1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
131		Medium Voltage Network Real Time Monitoring (MVRTM)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The use case consists in collecting in a unique repository â€“ located in the Primary Substation â€“ measurement (mean values and PQ indexes), states and alarms from the MV grid.
Objective(s)	This information is needed to perform correctly algorithms (State Estimation, State Forecasting, Optimal Power Flow, â€¦) and control actions in order to increase the network reliability and performance.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case

Short description

The data collection for the MV grid is performed storing real-time measurements (mean values and PQ indexes), states and alarms in a unique repository – located in the Primary Substation – after managing some implementation issues, such as protocol conversion and writing of data into the PSAU.RDBMS.

“Real-time” in this context means something in between 1 second and some minutes.

Complete description

On the MV grid, several monitoring devices will be installed:

- Remote Terminal Units (RTUs), Power Quality Meters (PQMs) or – more in general – Intelligent Electronic Devices (IEDs)

Data considered by the use case are:

- Mean values of V, I, Q, P:
    - MV busbars, MV side of transformers and MV lines in secondary substations (RTU, IED)
    - On the connection point of MV customers/productions (RTU, IED)
- PQ indexes both from the primary substations and from some relevant secondary substations (PQM)
- Status of remote-controllable elements in primary substations and in secondary

substations (RTU-IED)
    - breakers/disconnectors
    - tap changers of HV/MV transformers
    - voltage or reactive power set-points for generations connected on the MV network
- Alarms related to events and faults (IED-PQM-RTU)

Measures, events and states not provided by those devices are provided by the Distribution Management System (DMS).

The communication with the secondary substations should also be implemented.

Measures are fetched from RTUs/IEDs/DMS by using the IEC61850 protocols (mainly MMS) and stored into the database which presents a data model compliant with the IEC61850.

Protocol conversion have to be implemented before writing the data – collected from different sources – into the PSAU.RDBMS to enable the execution of other use cases.

The PSAU.RDBMS should contain a Data layer, composed by a relational database, where the data are written.

The PSAU.Monitoring must include an Interface layer which implements required communication protocols and which is able to extract data from other systems.

The PSAU.Reporting is composed of an Application layer, which analyses the data to:

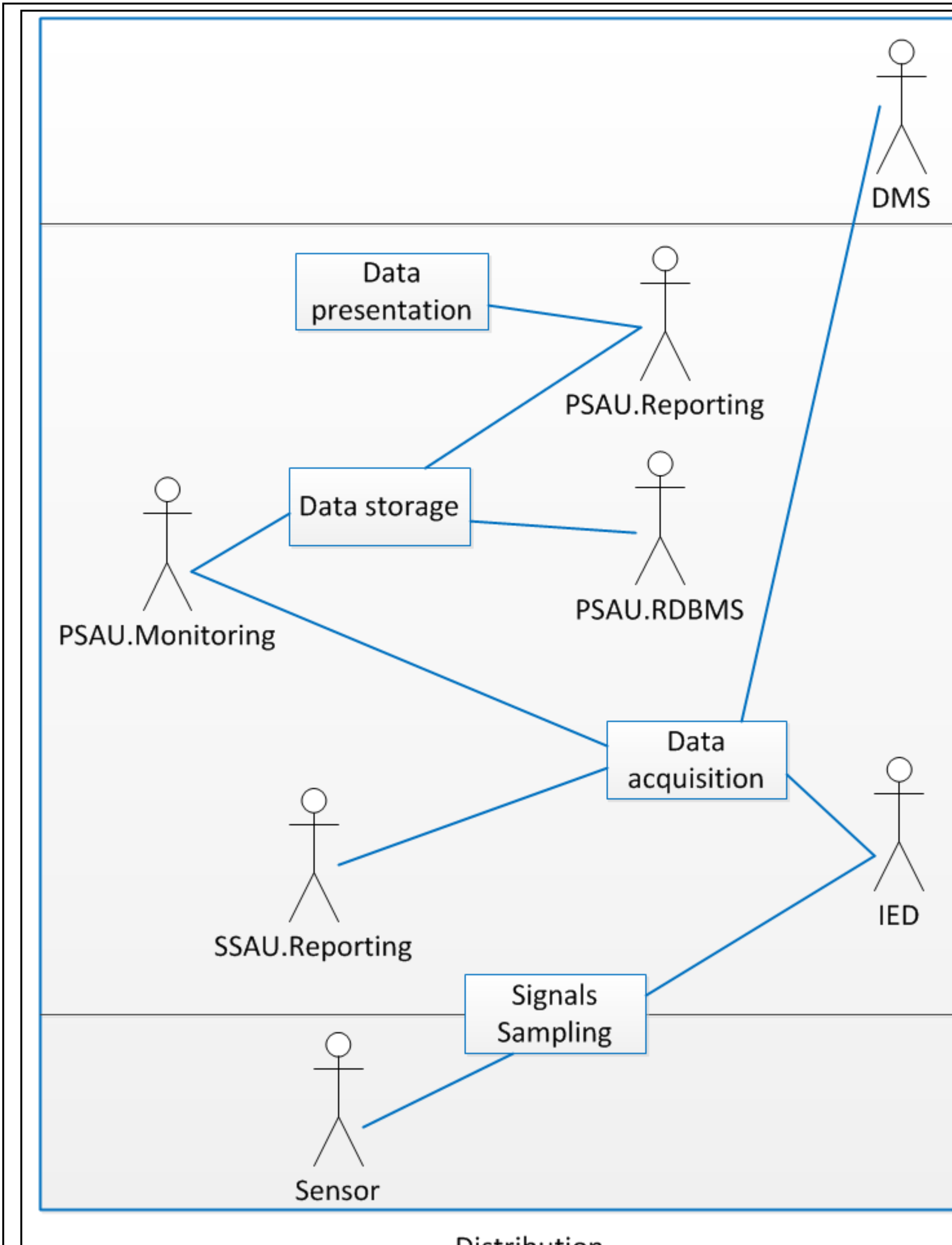
- calculate statistical values such as min, max, avg, std, etc.
- generate reports for DMS

1.5 General Remarks

General Remarks

2 Diagrams of Use Case

function layer



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(PSAU).MMS	function	DXP, client server interface for MMS Primary Substation Automation Unit Monitoring It represents the monitoring functionalities which are implemented in the Primary Substation Automation Unit	
SAU(PSAU).RDBMS	function	Primary Substation Automation Unit Relational Database Management System It represents the database and the related management system which compose the Primary Substation Automation Unit storage system	
SAU(PSAU).IEC 104	function	Primary Substation Automation Unit Reporting It represents the reporting functionalities which are implemented in the Primary Substation Automation Unit	
DMS.MMS	function	DXP communication interface Depending on the particolar interface it can be - 104 master - 61850 client/server - Modbus/TCP master Distribution Management System (DMS) Def. 1 Application server of a Distribution Management System which hosts applications to monitor and control a distribution grid from a centralized location, typically the control center. Def. 2 DMS SCADA System refers to the real-time information system and all the elements needed to support all the relevant operational activities and functions used in distribution	

		automation at dispatch centers and control rooms. Actor in Enterprise zone	
Sensor	other	It is a generic sensor such as voltage sensor, current sensor, state sensor, etc. which can be acquired by a generic IED (RTU, PD, etc.)	
SAU(SSAU).MMS	function	DXP, client server interface for MMS Secondary Substation Automation Unit Monitoring It represents the monitoring functionalities which are implemented in the Secondary Substation Automation Unit	
DMS.Modbus	function		
SAU(PSAU).Functions	function	PSAU.SC PSAU statistical calculation	
SAU(PSAU).Modbus	function		
DMS.IEC104	function		
IED(PSIED).MMS	function	Intelligent Electronic Device (IED): MMS interface	
IED(PSIED).functions	function	Def. 2 IEDs are devices incorporating one or more processors with the capability to receive or send data/control from or to an external source (e.g., electronic multifunction meters, digital relays, controllers). Similar devices: Power Quality Meter (PQM), and Remote Terminal Unit (RTU).	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Low Voltage Network Real Time Monitoring (LVRTM);
Level of Depth
Primary Use Case
Priorisation
Generic, Regional or National Relation
European
Viewpoint
Technical
Further Keyword for Classification
Medium Voltage Grid, Monitoring, Report

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - DMS No Monitored Event [normal]					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	No Monitored Event from MV grid	Data acquisition	DMS sends a report to the PSAU.Monitoring containing data related to the event	REPORT	DMS.MMS	SAU(PSAU).MMS
2	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the data received by the DMS into the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU).RDBMS

Scenario						
Scenario Name:	No. 2 - IED Timed MMS Report [normal]					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Informati (Actor)

1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(PSIED
2	Periodically	Data acquisition	IED generates a new report that will be transmitted to the PSAU.Monitoring. Report can contains one or more values	REPORT	IED(PSIED).MMS	SAU(PSAU
3	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the received report data inside the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU

Scenario						
Scenario Name:		No. 3 - IED Threshold/Event MMS Report [normal]				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Informati (Actor)**
1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(PSIED

2	Threshold crossed	Data acquisition	IED generate a new report that will be transmitted to the PSAU.Monitoring. Report can contains one or more values	REPORT	IED(PSIED).MMS	SAU(PSAU
3	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the received report data inside the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU

Scenario						
Scenario Name:		No. 4 - IED Read MMS [normal]				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Informati (Actor)**
1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(PSIED
2	Read request	Data acquisition	SAU.Monitoring requestes a read then IED answers sending the requested values	GET	IED(PSIED).MMS	SAU(PSAU

3	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the received report data inside the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU

Scenario						
Scenario Name:		No. 5 - SSAU.Reporting Timed MMS Report [normal]				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	Periodically	Data acquisition	SSAU.Reporting generates a new report that will be transmitted to the PSAU.Monitoring. Report can contains one or more values	REPORT	SAU(SSAU).MMS	SAU(PSAU).MMS
2	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the received report data inside the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU).RDBMS

Scenario						
Scenario Name:		No. 6 - SSAU.Reporting Threshold/Event MMS Report [normal]				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	Threshold crossed	Data acquisition	SSAU.Reporting generate a new report that will be transmitted to the PSAU.Monitoring. Report can contains one or more values	REPORT	SAU(SSAU).MMS	SAU(PSAU).MMS
2	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the received report data inside the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU).RDBMS

Scenario						
Scenario Name:		No. 7 - SSAU.Reporting Read MMS [normal]				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	Read request	Data acquisition	PSAU.Monitoring requestes a read then	GET	SAU(SSAU).MMS	SAU(PSAU).MMS

			SSAU.Reporting answers sending the requested values			
2	PSAU.Monitoring data acquired	Data storage	PSAU.Monitoring stores the received report data inside the PSAU.RDBMS	REPORT	SAU(PSAU).MMS	SAU(PSAU).RDBMS

Scenario						
Scenario Name:	No. 8 - Reporting Timed Report [normal]					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (A**
1	Periodically	Data storage	PSAU.Reporting reads data from PSAU.RDBMS	GET	SAU(PSAU).RDBMS	SAU(PSAU).MMS SAU(PSAU).IEC 104 SAU(PSAU).Modbus
2	PSAU.Reporting data retrieved	Data report	PSAU.Reporting generates a new report	REPORT	SAU(PSAU).MMS	DMS.MMS

			which contains the data retrieved from PSAU.RDBMS			
3	PSAU.Reporting data retrieved	Data report	PSAU.Reporting generates a new report which contains the data retrieved from PSAU.RDBMS	REPORT	SAU(PSAU).Modbus	DMS.Modbus

Scenario							
Scenario Name:	No. 9 - Reporting Threshold Report [normal]						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informati Exchang**
1	Periodically	Data storage	PSAU.Reporting reads data from PSAU.RDBMS	GET	SAU(PSAU).RDBMS	SAU(PSAU).IEC 104	Voltage magnitude Current magnitude Energy measuren Switch sta Statistical measuren Current phase ang Voltage phase ang Reactive power Active pov
2	Threshold crossed	Data report	PSAU.Reporting generates a new report if a	REPORT	SAU(PSAU).MMS	DMS.MMS	Voltage magnitude Current magnitude

			predefined threshold is crossed				Energy measuren Switch sta Statistical measuren Current phase ang Voltage phase ang Reactive power Active pov
3	Threshold crossed	Data report	PSAU.Reporting generates a new report if a predefined threshold is crossed	REPORT	SAU(PSAU).IEC 104	DMS.IEC104	Voltage magnitude Current magnitude Energy measuren Switch sta Statistical measuren Current phase ang Voltage phase ang Reactive power Active pov
4	Threshold crossed	Data report	PSAU.Reporting generates a new report if a predefined threshold is crossed	REPORT	SAU(PSAU).Modbus	DMS.Modbus	Voltage magnitude Current magnitude Energy measuren Switch sta Statistical measuren Current phase ang Voltage phase ang Reactive power Active pov

Scenario						
Scenario Name:		No. 10 - Reporting Read MMS [normal]				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	Read request from	Data acquisition	PSAU.Reporting receives a read data request	GET	SAU(PSAU).RDBMS	SAU(PSAU).MMS SAU(PSAU).IEC 104 SAU(PSAU).Modbus

	external entity		from an external entity so it retrieves data from PSAU.RDBMS			

Scenario						
Scenario Name:		No. 11 - Statistical Calculation [normal]				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiv (Actor)**
1	Periodically	Data storage	PSAU.Reporting retrieves data required to calculate new statical values (such as min, max, avg, etc.)	GET	SAU(PSAU).RDBMS	SAU(PSAU).Functior
2	PSAU.calculate statistical value (e.g. average on 1 minute). Not necessary a state estimation	Statistical calculation	PSAU.Reporting calculates a set of statistical values	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functior
3	Statistical data calculated	Data storage	PSAU.Reporting stores the calculated statical data inside the PSAU.RDBMS	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS

5 Information Exchanged

Information Exchanged

Name of Information (ID)	Description of Information Exchanged	Requirements to information data
Voltage magnitude	Voltage magnitude [V]	
Current magnitude	Current magnitude [A]	
Energy measurement	Energy measurement [Wh]	
Switch status	Information about devices states (i.e. breaker: open, close, undefined; tap changer position; etc.)	
Statistical measurement	Statistical values such as min, max, avg, std, etc.	
Current phase angle	Current phase angle [rad]	
Voltage phase angle	Voltage phase angle [rad]	
Reactive power	Reactive power injection [VAr]	
Active power	Active power injection [W]	

1 Description of the Use Case1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
132		Low Voltage Network Real Time Monitoring (LVRTM)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The use case consists in collecting in a unique repository â€“ located in the Secondary Substation â€“ measurement (mean values and PQ indexes), states and alarms from the LV grid.
Objective(s)	This information is needed to perform correctly algorithms (State Estimation, State Forecasting, Optimal Power Flow, â€¦) and control actions in order to increase the network reliability and performance.
Related business	

case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The data collection for the LV grid is performed storing real-time measurements (mean values and PQ indexes), states and alarms in a unique repository – located in the Secondary Substation – after managing some implementation issues, such as protocol conversion and writing of data into the SSAU.RDBMS. "Real-time" in this context means something in between 1 second and some minutes.
Complete description

On the LV grid, several monitoring devices will be installed:

- Smart Meters (SM) on the connection point of LV customers/productions. Data of SMs are often collected by a Meter Data Collector (MDC) system, installed in the secondary substation and aggregated in an Automatic Metering Management system (AMM) located in the control center.

- Remote Terminal Units (RTUs), Power Quality Meters (PQMs) or – more in general – Intelligent Electronic Devices (IEDs)

Data considered by the use case is:

- Mean values of V, I, Q, P:
  - LV busbars, LV side of transformers and LV lines in secondary substations (RTU, IED)
  - On the connection point of LV customers/productions (SM/MDC)
- Load profiles from LV customers and generations (SM/MDC)
- PQ indexes both from the secondary substations and from some relevant nodes of the LV grid, such has street cabinets (PQM)
- Status of remote-controllable elements in secondary substations (RTU-IED)
  - breakers/disconnectors
  - tap changer of MV/LV transformers
  - voltage or reactive power set-points for generation connected on the LV network
- Alarms related to events and faults (IED-PQM-RTU)

Measures, events and states not provided by those devices are provided by the Distribution Management System (DMS).

Measures, events and states from the MV side of the secondary substation should be considered as well. In that case they will be transfer to the primary substation by the DMS.

Measures are fetched by using:

- the IEC61850 protocols (mainly MMS) and stored into the database which presents a data model compliant with the IEC61850 for the general monitoring of the LV grid (from RTUs, IEDs, DMS…)
- DLMS/COSEM protocol for the communication with electronic meters(EM)

Protocol conversion have to be implemented before writing the data – collected from different sources – into the SSAU.RDBMS to enable the execution of other use cases.

The SSAU.RDBMS should contain a Data layer, composed by a relational database, where the data are written

The SSAU.Monitoring must include an Interface layer which implements required communication protocols and which is able to extract data from other systems.

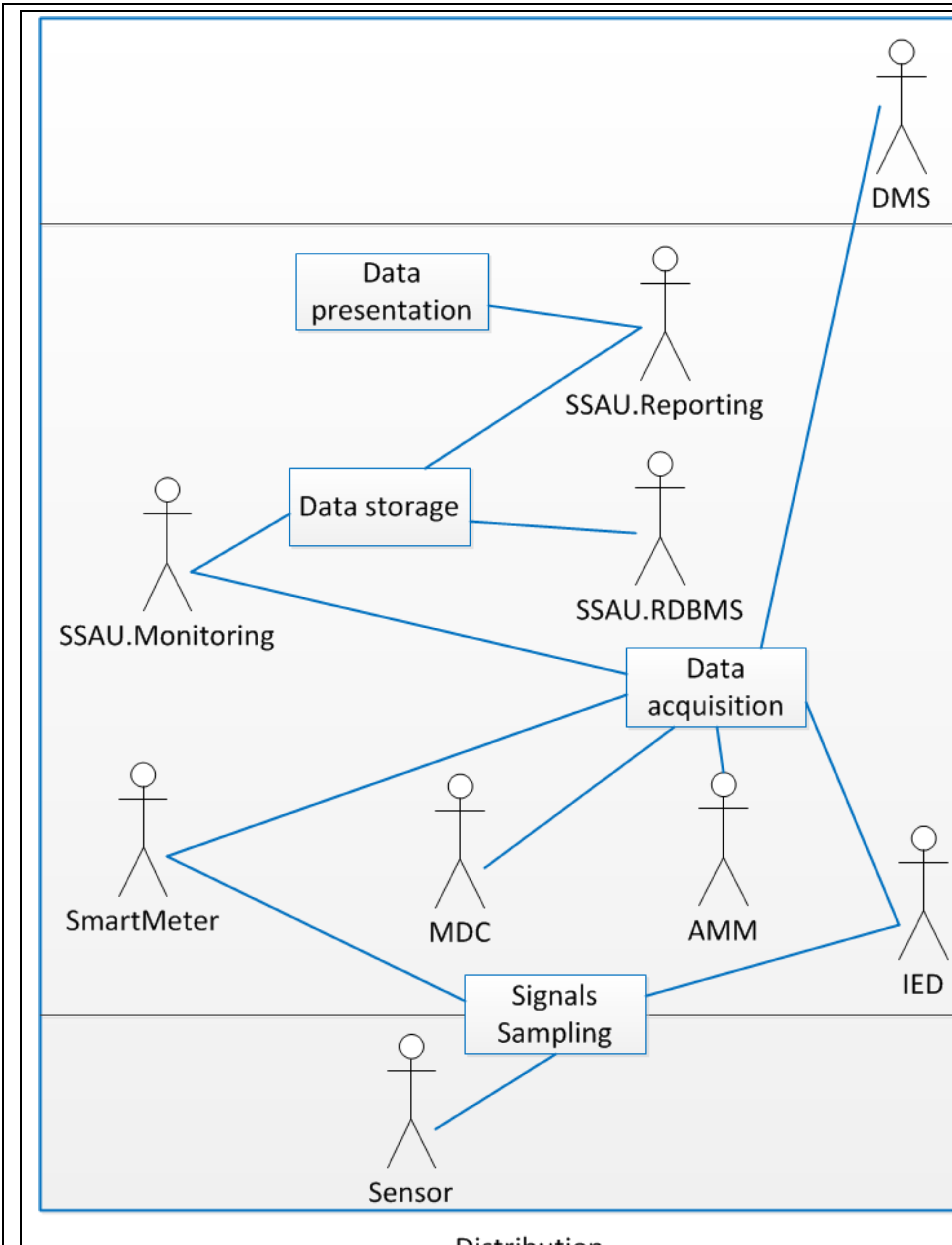
The SSAU.Reporting is composed of an Application layer, which analyses the data to:

- calculate statistical values such as min, max, avg, std, etc.
- generate reports for the primary substation/DMS

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


DMS
Data presentation
SSAU.Reporting
Data storage
SSAU.Monitoring
SSAU.RDBMS
Data acquisition
SmartMeter
MDC
AMM
IED
Signals Sampling
Sensor

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.MMS	function	DXP communication interface Depending on the particolar interface it can be - 104 master - 61850 client/server - Modbus/TCP master Distribution Management System (DMS) Def. 1 Application server of a Distribution Management System which hosts applications to monitor and control a distribution grid from a centralized location, typically the control center. Def. 2 DMS SCADA System refers to the real-time information system and all the elements needed to support all the relevant operational activities and functions used in distribution automation at dispatch centers and control rooms. Actor in Enterprise zone	
IED(SSIED-MDC).DLMS/COSEM	function	Meter Data Concentrator (MDC) Def. 1 A party responsible for meter reading and quality control of the reading. Def. 2 Device or application typically in a substation which establishes the communication to smart meters to collect the metered information and send it in concentrated form to an AMI head end. Actor in Station zone	
AMM.DLMS/COSEM	function	Automatic Meter Management is the system which is in charged to	

		manage meter data concentrators collecting data in a centralzed database and performing a set of diagnostic functions	
Sensor	other	It is a generic sensor such as voltage sensor, current sensor, state sensor, etc. which can be acquired by a generic IED (RTU, PD, etc.)	
IED(DIED-SM).DLMS/COSEM	function	Smart Meter (SM) Def. 1 Meter with additional functionalities one of which is data communication. Def. 2 The metering end device is a combination of the following meter-related functions from the Smart Metering reference architecture: Metrology functions including the conventional meter display (register or index) that are under legal metrological control. When under metrological control, these functions shall meet the essential requirements of the MID; One or more additional functions not covered by the MID. These may also make use of the display; Meter communication functions Actor in the Field zone	
SAU(SSAU).MMS	function	DXP, client server interface for MMS Secondary Substation Automation Unit Monitoring It represents the monitoring functionalities which are implemented in the Secondary Substation Automation Unit	
SAU(SSAU).RDBMS	function	Secondary Substation Automation Unit Relational Database Management System It represents the database and the related management system which compose the Secondary Substation Automation Unit storage system	
SAU(PSAU).MMS	function	DXP, client server interface for MMS Primary Substation Automation Unit Monitoring It represents the monitoring functionalities which are	

		implemented in the Primary Substation Automation Unit	
IED(SSIED).MMS	function	IED of secondary substation, MMS interface	
SAU(SSAU).Functions	function	SSAU.SC SSAU statistical calculation	
SAU(SSAU).DLMS/COSEM	function	SSAU data exchange platform for DLMS/COSEM protocol (smart meter data)	
SAU(SSAU).IEC104	function	Secondary Substation Automation Unit Reporting It represents the reporting functionalities which are implemented in the Secondary Substation Automation Unit	
IED(DIED-SM).functions	function	Smart meter	
IED(SSIED).functions	function	IED of secondary substation	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Medium Voltage Network Real Time Monitoring (MVRTM);
Level of Depth
Primary Use Case
Priorisation
Generic, Regional or National Relation
European
Viewpoint
Technical
Further Keyword for Classification
Low Voltage Grid, Monitoring, Report, DLMS/COSEM

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario Name:						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information (Actor)
1	Periodically	Signals acquisition	SM samples sensors signals (voltages and currents) and calculate powers and energies	REPORT	Sensor	IED(DIED-SM
2	Periodically	Data acquisition	MDC acquires data from conneted SMs	GET	IED(DIED-SM).DLMS/COSEM	IED(SSIED-MDC).DLMS
3	Periodically	Data acquisition	SSAU.Monitoring acquires data from MDC	GET	IED(SSIED-MDC).DLMS/COSEM	SAU(SSAU).I
4	SSAU.Moitoring	Data	SSAU.Monitoring	REPORT	SAU(SSAU).DLMS/COSEM	SAU(SSAU).I

	Data acquired	storage	writes acquired data in SSAU.RDBMS			

Scenario Name:						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Informatio (Actor)**
1	Periodically	Signals acquisition	SM samples sensors signals (voltages and currents) and calculate powers and energies	REPORT	Sensor	IED(DIED-S
2	Periodically	Data acquisition	SSAU.Monitoring acquires values from connected SMs	GET	IED(DIED-SM).DLMS/COSEM	SAU(SSAU)
3	SSAU.Monitoring data acquired	Data storage	SSAU.Monitoring writes acquired data in SSAU.RDBMS	REPORT	SAU(SSAU).DLMS/COSEM	SAU(SSAU)

Scenario Name:						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Informatio (Actor)
1	Periodically	Signals acquisition	SM samples sensors signals (voltages and currents) and calculate powers and energies	REPORT	Sensor	IED(DIED-S
2	Periodically	Data acquisition	MDC acquires data from conneted SMs	GET	IED(DIED-SM).DLMS/COSEM	IED(SSIED-MDC).DLM
3	Periodically	Data acquisition	AMM acquires data from conneted MDCs	GET	IED(SSIED-MDC).DLMS/COSEM	AMM.DLM
4	Periodically	Data acquisition	AMM acquires data from conneted SMs	GET	IED(DIED-SM).DLMS/COSEM	AMM.DLM

5	Periodically	Data acquisition	SSAU.Monitoring acquires data from conneted AMM	GET	AMM.DLMS/COSEM	SAU(SSAU)
6	SSAU.Monitoring data acquired	Data storage	SSAU.Monitoring writes acquired data in SSAU.RDBMS	REPORT	SAU(SSAU).DLMS/COSEM	SAU(SSAU)

Scenario Name:						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	No Monitored Event from LV grid	Data acquisition	DMS sends a report to the SSAU.Monitoring containing data related to the event	REPORT	DMS.MMS	SAU(SSAU).MMS
2	SSAU.Monitoring data acquired	Data storage	SSAU.Monitoring stores the data received by the DMS into the SSAU.RDBMS	REPORT	SAU(SSAU).MMS	SAU(SSAU).RDBMS

Scenario						
Scenario Name:	No. 5 - IED Timed MMS Report [normal]					
Step	**Event.**	**Name of**	**Description of Process/**	**Service**	**Information**	**Informa**

No.		Process/ Activity	Activity.		Producer (Actor)	(Actor)
1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(SSIE
2	Periodically	Data acquisition	IED generates a new report that will be transmitted to the SSAU.Monitoring. Report can contains one or more values	REPORT	SSIED	SSAU.D
3	SSAU.Monitoring data acquired	Data storage	SSAU.Monitoring stores the received report data inside the SSAU.RDBMS	REPORT	SSAU.DXP.MMS	SAU(SS

Scenario Name:						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Informa (Actor)
1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(SSI
2	Periodically	Data acquisition	IED generates a new report that will be transmitted to the SSAU.Monitoring. Report can contains one or more values	REPORT	IED(SSIED).MMS	SAU(SS

3	SSAU.Monitoring data acquired	Data storage	SSAU.Monitoring stores the received report data inside the SSAU.RDBMS	REPORT	SAU(SSAU).MMS	SAU(SS

Scenario						
Scenario Name:	No. 7 - IED Read MMS [normal]					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Informati (Actor)**
1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(SSIED
2	Threshold crossed	Data acquisition	IED generate a new report that will be transmitted to the SSAU.Monitoring. Report can contains one or more values	REPORT	IED(SSIED).MMS	SAU(SSAU
3	SSAU.Monitoring data acquired	Data storage	SSAU.Monitoring stores the received report data inside the SSAU.RDBMS	REPORT	SAU(SSAU).MMS	SAU(SSAU

Scenario Name:						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information R (Actor)**
1	Periodically	Signals acquisition	IED samples and acquires voltages/currents/states/etc. signals from sensors	REPORT	Sensor	IED(SSIED).fu
2	Read request	Data acquisition	SSAU.Monitoring requestes a read then IED answers sending the requested values	GET	IED(SSIED).MMS	SAU(SSAU).M

Scenario Name:						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Inform Excha**
1	Periodically	Data storage	SSAU.Reporting reads data from	GET	SAU(SSAU).RDBMS	SAU(SSAU).MMS	Statist measu Reacti power

			SSAU.RDBMS				Curren phase Voltag phase Voltag magnit Curren magnit Active Energy measu Switch
2	Threshold crossed	Data report	SSAU.Reporting generates a new report if a predefined threshold is crossed	REPORT	SAU(SSAU).MMS	SAU(PSAU).MMS	Statist measu Reacti power Curren phase Voltag phase Voltag magnit Curren magnit Active Energy measu Switch

Scenario							
Scenario Name:	No. 10 - Reporting Read MMS [normal]						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informa Exchan**
1	Read request from external entity	Data acquisition	SSAU.Reporting receives a read data request from an external entity so it retrieves data from SSAU.RDBMS	GET	SAU(SSAU).RDBMS	SAU(SSAU). MMS SAU(SSAU). Modbus SAU(SSAU).IEC104	Statistic measure Reactive power Current phase a Voltage phase a Voltage magnitu Current magnitu Active p Energy measure Switch s

Scenario Name:						
Step	**Event.**	**Name of**	**Description of**	**Service**	**Information Producer**	**Information Receive**

No.		Process/ Activity	Process/ Activity.		(Actor)	(Actor)
1	Periodically	Data storage	SSAU.Reporting retrieves data required to calculate new statical values (such as min, max, avg, etc.)	GET	SAU(SSAU).RDBMS	SAU(SSAU).Functions
2	Data retrieved	Statistical calculation	SSAU.Reporting calculates a set of statistical values	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions
3	Statistical data calculated	Data storage	SSAU.Reporting stores the calculated statical data inside the SSAU.RDBMS	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Statistical measurement	Statistical values such as min, max, avg, std, etc.	
Reactive power	Reactive power injection [VAr]	
Current phase angle	Current phase angle [rad]	
Voltage phase angle	Voltage phase angle [rad]	
Voltage magnitude	Voltage magnitude [V]	
Current magnitude	Current magnitude [A]	
Active power	Active power injection [W]	

Energy measurement	Energy measurement [Wh]	
Switch status	Information about devices states (i.e. breaker: open, close, undefined; tap changer position; etc.)	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
161		Distribution grid dynamic monitoring for providing dynamic information to TSOs

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Defining monitoring applications and algorithms that can provide â€œdynamicsâ€• information for TSOs. The business case sought here is to manage the new complexity and inter-dependence between electric power transmission and distribution systems to support a long-term sustainable energy system.
Objective(s)	Manage the new complexity and inter-dependence between electric power transmission and distribution systems to support a long-term sustainable energy system.
Related business case(s)	

1.4 Narrative of Use Case

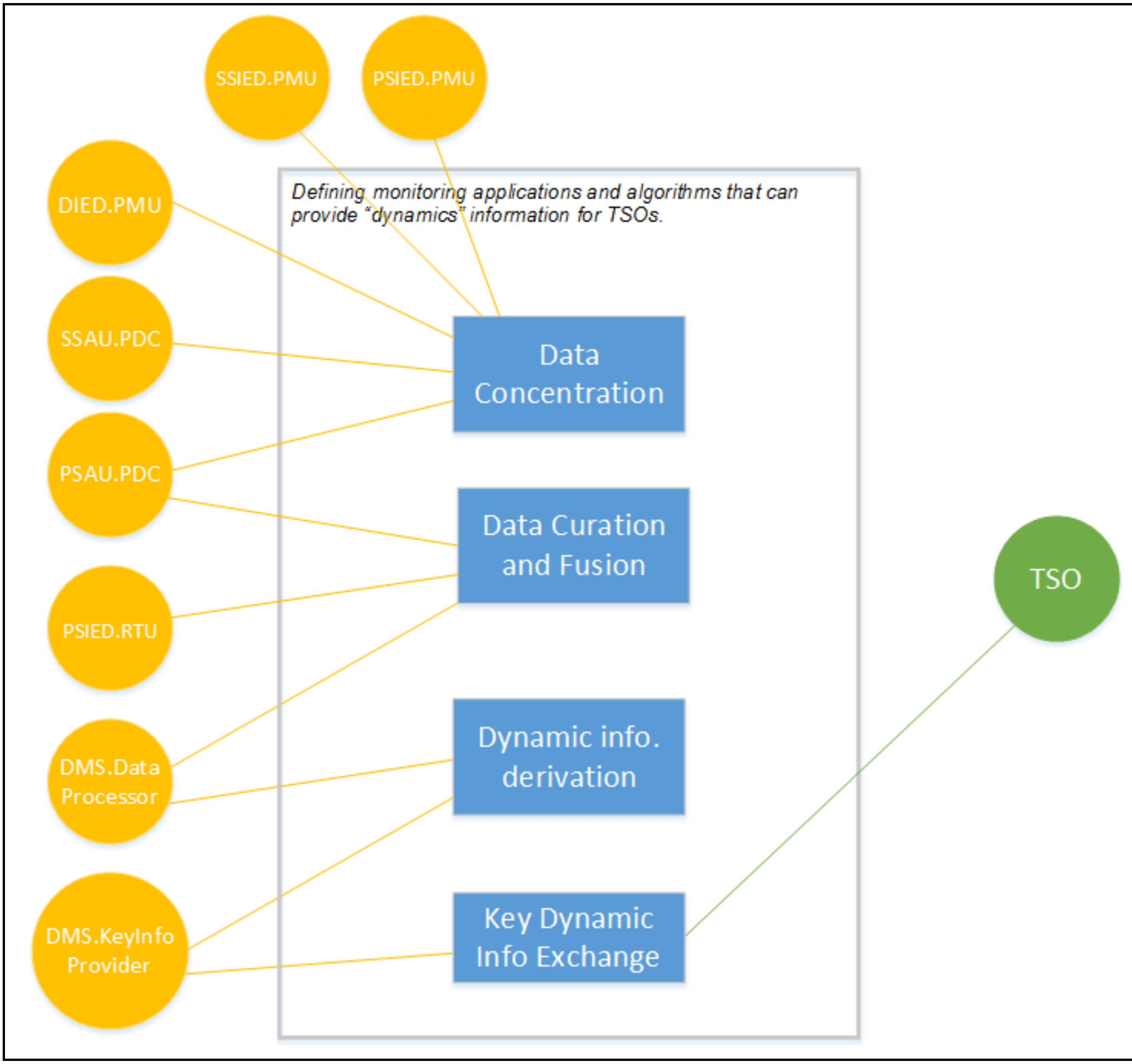
Narrative of Use Case
Short description
Utilizing time-stamped PMU data and discrete traditional measurements for providing “dynamics” information on distribution grid operation to TSOs.
Complete description
The paradigm shift towards Smart Grids requires a tighter integration of the operation of transmission grids (HV) with distribution grids (MV and LV). Coupling the use of PMU data from both the HV grid and MV and LV grids coherently with advanced communication protocols for can allow for a tighter interaction between transmission and distribution. To this aim, key information exchange of specific distribution network dynamics to the transmission system

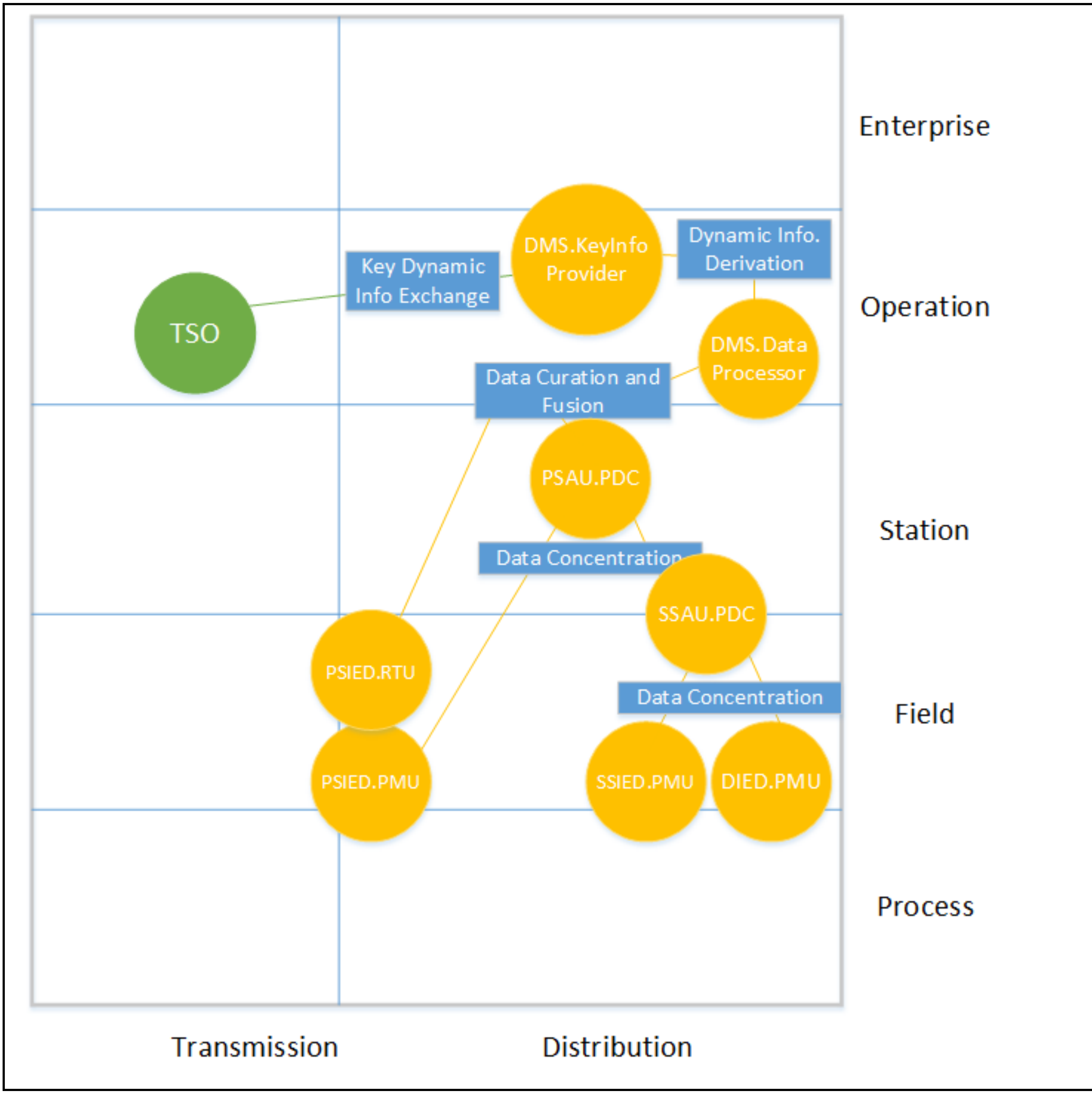
operator is considered in this use case. The monitoring algorithms receive inputs of time-stamped PMU data and discrete traditional measurements and outputs “dynamics” information on distribution grid operation to TSOs. The algorithms sits in the primary substation.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


SSIED.PMU
PSIED.PMU
DIED.PMU
SSAU.PDC
PSAU.PDC
PSIED.RTU
DMS.Data Processor
DMS.KeyInfo Provider
Defining monitoring applications and algorithms that can provide "dynamics" information for TSOs.
Data Concentration
Data Curation and Fusion
Dynamic info. derivation
Key Dynamic Info Exchange
TSO



3 Technical Details

3.1 Actors

Actors			
Grouping		Group Description	
Actor Name	Actor Type	Actor Description	Further

			information specific to this Use Case
SAU(PSAU).TSDB	function	*Phasor data concentrator* *A function which receives data from multiple PMUs, sorts the data by their time-tags and publishes them to be used by other applications*	
IED(PSIED-RTU).DNP3	function	A remote terminal unit is a microprocessor-controlled electronic device thta Interfaces objects in the physical world to a distributed control System or SCADA by transmitting telemetry data to the System, and by using Messages from the supervisory. Actor in Process, Field, Station	
IED(PSIED-PMU).61850-90-5	function	61850-90-5 interface of PMU	
IED(SSIED-RTU).DNP3	function	A remote terminal unit is a microprocessor-controlled electronic device thta Interfaces objects in the physical world to a distributed control System or SCADA by transmitting telemetry data to the System, and by using Messages from the supervisory. Actor in Process, Field, Station	
IED(SSIED-PMU).61850-90-5	function	61850-90-5 interface of PMU	
IED(DIED-PMU).61850-90-5	function	61850-90-5 interface of PMU	
SAU(SSAU).61850-90-5	function	61850-90-5 interface of SAU	
SAU(PSAU).61850-90-5	function	61850-90-5 interface of SAU	
DMS.TSDB	function	Time series database	
TSOEMS	function	According to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet	

		reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.	
SAU(SSAU).TSDB	function	Time series database	
DMS.61850-90-5	function	61850-90-5 interface of DMS	
DMS.DNP3	function	DNP3 interface of DMS	
DMS.functions	function	DMS dynamic info elaboration	
DMS.WS	function	Web service interface of DMS	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed
Priorisation
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
PMU, dynamics monitoring

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

	Name				

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - Transmitting traditional measurements from RTU to DMS via DNP3					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**
1	DMS polling	Data acquisition	DMS sends a request to RTU to collect data	EXECUTE	DMS.DNP3	IED(PSIED-RTU).DNP3 IED(SIED-RTU).DNP3	Voltage magnitude Current magnitude Frequency measurement Current phase angle Voltage phase angle
2	RTU response PS level	Data acquisition	RTU sends data to DMS	REPORT	IED(PSIED-RTU).DNP3	DMS.DNP3	Voltage magnitude Current magnitude Frequency measurement Current phase angle Voltage phase angle
3	RTU response SS level	Data acquisition	RTU sends data to DMS	REPORT	IED(SIED-RTU).DNP3	DMS.DNP3	Voltage magnitude Current magnitude Frequency measurement Current phase angle Voltage phase angle
4	Store RTU data intodatabase	Data storage	Storage RTU measurement	EXECUTE	DMS.DNP3	DMS.TSDB	RTU measurements

Scenario							
Scenario Name:		No. 2 - Transmitting PMU to PDC via standard protocols such as IEC 61850-90-5 and C37.118.a					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Info Exc**
1	PMU reporting PS	Data report	PMU streams data to PDC	REPORT	IED(PSIED-PMU).61850-90-5	SAU(PSAU).61850-90-5	Vol ma Cur

	level						ma Fre me Cur ang Vol ang
2	storage synchrophasor and frequency in time series database	Data storage	Store measurements	EXECUTE	SAU(PSAU).61850-90-5	SAU(PSAU).TSDB	syn and

Scenario							
Scenario Name:		No. 2 - Transmitting PMU to PDC via standard protocols such as IEC 61850-90-5 and C37.118.					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Info Exc**
1	PMU reporting SS level	Data report	PMU streams data to PDC	REPORT	IED(SSIED-PMU).61850-90-5	SAU(SSAU).61850-90-5	Volt mag Cur mag Fre mea Cur ang Volt ang
2	PMU oustide substation reporting	Data report	PMU streams data to PDC	REPORT	IED(DIED-PMU).61850-90-5	SAU(SSAU).61850-90-5	Volt mag Cur mag Fre mea Cur ang Volt ang
3	storage synchrophasor and frequency in time series database	Data storage	Store measurements	EXECUTE	SAU(SSAU).61850-90-5	SAU(SSAU).TSDB	syn and

Scenario							
Scenario Name:		No. 3 - Streaming PMU data from PDC to DMS					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informati Exchang**

1	PDC reporting	Data report	PDC streams data to applications	REPORT	SAU(PSAU).61850-90-5	DMS.61850-90-5	Voltage magnitude Current magnitude Frequenc measurem Current pl angle Voltage p angle
2	PDC reporting SS to PS	Data report	PDC streams data to applications	REPORT	SAU(SSAU).61850-90-5	DMS.61850-90-5	Voltage magnitude Current magnitude Frequenc measurem Current pl angle Voltage p angle
3	PDC stores the measurements	Data storage	Store measurements	EXECUTE	DMS.61850-90-5	DMS.TSDB	synchrop and frequ

Scenario							
Scenario Name:		No. 4 - Extracting key information					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informat Exchang**
1	Bad data handling of RTU and PDC	Data Curation and Fusion	Bad data handling of RTU and PDC	EXECUTE	DMS.TSDB	DMS.functions	Voltage magnitud Current magnitud Current phase angle Voltage phase angle
2	Harmonizing PMU and traditional measurements	Data Curation and Fusion	Harmonizing PMU and traditional measurements	EXECUTE	DMS.functions	DMS.functions	Voltage magnitud Current magnitud Current phase angle Voltage phase angle
3	Deriving low-frequency oscillations,	Dynamic info derivation	Deriving low-frequency oscillations,	EXECUTE	DMS.functions	DMS.TSDB	Key Dynamic Informati

	sub-synchronous oscillations, voltage stability indices, reduced model synthesis, etc. out of the harmonized data		sub-synchronous oscillations, voltage stability indices, reduced model synthesis, etc. out of the harmonized data				

Scenario								
Scenario Name:	No. 5 - Sending derived dynamic information to TSO							
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
1	Report to TSO	Data report	PDC streams data to applications running on the technical aggregator	EXECUTE	DMS.WS	TSOEMS	Key Dynamic Information	

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data
Voltage magnitude	Voltage magnitude [V]	
Current magnitude	Current magnitude [A]	
Frequency measurement	Frequency [Hz]	
Key Dynamic Information	This information includes all dynamic data to be sent to TSO including: 1. Steady state model synthesis of distribution system 2. Modes of the distribution systems together with indices indicating how stable the distribution system is in terms of dynamic stability 3. Indices showing how stable the distribution system is in terms of	

	voltage stability 4. Indicators of sub-synchronous oscillations	
Current phase angle	Current phase angle [rad]	
Voltage phase angle	Voltage phase angle [rad]	

6 Requirements (optional)

Requirements (optional)	

7 Common Terms and Definitions

Common Terms and Definitions	
Term	Definition

8 Custom Information (optional)

Custom Information (optional)		
Key	Value	Refers to Section

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
133		Real-Time Medium Voltage Network State Estimation (MVSE)

1.2 Version Management

Version Management
From V1.0 15.12.2014 Antti Mutanen Added the word "Real-Time" to the title to be consistant with the LVSE use case. 2015-04-10Fannar Thordarson Made changes according to the latest updates from Antti (available on wiki from 2015-04-02)

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the real-time PSAU.SE is to obtain the best possible estimate for the MV network state. The state estimation task has been divided into two parts; MV and LV network estimation. This use case considers only the MV network state estimation.
Related business case(s)	

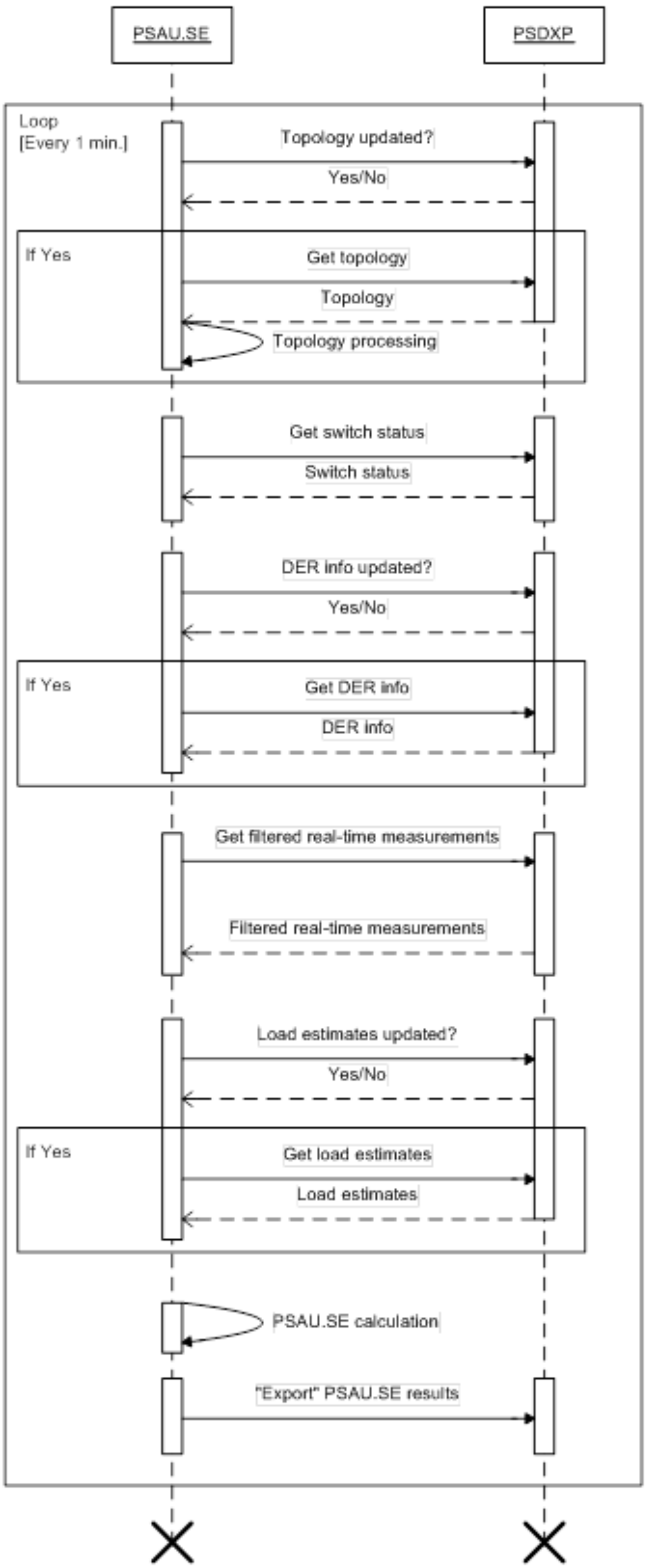
1.4 Narrative of Use Case

Narrative of Use Case
Short description
The medium voltage state estimator (PSAU.SE) combines all the available measurement information and calculates the most likely state of the network. State estimates are calculated for present time (t=0) using the newest available input data. PSAU.SE calculation will run an intelligent device located either on a primary substation or in a control center. Real-time PSAU.SE is a secondary function serving primary functions (e.g. medium voltage network power control, PSAU.PC) and will be run based on primary function needs (on-demand or periodically). The input data includes the real-time measurements for the load, production and line flows, load estimates for unmeasured loads, and the network topology. Output will be the network state described with node voltages, line current flows, and node power injection values.
Complete description
A PSAU.SE algorithm is developed, that can be utilized for estimating the present states in a medium voltage network. The algorithm will be a branch current based weighted least squares estimator. Medium voltage network states; node voltages, line current flows and line power flows are calculated for all three phases. For a normal MV feeder, the computing time will be some tens of milliseconds and the overall execution time will depend on the number and size of the feeders. The basic steps in real-time PSAU.SE are as follows (in normal operation conditions): 1. The state estimator reads the current network topology and configuration from the Primary Substation Data Exchange Platform (PSAU.DXP.RDBMS). 2. The latest (filtered) MV network measurements and the related LV network state estimates are retrieved from PSAU.DXP.RDBMS. 3. Load and production estimates (for time t=0) supplied by the forecaster are used as pseudo-measurements for unmeasured load and production points. 4. State estimation is calculated using the filtered measurements, pseudo-measurements and the present network topology and configuration. The outputs (node voltages, line current flows and line power flows for all three phases) will be stored to the PSAU.DXP.RDBMS where they are available for other functions that need real-time medium voltage network state estimates.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


PSAU.SE
PSDXP
Loop
[Every 1 min.]
Topology updated?
Yes/No
If Yes
Get topology
Topology
Topology processing
Get switch status
Switch status
DER info updated?
Yes/No
If Yes
Get DER info
DER info
Get filtered real-time measurements
Filtered real-time measurements
Load estimates updated?
Yes/No
If Yes
Get load estimates
Load estimates
PSAU.SE calculation
"Export" PSAU.SE results

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(PSAU).Functions	function	State estimation function	
SAU(PSAU).RDBMS	function	Primary Substation Automation Unit Relational Database Management System It represents the database and the related management system which compose the Primary Substation Automation Unit storage system	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed Use Case
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
State Estimation; Real-Time; Distribution Network

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - Normal Sequence					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Rece (Actor)
1	Grid data import	Data storage	If grid data information has not been imported before or if grid data information has changed the grid data import function requests network grid data information from the PSAU.DXP.RDBMS.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functi
3	Switch status import	Data storage	Switch status import function requests the latest switch and fuse status information from the MV DXP.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functi
4	DER information import	Data storage	If DER information has not been imported before or if it has changed the information regarding customers, generators, capacitors etc. is requested from the MV DXP	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functi
5	Real-time measurement reading	Data storage	Real-time measurements (RTU and smart	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functi

			meter measurements) are requested from the PSAU.DXP.RDBMS.			
6	Load Estimate Import	Data storage	If load and production estimates have not been imported before or if they have changed, the load and production estimates are requested from the MV DXP.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functi
7	PSAU state estimation execution	State estimation	Calculate the state of the network	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functi
8	Export PSAU.SE results	Data storage	The results from PSAU.SE are exported to PSAU.DXP.RDBMS.	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBM

Scenario

Scenario Name:	No. 2 - Convergence issues					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
7.1	Detection non-convergence	detect error	Remove the most likely source of non-convergence. The Largest Normalized Residual Test is used to decide which real-time measurement is removed from input set.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions
7.2	Possible source removed	detect error	Recalculated PSAU.SE and re-evaluate convergence.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions
7.2.1	MVSE converged	detect error	If convergence is achieved, continue to step 8 in the Normal Sequence and set the status flag to "executed, but with limited accuracy".	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions

Scenario						
Scenario Name:	No. 3 - Gross error in Real-time measurements					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
5.1.1	Gross error in MVSE Real-time measurements removal	detect error	Gross error occurs as the real-time measurements are imported	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functions

			to PSAU.SE			
5.1.2	Erroneous measurements removed	detect error	Remove the erroneous data and proceed to step 6 in the normal sequence. Set the satus flag to "executed, but with limited accuracy.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions
5.1.3	Erroneous measurements removed	detect error	Remove the erroneous data and proceed to step 6 in the normal sequence. Set the satus flag to "executed, but with limited accuracy.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

Scenario							
Scenario Name:	No. 4 - Gross error in load/production data						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Infor Excha**
6.1	Gross error in MVSE load and production data	detect error	Gross error occurs as the load and production data are imported to PSAU.SE	REPORT	SAU(PSAU).Functions	SAU(PSAU).Functions	algori perfo index
5.2	Erroneous data removed	detect error	Remove the erroneous data and proceed to	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions	algori perfo index

			step 7 in the normal sequence. Set the satus flag to "executed, but with limited accuracy.				

Scenario						
Scenario Name:	No. 5 - Voltage measurement missing					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
5.2	Voltage measurements (connection to LV) missing	Missing data	PSAU.SE doesn't receive voltage measurements and, thus, cannot be executed. Set the status flag to "error, execution not possible".	CANCEL	SAU(PSAU).Functions	SAU(PSAU).RDBMS
5.3	Quality index estimation update	algorithm performance index	PSAU.SE doesn't receive voltage measurements and, thus, cannot be executed. Set the status flag to "error, execution not possible".	CHANGE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

Scenario						
Scenario Name:	No. 6 - Real-time measurements missing					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Re (Actor)**
5.3	Real-time	Missing data	If real-time	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Func

	measurements missing		measurements (some or all) are missing, use load and production estimates (pseudo measurements) instead. Continue to step 6 in the normal sequence and set the status flag to "executed, but with limited accuray".			
5.4	Quality indexestimation update	algorithm performance index	If real-time measurements (some or all) are missing, use load and production estimates (pseudo measurements) instead. Continue to step 6 in the normal sequence and set the status flag to "executed, but with limited accuray".	CHANGE	SAU(PSAU).Functions	SAU(PSAU).RDB

Scenario						
Scenario Name:		No. 7 - Pseudo measurements missing				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Rec (Actor)**
5.4	Pseudo measurements missing	Missing data	If load and production estimates and some or all	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Func

			secondary substation measurements are missing, but real-time primary substation measurements exist, the PSAU.SE is "executed, but with very limited accuracy". This can be achieved by distributing the measured load to load and production points in relation to transformer and DG nominal powers.			
5.5	Quality indexestimation update	algorithm performance index	If load and production estimates and some or all secondary substation measurements are missing, but real-time primary substation measurements exist, the PSAU.SE is "executed, but with very limited accuracy". This can be achieved by distributing	CHANGE	SAU(PSAU).Functions	SAU(PSAU).Func

			the measured load to load and production points in relation to transformer and DG nominal powers.			

Scenario						
Scenario Name:		No. 8 - Measurements not available				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Rec (Actor)**
5.5	No measurements available	Missing data	In all real-time and pseudo measurements are missing, PSAU.SE cannot be executed. Set the status flag to "error, execution not possible"	CANCEL	SAU(PSAU).RDBMS	SAU(PSAU).Funct
5.6	Quality indexestimation update	algorithm performance index	In all real-time and pseudo measurements are missing, PSAU.SE cannot be executed. Set the status flag to "error, execution not possible"	CHANGE	SAU(PSAU).Functions	SAU(PSAU).RDBM

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Customer information	Nominal power Power limits	

	Type of customer Connection point Phases connected (in case to which phase)	
Reactive power	Reactive power injection [VAr]	
Current phase angle	Current phase angle [rad]	
Quality index	Quality index of state estimation. Could be a number between 0 and 5 or a string	
Voltage phase angle	Voltage phase angle [rad]	
long term load and production forecast	Valid for the next 24 hours	
State Estimation results	node voltages, line currents etc.	
short term load and production forecast	Load and Production Estimates on 10 minutes time range	
Static Grid Data	Data exchanged: - Line parameters (R, X, B, G) - Line connections - Location of swithes, breakers and fuses - Transformer parameters	
Switch and Fuse status		
Der information	Nominal power Power limits Type of DER Connection point Phases connected (in case to which phase)	
Active power	Active power injection [W]	
Current magnitude	Current magnitude [A]	
Voltage magnitude	Voltage magnitude [V]	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/	Name of the Use Case

	Zone(s)	
134		Real-Time Low Voltage Network State Estimation (LVSE)

1.2 Version Management

Version Management
From V1.0 15.12.2014 Antti Mutanen Modified by adding step 8 ß 12 to scenario 1. 15-04-14 Fannar Thordarson UC updated according to latest updates from Antti (available on wiki-page on 2/4/2015)

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the real-time SSAU.SE is to obtain the best possible estimate for the LV network state. The state estimation task has been divided into two parts; MV and LV network estimation. This use case considers only the LV network state estimation.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The state estimator combines all the available measurement information and calculates the most likely state of the network. State estimates are calculated for present time (t=0) using the newest available input data. SSAU.SE calculation will run on an intelligent device located on a secondary substation. Real-time SSAU.SE is a secondary function serving primary functions (e.g. low voltage network power control, SSAU.PC) and will be run based on primary function needs (on-demand or periodically). The input data includes the real-time measurements for the load, production and line flows, load estimates for unmeasured loads, and the network topology. Output will be the network state described with node voltages, line current flows, and node power injection values.
Complete description
A SSAU.SE algorithm is developed that can be utilized on-demand for estimating the present states in a low voltage grid. SSAU.SE calculation is done in a decentralized manner where the SSAU.SE algorithm is run in an intelligent device located in the secondary substation. Low voltage network states; node voltages, line current flows and line power flows are estimated for all three phases. Computing time will be some tens of milliseconds or more if network is very large. Steps in the real-time SSAU.SE are as follows (in normal operation conditions): 1. The state estimator reads the current network topology and configuration from the Data Exchange Platform (SAU(SSAU).RDBMS). 2. The latest measurements are retrieved from the SAU(SSAU).RDBMS: 1) Smart meter measurements (load and production in the network nodes) 2) Remote terminal measurements (Voltages, line flows) 3. Load and production estimates (for time t=0) supplied by the forecaster are used as pseudo-

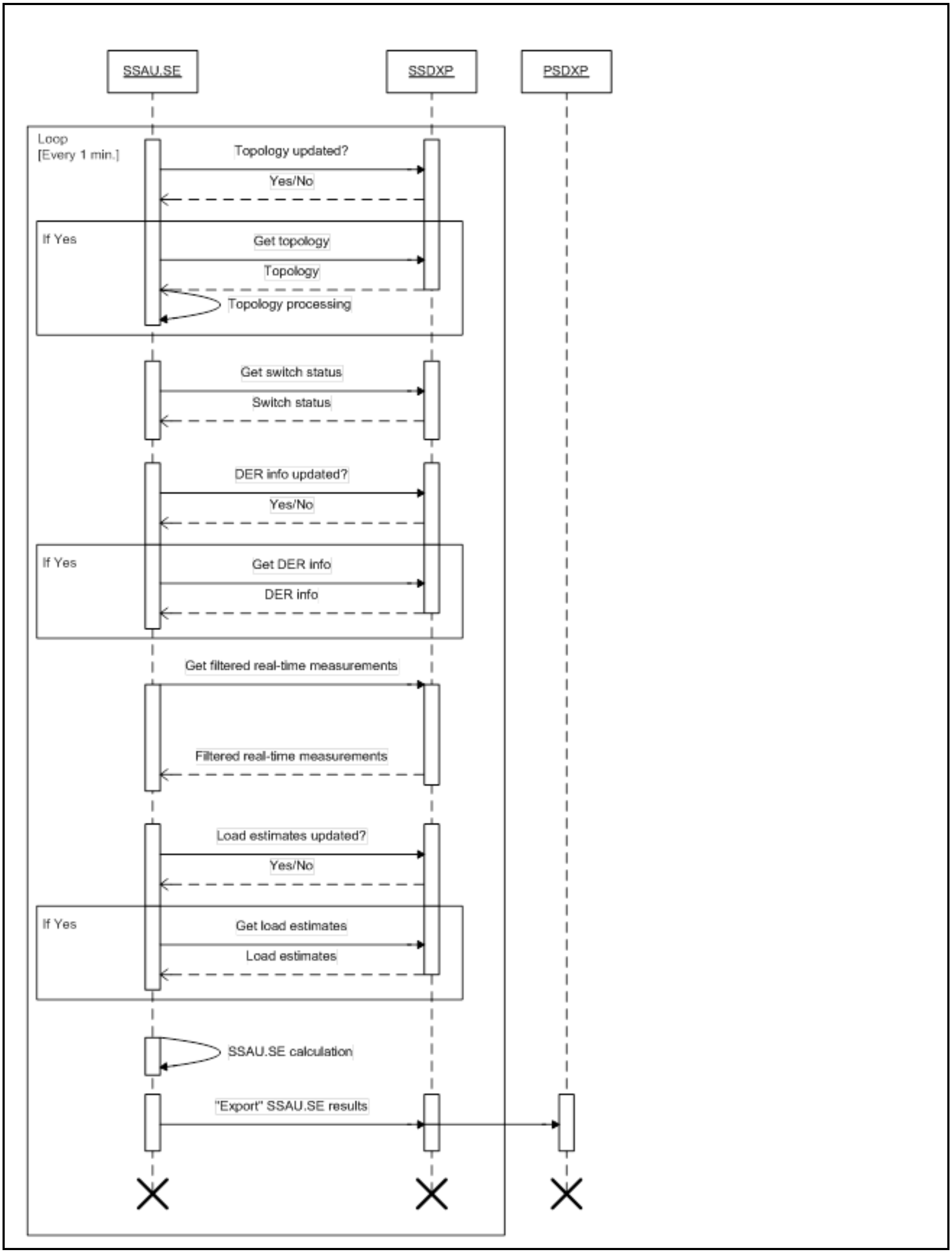
measurements for unmeasured load and production points.

State estimation is calculated using the filtered measurements, pseudo-measurements and the present network topology and configuration. The outputs (node voltages, line current flows and line power flows for all three phases) will be stored to the SAU(SSAU).RDBMS where they are available for other functions that need real-time low voltage network state estimates. Some aggregated results are synchronised also to PSAU.DXP.RDBMS.

1.5 General Remarks

General Remarks
[redacted]

2 Diagrams of Use Case



SSAU.SE
SSDXP
PSDXP
Loop
[Every 1 min.]
Topology updated?
Yes/No
If Yes
Get topology
Topology
Topology processing
Get switch status
Switch status
DER info updated?
Yes/No
If Yes
Get DER info
DER info
Get filtered real-time measurements
Filtered real-time measurements
Load estimates updated?
Yes/No
If Yes
Get load estimates
Load estimates
SSAU.SE calculation
"Export" SSAU.SE results

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(SSAU).Functions	function	State estimation function	
SAU(SSAU).RDBMS	function	Secondary Substation Automation Unit Relational Database Management System It represents the database and the related management system which compose the Secondary Substation Automation Unit storage system	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed Use Case
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
State Estimation, Real-time, Distribution Network

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - Normal Sequence					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Rec (Actor)
1	Grid data import	Data storage	If topology information has not been imported before or if topology information has changed the network topology import function requests network topology information from the secondary substation database	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Funct
2	Grid data processing	Data storage	Process the topology information into a format understood by the state estimator	EXECUTE	SAU(SSAU).RDBMS	SAU(SSAU).Funct
3	Switch status import	Data storage	Switch status import function requests the latest switch and fuse status information from the secondary substation database	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Funct
4	DER and customer information import	Data storage	If DER information has not been imported before or if it has changed the information regarding	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Funct

			customers, generators, capacitors etc. is requested from the secondary substation database			
7	Real-time measurement reading	Data storage	If DER information has not been imported before or if it has changed the information regarding customers, generators, capacitors etc. is requested from the secondary substation database	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Funct
6	Load Estimate Import	Data storage	If load and production estimates have not been imported before or if they have changed, the load and production estimates are requested from the SAU(SSAU).RDBMS.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Funct
7	SSAU.SE calculation	State estimation	Calculate the state of the network	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Funct
8	Export LVSE results (LV DXP)	Data storage	Calculate the state of the network	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBM

Scenario						
Scenario Name:	No. 2 - Convergence issues					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
7.1	Detection non-convergence	detect error	Remove the most likely source of non-convergence. The Largest Normalized Residual Test is used to decide which real-time measurement is removed from input set.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions
7.2	Possible source removed	detect error	Recalculated PSAU.SE and re-evaluate convergence.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions
7.2.1	MVSE converged	detect error	If convergence is achieved, continue to step 8 in the Normal Sequence and set the status flag to "executed, but with limited	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions

			accuracy".				

Scenario						
Scenario Name:		No. 3 - Gross error in Real-time measurements				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
5.1.1	Gross error in MVSE Real-time measurements removal	detect error	Gross error occurs as the real-time measurements are imported to PSAU.SE	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions
5.1.2	Erroneous measurements removed	detect error	Remove the erroneous data and proceed to step 6 in the normal sequence. Set the satus flag to "executed, but with limited accuracy.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions
5.1.3	Erroneous measurements removed	detect error	Remove the erroneous data and proceed to step 6 in the normal sequence. Set the satus flag to "executed, but with limited accuracy.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS

Scenario							
Scenario Name:		No. 4 - Gross error in load/production data					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Inform Excha**
6.1	Gross	detect	Gross	REPORT	SAU(SSAU).Functions	SAU(SSAU).Functions	algori

	error in MVSE load and production data	error	error occurs as the load and production data are imported to PSAU.SE				perfor index
5.2	Erroneous data removed	detect error	Remove the erroneous data and proceed to step 7 in the normal sequence. Set the satus flag to "executed, but with limited accuracy.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions	algorit perfor index

Scenario						
Scenario Name:		No. 5 - Voltage measurement missing				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
5.2	Voltage measurements (connection to LV) missing	Missing data	PSAU.SE doesn't receive voltage measurements and, thus, cannot be executed. Set the status flag to "error, execution not possible".	CANCEL	SAU(SSAU).Functions	SAU(SSAU).RDBMS
5.3	Quality index estimation update	algorithm performance index	PSAU.SE doesn't receive voltage measurements and, thus,	CHANGE	SAU(SSAU).Functions	SAU(SSAU).RDBMS

			cannot be executed. Set the status flag to "error, execution not possible".			

Scenario						
Scenario Name:		No. 6 - Real-time measurements missing				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Re**
5.3	Real-time measurements missing	Missing data	If real-time measurements (some or all) are missing, use load and production estimates (pseudo measurements) instead. Continue to step 6 in the normal sequence and set the status flag to "executed, but with limited accuray".	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Func
5.4	Quality indexestimation update	algorithm performance index	If real-time measurements (some or all) are missing, use load and production estimates (pseudo measurements) instead. Continue to step 6 in the normal sequence and set the status flag to	CHANGE	SAU(SSAU).Functions	SAU(SSAU).RDBI

			"executed, but with limited accuray".			

Scenario						
Scenario Name:		No. 7 - Pseudo measurements missing				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Rec (Actor)**
5.4	Pseudo measurements missing	Missing data	If load and production estimates and some or all secondary substation measurements are missing, but real-time primary substation measurements exist, the PSAU.SE is "executed, but with very limited accuracy". This can be achieved by distributing the measured load to load and production points in relation to transformer and DG nominal powers.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Funct
5.5	Quality indexestimation update	algorithm performance index	If load and production estimates and some or all secondary substation measurements	CHANGE	SAU(SSAU).Functions	SAU(SSAU).Funct

			are missing, but real-time primary substation measurements exist, the PSAU.SE is "executed, but with very limited accuracy". This can be achieved by distributing the measured load to load and production points in relation to transformer and DG nominal powers.			

Scenario						
Scenario Name:		No. 8 - Measurements not available				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Rec (Actor)**
5.5	No measurements available	Missing data	In all real-time and pseudo measurements are missing, PSAU.SE cannot be executed. Set the status flag to "error, execution not possible"	CANCEL	SAU(SSAU).RDBMS	SAU(SSAU).Funct
5.6	Quality indexestimation update	algorithm performance index	In all real-time and pseudo measurements are missing, PSAU.SE cannot be	CHANGE	SAU(SSAU).Functions	SAU(SSAU).RDBM

			executed. Set the status flag to "error, execution not possible"			

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
long term load and production forecast	Valid for the next 24 hours	
short term load and production forecast	valid for the next 15-30 minutes	
Current phase angle	Current phase angle [rad]	
Static Grid Data	Data exchanged: - Line parameters (R, X, B, G) - Line connections - Location of swithes, breakers and fuses - Transformer parameters	
Switch and Fuse status		
Der information	Nominal power Power limits Type of DER Connection point Phases connected (in case to which phase)	
Voltage phase angle	Voltage phase angle [rad]	
Voltage magnitude	Voltage magnitude [V]	
Current magnitude	Current magnitude [A]	
Active power	Active power injection [W]	
Reactive power	Reactive power injection [VAr]	
Customer information	Nominal power Power limits Type of customer Connection point	

	Phases connected (in case to which phase)	
Quality index	Quality index of state estimation. Could be a number between 0 and 5 or a string	

6 Requirements (optional)

Requirements (optional)	

7 Common Terms and Definitions

Common Terms and Definitions	
Term	Definition

8 Custom Information (optional)

Custom Information (optional)		
Key	Value	Refers to Section

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
249		Medium Voltage load/production Forecaster (MVF)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the PSAU forecaster is to forecast MV customer level load and micro-generation production 1-24 hours ahead and to provide a statistical measure for the forecast uncertainty.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The medium voltage load forecasting algorithm provides estimated future load demands and micro-generation production for the medium voltage network. The input data are the historical measurements of smart meters, the flexible demand schedule and meteorological forecasts.
Complete description
The medium voltage load forecaster (PSAU.FC) will be developed in order to provide estimations of the load and micro generation production in the future. The secondary (MV and LV) and tertiary control algorithms will use this information. The PSAU.FC algorithm receives meteorological predictions up to the forecasting horizon, flexible demand scheduling and newly available measurements, recorded by the smart meters, which are stored in the PSAU.DXP.RDBMS. The PSAU.FC algorithm performs a regression of the input data on a model that has been trained with previous historical data. If the data from the PSAU.DXP.RDBMS holds missing values, the PSAU.FC algorithm will internally fill those with previous forecasts or load profiles for each specific type of client.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case

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3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
PSAU.DXP.RDBMS	function	Def. 2 Platform for exchanging data between different actors and functions. Actor in both Operation and Station zones	
PSAU.FC	function		

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed use case
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Medium Voltage Load Forecasting

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - Generate Short-Term and Long term MV Load Forecast					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	MVF algorithm collects historic load data.	Data storage	MVF algorithm receives the latest smart meter data, if any.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functions
2	MVF algorithm collects flexible demand schedule.	Data storage	MVF algorithm receives the flexible demand schedule, if	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functions

			any.			
3	MVF algorithm collects meteorological forecasts.	Data storage	MVF algorithm receives the meteorological forecasts, if any.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functions
4	MVF algorithm executes	Load forecast	MVF algorithm generates forecasts for the requested horizon.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions
5	MVF algoritm exports forecasting results	Data storage	MVF algorithm sends forecasted values to the DXP.	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS

Scenario						
Scenario Name:		No. 2- Error Management				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Re (Actor)**
1.1	Communication with DXP cannot be established	Detect error	MVF algorithm sends forecasted values to the DXP	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Fun
1.2	The MVF algorithm will fill, internally, those missing values in order to provide a Load forecast.	Data reconstruction	MVF algorithm sends forecasted values to the DXP	REPORT	SAU(PSAU).Functions	SAU(PSAU).Fun
1.3	LVF algorithm sends forecasted values to the DXP	Missing data	MVF algorithm can't collect meteorological data. The third party is not able to produce a meteorological forecast or there has been	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Fun

			a communication problem. The LF algorithm will produce a meteorological forecast and use it in order to provide a Load forecast.			

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
235		Low Voltage load/production Forecaster (LVF)

1.2 Version Management

Version Management
Based on 0.1 2014-12-10 Daniel Olmeda, Hortensia Amarís Updated: Fannar Thordarson (Dansk Energi), 2015-04-10

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the SSAU forecast is to forecast LV customer level load and micro-generation production 1-24 hours ahead and to provide a statistical measure for the forecast uncertainty.
Related business case(s)	

1.4 Narrative of Use Case

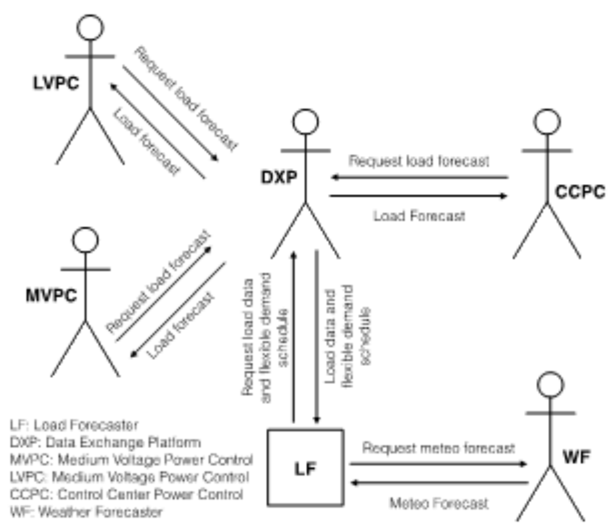
Narrative of Use Case
Short description
The low voltage load forecasting algorithms outputs estimated future load demands and micro generation production for the low voltage network. The input data are the historical measurements of smart meters, the flexible demand schedule and meteorological forecasts.
Complete description

The low voltage load forecaster (SSAU.FC) will be developed in order to provide estimations of the load and micro-generation production in the future. The secondary (MV and LV) and tertiary control algorithms will use this information. The SSAU.FC algorithm receives meteorological predictions up to the forecasting horizon, flexible demand scheduling and newly available measurements, recorded by the smart meters, which are stored in the SAU(SSAU).RDBMS. The SSAU.FC algorithm performs a regression of the input data on a model that has been trained with previous historical data. If the received data from the SAU(SSAU).RDBMS holds missing values, the SSAU.FC algorithm will internally fill those with previous forecasts or load profiles for each specific type of client.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		Group Description	
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
SAU(SSAU).Functions	function	Forecaster function	
SAU(SSAU).RDBMS	function	Database of secondary SAU	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions

Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed use case
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Low Voltage Load forecasting

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:		No. 1 - Generate Medium Term LV Load Forecast				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	DXP reports load data.	Data Storage	LVF algorithm requests the latest measurements from the smart meter from the DXP.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions

5	LVF algorithm collects flexible demand schedule.	Data Storage	LVF algorithm receives the flexible demand schedule, if any.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions
7	LVF algorithm collects meteorological forecasts.	Data Storage	LVF algorithm receives the meteorological forecast, if any.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions
8	LVF algorithm executes.	Load Forecast	LVF algorithm generates forecasts for the requested horizon.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions
9	LVF algorithm exports forecast results	Data Storage	LVF algorithm sends forecasted values to the DXP	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS

Scenario						
Scenario Name:	No. 2 - Generate Short Term LV Load Forecast					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
3	LVF algorithm collects historic load data.	Data Storage	LVF algorithm receives the latest smart meter data, if any.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions
5	LVF algorithm collects flexible demand schedule.	Data Storage	LVF algorithm receives the flexible demand schedule, if any.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions
7	LVF algorithm collects meteorological forecasts.	Data Storage	LVF algorithm receives the meteorological forecasts, if any.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions
8	LVF algorithm executes	Load Forecast	LVF algorithm generates forecasts for the requested horizon.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions
9	LVF algorithm exports forecasting	Data Storage	LVF algorithm sends forecasted	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS

	results		values to the DXP			

Scenario						
Scenario Name:		No. 3 - Error Management				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information R (Actor)
1.1	No communication with data exchange platform	Detect error	Communication with DXP cannot be established	REPORT	SAU(SSAU).Functions	SAU(SSAU).Fur
2	Recontruction of data	Data reconstruction	The LVF algorithm will fill, internally, those missing values in order to provide a load forecast.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Fur
1.2	Cannot collect forecast data	Detect error	LVF algorithm can't collect meteorological data. The third party is not able to produce a meteorological forecast or there has been a communication problem. The LF algorithm will produce a meteorological forecast and use it in order to provide a load forecast.	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Fur

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data
Demand data	Series of [powert, time, ID of the bus]	
Load data	Series of [Power, time, ID of the bus]	
Meteorological Forcast	for the area in which the load is located	

Error flag	Success or Failure	
short term load and production forecast	valid for the next 15-30 minutes	
long term load and production forecast	Valid for the next 24 hours	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
137		Medium Voltage Network State Forecasting (MVSF)

1.2 Version Management

Version Management
From V1.0 15.12.2014 Antti Mutanen 10.04.2015 - Edited by Fannar Thordarson: According to the updated version of the UC from Antti Mutanen (uploaded to the wiki-page, on the 2/4 2015)

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the PSAU.SF (formerly known as MVSF) is to obtain distributional forecasts for the MV network states. The available distributional load and production forecasts from the forecaster are used as inputs in calculation of state forecasts â€“ K time steps ahead.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The PSAU.SF provides forecasts for the states that are related to a specific MV network. The PSAU.SF will run once every 10 minutes after the PSAU.FC and deliver distributional properties for the pre-requested prediction horizon. The PSAU.SF algorithm utilizes the available secondary substation, MV customer, and distributed generation forecasts to provide distributional forecasts for the electric quantities of the MV network.
Complete description
A PSAU.SF algorithm is developed that can be utilized on-demand for generating forecasts for the

states in a medium voltage grid. A PSAU.SF calculation is done either in primary substation or in the control centre. The PSAU.SF is conditioned on the MV forecaster (PSAU.FC), since the needed predictions for secondary substation load, MV customer load, and distributed generation are acquired from the forecaster. These required input forecasts, corresponding to the K steps ahead, are retrieved from the Data eXchange Platform (PSAU.DXP.RDBMS). By accounting for the distributional properties of the predicted loads and productions, corresponding forecasts can be obtained for the medium voltage network states; node voltages, line current flows and node injections for all three phases. Hence, the PSAU.FC and the PSAU.SF are both required for generating forecasts for the medium voltage network, where the communication is through the PSAU.DXP.RDBMS. Estimated computing time will be several minutes.

The PSAU.SF procedure can be divided into three basic steps. First the state forecaster reads the scheduled MV network topology and configuration (for the upcoming K time steps ahead) from the PSAU.DXP.RDBMS. Then the forecasts for the network's secondary substation, MV customer loads and distributed generators are retrieved from the PSAU.DXP.RDBMS. Since the PSAU.FC is based on filtered data the input data to the PSAU.SF doesn't need filtering. Finally, the MV network state forecasts are generated by using data from these earlier steps. The output states are; node voltages, line current flows and node injections for all three phases. The results from the PSAU.SF are stored in the PSAU.DXP.RDBMS, available for other functions that request the specific state forecasts on the medium voltage network.

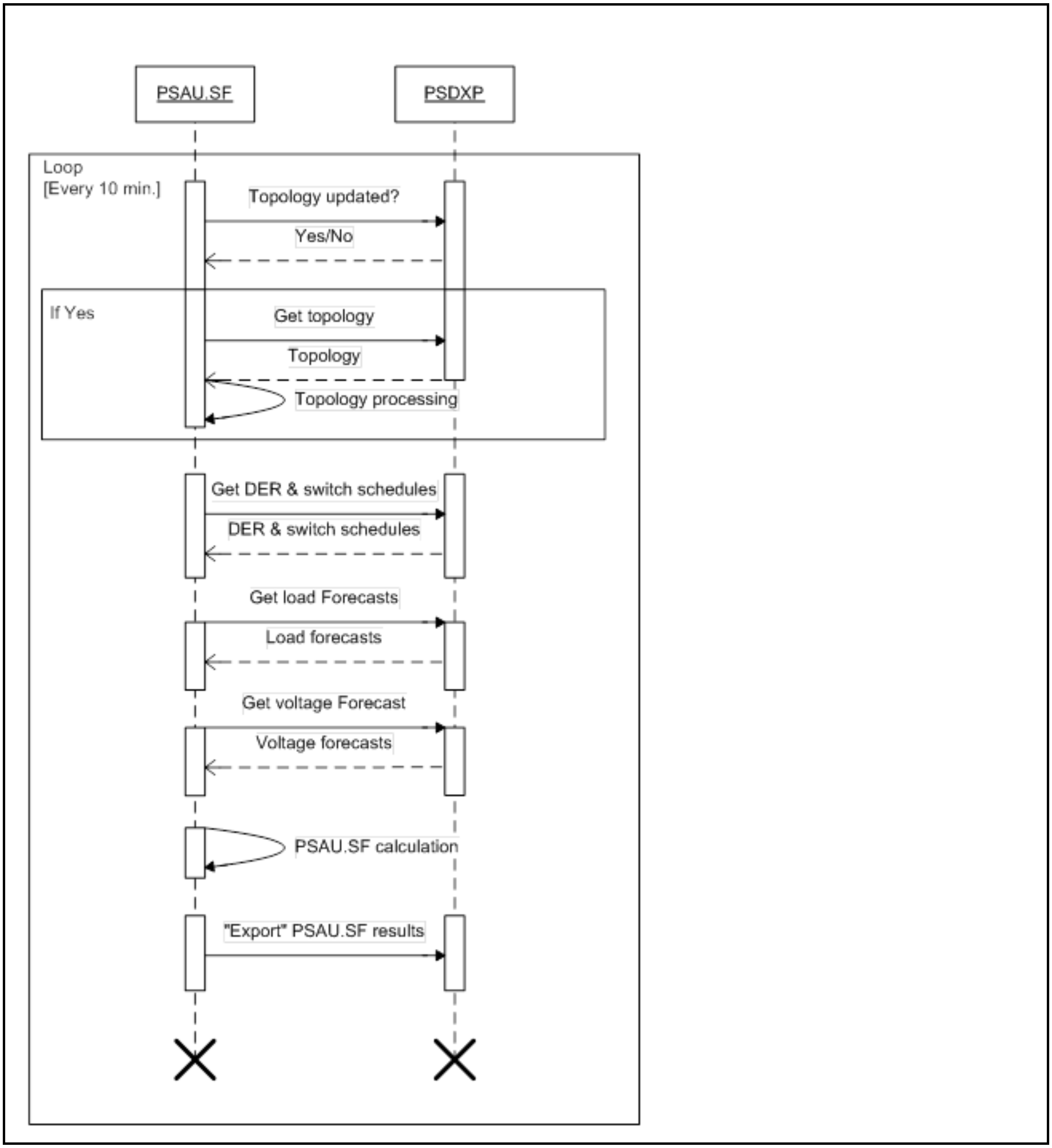
1.5 General Remarks

General Remarks

1. ***Basic Information to Use Case***

Source(s) / Literature	*Link*	*Conditions (limitations) of Use*
Design Specification: Medium Voltage network State Estimator (MVSE) ß Medium Voltage network State Forecaster (MVSF)	https://wiki.tut.fi/pub/IDE4L/ DesignSpecification/ DesignSpecification_WP_5_1_MVSE_final.docx	Internal (IDE4L)

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information**

			specific to this Use Case
SAU(PSAU).RDBMS	function	Def. 2 Platform for exchanging data between different actors and functions. Actor in both Operation and Station zones	
SAU(PSAU).Functions	function	State forecast of PSAU	
SAU(SSAU).MMS	function	MMS interface	
SAU(PSAU).MMS	function	MMS interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed Use Case
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
State Forecasting, Distribution Network

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	**Scenario**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**

	Name				

4.2 Steps - Scenarios

Scenario						
Scenario Name:		No. 1 - Medium voltage state forecast				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receive (Actor)
1	Grid data (topology and parameters) import	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Function
3	DER and switch schedule import	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Function
4	Get Load forecasts. Load and production forecasts are requested from the secondary substation	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Function

	database.		topology information from the SSAU.DXP.RDBMS.			
5	LV network connection point voltage forecast is requested from SSAU	Data acquisition	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(SSAU).MMS	SAU(PSAU).MMS
6	LV network connection point voltage forecast is requested from MV DXP.	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(PSAU).MMS	SAU(SSAU).MMS
7	LVSF calculation	State forecast	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(PSAU).Functions	SAU(PSAU).Function

8	The MVSF results are exported to SSAU	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU. RDBMS.	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS
9	The MVSF results are exported to MV DXP.	Data Report	Note, only aggregated results are exported to the MV DXP.	REPORT	SAU(PSAU).RDBMS	SAU(SSAU).MMS
10	The MVSF results are exported to MV DXP.	Data Report	Note, only aggregated results are exported to the MV DXP.	REPORT	SAU(PSAU).MMS	SAU(SSAU).MMS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
DER and switch schedules		
Voltage forecast		
State forecasting result	line currents, node voltages, line power flow, estimated load and productions etc.	
Static Grid Data	Included: - Line parameters (R, X, B, G) - Line connections - Location of swithes, breakers and fuses - Transformer parameters	
short term load and production forecast	valid for the next 15-30 minutes	
long term load and production forecast	Valid for the next 24 hours	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
136		Low Voltage Network State Forecasting (LVSF)

1.2 Version Management

Version Management
From V1.0 15.12.2014 Antti Mutanen Added scenario step 9. 10.04.2015 - Edited by Fannar Thordarson: according to the updated UC from Antti Mutanen (uploaded to the wiki-page, on the 2/4 2015).

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the SSAU.SF (formerly known as LVSF) is to obtain distributional forecasts for the LV network states. The available distributional load and production forecasts from the forecaster are used as inputs in calculation of state forecasts â€“ K time steps ahead.
Related business case(s)	

1.4 Narrative of Use Case

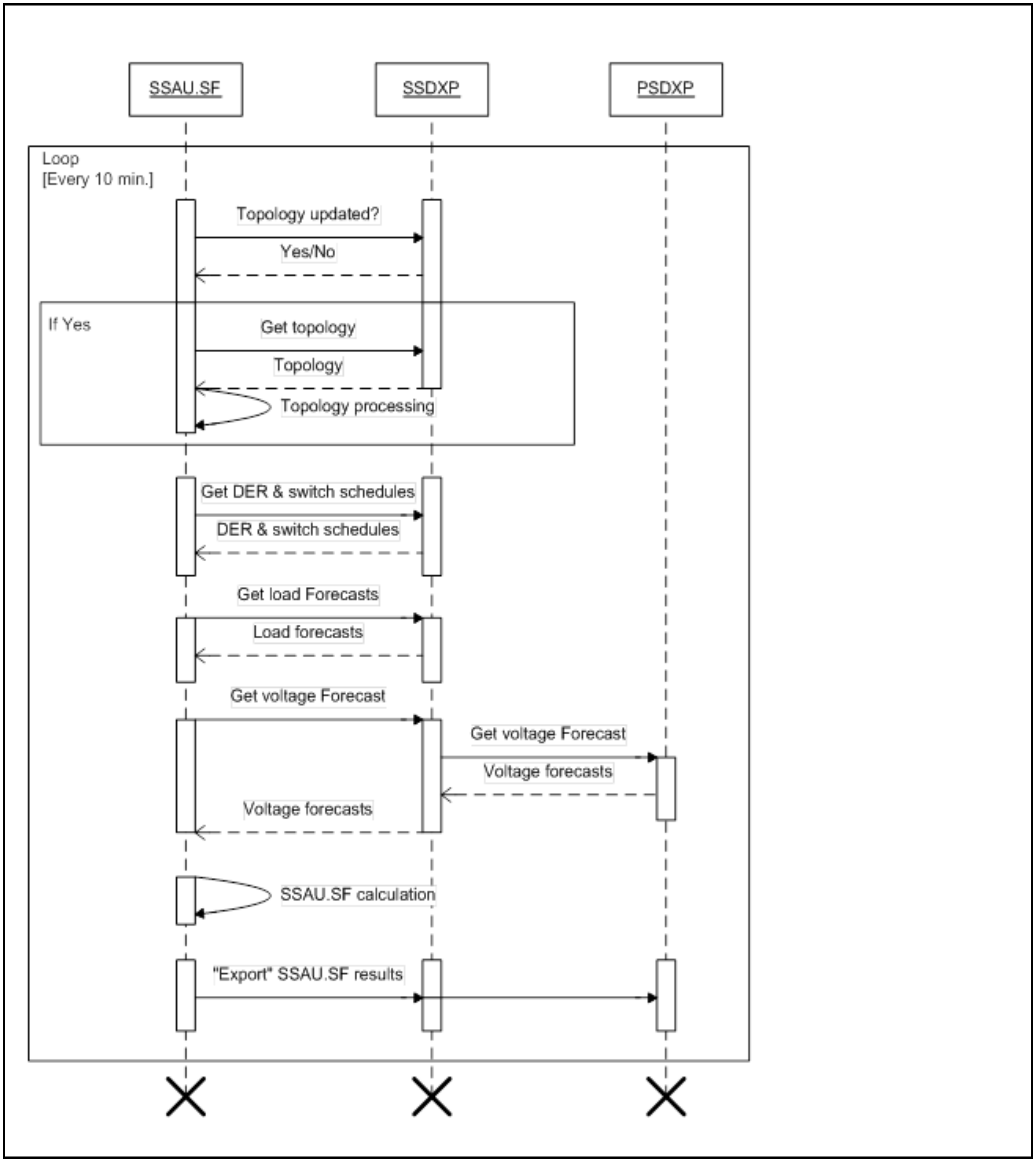
Narrative of Use Case
Short description
SSAU.SF provides forecasts for the states that are related to the specific secondary substation on a low voltage network. The SSAU.SF will run onec every 10 minutes after the SSAU.FC and deliver distributional properties for the pre-requested prediction horizon. The SSAU.SF algorithm utilizes the available customer load forecasts and micro-production forecasts to provide distributional forecasts for the electric quantities of the LV states.
Complete description
A SSAU.SF algorithm is developed that can be utilized on-demand for generating forecasts for the states in a low voltage grid. SSAU.SF calculation is done in a decentralized manner where the SSAU.SF algorithm is run in an intelligent device located in the secondary substation. The SSAU.SF is conditioned on the LV forecasts (SSAU.FC), since the delivered predictions for customer load and micro-production, acquired from the forecaster, are required for providing the LV state forecasts. These required input forecasts, corresponding to the K steps ahead, are retrieved from the Data eXchange Platform (SAU(SSAU).RDBMS). By accounting for the distributional properties of the predicted

customer load and the micro-production forecasts, corresponding forecasts can be obtained for the low voltage network states; node voltages, line current flows and line power flows for all three phases. Hence, the SSAU.FC and the SSAU.SF are both required for generating forecasts for the low voltage network, where the communication is through the SAU(SSAU).RDBMS. Estimated computing time will be several minutes. The SSAU.SF procedure can be divided into three basic steps. First are the state forecaster reads the scheduled LV network topology and configuration (for the upcoming K time steps ahead) from the SAU(SSAU).RDBMS. Then the forecasts for the network's customer loads and micro-productions are retrieved from the SSAU.DXPRDBMS. Since the SSAU.FC is based on filtered data the input data to the SSAU.SF doesn't need filtering. Finally, the LV network state forecasts are generated by using data from earlier steps. The output states are; node voltages, line current flows and node injections for all three phases. The results from the SSAU.SF are stored in the SAU(SSAU).RDBMS, available for other functions that request the specific state forecasts on the low voltage network.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		Group Description	
Actor Name	Actor Type	Actor Description	Further

			information specific to this Use Case
SAU(SSAU).Functions	function	State forecast function	
SAU(SSAU).RDBMS	function	Def. 2 Platform for exchanging data between different actors and functions. Actor in both Operation and Station zones	
SAU(PSAU).RDBMS	function	Def. 2 Platform for exchanging data between different actors and functions. Actor in both Operation and Station zones	
SAU(PSAU).MMS	function	MMS Interface	
SAU(SSAU).MMS	function	MMS Interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed Use Case
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification

State Forecasting, Distribution Network

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 – SSAU state forecast Started					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receive (Actor)
1	Grid data (topology and parameters) import	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Function
4	DER and switch schedule import	Data storage	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Function
5	Get Load forecasts.	Data storage	If grid data information has	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Function

	Load and production forecasts are requested from the secondary substation database.		not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.			
6	MV network connection point voltage forecast is requested from PSAU	Data acquisition	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(PSAU).MMS	SAU(SSAU).MMS
7	MV network connection point voltage forecast is requested from MV DXP.	Data acquisition	If grid data information has not been imported before or if topology information has changed the network topology import function requests network topology information from the SSAU.DXP.RDBMS.	REPORT	SAU(PSAU).MMS	SAU(SSAU).MMS
8	LVSF calculation	State forecast	If grid data information has not been imported before or if topology information has changed the	REPORT	SAU(SSAU).Functions	SAU(SSAU).Functions

			network topology import function requests network topology information from the SSAU.DXP.RDBMS.			
9	The LVSF results are exported to MV DXP.	Data storage	Note, only aggregated results are exported to the MV DXP.	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS
10	The LVSF results are exported to MV DXP.	Data Report	Note, only aggregated results are exported to the MV DXP.	REPORT	SAU(SSAU).MMS	SAU(PSAU).MMS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
State forcasting result	node voltages, line currents, aggregated production etc.	
MV connection point Voltage forecast		
DER and switch schedules		
Static Grid Data	Included: - Line parameters (R, X, B, G) - Line connections - Location of swithes, breakers and fuses - Transformer parameters	
short term load and production forecast	valid for the next 15-30 minutes	
long term load and production forecast	Valid for the next 24 hours	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
139		Network Description Update (NDU)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The use case consists in updating the network description (topology, assets, customers) of the RDBMS â€“ located in substations â€“ when a change is performed in the Distribution Management System (DMS) â€“ located in the Control Center.
Objective(s)	This information is needed to perform correctly algorithms (State Estimation, State Forecasting, Optimal Power Flow, â€¦) and control actions in order to increase the network reliability and performance.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
This update process maintains aligned: • the description of the network topology • the list of assets and their parameters • the list of customers and some relevant information among the main database of the DMS – located in the utility Control Center – and the distributed database of RDBMS in the Primary and Secondary Substations every time a network change is performed in the DMS or a customer change is performed in the CIS.
Complete description
The DMS needs a subset of the whole information, in order to locally execute algorithms such as the State Estimation or the Optimal Power Flow. The same data are needed in primary and secondary substation – within the RDBMS – to allow a local execution of those algorithms. This distribution and replication of the information among different subsystems requires update processes every time a change is performed, and it has to be completed roughly in less than one minute in order to keep updated every node. One of the following changings have to trigger an update of the network description: • a new part of the grid is added/changed

- a new customer/generation is added/changed[1] on the grid

The first one is activated by DMS which manages, interacting with Asset Manager in the Enterprise level, extensions or modifications of the grid. Instead the second trigger is activated by Customer Information System which notifies possible customer/generation to the DMS. So that this first step identifies two different functions:

- **Customer change**: a customer/generation contract change is performed through CIS in the Enterprise level than a notification is sent to the DMS through an Enterprise Service Bus (this notification architecture is not in the project scope)
- **Grid change**: DMS, using information from AMS, manages and performs extensions and modifications of the grid.

In both cases, customer or grid change, if the change is referred to a section of the LV grid or a customer/production connected on it, the update involves the secondary substation fe eding the section/customer/production.If the change is referred to a section of the MV grid or a customer/production connected on it, the update involves:

- the primary substation feeding the section/customer/production in the standard grid configuration
- the other primary substations that could feed the element when a non-standard configuration is applied (e.g. after a fault occurs)

When one of the two trigger conditions is notified to the DMS the **Network Description Update** function is performed. DMS sends a description packet related to the updated grid part to the substation automation unit, which parses the information and updates its internal grid description.

In order to limit efforts in integration and to provide an easily-exploitable solution, the use case must leverage on standard protocols such as the Common Information Model (CIM).

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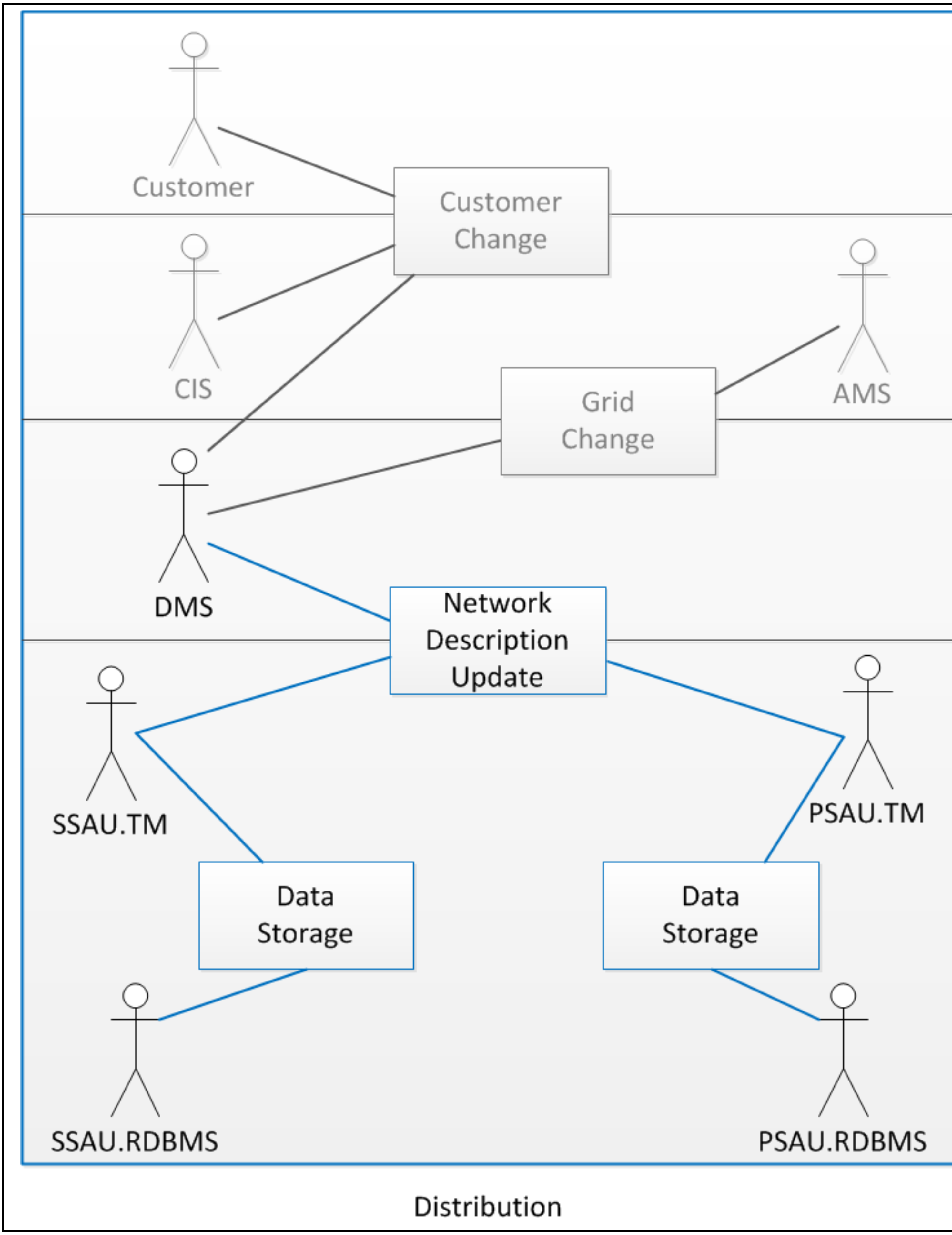
[1] customer/production change means for instance: the change of the contractual power; enable/disable the customer's contract; …

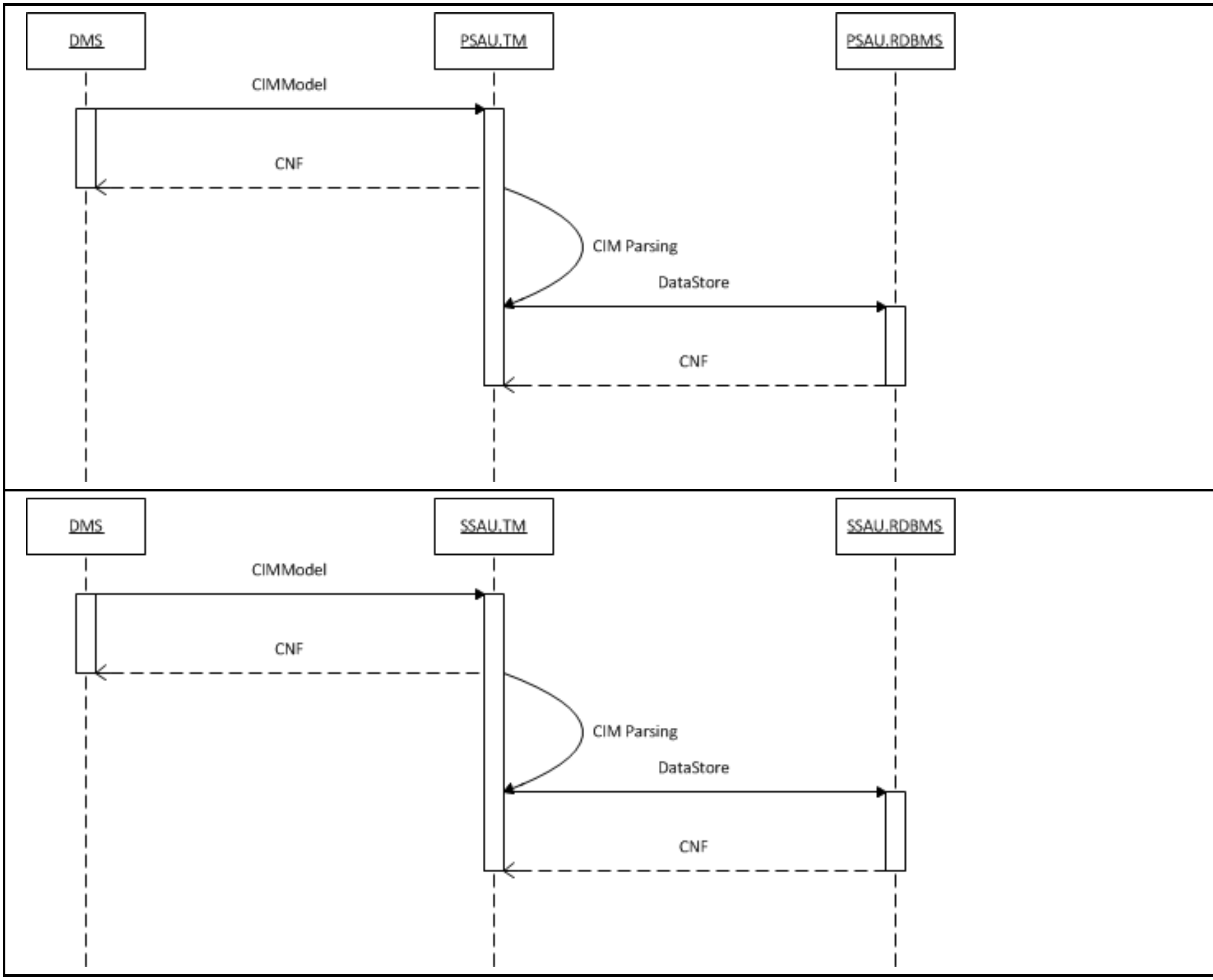
1.5 General Remarks

General Remarks

2 Diagrams of Use Case



Customer
Customer Change
CIS
AMS
Grid Change
DMS
Network Description Update
SSAU.TM
PSAU.TM
Data Storage
Data Storage
SSAU.RDBMS
PSAU.RDBMS
Distribution



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.MMS	function	MMS interface	
SAU(SSAU).RDBMS	function	Secondary Substation Automation Unit Relational Database Management System	

		It represents the database and the related management system which compose the Secondary Substation Automation Unit storage system	
SAU(PSAU).RDBMS	function	Primary Substation Automation Unit Relational Database Management System It represents the database and the related management system which compose the Primary Substation Automation Unit storage system	
SAU(SSAU).Functions	function	It represents the topology manager functionality implemented in the Secondary Substation Automation Unit	
SAU(PSAU).Functions	function	It represents the topology manager functionality implemented in the Primary Substation Automation Unit	
SAU(SSAU).MMS		MMS Interface	
SAU(PSAU).MMS		MMS Interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Primary Use Case
Priorisation
??
Generic, Regional or National Relation
European
Viewpoint
Technical
Further Keyword for Classification

Network Model

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - MV Network Update					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	
1	Change (topology and parameters) in MV Network	Grid change	DMS sends the new MV network CIM model to the PSAU.TM	REPORT	DMS.MMS	SAU(SSAU).MMS	
2	CIM model received	CIM Parsing	PSAU.TM parses the received CIM model	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functions	
3	CIM model parsed	Data Storage	PSAU.TM stores the new network model in the PSAU.RDBMS	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	

Scenario							
Scenario Name:		No. 2 - LV Network Update					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	
1	Change (both topology and parameters) in LV Network	Grid change	DMS sends the new LV network CIM model to the SSAU.TM	REPORT	DMS.MMS	SAU(PSAU).MMS	
2	CIM model received	CIM Parsing	SSAU.TM parses the received CIM model	EXECUTE	SAU(SSAU).RDBMS	SAU(SSAU).Functions	

3	CIM model parsed	Data Storage	SSAU.TM stores the new network model in the SSAU.RDBMS	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS

Scenario						
Scenario Name:	No. 3 - Customer/DER update					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information R (Actor)**
1	Customer/DER change	Customer/DER change	Customer/DER change	REPORT	DMS.MMS	SAU(SSAU).MN SAU(PSAU).MN
2	Parsing of CIM table (primary substation)	CIM parsing	Parsing of CIM table (primary substation)	EXECUTE	SAU(PSAU).RDBMS SAU(SSAU).RDBMS	SAU(PSAU).Fur SAU(SSAU).Fur
3	New customer/DER info storage (primary substation)	Data Storage	New customer/DER info storage (primary substation)	REPORT	SAU(PSAU).Functions	SAU(PSAU).RD
4	New customer/Der info storage (Secondary substation)	Data Storage	New customer/Der info storage (Secondary substation)	REPORT	SAU(SSAU).Functions	SAU(SSAU).RD

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
CIM Network Model	LV and/or MV Network (or piece of network) modelled with CIM XML	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
140		Protection Configuration Update (PCU)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The use case consists in updating the configuration file of protection devices when a change is done in the network configuration (status of breakers and disconnectors).
Objective(s)	This information is needed to perform correctly the FLISR algorithms on MV â€“ for each network configuration â€“ in order to further increase the network reliability and the service continuity (i.e. SAIDI, SAIFI, â€¦).
Related business case(s)	

1.4 Narrative of Use Case

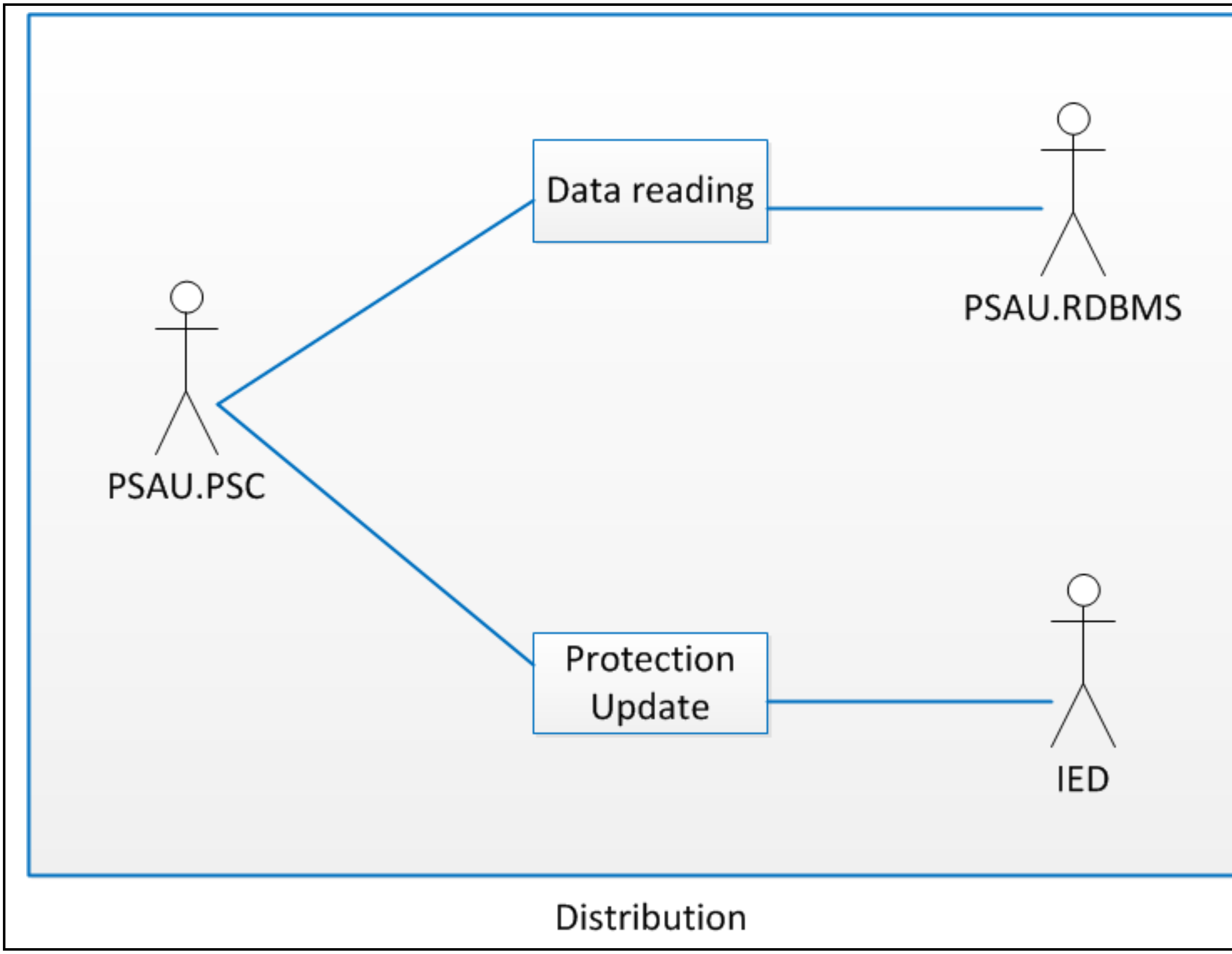
Narrative of Use Case
Short description
The use case consists in updating the configuration file of protection devices when a change is done in the network configuration (status of breakers and disconnectors). The changes has to be reflected in the setting of protection functions and in the coordination between protection devices used by the FLISR use case.
Complete description
The update process takes place only when a change is performed in the network configuration (status of breakers and disconnectors) and it has to be completed roughly in less than one minute. This update includes: • changing in settings such as maximum current threshold, voltage/frequency bands, trip delays • changing in the logic selectivity rules (publish/subscribe relations) Protection devices configurations are updated by the Primary Substation Unit (PSAU) after it detects a change in the downstream network configuration (MV network real time monitoring Use Case). The PSAU reads the actual status of the network in the local data storage system. The involved functions are: • **Data reading**: PSAU reads the current network configuration from the local database that it has been written by MV real time monitoring. • **Protection update**: when PSAU detects a network configuration update it starts the update process sending the new parameters values to the protection devices. Devices that receive the update request parse it and write their new parameters values according with the PSAU notification.

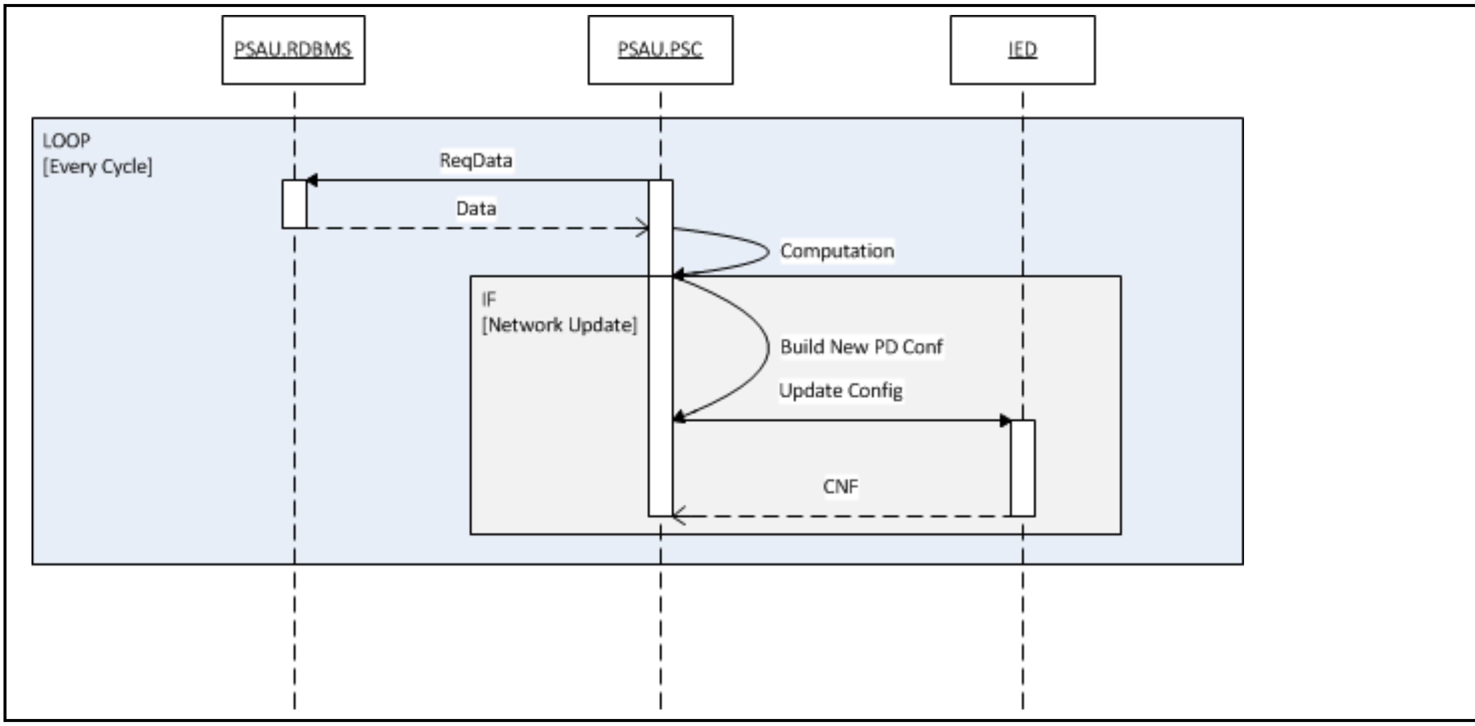
In order to limit efforts in integration and to provide an easily-exploitable solution the use case must leverage on standard protocols such as the IEC61850 Substation Configuration Language (SCL) for the description of the automation system and the IEC61850-MMS for the updates of the configuration files/values.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case





3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(PSAU).RDBMS	function	Primary Substation Automation Unit Relational Database Management System It represents the database and the related management system which compose the Primary Substation Automation Unit storage system	
IED(PSIED).MMS	function	Intelligent Electronic Device (IED), protection devices Def. 2 Any other Intelligent Electronic Device (IED) not included in the list. IEDs are devices incorporating one or more processors with the capability to receive or send data/control from or to an external source (e.g., electronic multifunction meters, digital relays, controllers). Similar devices: Power Quality Meter	

		(PQM), and Remote Terminal Unit (RTU). Actor in Field zone	
SAU(PSAU).Functions	function	Primary Substation Automation Unit Protection System Configurator (PSAU.PSC) It represents the protection system configuration functionalities which are implemented in the Primary Substation Automation Unit	
SAU(PSAU).MMS	function	MMS Interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Decentralized FLISR;
Level of Depth
Primary Use Case
Priorisation
??
Generic, Regional or National Relation
European
Viewpoint
Technical
Further Keyword for Classification
Protection System, FLISR

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	**Scenario**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**

	Name				

4.2 Steps - Scenarios

Scenario						
Scenario Name:		No. 1 - Protection Device Update [normal]				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	Periodically	Data storage	PSAU.PSC reads network configuration from PSAU.RDBMS	GET	SAU(PSAU).RDBMS	SAU(PSAU).Functions
2	Network configuration updated	Protection update	PSAU.PSC retrieved a new network configuration from PSAU.RDBMS, PSAU.PSC builds a new PD configuration and it sends, using IEC61850 MMS and SCL file transfer, new configuration to the involved IEDs	EXECUTE	SAU(PSAU).MMS	IED(PSIED).MMS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data
MV Network configuration	Dynamic network configuration for MV grid (breakers/disconnectors status)	
Protection Device Configuration	Configuration and settings of a protection device (current/voltage threshold, time, etc.)	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
255		Control Centre Power Control (CCPC): Offline Operation

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The CCPC is part of a more general scheme called â€œCongestion Managementâ€• . Offline operation of the CCPC tries to solve MV network congestions for the Day-Ahead right after the market clearing.
Objective(s)	The objective of the CCPC is to solve MV congestions for Day-ahead (or hours-ahead) by means of distribution asset resources or by network reconfiguration and market based methods.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The primary objective of the CCPC during offline operation is to define and develop functions for the congestion management of MV distribution network for the next hours (day-ahead market or intraday market timeframe). These functions are implemented on control centre level to manage MV networks by means of: • Network related measures, in particular through network circuit reconfiguration and changes of the setting values of voltage controllers in the MV network and reactive power units. • Market related measures to propose changes of scheduled generation/consumption values of DER units, through flexibility products to provide a feasible combination of schedules. These functionalities can be obtained by means of two different algorithms: Network reconfiguration and Market Agent algorithms.
Complete description
Congestions appearing in the distribution grid (MV level) after the market clearing should be solved first through the distribution asset resources or by network reconfiguration. If these actions are insufficient to solve the congestions, or are not practicable, then the purchase of flexibility products from Commercial Aggregators (CAs) is evaluated through the Market Agent tool. The main program running the CCPC algorithm during offline operation can be divided into the following steps: 1) Initialization: Schedule fixed time period (i.e.: 24h). The offline validation algorithm is run for timeslots of one hour

independently.

2) Check MV grid constraints: Run power flow to check the technical validation of the schedule coming from the market clearing program.

3) Validate input data: Validate if the initial schedule coming from the market clearing program does not produce any congestion at MV network. Outputs are sent to the CCDXP and CA.

4) Send request message to NR: in case of congestion problems the tertiary controller manager will send a request message to the NR to execute the network reconfiguration algorithm.

5) Receive message from NR: Tertiary controller manager will receive a message from NR as soon as the Network reconfiguration algorithm has finished.

6) Validate Network Reconfiguration outputs: Outputs are sent to the CCDXP and MV IEDs.

7) In case of congestion problems, Run Market Agent: Execute Market Agent algorithm .

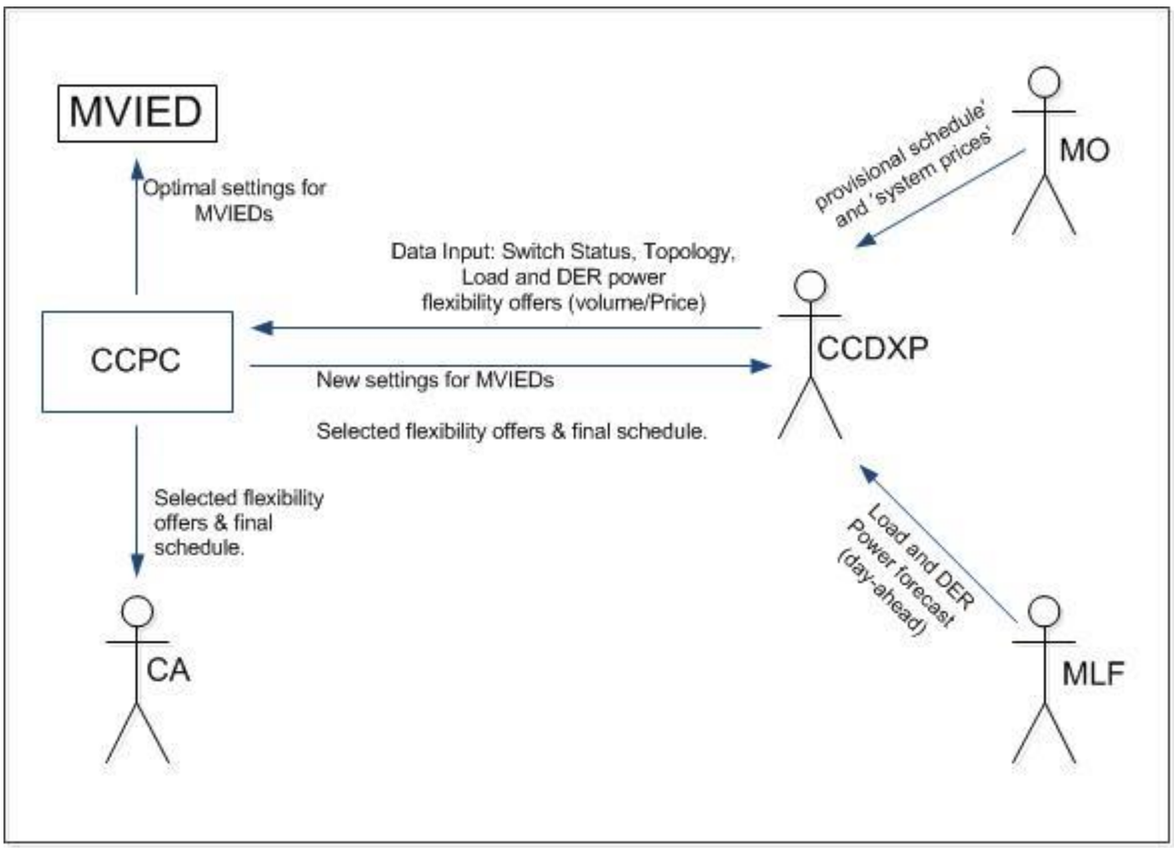
8) Validate Market Agent outputs: Outputs are sent to the CCDXP and CAs.

9) Finish Tertiary controller execution.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



MLF: Medium-term Load and Production Forecast
CCDXP: Control Center Data Exchange Platform
CCPC: Control Center Power Control (or the tertiary controller)
CA: Commercial Aggregator
MVIED: Medium Voltage IED
MO: Market Operator

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.MMS	function	Data exchange platform of DMS MMS client server interface	
DMS.WS	function	DXP of DMS for webservices	
DMS.functions	function	Power control functions	
DMS.functions	function	DMS Network reconfiguration	
DMS.RDBMS	function	Database of DMS	
SAU(PSAU).MMS	function	MMS interface	
IED(PSIED).MMS	function	MMS interface	
CA.WS	function	Commercial aggregator offers services to aggregate energy production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand Response management) and supply (generation management). In cases where the aggregator is not a supplier, it maintains a contract with the supplier.	
DMS.functions	function	Distribution System Operator - Technical Aggregator (DSO. Technical aggregator) according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:		No. 1 - Normal Sequence				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	CCPC asks CC DXP if data has been updated	Check flag	CCPC asks CC DXP if data has been updated	EXECUTE	DMS.functions	DMS.RDBMS
2	CC DXP confirms whether data has been updated	Check flag	CC DXP confirms whether data has been updated	REPORT	DMS.RDBMS	DMS.functions

3	Read updated topology and parameters from CC DXP	Data storage	Read updated topology and parameters from CC DXP	EXECUTE	DMS.RDBMS	DMS.functions
4	Read MV Load demand (active/reactive) forecast (24h day ahead), MV production forecast (24h day ahead)	Data storage	Read MV Load demand (active/reactive) forecast (24h day ahead), MV production forecast (24h day ahead)	EXECUTE	DMS.RDBMS	DMS.functions
5	CCPC takes the information relative to the available flexibility in the MV grid and its price (SRPs)	Data storage	CCPC takes the information relative to the available flexibility in the MV grid and its price (SRPs)	EXECUTE	DMS.RDBMS	DMS.functions
6	Run power flow to check the feasibility of Provisional schedule (hourly based) after the market clearing	Power flow	Run power flow to check the feasibility of Provisional schedule (hourly based) after the market clearing	EXECUTE	DMS.functions	DMS.functions
7	CCPC sends its outputs into CCDXP	Data storage	CCPC sends its outputs into CCDXP	EXECUTE	DMS.functions	DMS.RDBMS
8	Medium voltage network reconfiguration UC. In case of congestion problems, CCPC request the execution of the NR algorithm Calculate the optimal network configuration and/or voltage control set-points to	Medium voltage network reconfiguration UC	Medium voltage network reconfiguration UC. In case of congestion problems, CCPC request the execution of the NR algorithm Calculate the optimal network configuration and/or voltage control set-points to	EXECUTE	DMS.functions	DMS.RDBMS

9	alleviate MV congestion problems		alleviate MV congestion problems			
9	CCPC sends open/close commands to the modified IEDs controlling the switches	Reading/Writing IEDs setting	CCPC sends open/close commands to the modified IEDs controlling the switches	REPORT	DMS.MMS	SAU(PSAU).MMS
10	MVIEDs confirm the new settings to the CCPC	Check flag	MVIEDs confirm the new settings to the CCPC	REPORT	IED(PSIED).MMS	SAU(PSAU).MMS DMS.MMS
11	Run power flow to check the feasibility of Provisional schedule (hourly based) after the market clearing	Power flow	Run power flow to check the feasibility of Provisional schedule (hourly based) after the market clearing	EXECUTE	DMS.functions	DMS.functions
12	CCPC sends its outputs into CCDXP if there are not MV congestion problems. Otherwise the exectution of the market agent algorithm is required	Data storage	CCPC sends its outputs into CCDXP if there are not MV congestion problems. Otherwise the exectution of the market agent algorithm is required	REPORT	DMS.functions	DMS.RDBMS
13	CCPC sends its outputs into CCDXP if there are not MV congestion problems. Otherwise the exectution of the market agent algorithm is required	Data storage	CCPC sends its outputs into CCDXP if there are not MV congestion problems. Otherwise the exectution of the market agent algorithm is required	REPORT	DMS.functions	DMS.RDBMS
14	Off line validation UC	Off line validation UC	Off line validation UC	EXECUTE	DMS.RDBMS	DMS.functions

15	CCPC runs the OPF to select the optimal flexibility offer solving the congestion	Optimal power flow	CCPC runs the OPF to select the optimal flexibility offer solving the congestion	EXECUTE	DMS.functions	DMS.functions
16	MA results are exported to CC DXP	Data storage	MA results are exported to CC DXP	REPORT	DMS.functions	DMS.RDBMS
17	Send commands to CAs. Communicate MA results (accepted flexibility offer and final schedule) to Commercial aggregators, including load shedding if needed.	CRP activation UC	Send commands to CAs. Communicate MA results (accepted flexibility offer and final schedule) to Commercial aggregators, including load shedding if needed.	REPORT	DMS.WS	CA.WS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Activation flag		
Is data updated-Reply		
Is data updated-Request		
Static Grid Data	Data exchanged: - Line parameters (R, X, B, G) - Line connections - Location of swithes, breakers and fuses - Transformer parameters	
State Estimation results	node voltages, line currents etc.	
Bid for SRP		

long term load and production forecast	Valid for the next 24 hours	
OPF result	optimal power flow calculation	
Power flow validation results		
Switch State Schedule		
Setting Values of IEDs		
Bid Acceptance or Modification	In case the bids can not be validated, due to network constraints violation, a modification is requested, else they are accepted. It contains a curtailment factor. So that the commercial aggregator can apply that CRP with a certain Delta P	
Power schedule	Provisional schedule. Planned schedules Power + time (positive or negative)	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
254		Control Centre Power Control (CCPC): Real Time Operation

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The CCPC is part of a more general scheme called â€œCongestion Managementâ€• . The CCPC working on real time tries to solve MV network congestions which appear during real time operation which corresponds to post-fault situations and MVPC request.
Objective(s)	The objective of the CCPC is to solve MV congestions for the next hour by means of distribution asset resources or by network reconfiguration and market based methods.

Related business case(s)	

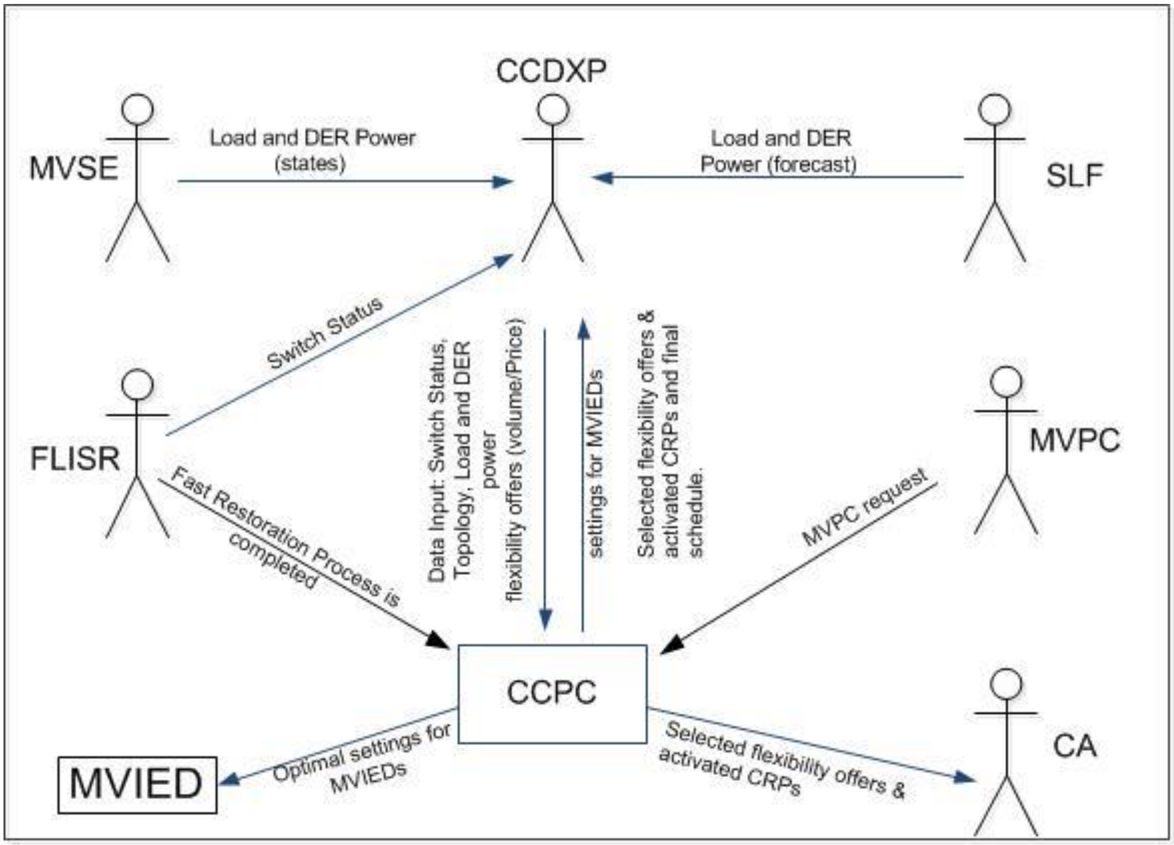
1.4 Narrative of Use Case

Narrative of Use Case
Short description
The primary objective of the CCPC working on real time is to define and develop functions for the congestion management of MV distribution network. These functions are implemented on control centre level to manage MV networks by means of: • Network related measures, in particular through network circuit reconfiguration and changes of the setting values of voltage controllers in the MV network and reactive power units. • Market related measures to propose changes of scheduled generation/consumption values of DER units, through flexibility products to provide a feasible combination of schedules. These functionalities can be obtained by means of two different algorithms: Network Reconfiguration and Market Agent algorithms.
Complete description
Congestions appearing in the distribution grid (MV level) during real time operation (e.g.: Post-fault situations and MVPC requests) should be solved first through the DSO distribution asset resources or by network reconfiguration. If these actions are insufficient to solve the congestions, or are not practicable, then the purchase of flexibility products from Commercial Aggregators (CAs) is evaluated through the Market Agent tool. The main program running the CCPC algorithm on real time can be divided into the following steps: 1. Initialization: “Fast Restoration Complete” signal/message or request message from MVPC is received. 2. Check MV grid constraints: Run power flow to check the feasibility of the switches status once the Fast Restoration Process is completed. 3. Validate inputs data: Validate if the initial switches status received from WP4 (after the FLISR process) do not produce any congestion at MV network. Outputs are sent to the CCDXP and MV IEDs. 4. Send request message to NR: in case of congestion problems the tertiary controller manager will send a request message to the NR to execute the network reconfiguration algorithm. 5. Receive message from NR: Tertiary controller manager will receive a message from NR as soon as the Network reconfiguration algorithm has finished. The message from NR can be: “Modified switches status” if the congestion problem has been solved by the network reconfiguration algorithm or “Finished” if NR is not capable to find out a solution by network reconfiguration. 6. Validate Network Reconfiguration outputs: Outputs are sent to the CCDXP and MV IEDs. 7. Run Market Agent: Execute Market Agent algorithm if NR message is “Finished”. 8. Validate Market Agent outputs: Outputs are sent to the CCDXP and CAs. 9. Finish Tertiary controller execution.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



SLF: Short-term Load and Production Forecast
CCDXP: Control Center Data Exchange Platform
FLISR: Fault Location Isolation and Service Restoration
MVPC: Medium Voltage Power Control
MVSE: Medium Voltage State Estimator
CCPC: Control Center Power Control (or the tertiary controller)
CA: Commercial Aggregator
MVIED: Medium Voltage IED
CRP: Conditional Re-Profiling flexibility service
SRP: Scheduled Re-Profiling flexibility service

3 Technical Details

3.1 Actors

Actors			
Grouping		Group Description	
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
DMS.functions	function	DMS Power control	
CA.WS	function	offers services to aggregate energy	

		production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand Response management) and supply (generation management). In cases where the aggregator is not a supplier, it maintains a contract with the supplier.	
SAU(PSAU).MMS	function	MMS Interface	
DMS.RDBMS	function	Database of DMS	
DMS.functions	function	Distribution System Operator - Technical Aggregator (DSO. Technical aggregator) according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.	
IED(PSIED).MMS	function	IED MMS interface	
DMS.functions	function	DMS Network reconfiguration	
DMS.WS	function	DXP of DMS for webservices	
MOP	function	The unique power exchange of trades for the actual delivery of energy that receives the bids from the Balance Responsible Parties that have a contract to bid. The market operator determines the market energy price for the market balance area after applying technical constraints from the system operator. It may also establish the price for the reconciliation within a metering grid area.	
DMS.MMS	function	Data exchange platform of DMS MMS client server interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - Normal Sequence					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information
1	Activation CCPC due to Post fault situations (Fast Restoration Process is completed) or MVPC signal request	Check flag	Activation CCPC due to Post fault situations (Fast Restoration Process is completed) or MVPC signal request	REPORT	DMS.RDBMS	DMS.functior
2	CCPC asks CC DXP if data has been	Check flag	CCPC asks CC DXP if data has been	REPORT	DMS.functions	DMS.RDBMS

	updated		updated			
3	CC DXP confirms whether data has been updated	Check flag	CC DXP confirms whether data has been updated	REPORT	DMS.RDBMS	DMS.functior
4	Import grid data.Read updated grid data (topology and parameters) from CC DXP	Data storage	Import grid data.Read updated grid data (topology and parameters) from CC DXP	REPORT	DMS.RDBMS	DMS.functior
5	Get Load demand and power Production states. Read Active and Reactive power (state estimator) for all MV nodes, MV/LV aggregated substation load demand (active/reactive)	Data storage	Get Load demand and power Production states. Read Active and Reactive power (state estimator) for all MV nodes, MV/LV aggregated substation load demand (active/reactive)	REPORT	DMS.RDBMS	DMS.functior
6	Get Load demand and power Production forecast. Read MV Load demand (active/reactive) forecast (k steps ahead), MV production forecast (k-steps ahead)	Data storage	Get Load demand and power Production forecast. Read MV Load demand (active/reactive) forecast (k steps ahead), MV production forecast (k-steps ahead)	REPORT	DMS.RDBMS	DMS.functior
7	Read flexibility offers (SRPs) and activation parameters of CRPs	Data storage	Read flexibility offers (SRPs) and activation parameters of CRPs	REPORT	DMS.RDBMS	DMS.functior
8	PF Validation. Run power flow to check the feasibility of the switches status	Power flow	PF Validation. Run power flow to check the feasibility of the switches status	EXECUTE	DMS.functions	DMS.functior

	once the Fast Restoration Process is completed or MVPC signal has been received		once the Fast Restoration Process is completed or MVPC signal has been received			
9	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems "Network reconfiguration is activated"	Data storage	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems "Network reconfiguration is activated"	EXECUTE	DMS.functions	DMS.RDBMS
10	NR use case. Calculate the optimal network configuration and/or voltage control set-points to alleviate MV congestion problems	Medium voltage network reconfiguration UC	NR use case. Calculate the optimal network configuration and/or voltage control set-points to alleviate MV congestion problems	EXECUTE	DMS.functions	DMS.RDBMS
11	Send commands to MVIEDs. CCPC sends open/close commands to the modified IEDs controlling the switches	Reading/Writing IEDs setting	Send commands to MVIEDs. CCPC sends open/close commands to the modified IEDs controlling the switches	REPORT	DMS.MMS	SAU(PSAU).M IED(PSIED).M
12	MVIEDs confirm the new settings to the CCPC	Reading/Writing IEDs setting	MVIEDs confirm the new settings to the CCPC	REPORT	IED(PSIED).MMS	DMS.MMS SAU(PSAU).
12	MVIEDs confirm the new settings to the CCPC	Reading/Writing IEDs setting	MVIEDs confirm the new settings to the CCPC	REPORT	DMS.RDBMS	DMS.MMS
13	PF Validation. Run power flow to check the feasibility of the switches status once the Fast	Power flow	PF Validation. Run power flow to check the feasibility of the switches status once the Fast	EXECUTE	DMS.functions	DMS.functio

	Restoration Process is completed or MVPC signal has been received		Restoration Process is completed or MVPC signal has been received			
14	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems "Network reconfiguration is activated"	Check flag	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems "Network reconfiguration is activated"	EXECUTE	DMS.functions	DMS.functior
14	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems "Network reconfiguration is activated"	Data storage	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems "Network reconfiguration is activated"	EXECUTE	DMS.functions	DMS.RDBMS
15	Request to MA execution (RTV algorithm).In case of congestion problems not solved by the NR, CCPC request the execution of the Market Agent algorithm (Real Time Validation algorithm)	Real time validation UC	Request to MA execution (RTV algorithm).In case of congestion problems not solved by the NR, CCPC request the execution of the Market Agent algorithm (Real Time Validation algorithm)	REPORT	DMS.RDBMS	DMS.functior
16	OPF Calculation. CCPC runs the OPF to select the optimal flexibility solving the congestion: activation of CRPs	Optimal power flow	OPF Calculation. CCPC runs the OPF to select the optimal flexibility solving the congestion: activation of CRPs	REPORT	DMS.functions	DMS.functior

	or the purchase of new SRPs		or the purchase of new SRPs			
17	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems it saves he accepted flexibility offer and/or the activated CRP to Commercial aggregators (or prosumers	Commercial optimal planning	Evaluate PF validation. CCPC sends its outputs into CCDXP if there are not MV congestion problems. If there are problems it saves he accepted flexibility offer and/or the activated CRP to Commercial aggregators (or prosumers	REPORT	DMS.functions	DMS.functior
18	Export results SRP, CRP to database of DMS	Data storage	Export results SRP, CRP to database of DMS	REPORT	DMS.functions	DMS.RDBMS
19	Trade of SRP bids in electrical market	SRP day-ahead and intra-day market procurement UC	Trade of SRP bids in electrical market	REPORT	DMS.WS	MOP
20	Send activation of CRP commands to CAs.Communicate the accepted flexibility offer and/or the activated CRP to Commercial aggregators (or prosumers), including load shedding if needed.	CRP activation UC	Send activation of CRP commands to CAs.Communicate the accepted flexibility offer and/or the activated CRP to Commercial aggregators (or prosumers), including load shedding if needed.	REPORT	DMS.WS	CA.WS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data
Activation flag		

Is data updated-Request		
Is data updated-Reply		
Static Grid Data	Data exchanged: - Line parameters (R, X, B, G) - Line connections - Location of swithes, breakers and fuses - Transformer parameters	
State Estimation results	node voltages, line currents etc.	
Volumes and prices of SRPs	Volumes and prices of Scheduled re profiling	
activation parameters of contracted CRPs		
Setting Values of IEDs		
Switch State Schedule		
Bid for SRP		
ON/OFF CRP	activate or deactivate conditional reprofiling product	
short term load and production forecast	valid for the next 15-30 minutes	
Power flow validation results		
Bid Acceptance or Modification	In case the bids can not be validated, due to network constraints violation, a modification is requested, else they are accepted. It contains a curtailment factor. So that the commercial aggregator can apply that CRP with a certain Delta P	
OPF result	optimal power flow calculation	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case

237		Medium Voltage Network Reconfiguration

1.2 Version Management

Version Management
From V1.0 15.12.2014 MÃ³nica Alonso, Hortensia AmarÃs

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of the MVNR is to obtain the optimal MV network configuration by closing some normally open switches and opening some normally closed switches in order to reduce MV network congestions during normal or post-fault situations.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
MVNR update network switches status in order to alleviate congestion problems that are related to a specific MV network. The MVNR runs on demand and also run on fixed intervals such as once a day or scheduled hours to find the optimal configuration of the network. The MVNR algorithm utilizes switches state information (open/close), and the load and production forecast that are saved at the DXP.
Complete description
In normal operation the Network reconfiguration algorithm will be executed to reduce system losses, balance loads (exchange between feeders) and to avoid overload of network elements. The main program running the network reconfiguration algorithm can be divided into the following steps: 1) Activation of trigger signals. The network reconfiguration algorithm runs on demand and also run on fixed intervals such as once a day or scheduled hours to find the optimal configuration of the network. So it would be executed whenever the activation trigger signals is activated. 2) Read Network topology and switch data position from the control centre level DXP. Two types of switches will be considered: normally closed switches which connect line sections (sectionalizing switches) and normally open switches on the tie-lines which connect two feeders. 3) Read Real-time measurement reading and/or state estimation outputs. 4) Topology information processing. 5) Optimal network reconfiguration execution. Network reconfiguration is a mixed integer non linear optimization problem containing both binary variables (operative status of switching devices, on/off) and continuous variables (branch currents, power injections and nodal voltages).

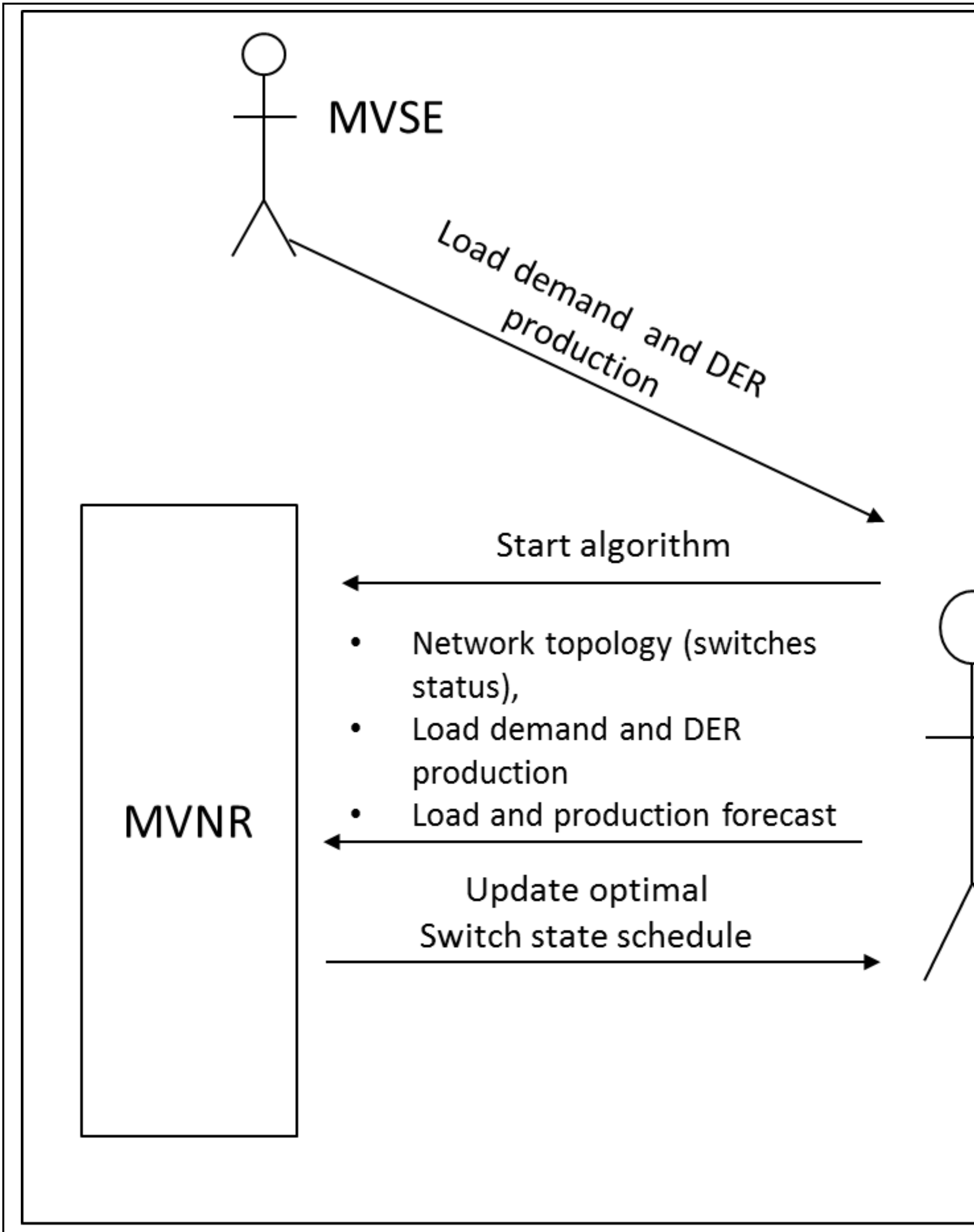
1.5 General Remarks

General Remarks

1. ***Basic Information to Use Case***

Source(s) / Literature	*Link*	*Conditions (limitations) of Use*
Tertiary Control: Network reconfiguration	https://wiki.tut.fi/pub/IDE4L/ designspecification-wp-5-2-3-network-reconfigurartion-2nd_draft.docx	Internal (IDE4L)

2 Diagrams of Use Case



MVNR: Medium Voltage Network Reconfiguratio

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.RDBMS	function		
DMS.functions	function	DMS Network reconfiguration	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Control, Distribution Network

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	**Scenario**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**

	Name				

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - MVNR Started					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Informat Exchang
1	Activation of trigger signals. MVNR withdraw switches state schedule for the next K hours.	Data storage	Internal calculations	REPORT	DMS.RDBMS	DMS.functions	Switch State
2	If topology information has not been imported before or if topology information has changed the network topology import function requests network topology information from the MV DXP.	Data storage	Internal calculations	REPORT	DMS.RDBMS	DMS.functions	Network Topology
4	Get load and production forecasts	Data storage	Internal calculations	REPORT	DMS.RDBMS	DMS.functions	short terr load and productio forecast long term load and productio forecast
5	Get load and production forecasts	Data storage	Internal calculations	REPORT	DMS.RDBMS	DMS.functions	State Estimatio results

6	Get load and production states. Active and reactive power MV Load demand and Active and reactive power MV injected power from DER are requested from the MV DXP.	Data storage	Internal calculations	REPORT	DMS.RDBMS	DMS.functions	Switch State Schedule
7	MVNR calculation. Calculate the optimal network configuration to alleviate MV congestion problems.	Medium voltage network reconfiguration UC	Internal calculations	REPORT	DMS.functions	DMS.functions	Switch State Schedule

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Switch State		
Network Topology		
Switch State Schedule		
short term load and production forecast	valid for the next 15-30 minutes	
long term load and production forecast	Valid for the next 24 hours	
State Estimation results	node voltages, line currents etc.	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
238		Medium Voltage Network Power Control (MVPC) Offline Cost Parameter Update

1.2 Version Management

Version Management
From Version 1.2.: Minor modifications based on Jasmin’s comments. 9.2.2015 Author: Farzad Azimzadeh Moghaddam (TUT) Reviewer: Anna Kulmala

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The MVPC in offline operation is part of a more general scheme called â€œCongestion Managementâ€• . The MVPC (offline) tries to control and optimize the power flow in future states of the MV network.
Objective(s)	The objective of the offline MVPC is to utilize the medium voltage state forecaster (MVSF) information to define the value of cost parameters and prevent extra control actions (e.g. to decrease the number of tap changer operations in the future states of the network).
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case demonstrates how the offline MVPC interacts with other actors in order to define the value of cost parameters and prevent extra control actions (e.g. to decrease the number of tap changer operations in the future states of the network).
Complete description
The main functionality of the offline MVPC is to define cost parameters to avoid extra actions. For instance, it prevents constant operation i.e. hunting of transformer tap changers by changing the cost parameters of the real-time MVPC. For defining the cost parameters, the offline MVPC requires interacting with other actors. The actors directly interacting with offline MVPC (PSAU.PCPU application) are the following: • Primary Substation Automation Unit Data Exchange Platform (PSAU.DXP) where offline MVPC reads all necessary inputs and

writes changes of OPF cost parameters.

The actors updating necessary data in the PSAU.DXP to be further used by offline MVPC are as following:

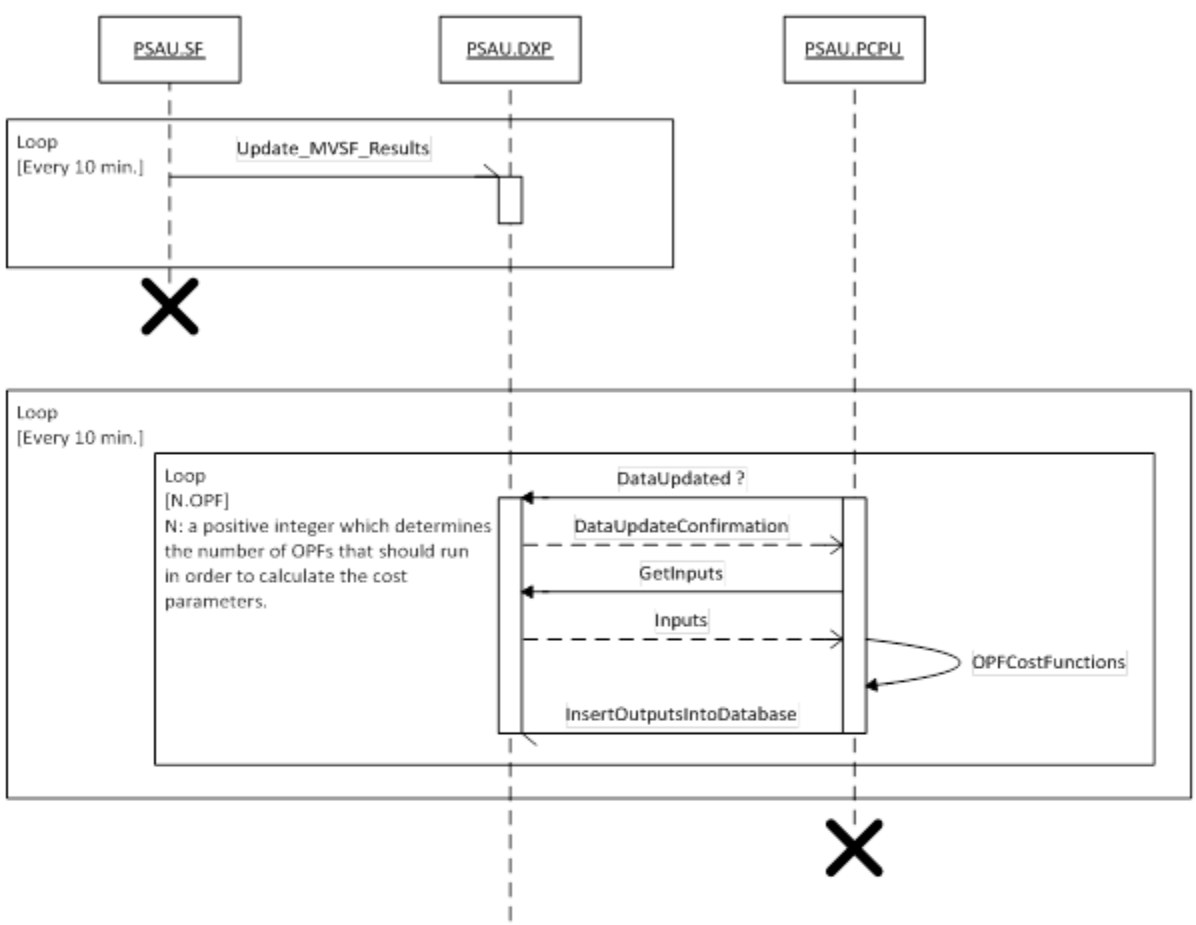
- Primary Substation Automation Unit State Forecaster (PSAU.SF)
- Control Centre Topology Manager (DMS.TM)

This use case presents the required interfaces for operation of the offline MVPC.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(PSAU).Functions	function	Primary Substation Automation Unit Power Control Offline Cost Parameter Updator	
SAU(PSAU).RDBMS	function	PSAU Data Exchange Platform	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Distribution grid management...

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions

No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - PS1: Normal sequence					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Inf Ex**
2	PSAU.PCPU asks PSAU.DXP if new data has been updated into PSAU.DXP	Check flag	internal calculations	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Is up Re
3	MVDXP confirms the data update	Check flag	internal calculations	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functions	Is up Re
4	MVPC ask for data import	Data storage	internal calculations	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Da rec
5	PSAU.PCPU imports inputs(state forecasts, network data (topology and parameters)) from PSAU.DXP	Data storage	internal calculations	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functions	Da OF ca
6	OPF calculation for computing the cost parameters	Optimal power flow	Note: Depending on the time horizon used, the OPF will run several times to compute the cost parameters	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions	Da OF ca Co Pa
7	OPF	Optimal	Note:	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions	Co

	calculation for computing the cost parameters	power flow	Depending on the time horizon used, the OPF will run several times to compute the cost parameters					Pa

Scenario						
Scenario Name:		No. 2 - AS1: OPF does not converge				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	Step 5 of the normal sequence has been successfully completed and OPF calculation of step 6 does not converge.PSAU.PCPU checks whether this happened also at the previous round	Detect error	Internal calculations	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS
2	If OPF converged. Stop PSAU.PCPU operation and wait for the next measurements to come in. Write a log message to the database.	Detect error	Internal calculations	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS
3.1	if OPF did not converge at the previous round. Write a log message to the database.	Detect error	Internal calculations	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS
3.2	Send predetermined cost parameters to the PSAU.DXP	Data storage	Internal calculations	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

Scenario							
Scenario Name:		No. 3 - AS2: Proper input data is not available					
Step	**Event.**	**Name of**	**Description**	**Service**	**Information Producer**	**Information**	**Info**

No.		Process/ Activity	of Process/ Activity.		(Actor)	Receiver (Actor)	Exc
1	if PSAU.PCPU was successful at the previous round	Detect error	Internal calculations	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Stat fore resu
2	if PSAU.PCPU was not successful at the previous round. Send predetermined cost parameters to the PSAU.DXP.	Data storage	Internal calculations	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Log
3	if PSAU.PCPU was not successful at the previous round. Write a log message to the database	Detect error	Internal calculations	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Pre cost para
3.1	if PSAU.PCPU was successful at the previous round	Detect error	Internal calculations	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Log

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
State forecasting result	line currents, node voltages, line power flow, estimated load and productions etc.	
Data import request		
Log message	Log message	
Predetermined cost parameters		
Is data updated-Request		
Is data updated-Reply		

Data for OPF calculation	PSAU.SF results Network data (topology and parameters)	
Cost Parameters	cost of operation of on-load tap changers (OLTCs) etc. cost of generation curtailment cost of demand response	

6 Requirements (optional)

Requirements (optional)	

7 Common Terms and Definitions

Common Terms and Definitions	
Term	Definition

8 Custom Information (optional)

Custom Information (optional)		
Key	Value	Refers to Section

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
142		Medium Voltage Network Power Control (MVPC) in Real Time Operation

1.2 Version Management

Version Management
From: Version 1.2 9.2.2015 Authors: Anna Kulmala and Farzad Azimzadeh Moghaddam (TUT) Reviewers: Sami Repo and Jasmin Mehmedalic

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The MVPC is part of a more general scheme called â€œCongestion Managementâ€• . The MVPC tries to control and optimize the power flow in MV network.

Objective(s)	The objective of the MVPC is to utilize the medium voltage state estimation (MVSE) information to control and optimize the power flow in MV network.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case demonstrates how the MVPC interacts with other actors in order to optimize and control the power flow in MV network.
Complete description
The main functionality of the MVPC is to mitigate congestion in the MV networks. The MVPC tries to reach and balance the following goals: • Reduction of the MV network losses • Reduction of production curtailment • Minimizing the load control actions and tap changer operations • Reducing the cost of reactive power flow supplied by the transmission network • Reducing the cost of active power flow supplied by the transmission network • Reducing the voltage violation at each node In order to reach the above-mentioned goals, the MVPC requires interacting with other actors. The actors directly interacting with MVPC (PSAU.PC application) are the following: • Primary Substation Automation Unit Data Exchange Platform (PSAU.DXP) where PC reads all necessary inputs and writes changes of IED settings. The actors updating necessary data in the PSAU.DXP to be further used by MVPC are as follows: • Control Centre Topology Manager (DMS.TM) • Primary Substation Unit Block OLTC's of Transformers (PSAU.BOT) • Primary Substation Automation Unit Power Control Offline Cost Parameter Update (PSAU.PCPU) • Primary Substation Automation Unit State Estimation (PSAU.SE) and complete medium voltage network real-time monitoring use case providing necessary data to PSAU.SE • Intelligent electronic devices (IEDs) located in the MV network where measurement data is received and control commands are sent • Secondary Substation Automation Unit Power Control (SSAU.PC) This use case presents the required interfaces for operation of the MVPC.

1.5 General Remarks

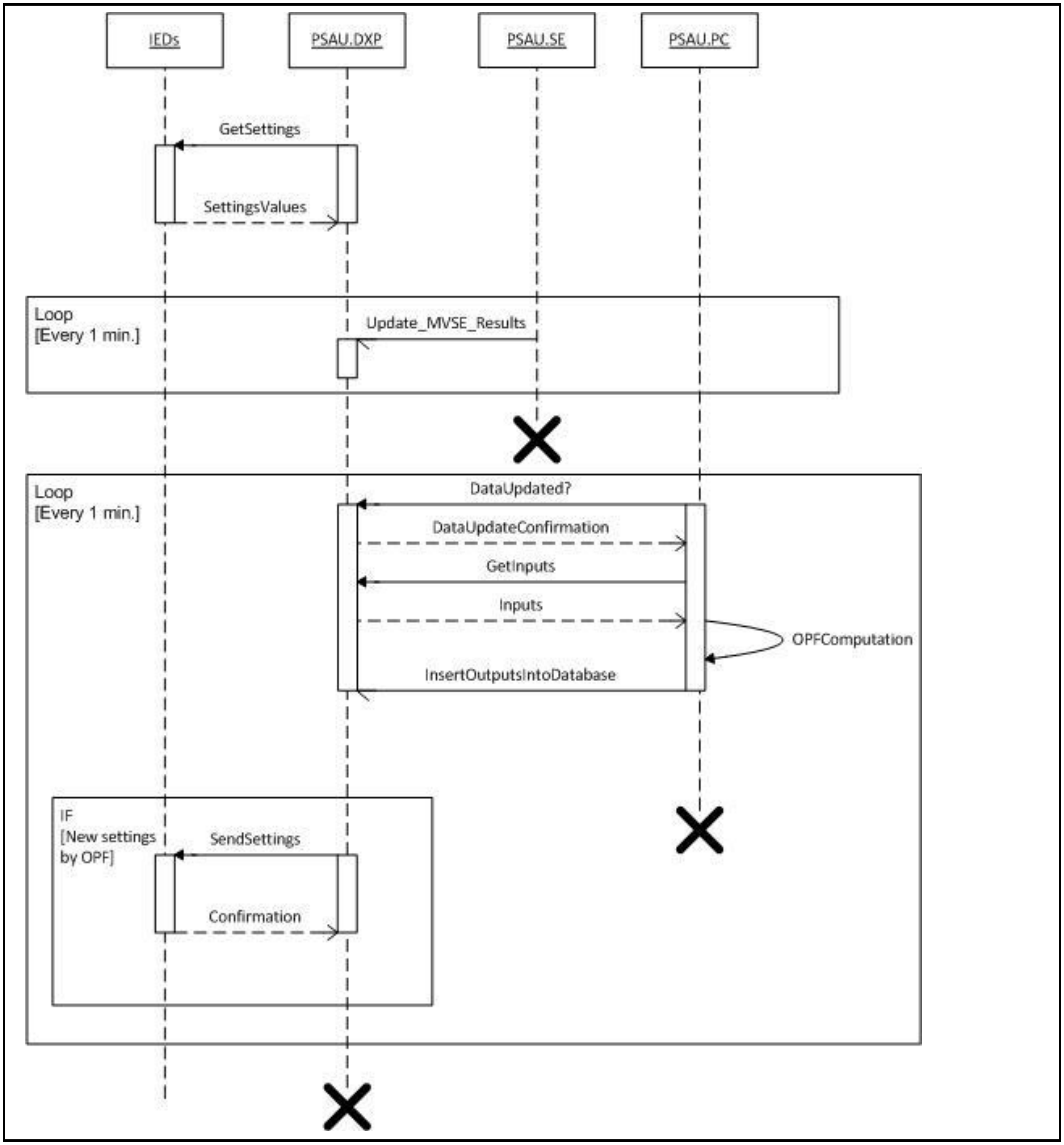
General Remarks

1. ***Issues: Legal Contracts, Legal Regulations,Constraints and others***

***Issue** - here specific ones*	***Impact of Issue on Use Case***	***Reference** – law, standard, others*

Customer-owned distributed generations (DGs) metering information	Measurements from customer-owned DG units is required as input of the MVPC.	
Information of customer's controllable loads	This is required as input of the MVPC.	

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
IED(PSIED).MMS	function	IED MMS interface	
SAU(PSAU).RDBMS	function	PSAU Data Exchange Platform	
SAU(PSAU).MMS	function	PSAU MMS interface	
SAU(PSAU).Functions	function	PSAU Power Control	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Low Voltage Network Power Control (LVPC) in Real Time Operation;
Level of Depth
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Distribution grid management...

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:		No. 1 - Normal Sequence				
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Recei (Actor)
1	PSAU requests settings of MVIEDs	Reading/Writing IEDs setting	PSAU requests settings of MVIEDs	EXECUTE	SAU(PSAU).MMS	IED(PSIED).MMS
2	MVIEDs send value of their settings to SAU	Reading/Writing IEDs setting	MVIEDs send value of their settings to SAU	EXECUTE	IED(PSIED).MMS	SAU(PSAU).MMS
3	PSAU inserts the MVIED settings into MV database (MVDXP)	Data storage	PSAU inserts the MVIED settings into MV database (MVDXP)	EXECUTE	SAU(PSAU).MMS	SAU(PSAU).RDBMS
5	MVPC asks MVDXP if new data (state estimation, network model (parameters and topology) BOT, network state) have been updated into MVDXP	Check flag	MVPC asks MVDXP if new data (state estimation, network model (parameters and topology) BOT, network state) have been updated into MVDXP	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS
6	MVDXP confirms the data update	Check flag	MVDXP confirms the data update	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functio
7	MVPC asks	Data storage	MVPC asks	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

	for inputs		for inputs			
8	MVPC imports inputs from MVDXP	Data storage	MVPC imports inputs from MVDXP	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functio
9	MVPC imports inputs from MVDXP	Data storage	MVPC imports inputs from MVDXP	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functio
10	MVPC runs the OPF algorithm to calculate the optimum in MV network	Optimal power flow	MVPC runs the OPF algorithm to calculate the optimum in MV network	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functio
11	MVPC sends its outputs into MV database (MVDXP)	Data storage	MVPC sends its outputs into MV database (MVDXP)	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS
12	MVIEDs confirmation regarding new settings	Reading/Writing IEDs setting	MVIEDs confirmation regarding new settings	EXECUTE	IED(PSIED).MMS	SAU(PSAU).MMS
13	MVIEDs confirmation regarding new settings	Data storage	MVIEDs confirmation regarding new settings	EXECUTE	SAU(PSAU).MMS	SAU(PSAU).RDBMS

Scenario						
Scenario Name:		No. 2 - AS1: OPF does not converge				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	OPF calculation of step 9 in the normal sequence does not converge. Recovery methods are tried. These can include	Detect error, Control functions	OPF calculation of step 9 in the normal sequence does not converge. Recovery methods are tried. These can include	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions

	e.g. changing the optimization algorithm parameters such as the number of iteration rounds, type of limits etc.		e.g. changing the optimization algorithm parameters such as the number of iteration rounds, type of limits etc.			
2	OPF converges after recovery methods. Return to step 10 in the normal sequence.	Data storage	OPF converges after recovery methods. Return to step 10 in the normal sequence.	EXECUTE	SAU(PSAU).Functions	PSAU.DXP.RDBMS
3	OPF does not converge after recovery methods and network state is acceptable. Write a log message stating that OPF did not converge to the database.	Data storage	OPF does not converge after recovery methods and network state is acceptable. Write a log message stating that OPF did not converge to the database.	EXECUTE	SAU(PSAU).Functions	PSAU.DXP.MMS
4	OPF does not converge after recovery methods and network state is unacceptable. Rule based algorithm is tried to restore the network to an acceptable state.	Control functions	OPF does not converge after recovery methods and network state is unacceptable. Rule based algorithm is tried to restore the network to an acceptable state.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions
5	Rule based algorithm is able to restore the network to an acceptable state. Return to step 10 in normal sequence. Write a log message	Data storage	Rule based algorithm is able to restore the network to an acceptable state. Return to step 10 in normal sequence. Write a log message	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

	stating that OPF did not converge to the database.		stating that OPF did not converge to the database.			
6	Rule based algorithm is unable to restore the network to an acceptable state. Send an alarm signal to the operator. Send a help request to upper level controller.	Data storage	Rule based algorithm is unable to restore the network to an acceptable state. Send an alarm signal to the operator. Send a help request to upper level controller.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS
7	Unacceptable network state remained longer than a predefined time. Write predetermined IED settings to the database (step 10 in the normal sequence).	Data storage	Unacceptable network state remained longer than a predefined time. Write predetermined IED settings to the database (step 10 in the normal sequence).	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

Scenario							
Scenario Name:		No. 3 - AS2: Proper input data not available					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**I E**
1	Adequate input data is not available. Call a function that tries to solve the problem. Write an alarm message to the database.	Detect error	Adequate input data is not available. Call a function that tries to solve the problem. Write an alarm message to the database.	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS	L n
2	Input data has been missing for a predefined time. Predetermined	Data storage	Input data has been missing for a predefined time. Predetermined	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS	S V I

	IED settings are written to the database.		IED settings are written to the database.				

Scenario							
Scenario Name:	No. 4 - AS3: Network in fault location, isolation or supply restoration state						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informati Exchang**
1	Network is in fault location, isolation or supply restoration state. PC algorithm is not executed.	Check flag	Network is in fault location, isolation or supply restoration state. PC algorithm is not executed.	EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functions	Flag

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Setting Values of IEDs-Request		
Setting Values of IEDs		
State Estimation Results	line currents, node voltages, line power flow, estimated load and productions etc	
Is data updated-Request		
Is data updated-Reply		
Data import request		
Medium Voltage Power Control output	automatic voltage regulator set points of transformers, automatic reactive power set points of MV capacitor banks, MV DG units reference reactive power, MV DG unit curtailed power etc	
Confirmation of new IED settings		
Help request	Help request from other controller	
Log message	Log message	

6 Requirements (optional)

Requirements (optional)	

7 Common Terms and Definitions

Common Terms and Definitions	
Term	Definition

8 Custom Information (optional)

Custom Information (optional)		
Key	Value	Refers to Section

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
239		Low Voltage Power Control (LVPC) Offline Cost Parameter Update

1.2 Version Management

Version Management
From: Version 1.2.: Minor modifications based on Jasmin’s comments, 9.2.2015, Anna Kulmala

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The LVPC in offline operation is part of a more general scheme called â€œCongestion Managementâ€• . The LVPC (offline) tries to control and optimize the power flow in future states of the LV network.
Objective(s)	The objective of the offline LVPC is to utilize the low voltage state forecaster (LVSF) information to define the value of cost parameters and prevent extra control actions (e.g. to decrease the number of tap changer operations in the future states of the network).
Related business case(s)	

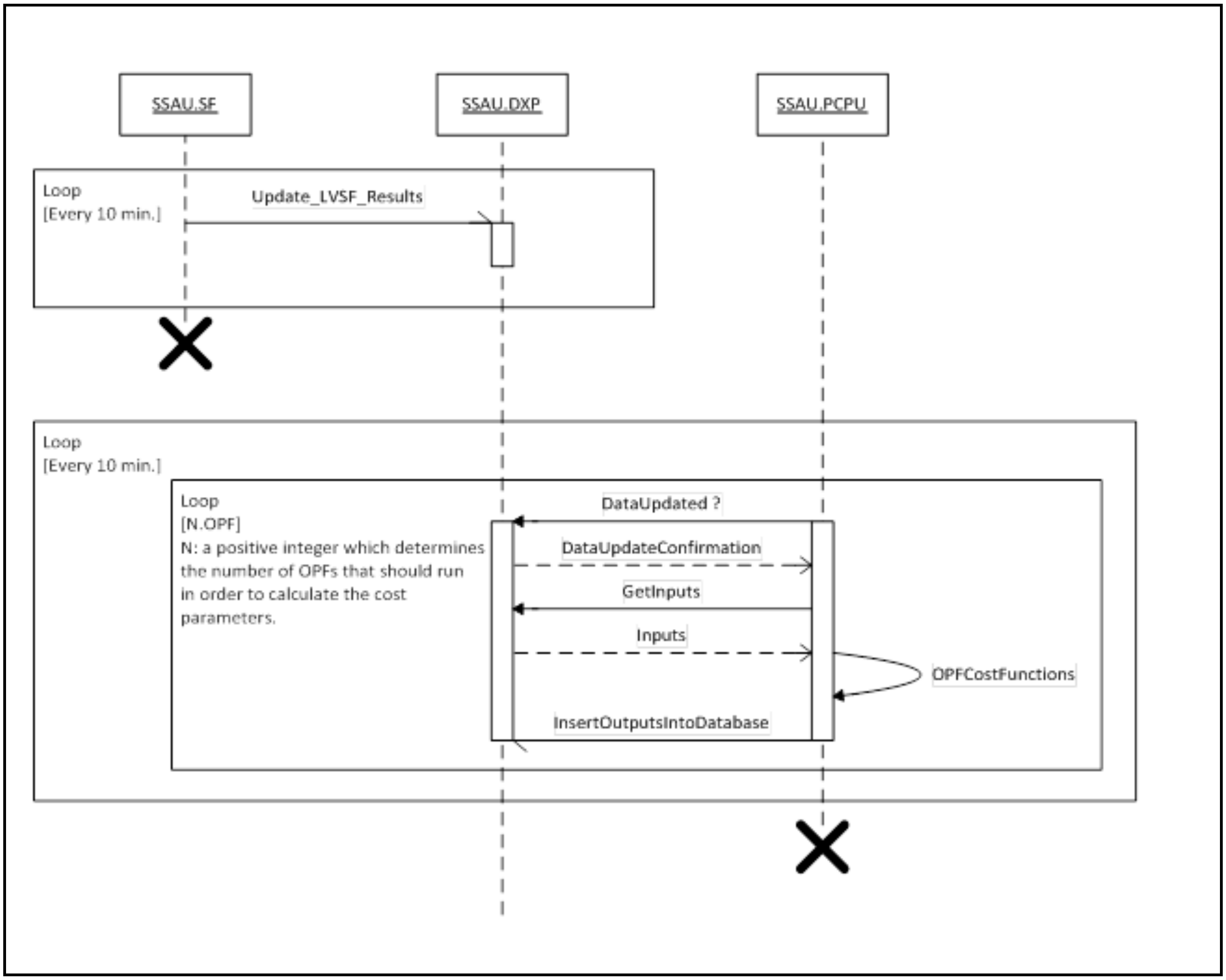
1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case demonstrates how the offline LVPC interacts with other actors in order to define the value of cost parameters and prevent extra control actions (e.g. to decrease the number of tap changer operations in the future states of the network).
Complete description
The main functionality of the offline LVPC is to define cost parameters to avoid extra actions. For instance, it prevents constant operation i.e. hunting of transformer tap changers by changing the cost parameters of the real-time LVPC. For defining the cost parameters, the offline LVPC requires interacting with other actors. The actors directly interacting with offline LVPC (SSAU.PCPU application) are the following: • Secondary Substation Automation Unit Data Exchange Platform (SSAU.DXP) where offline LVPC reads all necessary inputs and writes changes of OPF cost parameters. The actors updating necessary data in the SSAU.DXP to be further used by offline LVPC are as following: • Secondary Substation Automation Unit State Forecaster (SSAU.SF) • Control Centre Topology Manager (DMS.TM) This use case presents the required interfaces for operation of the offline LVPC.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(SSAU).Functions	function	Secondary Substation Automation Unit Power Control Offline Cost Parameter Update	
SAU(SSAU).RDBMS	function	Database SSAU	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering**	**Pre-**	**Assumption**

	Event	conditions	

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Techincal
Further Keyword for Classification
Distribution grid management...

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:	No. 1 - PS1: Normal Sequence						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Info Exc
1	SSAU.PCPU checks if data updated into SSAU.DXP	Check flag	Executed in parallel with step 81	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Is da upda Req
2	SSAU.DXP confirms	Check flag	Executed in parallel	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions	Is da upda

	the data update		with step 81				Rep
3	SSAU.PCPU asks for data import	Data storage	Executed in parallel with step 81	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Data requ
4	SSAU.PCPU imports inputs from SSAU.DXP	Data storage	Executed in parallel with step 81	REPORT	SAU(SSAU).RDBMS	SAU(SSAU).Functions	Stat fore resu
5	SSAU.PCPU runs the OPF algorithm to calculate the cost parameters.	Optimal power flow	Note: Depending on the time horizon used, the OPF will run several times to compute the cost parameters	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions	Cos Para
6	SSAU.PCPU sends its outputs into SSAU.DXP	Data storage	Note: Depending on the time horizon used, the OPF will run several times to compute the cost parameters	REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Cos Para

Scenario							
Scenario Name:		No. 2 - AS1: OPF does not converge					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Info Exc**
1	Step 5 of the normal sequence has been successfully completed and	Detect error	Note: Depending on the time horizon used, the	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Log

	OPF calculation of step 6 does not converge. SSAU.PCPU checks whether this happened also at the previous round		OPF will run several times to compute the cost parameters				
2	OPF converged at the previous round. Stop SSAU.PCPU operation and wait for the next measurements to come in. Write a log message to the database.	Detect error	Note: Depending on the time horizon used, the OPF will run several times to compute the cost parameters	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Log
3	OPF did not converge at the previous round.Write a log message to the database.	Detect error	Note: Depending on the time horizon used, the OPF will run several times to compute the cost parameters	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Log
4	Send predetermined cost parameters to the SSAU.DXP.	Data storage	Note: Depending on the time horizon used, the OPF will run several times to compute the cost parameters	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Pre cost para

Scenario							
Scenario Name:		No. 3 - AS2: Proper input data is not available					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)
1	SSAU.PCPU input data is not available or is not valid.SSAU.PCPU checks whether this happened also at the previous round	Detect error	internal calculations	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions SAU(SSAU).RDBMS
2	if SSAU.PCPU checks whether this happened also at the previous round.Stop SSAU.PCPU operation and wait for the next measurements to come in. Write a log message to the database.	Report error		REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS
3	if SSAU.PCPU was not successful at the previous round. Write a log message to the database.	Report error		REPORT	SAU(SSAU).Functions	SAU(SSAU).RDBMS
4	Send predetermined cost parameters to the SSAU.DXP.	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data
State forecasting result	line currents, node voltages, line power flow, estimated load and productions etc.	
Is data updated-Request		
Is data updated-Reply		

Data import request		
Cost Parameters	cost of operation of on-load tap changers (OLTCs) etc. cost of generation curtailment cost of demand response	
Log message	Log message	
Predetermined cost parameters		

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
143		Low Voltage Network Power Control (LVPC) in Real Time Operation

1.2 Version Management

Version Management
From: Version 1.2 9.2.2015 Authors: Anna Kulmala and Farzad Azimzadeh Moghaddam (TUT) Reviewers: Sami Repo and Jasmin Mehmedalic

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The LVPC is part of a more general scheme called â€œCongestion Managementâ€• . The LVPC tries to control and optimize the power flow in LV network.
Objective(s)	The objective of the LVPC is to utilize the low voltage state estimation (LVSE) information to control and optimize the power flow in LV network.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case demonstrates how the LVPC interacts with other actors in order to optimize and control the power flow in LV network.
Complete description

The main functionality of the LVPC is to mitigate congestion in the LV networks. The LVPC tries to reach and balance the following goals:

- Reduction of the LV network losses
- Reduction of production curtailment
- Minimizing the load control actions and tap changer operations
- Reducing the voltage violation at each node

In order to reach the above-mentioned goals, the LVPC requires interacting with other actors. The actors directly interacting with LVPC (SSAU.PC application) are the following:

- Secondary Substation Automation Unit Data Exchange Platform (SSAU.DXP) where LVPC reads all necessary inputs and writes changes of IED settings.

The actors updating necessary data in the SSAU.DXP to be further used by LVPC are as follows:

- Control Centre Topology Manager (DMS.TM)
- Primary Substation Unit Block OLTC's of Transformers (PSAU.BOT)
- Secondary Substation Automation Unit Power Control Offline Cost Parameter Update (SSAU.PCPU)
- Secondary Substation Automation Unit State Estimation (SSAU.SE) and complete low voltage network real-time monitoring use case providing necessary data to SSAU.SE
- Intelligent electronic devices (IEDs) located in the LV network where measurement data is received and control commands are sent

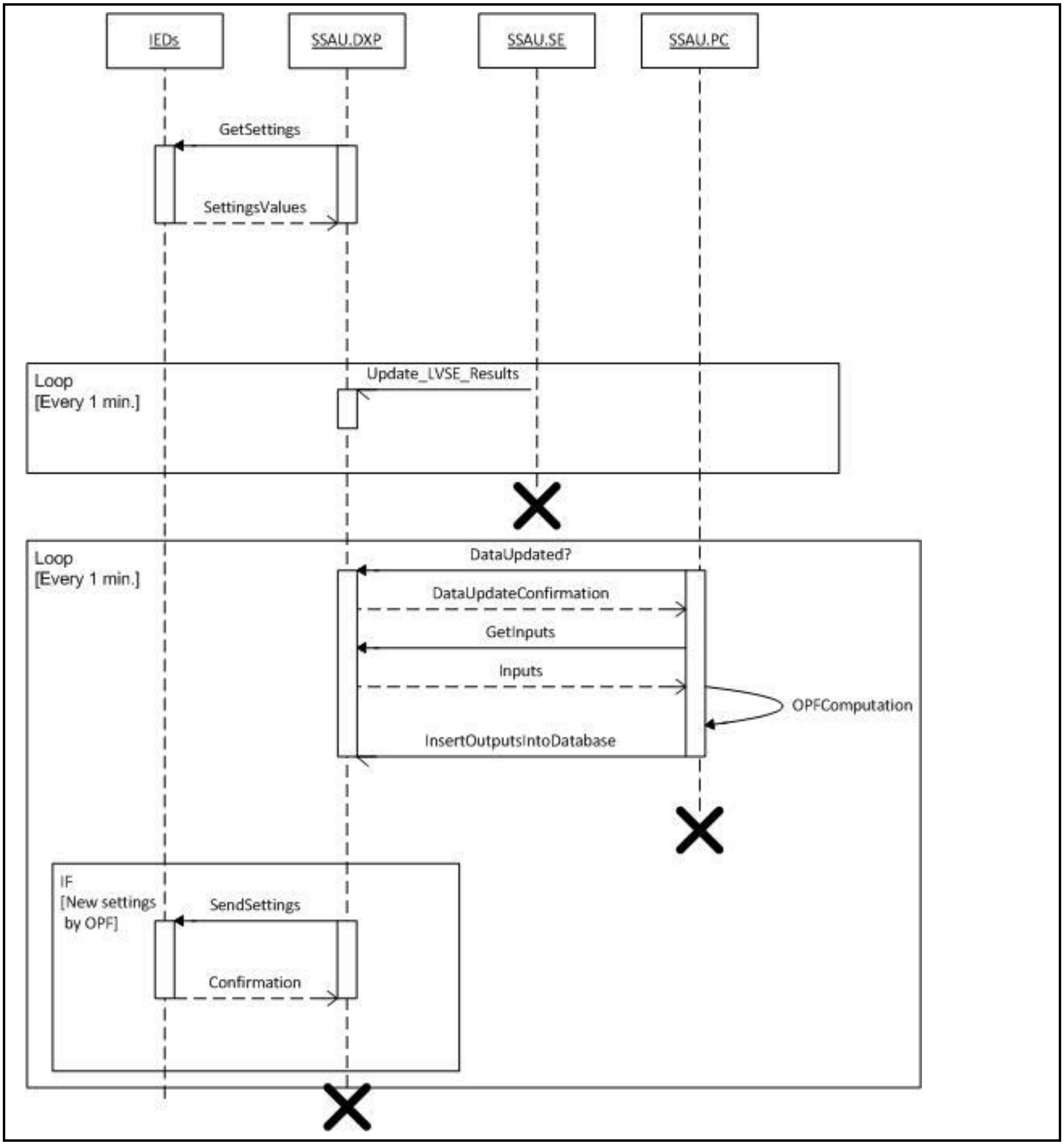
This use case presents the required interfaces for operation of the LVPC.

1.5 General Remarks

General Remarks

Issue - *here specific ones*	***Impact of Issue on Use Case***	***Reference*** *– law, standard, others*
Customer-owned distributed generations (DGs) metering information	Measurements from customer-owned DG units is required as input of the LVPC.	
Information of customer's controllable loads	This is required as input of the LVPC.	

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this**

			Use Case
SAU(SSAU).MMS	function	MMS interface of SSAU	
SAU(SSAU).RDBMS	function	Database of SSAU	
IED(SSIED).MMS	function	MMS interface of secondary substation IED	
SAU(SSAU).Functions	function	SSAU Power Control	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Distribution grid management...

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario

Scenario Name:	No. 1 - Normal Sequence					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Recei**
1	SSAU requests settings of LVIEDs	Reading/Writing IEDs setting	SSAU requests settings of LVIEDs	REPORT	SAU(SSAU).MMS	IED(SSIED).MMS
2	LVIEDs send value of their settings to SAU	Reading/Writing IEDs setting	LVIEDs send value of their settings to SAU	REPORT	IED(SSIED).MMS	SAU(SSAU).MMS
3	SSAU inserts the LVIED settings into LV database (LVDXP)	Data storage	SSAU inserts the LVIED settings into LV database (LVDXP)	EXECUTE	SAU(SSAU).MMS	SAU(SSAU).RDBMS
4	LVPC asks LVDXP if new data have been updated into LVDXP	Check flag	LVPC asks LVDXP if new data have been updated into LVDXP	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS
5	LVDXP confirms the data update	Check flag	LVDXP confirms the data update	EXECUTE	SAU(SSAU).RDBMS	SAU(SSAU).Functio
6	LVPC ask for data import	Data storage	LVPC ask for data import	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS
7	LVPC imports inputs from LVDXP	Data storage	LVPC imports inputs from LVDXP	EXECUTE	SAU(SSAU).RDBMS	SAU(SSAU).Functio
8	LVPC runs the OPF algorithm to calculate the optimum in LV network	Optimal power flow	LVPC runs the OPF algorithm to calculate the optimum in LV network	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functio
9	LVPC sends its outputs into LV database	Data storage	LVPC sends its outputs into LV database	EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS

	(LVDXP)		(LVDXP)			
10	In the case of new settings for LVIEDS	Reading/Writing IEDs setting	In the case of new settings for LVIEDS	REPORT	SAU(SSAU).MMS	IED(SSIED).MMS
11	LVIEDs confirmation regarding new settings	Check flag	LVIEDs confirmation regarding new settings	REPORT	IED(SSIED).MMS	SAU(SSAU).MMS

Scenario							
Scenario Name:		No. 2 - AS1: OPF does not converge					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Inf Ex**
1	OPF calculation of step 9 in the normal sequence does not converge. Recovery methods are tried. These can include e.g. changing the optimization algorithm parameters such as the number of iteration rounds, type of limits etc.	Detect error		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions	
2	OPF converges after recovery methods. Return to step 10 in the normal sequence.	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Lo Vo Po Co ou
3	OPF does not converge after recovery methods and network state is acceptable. Write a log	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions	Lo mo

	message stating that OPF did not converge to the database.						
4	OPF does not converge after recovery methods and network state is unacceptable. Rule based algorithm is tried to restore the network to an acceptable state.	Control functions		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).Functions	Lo me
5	Rule based algorithm is able to restore the network to an acceptable state. Return to step 10 in normal sequence. Write a log message stating that OPF did not converge to the database.	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Lo Vo Po Co ou Lo me
6	Rule based algorithm is unable to restore the network to an acceptable state. Send an alarm signal to the operator. Send a help request to upped level controller.	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	He re Lo me
7	Unacceptable network state remained longer than a predefined time. Write predetermined	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Se Va IE

	IED settings to the database (step 10 in the normal sequence).						

Scenario							
Scenario Name:	No. 3 - AS2: Proper input data not available						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Info Exc**
1	Adequate input data is not available. Call a function that tries to solve the problem. Write an alarm message to the database.	Detect error		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Log mes
2	Input data has been missing for a predefined time. Predetermined IED settings are written to the database.	Data storage		EXECUTE	SAU(SSAU).Functions	SAU(SSAU).RDBMS	Sett Valu IED

Scenario							
Scenario Name:	No. 4 - AS3: Network in fault location, isolation or supply restoration state						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informa Exchang**
1	Network is in fault location, isolation or supply restoration state. PC algorithm is not executed.	Check flags		EXECUTE	SAU(SSAU).RDBMS	SAU(SSAU).Functions	Flag

5 Information Exchanged

Information Exchanged

Name of Information (ID)	Description of Information Exchanged	Requirements to information data
Confirmation of new IED settings		
Setting Values of IEDs		
Setting Values of IEDs-Request		
State Estimation Results	line currents, node voltages, line power flow, estimated load and productions etc	
Is data updated-Request		
Is data updated-Reply		
Data import request		
Low Voltage Power Control outputs	automatic voltage regulator set points of transformers, automatic reactive power set points of LV capacitor banks, LV DG units reference reactive power, LV DG unit curtailed power etc.	
Help request	Help request from other controller	
Log message	Log message	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
240		Block OLTC's of Transformers (BOT)

1.2 Version Management

Version Management
From Version 1.2, 10.2.2015, Author: Farzad Azimzadeh Moghaddam (TUT) Comments by: Sami Repo, Anna Kulmala, Jasmin Mehmedalic

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The BOT unit is an input provider for medium voltage power control (MVPC) and low voltage power control (LVPC) and also the automatic voltage control relays

	controlling tap changers of HV/MV and MV/LV transformers. It sends block and unblock signal to MVPC, LVPC, MVIEDs and LVIEDs. Block signal prevents operation of OLTCs. Note: Intelligent Electronic devices (IEDs) in this document are Automatic Voltage Controllers of HV/MV and MV/LV transformers.
Objective(s)	The objective of the BOT unit is to utilize state estimation (SE) information from both MV and LV networks. Using this information Bot is able to prevent unnecessary tap action of the OLTCs by sending block signals.
Related business case(s)	

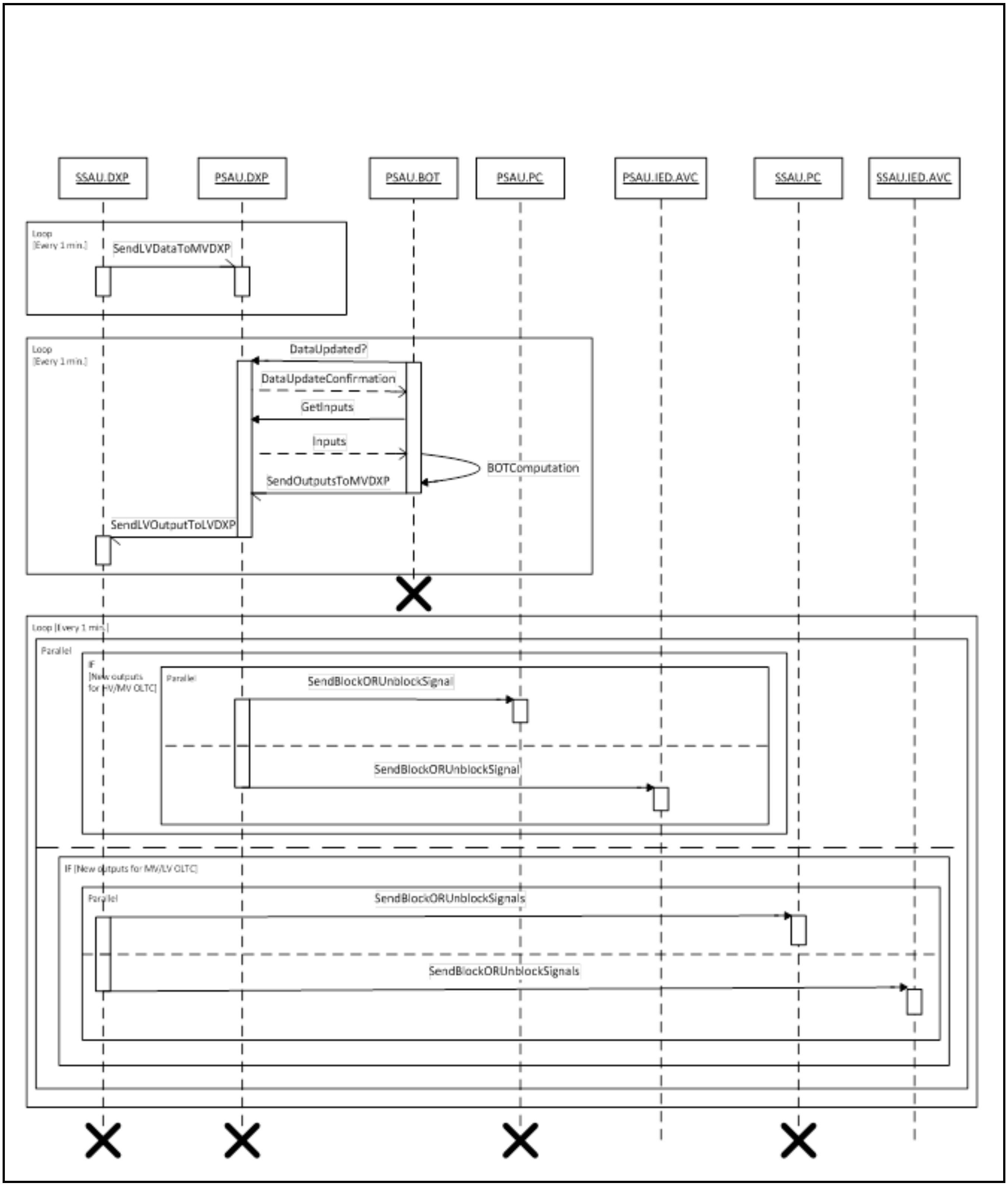
1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case demonstrates how the BOT unit interacts with other units in order to generate its outputs. The main purpose is to show how different actors interact with each other.
Complete description
The main functionality of the BOT unit is to send block signals (along with block validity times) and unblock signals to LVPC and MVPC units and also their respective IEDs. Block and unblock signals are for the following reasons: • Solve the voltage disturbance problem as local as possible • Prevent hunting phenomenon of OLTCs operating in different voltage layers In order to reach the above-mentioned goals, the following actors are required: • PSAU Block OLTC's of Transformers (PSAU.BOT) • PSAU Data Exchange Platform (PSAU.DXP) • PSAU Power Control (PSAU.PC) • Automatic Voltage Controller of Primary Substation (PSAU.IED.AVC) • SSAU Data Exchange Platform (SSAU.DXP) • SSAU Power Control (SSAU.PC) • Automatic Voltage Controller of Secondary Substation (SSAU.IED.AVC) Note: - PSAU stands for Primary Substation Automation Unit - SSAU stands for Secondary Substation Automation Unit State estimation data from MVSE and LVSE and network topology data from Topology Manager (TM) are required as inputs. This data is transferred to the BOT unit through MV and LV databases. Therefore, the following actors are also indirectly involved in the process of generating the BOT outputs: • PSAU State Estimation (PSAU.SE) • SSAU State Estimation (SSAU.SE) • DMS.TM This use case presents the required interfaces for operation of the BOT unit.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
SAU(PSAU).MMS	function	MMS interface	
SAU(PSAU).RDBMS	function	PSAU Data Exchange Platform	
IED(PSIED-AVC-CTRL).MMS	function	Automatic Voltage Controller of Primary Substation	
SAU(SSAU).MMS	function	MMS interfaces	
SAU(PSAU).Functions	function	PSAU Power Control	
SAU(PSAU).Functions	function	PSAU Block OLTC's of Transformers	
IED(SSIED-AVC-CTRL).MMS	function	Automatic Voltage Controller of Secondary Substation	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keyword for Classification
Distribution grid management...

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - Normal sequence					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	LVDXP inserts its outputs (OLTC state) into MVDXP	Data report		REPORT	SAU(SSAU).MMS	SAU(PSAU).MMS
2	BOT sends input request to MVDXP. BOT unit asks its required inputs from MVDXP	Data storage		REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS
3	BOT data import. BOT receives its inputs from MVDXP	Data storage		EXECUTE	SAU(PSAU).RDBMS	SAU(PSAU).Functions
5	BOT sends its outputs	Data storage		EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

	to MVDXP						
6	BOT sends its outputs to LVDXP via MVDXP	Data report		REPORT	SAU(PSAU).MMS	SAU(SSAU).MMS	
7	BOT sends new settings to MVIEDS	Reading/Writing IEDs setting	Executed in parallel with step 5	REPORT	SAU(PSAU).MMS	IED(PSIED-AVC-CTRL).MMS	
8	BOT sends new settings to LVIEDs	Data report	Executed in parallel with step 6	REPORT	SAU(PSAU).MMS	SAU(SSAU).MMS IED(SSIED-AVC-CTRL).MMS	

Scenario							
Scenario Name:		No. 2 - AS 1: No input data for BOT					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	The PSAU.BOT has not received input data	Missing data	Executed in parallel with step 8	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	Error signal generated by PSAU.BOT

Scenario							
Scenario Name:		No. 3 - AS 2: BOT is not able to provide its outputs					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informat Exchang**
1	The PSAU.BOT has not generated its outputs.If for any	Check flag	Executed in parallel with step 8	REPORT	SAU(PSAU).Functions	SAU(PSAU).RDBMS	OLTC block an unblock signals

	reason PSAU.BOT has not generated its outputs, no block signal will be send i.e. all transformers are free to operate						

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Data import request		
OLTC block and unblock signals	including the validity time of block signals	
Error signal generated by PSAU.BOT		
State forecasting result	node voltages, line currents, aggregated production etc.	
State Estimation results	node voltages, line currents etc.	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
146		Power Quality Control

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The aim is to propose methods to improve power quality in LV/MV networks with high penetration of power electronic-based generating units and/or other equipments.
Objective(s)	The particular objectives of the UC are devoted to the design of the control algorithm for the proposed device --which is based on short-term storage systems-- for flicker filtering in LV/MV grids. The proposed concepts are to be validated using lab-scale equipments.
Related business case(s)	

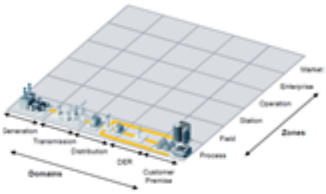
1.4 Narrative of Use Case

Narrative of Use Case
Short description
With the aim of power quality improvement, the UC explores the use of fast energy storage systems with high ramp power rates and short time responses, to rapidly exchange active and reactive power, thus smoothing power flows in LV networks and improving quality of current and voltage waveforms.
Complete description
Storage systems will act as active filters connected at certain point of LV/MV networks. The storage system will be the tool for an ancillary service provider for the distribution network to perform such active filtering of flicker emission in the network. The steps are described below: 1. Data with high resolution time from power quality meter and, with low resolution time from state estimation, are extracted by PSAU and SSAU at the local DXPs, through the function DS. 2. Power quality indexes are calculated and compared with the threshold indicated by power quality standards (e.g. EN 50160), through the function Check Status of Electrical Variables (CSEV). 3. In case some indexes are not satisfying control functions are run in order to obtain some effective control actions, through the function Control Functions (CFs). 4. Control actions are sent to IEDs and to local DPXs through the function Compute Control Signals (SCSs). 5. Control actions are stored by SSDXP and PSDXP with the function DS.

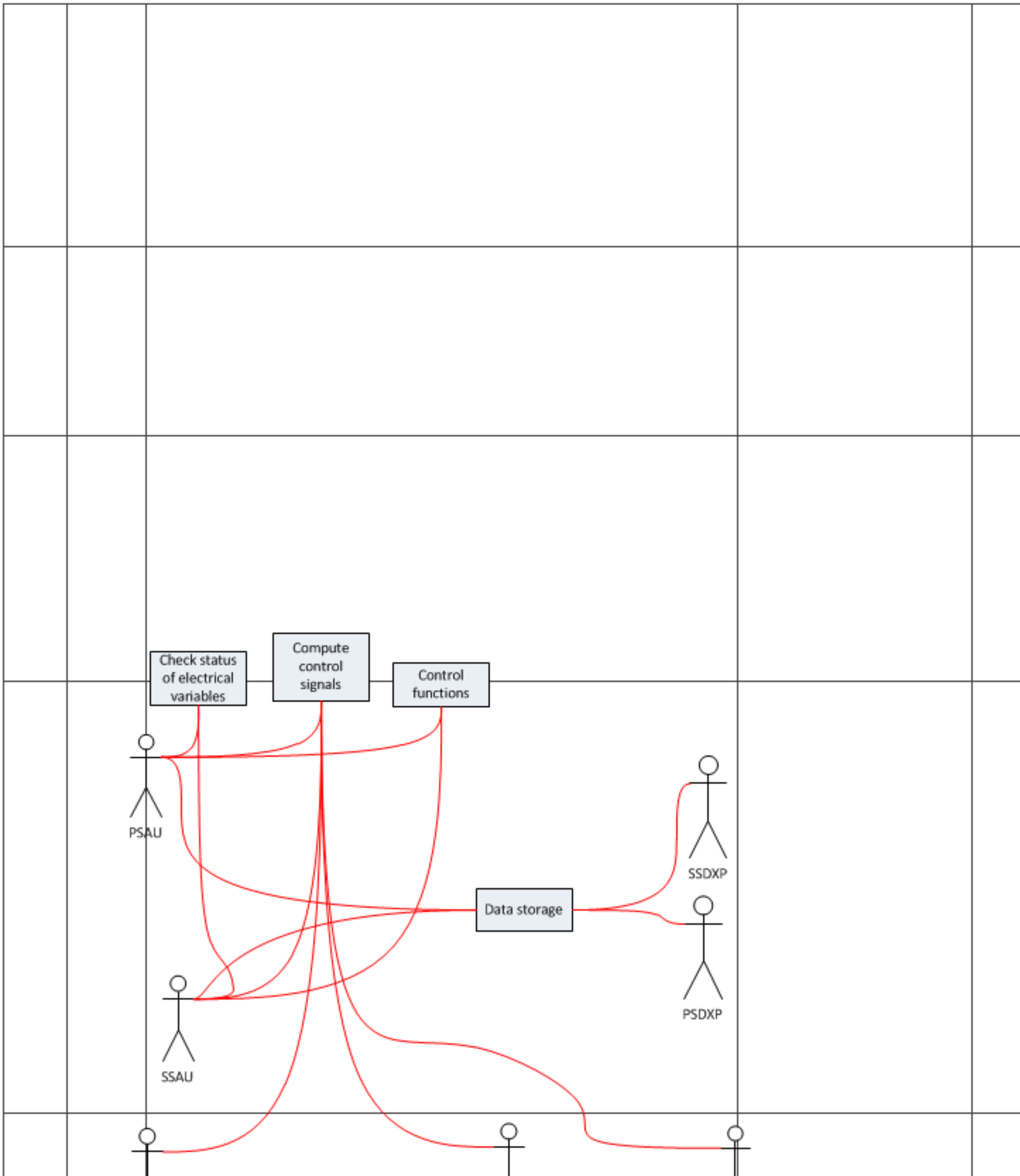
1.5 General Remarks

General Remarks

2 Diagrams of Use Case



Smart Grid Plane



3 Technical Details

3.1 Actors

Actors			
Grouping		Group Description	
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
IED(DIED).MMS	function	Distributed IED MMS interface	
SAU(PSAU).Functions	function	Primary Substation Automation Unit (PSAU)	
SAU(PSAU).MMS	function	MMS interface for PSAU	
SAU(PSAU).RDBMS	function	Database for PSAU	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario						
Scenario Name:	No. 1 - Flicker Reduction (similar scenarios for the other power quality problems)					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	Normal operating conditions of the grid	Data storage	Data with high resolution time from power quality meter and, with low resolution time from state estimation, are extracted by PSAU and SSAU at the local DXPs, through the function DS	REPORT	SAU(PSAU).RDBMS	SAU(PSAU).Functions
2	Data received by PSAU	power quality indexes	Power quality indexes are calculated and compared with the threshold indicated by power quality standards (e.g. EN 50160), through the	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions

			function CSEV			
5	Power quality indexes evaluated	power quality control	In case some indexes are not satisfying control functions are run in order to obtain some effective control actions, through the function CF	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).Functions
3	Decision on control actions determined and sent to DIEDs	Reading/Writing IEDs setting	Control actions are sent to DIEDs and to local DPXs through the function SCSs	EXECUTE	SAU(PSAU).MMS	IED(DIED).MMS
4	Control action performed by DIEDs	Data storage	Control actions are stored by SSDXP and PSDXP with the function DS	EXECUTE	SAU(PSAU).Functions	SAU(PSAU).RDBMS

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Power quality metrics	Data with high resolution time from power quality meter	

Threshold levels for power quality metrics	Comparison between power quality measurements and threshold levels through the function CSEV.	
ON/OFF signal for function CF	In case some indexes are not satisfying control functions are run in order to obtain some effective control actions, through the function CF.	
Package sending ON/OFF signal for function CF to other functions	Control actions are sent to IEDs and to local DPXs through the function SCSs	
Control actions performed by IEDs	Control actions are stored by SSDXP and PSDXP with the function DS	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
233		Commercial aggregator asset planning

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Distribution network operation and interaction with aggregator.
Objective(s)	Design and simulate the optimal participation of customers in electricity market, considering the grid constraints.
Related business case(s)	

1.4 Narrative of Use Case

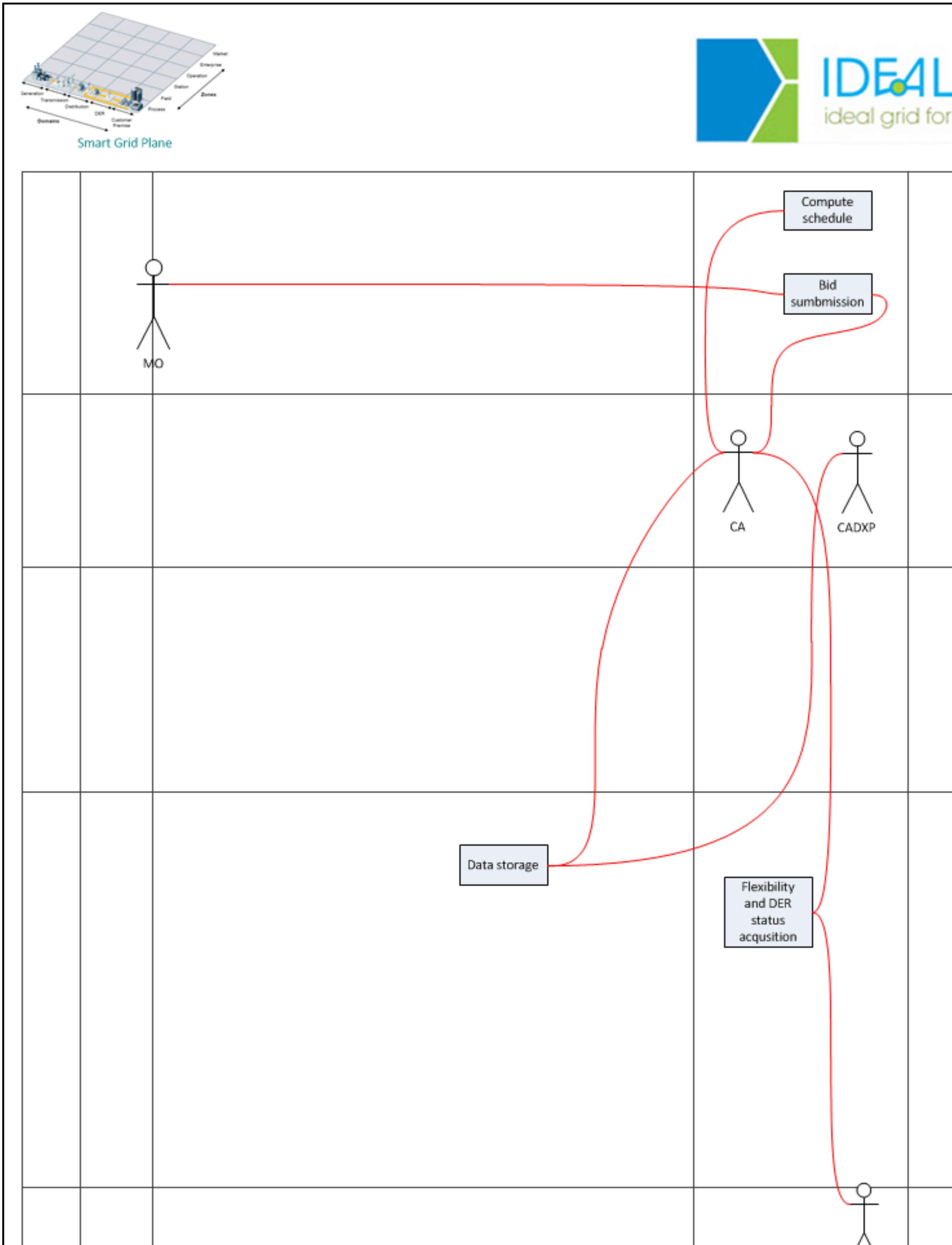
Narrative of Use Case
Short description
This UC describes the operation of the commercial aggregator in order to evaluate the capacity of the DERs within its load area to perform scheduled Re-profiling (SRP) and conditional Re-profiling (CRP) actions (later described), then to match this availability with the requirements of the TSOs and technical

aggregator contained in the flexibility tables and finally to send the bids of SRPs and CRPs to the market.
Complete description
SRP is the offer of one or more DERs to produce an assigned power during an assigned period of time, meanwhile CRP is the offer of one or more DERs to be ready and available to change the output power in a certain range for an assigned period of time. The commercial aggregator cannot access to the property information of the DSO, for security reasons, namely the need for reservation of key information as the weaknesses of the grid. However, it receives from the technical aggregator the flexibility tables that represent the scope within the commercial aggregator can bid for. Furthermore, in the view of developing a concept closer to a free market, the commercial aggregator can access the information of the HEMS within its load area and can use forecast services, weather forecast agencies reports, and in general, information from external providers in order to optimize the schedules of the DERs belonging to its load area. The designed process consists in the following steps: 1. Information about the customers of the Commercial Aggregator (CA) is retrieved periodically, with the function Flexibility and DER Status Acquisition (FDA) from the HEMSs and stored in the Commercial aggregator Data eXchange Platform (CADXP) with the function DS. The same is done for forecasts for the production of the DERs and the demand obtained from external entities. 2. The flexibility tables, sent by the technical aggregator, are retrieved by the Commercial Aggregator (CA) with the function data storage from the Commercial aggregator Data eXchange Platform (CADXP), with the function data storage (DS). 3. The commercial aggregator, taken into consideration the data from the customer, the forecast and the flexibility tables, calculates the optimal scheduling for the resources and customers that it manages, with the function Compute Schedule (CS). 4. The commercial aggregator submits a bid to the Market Operator (MO), with the function Bid Submission (BS).

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



Smart Grid Plane
Compute schedule
Bid sumbmission
MO
CA
CADXP
Data storage
Flexibility and DER status acqusition

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
CA.RDBMS	function	Commercial aggregator Data eXchange Platform (CADXP)	
CA.functions	function	Statistical calculations performed by the Commerical aggregator in order to obtain key information for SRP and CRP trading and otpimal energy procurement	
CA.WS	function	web services interface of commercial aggregator	
MOP	function	Market Operator Platform	
SPP	function	Wheater data provider Energy prices for the next day and intraday. Forecast of DERs and demand for the area of the CA for next day and intraday. Chariging hours vehicle	
IED(HEMS).WS	function	Home energy managment system Distributed Energy Resource (Distributed Generation, Demand Response and Storage) interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on Use Case**	**Organistaor / Organisation**	**Link**

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:	No. 1 - Relevant information for commercial aggregator energy procurement						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchange
1	Aggregator receives the relevant information to prepare the bids	Data storage	Executed in parallel with step 81	REPORT	SPP	CA.WS	Demand data DER and switch schedu Meteorological Forcas
2	Aggregator extract historical load and demand information from its database	Data storage	Executed in parallel with step 81	REPORT	CA.RDBMS	CA.functions	long term load and pro forecast short term load and pr forecast
3	Aggregator matches service provider and its own information and store	Data storage	Executed in parallel with step 81	EXECUTE	CA.functions	CA.RDBMS	Control function result

	them in database						

Scenario							
Scenario Name:		No. 2 - Bid preparation					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Infor Exch
1	Extract key information for bid preparation from database	Data storage	Executed in parallel with step 81	EXECUTE	CA.RDBMS	CA.functions	Cont func resul
2	The aggregator prepare the bids to be submitted to the market operator	Commercial optimal planning	Executed in parallel with step 81	EXECUTE	CA.functions	CA.RDBMS	SRP I
3	The aggregator submits the bid to the market operator	Bid submission	Executed in parallel with step 81	REPORT	CA.WS	MOP	SRP I
4	The market operator matches the bid by means of a dedicated algorithm/software	Market clearance	Executed in parallel with step 81	EXECUTE	MOP	MOP	SRP I
5	The market opeartor realize the validation of the technical constraints (asking to DSO and TSO)	Off line validation UC Real time validation UC	Executed in parallel with step 81	EXECUTE	MOP	CA.WS	Valid Resu
6	The aggregator prepare the power schedules	Commercial optimal planning	Executed in parallel with step 81	EXECUTE	CA.functions	CA.RDBMS	Ener plan
7	Commercial aggregator reorganize and forward the poewr schedules to the prosumers	Reading/Writing IEDs setting	Executed in parallel with step 81	REPORT	CA.WS	IED(HEMS).WS	Ener plan

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data

6 Requirements (optional)

Requirements (optional)	

7 Common Terms and Definitions

Common Terms and Definitions	
Term	Definition

8 Custom Information (optional)

Custom Information (optional)		
Key	Value	Refers to Section

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of the Use Case
145		Decentralized FLISR

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Assessment of performance of fault detection, isolation and location algorithms designed for loop scheme network; even in MV grids with a high impact of DG connection.
Objective(s)	
Related business case(s)	

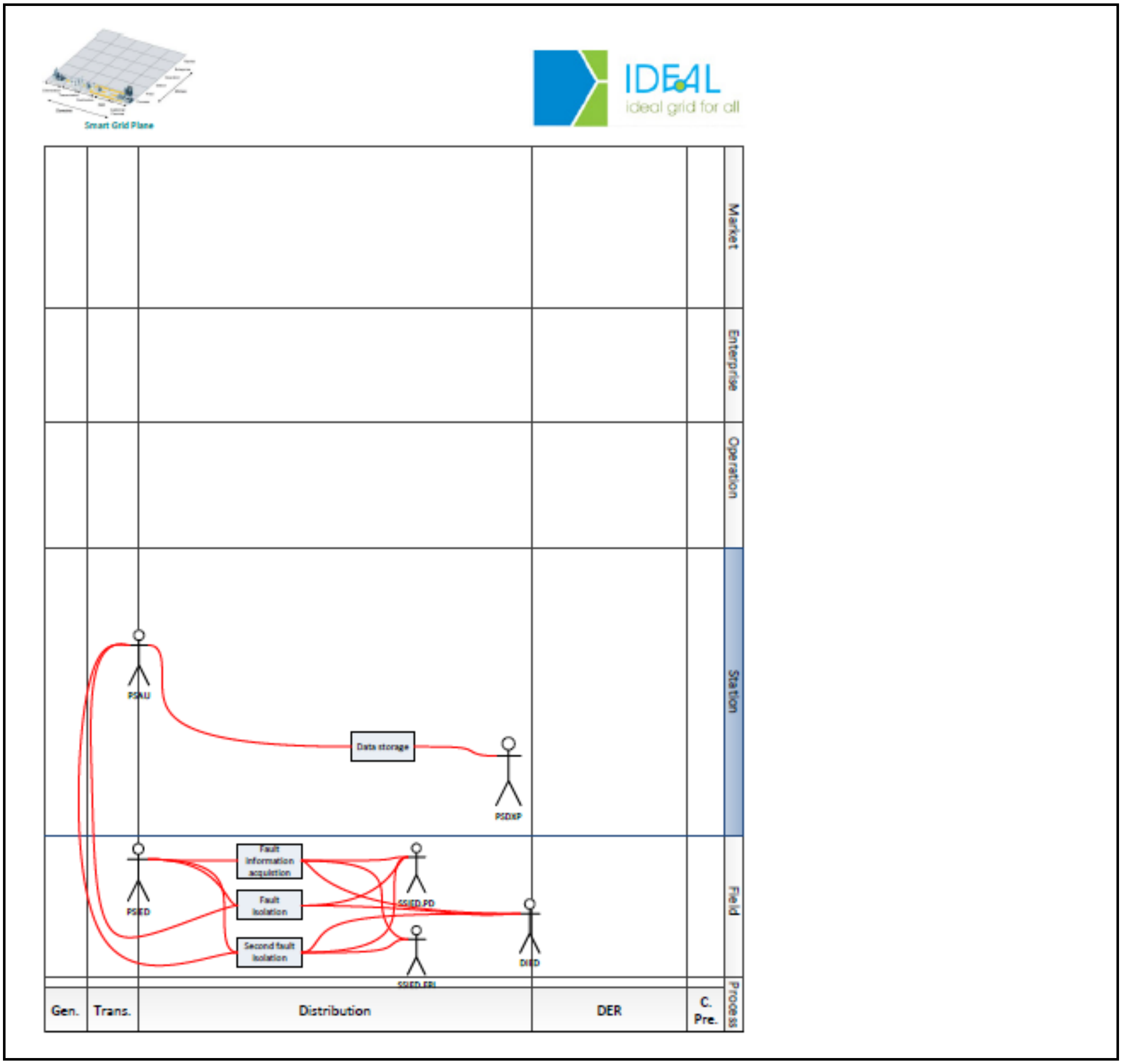
1.4 Narrative of Use Case

Narrative of Use Case
Short description
The use case contemplates the detection process using relevant information for different types of faults. A distributed control functions is proposed in order to locate and isolate the part of the network that has been affected by acting on circuit breakers, switches and microgrid interconnection switches located along the feeder under test. Once the fault is located and isolated, the service restoration process will start.
Complete description
The steps are described below: 1. When a fault happens in one of the areas covered by the feeder, IEDs distributed along the grid will detect it and will extract the fault related information as faulted phases, power flow direction, fault currents, faulted equipment, etc and send directly to peer protection IEDs and reporting it over to the central Primary Substation Data eXchange Platform (PSDXP). This process goes under the name of Fault information acquisition (FIA). 2. The fault detection will trigger a communication process between peer IEDs, located within the area affected by the fault and the protection function which is operating within the Primary Substation Automation Unit (PSAU). The information received will be processed by each intelligent electronic device in order to determine the circuit breaker controller which is nearest the fault location. The opening of this CB will be commanded by its corresponding intelligent electronic device, as well as the block of the opening of the other CBs located along the faulted feeder. This procedure goes under the name of fault processing (FP) function. 3. With the Fault Information Acquisition (FIA) function, the decentralized IEDs controlling switches will communicate, among them and with the PSAU, the fault related information, allowing determining a more precise faulted section area, thus reducing the isolated area. Once the system reaches a steady configuration, all final state reports are sent to the PSAU to inform about the fault location and the current state of CB and Switches. 4. For the service restoration phase, IEDs will run a fast restoration algorithm in order to minimize the outage cost. This procedure goes also under the name Fault processing (FP). Once all possible costumers have been reenergized, a slow restoration algorithm will be performed in a centralized system, with the CCPC use case, in order to determine the optimum reconfiguration according to different cost functions. 5. Data regarding the FLISR process and the new topology are stored, through DS function, in the local DXPs (Primary Substation Data eXchange Platform (PSDXP)).

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
IED(BR-	function	IED controlling a breaker	

CTRL).functions			
IED(BR-CTRL).MMS	function	IED controlling a breaker, MMS interface	
IED(SW-CTRL).GOOSE	function	IED controlling a switch, GOOSE interface	
MGCC.MMS	function	Microgrid central controller, MMS interface	
IED(BR-CTRL).GOOSE	function	IED controlling a breaker, GOOSE interface	
IED(SW-CTRL).functions	function	IED controlling a switch	
IED.MMS	function	IED, MMS interface	
IED.GOOSE	function	IED goose interface	
IED(SW-CTRL).MMS	function	IED controlling a switch, MMS interface	
Actuator(BR)	component	Actuator, breaker	
SAU(PSAU).MMS	function	PSAU, MMS interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**

4.2 Steps - Scenarios

Scenario							
Scenario Name:	No. 1 - Fault event next to the breaker						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	Fault event detected	Fault detection		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
2	Trip delay START	Fault detection		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
3	Trip delay EXPIRED	Fault detection		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
4	Breaker trip	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
5	Trip reporting	Fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
6	MGCC keep connected	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
7	MGCC disconnect	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block connectior
8	DG keep connected	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
9	DG disconnect	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block connectior
10	Autoreclosing timer START	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connectior

11	Autoreclosing timer EXPIRED	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connectio
12	MG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
13	DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).MMS	IED.MMS	Block mess (block disconnect
14	Breaker reclosing process	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Close)
15	Isolation completed	Second fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	AutoReclo

Scenario							
Scenario Name:		No. 2 - Fault event solved by IED operating a switch					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	Fault event detected	Fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
2	Trip delay START	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
3	Trip delay EXPIRED	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
4	Breaker trip	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
5	Trip reporting	Fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
6	MGCC keep connected	Fault isolation		EXECUTE	MGCC.MMS	MGCC.MMS	Block mess (block disconnect
7	MGCC disconnect	Fault isolation		EXECUTE	MGCC.MMS	MGCC.MMS	Block mess (block connectio
8	DG keep connected	Fault isolation		EXECUTE	MGCC.MMS	IED.MMS	Block mess (block disconnect

9	DG disconnect	Fault isolation		EXECUTE	MGCC.MMS	IED.MMS	Block mess (block connectio
10	Autoreclosing timer START	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connectio
11	FPI block messages	Second fault isolation		EXECUTE	IED(SW-CTRL).GOOSE	IED.GOOSE	Block mess (block trip
12	Trip delay START	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip
13	Trip delay EXPIRED	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip
14	Switch open	open/close switch		EXECUTE	IED(SW-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
15	Open reporting	Second fault isolation		REPORT	MGCC.MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
16	MGCC keep connected	Second fault isolation		EXECUTE	MGCC.MMS	MGCC.MMS	Block mess (block disconnect
17	MGCC unblock connect	Second fault isolation		EXECUTE	MGCC.MMS	MGCC.MMS	Block mess (unblock connectio
18	MGCC disconnect	Second fault isolation		EXECUTE	MGCC.MMS	MGCC.MMS	Block mess (block connectio
19	DG keep connected	Second fault isolation		EXECUTE	MGCC.MMS	IED.MMS	Block mess (block disconnect
20	DG disconnect	Second fault isolation		EXECUTE	MGCC.MMS	IED.MMS	Block mess (block connectio
21	Autoreclosing timer EXPIRED	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connectio
22	MG and DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect

23	MG and DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).MMS	IED.MMS	Block mess (block disconnect
24	Breaker reclosing process	Second fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Open / Clo command (Close)
25	Isolation completed	Second fault isolation		REPORT	IED.MMS	SAU(PSAU).MMS	AutoReclos

Scenario							
Scenario Name:		No. 3 - Faulty breaker + Chronometric selectivity					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	Fault event detected	Fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block trip)
2	Trip delay START	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
3	Fault event block from another CB	Fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
4	Breaker fail report	Fault isolation		REPORT	IED.GOOSE	IED.GOOSE	Breaker or switch stat (Trouble)
5	Trip delay EXPIRED	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Breaker or switch stat (Trouble)
6	Breaker trip	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
7	Trip reporting	Fault isolation		REPORT	IED.MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
8	MGCC keep connected	Fault isolation		EXECUTE	IED.MMS	MGCC.MMS	Block mess (block disconnect
9	MGCC disconnect	Fault isolation		EXECUTE	IED.MMS	MGCC.MMS	Block mess (block connectior
10	DG keep connected	Fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block

							disconnect
11	DG disconnect	Fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block connection
12	Autoreclosing timer START	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connection
13	FPI block messages	Second fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block trip)
14	Trip delay START	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip)
15	Trip delay EXPIRED	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip)
16	Switch trip	open/close switch		EXECUTE	IED(SW-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
17	Trip reporting	Second fault isolation		REPORT	IED.MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
18	MGCC keep connected	Second fault isolation		EXECUTE	IED.MMS	MGCC.MMS	Block mess (block disconnect
19	MGCC unblock connect	Second fault isolation		EXECUTE	IED.MMS	MGCC.MMS	Block mess (unblock connection
20	MGCC disconnect	Second fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block connection
21	DG keep connected	Second fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block disconnect
22	DG disconnect	Second fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block connection
23	Autoreclosing timer EXPIRED	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connection
24	MG and DG	Second		EXECUTE	IED(BR-	MGCC.MMS	Block mess

	keep connected	fault isolation			CTRL).MMS		(block disconnect
25	MG and DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).functions	IED.GOOSE	Block mess (block disconnect
26	Breaker reclosing process	Second fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Open / Clo command (Close)
27	Isolation complete	Second fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	AutoReclos

Scenario							
Scenario Name:		No. 4 - Fault event solved by IED operating a switch					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	Fault event detected	Fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
2	Trip delay START	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
3	Trip delay EXPIRED	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
4	Breaker trip	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
5	Trip reporting	Fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
6	MGCC keep connected	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
7	MGCC disconnect	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block connection
8	DG keep connected	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
9	DG disconnect	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block connection
10	Autoreclosing	Second		TIMER	IED(BR-	IED(BR-	Block mess

	timer START	fault isolation			CTRL).functions	CTRL).functions	(block connectio
11	FPI block messages	Second fault isolation		EXECUTE	IED.GOOSE	IED.GOOSE	Block mess (block trip)
13	Trip delay START	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip)
14	Fault event block from another FPI	Second fault isolation		EXECUTE	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip)
15	Switch fail report	Second fault isolation		REPORT	IED(SW-CTRL).MMS	SAU(PSAU).MMS	Breaker or switch stat (Trouble)
16	Trip delay EXPIRED	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Breaker or switch stat (Trouble)
17	Switch open	open/close switch		EXECUTE	IED(SW-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
18	Open status reporting	Second fault isolation		REPORT	IED(SW-CTRL).MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
19	MGCC keep connected	Second fault isolation		EXECUTE	IED(SW-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
20	MGCC unblock connect	Second fault isolation		EXECUTE	IED(SW-CTRL).MMS	MGCC.MMS	Block mess (unblock connectio
21	MGCC disconnect	Second fault isolation		EXECUTE	IED(SW-CTRL).MMS	MGCC.MMS	Block mess (block connectio
22	DG keep connected	Second fault isolation		EXECUTE	IED(SW-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
23	DG disconnect	Second fault isolation		EXECUTE	IED(SW-CTRL).GOOSE	IED.GOOSE	Block mess (block connectio
24	Autoreclosing timer EXPIRED	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connectio

25	MG and DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
26	MG and DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
27	Breaker reclosing process	Second fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Open / Clo command (Close)
28	Isolation completed	Second fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	AutoReclo

Scenario							
Scenario Name:		No. 5 - Failure in single breaker communication					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	Fault event detected	Fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
2	Trip delay START	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
3	Fault event block from another CB NOT Received	Fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
4	Trip delay EXPIRED in prioritary breaker	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
5	Trip delay EXPIRED	Fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block trip)
6	Prioritary breaker trip	Fault isolation		EXECUTE	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Open / Clo command (Open)
7	Breaker trip	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
8	Trip reporting by prioritary breaker	Fault isolation		REPORT	IED(BR-CTRL).functions	SAU(PSAU).MMS	Breaker or switch stat (Open)

9	Trip reporting	Fault isolation		REPORT	IED(BR-CTRL).functions	SAU(PSAU).MMS	Breaker or switch stat (Open)
10	MGCC keep connected by prioritary breaker	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
11	MGCC keep connected	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
12	MGCC disconnect by prioritary breaker	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block connection
13	MGCC disconnect	Fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block connection
14	DG keep connected by prioritary breaker	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
15	DG keep connected	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
16	DG disconnect by prioritary breaker	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block connection
17	DG disconnect	Fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block connection
18	Autoreclosing timer START	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connection
19	FPI block messages	Second fault isolation		EXECUTE	IED(SW-CTRL).functions	IED.GOOSE	Block mess (block trip)
20	Trip delay START	Second fault isolation		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip)
21	Trip delay EXPIRED	Second fault		TIMER	IED(SW-CTRL).functions	IED(SW-CTRL).functions	Block mess (block trip)

		isolation					
22	Switch trip	open/close switch		EXECUTE	IED(SW-CTRL).functions	Actuator(BR)	Open / Clo command (Open)
23	Trip reporting	Second fault isolation		REPORT	IED(SW-CTRL).MMS	SAU(PSAU).MMS	Breaker or switch stat (Open)
24	MGCC keep connected	Second fault isolation		EXECUTE	IED(SW-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
25	MGCC unblock connect	Second fault isolation		EXECUTE	IED(SW-CTRL).MMS	MGCC.MMS	Block mess (unblock connection
26	MGCC disconnect	Second fault isolation		EXECUTE	IED(SW-CTRL).MMS	MGCC.MMS	Block mess (block connection
27	DG keep connected	Second fault isolation		EXECUTE	IED(SW-CTRL).functions	IED.GOOSE	Block mess (block disconnect
28	DG disconnect	Second fault isolation		EXECUTE	IED(SW-CTRL).GOOSE	IED.GOOSE	Block mess (block connection
29	Autoreclosing timer EXPIRED in prioritary breaker	Second fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block connection
30	Autoreclosing timer EXPIRED	Second fault isolation		TIMER	IED(BR-CTRL).functions	IED(BR-CTRL).functions	Block mess (block connection
31	MG and DG keep connected by prioritary breaker	Second fault isolation		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block disconnect
32	MG and DG keep connected by prioritary breaker	Second fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
33	MG and DG keep	Second fault		EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block mess (block

	connected	isolation					disconnect
34	MG and DG keep connected	Second fault isolation		EXECUTE	IED(BR-CTRL).GOOSE	IED.GOOSE	Block mess (block disconnect
35	Prirority Breaker reclosing process	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Close)
36	Breaker reclosing process	open/close switch		EXECUTE	IED(BR-CTRL).functions	Actuator(BR)	Open / Clo command (Close)
37	Isolation complete	Second fault isolation		REPORT	IED(BR-CTRL).MMS	SAU(PSAU).MMS	AutoReclo

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Open / Close command	Open or trip command Close command	
Breaker or switch status	Open Close Trouble	
Isolation complete		
Block message	XCBR -Block open XCBR -Block close	
AutoreclosingSt	Message reporting a status change in the local autoreclosing function. Active/Inactive	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
144		Microgrid FLISR

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	This use case explains the disconnection of a microgrid from the MV distribution grid responding to a status change and analyzes the reconnection to the distribution grid after fault restoration.
Objective(s)	The objective of this use case is to help to develop an isolation switch capable of isolating microgrids.
Related business case(s)	

1.4 Narrative of Use Case

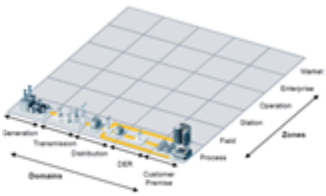
Narrative of Use Case
Short description
This use case explains the disconnection of a microgrid from the MV or LV distribution grid responding to a status change and analyzes the reconnection to the distribution grid after fault restoration. The isolation of microgrids will allow the continuity of the service in case of contingencies in the distribution network.
Complete description
Microgrids can be classified as urban microgrids and rural microgrids, given that the main difference is the point of common coupling (PCC). Urban microgrids are typically connected on a dedicated feeder of the secondary substation, whereas the rural microgrids are connected directly to a MV line through a step-down transformer. All microgrids are connected to the distribution grid through an Interconnection Switch (IS), which in the following description is classified as an IED actor, i.e. the physical element which isolates the microgrid, which consequently defines permanently the borders of the micro grid, as IED.IS. The IS is a smart power switch capable to detect a local (near the PCC) fault in the MV or LV distribution grid or to receive disconnection orders from a higher level agent, such as the microgrid aggregator, the PSAU, or the SSIED.PD. The steps are described as follows: 1. In case of contingencies in the distribution network, the DIED.SWITCH autonomously isolates the microgrid, informing Microgrid central controller (MGCC), by sending a signal with the function Compute Control Signals (SCSs). 2. Messages will be sent from the MGCC to PSAU, with the function Fault Information Acquisition (FIA), to inform it about microgrid status. 3. In island mode, the microgrid has its own local primary control, situated at the DIED.CTRL.MGLC, stabilizing the voltage and frequency of the isolated electrical area. In addition to the primary control, there is an energy management system (EMS) optimizing the internal power flow. This process requires the monitoring of electrical quantities, with function Measurement Acquisition (MA), their checking with Check Status of Electrical Variables (CSEV) function, and some control algorithms, which go under the Control function “CF” set. The control actions are communicated to DIED.CTRL.MGLC through “compute control signals” (SCS) function.

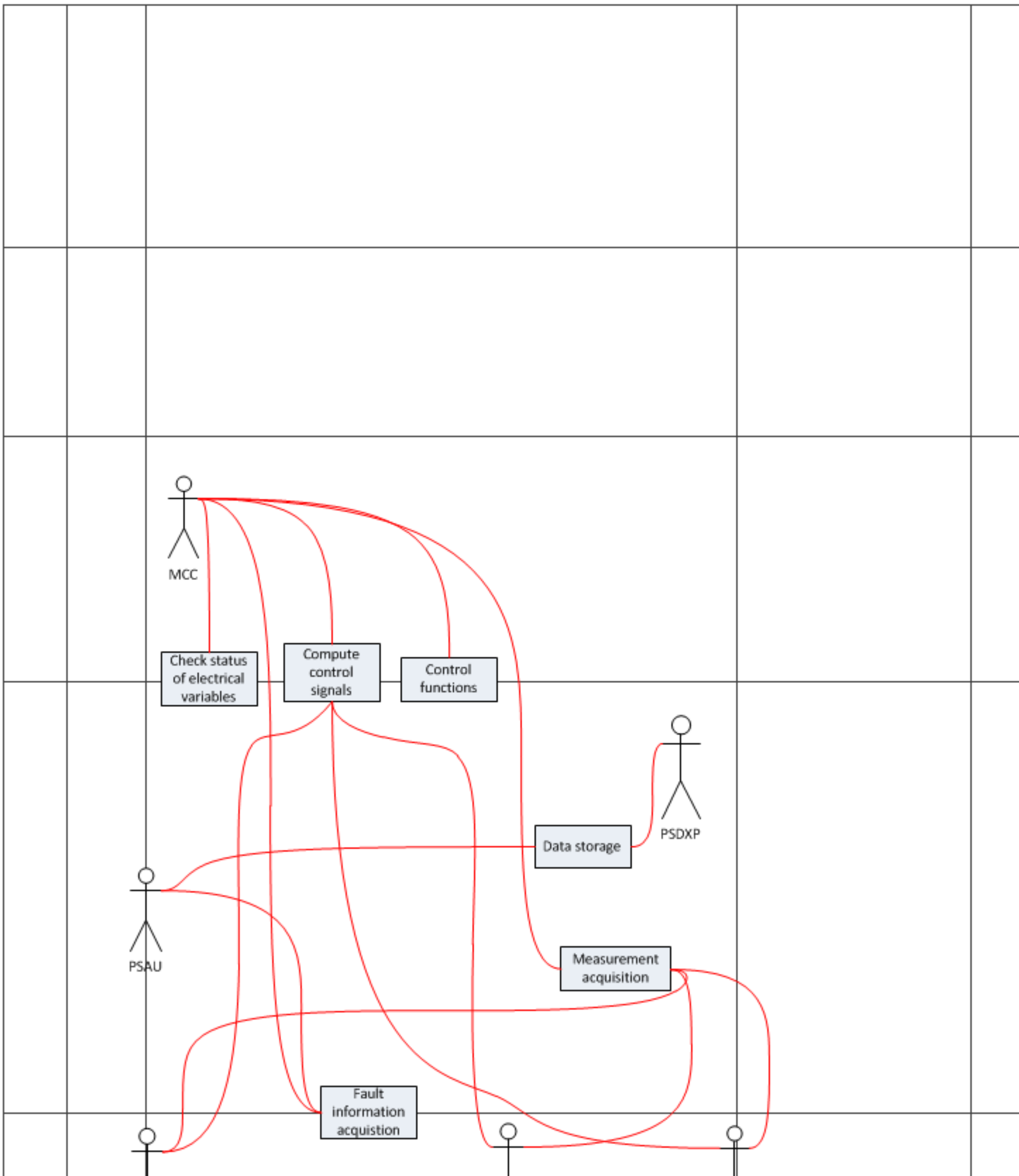
4. During island mode, the MGCC keeps on monitoring the distribution grid to detect whether the fault has been cleared or not, with the Fault Information Acquisition (FIA) function; moreover, MGCC can receive inputs from SSIED.PD.SW or SSIED.PD.BRK indicating the fault has been cleared. These operations go under the function FIA. 5. After the fault has been cleared, the microgrid is coordinated by the microgrid EMS, which goes under the function Control Functions (CFs), situated at MCC level, to synchronize with the distribution grid voltage phase and frequency. Then, DIED.Switch is comanded to resume electrical connection with the rest of the grid, through Compute Control Signals (SCSs) function. 6. Information about the new state of the microgrid is send to the PSAU.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


Smart Grid Plane



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
MGCC.Modbus	function	Centralized microgrid controller aimed to manage the microgrid to perform the reconnection protocol.Modbus interface	
SAU(PSAU).MMS	function	PSAU, MMS interface	
IED.MMS	function	Def. 1 Intelligent Electronic Device located at the distribution network providing capabilities to implement the FLISR . MMS Interface	
MGCC.MMS	function	MGCC, MMS interface	
MGCC.RDBMS	function	MGCC, Database	
MGCC.Functions	function	Reclosure function of MGCC	
IED(DIED-IS-CTRL).Modbus	function	Controller interconnection switch Microgrid Intelligent Electronic Device operating the Interconnection Switch (DIED.SWITCH) Modbus interface	
SAU(SSAU).MMS	function	SSAU, MMS interface	
IED(BR-CTRL).MMS	function	IED, managing the breaker, MMS interface	
IED(DIED-IS-CTRL).functions	function	Controller interconnection switch	
Actuator(IS-CTRL)	component	Actuator of interconnection switch	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References

No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions

No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario

Scenario Name: No. 1 - local fault detection

Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	F F
1	Microgrid isolation information	Data report	The microgrid DIED.SWITCH detects a tripping condition and isolates the microgrids informing the micrgrid central controller MGCC	REPORT	IED(DIED -IS-CTRL).Modbus	MGCC.Modbus	Breaker or switch status	
2	Inform Secondary Substation	Data report	The microgrid informs the	REPORT	MGCC.MMS	SAU(SSAU).MMS	Breaker or switch status	

	about isolation		secondary substation that has been isolated					

Scenario							
Scenario Name:	No. 2 - SSIED.PD blocks isolation						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Infor Exch
1	remote fault occurs, FLISR sends block (opening) signal	Reading/Writing IEDs setting	The FLISR commands the MGCC to block the interconnection switch to remain connected to the distribution grid.	REPORT	SAU(SSAU).MMS	MGCC.MMS	Block mess
2	block IS	Reading/Writing IEDs setting	The MCC informs the microgrid IED (IS) to stay closed during the remote fault	REPORT	MGCC.Modbus	IED(DIED -IS-CTRL).Modbus	Block mess
3	block signal received	Reading/Writing IEDs setting	The MGCC has received the block signal from the FLISR and forwards it to the interconnection switch DIED.SWITCH	REPORT	IED(DIED -IS-CTRL).Modbus	MGCC.Modbus	Block mess

Scenario							
Scenario Name:	No. 3 - Primary substation request status of the microgrid (connected or not)						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged
1	update MGCC	Reading/Writing IEDs setting	The MGCC updates its	GET	IED(DIED -IS-CTRL).Modbus	MGCC.Modbus	Breaker or switch status

	status		internal status vector by polling al IED from the microgrid				
2	update MGCC status	Data storage	The MGCC updates its internal status vector by polling al IED from the microgrid	GET	MGCC.Modbus	MGCC.RDBMS	Breaker or switch status
3	update PSAU with info. from MGCC	Data report	The PSAU requests updated information form MGCC	GET	MGCC.MMS	SAU(PSAU).MMS	Breaker or switch status

Scenario						
Scenario Name:		No. 4 - Grid reconnection				
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**
1	PSAU informs MCC about a fault that has been cleared	Data report	The secondary substations informs that the fault has been cleared and allows the microgrid to reconnect to the distribution grid	REPORT	SAU(PSAU).MMS	MGCC.MMS
2	microgrid synchronizes with dist. grid	synchronization	The MCC commands microgrid IED to sync with the distribution	EXECUTE	MGCC.Modbus	IED(DIED).Modbus

			grid.			
3	IS closes	Reading/Writing IEDs setting	the IS closes autonomously upon sync of microgrid with dist. grid and informs the MCC	REPORT	IED(DIED -IS-CTRL).Modbus	MGCC.Modbus
4	inform secondary substation	Reading/Writing IEDs setting	The MCC informs the SSIED that the microgrid has been reconnected	REPORT	MGCC.MMS	SAU(SSAU).MMS

Scenario							
Scenario Name:	No. 5 - Remote disconnection						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informatio Exchange**
1	IED.BRK sends block (closing)	Reading/Writing IEDs setting	FLISR decides the microgrid should disconnect	EXECUTE	IED(BR-CTRL).MMS	MGCC.MMS	Block message
2	transmits command	Reading/Writing IEDs setting	MCC sends command to the IS	EXECUTE	MGCC.Modbus	IED(DIED-IS-CTRL).Modbus	Block message
3	command received - execute isolation	open/close switch	The micrgrids becomes isolated	EXECUTE	IED(DIED-IS-CTRL).functions	Actuator(IS-CTRL)	Block message

Scenario							
Scenario Name:	No. 6 - Conflicting commands						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Infor Exch**
1	received flag keep connected (block open)	Reading/Writing IEDs setting	SSIED.PD sends a flag to MGCC to block open,	EXECUTE	IED.MMS	MGCC.MMS	recei keep conn (bloc

			i.e. remain connected to distribution grid				
2	received flag keep disconnected, block (close)	Reading/Writing IEDs setting	SSIED.PD sends a block close command to MDCC, i.e. remain disconnect from distribution grid	EXECUTE	IED.MMS	MGCC.MMS	recei keep disco block
3	resolve control conflict	Detect error	MGCC detects conflict in flags from SSIED.PD and triggers isolation of the microgrid	EXECUTE	MGCC.Functions	MGCC.RDBMS	Block mess
4	resolve conflict	Reading/Writing IEDs setting	MGCC detects conflict in flags from SSIED.PD and triggers isolation of the microgrid	EXECUTE	MGCC.Modbus	IED(DIED-IS-CTRL).Modbus	Block mess
5	isolate / keep connected microgrid	Reading/Writing IEDs setting	IS opens and isolates microgrid	EXECUTE	MGCC.Modbus	IED(DIED-IS-CTRL).Modbus	Block mess
6	isolation	open/close switch	IS opens and isolates microgrid	EXECUTE	IED(DIED-IS-CTRL).functions	Actuator(IS-CTRL)	Block mess

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Breaker or switch status	Open Close Trouble	
Block message	XCBR -Block open XCBR -Block close	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
150		Real-Time Validation (RTV)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	This use case shows the interaction between the aggregators and the DSO.Technical aggregators required to validate the technical feasibility of the activation of flexibility products in the short term (15 mintues in advance).
Objective(s)	The objective of this use case is to validate the activation of CRPs previously validated by the Off-Line Validation (OLV) whose activation is required
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The core procedure is almost the same as in the OLV tool. The main difference is that this Tool is used for products traded during the intra-day market and for CRPs that are activated by the CA at any time of the day. Due to the close to real-time use of this Tool (i.e. 15 minutes before the deployment), the real description of the system is used (topology, load, generation etc.)
Complete description
1. **DR Products** RTV Re-checks the feasibility of • CRPs previously validated by the Off-Line Validation (OLV), whose activation is

required

- **NOT** the SRP products already validated by OLV. They are considered as activated.
- **NOT** the CRP products activated by the DSO.Technical aggregator

2. **Sequence Description:**

   The RTV is used by both the DSO.Technical aggregator and the TSO. The procedure that is followed is:

   - First, the CA submits the bids to be Validated by the DSO.Technical aggregator
   - The DSO.Technical aggregator aggregates the bids per Load Area and validates them. If needed, a curtailment factor is applied
   - The DR products are aggregated per Macro Load Area (MLA) and sent to the TSO.
   - The validation procedure is repeated by the TSO
   - A final validation or curtailment factor is applied, by combining the response of both the DSO.Technical aggregator and the TSO.
   - The combined responses of the DSO-TA and the TSO, i.e. the acceptance reply or the curtailment factor per load area, are sent to the CAs involved.

3. **Time Frame**

   This process is repeated every 15 minutes

4. **Differences with OLV**

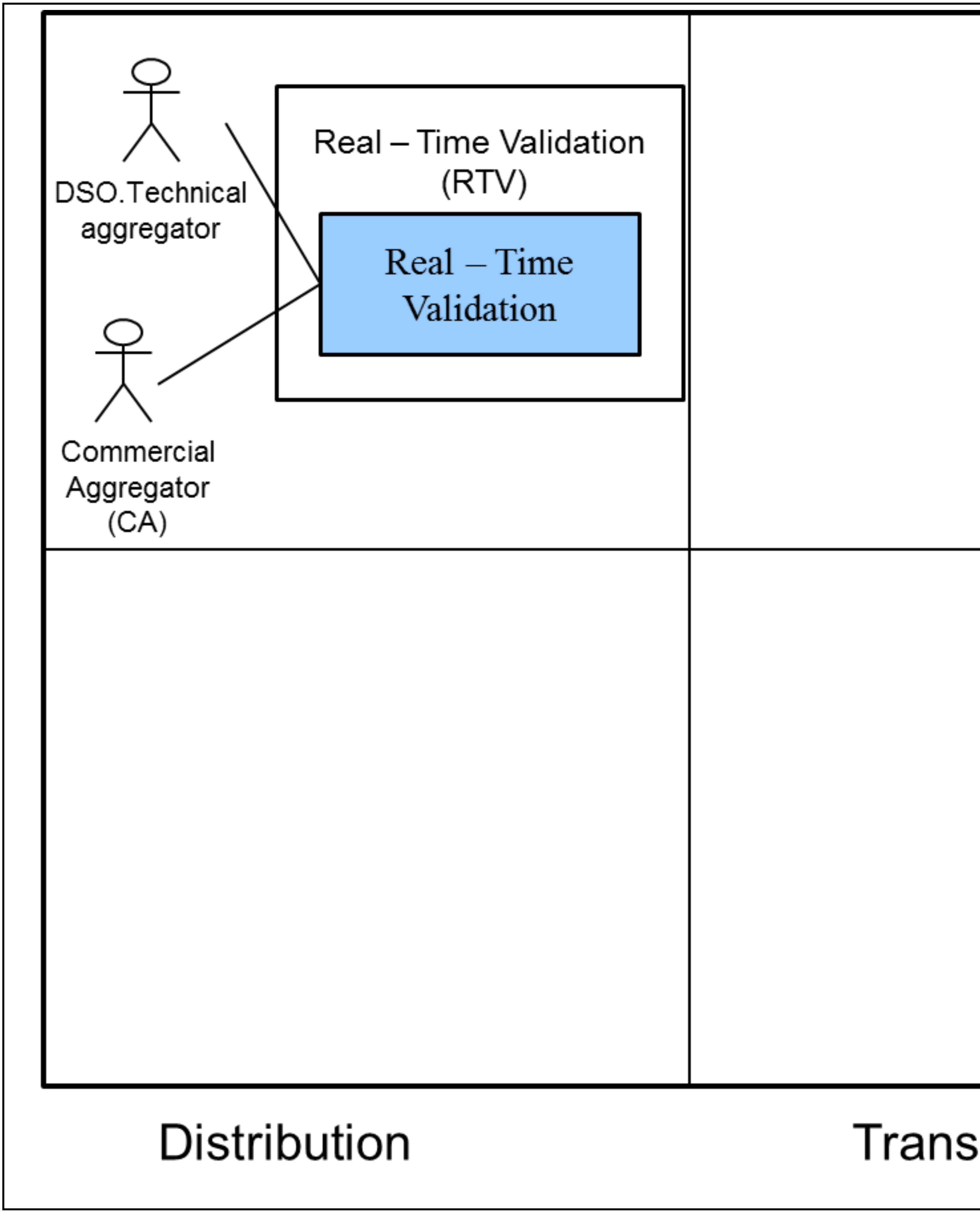
The differences with the OLV algorithm are that:

- Only the CRPs to be activated are checked. The previously validated SRPs are considered as validated.
- The real network topology is now used for the Power flow.
- The RTV algorithm applies corrective actions for the voltage control trying to maximize DR products feasibility.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



DSO.Technical aggregator
Real – Time Validation (RTV)
Real – Time Validation
Commercial Aggregator (CA)
Distribution
Trans

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.functions	function	Distribution System Operator - Technical Aggregator (DSO. Technical aggregator) according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.	
TSOEMS	function	Transmission system energy management system according to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.	
CA.functions	function	The commercial aggregator offers services to aggregate energy production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand	

		Response management) and supply (generation management). In cases where the aggregator is not a supplier, it maintains a contract with the supplier.	
DMS.WS	function	DMS web service interface	
CA.WS	function	commercial aggregator web service interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Off-line Validation (OLV);
Level of Depth
Detatailed Use CAse
Priorisation
Generic, Regional or National Relation
National Relation
Viewpoint
Technical
Further Keyword for Classification
Off-line Validation, CRP, SRP, DSO

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - Bid Acceptance					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**
1	Validation	Validation request	The bids to be validated are sent to the DSO.Technical aggregator	EXECUTE	CA.functions	CA.WS	Request for CRP Activation
2	Validation	Validation request	The bids to be validated are sent to the DSO.Technical aggregator	EXECUTE	CA.WS	DMS.WS	Request for CRP Activation
3	Corrective actions and Validation by the DSO.Technical aggregator	Power flow	The DSO.Technical aggregator accepts the bids or applies corrective actions and then sents the bids for validation by the TSO	EXECUTE	DMS.WS	DMS.functions	Request for Validation (by TSO)
4	Forwarding plan to TSO	Data report	The validation results of the TSO are sent to the DSO.Technical aggregator	EXECUTE	DMS.WS	TSOEMS	Response of TSO
5	Response by the TSO	Power flow	The validation results of the TSO are sent to the DSO.Technical aggregator	EXECUTE	TSOEMS	DMS.WS	Response of TSO
6	Modification Reply	Validation reply	The combined validation results are sent to the CA	EXECUTE	DMS.WS	CA.WS	Bid Acceptance or Modification

Scenario

Scenario Name:		No. 2 - Bid Modification					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged
1	Validation	Validation Request	The bids to be validated are sent to the DSO.Technical aggregator	EXECUTE	CA.WS	DMS.WS	validation request
2	Validation	Power flow	The bids to be validated are sent to the DSO.Technical aggregator	EXECUTE	DMS.WS	DMS.functions	Request for CRP Activation
3	Corrective actions and Validation by the TSO	Data report	The DSO.Technical aggregator accepts the bids or applies corrective actions and then sents the bids for validation by the TSO	EXECUTE	DMS.WS	TSOEMS	Request for Validation (by TSO)
4	Response by the TSO	Validation reply	The validation results of the TSO are sent to the DSO.Technical aggregator	EXECUTE	TSOEMS	DMS.WS	Response of TSO
5	Modification Reply	Validation reply	The combined validation results are sent to the CA	EXECUTE	DMS.WS	CA.WS	Bid Acceptance or Modification

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	Description of Information Exchanged	Requirements to information data
Request for CRP Activation	The Commercial Aggregator sends a signal to the DSO-TA to request the validation of a CRP to be activated. They are sent through internet services. It contains power to be activated, load area, time	

Request for Validation (by TSO)	The DSO.Technical aggregator sends the bids (CRPs or SRPs) to be validated by the TSO	
Response of TSO	The TSO sends his response, either accepting or curtailing the bids	
Bid Acceptance or Modification	In case the bids can not be validated, due to network constraints violation, a modification is requested, else they are accepted. It contains a curtailment factor. So that the commercial aggregator can apply that CRP with a certain Delta P	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
183		Off-line Validation (OLV)

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	This use case shows the interaction between the CAs and the DSO.Technical aggregators, and the DSO.Technical aggregators and the TSO, required to validate technical feasibility of the bids resulting from the market clearing process
Objective(s)	Validation of the CA's day-ahead and intra-day market bidding
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Used for Day-Ahead, Intra-day Market Validation. Validation in fixed steps (15 minutes steps) rather than over the whole day-ahead period. If flexibility products are not feasible during a time slot, they will be curtailed with disregard of the results for another time slot.
Complete description
1. **AD Products**

All the Demand Response (DR) products by the different CAs, which have to be validated in the same Load Area (LA), are aggregated. The DR products validated can be:

- SRPs
- Already activated CRPs (the re-profiling is obligatory for the activated CRPs)
- The CRPs that may or may not be activated in intraday market should be validated afterwards.
- The SRPs and the already activated CRPs are prioritized.

2. **Sequence Description:**

The OLV is used by both the DSO.Technical aggregator and the TSO. The procedure that is followed is:

- First, the MO submits the bids to be Validated by the DSO.Technical aggregator
- The DSO.Technical aggregator aggregates the bids per Load Area and validates them. If needed, a curtailment factor is applied
- The DR products are aggregated per Macro Load Area (MLA) and sent to the TSO.
- The validation procedure is repeated by the TSO
- A final validation or curtailment factor is applied, by combining the response of both the DSO.Technical aggregator and the TSO.
- The results are sent to the MO

3. **Time Frame**

This process is applied right after the day-ahead market gate. The validation algorithm is run for timeslots of 15 minutes. This means that the validation is not executed for the whole day-ahead period, but for every 15 min. time slot independently.

4. **OLV Algorithm**

The submitted bids (DR Products), as well as the forecasted state of the network (Loads, Generation, Topology), are the inputs of the OLV algorithm. Then, the System Operator runs a Power Flow and/or an Optimal Power Flow, in order to check for any limit violation in the network. If no violations are calculated the DR products are accepted, else they are curtailed or rejected.

The steps of the algorithm are:

- During the day ahead, the base load/generation of the network, without the activation of the DR, is forecasted, along with the plans for the network topology for the day after.
- The DR products to be validated are sent by the CAs to the DSO.Technical aggregator . They are aggregatedper load area and added to the bus data
- A Power Flow is executed by the DSO.Technical aggregator , to check the voltage, branch loading and power capabilities constraints of the network.
- If from DSO.Technical aggregator's point of view, the requirement is not accepted, DSO.Technical aggregator performs an Optimal Power Flow in order to find the *minimum* amount of DR that should be curtailed

It is Formulated as single period MINL **Optimal Power Flow:**

- Objective function: Minimise flexibility products curtailment
- Equalities: Power flow in each node
- Inequalities:
  - Voltage constraints
  - Branch capacity constraints

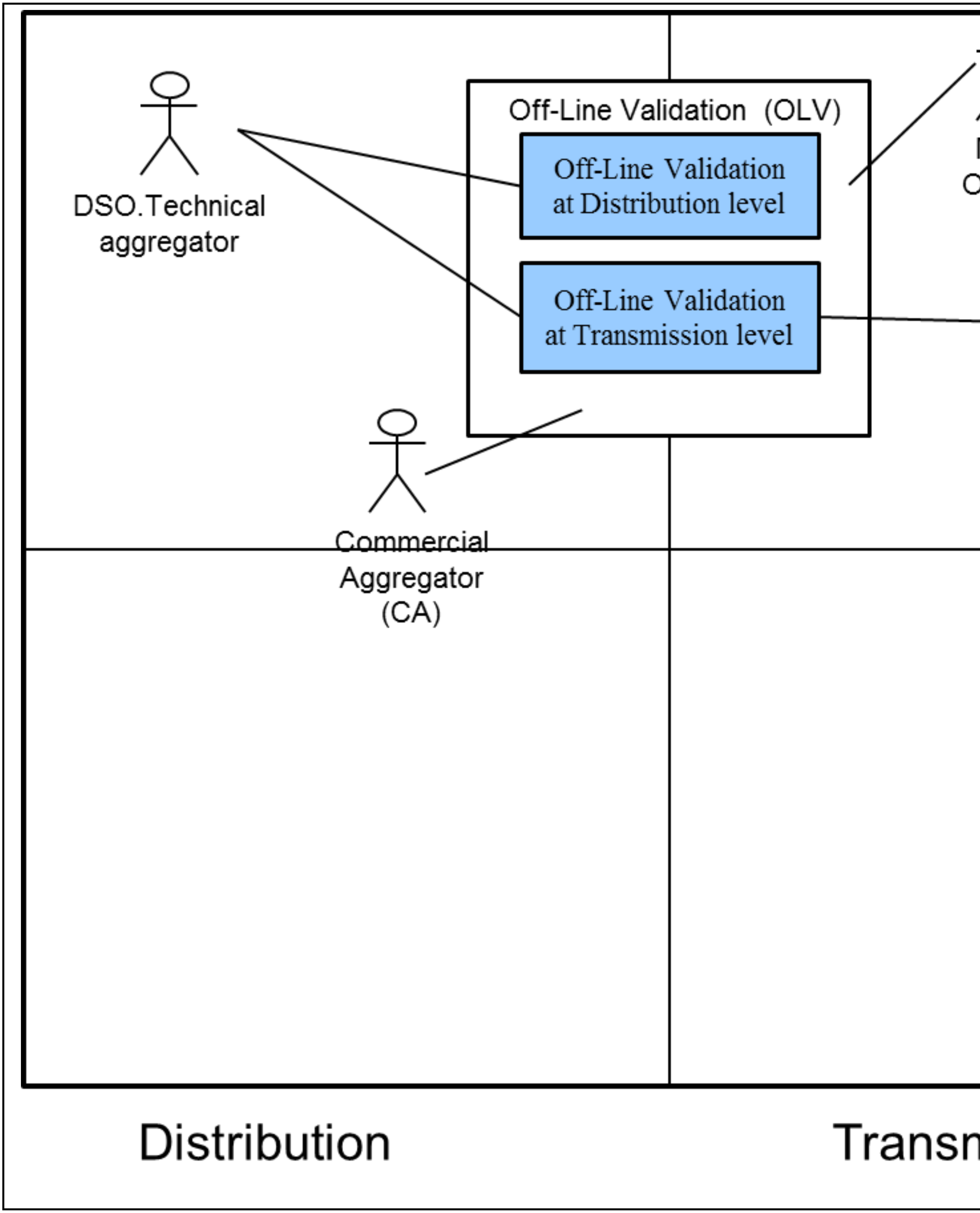
- Power generation capabilities of flexible injection model that can be used for both DG and DR

- Next, the TSO must validate and verify this DR service. In order to carry out this step, DSO.Technical aggregator aggregates the (possibly already curtailed) product per Macro Load Area and sends the request to TSO for validation, using the same procedure
- The final reply is sent to the CAs

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


Off-Line Validation (OLV)
Off-Line Validation at Distribution level
Off-Line Validation at Transmission level
DSO.Technical aggregator
Commercial Aggregator (CA)
Distribution

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.functions	Function	Distribution System Operator - Technical Aggregator (DSO. Technical aggregator) according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.	
DMS.WS	function	DMS, Web service interface	
TSOEMS	function	according to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.	
MOP	function	The unique power exchange of trades for the actual delivery of energy that receives the bids from the Balance Responsible Parties that have a contract to bid. The market operator determines the market energy price for	

		the market balance area after applying technical constraints from the system operator. It may also establish the price for the reconciliation within a metering grid area.	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed Use Case
Priorisation
Generic, Regional or National Relation
National Relation
Viewpoint
Technical
Further Keyword for Classification
DSO.Technical aggregator, TSO, Validation, Bids

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario								
Scenario Name:		No. 1 - Bid Acceptance						
Step No.	Event.	Name of Process/	Description of Process/	Service	Information Producer	Information Receiver	Information Exchanged	

		Activity	Activity.		(Actor)	(Actor)		
1	Validation from MO to DMS.TA	Validation request	The bids to be validated are sent to the DSO.Technical aggregator	EXECUTE	MOP	DMS.WS	Request for bid Validation (by DSO.Technical aggregator)	
2	Validation by the DMS.TA	Power flow	The DSO.Technical aggregator sents the bids for validation by the TSO	EXECUTE	DMS.WS	DMS.functions	Request for Validation (by TSO)	
3	Response of the TSO	Data report	The validation results of the TSO are sent to the DSO.Technical aggregator	EXECUTE	DMS.WS	TSO	Bid Acceptance or Modification	
	Response of the TSO	Validation reply	The validation results of the TSO are sent to the DSO.Technical aggregator	EXECUTE	TSO	DMS.WS	Bid Acceptance or Modification	
4	Validation	Validation reply	The combined validation results are sent to the MO	EXECUTE	DMS.WS	MOP	Bid Acceptance or Modification	

Scenario								
Scenario Name:		No. 2 - Bid Modification						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Re R-**
1	Validation	Validation request	The bids to be validated are sent to the DSO.Technical aggregator	EXECUTE	MOP	DMS.WS	Request for bid Validation (by DSO.Technical aggregator)	
2	Curtailment and validation by the TSO	Power flow	The bid are curtailed by the DSO.Technical aggregator to	EXECUTE	DMS.WS	TSO	Request for Validation (by TSO)	

			comply with the network constraints. Then they are sent to the TSO to be validated.					
3	Validation or modification by the TSO	Power flow	The validation results of the TSO (acceptance or modification) are sent to the DSO.Technical aggregator	EXECUTE	TSO	DMS.WS	Bid Acceptance or Modification	
4	Validation	Validation reply	The combined validation results are sent to the Aggregator	EXECUTE	DMS.WS	MOP	Bid Acceptance or Modification	

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Bid Acceptance or Modification	In case the bids can not be validated, due to network constraints violation, a modification is requested, else they are accepted. It contains a curtailment factor. So that the commercial aggregator can apply that CRP with a certain Delta P	
Request for Validation (by TSO)	The DSO.Technical aggregator sends the bids (CRPs or SRPs) to be validated by the TSO	
Request for bid Validation (by DSO.Technical aggregator)	The MO sends the bids (CRPs or SRPs) to be validated by the DSO.Technical aggregator	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
151		Load Areas Configuration

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	This use case shows the interaction between the TSO and the DSO.Technical aggregators, and between the DSO.Technical aggregators and the CAs, required to assign the macro load areas/load areas/prosumers properly.
Objective(s)	This configuration process would be performed for including new prosumers in the aggregation portfolio and should be updated periodically.
Related business case(s)	

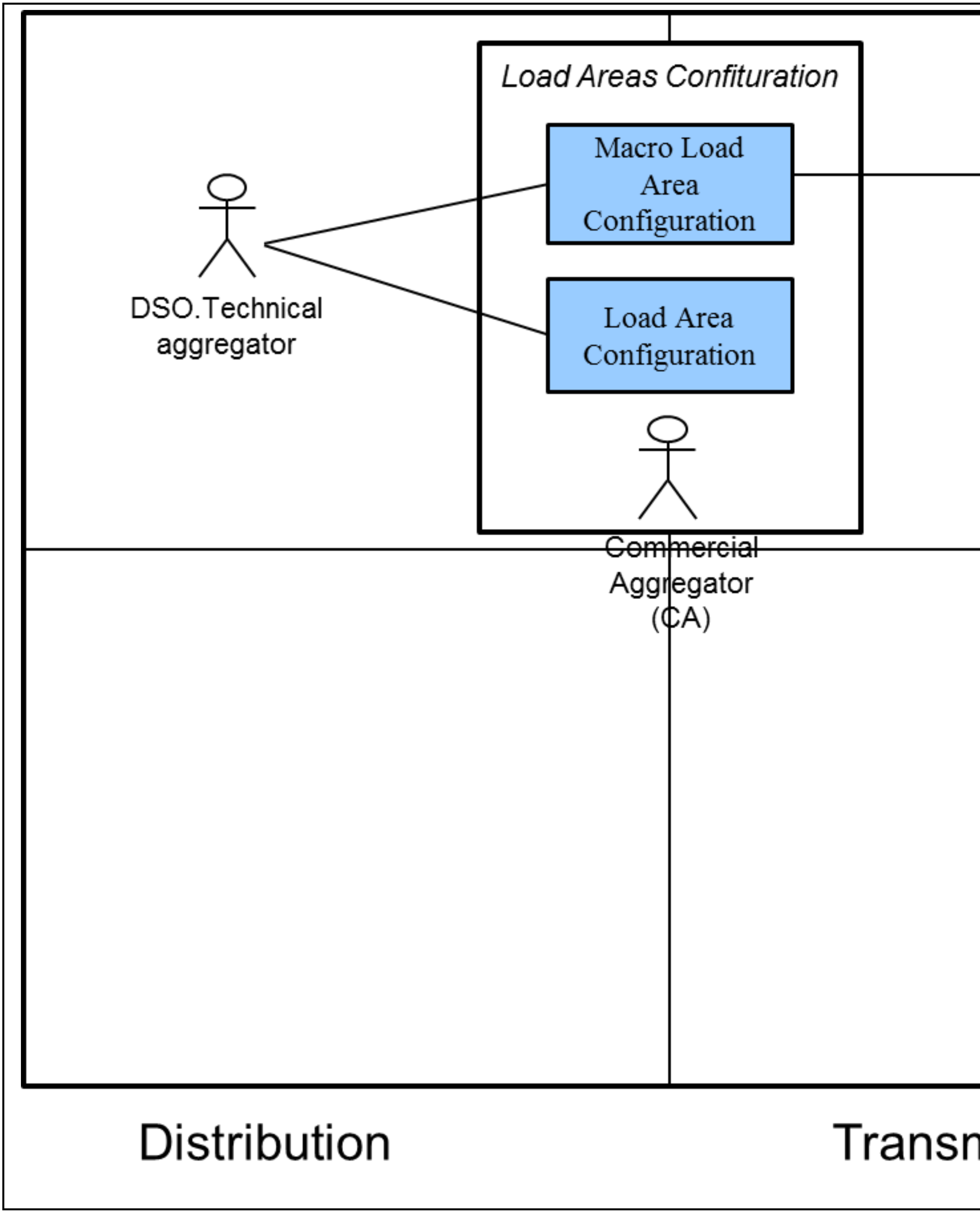
1.4 Narrative of Use Case

Narrative of Use Case
Short description
The function of the load area is to group prosumers in terms of: consumption pattern, impedance value, prosumer connectivity, and other parameters to be considered by the DSO.Technical aggregator .
Complete description
Steps: • TSO assigns each (DSO.Technical aggregator s') load area to a macro load area and communicates this information to the DSO.Technical aggregator s. • The DSO.Technical aggregator assigns each prosumer to a load area and communicates this information to the CAs. Assumption: DSO.Technical aggregator has the knowledge of which low voltage consumer is in the portfolio of each CA; this is done off-line and would not be part of this use case.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



Load Areas Confituration
Macro Load Area Configuration
Load Area Configuration
DSO.Technical aggregator
Commercial Aggregator (CA)
Distribution
Transm

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
TSOEMS		according to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.	
DMS.functions		Distribution System Operator - Technical Aggregator (DSO. Technical aggregator) according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.	
CA.WS		The commercial aggregator offers services to aggregate energy production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand Response management) and supply (generation management). In cases	

		where the aggregator is not a supplier, it maintains a contract with the supplier.	
DMS.WS		DMS, WS interface	
DMS.RDBMS		DMS Database	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Detailed Use Case
Priorisation
Generic, Regional or National Relation
National Relation
Viewpoint
Technical
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - LA Configuration due to network changes					
Step No.	Event.	Name of Process/	Description of Process/	Service	Information Producer	Information Receiver	Informatio Exchange

		Activity	Activity.		(Actor)	(Actor)	
1	Macro Load area configuration	Load area configuration	Assignment of LAs to MLAs	EXECUTE	TSO	TSO	Configurat of the Mac Load Area
2	Macro Load area configuration	Data report	Assignment of LAs to MLAs	EXECUTE	TSO	DMS.WS	Configurat of the Mac Load Area
3	Macro Load area configuration	Data storage	Assignment of LAs to MLAs	EXECUTE	DMS.WS	DMS.RDBMS	Configurat of the Mac Load Area
4	Macro Load area configuration	Load area configuration	Assignment of LAs to MLAs	EXECUTE	DMS.RDBMS	DMS.functions	Configurat of the Mac Load Area
5	Macro Load area configuration	Data storage	Assignment of LAs to MLAs	EXECUTE	DMS.functions	DMS.RDBMS	Configurat of the Mac Load Area

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Configuration of the Macro Load Areas	The Macro Load Area configuration is assigned	
Configuration of the Load Areas	The Load Area configuration is assigned	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
149		SRP Day-ahead and intra-day market procurement

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Market trading of SRP (Scheduling Re-Profiling) products for the day-ahead and intra-day energy markets, where the CA will have the obligation to provide a specified demand modification (reduction or increase) at a given time to a flexibility buyer.
Objective(s)	Day-ahead and intra-day market clearing for obtaining the set of accepted bids and the market clearing price.
Related business case(s)	

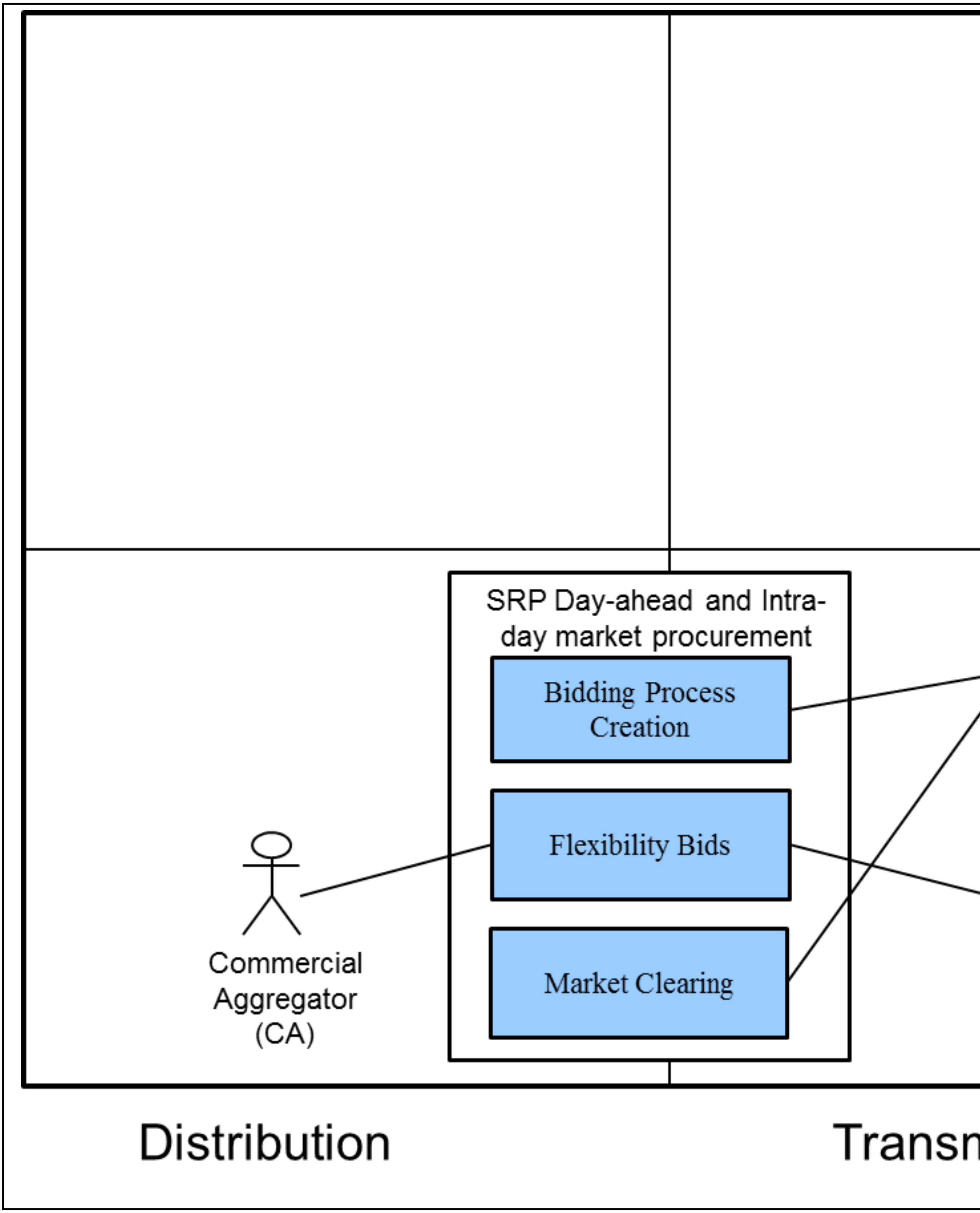
1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case shows the interaction of the flexibility buyers (BRPs) and suppliers (CAs) with the MO so as to enable market clearing for SRP products in the day-ahead and intra-day markets
Complete description
The MO will send a bidding process creation message to flexibility providers/buyers before the gate opens for the day-ahead or intra-day market (SRP). In between gate opening and gate closure of the market, flexibility bids will be taken into consideration during the clearing phase. Flexibility buyers/providers will submit flexibility bids to be considered during the market clearing phase. These bids should be sent during the gate opening period. One message will be sent for each load area for which the service is required/offered. Finally the market will clear itself to work out the set of accepted bids and the market clearing price. This information will be published by the MO to inform the flexibility buyers/providers about the market clearing price and the bidding acceptance. For those accepted bids, the possible modifications on the accepted volume will be also communicated.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


SRP Day-ahead and Intra-day market procurement
Bidding Process Creation
Flexibility Bids
Market Clearing
Commercial Aggregator (CA)
Distribution

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
CA.WS	roles	Offers services to aggregate energy production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand Response management) and supply (generation management). In cases where the CA is not a supplier, it maintains a contract with the supplier.	
BRPP	function	A party that has a contract proving financial security and identifying balance responsibility with the imbalance settlement responsible of the market balance area entitling the party to operate in the market. This is the only role allowing a party to buy or sell energy on a wholesale level.	
MOP	function	The unique power exchange of trades for the actual delivery of energy that receives the bids from the Balance Responsible Parties that have a contract to bid. The market operator determines the market energy price for the market balance area after applying technical constraints from the system operator. It may also establish the price for the reconciliation within a metering grid area.	
DMS.WS	function	according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO.Technical aggregator is responsible for regional grid access	

		and grid stability, integration of renewables at the distribution level and regional load balancing.	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Off-line Validation (OLV);
Level of Depth
Detailed Use Case
Priorisation
Generic, Regional or National Relation
National Relation
Viewpoint
Business
Further Keyword for Classification
Scheduled Re-Profiling, SRP, Market

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - SRP procured by BRP					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Informatio Exchange

1	Market Gate opening	Market infos	The submission of offers and demand starts	EXECUTE	MOP	CA.WS	Market Gate-opening signal
2	SRP submission from CA	Bid submission	The SRPs are submitted to the market	EXECUTE	CA.WS	MOP	Flexibility Offer
3	SRP demand from BRPs	Bid submission	The demand of SRPs is submitted to the market by the BRP	EXECUTE	BRPP	MOP	Flexibility Demand
4	Market Gate Closure	Market infos	The trading stops	EXECUTE	MOP	CA.WS	Market Ga closure
5	off-line validation use case	off line validation	The trading is completed	EXECUTE	MOP	MOP	Bid Acceptanc or Modificati
6	Bid Validation	Bid acceptance/modification	If the SRP violates the network constraints, then it is modified, else it is accepted	EXECUTE	MOP	CA.WS	Bid Acceptanc or Modificati
7	Bid Validation	Bid acceptance/modification	If the SRP violates the network constraints, then it is modified, else it is accepted	EXECUTE	MOP	BRPP	Bid Acceptanc or Modificati
5	Market clearance	Market clearance	The trading is completed	EXECUTE	MOP	MOP	Results Publishme

Scenario							
Scenario Name:		No. 2 - SRP Procured by DSO.Technical aggregator					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Inform Excha**
1	Market Gate Opening	Market infos	The submission of offers and demand starts	EXECUTE	MOP	CA.WS	Marke Gate- openi signal
2	SRP submission from CA	Bid submission	The SRPs are submitted to the market	EXECUTE	CA.WS	MOP	Flexibi Offer
3	SRP demand from DSO.TA	Bid submission	The demand for SRPs is submitted to the market by the DSO.Technical aggregator	EXECUTE	DMS.WS	MOP	Flexibi Demar
4	Market Gate Closure	Market infos	The trading stops	EXECUTE	MOP	CA.WS	Marke closur
5	Market clearance	Market clearance	The trading is completed	EXECUTE	MOP	MOP	Result Publis
6	Off line validation UC	off line validation	The trading is completed	EXECUTE	MOP	MOP	Bid Accep or Modif
7	Bid modification submission	Bid acceptance/modification	The trading is completed	REPORT	MOP	CA.WS	Bid Accep or Modif
8	Bid modification submission	Bid acceptance/modification	The trading is completed	REPORT	MOP	DMS.WS	Bid Accep or Modif

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Market Gate-	Used by the MO to inform about the	

opening signal	opening of the market.	
Flexibility Offer	The CA submits the available offers of DR.	
Flexibility Demand	The DR product buyers submit their demand for products	
Market Gate closure	The MO informs about the market gate closure, i.e. the end of bid submission.	
Results Publishment	The MO publishes the results of the market clearance, in order to inform the interested actors.	
Bid Acceptance or Modification	In case the bids can not be validated, due to network constraints violation, a modification is requested, else they are accepted. It contains a curtailment factor. So that the commercial aggregator can apply that CRP with a certain Delta P	

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
182		CRP Activation

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Interaction between the flexibility buyers and the CAs required to activate a CRP (conditional re-profiling) flexibility product. DSO.Technical aggregator technical validation is out of the scope of this use case.
Objective(s)	To define the procedure for the activation of a CRP service (conditional re-profiling): The CA must have the capacity to provide a specified load profile modification (reduction or increase) during a given period. The delivery is called upon by the buyer of the flexibility product (similar to a reserve service).
Related business case(s)	

1.4 Narrative of Use Case

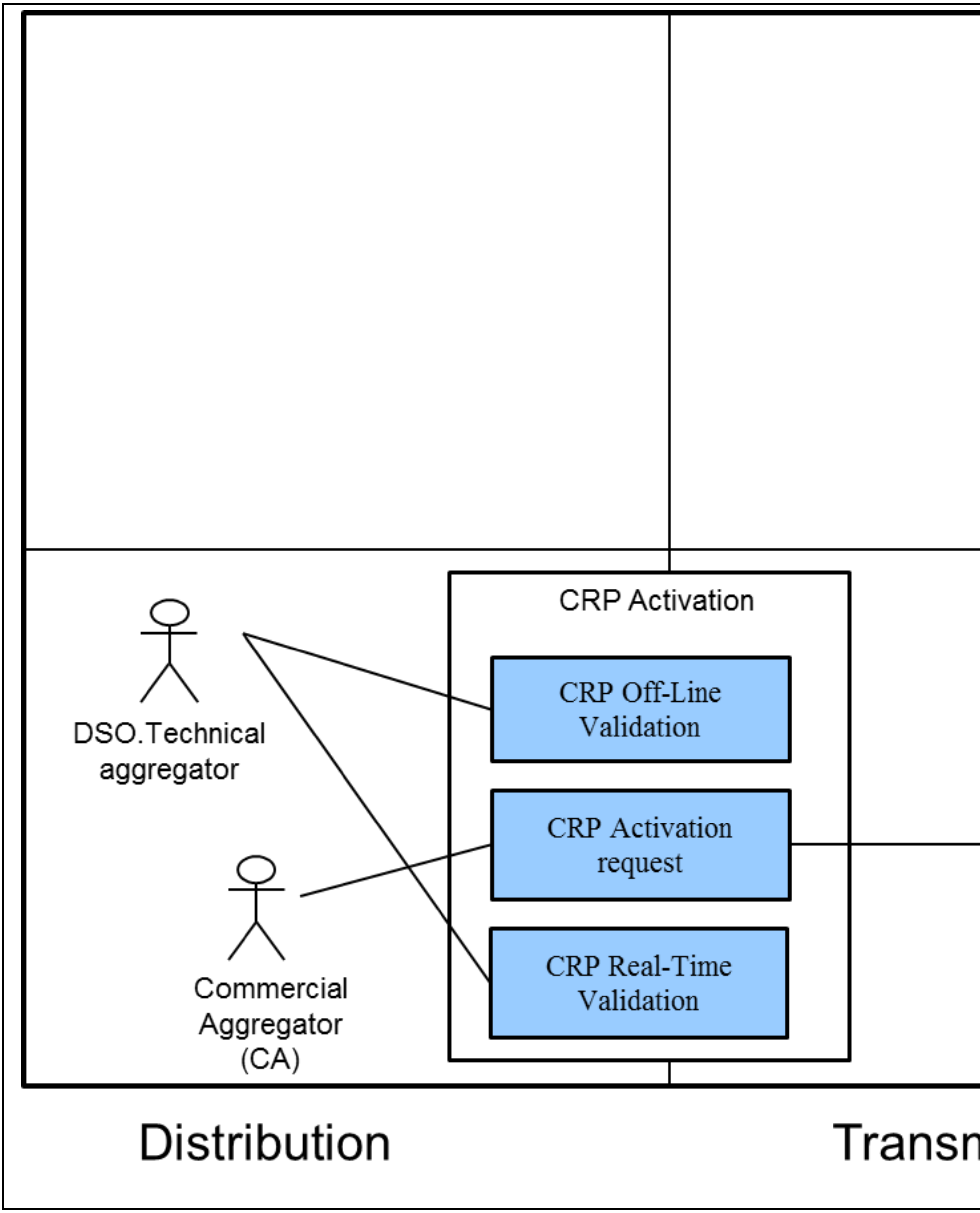
Narrative of Use Case

Short description
This use case shows the interaction between the flexibility buyers and the aggregators, required to activate a CRP (conditional re-profiling) flexibility product.
Complete description
A flexibility buyer (DSO.Technical aggregator, TSO…) identifies the need to activate a previously settled CRP product for balancing and/or congestion management proposes. The flexibility buyer needs to send an explicit signal to the CA, telling that the CRP product needs to be activated. CRPs were previously validated by the Off-Line Validation (OLV). The DSO.Technical aggregator Real Time Validation (RTV) process has to approve the CRP activation request before its activation. Both validation processes are out of the scope of this use case and are further described in the RTV and OLV use cases.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case


CRP Activation
CRP Off-Line Validation
CRP Activation request
CRP Real-Time Validation
DSO.Technical aggregator
Commercial Aggregator (CA)
Distribution
Transm

3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
CA.WS	roles	Offers services to aggregate energy production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand Response management) and supply (generation management). In cases where the CA is not a supplier, it maintains a contract with the supplier.	
DMS.WS	roles	according to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity". Moreover, the DSO.Technical aggregator is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.	
BRPP	Roles	Balance responsible party as potential buyer of a CRP, including the BRP, the retailer, the producer, etc.	
IED(HEMS).WS	function	Home energy management system, WS interface	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Real-Time Validation (RTV);
Level of Depth
Detailed Use Case
Priorisation
Generic, Regional or National Relation
National Relation
Viewpoint
Business
Further Keyword for Classification
Conditional Re-profiling, CRP

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:	No. 1 - CRP Activation						
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged
1	Activation signal	CRP activation request	The BRP request for a CRP to be activated by the CA	EXECUTE	BRPP DMS.WS	CA.WS	CRP activation request
2	Validation request	Real time validation UC	The CRP must be validated by the DSO.Technical aggregator before it can be activated	EXECUTE	CA.WS	CA.WS	validation results

3	Activation of CRP	Data report	The CRP is activated by the CA	EXECUTE	CA.WS	BRPP DMS.WS	CRP Activation
4	Activation of CRP	Reading/Writing IEDs setting	The CRP is activated by the CA	EXECUTE	CA.WS	IED(HEMS).WS	CRP Activation

Scenario							
Scenario Name:		No. 2 - Modifed CRP activation					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Informati Exchange**
1	Activation Signal	CRP activation request	The BRP request for a CRP to be activated by the CA	EXECUTE	BRPP DMS.WS	CA.WS	CRP activation request
2	Validation request	CRP Validation request	The CRP must be validated by the DSO.Technical aggregator before it can be activated	EXECUTE	CA.WS	DMS.WS	validation results
3	Modification of the CRP before it is actvated	Real time validation UC	The corrective actions taken by the DSO.Technical aggregator are not enough. The CRP must be modified before activated	EXECUTE	DMS.WS	CA.WS	Validatior Results
4	Activation	Reading/Writing IEDs setting	The CRP is activated by the CA	EXECUTE	CA.WS	IED(HEMS).WS	CRP Activatior

Scenario								
Scenario Name:		No. 3 - CRP Activation by the DSO.Technical aggregator						
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**R R**

1	Activation Signal	CRP activation request	The BRP request for a CRP to be activated by the Aggregator	EXECUTE	DMS.WS	CA.WS	CRP Activation Request	
2	Activation	Data report	The CRP is activated by the Aggregator	EXECUTE	CA.WS	DMS.WS	CRP Activation	
3	Activation	Reading/Writing IEDs setting	The CRP is activated by the Aggregator	EXECUTE	CA.WS	IED(HEMS).WS	CRP Activation	

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
CRP Activation	The activation of the CRP is announced to the procurer of the CRP	
CRP Activation Request	The buyer of the CRP request its activation by the CA	
CRP Validation	The CA asks the DSO.Technical aggregator to validate the activation of the CRP	
Validation Results	The results of the DSO.Technical aggregator's validation are sent to the CA and the CRPs are activated or curtailed.	

6 Requirements (optional)

Requirements (optional)	

7 Common Terms and Definitions

Common Terms and Definitions	
Term	**Definition**

8 Custom Information (optional)

Custom Information (optional)

Key	Value	Refers to Section

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
153		Day-ahead demand response of the flexible demand

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Demand response is mainly a response to prices; therefore, there must be a concrete market structure to support the demand response. The spot market (or day-ahead market) and the day-ahead dynamic tariff (DT) are used as the market structure for defining demand response.
Objective(s)	The objective of the demand response is to generate a flexible demand schedule of a predefined time horizon, e. g. the next operation day (24 hours). The demand response defined in this use case is to fulfill the requirements of WP5 and the demand response in general can have much broader implication. The other functions, such as Forecasting in task 5.1 and Power Flow Control in task 5.2, can use the results of the demand response.
Related business case(s)	

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The day-ahead demand response function runs at the distribution network operator (DNO) side for the purpose of both demand forecast and congestion management. It receives input data, such as system price forecast, dynamic tariff (DT), weather forecast (temperature), EV driving pattern forecast, (driving distances, arriving or leaving times), and consumer requirements on house temperature from the data exchange platform (DXP). Then a least cost demand plan will be determined and sent back to DXP.
Complete description
The demand response function is performed before the clear of the day-ahead market because after the clear, the demand plan shall be determined and the aggregators or retailers should stick to their plan as much as possible. The DNO will use an optimization method to find a flexible demand plan that minimizes the total cost of the demands over a time horizon (e.g. 24

hours). Since it is assumed that the aggregators economically plan their demands, the demand plan determined by the DNO is a good estimation of the summation of the aggregators' demand plans. Therefore, the demand response function can output this demand plan as the final result.

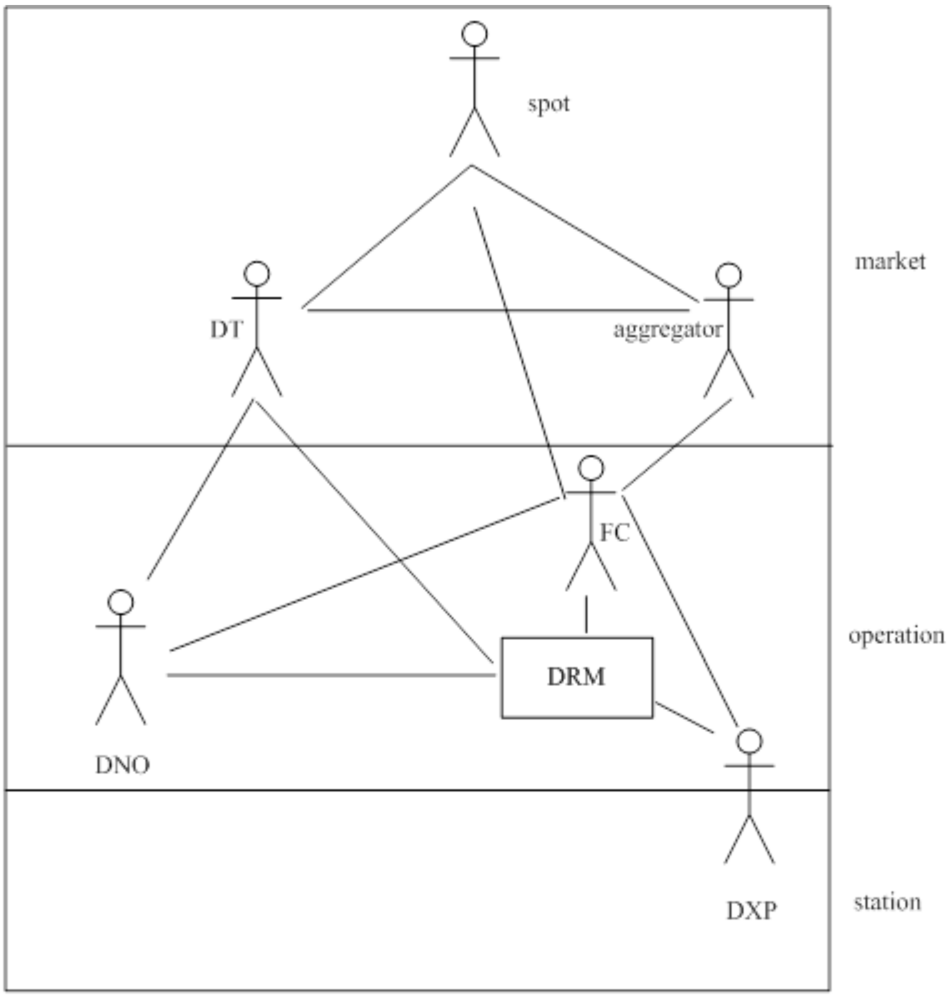
The steps of the demand response function are as follows:

1. *Obtain the input data including system prices, DT, weather forecast, EV driving pattern forecast and customer house temperature requirements for the demand response function, which is provided by other actors directly or through the DXP*
2. *run the optimization model, where the energy demands, comfort requirements of the customers and the availability of the flexible demands are included as constraints and the cost is the objective function.*
3. *the optimal demand plan found in step 2 will be sent to the DXP or other actors*

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



spot: spot market
FC: forecast
DXP: data exchange platform
DNO: distribution network operator
DT: day-ahead dynamic tariff
DRM: demand response model

3 Technical Details

3.1 Actors

Actors			
Grouping		Group Description	
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario							
Scenario Name:		No. 1 - Primary usecase					
Step No.	Event.	Name of Process/ Activity	Description of Process/ Activity.	Service	Information Producer (Actor)	Information Receiver (Actor)	Infor Exch
1	DADT algorithm starts. The CCPC starts the DADT algorithm	Check flags	The CCPC starts the DADT algorithm	REPORT	DMS.CCPC	DMS.DADT	start
3	DADT	Data	The DADT	REPORT	DMS.DXP.RDBMS	DMS.DADT	Grid

	algorithm collects data. The DADT algorithm receives the grid topology information, the predicted demand and production and the grid model	Storage	algorithm receives the grid topology information, the predicted demand and production and the grid model				netw Histo Fore Conv dema Fore infor
5	Exporting results of DADT. The DADT algorithm report the status of the algorithm and the final DT to DXP	Data Storage	The DADT algorithm report the status of the algorithm and the final DT to DXP	REPORT	DMS.DXP.RDBMS	DMS.CCPC	Algor Grid Ener Maxi perce
4	DADT algorithm running. Optimal power flow with grid model and predicted flexible and not-flexible demand and local production.	Day ahead dynamic tariff calculation		EXECUTE	DMS.DADT	DMS.DXP.RDBMS	Algor Grid Ener Maxi perce

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Grid tariff		
Energy plan		
Forecasted energy price		

Environment temperature		

1 Description of the Use Case

1.1 Name of the Use Case

Use Case Identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of the Use Case**
155		Day-Ahead Dynamic Tariff for Medium Voltage Grid Congestion Management - Based on predicted demand and local production

1.2 Version Management

Version Management

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	
Objective(s)	The objective of DADT2 is to determine a day-ahead dynamic tariff (DADT) to alleviate potential congestion induced by the demand or local production based on the predicted demand and local production.
Related business case(s)	

1.4 Narrative of Use Case

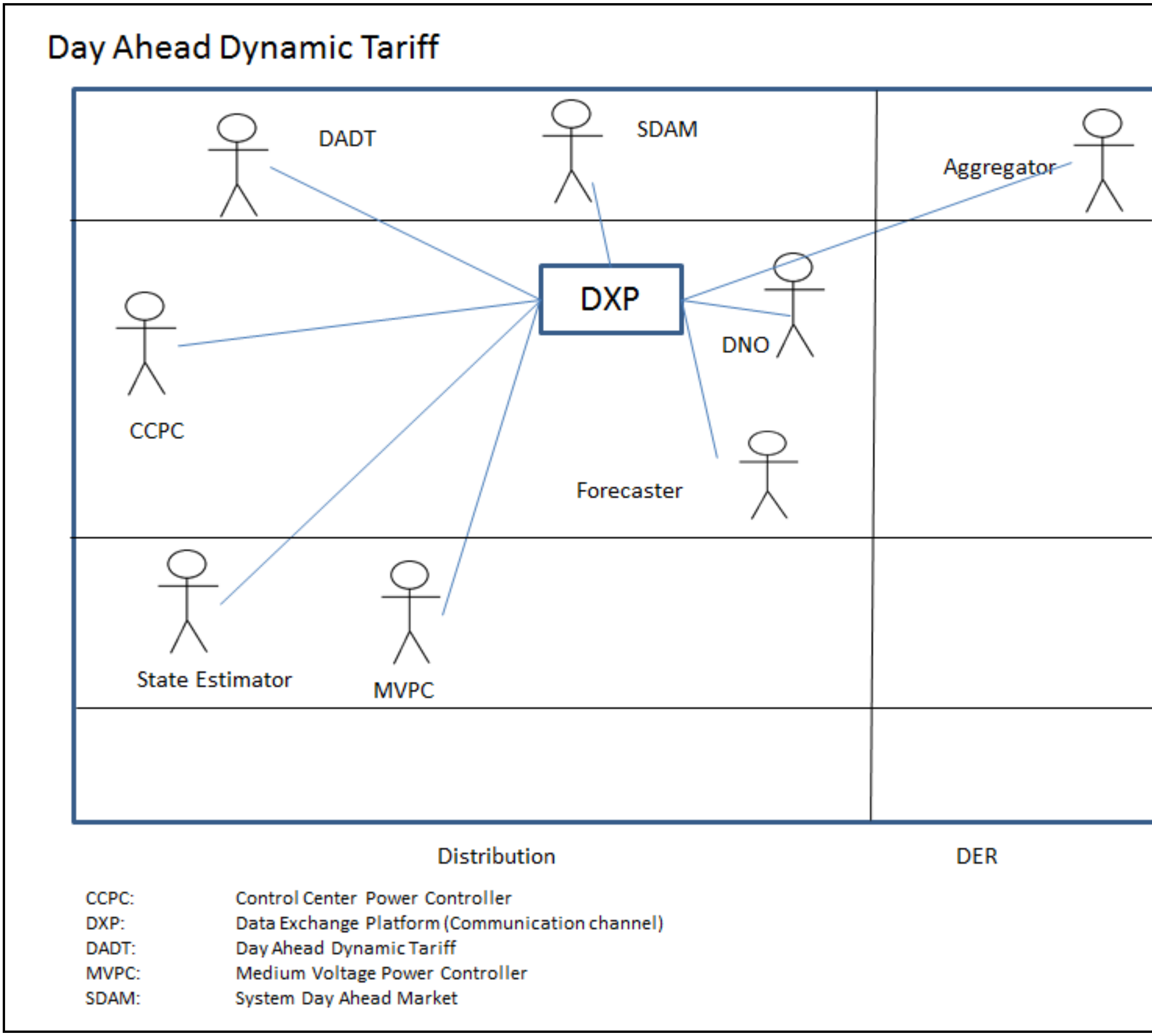
Narrative of Use Case
Short description
The day-ahead dynamic tariff algorithm based on the predicted demand and local production (DADT2) is to determine a day-ahead tariff for the distribution network to alleviate potential congestion induced by the demand or local production. The congestion in this context is the component overloading. The input data are the customer day-ahead energy plan and local production forecast, the grid topology and the grid model.
Complete description
The Day-Ahead Dynamic Tariff for medium voltage grid congestion management - based on the predicted demand and local production (DADT2) will be developed to alleviate the congestion in the day-ahead time frame. The congestion is defined as the overloading issue in the dynamic tariff concept work. The DNO receives the predicted day-ahead demand and local production from the forecaster, the grid model and the grid topology from the control center network power control as inputs. The DNO runs time series power flow to check if there is any overloading in the distribution network. If there is congestion, the DNO will determine the day-ahead dynamic tariff to influence the flexible demands by putting an extra cost of electricity consumption. The determination of the grid tariff can be done in

different manners, i.e. use capacity allocation algorithm to alleviate congestion, use a market clearing process for the day-ahead DSO market with two options – buy flexibility from aggregators or locational prices. Steps in the DADT1 are as follows: 1. The forecaster at the DNO side predicts the demand and the local production within the distribution network 2. The control room network power control determines the optimal grid topology according to the predicted demand and the local production within the distribution network 3. The DADT algorithm receives the grid topology information, the predicted demand and production and the grid model to check if there is any congestion. 4. The DADT algorithm determines the day-ahead tariffs for the distribution network to alleviate congestion; The tariff calculation can be done in ways.

1.5 General Remarks

General Remarks

2 Diagrams of Use Case



3 Technical Details

3.1 Actors

Actors			
Grouping		**Group Description**	
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
DMS.functions	Function	DMS demand response algorithm	

SPP	Function	Service provide platform	
DMS.WS	Function	DMS, WS interface	
CA.WS	Function	CA , WS interface	
CA.functions	Function	Commercial aggregator, asset planning functions	
DMS.RDBMS	Function	DMS database	
CA.RDBMS	Function	CA database	

3.2 Triggering Event, Preconditions, Assumptions

Use Case Conditions			
Actor/System/Information/Contract	Triggering Event	Pre-conditions	Assumption

3.3 References

References						
No.	References Type	Reference	Status	Impact on Use Case	Organistaor / Organisation	Link

3.4 Further Information to the Use Case for Classification / Mapping

Classification Information
Relation to Other Use Cases
Level of Depth
Priorisation
Generic, Regional or National Relation
Viewpoint
Further Keyword for Classification

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

4.2 Steps - Scenarios

Scenario

Scenario Name:		No. 1 - Primary scenario. Once per day					
Step No.	**Event.**	**Name of Process/ Activity**	**Description of Process/ Activity.**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**
1	DADT algorithm initiates the DT calculation. DADT algorithm initiates the algorithm by sending initial DT to DXP	Check flag	DADT algorithm initiates the algorithm by sending initial DT to DXP	EXECUTE	DMS.functions	DMS.RDBMS	Grid tariff
2	The DR algorithm receives necessary data. The aggregator receives the predicted day-ahead system price and weather forecast	Data storage	The aggregator receives the predicted day-ahead system price and weather forecast	EXECUTE	SPP	CA.WS	Forecasted energy price Environmen temperatur
3	The aggregator receives DT.The aggregator receives DT from the DXP	Data Report	The aggregator receives DT from the DXP	EXECUTE	DMS.WS	CA.WS	Grid tariff
4	The aggregator receives DT.The aggregator receives DT from the DXP	Data Report	The aggregator receives DT from the DXP	EXECUTE	CA.WS	CA.RDBMS	Grid tariff
5	CA manages its resources	Commercial aggregator	The DADT algorithm	EXECUTE	CA.functions	CA.RDBMS	Energy plan

	with a certain dynamic tariff. Optimization of CA's resources	asset planning UC	receives the preliminary energy planning				
6	Demand response. The aggregator sends the preliminary energy planning of flexible demands to the data exchange platform (DXP)	Data Report	The aggregator sends the preliminary energy planning of flexible demands to the data exchange platform (DXP)	EXECUTE	CA.WS	DMS.WS	Energy plan
7	Demand response. The aggregator sends the preliminary energy planning of flexible demands to the data exchange platform (DXP)	Data storage	The aggregator sends the preliminary energy planning of flexible demands to the data exchange platform (DXP)	EXECUTE	DMS.WS	DMS.RDBMS	Energy plan
8	The DADT algorithm receives DRThe DADT algorithm receives the preliminary energy planning	Data storage	The DADT algorithm receives the preliminary energy planning	EXECUTE	DMS.RDBMS	DMS.functions	Energy plan

5 Information Exchanged

Information Exchanged		
Name of Information (ID)	**Description of Information Exchanged**	**Requirements to information data**
Grid model and network topology		
Historical system price		
Forecasted Conventional/inflexible demand information		
Forecasted production information of DER		
Environment temperature		
Algorithm status		
Grid tariff		
Energy plan		
Maximum overloading percentage		
start command		