CEN-CENELEC-ETSI Smart Grid Coordination Group

November 2012

CEN-CENELEC-ETSI Smart Grid Coordination Group — Framework Document

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Foreword

This document (SGCG/M490/A_Framework for Smart Grid Standardization) has been prepared by CEN-CENELEC-ETSI Smart Grid Coordination Group (SG-CG). This document has been prepared under Mandate M/490 [1] given to CEN, CENELEC and ETSI by the European Commission and the European Free Trade Association.

1 Scope

This document provides an overview of the activities and reports of the SG-CG and its individual working groups. It describes how the individual elements and reports fit together so as to provide the consistent framework for identifying the Smart Grid standards required by the mandate. The relationships between the SG-CG working groups and their contribution to the overall picture and process are explained.

Through its work under the EC mandate M/490 (M/490), the SG-CG has developed a consistent yet flexible framework for standardization. This framework includes methodologies and tools that can be used to provide answers to a number of important questions. Part of the work focuses on providing a list of mature standards that can be used today for the implementation of Smart Grids in Europe. This work is described in SGCG/M490/B_Smart Grid Set of Standards [2]. Another part focuses on the question, how to close the most important gaps identified in the Joint Working Group (JWG) report [3]. This part can be found in the reports on *"Prioritization"* SGCG_Sec0028_DC [4] and *"Work Programme"* SGCG_Sec0032_DC (version 1.6) [5]. The overall methodology and tools used are described in SGCG/M490/C_Smart Grid Reference Architecture [6], SGCG/M490/E_Smart Grid Use Cases Management Process [7] and SGCG/M490/D_Smart Grid Information Security [8].

<u>Versions:</u>

- Version 0.1 for initial reactions by the editorial team of the SG-CG
- Version 0.2 for official commenting within the SG-CG and the associated organizations
- Version 0.3 (this version) for circulation in the Steering Group of SG-CG
- Version 1.0 (endorsed by CEN, CENELEC and ETSI) is provided to the European Commission as result of the mandate M/490

2 References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[1] European Commission, Smart Grid Mandate M/490, Standardization Mandate to European Standardisation Organisations (ESOs) to support European Smart Grid deployment Mandate M/490 Smart Grids, Brussels, 2011

[2] CEN-CENELEC-ETSI Smart Grid Working Group Smart Grid First Set of Standards, 'Smart Grid Set of Standards' (SGCG/M490/B_Smart Grid Set of Standards), Brussels, 2012

[3] CEN/CENELEC/ETSI Joint Working Group on Standards for Smart Grids: "Final report of the CEN/CENELEC/ETSI Joint Working Group on Standards for Smart Grids ", Brussels, 2011

[4] CEN-CENELEC-ETSI Smart Grid Coordination Group, 'Standardization Gaps Prioritization for the Smart Grid' v.2.1, (SGCG_Sec0028_DC), Brussels, 2011

[5] CEN-CENELEC-ETSI Smart Grid Coordination Group, ' Programme of standardisation work for the Smart Grid' (SGCG_Sec0032_DC (version 1.6)), Brussels, 2012

[6] CEN-CENELEC-ETSI Smart Grid Working Group Reference Architecture, 'Reference Architecture for the Smart Grid' (SGCG/M490/C_Smart Grid Reference Architecture), Brussels, 2012

[7] CEN-CENELEC-ETSI Smart Grid Working Group Sustainable Processes 'Use Case Collection, Management, Repository, Analysis and Harmonization' (SGCG/M490/E_Smart Grid Use Cases Management Process), Brussels, 2012

[8] CEN-CENELEC-ETSI Smart Grid Working Group Smart Grid Information Security, 'Smart Grid Information Security' (SGCG/M490/D_Smart Grid Information Security), Brussels, 2012

[9] CEN-CENELEC-ETSI Smart Grid Coordination Group, 'Terms of Reference of the Smart Grid Coordination Group', Brussels, May 2011

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
System
a typical industry arrangement of components and systems, based on a single architecture, serving a specific set of use cases
[SOURCE: SG-CG/M490/B]

3.2
Actor
entity that communicates and interacts.

NOTE These actors can include people, software applications, systems, databases, and even the power system itself.

[based on IEC/PAS 62559]

NOTE In the actor list the ENTSO-E role model, generic actors and technical system actors are considered

[SOURCE: SG-CG/M490/E]

3.3
Service
the contract to perform a certain task, with certain deliverables (output) and other agreements on what's included (*external view*).

3.4
Function
when the service is carried out (*internal view*).

3.5
Use Case
Class specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system

[SOURCE: IEC 62559, ed.1 2008-01 - IEC 62390, ed 1.0:2005-01] alternative: description of the possible sequences of interactions between the system under

discussion and its external actors, related to a particular goal

[SOURCE: A. Cockburn "Writing effective use cases"]

NOTE A use case is the description of one or several functions performed by the respective actors.

[SOURCE: SG-CG/M490/E]

3.6
Architecture
fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution.

[SOURCE: SG-CG/M490/C]

3.7
Reference Architecture
the *structure* of a system with its element types and their structures, as well as their *interaction* types, among each other and with their environment. Through abstraction from individual details, a Reference Architecture is universally valid within a specific domain.

[SOURCE: SG-CG/M490/C]

4 Symbols and abbreviations

CEN	European Committee for Standardization (Comité Européen de Normalisation)
CENELEC	European Committee for Electrotechnical Standardization (Comité Européen de Normalisation Electrotechnique)
CIA	Confidentiality, Integrity and Availability
DR	Demand Response
DSM	Demand Side Management
EM-CG	E-Mobility Coordination Group
ESO	European Standards Organizations (CEN, CENELEC and ETSI)
ETSI	European Telecommunications Standards Institute
GWAC	GridWise Architecture Council
JWG	Joint Working Group (of CEN, CENELEC and ETSI on standards for smart grids)
M/490	Mandate issued by the European Commission to European Standardization Organizations (ESOs) to support European Smart Grid deployment [1]

NIST	National Institute for Standards and Technology
R&D	Research and Development
SGAM	Smart Grid Architecture Model – delivered by the SG-CG-RA team as part of the mandated deliveries of M/490, which proposes 3 different axes to map a Smart Grid feature (Domains, Zones and Layers) – details available in [6]
SG-DPC	Smart Grid Data Protection Classes
SGIS-SL	Smart Grid Information Security - Security Levels
SG-CG	Smart Grid Coordination Group, reporting to CEN-CENELEC-ETSI and in charge of answering the M/490 mandate
SG-CG/FSS	Team of experts acting on behalf of the CEN-CENELEC-ETSI SG-CG to manage part of the mandated tasks as defined by SG-CG in the “First Set of Standards” package. Sometimes called FSS only
SG-CG/RA	Team of experts acting on behalf of the CEN-CENELEC-ETSI SG-CG to manage part of the mandated tasks as defined by SG-CG in the “Reference Architecture” package. Sometimes called RA only
SG-CG/SGIS	Team of experts acting on behalf of the CEN-CENELEC-ETSI SG-CG to manage part of the mandated tasks as defined by SG-CG in the “smart grid information security” package. Sometimes called SGIS only.
SG-CG/SP	Team of experts acting on behalf of the CEN-CENELEC-ETSI SG-CG to manage part of the mandated tasks as defined by SG-CG in the “Sustainable Processes” package. Sometimes called SP only
SG-CG/StG	Steering Group of Smart Grid Coordination Group
SM-CG	Smart Metering Coordination Group, reporting to CEN-CENELEC-ETSI and in charge of answering the M/4441 mandate
TOGAF	The Open Group Architecture Framework
UC	Use Case
UCMR	Use Case Management Repository
UML	Unified Modeling Language

5 Executive summary

Generally the tasks performed by SG-CG can be grouped according to two characteristics: Maturity and Time. For mature and proven standards which can be readily applied, SGCG/M490/B_Smart Grid Set of Standards [2] shows the current status. The methodologies developed by the reference architecture, sustainable processes and Smart Grid information security working groups help to justify this initial list of mature standards, which are available by end of 2012.

For other more future-oriented scenarios, where yet less experience exists in implementation and in the market, a number of major gaps are already identified in the work plan. Not all of these identified gaps are actually closed by end of 2012. A number of work streams extend to 2014 and beyond. Details can be found in the *"Work Programme"* report [5]. Even beyond this point the developed methodology for architecture, processes and information security will need to be applied iteratively to address further gaps in standardization which become evident in the light of findings from R&D, pilots and implementation. In this respect, Smart Grids will require a continuous effort and a "complete" list of standards will not exist. Indeed it can never exist, since Smart Grids technology and R&D will evolve over time, along with the associated standardization needs. However the methodology can be applied to this changing environment.

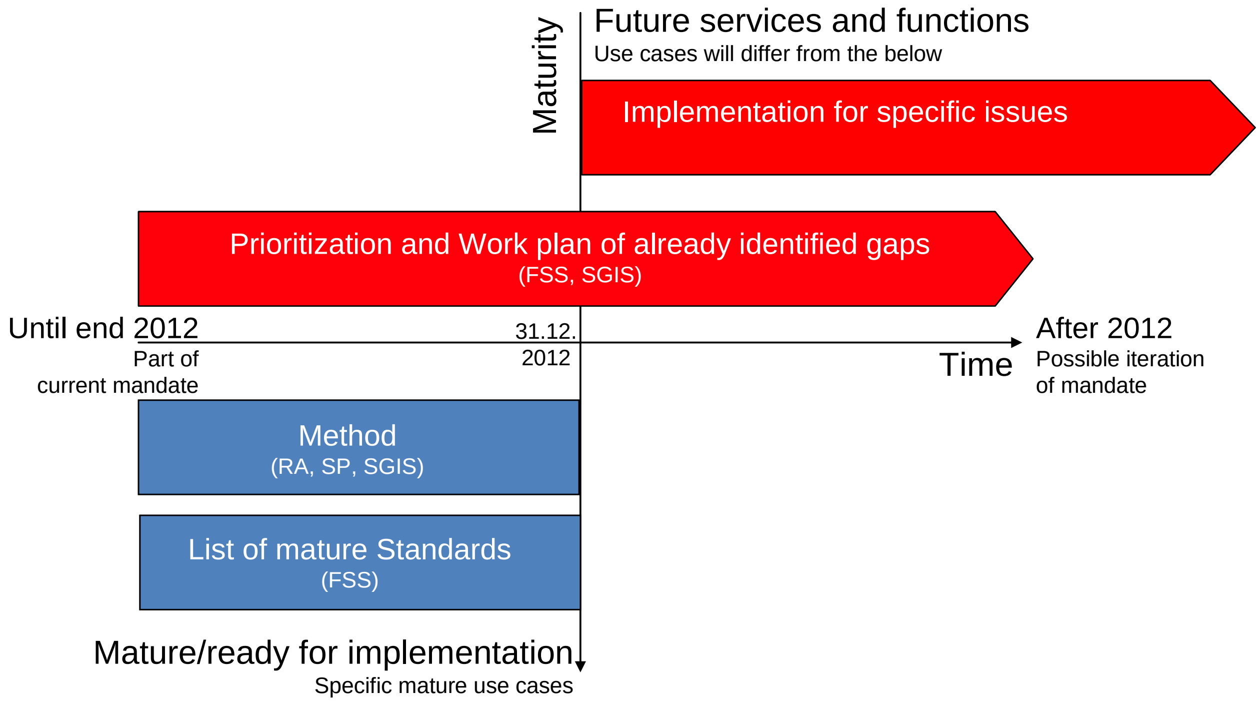

Figure 1 Deliverables of the Mandate and their classification

The above figure shows in the lower part those standardization activities which are finished by end of 2012. These include the "First Set of Standards" which includes mature applications (systems), use cases and standards, which can be used for the implementation of Smart Grids in Europe. Also available are the methods proposed by Reference Architecture, Sustainable Processes and Information Security.

In the upper part the more future-oriented services and functions and their respective standardization needs are shown. On the part of the selected priority gaps from the JWG and Prioritization report the work already started. Most issues will continue after 2012. As noted in the JWG report a relatively small number of standards still need to be developed by the European Standardization Organizations in cooperation with its international partner organizations. Further to the already known gaps it can be expected that the progress in R&D, pilot projects and implementation will detect new gaps. These however will be investigated according to the defined methodology.

6 Introduction

6.1 The scope of the mandate

Mandate M/490 was officially announced on 01.03.2011. It was formally accepted by the ESOs on 01.06.2011[1].

The scope of the M/490 is defined as

> *"The objective of this mandate is to develop or update a set of consistent standards within a common European framework that integrating a variety of digital computing and communication technologies and electrical architectures, and associated processes and services, that will achieve interoperability and will enable or facilitate the implementation in Europe of the different high level Smart Grid services2 and functionalities as defined by the Smart Grid Task Force that will be flexible enough to accommodate future developments.*
> *Building, Industry, Appliances and Home automation are out of the scope of this mandate; however, their interfaces with the Smart Grid and related services have to be treated under this mandate."*

Thus, the interface to Home Automation has been taken into account, but without going into detail.

Smart Metering is being covered by the Smart Metering Coordination Group (SM-CG) under the M/441 mandate. The SG-CG reports will refer to the SM-CG work for the elements of the framework related to Smart Metering. E-Mobility is being covered by the E-Mobility Coordination Group (EM-CG) under the M/468 mandate. The SG-CG reports will refer to EM-CG work for the elements of the framework related to E-Mobility.

Within M/490 the following deliverables are specified: "

1. *A technical reference architecture, which will represent the functional information data flows between the main domains and integrate many systems and subsystem architectures.*

2. *A set of consistent standards, which will support the information exchange (communication protocols and data models) and the integration of all users into the electric system operation.*

3. *Sustainable standardization processes and collaborative tools to enable stakeholder interactions, to improve the two above and adapt them to new requirements based on gap analysis, while ensuring the fit to high level system constraints such as interoperability, security, and privacy, etc. and to collect and harmonize use cases"*

6.2 The Smart Grid Coordination Group

In response to the mandate, the Smart Grid Coordination Group was formed on 01.07.2011. This group emerged from the earlier Joint Working Group on Standards for Smart Grids, which produced, in 2010, a report on European Standardization of Smart Grids [3].

The Smart Grid Coordination Group is not a standardization body as such, but a coordination group to steer and support the execution of the mandate. In detail SG-CG shall:

- Further develop the initial report on smart grid standardization in Europe.

- Manage the whole work process concerning the smart grid mandate

- Clarify non-technical questions to avoid unnecessary discussions in technical groups

- Provide the list of proposed European Standards and other consensus based deliverables to be developed by the ESOs for smart grid functionalities related to the execution of the programs required by the mandate and propose the work program for approval by the ESOs and EC

- Provide comments and recommendations to the European Standardization Organizations, related to smart grid standardization, covered by the current mandate

- Make proposals for the allocation of work

- Provide a suitable platform for discussion of smart grid standardization-related issues with the ESOs and European Commission

- The SG-CG shall not itself produce any draft standardization deliverables.

More details can be found in the SG-CG Terms of Reference [9].

The Smart Grid Coordination Group established four working groups corresponding to the deliverables of the mandate:

- Working Group “First Set of Standards” SG-CG/FSS

- Working Group “Reference Architecture” SG-CG/RA

- Working Group “Sustainable Processes” SG-CG/SP

- Working Group “Smart Grid Information Security” SG-CG/SGIS

Furthermore close relations were established with the mandate M/441 (“Smart Metering”) and mandate M/468 (“E-Mobility”) through ‘rapporteurs’.

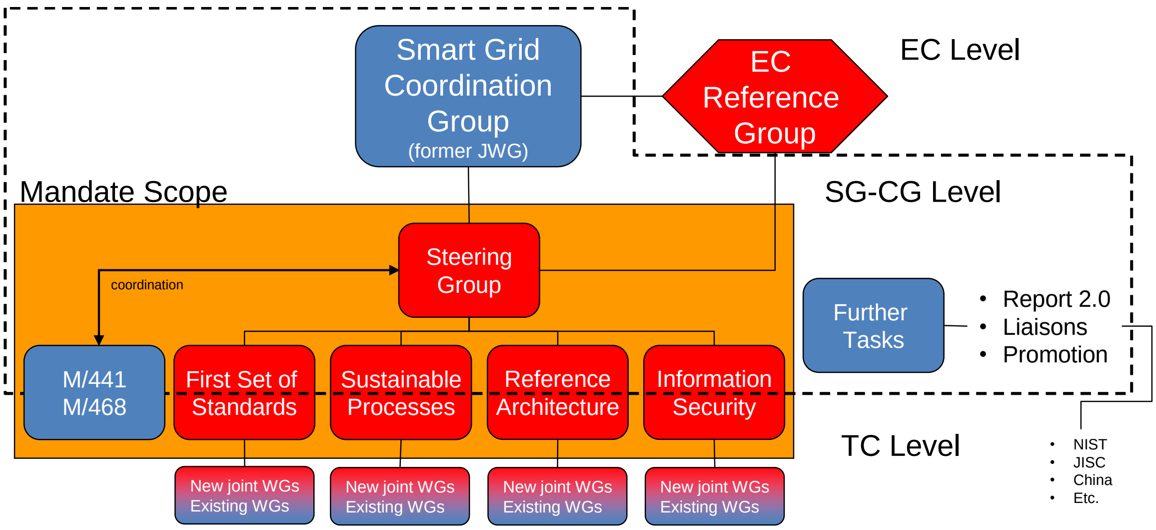

Figure 2 Organization of SG-CG

It is of utmost importance to understand, that although there are separate working groups and work-streams in the mandate as well as in the organization of the SG-CG, the work results are not independent from each other.

The Smart Grid Coordination Group established a Steering Group (SG-CG/StG). Tasks of this group is to manage the overall work programme and to ensure that deliverables are met. Within the ESO structure, the SG-CG/StG acts as joint advisory group to the ESOs and helps to resolve any issues arising from smart grid working groups discussions. Within the M/490 project and on behalf of the SG-CG, the SG-CG/StG oversees and manages the overall M/490 work programme and coordinates input as well as facilitates consistency. The SG-CG/StG is responsible for managing communications related to the M/490 work to relevant stakeholders. Membership comprises of CENELEC Secretariat, Chairman SG-CG, working group Convenors and main TC representatives (CLC/TC 8X 'System aspects of electrical energy supply', ETSI TC/Machine 2 Machine, etc…).

In parallel, the EC Smart Grid Reference Group was set up under European Commission leadership. It is part of four groups established by the European Commission under the umbrella of the Smart Grid Task Force in order to advise the Commission on policy and regulatory frameworks at European level to coordinate the first steps towards the implementation of Smart Grids under the provision of the Third Energy Package. In order to do so four Expert Groups (EG) have been established:

- EG 1: Standardisation (so called Smart Grid Reference Group)
- EG 2: Data Protection and Security
- EG 3: Regulation: market model and options
- EG 4: Infrastructure

The objective of the Smart Grid Reference Group is to ensure timely adoption of the Smart Grid-related standardisation work under Mandate M/490 to CEN, CENELEC and ETSO. EG1 is already considered in the structure of M/490. The work will focus on following up the progress and validate the deliverables, ensure coordination of the work and deliverables of M490 with other related mandates and relevant European actors associated with the work.

6.3 Methodology

The basic idea behind the establishment of the SG-CG is to provide a way forward on how to deal with the complex issues in Smart Grid standardization in an efficient and effective way. When the characteristics of Smart Grids systems are considered - the number of components and the nature of these components, the number and extent of interactions and finally the number of stakeholders, it is clearly evident that the Smart Grid represents a complex system. Smart Grids can in fact be seen as a system of (sub-)systems, an idea that is reflected in the SG-CG/FSS work. Such complex systems need a specific approach, called system engineering, which has frequently been applied in such cases.

Concepts

The main elements of system engineering are modelling and descriptions of functions. In complex systems a simplified representation of the system is needed, which is able to describe the major parts of the system, its interactions and structure. A model also greatly benefits the common understanding of all stakeholders involved. Describing what the system does comes from analysing the functions or as they are often called, the use cases which are envisaged in the design of the system. In addition, a list of actors is necessary to identify who or what is performing or using the functions. In the work of the SG-CG these elements – system, model (architecture), use cases and actors – play a vital role. Since these concepts are vital to the systematic approach they are described in some more detail:

According to the definition a system is representing a typical industry arrangement of components and systems, based on a single architecture, serving a specific set of use cases. It is important to note, that systems can be composed of 0 to n systems and/or components and that components differ from systems by not having connections to external actors. Every system has external actors. External actors can also be of “system” type, i.e when interacting with other systems. For modelling purpose, system elements may appear as internal system actors. The following diagram shows in more detail the definition and its use in Smart Grids.

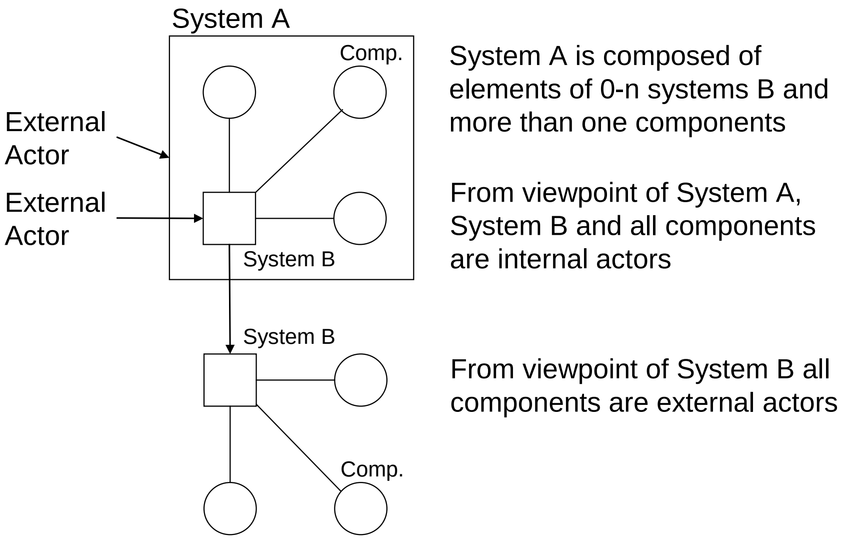

Figure 3 Relation of systems to components and actors

A further necessary part of system engineering is architecture or more general architecture model. In SG-CG/RA a so called Smart Grid Architecture Model (SGAM) was developed. This framework and its methodology are intended to present the design of smart grid use cases in an architectural but solution and technology neutral manner. In accordance to the present scope of the M/490 program, the SGAM framework allows the validation of smart grid use cases and their support by standards. The SGAM framework consists of five layers representing business objectives and processes, functions, information exchange and models, communication protocols and components. These five layers represent an abstract and condensed version of the interoperability categories. Each layer covers the smart grid plane, which is spanned by electrical domains and information management zones. The intention of this model is to represent on which zones of information management interactions between domains take place. It allows the presentation of the current state of implementations in the electrical grid, but furthermore to depict the evolution to future smart grid scenarios by supporting the principles universality, localization, consistency, flexibility and interoperability.

A system is hosting a set of use cases. These use cases describe the interaction within the system and with external actors. The system is an implementation of a specific primary use case. By mapping the system and the respective set of use cases on the SGAM an investigation of the availability of standards for this specific system is performed.

The relation of the introduced terms is shown in the following diagram.

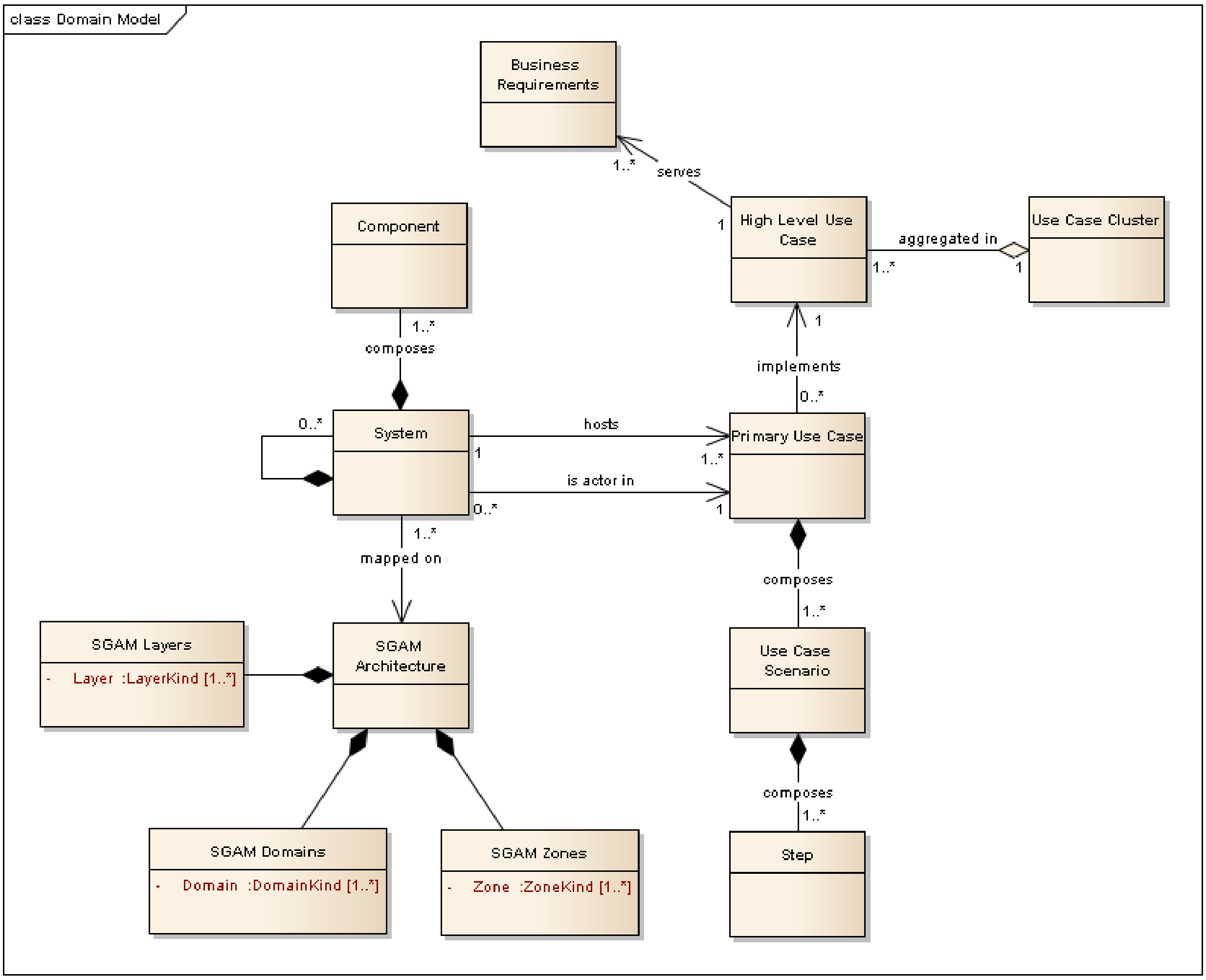

Figure 4 Main terms in SG-CG work and their interrelation

Approach to standardization

An initial inventory of Smart Grids standards was given in the JWG report of 2011. However, while the standards were derived from the experience and knowledge of the participating experts, no overall concept of the structure of the system was applied to ensure a systematic and comprehensive investigation of the subject. The SG-CG now provides a methodology to ensure this. The fundamental difference of the SG-CG work is that standardization is directed towards cooperative work on basic functions which are represented as the generic use cases. Only by using generic use cases as the base of further standardization it can be assured that the resulting standards framework meets the desired quality level. Use cases can be collected on a collaborative base within and outside the standardization organizations. It is however a major task to reduce the number of use cases (450 were collected in a six weeks period in 2011 alone) to a relative small number of high level use cases, which can be further worked on in the standardization community. The high level use cases thus constitute the backbone of all future standardization work in the area of Smart Grids.

It should be emphasized that this approach is a major change in the way in which standardization has been typically organized. Basically, the SG-CG is applying the principles of system engineering to standardization, in this case in the area of Smart Grids. Furthermore it can be applied in other areas of complex systems, e.g. Smart Metering has been using the same approach in its work for the Mandate M/441, and currently it is already starting to be used in a number of other areas, e.g. E-Mobility, Energy Efficiency, Home Installation etc.

Furthermore security aspects were investigated. Therefore standards were analyzed through two axes: the first one is their relevance for Organisations (Smart Grid actors) and products and services (product manufacturer and service providers), the second one is their relevance from a technical and organizational point of view. Since Smart Grid is such a complex system, also covering exhaustively all standards needed to secure the Smart Grid is a quite complex task. Smart Grid use cases are as numerous and different as are the technologies used to deliver the identified services. Hence a tool was needed to identify standards to establish the today basis and future of Smart Grid Information Security. This tool is the SGIS Toolbox that helps identifying which standards can be used in Europe today and in future as well as systematically identifying gaps in existing SGIS standards. The application must be a continuous exercise integrating the evolution of the Smart Grid information security needs.

6.4 Implementation

In addition to providing a methodology for the overall treatment of functional and non-functional requirements and use cases, there is also further mandated work, which is of different nature.

On the one hand a part of the mandate dealing with *"First Set of Standards"* asks for two different deliverables, which are detailed in the mandate text as follows:

> *"Considering the very wide scope of requests to be answered, CEN, CENELEC, ETSI will first produce <u>a development prioritisation of all required standards within 2 months upon acceptance of the mandate</u>. The proposed list of priorities (importance for Smart Grid deployment, effort evaluation to answer the request) will be then validated by the Smart Grids Reference Group of the Smart Grid Task Force.*
>
> *Further a<u> comprehensive work plan will be proposed to the Smart Grids Reference Group of the Smart Grid Task Force 6 months upon acceptance of the mandate, for validation</u>. The presentation of such a work plan will take place in a pre-study report that outlines selected priorities and that describes concrete new work items in CEN, CENELEC, ETSI, in term of in-depth expected content description, planning and workload.*

To cover these two items the work group *"First Set of Standards"* provided a way how to close the most important gaps identified in the JWG report. The SG-CG/FSS prioritization and the work plan build on the JWG report recommendations. Among the aspects considered there are a number of open issues, where some kind of standards work is needed. Out of the 65 recommendations for possible further work, 14 were chosen following a selection according to relevance and risk/probability estimation by the SG-CG. Often these are in areas where there is no single technical committee that can close the gap on its own. The *"Work Programme"* report [5] explains in details the provisions taken to systematically close these gaps. Since its publication the work plan is reviewed every 3 months.

On the other hand, the *"First Set of standards"* report [2] is a selection guide for mature and existing standards; which should help the implementation of Smart Grids in Europe and which meet requirements concerning maturity, availability and soundness of the underlying business model; this clearly separates them from the areas of less maturity, like new market models and their consequences for standardization.

7 Process

As previously noted, the overall goal of the activities of the SG-CG is to develop or update a set of consistent standards for implementation of Smart Grids in Europe. This framework for standardization should provide the answer to a number of important questions:

7.1 What standards can be used in Europe today for the implementation of Smart Grids?

The answer to this question is directly addressed through the deliverable of SG-CG/FSS. Considering the main expectation, i.e. to get a standards selection guide for the implementation of Smart Grids in Europe, the entry point considered for presenting the "First set of standards" are Smart Grid systems as introduced in the report SGCG/M490/C_Smart Grid Reference Architecture – functional breakdown [6]. Then systems, including associated use cases are mapped on the SGAM reference model. This mapping shows then which standards

are to be considered and where to use them. Standards are selected from Standardization bodies, following a ranking method and including “maturity information”. Some cross-cutting domains (such as EMC, power quality, functional safety, security or communication) are treated separately to avoid too many repetitions and/or provide a global, higher level picture. The work fully relies on the work performed by the 3 other main parts of SG-CG committed to fulfill the M/490 expected deliverables (Reference Architecture, Sustainable Processes, Smart Grid Information Security), as well as on the outcome of the Smart Metering Coordination Group in charge of answering the M/441 mandate.
The mandate [1] requested the ESOs to anticipate the expected long term duration of Smart Grid deployment. Therefore the current SGCG/M490/B_Smart Grid Set of Standard is the first attempt in building the framework of standards which can support Smart Grids deployment in Europe, however also stating in the clearest way what is available and what is coming. Generally and in accordance with JWG report findings, it is expected that a majority of standards to help implement Smart Grids in Europe is already available and mature.

7.2 How can we solve the already identified gaps?

The starting point for answering this question is the JWG report on the status of standardization in Europe, and the subsequent work which has been initiated to consider the subject in a more generic manner and to address priority standardization gaps. Responsible for this workstream is the SG-CG/FSS.

The process was started by selecting the main gaps through a prioritization process, which is described in the *“Prioritization”* report [4]. Then these identified 14 priority gaps were transferred to a work plan, which is described in *“Work Programme”* report [5]. For this purpose a template for each gap is provided, which provides technical committees, responsible persons and a project plan with milestones and deliverables. An overview description for each gap is available. The progress of the work program is monitored by SG-CG/FSS every 3 months.

7.3 How can we in future systematically identify a coherent set of standards?

The mandate [1] requested the ESOs to anticipate the expected long term duration of Smart Grid deployment. This therefore suggests the ESOs should set up a framework that is:

- Comprehensive and integrated enough to embrace the whole variety of Smart Grid actors and ensure communications between them
- In-depth enough to guarantee interoperability of Smart Grids from basic connectivity to complex distributed business applications, including a unified set of definitions so that all Member States have a common understanding of the various components of the Smart Grid.
- Flexible and fast enough to take advantage of the existing telecommunications infrastructure and services as well as the emergence of new technologies while enhancing competitiveness of the markets
- Flexible enough to accommodate some differences between EU Member State approaches to Smart Grids deployment

Further the section 4.4 of the mandate [1] clearly opened the path for further iterations of this work, in order to update the mandated deliverables. This means that this framework is seen as the base for a longer term enhancement of the Set of Smart Grid standards. This further development will happen according to the following process established by SG-CG.

1. Further findings will be included in the set of use cases. The use cases will be investigated and so called generic use cases are extracted. Use Cases Use cases which are characterized as generic should describe the general concept and not a project specific realization. Generic use cases will be stored and maintained in the Use Case Management Repository (UCMR).
2. The identified Use Cases will be mapped to the Smart Grid Architecture Model (SGAM). This is done in order to identify the usage of standards at specific layers of the SGAM for the specific system or Use Case. The challenge for mapping such a system/use case on the SGAM to represent associated standards is then being accurate enough to show the typical usage of standards while being generic enough not to “dictate” any preferences regarding technology. The result is a functional view of the system on the SGAM layers.
3. For this functional view the requirements on the specific layers must be investigated and compared to the capabilities or existence of standards.

4. If for parts of the system/use case no standards exists or the requirements for existing standards are not met, a gap in the standard framework for Smart Grid is identified. This gap serves as input to the work programme.

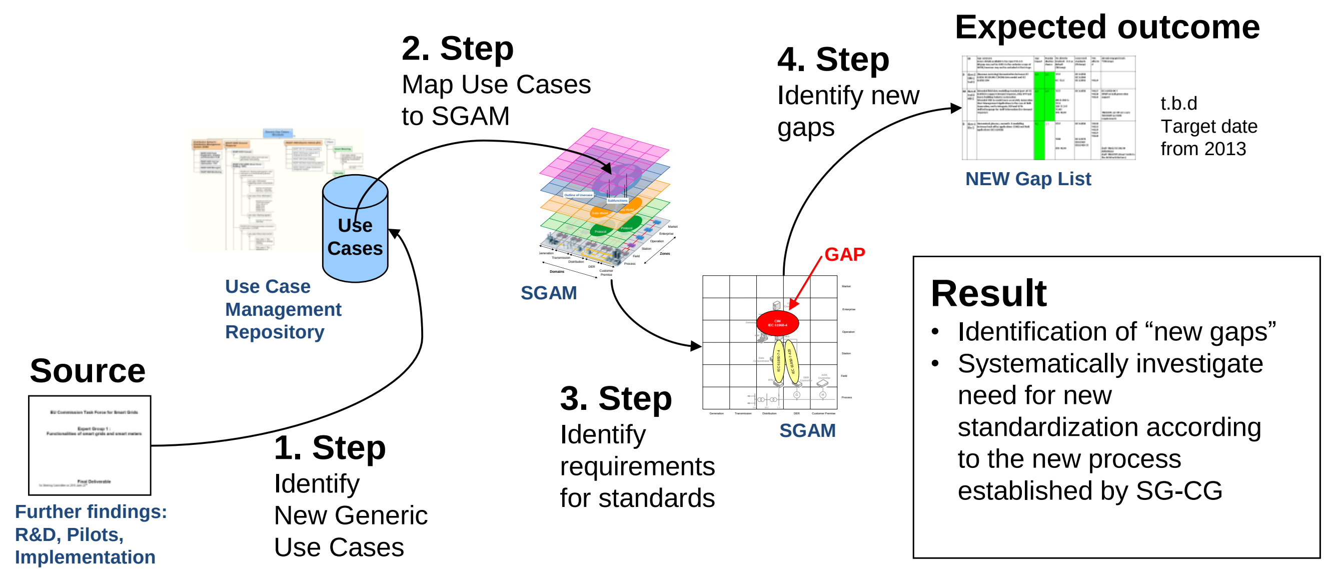

Figure 5 Process for future identification of standardization needs

An iteration of the list of standards provided by SGCG/M490/B_Smart Grid Set of Standard [2] can be expected at a later time. The general process and its iterative nature will help to ensure a consistent and systematic approach.

7.4 How to integrate security in the general framework?

The SG-CG/SGIS has worked on this issue. The SGIS toolbox is the answer to this question as illustrated hereunder.

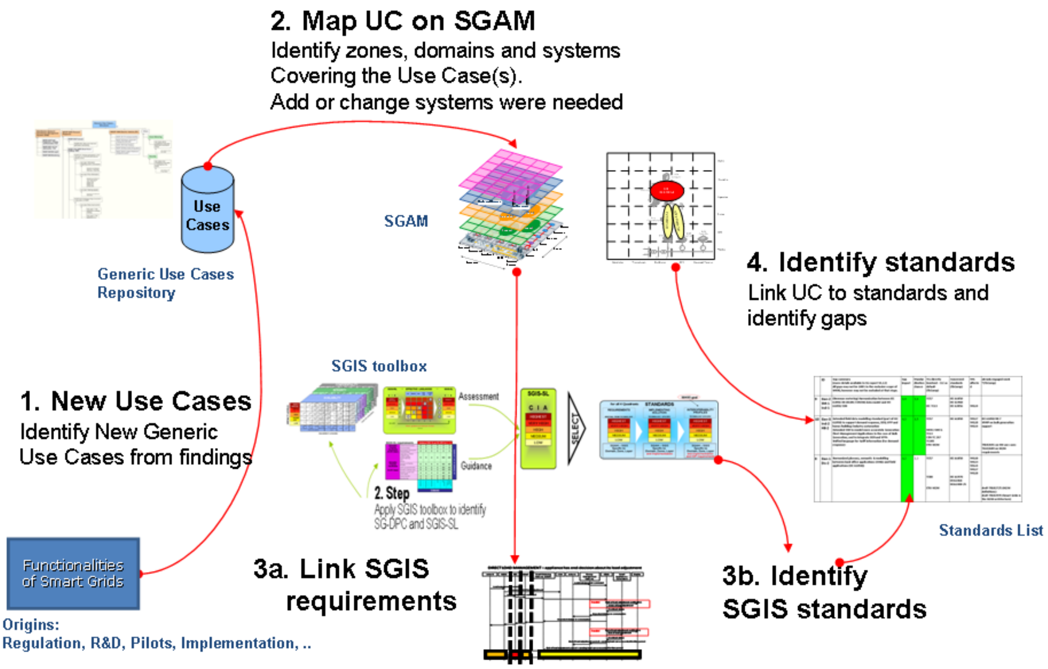

Figure 6 SGIS Toolbox in Smart Grid Framework

The SGIS toolbox objective is to provide Smart Grid stakeholders an easy and pragmatic way to identify what might be their security needs for the specific use case and on which standards they can rely on to enforce them. The SGIS toolbox will thus help identifying which standards can be used in Europe today and in future and systematically identifying gaps in existing SGIS standards. The toolbox makes use of the above described general process how to systematically derive standardization needs from use cases and amend the process with security tools. As with the standardization framework in general, this security standards gap analysis can not be one shot only. This must be a continuous exercise integrating the evolution of the Smart Grid information security needs.

8 Work results of the working groups

8.1 FSS - First set of Standards

Extract of Executive Summary of *“Prioritization”* report. Reference to report [4].

“In order to answer the M/490 mandate first delivery, i.e a prioritisation of standards gaps and related standardisation work, CEN-CENELEC-ETSI conveyed a survey to all members of the Smart Grid Coordination Group in order to evaluate in a balanced way what are the most important standardisation areas to consider.

This document (ref. to SGCG_Sec0028_DC) *presents the methods chosen for reaching this goal, the list of gaps considered, the raw survey result and the final conclusion.*

This survey shows a quite good alignment of stakeholders on the highest standardisation priorities needed to achieve in order to in order to ensure the most seamless deployment of Smart Grid in Europe and to provide a frame from interoperability between all Smart Grid components.

The most important gaps expressed through the survey are focusing (but not restricted to):

- *on data model harmonisation. This concerns mostly the integration of field level, with remote monitoring and control levels, as well as integration of smart metering into smart grid systems;*

- *on protocols (including data-models and communication services) for connecting smart producers and consumers, including the associated aggregations levels;*

- *on connecting new types of generators, while ensuring the expected level of quality and grid stability, as well as enabling new types of operating distribution networks;*

- *on deploying cyber-security.*

It is also important to consider that this list of gaps will be reassessed all along the mandate duration, in order to take into account the outputs of the security, architecture and processes-related works."

Extract of Executive Summary of *"Work Programme"* report. Reference to report [5].

"This report (ref. to SGCG_Sec0032_DC (version 1.6)) *aims to provide a 3-months basis update of the M/490 mandate programme of standardisation work, proposed to fill the main standard gaps mentioned in section 7 of the* [4].

As a reminder these gaps selection results from a large survey CEN-CENELEC-ETSI conveyed to all members of the Smart Grid Coordination Group. Results of this survey showed a quite good alignment of the stakeholders view. Final gaps ranking and gaps selection were summed-up in the report [4]*, which circulated to all stakeholders, and was finalised and approved at the Oct 7th 112 2011 SGCG plenary meeting.*

This document aims not only to describe the work programme, but also to offer a tool for monitoring and reporting of all these actions. It will also enable capturing/following-up the new needs for standardisation resulting from the re-assessment of smart grid market needs.

Each set of standardisation works, focusing on one selected gap, is described using the same template specifying :

- *The gap to be filled, and its reference to the JWG Smart Grid Standard report* [3]

- *The standardisation bodies involved in filling the gap*

- *The leader name*

- *The standards considered in this work package, with their expected impacts, and associated status*

- *The plan of actions associated with the work package, including title, initial forecasted completion date and updated one, in order to monitor the following-up of the gap filling*

The establishment of this work programme provides a unique overview of Smart Grid related standardisation activities, together with a mean to ensure the consistency and completeness of the standardisation work under focus.

At that stage, the work programme includes the revision of 21 standards, and the creation of 28 standards.

These figures will vary, during time, mostly due to the fact that further refinement of the requirement will lead to further identification of impacted standards, especially in the case of standards which are formed of series such as CIM or IEC 61850."

Extract of Executive Summary of *"FSS"* report. Reference to report [2].

"As the result of the mandated work requested through the M/490 mandate [1], this report (ref. to SGCG/M490/B_Smart Grid Set of Standards) *intends to build a first list of standards, enabling or supporting the deployment of Smart Grid systems in Europe.*

More than just a flat list, this reports aims to provide to any kind of Smart Grid users a ***selection guide which, depending on the targeted system and the targeted layer (component, communication or information layers), will set out the most appropriate standards to consider.*** *This report fully relies on the work* *performed by the 3 other main parts of Smart Grid Co-ordination Group (SG-CG) committed to fulfill the M/490 expected deliverables (Reference Architecture, Sustainable processes, Smart Grid Security), as well as on the outcome of the Smart Metering Co-ordination Group in charge of answering the M/441 mandate (…).*

Because Smart Grids may appear of very wide scope and too complex, the writers of these reports have chosen to present their selection in the easiest way, mostly using graphics, re-using the Smart Grid Architecture Model.

The objective is not to be comprehensive, but more to provide guidance within the galaxy of standards which may apply. Preference is given to consistency wherever possible. Then possibly all available standards may not be reflected in this report.

At the end this guide includes about 24 types of Smart Grid systems, more than 400 standard references, coming from more than 50 different bodies. In addition, it also indicates the standardization work which may have started, stating in the most accurate manner, on a per system approach, the user impact (use case) this standardization work may have in a near future, in order to fill the identified gaps.

That why this report is called "First set of standards" : a regular re-assessment, based on new market requirements but also new standardization achievements, will provide periodic updates of the relevant list of standards to consider for the most efficient deployment of Smart Grids in Europe."

8.2 RA – Reference Architecture

Extract of Executive Summary of *"Reference Architecture"* report. Reference to report [6].

"The "SG-CG/M490/C_ Smart Grid Reference Architecture" report (ref. to SGCG/M490/C_Smart Grid Reference Architecture) *prepared by the Reference Architecture Working Group (SG-CG/RA) addresses the M/490 mandate deliverable regarding the development of a Technical Reference Architecture.*

The Reference Architecture challenge
The CEN/CENELEC/ETSI Joint Working Group report on standards for smart grids has defined the context for the development of the Smart Grids Reference Architecture (RA):

> *"It is reasonable to view [the Smart Grid] as an evolution of the current grid to take into account new requirements, to develop new applications and to integrate new state-of-the-art technologies, in particular Information and Communication Technologies (ICT). Integration of ICT into smart grids will provide extended applications management capabilities over an integrated secure, reliable and high-performance network.*
>
> *This will result in a new architecture with multiple stakeholders, multiple applications, multiple networks that need to interoperate: this can only be achieved if those who will develop the smart grid (and in particular its standards) can rely on an agreed set of models allowing description and prescription: these models are referred to in this paragraph as Reference Architecture."*

To develop a coherent and useful Reference Architecture, two main issues have been addressed:

- *Clarification of the requirements for the reference architecture and description of its major elements. Reuse of existing results has been considered essential to a fast progress. In particular, the Reference Architecture elements are positioned with respect to existing models (e.g. NIST) and architectural frameworks (GWAC, TOGAF, etc.). Extensions have been limited and, in general, focused on addressing the European specificities.*

- *Coherence of the RA with respect to the overall Smart Grids standardization process. Notably, the work of SG-CG/RA has been aligned with the other SG-CG Work Groups.*
  - *Using upstream results of SG-CG/SP on (generic) use cases and the flexibility concept;*
  - *Providing results to SG-CG/FSS regarding the identification of useful standards and a method to support standards gap analysis;*
  - *Clarifying the alignment with SG-CG/SGIS regarding the representation of the Security viewpoint in the RA and providing a method to analyze Information Security use cases.*

In addition, alignment with existing initiatives from other organizations (e.g. NIST, ENTSO-E, EU Task Force Experts Groups …) has been a constant objective.

Main elements of the Reference Architecture

The main components of the Reference Architecture are now in place. The most important are described below.

European Conceptual Model

The National Institute of Standards and Technology (NIST) has introduced the Smart Grid Conceptual Model which provides a high-level framework for the Smart Grid that defines seven high-level domains and shows all the communications and energy/electricity flows connecting each domain and how they are interrelated.

Though the NIST model is a sound and recognized basis, it has been necessary to adapt it in order to take into account some specific requirements of the EU context that the NIST model did not address. Two main elements are introduced to create the EU Conceptual Model. The first one is the Distributed Energy Resource (DER) domain that allows addressing the very important role that DER plays in the European objectives. The second one is the Flexibility concept (developed in SG-CG/SP) that group consumption, production and storage together in a flexibility entity.

The EU Conceptual Model is a top layer model (or master model) and will also act as a bridge between the underlying models in the different viewpoints of the Reference Architecture.

During the course of this first iteration of the M/490 mandate, a constant discussion has taken place with NIST SGIP/SGAC to ensure optimal alignment on the Conceptual Model. The model that is presented in the main part of the SG-CG/RA report is reflecting these discussions.

Smart Grids Architecture Model (SGAM) Framework

The SGAM Framework aims at offering a support for the design of smart grids use cases with an architectural approach allowing for a representation of interoperability viewpoints in a technology neutral manner, both for current implementation of the electrical grid and future implementations of the smart grid.

It is a three dimensional model that is merging the dimension of five interoperability layers (Business, Function, Information, Communication and Component) with the two dimensions of the Smart Grid Plane, i.e. zones (representing the hierarchical levels of power system management: Process, Field, Station, Operation, Enterprise and Market) and domains (covering the complete electrical energy conversion chain: Bulk Generation, Transmission, Distribution, DER and Customers Premises).

SGAM Methodology

This SGAM Framework can be used by the SGAM Methodology for assessing smart grid use cases and how they are supported by standards, thus allowing standards gap analysis. The model has largely evolved in v2.0, with clearer basic definitions, more detailed presentation of the elements (zones, domains, etc.), a clarification of the methodology and a complete detailed example.

Architecture Viewpoints

They represent a limited set of ways to represent abstractions of different stakeholders' views of a Smart Grid system. Four viewpoints have been selected by the SG-CG/RA: Business, Functional, Information and Communication, with associated architectures:

- *The Business Architecture is addressed from a methodology point of view, in order to ensure that whatever market or business models are selected, the correct business services and underlying architectures are developed in a consistent and coherent way;*
- *The Functional Architecture provides a meta-model to describe functional architectures and gives an architectural overview of typical functional groups of Smart Grids (intended to support the high-level services that were addressed in the Smart Grids Task Force EG1);*
- *The Information Architecture addresses the notions of data modeling and interfaces and how they are applicable in the SGAM model. Furthermore, it introduces the concept of "logical interfaces" which is aimed at simplifying the development of interface specifications especially in case of multiple actors with relationships across domains;*
- *The Communication Architecture deals with communication aspects of the Smart Grid, considering generic Smart Grid use cases to derive requirements and to consider their adequacy to existing*

communications standards in order to identify communication standards gaps. It provides a set of recommendations for standardization work as well as a view of how profiling and interoperability specifications could be done.

How to use the Reference Architecture

Given the large span of the Reference Architecture components described above, the Reference Architecture can be used in a variety of ways, amongst which:

- *Adaption of common models and meta-models to allow easier information sharing between different stakeholders in pre-standardization (e.g. research projects) and standardization;*
- *Analysis of Smart Grids use cases via the SGAM methodology. This is a way to support, via an easier analysis of different architectural alternatives, the work of those who are going to implement those use cases;*
- *Gap analysis: analysis of generic use cases in order to identify areas where appropriate standards are missing and should be developed in standardization;*
- *…*

Outlook

The current version of the Reference Architecture document is the result of the work done by the SG-CG/RA Working Group during the first iteration of the M/490 Mandate.

The final version (v3.0) of this report addresses the comments made on v2.0 and clarifies some of the remaining issues, such as the handling of Security aspects in the Architecture and in SGAM, an (SG-CG) agreed functional meta-model, or the respective role of markets and business viewpoints.

However, there are still areas where the document can be completed such as a role-based definition of the European Conceptual Model (developed but still to be validated), expansion of the Functional Architecture, more in-depth exploration of the communication profiles, etc. This work could be addressed if the extension of the M/490 Mandate for a second iteration is decided."

8.3 SP – Sustainable Processes

Extract of Executive Summary of *"Sustainable Processes"* report. Reference to report [7].

"Based on the modified use case template, use cases have been collected from a diverse range of stakeholders. These use cases have been grouped and generic use cases have been suggested reflecting key stakeholder feedback around the provided use cases. Use cases can therefore be considered are essentially describing the functionality or requirements with respect to needs of an array of actors. Actors can be classified as people (their roles or jobs), systems, databases, organizations, and devices involved in or affected by the use case.

It was not the aim of the SG-CG/SP to determine as many use cases as possible. Instead the goal was to establish a prioritized list of high level use cases with respect to functioning of a Smart Grids. Use cases which are characterized as generic should be considered as describing the general concept and not a project specific outcome. Furthermore, generic use cases will be stored and maintained in the Use Case Management Repository (UCMR). Moreover, drawing on the suggested procedure other SG-CG working groups, such as the WG "First set of standards", suggested further generic use cases.

It is worth noting that the suggested generic use cases have been discussed and reviewed following key stakeholder workshops. However, continuing this overall process it is expected that these generic use cases will be extended resulting in a first set of broadly accepted use cases. Also the specific role of use cases in standardization needs to be clarified. Further it is expected that together with the domain experts of the Technical Committees generic use cases will be further refined and interrelations and interdependencies will be investigated in more detail.

As described later in this document, the use cases developed in the context of the M/490 mandate, may serve as a basis to evaluate further Smart Grid standards.

Based on generic use cases a standardization gap analysis can thereafter be applied to support the different technical committees allowing them to draw on a consistent array of functional concepts within the Smart Grid (…). Therefore, use cases can be seen as part of a methodology to increase the collaboration between the various key stakeholder communities and sectors (e.g. smart metering, home automation, utilities, IT, appliances, manufacturers etc.) and their respective technical committees in standardization. A mapping of the use cases to the business and function layer of the proposed Smart Grid Reference Architecture (SGAM) established by the Working Group Reference Architecture(SG-CG/RA) is a further key element of supporting material to this generic use case analysis (…).

(….)

The working group "First set of standards" (SG-CG/FSS) is working with an approach centered around breaking down the Smart Grid into systems (..). In this approach use cases are used to describe the functionality of such systems. Actors should thereby be considered as linking the reference architecture on one hand (e.g. as components within the architecture or the users/roles of these components) and on the other hand with the system approach.

Furthermore the WG "Smart Grid Information Security" (SG-CG/SGIS) within the SG-CG also harnesses the use cases outlined in this document for the purpose of risk & threat analysis and for the assessment of proposed SGIS methods (…).

As such the work of the different working groups of the SG-CG is interlinked.

In a top down approach use cases are developed based on business cases/requirements[1] and / or a legal framework. A business case would reveal the legal, social, financial or environmental basis for a use case. However, the description of business cases/requirements was not a specific element of this work as use cases were only used to support standardization whereas business cases are relevant in an enterprise context. Nevertheless, in the descriptions of the use cases in the field "Scope and Objective" the general motivation behind each of the use cases has been outlined and therefore may only represent a general business case. In a bottom up approach existing lower level use cases or functional possibilities of devices enable or support new business cases/requirements (…).

In addition to the business cases/requirements the review and analysis of the collected use cases led to conceptual descriptions outlining the general ideas of clusters of use cases. These were roughly grouped as use cases clusters and high level use cases, which essentially describe the general functionality that might be realized in different systems and architectures (e.g. central or decentralized function), and primary use cases. As such, primary use cases are specializations of the high level use case and which are detailed enough to be mapped onto a specific architecture. However, one high level use case might comprise of several possible primary use cases (refer to chapter 6.5.3). Examples of generic use cases and clusters are provided in the UCMR.

(…)

Based on the structure described above, intermediate processes have been developed for the handling of use cases within a standardization organization. The processes are based on the developed Use Cases Management Repository (UCMR), an online database for use cases as collaborative platform for the description and discussion of use cases crossing various sectors. Recommendations for intermediate and later sustainable processes in standardization development organizations (SDO) have been proposed in this document (chapter 6.6).

The issues generating the greatest discussion with respect to the deployment of Smart Grids, include flexibility (demand response, DR, and markets) and smart charging, which are subsequently described in detail via conceptual models (found in Chapter 8). Moreover, conceptual models are worked out in generic use cases (chapter 9), a functional architecture and a suggestion for the inclusion of information security requirements based on the SGIS toolbox. Several other generic use cases in the field of distribution management are also described these include: FLIR (Fault Location, Identification, Restoration), VVO (Volt VAr Optimization), Forecast, Microgrid Management, Grid Monitoring for example.

1 *A business case is defined in the SG-CG/RA related to the business layer, ….*

Please note that use cases are not the magic bullets. The use case methodology should be seen as being part of a chain of necessary steps towards interoperable solutions. Related to standardization, technology tracking and reference architecture are also needed as basis for concrete standardization work like the definition of data models, interfaces, protocols etc."

8.4 SGIS – Smart Grid Information Security

Extract of Executive Summary of *"Smart Grid Information Security"* report. Reference to report [8].

"The objective of this report (ref. to SGCG/M490/D_Smart Grid Information Security) *is to support Smart Grid deployment in Europe providing Smart Grid Information Security guidance and SGIS standards landscape to Smart Grid stakeholders.*

SGIS essential requirements presented emphasize the importance of the CIA (Confidentiality, Integrity and Availability) triad for Information Security but also underline the varying weight of the Confidentiality, Integrity and Availability as essential requirements and the issue encountered to address Information Security topics for the Smart Grid as a whole.

Key SGIS elements like the SGAM (Smart Grid Architecture Model), SGIS-SL (SGIS Security Levels), Smart Grid Data Protection Classes (SG-DPC) and the Security View per SGAM layers are introduced and used to provide security requirements and recommendations on their implementations thru a European Electrical Smart Grid stability scenario.

SGIS standards landscape illustrates the role of standards in requirements implementation and establishes a current picture and a target for this landscape.

SGIS Toolbox provides Smart Grid Use Case stakeholders an easy and pragmatic way to identify what might be their use case security needs.

In conclusion, the standards needed to establish the basis of the Smart Grid Information Security are available today. Nevertheless there is a need for enhancement and for additional standards to integrate Smart Grid specific needs.

As a final thought, outside of standardization, the risks of connecting Smart Grid critical infrastructures equipments to public networks should be carefully considered in all implementations, as well as the opportunity to send encrypted and authenticated orders to smart grid components."

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