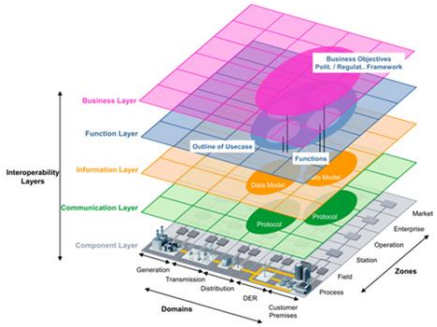
IDE4L architecture

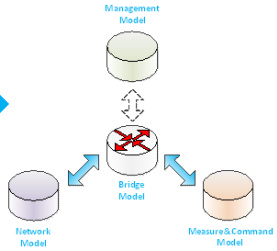
1. Use Cases

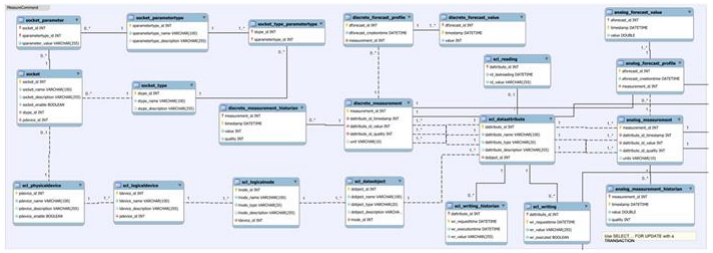
2. SGAM Architecture

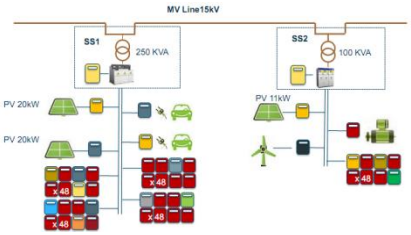
3. Implementation of architecture

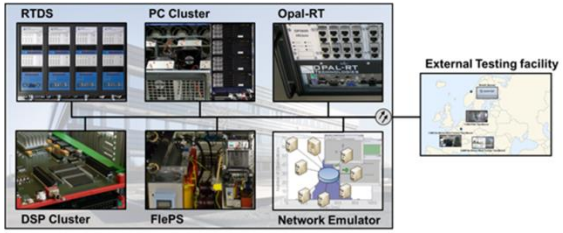
4. Field and Lab Demonstration



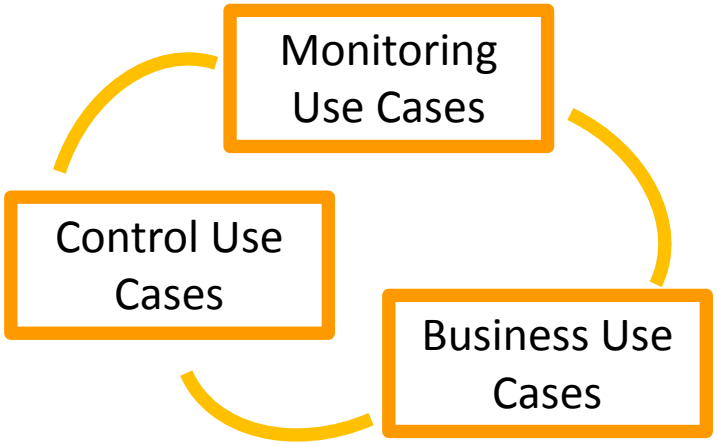








1. Use Cases

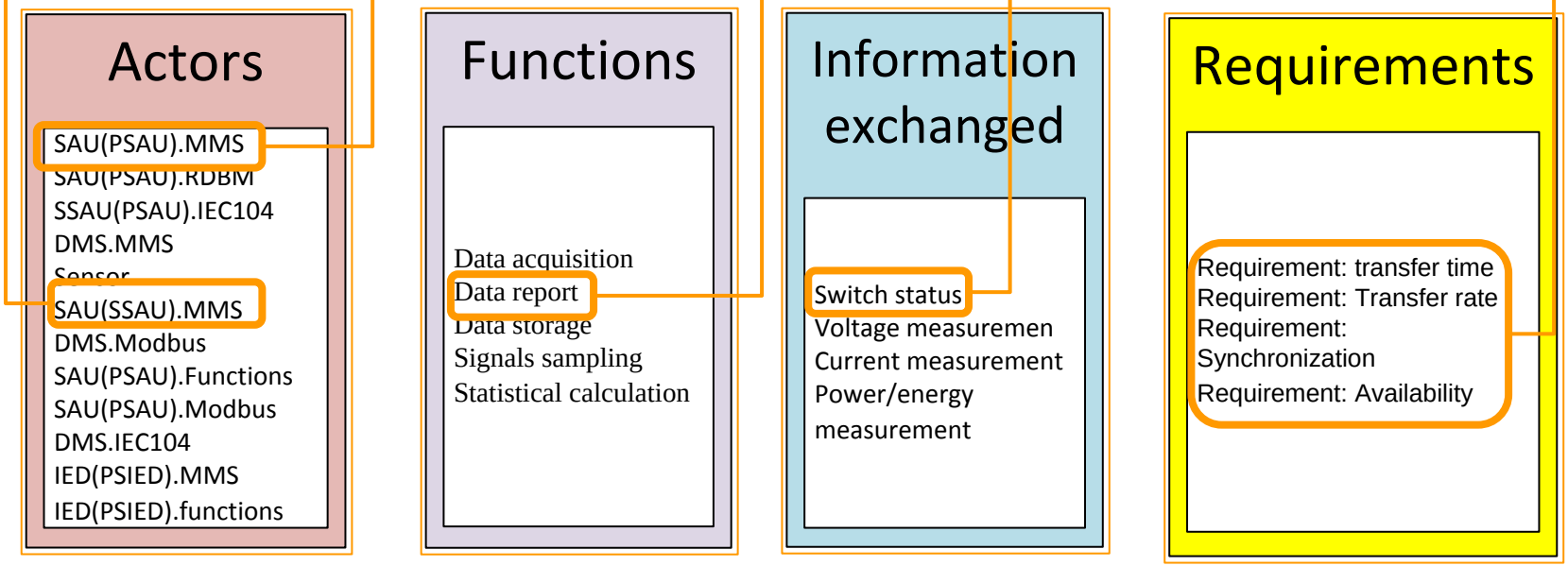


- State estimation, forecast, network update, measurement collection
- LV, MV, control center power control, block OLTCs, FLISR
- Purchase of energy and flexibility, activation of flexibility

1. Use Cases

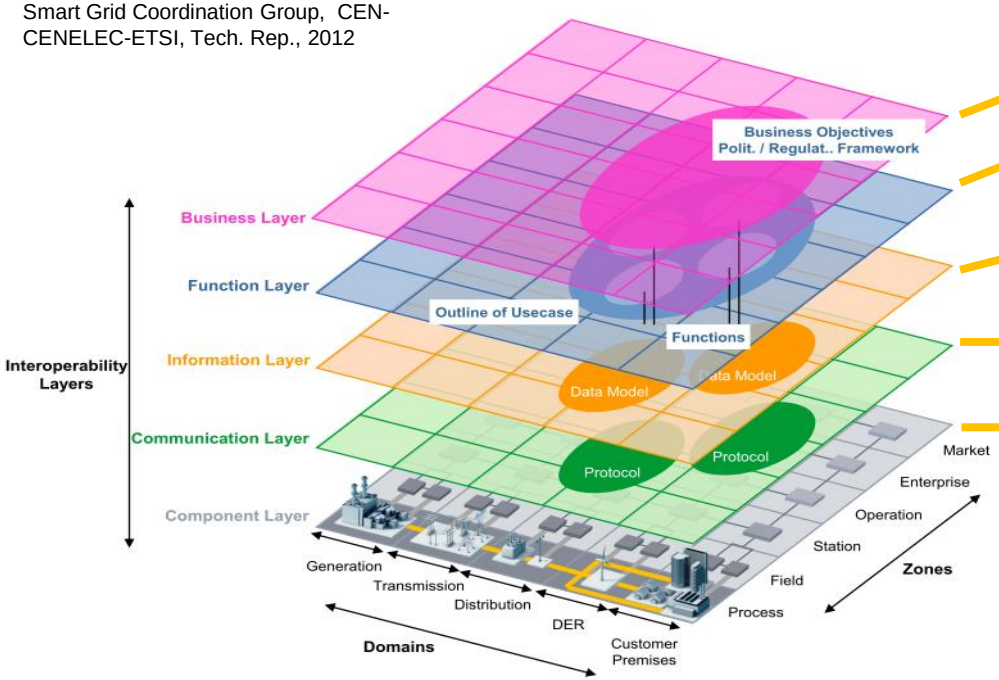
Use Case description

Steps	Information producer	Information receiver	Function	Information exchanged	Requirement
1	SAU(PSAU).MMS	SAU(SSAU).MMS	Data Report	Switch Status	TT = 100 ms …
2	…	…	…	…	



2. SGAM architecture
General description and link to use cases

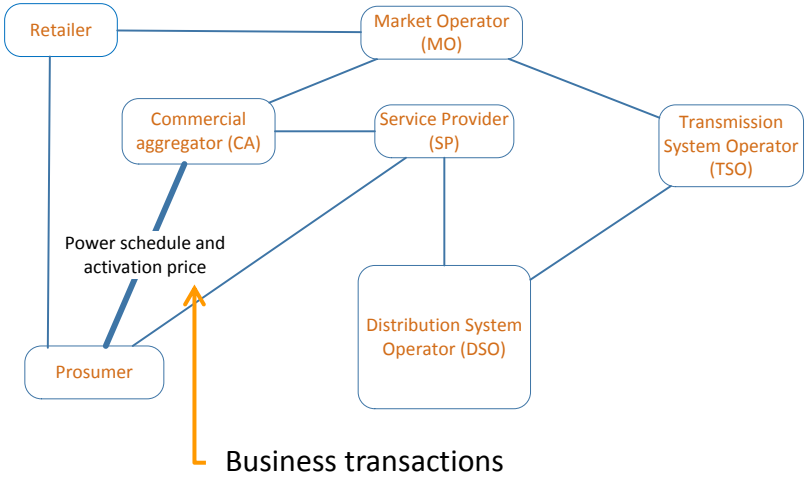
Smart Grid Coordination Group, CEN-CENELEC-ETSI, Tech. Rep., 2012

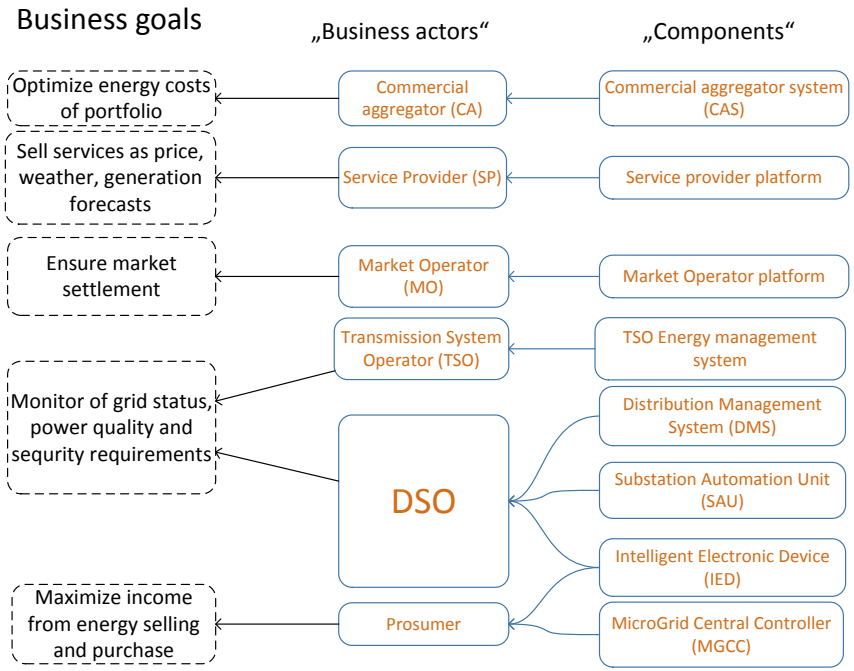


1. Business framework
2. Functions to be implemented
3. Data models in the main automation standards
4. Communication protocols
5. Components, both hardware and software to take part to the automation system

2. SGAM architecture

Business layer and mapping to component layer



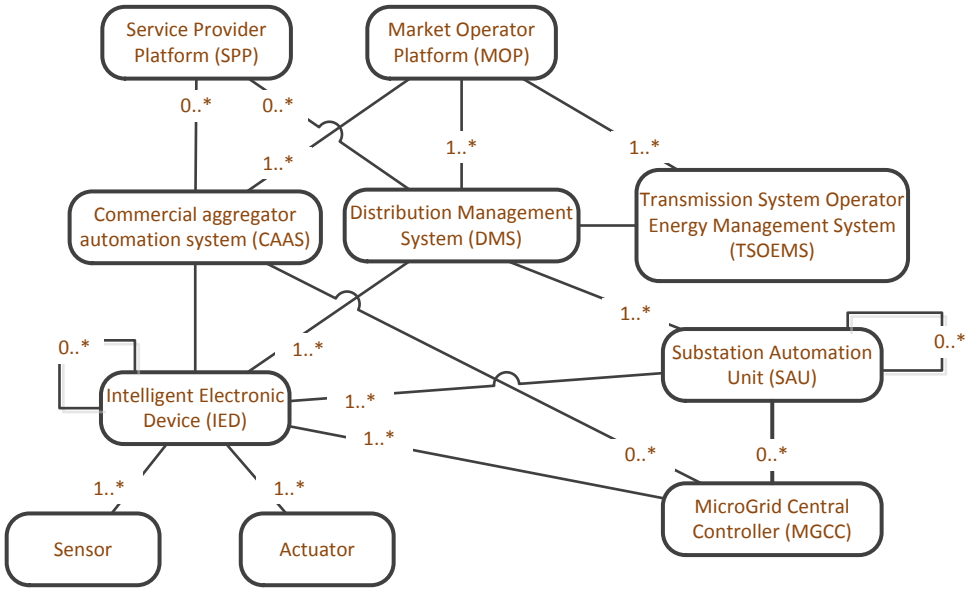


Business layer

- Business actors are connected by business transaction
- Each one has a business goal
- Business actors are mapped onto components

2. SGAM architecture

Component layer



New actor developed :

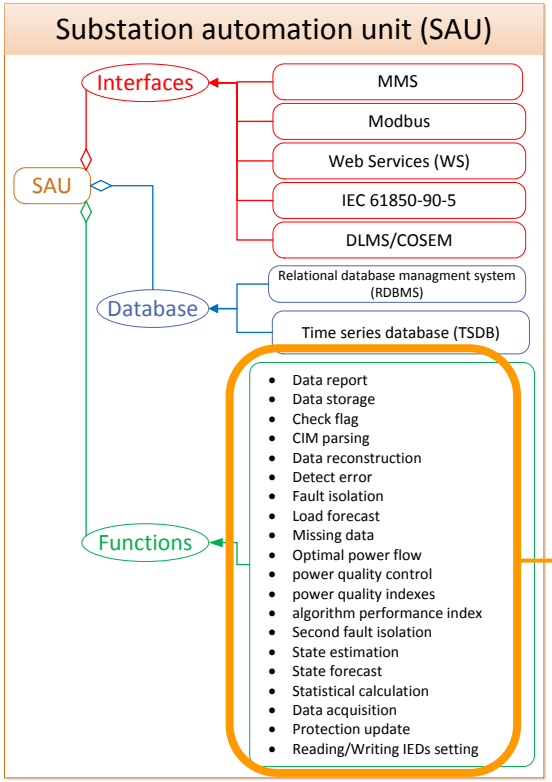
- Substation Automation Unit

Further development for

- Commercial aggregator
- Distribution management system (DMS)
- MicroGrid Central Controller

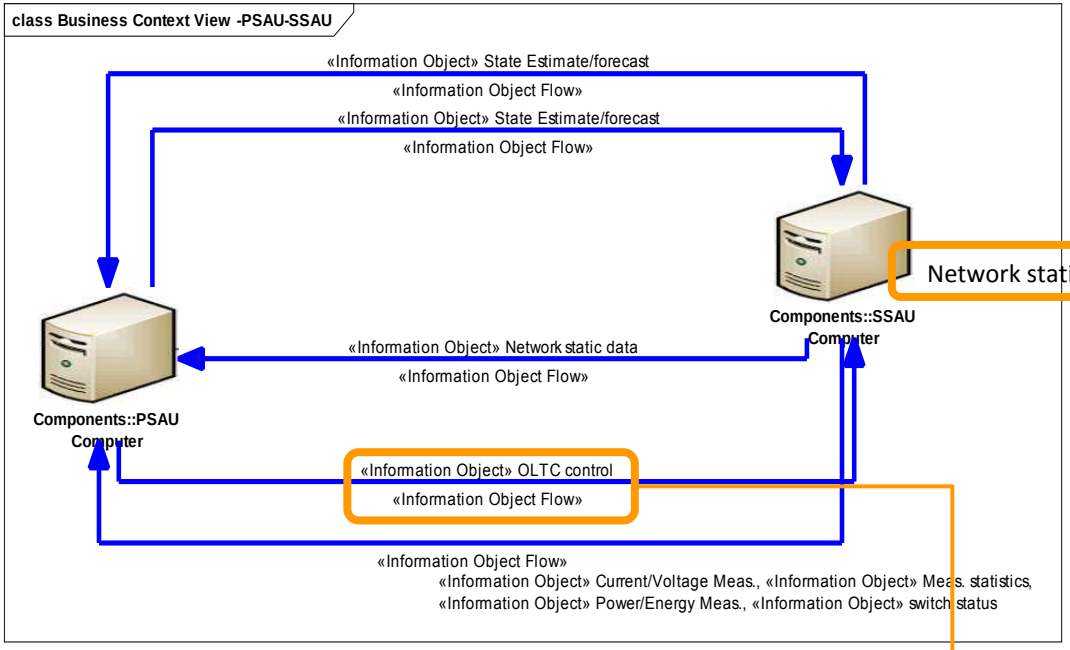
Each component has been defined in terms of

- Interfaces
- Database
- Functions



Also present in **function layer** and **UCs**

2. SGAM architecture
Information layer



Network static data → CIM – data models

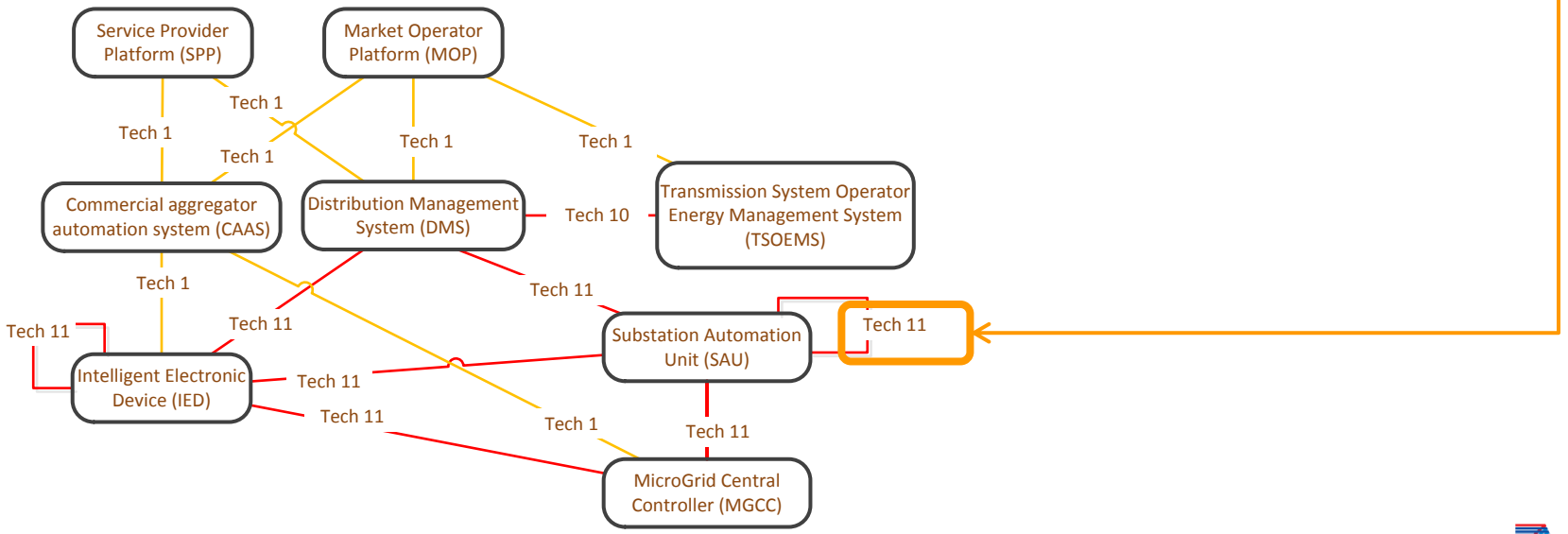
IEC 61850 – data models

Logical node	Data object		Data Attribute	
ATCC	BndCtr	ASG	setMag	AnalogueValue

2. SGAM architecture

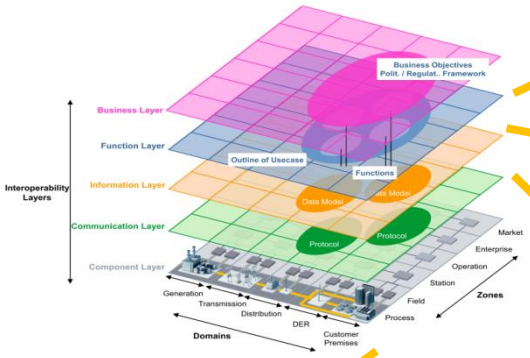
Communication layer

Steps	Information producer	Information receiver	Function	Information exchanged	Requirement
1	SAU(PSAU).MMS	SAU(SSAU).MMS	Data Report	Switch Status	Transfer Time = 500 ms Transfer Rate = 1000 kb/s Synchronization accuracy = … Availability = …
2	…	…	…	…	



2. SGAM architecture
One step toward implementation

Smart Grid Coordination Group, CEN-CENELEC-ETSI, Tech. Rep., 2012



Function layer

- Functions have been realized in WP4 (FLISR), WP5 (Monitoring and LV, MV, control center control), WP6 (business and commerical aggregator)
- Functions are adapted in order to read and write from a standardized IDE4L database

Information layer

Exchanged data are clustered onto classes and mapped to

- CIM data models for static data and business related data
- 61850 for real time data

Component layer

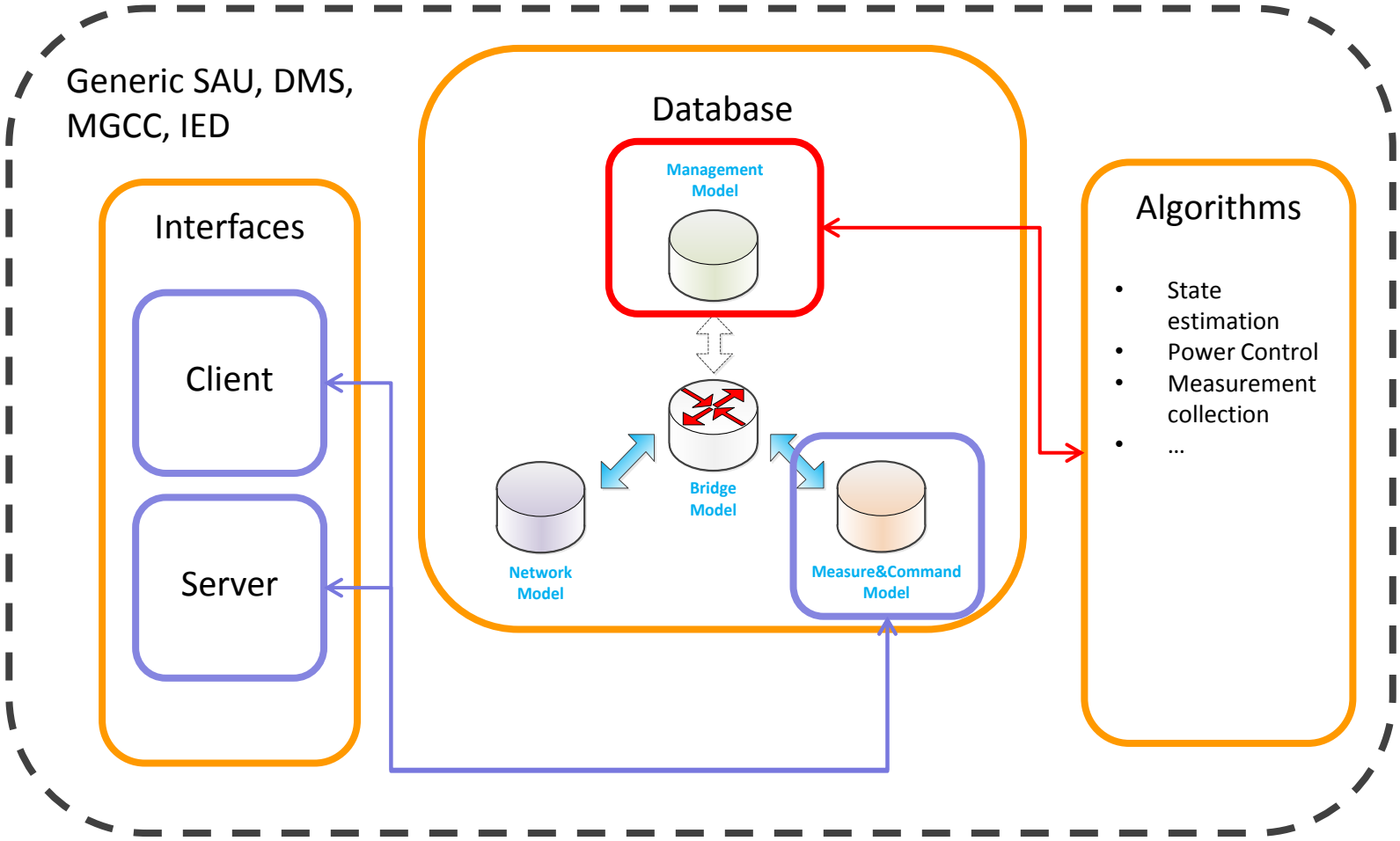
Each component has been defined in terms of

- Interfaces
- Database
- Functions

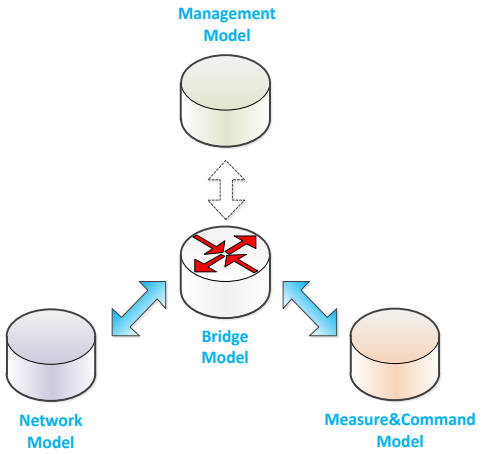
Communication layer

- The requirements of the information exchange grouped onto technology classes

3. Implementation of architecture
Interfaces, Database, Algorithms



3. Implementation of architecture
Database structure

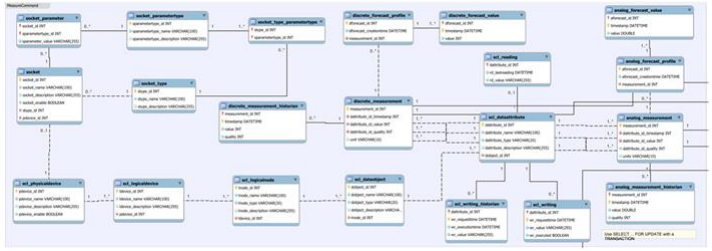


Measure & Command Model

- physical device, logical device, logical node, data object and data attribute
- set of information to parameterize the communications interface to each physical device (such as IP addresses, TCP ports, users and passwords, etc.)

Network Model

Contains the network topology and parameter representation



Management Model

- Represents the models related to an algorithm.
- instantiate, parameterize and control the execution of a specific algorithm

Bridge Model

It is the connection schema for all other schemas. In this data model every relation among Measure & Control, Management and Network are described

4. Field and Lab demonstration
Use Case mapping, KPIs

Use Case mapping and KPIs
- All use cases have been assigned to demonstrators
- Each use case has a set of Key Performance Indexes (KPIs) in order to evaluate the performance of the architecture (deliverable 7.1)

Field demonstrators
- Real loading/generation conditions
  - real PQ issues
  - real congestions
- Real amount of information exchanged
- Real components

Lab demonstrators
- “Real” → “Realistic” (past data or collection of statistics)
- Tests with different time windows and simulation steps → check different issues of PQ, congestions
- It is possible to introduce errors/issues in different parts of monitoring/control chain

Conclusions and Exploitation of IDE4L architecture

1. Use cases

- Around 30 use case detailed descriptions
- List/description of actors, information exchange, functions and requirements

(D3.1 and D3.2)

2. SGAM architecture

- SGAM communication, information, component, business layer in .xls or enterprise architect files

(D3.2)

3. Architecture Implementation

- 61850, CIM information mapping .xls tables to facilitate standard implementation of architecture
- Database structure and sample communication interfaces

(D3.2)

4. Field and Lab demonstration

- Demonstration results

(D7.2)

IDE4L Solutions

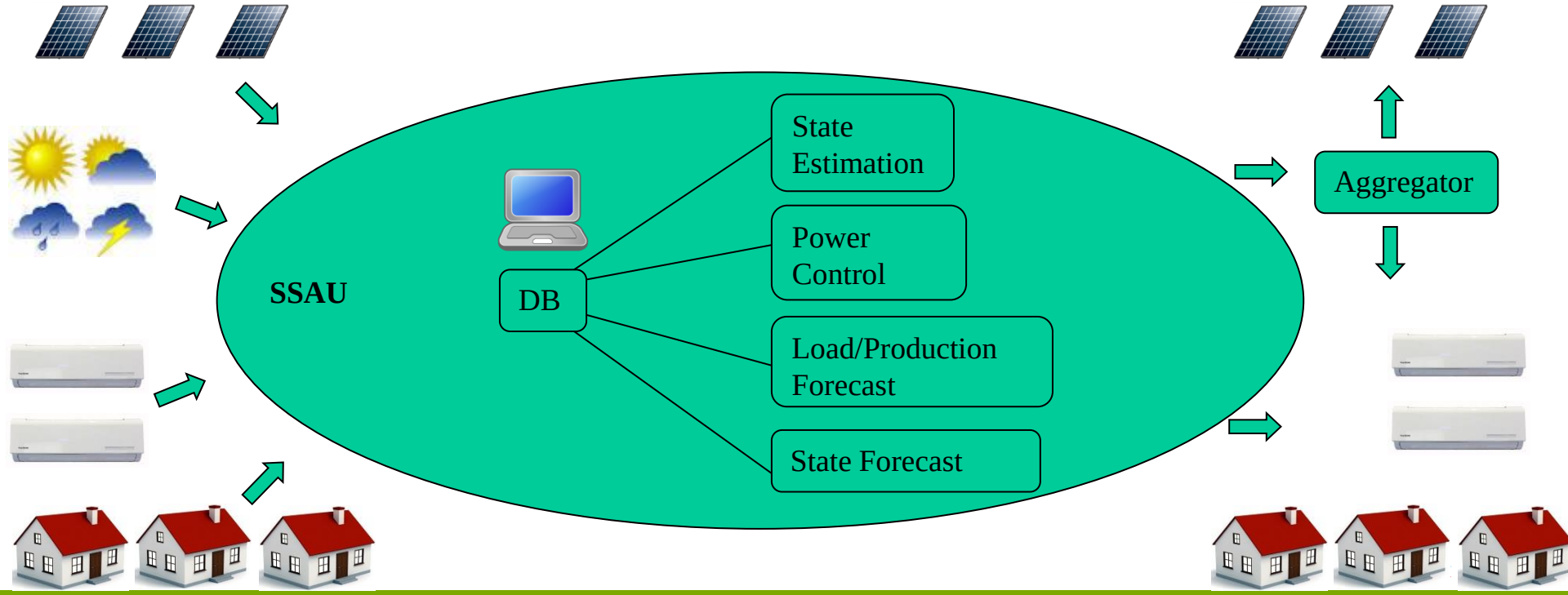
- Active network instead of a passive network
  - Decentralized
  - Automated
  - Hierarchical
- Postponing the costly traditional solutions
- Using the full capacity of distribution networks
  - Monitoring the state of the network
  - Automatic decentralized solutions to solve congestions
  - Better use of distributed energy resources – e.g. through market place

Developed algorithms

- *State Estimation*
- *Forecasting + State Forecasting*
- *Secondary Power Control*
- *Tertiary Control*
  - *Network Reconfiguration*
  - *Market Agent*
  - *Dynamic Tariff*

Application of IDE4L architecture: Grid control and monitoring

DB: Data base
NRA: Network Reconfiguration
MA: Market Agent
FC: Forecaster
SF: State Forecaster
LF: Load Forecaster
PF: Production Forecaster
SSAU: Secondary Sub-station Automation unit
PSAU: Primary Sub-station Automation unit
DMS: Distributed Management System
TC: Tertiary Controller



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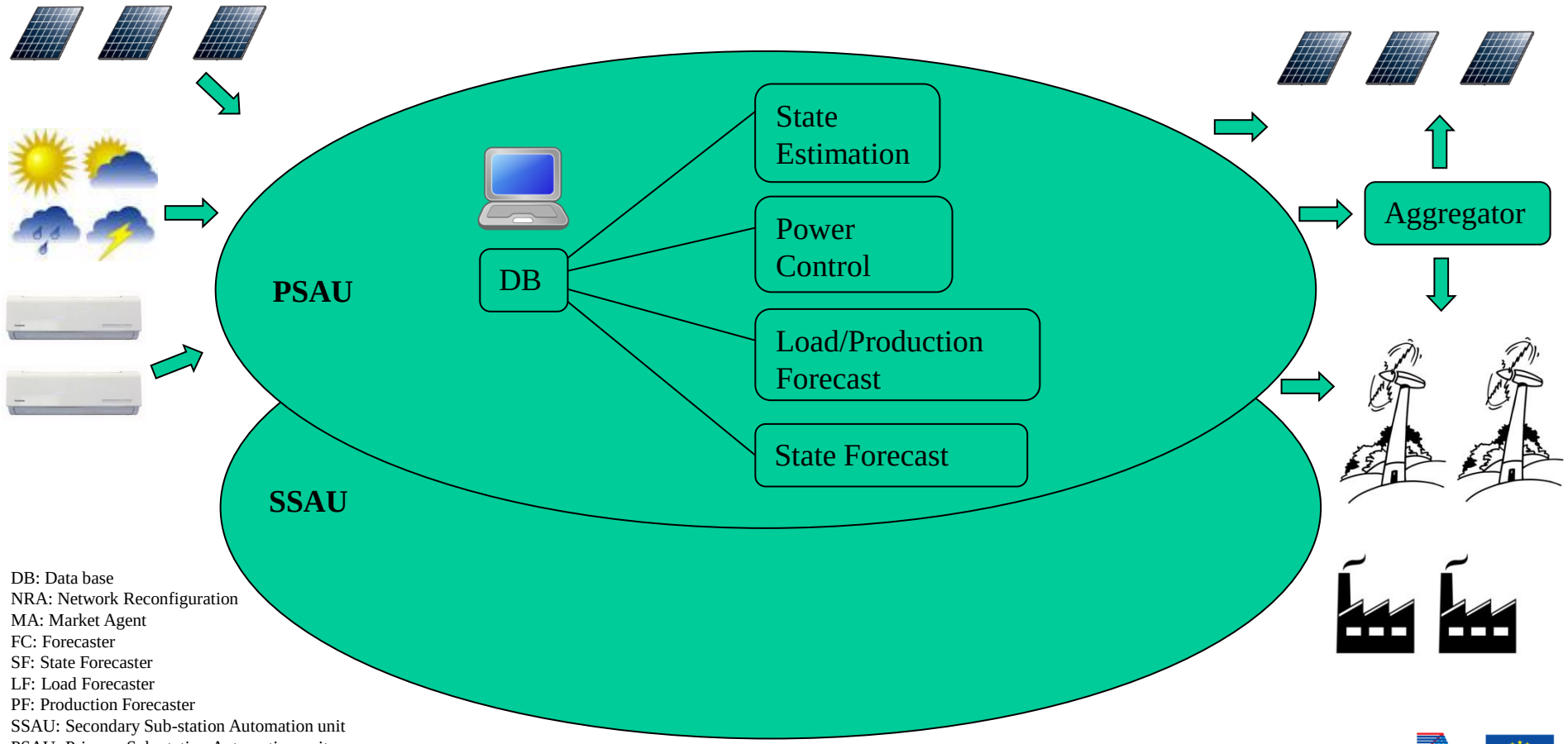

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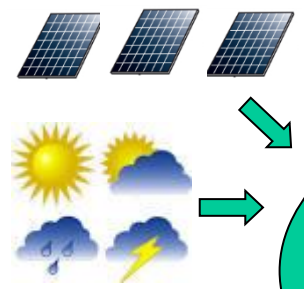
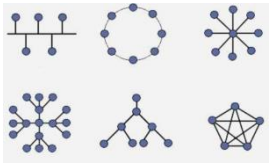
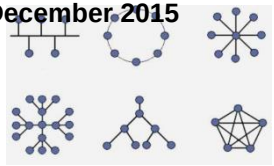



DMS

DB

Network Reconfiguration

Market Agent

Load/Production Forecast

State Forecast

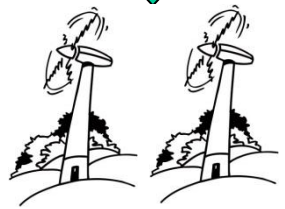
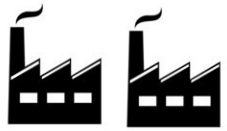
PSAU

Coordination

SSAU

Market

Aggregator

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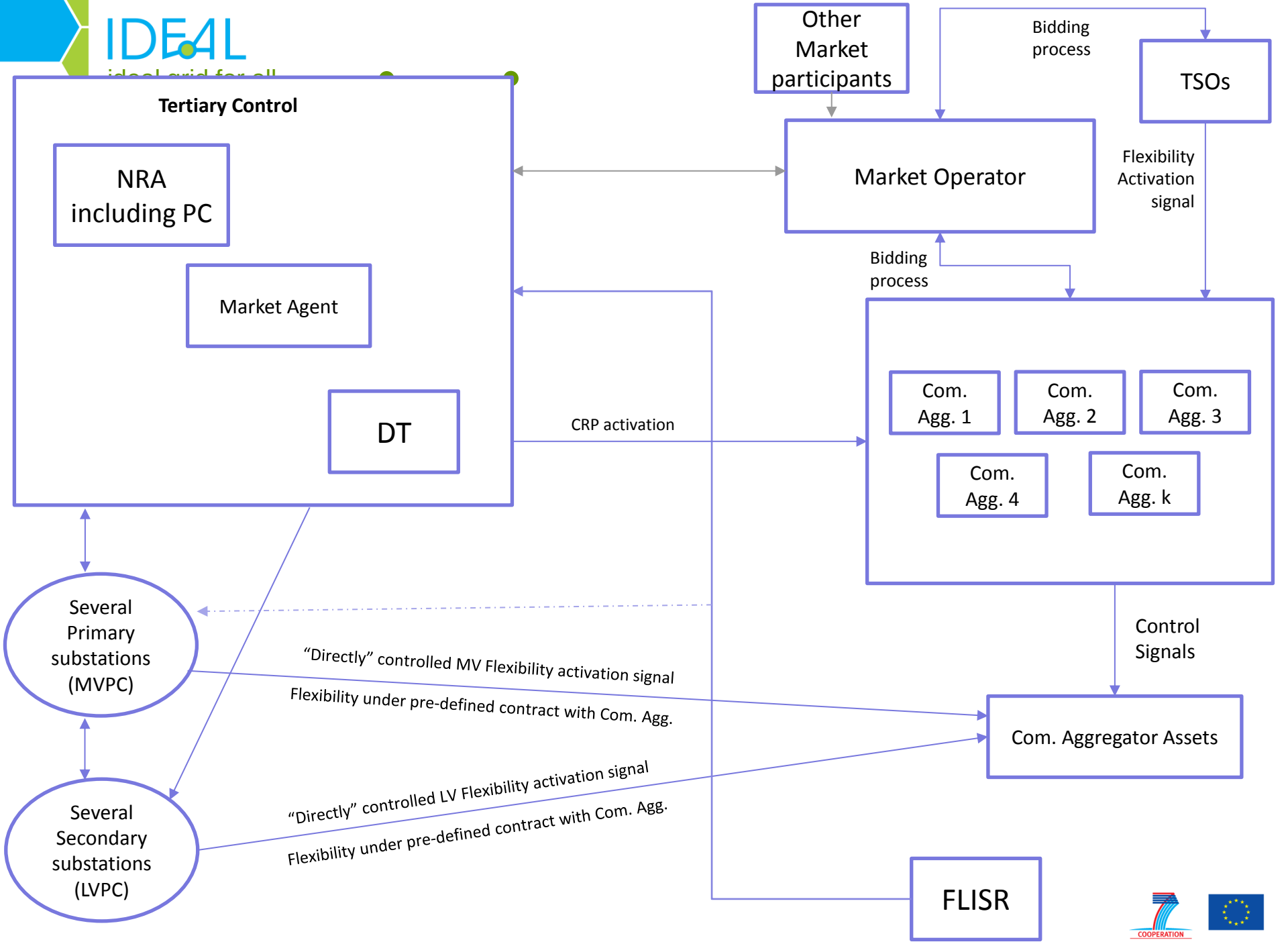
Other Market participants
Bidding process
TSOs
Tertiary Control
NRA including PC
Market Agent
DT
Market Operator
Flexibility Activation signal
Bidding process
CRP activation
Com. Agg. 1
Com. Agg. 2
Com. Agg. 3
Com. Agg. 4
Com. Agg. k
Several Primary substations (MVPC)
Several Secondary substations (LVPC)
"Directly" controlled MV Flexibility activation signal
Flexibility under pre-defined contract with Com. Agg.
"Directly" controlled LV Flexibility activation signal
Flexibility under pre-defined contract with Com. Agg.
Control Signals
Com. Aggregator Assets
FLISR

Thanks for the attention,

Questions ?