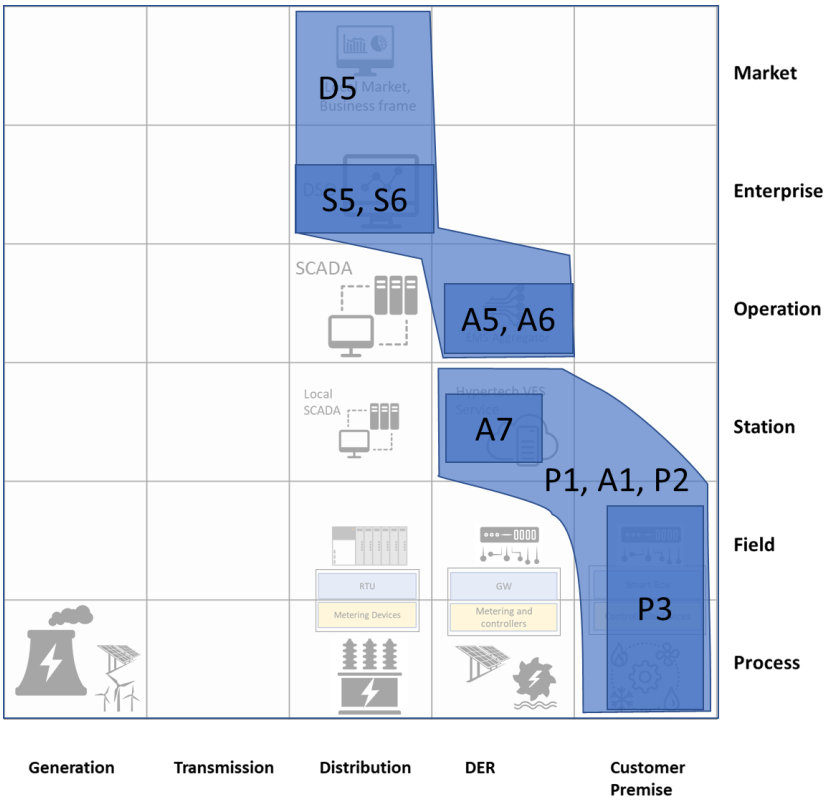


Figure 12: SGAM Function Layer

Information Layer (mapping with GBP2 "SO flexibility via prior bilateral agreement")

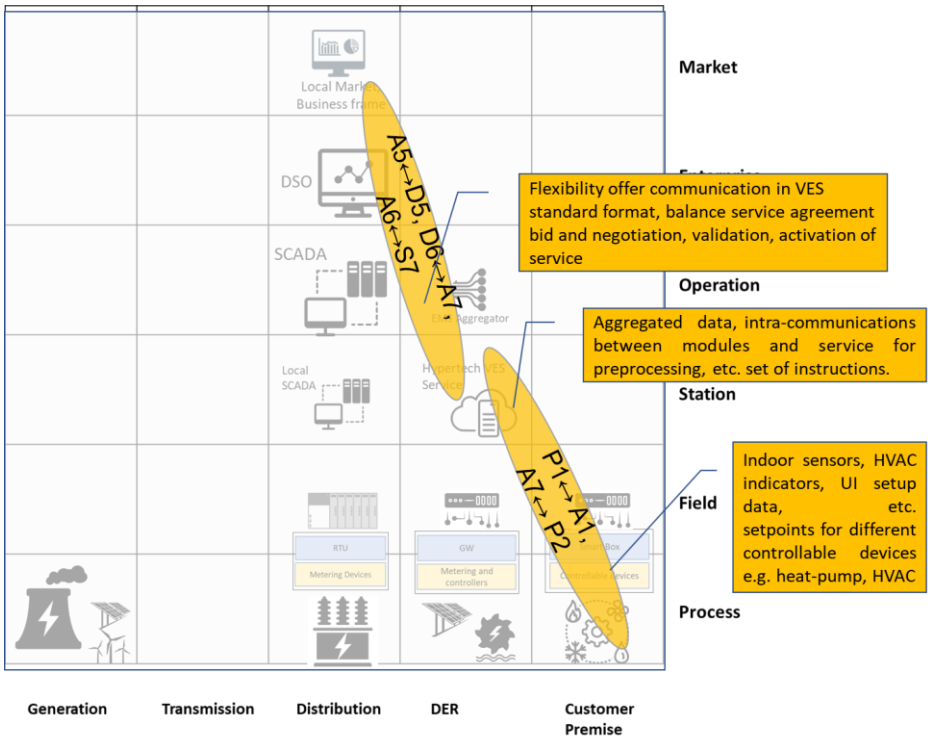


Figure 13: Information Layer

Sequence Diagram (mapping with GBP2 "SO flexibility via prior bilateral agreement")

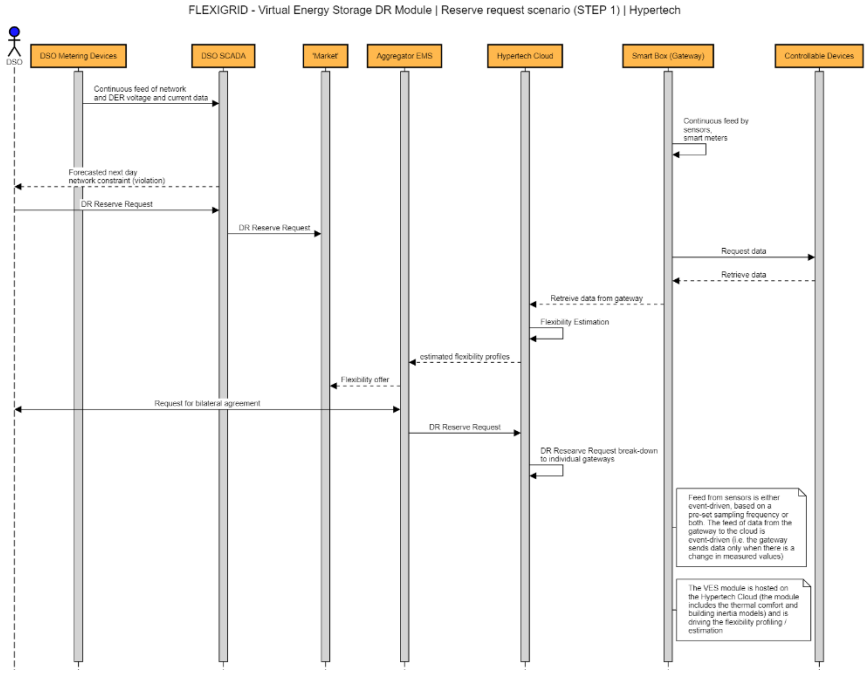


Figure 14 Agreement phase

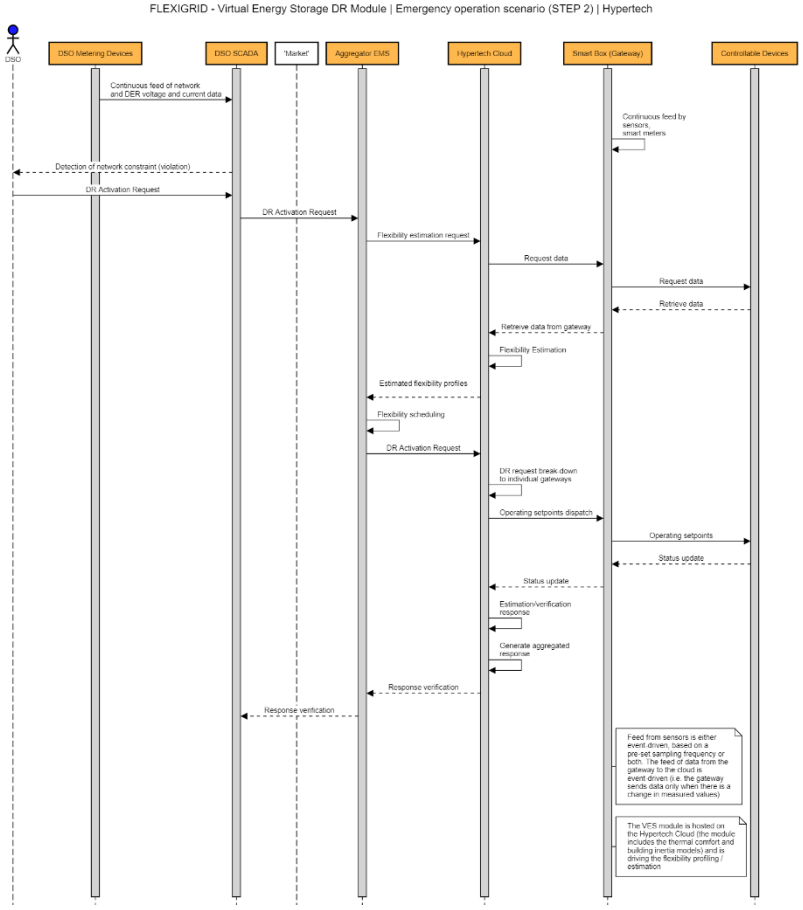


Figure 15: DR Request phase

4.1.4.3 Mapping with the generic business process

This use-cases is mapped to GBP2 “SO flexibility via prior bilateral agreement”.

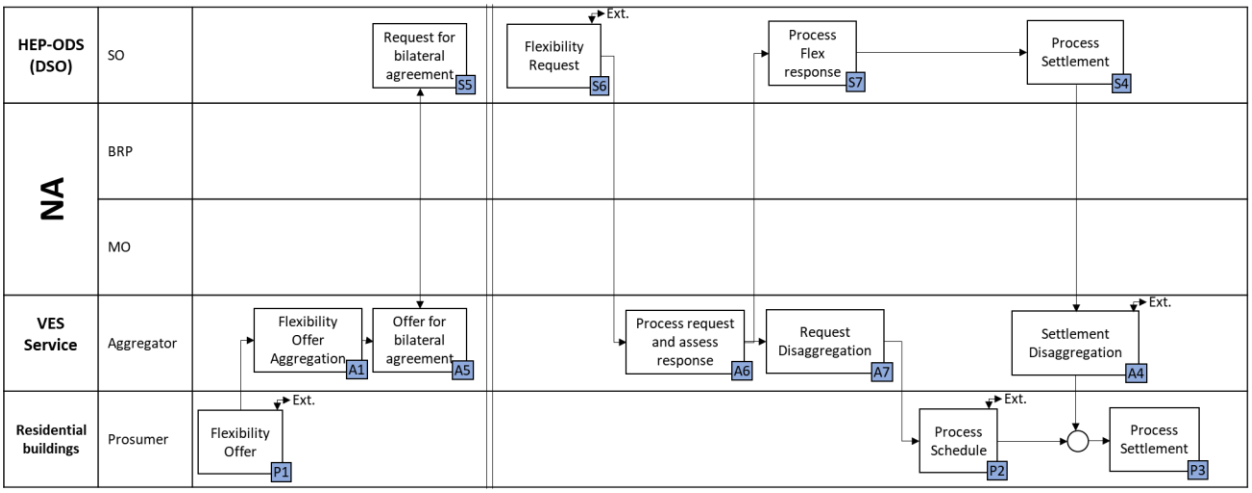


Figure 16: Emergency Operation GBP with Actors mapping

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	DSO (HEP-ODS)	
BRP	–	No BRP
MO	–	No MO
Aggregator	Hypertech’s VES service	
Prosumer	Three urban residential building	

Mapping of functions for agreement stage

GBP function	Mapped UC function	Comment
P1	Continuous feed from sensors, smart meters	This is divided in two step (functions) since smart devices are splitted from GW; 1-reading metering from various smart devices (meters→GW), 2-gateway data retention and communication (GW→Cloud)
A1	Aggregated flexibility estimation	VES is a cloud service that is in charge of accomplishing optimization and analytics process

GBP function	Mapped UC function	Comment
A5	Flexibility offer (optimization)	VES service, can be different than Aggregator
S5	Request for bilateral agreement	Aggregator ↔ DSO

Mapping of functions for activation stage

GBP function	Mapped UC function	Comment
S6	DR Activation Request	Request to aggregator is evaluated by this intermediary function.
A7	DR request breakdown to individual GWs	VES
P2	Operating setpoints dispatch	These setpoints are forwarded to GW. Then GW send commands to appropriate devices. Note that in some cases there are more than one controllable/flexible devices e.g., boiler, HVAC, heat pump, etc.
S7	NA	No such function considered yet
A4	NA	No such function considered yet
P3	Operating setpoints	Operating setpoints to individual devices

Mapping of the interfaces

GBP interface	Mapped UC interface	Comment
P1→ A1	Metering, sensors and user setup data communication to the VES service	Meter/sensor/control data to GW. Control data (user setup) gets used to interpret user's comfort.
A1→ A5	NA	Internal communication between various VES' modules
A5 ↔ S5	Bid/offer communication	Not yet in place, probably through OPC

GBP interface	Mapped UC interface	Comment
S6 → A6	DR activation request	Not yet in place
A6 → A7	NA	Internal communication between various VES' modules
A6 → S7	NA	Not yet considered
A7 → P2	Instruction communication	Aggregated instructions to GW (there might be one or more controllable devices downstream
P2 → P3	Splitted messages from GW to single controllable devices (e.g. heat-pump, HVAC, boiler)	Setpoint messages contains explicit content per devices
Ext. → P1	Weather forecast, energy prices from the spot market	In practice, third party forecasts are queried directly by the VES system, not the building clients.
Ext. → S6	System Monitoring	Entire process of distribution system monitoring in real-time, namely SCADA.

4.1.4.4 Solutions/standards being used

Interfaces (information models)

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/ deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
P1 → A1 (sensor↔GW)	No model applied (binary, analog signals)	-	-		*Protocol*: Agnostic (WiFi, Ble, Z-Wave, Zigbee). *Security measure*: not considered. *Transfer medium*: wireless communication.
P1↔A1 (GW↔Cloud)	openHAB information model	OS	-		*Protocol*: TCP/IP. *Security measure*: SSL/TLS, OpenVPN considered. *Transfer medium*: cloud (HTTP API and/or RabbitMQ).
A1↔A5 (intra-modular)	Not Applicable (fully customized)	-	-		Custom structure of json
A5↔S5	CIM	MES	Adding type of economics (typeOfEconomics) indicating whether economics option is set to 1-*pricing signal* or 2-number of activation		**Option 1**: Price-based signals, similar to energy tariffs. The DSO determines, based on observed grid constraints at specific times of a day, specific prices for energy consumed at different times of the day (e.g. during peak

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/ deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
					times for the network, the kWh is higher, and during non-peak hours, the kWh price is lower). **Option 2:** The DSO enters into a contractual agreement with the DR provider (e.g. customer, aggregator etc.) for provision of DR services for a predefined number of activations (e.g. 10 times in a year).
S6 ↔ A6	CIM	MES	Addition of information about used activation option (typeOfEconomicsApplied)		
A7 → P2	openHAB information model	OS			*Protocol*: TCP/IP. *Security measure*: SSL/TLS, OpenVPN considered. *Transfer medium*: cloud (HTTP API and/or RabbitMQ).
P2 → P3	No model applied (binary, analog signals)				
Ext.→P1	Customized model	P			
Ext.→S6	CIM	FS			

(*) Possible values: "FS" = Fully standard, "MES" = Modified or extended standard", "OS" = Open Specification, "P" = Proprietary

4.1.5 Project FLEXIGRID – Use case 8

Scope

Islanding mode operation in Sorrentino Valley, Italy

Objectives

Secure operation of a section of the grid in islanded condition, for a distribution network subjected to the frequent intentional and unintentional islanding operation condition. The mentioned distribution system is often with a positive energy balance meaning the power generation is higher than consumption. The main objectives are:

- Security of supply
  - Maintaining frequency and voltage within secure operational margin.
  - Upgrade of the automation and monitoring level of the system

- Increasing resilience against major weather events
    - Reducing non-supplied energy indicators by smart management of the assets
    - Improving system resilience in case of external communication network failure

Short narrative

There are two run-of-the-river power plants that contribute to a real demonstration of operation in islanding mode. the section of the grid subjected to islanding operation in located in a rural area northern Italy, which has open positive energy balance. The operation will require advanced automatic control system that in real-time communicates with the power plants and SCADA system to keep the frequency in secure stability margin. There are additional flexibility assets but mostly owned by the main islanding operator (DSO) or other DSOs operating in the region. This UC is being implemented in an area in which several small or medium size DSO are operating with not necessarily distinct portion the physical grid.

Flexibility Form: The flexibility of the two power plants are declared and considered in form of the capability curves, allowing SGC doing manoeuvres wither on active or reactive powers.

Actors list

UC-8 mainly involves:

- SGC: standing for Smart Grid Controller, it is a complex system containing software, hardware and set of interfaces for controlling Smart Grid in a stable mode.
- Uncontrollable Loads: MV loads with different nature of consumption in downstream.
- DSO: Classic role, but handling also contracts with the flexibility providers.
- Run-of-the-river hydraulic power plants, acting as flexibility providers.

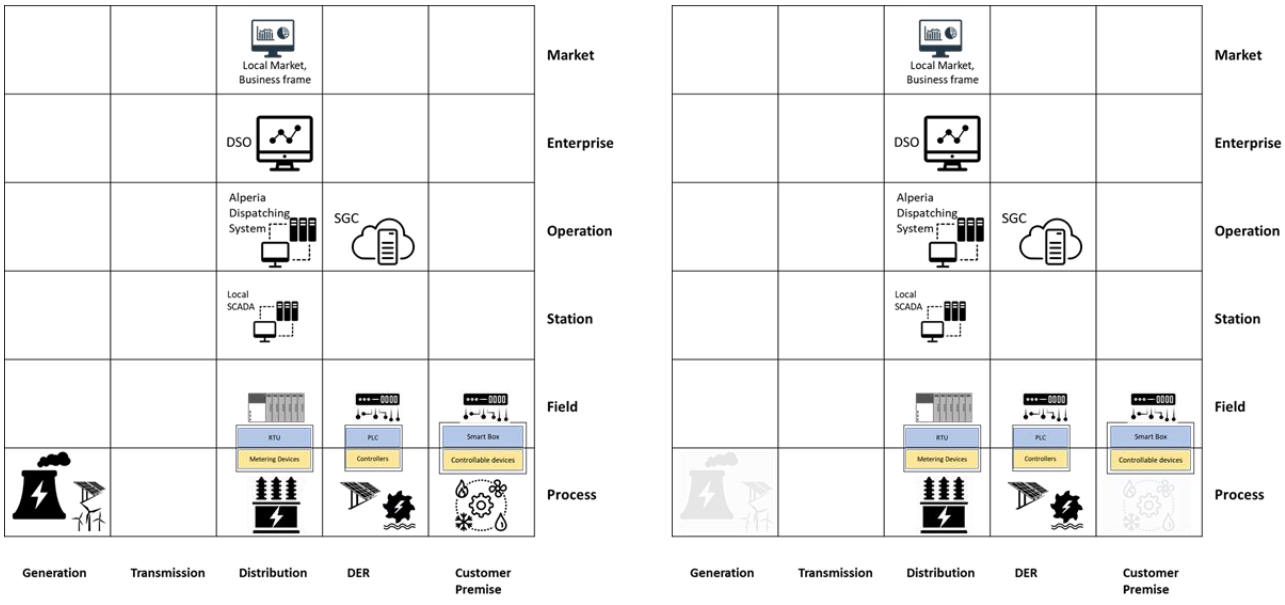


Figure 17: Actors' view

4.1.5.1 SGAM of the use-case

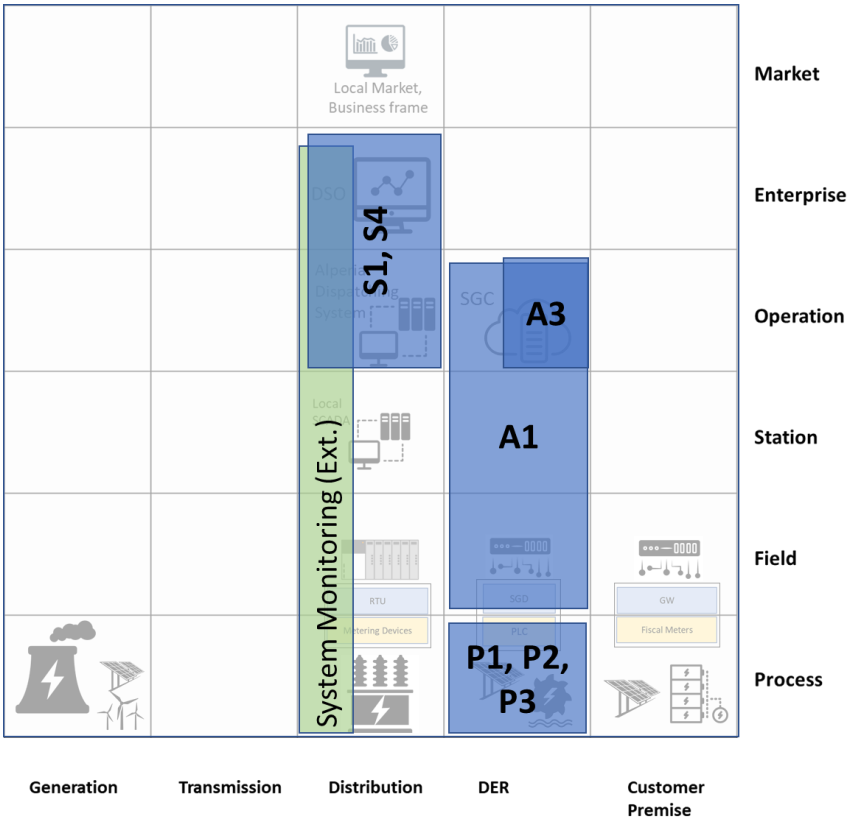


Figure 18: Function Layer

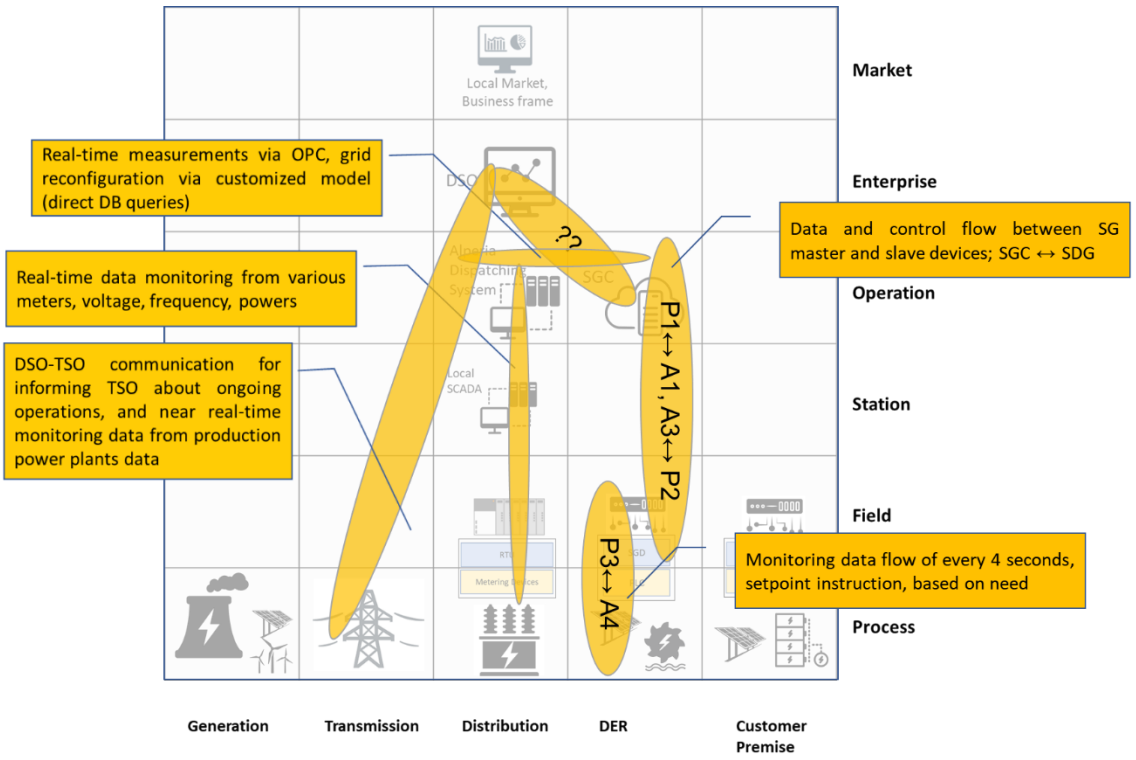


Figure 19: Information layer

4.1.5.2 Mapping with the generic business process

This use-case is mapped to GBP1 “Flexibility for SO through open market”. However, there are no clear agent distinction between market related actors and DSO-run entities.

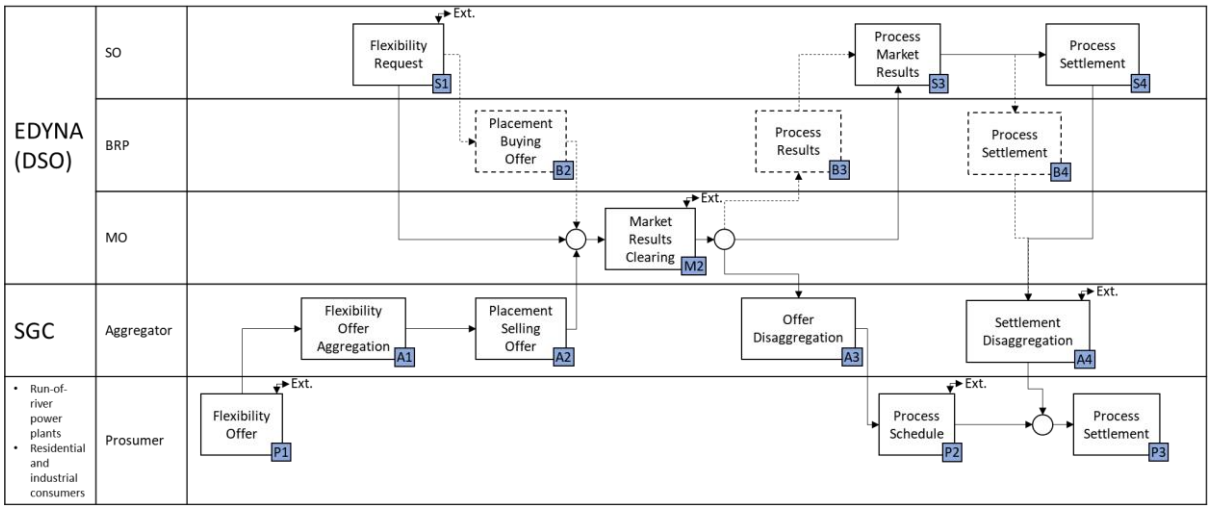


Figure 20: Actor mapping

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	EDYNA (DSO)	
BRP	-	There is no such explicit role
MO	-	There is no such explicit role
Aggregator	SGC	Smart Grid Controller agent
Prosumer	Distinct group of non-controllable prosumers and controllable producer actors	

Mapping between the GBP functions & UC functions

GBP function	Mapped UC function	Comment
P1	Flexibility Offer	Flexibility is offered for a certain period of time and is guaranteed, given the dimension of the plants
A1	Total Flexibility Aggregation	Performed in SGC

GBP function	Mapped UC function	Comment
A2	NA	SGC acts as flexibility aggregator from physical view but not business view
A3	Set point calculation	Criteria is technical results of OPF rather
A4	Plant validation and action	Power plant is to decide to how much follow the instructions
P2	Process schedule	Power plant is to convert set points table which is as active and reactive power, to mechanical setpoints for valves of excitation system
P3	Process settlement	Power plant is to actuate physical controllers accordingly
M2	NA	
B2	NA	
B3	NA	
B4	NA	
S1	Flexibility Request	
S3	NA	
S4	Process settlement	

Mapping between the GBP interfaces & UC interfaces

GBP interface	Mapped UC interface	Comment
P1 → A1	Available flexibility declaration	Certain amount of total capacity is kept reserve for frequency control, e.g. 50% of capability curve of hydro-power plant
A1→ A2	Intra-modular function	SGC does aggregate various entities' flexibilities
A2 ↔ M2	NA	

GBP interface	Mapped UC interface	Comment
A3 → P2	Setpoint instruction to plant control center	Active and reactive power according to the capability curve of single generators, tap-changer state for DSO-run transformers
P2→ P3	Setpoints reference update	Reference for control system (e.g. valves and exciter)
Ext↔S1	Information exchange with TSO	Information about state of operation and production data to the transmission system operator

4.1.5.3 Solutions/standards being used

Interfaces (information models)

GBP interface	Used information model/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Protocol	transfer medium/technology	Security measures	comments
P1 → A1	IEC61850	FS			OPC UA	Optic cable	SSL	
A1→ A2	CIM (IEC61850)	FS			-			
A3 → P2	IEC61850	FS			unknown	PLC	unknown	This level of communication is invisible to the flexibility chain
P2→ P3	IEC61850	FS						
Ext↔S1	IEC 60870-5-104	FS						

(*) Possible values: “FS” = Fully standard, “MES” = Modified or extended standard”, “OS” = Open Specification, “P” = Proprietary

4.1.6 Project iELECTRIX – Use case Voltage Management (EDIS)

4.1.6.1 Summary of the use-case

The site of Friedland (Mecklenburg-Western Pomerania) has been selected for the demonstration since this region already produces 200 % of the demand with renewable energy sources and expect a further increase of RES capacities.

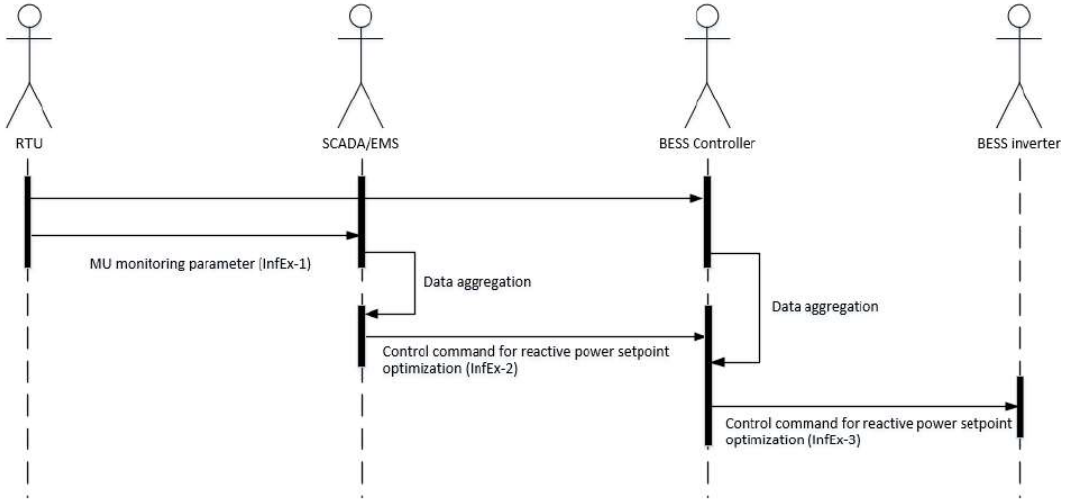
In order to postpone costly network reinforcements and vice versa to integrate more DER in a faster way, a network-integrated storage system is expected to significantly manage network congestions by provision of ancillary services, mainly supply reactive power to and from the grid, stabilize frequency by injecting active power and contribute to prevent disturbing harmonics as system pertubations, which will be tested by this demonstration within the project. It would also allow startup capabilities after blackouts.

A mobile electrical battery energy storage system (BESS) has been selected, which is transportable and could be connected to another site in case of future demands would be extremely helpful to manage the dynamic development since the hot spots of congestions in the network change during the time.

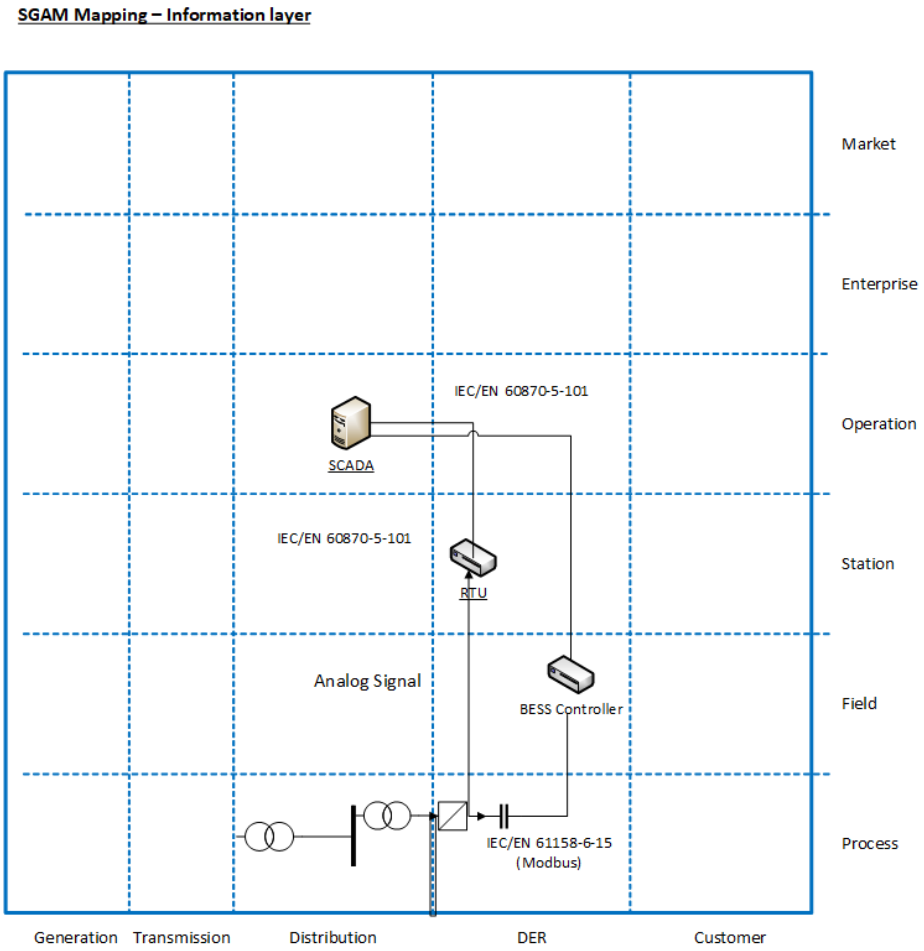
The BESS is built into an industrial container, where the main components are battery cells and power electronics. For congestion management and/or market purposes the battery energy and power as well as reaction times, expected life cycles and losses and efficiency are the main characteristics, which are attributes of the battery cells.

The congestion and voltage management use case are realized by providing flexibility in terms of controlling active power and voltage (in terms of providing support to the network), which is based on voltage management with reactive power control

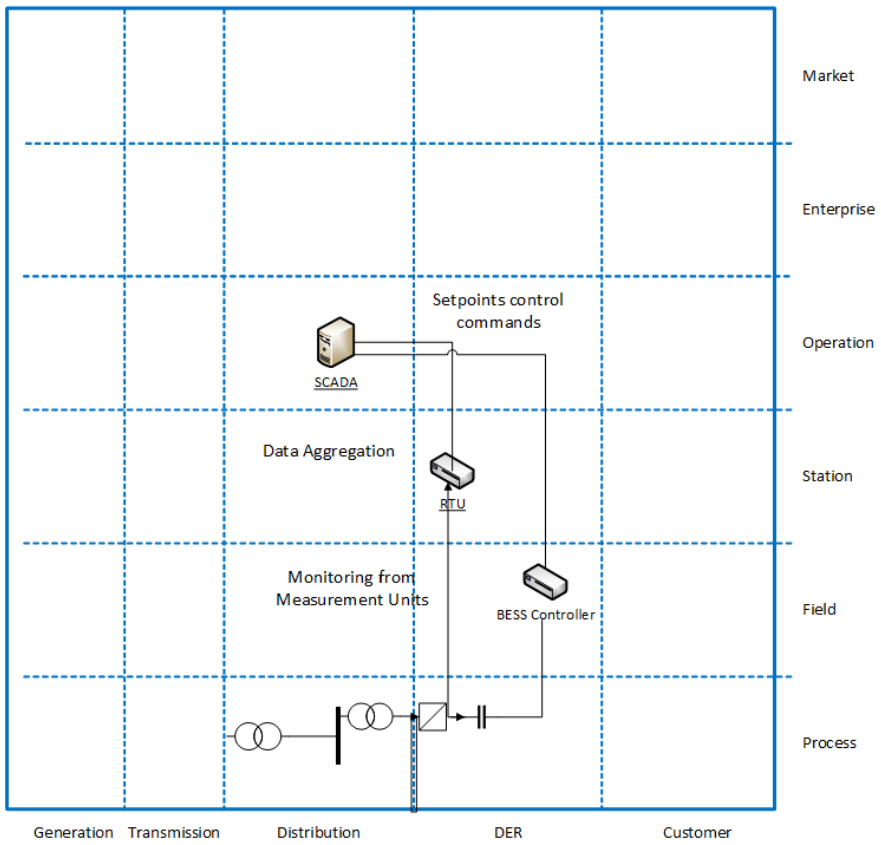
Scenario Description								
Scenario name:	Voltage management							
Step No.	Event	Name of process / activity	Description of process / activity	Service	Information Producer (actor)	Information receiver (actor)	Information exchanged (IDs)	Requirement, R-IDs
1	Voltage change in the grid	detect	The MU over the RTU in Friedland Substation detects a voltage change in the grid, exceeding predefined limits	REPORT	RTU	BESS controller and SCADA/ EMS		
2	Data aggregation and set point optimization	aggregate	BESS controller obtains aggregated data from SCADA/EMS and optimizes the reactive power setpoint	REPORT	SCADA/ EMS	BESS controller		
3	Setting reactive power setpoint	control	The reactive power setpoint of the BESS inverter is set positive or negative by BESS controller	EXECUTE	BESS controller	BESS inverter		



4.1.6.2 SGAM of the use-case



SGAM Mapping – Function Layer



4.1.6.3 Mapping with the generic business process

This use-cases is mapped to GBP2 “SO flexibility via prior bilateral agreement”

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	SCADA/EMS	The supervisory control and data acquisition system provides the basic functionality for implementing EMS, especially provides the communication with the substations and the control centre to monitor and control the grid
Aggregator	BESS Controller	The BESS controller receives and processes measurements and control signals (e.g. from the EMS) and is responsible to control the BESS inverter. The inverter can also be controlled automatically or remotely to supply active and reactive power to the grid in order to stabilize frequency and voltage.

Prosumer	BESS Inverter	Static power converter with control, protection, and filtering functions used to interface a BESS system with an electric utility system that converts DC into AC.

Mapping between the GBP functions & UC functions

GBP function	Mapped UC function	Comment
P1	Voltage level monitoring	The active and reactive power, current, voltage measurement and frequency
A1	Data Aggregation	The RTU collects data from the measurement Units
A5	Data Aggregation	BESS controller obtains aggregated data from SCADA/EMS and optimizes the reactive power setpoint
S5 and S6	Control command for reactive power at SCADA	The control command from the SCADA/EMS to BESS controller
S4	The setpoints is sent to the BESS controller	

Mapping between the GBP interfaces & UC interfaces

GBP interface	Mapped UC interface	Comment
P1 → A1	Measurements from BESS	
A1 → A5	RTU and BESS	
A5 ↔ S5	RTU to the SCADA	
S6 → A6	RTU to the SCADA	
A6 → S7	RTU to the BESS controller	

4.1.6.4 Solutions/standards being used

Interfaces (information models)

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
P2 → A1					Analog Signals
A1 → A5	IEC 61158-6-15	MES	The standard IEC 61158-6-15 has been combined with IEC 61918	The IEC 61158-6-15 does not specify o Network topologies, o Specification of ethernet-based and fibreoptic communication and o Specification of the wiring and optical fibres. Hence it has been combined with IEC 61918	Installation profiles for CPF 15 (MODBUS)
A5 ↔ S5	IEC 60870-5-101	FS		Currently, electricity prices are absent in the data-model, which should reflect scarcity and transmission costs. The recommended gaps should consist of market response of smart appliances and storage solutions like batteries and it is necessary important for ensuring flexibility.	SCADA Transmission protocols; Companion standard for basic telecontrol tasks
S6 → A6	IEC 60870-5-101	FS			
A6 → S7	IEC 61158-6-15	FS	Similar to above		
P2 → Ext					

(*) Possible values: “FS” = Fully standard, “MES” = Modified or extended standard”, “OS” = Open Specification, “P” = Proprietary

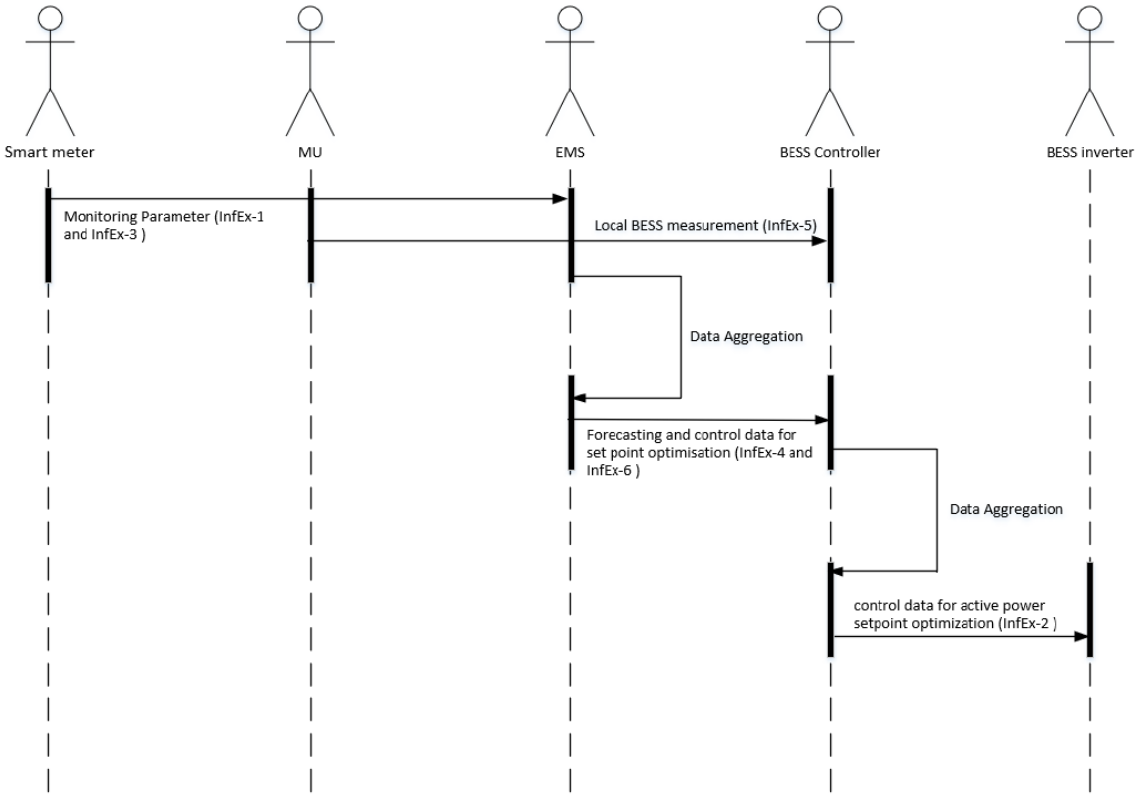
4.1.7 Project iELECTRIX – Use case Voltage Management (Güssing)

4.1.7.1 Summary of the use-case

The region of Guessing is located in the south-east of Austria close to Hungary and needs to include high amounts of installed renewable DER into supply networks, especially PV. Energie Guessing GmbH is the privately-owned operator of the local power grid (Guessing and surrounding area) and is committed to supply appr. 3500 customers with electrical power. The site of Guessing has been selected for the demonstrator.

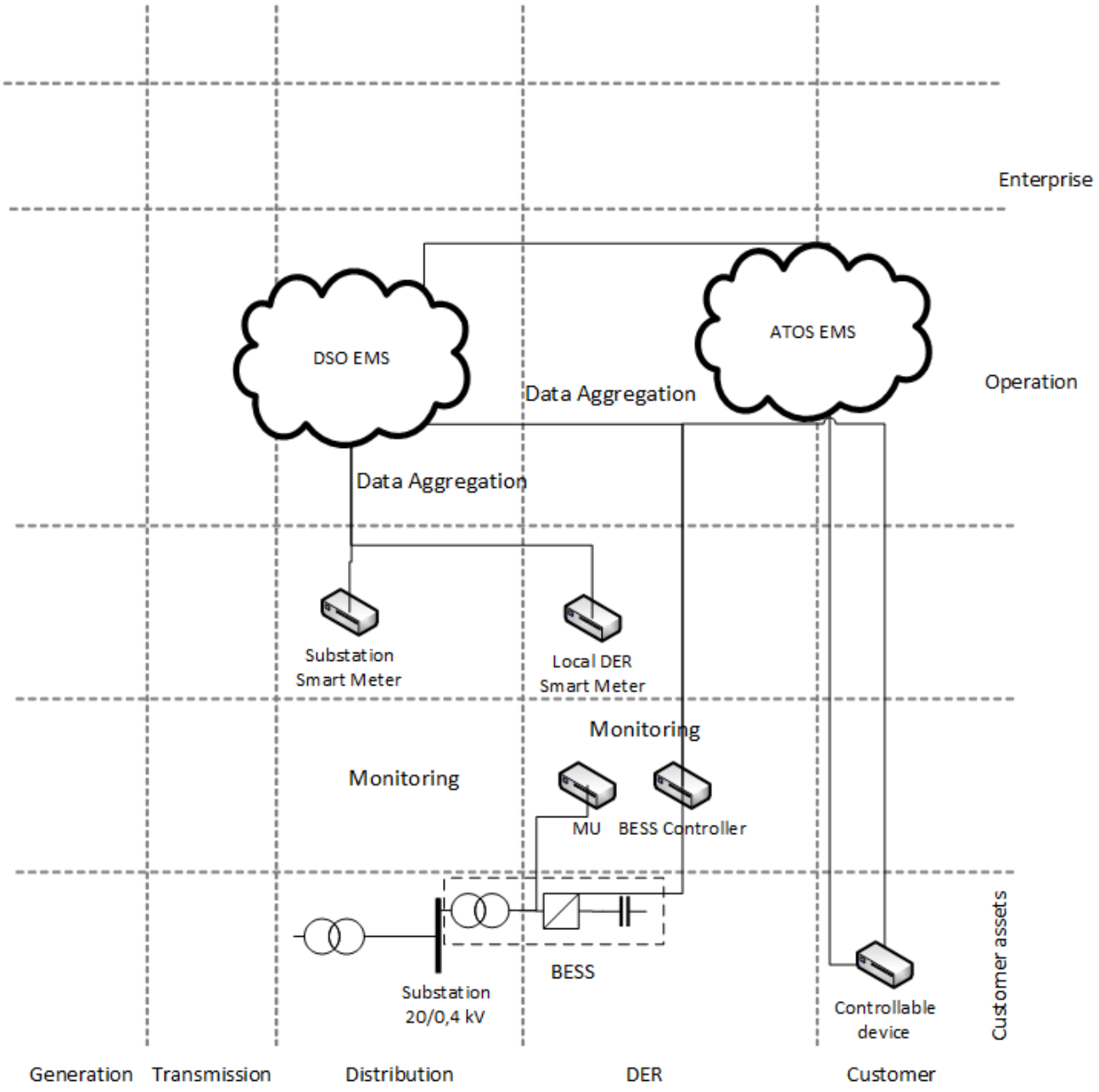
This use case optimises the quantity of local renewable generation which is locally injected into the grid. It manages overload while ensuring regulatory compliance. This would allow the integration of additional DER in a faster and more cost-efficient way, reducing RES curtailment and deferring/avoiding expensive grid reinforcements.

Scenario								
Scenario Name:	No. 1 – Voltage management							
Step No.	Event	Name of process / activity	Description of process / activity	Service	Information Producer (actor)	Information receiver (actor)	Information exchanged (IDs)	Requirement, R-IDs
1	Voltage change in the grid	detect	Smart meter in neighboring substations, local DER and MU detect a voltage change, exceeding predefined limits in the grid	report	Smart meter, MU	DSO EMS (from smart meter), BESS Controller (from MU)		
2	Data aggregation and set point optimization	aggregate	BESS controller obtains aggregated data from DSO EMS and forecasting data from ATOS EMS and optimizes the setpoints	report	DSO EMS, ATOS EMS	BESS controller		
3	Setting reactive power setpoint	Control	The reactive power setpoint of the BESS inverter is set positive or negative by BESS controller	execute	BESS controller	BESS inverter		

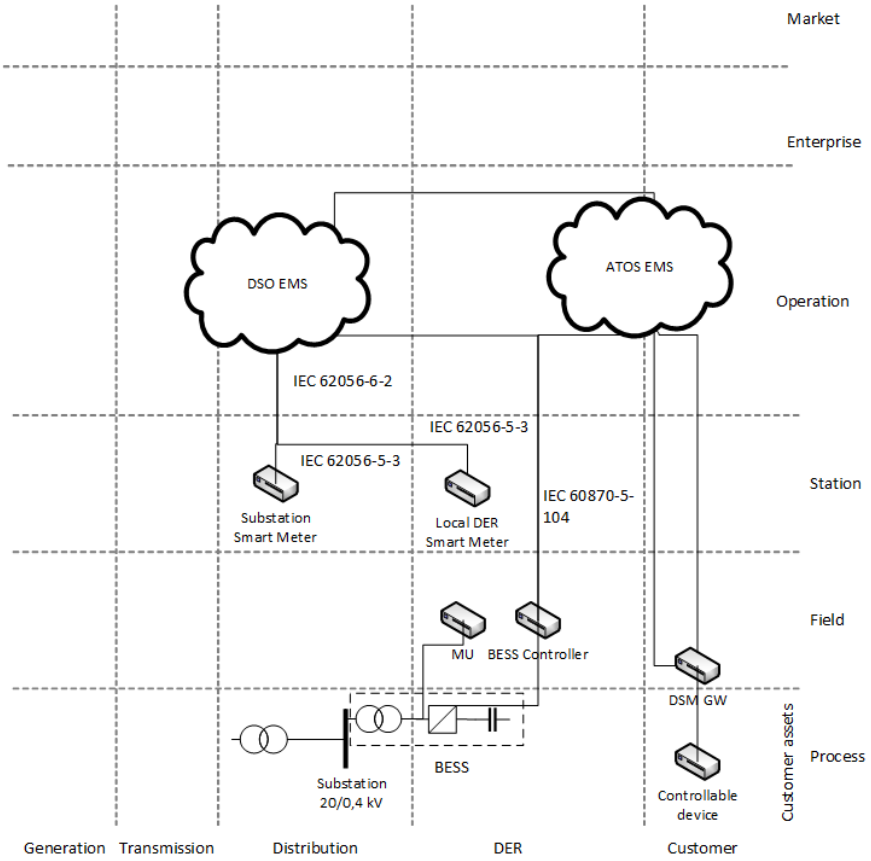

Smart meter
MU
EMS
BESS Controller
BESS inverter
Monitoring Parameter (InfEx-1 and InfEx-3)
Local BESS measurement (InfEx-5)
Data Aggregation
Forecasting and control data for set point optimisation (InfEx-4 and InfEx-6)
Data Aggregation
control data for active power setpoint optimization (InfEx-2)

4.1.7.2 SGAM of the use-case

SGAM Mapping – Function Layer



SGAM Mapping – Information layer



4.1.7.3 Mapping with the generic business process

This use-cases is mapped to GBP2 "SO flexibility via prior bilateral agreement".

Mapping between the GBP roles & UC actors

GBP role	Mapped UC actor	Comment
SO	DSO EMS and ATOS EMS	Energy Management System which hosts applications to monitor and control distribution grid functions and other non-regulated assets, such as local generation and loads. There are two EMS present namely SO EMS and ATOS EMS with the following functions: • The DSO EMS, acquiring data from local grid smart meters • The ATOS EMS acquiring data from local customers and load/ consumption forecasting
Aggregator	DSO EMS and ATOS EMS	
Prosumer	BESS Controller, Smart Meter	The BESS controller receives and processes measurements and control signals (e.g. from the EMS) and is responsible to control the BESS inverter. The inverter can be controlled automatically or remotely to supply active and reactive

GBP role	Mapped UC actor	Comment
		power to the grid in order to stabilize frequency and voltage. Meter with additional functionalities one of which is data communication. Typically, a smart metering system comprises the metering end device, the head end system (HES) and their communication infrastructure (AMI). Industrial smart meters installed in local substations and local DER with data acquisition in DSO EMS cloud, but without interfacing a smart meter infrastructure in between (different from domestic smart metering). Industrial smart meters installed in local substations and local DER with data acquisition in DSO EMS cloud, but without interfacing a smart meter infrastructure in between (different from domestic smart metering)

Mapping between the GBP functions & UC functions

GBP function	Mapped UC function	Comment
P1	Voltage level monitoring	Smart meter measures the voltage at customer level and the measurement units at the BESS controller
A1	Data Aggregation	Smart meter aggregated data is sent to the DSO EMS, whereas the data from Measuring unis are sent to the DSO EMS
A5	Data Aggregation	The measurement data from the EMS are exchanged between ATOS and DSO EMS
S5	The flexibility request	The load flow is performed and flexibility requires to the BESS controller and the controllable device is sent from the EMS
S4	The set points is sent to the BESS inverter and dispatchable loads	The set points are sent to the BESS controller and the dispatchable load at the customer
A4	Validate set points for flexibility resources	
P3	Process settlement at BESS	

Mapping between the GBP interfaces & UC interfaces

GBP interface	Mapped UC interface	Comment
P1 → A1	Measurements from BESS and the smart meter to the respective EMS	
A1 → A5	Data aggregation at ATOS EMS and DSO EMS	
A5 ↔ S5	Data sent to the EMS	
S6 → A6	Load forecasting data and load flow optimization at EMS	
A4→ S4	EMS to the BESS inverter and flexible loads	
A4→ P3	BESS obtains the optimized setpoints	

4.1.7.4 Solutions/standards being used

Interfaces (information models)

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
P1 → A1	IEC 62056-5-3	FS			Electricity metering data exchange using DLMS/COSEM suite for establishing and releasing application associations, and data communication services
A1 → A5	IEC 62056-6-2 and IEC 60870-5-104	MES	The standard IEC 60870-104 lacks description to model smart meters. Hence, generic building blocks are defined using object-oriented methods, in the form of interface classes to model smart meters ffor fleibility functions-		
A5 ↔ S5	IEC 60870-5-104	FS			SCADA Transmission protocols; Companion standard for basic telecontrol tasks

GBP interface	Used information model solution/standard	Type (*)	Extension/modification/deviation (if any, and why)	Gaps identified (if any)	Extra information / Comment
S6 → A6	IEC 60870-5-104	FS			SCADA Transmission protocols; Companion standard for basic telecontrol tasks
S4→ A4	IEC 61784-5-15	FS			
A4→ P3	IEC 61784-5-15				Installation profiles for smart meter

(*) Possible values: "FS" = Fully standard, "MES" = Modified or extended standard", "OS" = Open Specification, "P" = Proprietary

4.2 Analysis of project's input as a whole

Based on the inputs from the projects, several analyses are performed:

- List of relevant standards/solutions per GBP interface
- List of implemented extensions/modifications per standard
- List of identified gaps per GBP interface
- List of system functions per GBP function
- List of system actors per use-case and GBP role

4.2.1 List of relevant standards/solutions per GBP interface

The table below lists the solutions and standards implemented by the projects for each interface. It has several objectives:

1) to offer a catalogue of relevant standards per interface;
2) to identify if several standards are in competition for one interface and which standards are the most used;
3) to identify which interfaces led to the use of internal or proprietary solutions.

It has to be noted that, because only 4 projects have been included in this analysis, the list of relevant standards may be incomplete and the number of occurrences might not be significant.

Interface	List of solutions/standards (occurrence)	Number of internal or proprietary[2]
P1 → A1	FlexOffer (3) IEC 61850 (1) IEC 62056-5-3 (1)	

[2] "Proprietary" means vendor-specific or private specification (i.e. not standard nor open specification)

Interface	List of solutions/standards (occurrence)	Number of internal or proprietary[2]
	openHAB (1)	
A1 → A2	CIM (1)	1
A1 → A5	IEC 61158-6-15 (1) IEC 62956-6-2 (1) IEC 60870-5-104 (1)	1
A2 → M2	FlexOffer (2)	1
S1 → B2		
B2 → M2		
S1 → M2	CIM (1) FlexOffer (1)	
M2 → B3		
B3 → S3		
M2 → S3	FlexOffer (1)	
S3 → B4		
B4 → A4	FlexOffer (1)	
S3 → S4	FlexOffer (1)	
S4 → A4	FlexOffer (1) IEC 61784-5-15 (1)	
M2 → A3	FlexOffer (2)	1
A3 → P2	FlexOffer (3) IEC 61850 (1)	
P2 → P3	IEC 61850 (1)	

Interface	List of solutions/standards (occurrence)	Number of internal or proprietary[2]
A4 → P3	FlexOffer (2) IEC 61784-5-15 (1)	
A5 → S5	CIM (1) IEC 60870-5-101 (1) IEC 60870-5-104 (1)	
S6 → A6	CIM (1) IEC 60870-5-101 (1) IEC 60870-5-104 (1)	
A6 → S7	IEC 61158-6-15 (1)	
A6 → A7		
A7 → P2	openHAB (1)	
S7 → S4		
A2 → M1		
B1 → B2		
B2 → M1	FlexOffer (1)	
M1 ↔ S2		
M1 → B3	FlexOffer (1)	
B3 → B4	FlexOffer (1)	
B4 → A4	FlexOffer (1)	
S1 ↔ Ext	CIM (2) IEC 60870-5-104 (1)	
S2 ↔ Ext		

Interface	List of solutions/standards (occurrence)	Number of internal or proprietary[2]
S6 ↔ Ext	CIM (1)	
M1 ↔ Ext		
M2 ↔ Ext		
A4 ↔ Ext		
P1 ↔ Ext		1
P2 ↔ Ext	OCPP (1) Modbus (1)	

4.2.2 List of implemented extensions/modifications per standard

The table below lists the extensions/modifications applied to each standard in the projects. Its main objectives are:

- to feed standards development by highlighting needs from standards' users and possible solutions;
- to allow reusability of extension/modifications done by previous projects, by pinpointing which project did which extension.

Standard	Project / UC	Extension/modification/deviation
FlexOffer	FEVER	Needed extension to support settlement information
CIM	GIFT	Addition of readingQuality to Reading class ReadingType moved from Reading to MeterReading
	FLEXIGRID	Adding type of economics (typeOfEconomics) indicating whether economics option is set to 1-pricing signal or 2-number of activation
	FLEXIGRID	Addition of information about used activation option (typeOfEconomicsApplied)
	FEVER	Work ongoing. Modification in Meas package might be identified.
OCPP		

Standard	Project / UC	Extension/modification/deviation
openHAB information model		
IEC 61850		
IEC 61158-6-15	iELECTRIX (EDIS)	The standard IEC 61158-6-15 has been combined with IEC 61918
IEC 60870-5-101		
IEC 62056-5-3		
IEC 62056-6-2 and IEC 60870-5-104	iELECTRIX (Güssing)	The standard IEC 60870-104 lacks description to model smart meters. Hence, generic building blocks are defined using object-oriented methods, in the form of interface classes to model smart meters for flexibility functions.
IEC 61784-5-15		
IEC 61784-5-15		
IEC 60870-5-104		

4.2.3 List of identified gaps per GBP interface

The table below lists the gaps identified for each GBP interface. It could be either gaps related to the interface in general (e.g. missing standard) or gaps related to the use of a specific standard for this interface (e.g. missing feature in existing standard).

The main objectives of this table are:

- to feed standardization roadmap by identifying standardization gaps, i.e. interfaces for which a standard is missing;
- to feed standards development by highlighting needs from standards' users.

Interface	Project / UC	Gaps identified
P1 → A1	GIFT	No standard solution for flexibility offer data exchange ⇒ using open specification FlexOffer
A1 → A2		

Interface	Project / UC	Gaps identified
A1 → A5	iELECTRIX (EDIS)	The IEC 61158-6-15 does not specify o Network topologies, o Specification of ethernet-based and fibreoptic communication and o Specification of the wiring and optical fibres. Hence it has been combined with IEC 61918
A2 → M2		
S1 → B2		
B2 → M2		
S1 → M2		
M2 → B3		
B3 → S3		
M2 → S3		
S3 → B4		
B4 → A4		
S3 → S4		
S4 → A4		
M2 → A3		
A3 → P2	GIFT	No standard solution for flexibility offer data exchange ⇒ using open specification FlexOffer
P2 → P3		
A4 → P3		
A5 → S5	iELECTRIX (EDIS)	About IEC 60870-5-101: Currently, electricity prices are absent in the data-model, which should reflect scarcity and transmission costs. The identified gaps consist of market response of smart appliances and

Interface	Project / UC	Gaps identified
		storage solutions like batteries and it is necessary important for ensuring flexibility.
S6 → A6		
A6 → S7	iELECTRIX (EDIS)	The standard IEC 61158-6-15 has been combined with IEC 61918
A6 → A7		
A7 → P2		
S7 → S4		
A2 → M1		
B1 → B2		
B2 → M1		
M1 ↔ S2		
M1 → B3		
B3 → B4		
B4 → A4		
S1 ↔ Ext		
S2 ↔ Ext		
S6 ↔ Ext		
M1 ↔ Ext		
M2 ↔ Ext		
A4 ↔ Ext		
P1 ↔ Ext		

Interface	Project / UC	Gaps identified
P2 ↔ Ext		

4.2.4 List of system functions per GBP function

The table below lists the system functions mapped to each GBP functions. Its main objectives are:

- To show differences in system implementation of the GBP functions, based on the system function names;
- To identify the GBP functions that are rarely or never implemented in the systems.

It has to be noted that, because only 4 projects have been included in this analysis, the number of systems implementing each GBP function might not be significant.

Function	System functions (Project/UC)
S1 / Flexibility Request	Forecast (GIFT) Requesting flexibility services (FEVER 1) Flexibility request (FLEXIGRID 8)
S2 / Results validation	
S3 / Process Market Results	Flexibility trading (FEVER 1) Critical event prevention (FEVER 1)
S4 / Process Settlement	Flexibility trading (FEVER 1) Process settlement (FLEXIGRID 8) Sendpoint sent to BESS controller (iELECTRIX EDIS) Sendpoint sent to BESS inverter and dispatchable loads (iELECTRIX Güssing)
S5 / Request for bilateral agreement	
S6 / Flexibility request	DR Activation request (FLEXIGRID 6)
S7 / Process Flex response	
B1 / Flexibility request	Requesting flexibility services (FEVER 14)
B2 / Placement of Buying Offer	

Function	System functions (Project/UC)
B3 / Process Results	Flexibility trading (FEVER 14)
B4 / Process Settlement	Flexibility trading (FEVER 14)
M1 / Market Results Clearing (BRP)	Flexibility trading (FEVER 14)
M2 / Market Results Clearing (SO)	Virtual power station management (GIFT) Flexibility trading (FEVER 1)
A1 / Flexibility Offer Aggregation	Offering flexibility services (FEVER) Aggregated flexibility estimation (FLEXIGRID 6) Total flexibility (FLEXIGRID 8) Data aggregation (iELECTRIX)
A2 / Placement Selling Offer	Flexibility trading (FEVER)
A3 / Flexibility Offer Disaggregation	Offering flexibility services (FEVER) Set point calculation (FLEXIGRID 8)
A4 / Settlement Disaggregation	Offering flexibility services (FEVER) Plant validation and action (FLEXIGRID 8)
A5 / Offer for bilateral agreement	Flexibility offer (optimization) (FLEXIGRID 6) Data aggregation (iELECTRIX)
A6 / Process request and assess response	
A7 / Request disaggregation	DR request breakdown to individual GWs (FLEXIGRID 6)
P1 / Flexibility offer	Flexibility offer (GIFT) Offering flexibility services (FEVER) Continuous feed from sensors, smart meters (FLEXIGRID 6) Flexibility offer (FLEXIGRID 8) Voltage level monitoring (iELECTRIX)

Function	System functions (Project/UC)
P2 / Process schedule	Flexibility provision (GIFT) Offering flexibility services (FEVER) Operating setpoints dispatch (FLEXIGRID 6) Process schedule (FLEXIGRID 8)
P3 / Process Settlement	Offering flexibility services (FEVER) Operating setpoints (FLEXIGRID 6) Process settlement (FLEXIGRID 8) Process settlement at BESS (iELECTRIX Güssing)

4.2.5 List of system actors per use-case and GBP role

The tables below list, for each GBP, the system actors of each project fulfilling each GBP business roles. Their main objectives are:

- To show differences in system implementation of the GBP roles, based on the system actors names;
- To identify the GBP roles that are rarely or never implemented in the systems;
- To prepare a possible catalogue of solutions existing for each GBP actor, to be reused as part of the exploitation of each project results, e.g. for future projects or pilots or commercial deployment.

GBP1 "SO flexibility through open market" use-cases

Business role	GIFT	FEVER 1	FLEXIGRID 8
SO	Grid observability system + VPS module "Grid operation"	DSO Toolbox Flexibility Service Consuming Agent (FSCA) Supervisory Control and Data Acquisition system for Distribution System (DS-SCADA) Advanced Metering Infrastructure (AMI)	EDYNA (DSO)
BRP			
MO	VPS module "Flexibility market"	Flexibility Trading Platform (FTP)	

Business role	GIFT	FEVER 1	FLEXIGRID 8
Aggregator	VPS module "Flexibility manager"	Flexibility Management System (FMS)	Smart Grid Controller (SGC)
Prosumer	xEMS	Flexibility Service Providing Agent (FSPA) Energy Management System (CEMS)	Distinct group of non-controllable prosumers and controllable producer actors

GBP2 "SO flexibility via prior bilateral agreement" use-cases

Role	FLEXIGRID 6	iELECTRIX EDIS	iELECTRIX Güssing
SO	DSO (HEP-ODS)	SCADA/EMS	DSO EMS and ATOS EMS
Aggregator	Hypertech's VES service	BESS Controller	DSO EMS and ATOS EMS
Prosumer	Three urban residential buildings	BESS Inverter	BESS Controller, Smart Meter

GBP3 "BRP portfolio optimisation" use-cases

Role	FEVER 14
BRP	Balancing Responsible Party Management System (BRPMS)
MO	Flexibility Trading Platform (FTP)
Aggregator	Flexibility Management System (FMS)
Prosumer	Flexibility Service Providing Agent (FSPA) Energy Management System (CEMS)

4.3 Main outcomes

This section depicts the first outcomes, based on the analysis of the first projects. It has to be noted that, because only 4 projects have been included in the analysis, some findings and recommendations may be insufficiently justified and therefore would require future confirmation when including more projects.

Based on §4.2.1

A catalogue of relevant solutions/standards has been started, mapped to the interfaces of the three defined GBP. This catalogue should be further developed (so far only 7 use-cases from 4 projects have been analysed, so the results are not significant enough) and then publicly shared to help current and future BRIDGE projects to identify the proper solutions for each of their use-cases.

Based on §4.2.2

Extensions/modifications have been defined and implemented by some projects on the following solutions/standards:

- FlexOffer: extension to support settlement information
- CIM: several extensions
- IEC 61158-6-15: combination with IEC 61918
- IEC 62056-6-2 and IEC 60870-5-104: interface classes have been added to model flexibility functions in smart meters.

For each of these solutions/standards, their maintainers should:

1) Check if the case raised by the concerned BRIDGE project is within the scope of the solution/standard or if other solutions should be considered.
2) In case it is relevant, evaluate and define an update of the specification to support the requested feature.
3) In case other approaches should be considered, inform the concerned BRIDGE project and document the recommended approach within a FAQ or a “best practices” document.

Based on §4.2.3

General gaps have been identified for interfaces P1 → A1 and A3 → P2: no standard has been identified, resulting in the use of an Open Specification instead. The catalogue defined in §4.2.1 shows several existing solutions, including standards. Therefore:

- It confirms the need to publish and maintain a clear solutions/standards catalogue to help projects to easily identify relevant solutions for each interface.
- In case the existing standards do not fulfil the needs, extensions of the existing standards should be proposed or, when more relevant, new solutions should be standardized. The right approaches should be assessed in cooperation with the standard maintainers and also taking into account the standardization roadmap defined in IEC 63097 [2] [3].

Also, specific gaps have been identified in IEC 61158-6-15 and IEC 60870-5-101. As for the extensions/modifications listed in §4.2.2, the solutions/standards maintainers should:

1) Check if the gap identified by the concerned BRIDGE project is within the scope of the solution/standard or if other solutions should be considered.
2) In case it is relevant, evaluate and define an update of the specification to support the requested feature.
3) In case other approaches should be considered, inform the concerned BRIDGE project and document the recommended approach within a FAQ or a “best practices” document.

Based on §4.2.4

[3] The latest public version is dated 2017, but an update is under consideration in 2021.

Considering that only 7 use-cases from 4 projects have been analysed, the results are not significant enough to extract relevant outcomes.

Based on §4.2.5

Considering that only 7 use-cases from 4 projects have been analysed, the results are not significant enough to extract relevant outcomes.

5. Conclusion and perspectives

5.1 Main findings and recommendations

Topic	Methodology to study interoperability of flexibility assets
Findings	A methodology has been defined, allowing to analyse the system implementation of flexibility-related use-cases by BRIDGE projects and put them in relation to generate outcomes towards: • Current and future BRIDGE projects: providing tools, guidelines and existing solutions (e.g. ad-hoc extensions) to help reaching interoperability; • Standardisation bodies: sharing identified gaps and needs as an input to future standards development and revisions; • Regulation: summarizing how the market model is implemented in practice, e.g. which system actors for each role, which interfaces between business roles, …
Recommendation	Apply this methodology to more BRIDGE projects, to generate more significant and valuable outcomes. Make it mandatory for future projects to provide inputs to this "Interoperability of flexibility assets" activity when they have defined their use-cases and system architecture (probably at M12).

Topic	Reference framework to study interoperability of flexibility assets
Findings	A reference framework has been defined, based on three Generic Business Processes: • GBP1: Flexibility for SO through open market • GBP2: Flexibility for SO via prior bilateral agreement • GBP3: Flexibility for BRP portfolio optimization This reference framework is the common denominator between use-cases from different projects aiming the same business objectives, allowing a cross-projects interoperability study.
Recommendation	1) The content of the existing GBPs should be continuously challenged and enhanced based on the regulatory framework and on what is indeed implemented by BRIDGE projects. 2) Additional GBPs should be defined, if relevant, to support more use-cases. 3) Synergies with external initiatives (such as SGTF EG1) should be considered.

Topic	Catalogue of relevant solutions/standards for each interface
Findings	Based on the inputs from 7 first use-cases from 4 projects, a first draft (incomplete) catalogue of relevant solutions/standards for each interface has been outlined. This catalogue could help future projects to find relevant solutions/standards to implement their use-cases.
Recommendation	1) Further develop the content of this catalogue based on more BRIDGE projects. 2) Check alignment with CG-SEG "set of standards" and IEC "standardization roadmap" 3) Publish this catalogue towards the BRIDGE community (and beyond, e.g. SGTF, SDOs, ...)

Topic	Functions standardization
Findings	When designing the Generic Business Processes and analysing the inputs from the projects, it has been identified that there is no standard definition of the system functions. Therefore, it is not possible to provide guidelines nor reference solutions to projects about the system implementation of GBP functions, as it is done for GBP interfaces.
Recommendation	Further investigate how interoperability of functions should be analysed, and what related outcomes would be useful for BRIDGE projects. Possibly, harmonization could be on the vocabulary (harmonized definitions).

Topic	Gaps and extensions/modifications of solutions/standards
Findings	Several gaps and propositions of extensions/modifications have been listed by the analysed projects. These are useful inputs to: ● Provide feedback to the solutions/standards developers about the issues faced when putting these solutions in practice; ● Identify missing standards to be developed; ● Build a repository of relevant extensions of standards, to be reused (and improved?) by other BRIDGE projects having the same need, while waiting for proper integration into the official solution/standard.
Recommendation	1) Keep collecting inputs from projects about faced gaps and implemented extensions/modifications. 2) Set liaisons with relevant user groups and/or standardization bodies to provide the feedback from BRIDGE projects, including a list of unsatisfied needs and missing standards. 3) Set-up a repository of extensions/modifications, in which BRIDGE projects can find extensions/modifications having already being defined by previous projects for the same need.

5.2 Next steps

The work on the interoperability of flexibility assets needs to be continued in 2021, focusing on:

- Collecting inputs from more projects (a first objective could be ~30 use-cases from ~15 projects) – part of this data collection could be done in collaboration with the "BRIDGE Use-case Repository" action;
- Improving the Reference framework by challenging/updating the existing GBPs and, if relevant, adding new GBPs, based on the use-cases effectively implemented by BRIDGE projects;
- Starting discussions with relevant user groups and standardisation bodies to enable BRIDGE to provide feedback based on the projects' experience.

List of Acronyms and Abbreviations

AMI	Advanced Metering Infrastructure
BESS	Battery Energy Storage System
BPMN	Business Process Model and Notation
BRP	Balance Responsible Party
CEMS	Customer Energy Management System
CIM	Common Information Model
DER	Distributed Energy Resources
DR	Demand Response
DSO	Distribution System Operator
EMS	Energy Management System
ESB	Enterprise Service Bus
EV	Electrical Vehicle
FAQ	Frequently Asked Questions
FO	Flexibility Offer
FS	Fully Standard
GBP	Generic Business Process
GW	GateWay
HLUC	High-Level Use-Case
HVAC	Heating, Ventilation and Air-Conditioning
IEC	International Electrotechnical Commission
LEC	Local Energy Community
LV	Low Voltage
MES	Modified or Extended Standard
MO	Market Operator
MV	Medium Voltage
NA	Not Applicable
OCPP	Open Charge Point Protocol
OS	Open Specification
P	Proprietary
PLC	PowerLine Communications
PUC	Primary Use-Case
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition

SDO	Standards Development Organisation
SGAM	Smart Grid Architecture Model
SGC	Smart Grid Controller
SO	System Operator (i.e. TSO or DSO)
TSO	Transmission System Operator
UC	Use-Case
VPS	Virtual Power System
WG	Working Group

List of references

[1] BRIDGE, «BRIDGE General Assembly February 2020 – Conclusions & Next Steps,» [En ligne]. Available: https://www.h2020-bridge.eu/wp-content/uploads/2020/03/BRIDGE-GA2020_Conclusions-and-next-steps.pdf.

[2] IEC, «IEC TR 63097:2017 Smart grid standardization roadmap,» [En ligne]. Available: webstore.iec.ch/publication/27785.

List of figures

List of tables

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