IEC TR 62746-2

Edition 1.0 2015-04

TECHNICAL REPORT

colour inside

Systems interface between customer energy management system and the power management system –
Part 2: Use cases and requirements

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SYSTEMS INTERFACE BETWEEN CUSTOMER ENERGY MANAGEMENT SYSTEM AND THE POWER MANAGEMENT SYSTEM –

Part 2: Use cases and requirements

FOREWORD

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IEC TR 62746-2, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
57/1492/DTR	57/1546/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62746 series, published under the general title *Systems interface between customer energy management system and the power management system*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

Intelligent, integrated energy systems for smart environments

NOTE This Introduction is an extract from the "Demand – Response – White Paper, Siemens AG, 2010 [1][1].

In 2007, the number of people living in conurbations around the world surpassed that of those living in rural areas. Today, large cities worldwide account for 75 per cent of energy demand, and generate a large percentage of total carbon dioxide emissions. For this reason, a number of cities and metropolitan areas have set themselves ambitious goals towards reducing emissions by increasing the efficiency of their infrastructures. These goals aim to have a positive impact on the environment, while continuing to enhance the quality of life of growing urban populations.

The transition to a new "electrical era" in which electricity is becoming the preferred energy source for most everyday applications is currently taking place. This is governed by three key factors: demographic change, scarcity of resources, and climate change. In the meantime, two development trends are of particular interest:

- the demand for electricity is continuing to grow
- the energy system is subject to dramatic changes

The experienced changes to the energy system might vary, based on whether they are nationally or cross-nationally observed. Some of the changes are caused by electricity production and fluctuating power supply sources.

Until recently, load dictated production, a method which influenced how interconnected power systems were designed. Power generation was centralized, controllable, and above all, reliable. The load was statistically predictable, and energy flow was unidirectional, that is from producer to consumer.

These aspects of power generation are changing. Firstly, the rising percentage of fluctuating production within the energy mix brought about by renewables reduces the level of power generation control available. Secondly, the energy flow is no longer unidirectionally sent from producer to consumer; now the consumer is slowly turning into a "prosumer," a term which denotes a person who produces and consumes energy. More and more consumers are installing their own renewable energy products to increase energy efficiency. These prosumers are cogenerating heat and power with their own solar panels or microCHPs, for example. This trend is set to continue, as government bodies continue to provide incentives to domestic users to become "prosumers" as part of their increased energy efficiency policies.

Managing reactive power in relation with power system voltage control will become more important in situation and regions where distributed generation and power storage is or will become a substantial part of the total power demand of that region. The total power demand in the region will be generated partly by the central power stations that are connected to the transmission system and the power generated locally by generators and storage facilities connected to the distribution networks in that region. It will not be sufficient to switch distributed generators and/or storage facilities of premises off during emergency situations in the power system. In future it will be thinkable and it already happens that in certain regions distributed generation and storage will support power system restoration in emergency situations in the network. Voltage and frequency will not only be controlled by central power stations and dispatch centers a more advanced control will be needed, supported by appropriate energy market arrangements (contracts and transparent arrangements between different parties involved).

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1 Numbers in square brackets refer to the Bibliography.

Ultimately, the way of the future will have to be that, up to a certain extent, the load follows the energy availability.

The way in which loads (being demand or local generation) at the consumer side can be managed, is through the mechanisms of Demand Response and Demand Side Management.

When referring to Demand Response and Demand Side Management, within this technical report the following definition of EURELECTRIC [2] in its paper "EURELECTRIC Views on Demand-Side Participation" is used:

- "Demand Side Management (DSM) or Load Management has been used in the (mainly still vertically integrated as opposed to unbundled) power industry over the last thirty years with the aim "to reduce energy consumption and improve overall electricity usage efficiency through the implementation of policies and methods that control electricity demand. Demand Side Management (DSM) is usually a task for power companies / utilities to reduce or remove peak load, hence defer the installations of new capacities and distribution facilities. The commonly used methods by utilities for demand side management are: combination of high efficiency generation units, peak-load shaving, load shifting, and operating practices facilitating efficient usage of electricity, etc." Demand Side Management (DSM) is therefore characterized by a 'top-down' approach: the utility decides to implement measures on the demand side to increase its efficiency.
- Demand Response (DR), on the contrary, implies a 'bottom-up' approach: the customer becomes active in managing his/her consumption – in order to achieve efficiency gains and by this means monetary/economic benefits. Demand Response (DR) can be defined as "the changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time. Further, DR can be also defined as the incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized. DR includes all intentional modifications to consumption patterns of electricity of end use customers that are intended to alter the timing, level of instantaneous demand, or the total electricity consumption". DR aims to reduce electricity consumption in times of high energy cost or network constraints by allowing customers to respond to price or quantity signals."

The intent of demand response and demand side management programs is to motivate end users to make changes in electric use, lowering consumption when prices spike or when grid reliability may be jeopardized. These concepts refer to all functions and processes applied to influence the behaviour of energy consumption or local production. This leads to a more efficient energy supply which allows the consumer to benefit from reduced overall energy costs.

In this context, the report focuses on the signals exchanged between the grid and the premise, which may go from simple signalling to integrated load management.

Since many components must be integrated to interface within a demand response solution, a suitable communication infrastructure is of paramount importance.

There is a variety of equipment connected to the grid, which may be included in a demand response solution. Such devices can act as an energy source or load. Some devices can act as both an energy source and a load alternately, depending on the operation mode selected. In response to load peaks or shortages, selected generation sources can be switched on, loads switched off, and storages discharged. In addition, loads with buffer or storage capacity can be switched on to make use of preferred energy generation when available.

As shown in the examples in Figure 1, some device types provide storage or buffer capability for energy. A storage device can give back the energy in the same type as it was filled. An example of this is a battery. A buffer device, however, can store energy only in a converted form, in the way that a boiler stores energy by heating up water; it is only capable of load-shifting. Devices capable of storage, however, can be utilized fully for energy balancing within the electrical grid.

Table: Demand response communication infrastructure

Device type	Influenceable		Storage/ buffer	Comment
	Generation	Consumption		
Wind turbine	■			Only reduction of actual generation
Photovoltaic generation	■			Only reduction of actual generation
Backup generators	■			
Solar water radiators		■	B	Additional electrical heating in boiler required
Combined heat and power	■	■	B	Additional electrical heating in boiler required
Heat pump with boiler		■	B	
Electric radiators		■		
Central air-conditioning		■	B	
Decentral air-conditioning		■		
Drives for ventilation		■		
Drives for water pumps		■	B	Requires water tanks on top of buildings
Other drives		■		Elevators, escalators, etc.
Household appliances		■		Washing machines, tumble dryers, dishwashers, etc.
Industrial processes		■	S/B	Storage/buffer capability depends on process type
Batteries and supercaps	■	■	S	
E-cars (home charging)	■	■	S/B	Feedback is currently only future option
E-cars (public charging)		■		

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Source: Siemens AG [1]

Figure 1 – Examples of demand response capabilities

SYSTEMS INTERFACE BETWEEN CUSTOMER ENERGY MANAGEMENT SYSTEM AND THE POWER MANAGEMENT SYSTEM –

Part 2: Use cases and requirements

1 Scope

The success of the Smart Grid and Smart Home/Building/Industrial approach is very much related to interoperability, which means that Smart Grid and all smart devices in a Home/Building/Industrial environment have a common understanding of messages and data in a defined interoperability area (in a broader perspective, it does not matter if it as an energy related message, a management message or an informative message).

In contradiction, today's premises are covered by different networks and stand alone devices (see Figure 2).

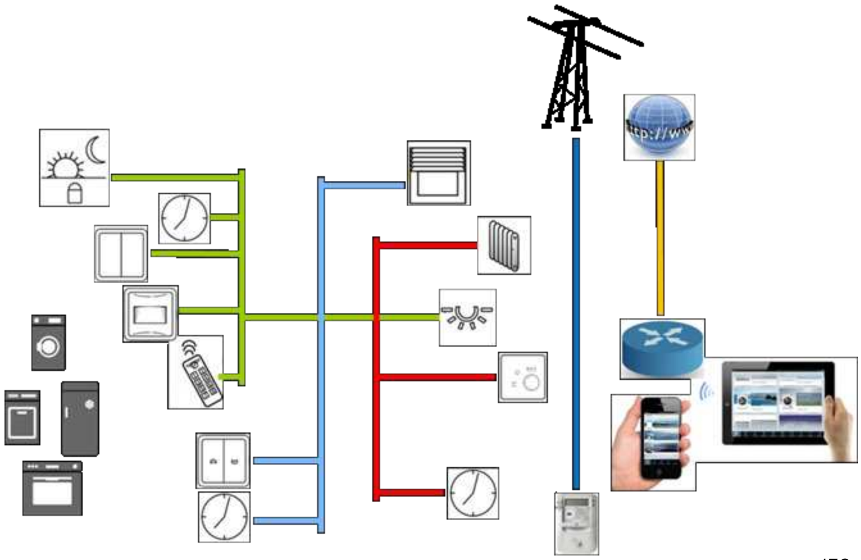


Figure 2 – Smart environment as of today

The scope of this technical report is to describe the main pillars of interoperability to assist different Technical Committees in defining their interfaces and messages covering the whole chain between a Smart Grid and Smart Home/Building/Industrial area (see Figure 3).

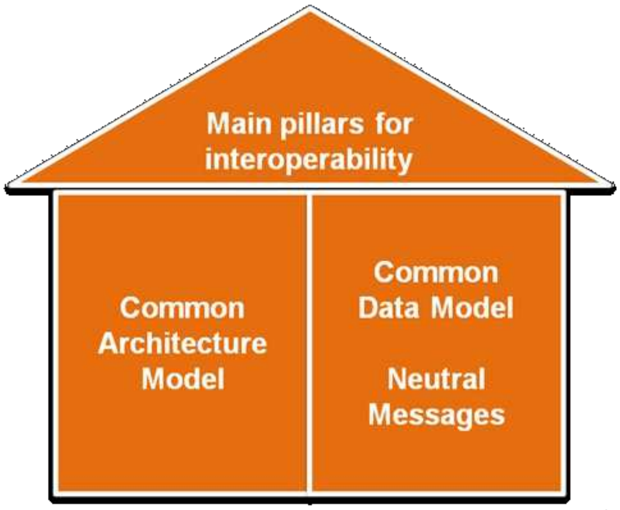


Figure 3 – Requirements for interoperability

The main topics of this technical report are:

- To describe an architecture model from a logical point of view;
- To describe a set of user stories that describe a number of situations related to energy flexibility and demand side management as well as an outline of potential upcoming Smart Building and Smart Home scenarios. The set of user stories does not have the ambition to list all home and building (energy) management possibilities, but is meant as a set of examples that are used as input in use cases and to check that the set of use cases is complete;
- To describe a set of use cases based on the user stories and architecture. The use cases describe scenarios in which the communication between elements of the architecture are identified;
- To further detail the communication, identified in the use cases, by describing the requirements for messages and information to be exchanged.

This technical report can also be used as a blue print for further smart home solutions like remote control, remote monitoring, ambient assistant living and so forth.

2 Terms, definitions and abbreviations

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

2.1 Terms and definitions

2.1.1
use case

2.1.1.1
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 62559:2008, IEC 62390:2005]

2.1.1.2
use case
description of the possible sequences of interactions between the system under discussion and its external actors, related to a particular goal

Note 1 to entry: A use case is the description of one or several functions performed by the respective actors.

[SOURCE: Alistair Cockburn, *Writing effective use cases*]

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.2
use case template
form which allows the structured description of a use case in predefined fields

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.3
cluster
group of use cases with a similar background or belonging to one system or one conceptual description

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.4
high level use case
use case which describes a general requirement, idea or concept independently from a specific technical realization like an architectural solution

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.5
primary use case
use cases which describe in detail the functionality of (a part of) a business process

Note 1 to entry: Primary use cases can be related to a primary goal or function which can be mapped to one architectural solution.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.6
secondary use case
elementary use case which may be used by several other primary use cases

EXAMPLE Communication functions.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.7
generic use case
use case which is broadly accepted for standardization, usually collecting and harmonizing different real use cases without being based on a project or technological specific solution

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.8
specialized use case
use case which is using specific technological solutions / implementations

EXAMPLE Use case with a specific interface protocol.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.9
individual use case
use case which is used specific for a project or within a company / organization

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.10
scenario
possible sequence of interactions

Note 1 to entry: Scenario is used in the use case template defining one of several possible routes in the detailed description of sequences.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.11
activity step
the one elementary step within a scenario representing the most granular description level of interactions in the use case

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.12
repository
place where information like use cases can be stored (Use Case Management Repository)

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.13
Use Case Management Repository
database for editing, maintenance and administration of use cases which are based on a given use cases template

Note 1 to entry: The UCMR is designed as collaborative platform for standardization committees, inter alia equipped with export functionalities as UML model or text template.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.14
actor
entity that communicates and interacts

Note 1 to entry: These actors can include people, software applications, systems, databases, and even the power system itself.

Note 2 to entry: In the actor list the ENTSO-E role model, generic actors and technical system actors are considered.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.15
actor [external]
entity having behavior and interacting with the system under discussion (system as 'black box') to achieve a specific goal (see Figure 4)

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

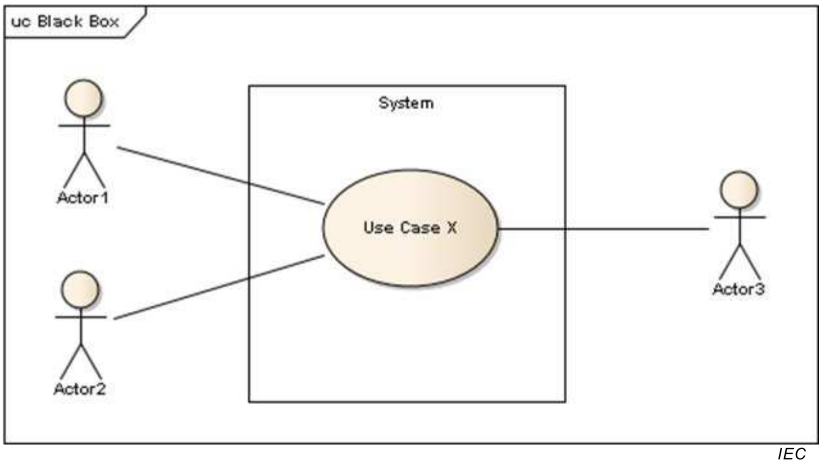


Figure 4 – External actor definition

2.1.16
actor [internal]
entity acting within the system under discussion (actor within the system; system as 'white box') to achieve a specific goal (see Figure 5)

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

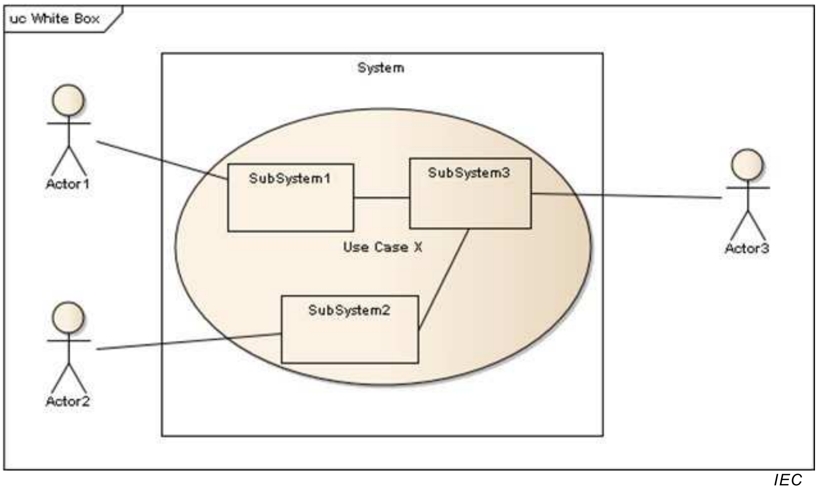


Figure 5 – Internal actor definition

2.1.17
role

2.1.17.1
role
role played by an actor in interaction with the system under discussion

Note 1 to entry: Legally or generically defined external actors may be named and identified by their roles.

2.1.17.2
role
external intended behavior of a party

EXAMPLES A legally defined market participant (e.g. grid operator, customer), a generic role which represents a bundle of possible roles (e.g. flexibility operator) or an artificially defined body needed for generic process and use case descriptions.

Note 1 to entry: A party cannot share a role.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.18
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/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.19
system
typical industry arrangement of components and systems, based on a single architecture, serving a specific set of use cases.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.20
coordinating TC
technical committee within a standardization organization taking over the responsibility for agreed use cases while involving other interested and concerned technical committees

Note 1 to entry: For example the responsibility might include further detailing, analysis, maintenance and harmonization of the use case

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.21
involved TC
technical committee within a standardization organization with an interest in a generic use case

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.22
flexibility
general concept of elasticity of resource deployment (demand, storage, generation) providing ancillary services for the grid stability and / or market optimization (change of power consumption, reduction of power feed-in, reactive power supply, etc.)

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.23
flexibility offer
flex-offer
offer issued by roles connected to the grid and providing flexibility profiles in a fine-grained manner dynamically scheduled in near real-time, e.g. in case when the energy production from renewable energy sources deviates from the forecasted production of the energy system

Note 1 to entry: Flexibility offer starts a negotiation process.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.24
flexibility operator
generic role which links the role customer and its possibility to provide flexibilities to the roles market and grid; generic role that could be taken by many stakeholders, such as a DSO company, an Energy Service Company (ESCO) or an energy supplier

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.25
market
open platform operated by a market operator trading energy and power on requests of market participants placing orders and offers, where accepted offers are decided in a clearing process, usually by the market operator

EXAMPLES Energy, balancing power / energy, capacities or in general ancillary services.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.26
Smart Grid Connection Point (SG CP)
borderline between the area of grid and markets towards the role *customer* (e.g. households, building, industry)

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.27
Customer Energy Manager (CEM)
internal automation function of the role *customer* for optimizations according to the preferences of the customer, based on signals from outside and internal flexibilities

CEM includes a semantic mapping for received and sent messages between CEM-connected devices

EXAMPLE A demand response approach uses variable tariffs to motivate the customer to shift consumption in a different time horizon (i.e. load shifting). On customer side the signals are automatically evaluated according to the preset customer preferences like cost optimization or CO2 savings and appropriate functions of one or more connected devices are initiated.

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.28
smart device
device which is capable to interact with a CEM and is able to be managed in an overall energy efficiency optimization according to its capabilities

2.1.29
traffic light concept
on one hand a concept which describes the relation between the use of flexibilities on the grid side (red phase) and the market side (green phase) and the interrelation between both (yellow phase), on the other hand a use case which evaluate the grid status (red, yellow, green) and provides the information towards the relevant market roles

[SOURCE: SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.30
demand side management (DSM)
load management

2.1.30.1
demand side management (DSM)
load management
measures taken by market roles (e.g. utilities, aggregator) controlling electricity demand as measure for operating the grid (“Top-down approach”) (based on EURELECTRIC Views on Demand-Side Participation [2])

2.1.30.2
demand side management (DSM)
load management
process that is intended to influence the quantity or patterns of use of electric energy consumed by end-use customers.

[SOURCE: IEC 60050-617:2009, 617-04-15, SG-CG/M490/E_Smart Grid Use Case Management Process:2012 [9]]

2.1.31
demand response
DR

2.1.31.1
demand response
DR
concept describing an incentivizing of customers by costs, ecological information or others in order to initiate a change in their consumption or feed-in pattern ("bottom-up approach" = Customer decides, based on EURELECTRIC Views on Demand-Side Participation [2])

2.1.31.2
demand response
DR
action resulting from management of the electricity demand in response to supply conditions

[SOURCE: IEC 60050-617:2009, 617-04-15]

2.1.32
function specific profile
set of data with requirements on the structure and type of data

Note 1 to entry: This contains a description of the information carried by the profile such that a mapping between different instantiations of that profile is possible with a minimum of semantic loss.

2.1.33
quantity
magnitude that is expressed as a value and reference (e.g. unit)

2.1.34
value
dimensionless number

2.1.35
unit
name of relative or absolute measurement unit from a system of units preceded by a conversion multiplier for the value

2.2 Abbreviations

2.2.1
JWG
Joint Working Group Use Cases and Requirements

EXAMPLE JWG1 Flex Start Washing Machine (see A.1.2).

2.2.2
WGSP

Working Group Sustainable Processes (working group of the European Smart Grid Coordination Group)

SEE: [5] to [11]

3 Requirements

3.1 Common architecture model – architectural requirements

The architecture in this technical report, is which is used for analysing requirements for messages and information models, focuses on in-premises architectural requirements, whereas other parts of IEC 62746 describe the architecture on the grid side.

The architecture shown in Figure 6 is the functional reference diagram, described in the Smart Grid Coordination Group – Working Group Sustainable Processes Report, see SG-CG/M490/E_Smart Grid Use Case Management Process [9].

In this logical architecture the Smart Grid Connection Point (SG CP) represents the interface from the Grid into the premises. The Customer Energy Manager (CEM) provides the flexibility by managing power consumption/generation of connected smart devices, through the energy management gateway, while the smart metering and the simple external consumer display provide a number of functionalities which are described in more detail in work of the Smart Meters Coordination Group. The energy management gateway communicates with the metering channel and the smart metering through the Smart Metering Gateway. The gateways in this architecture split different networks (Wide Area Network, Neighborhood Area Network and Local Area Network) and may be, as further described below, integrated with other functional entities. A detailed discussion can be found in 3.2.

The Customer Energy Manager (CEM) is the central managing function. It decides and manages based on information coming from the grid and/or from the smart devices. The term “Energy” within CEM reflects the demand of SG-CG to focus on Energy. In a typical home or building environment this manager will likely manage all kinds of future service and management scenarios and will be the basis for AAL (Ambient Assistant Living) and other future User Scenarios.

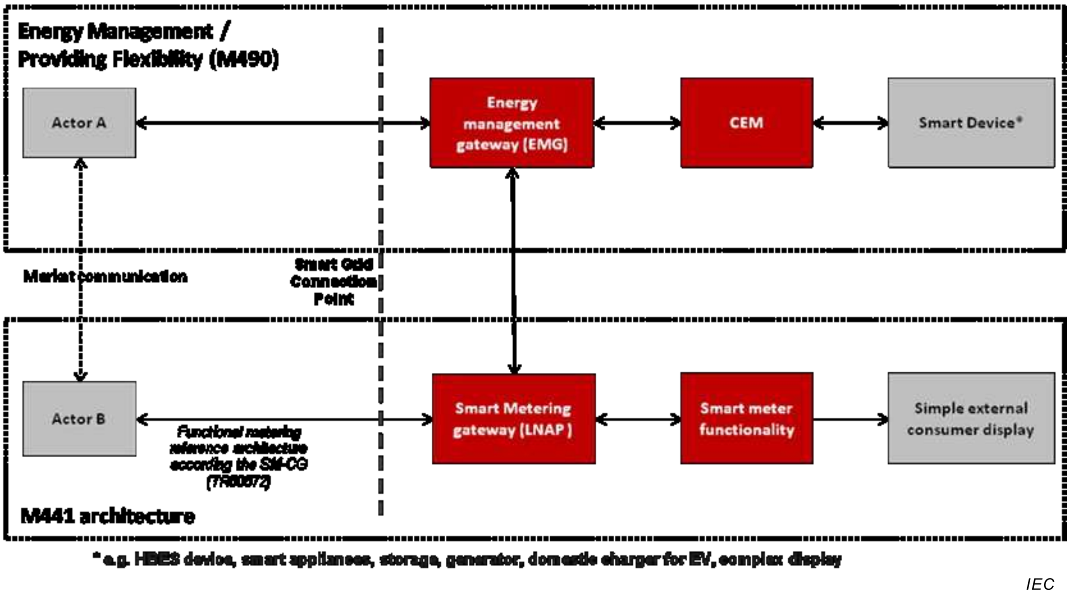


Figure 6 – Smart Grid Coordination Group Functional Architecture Model
(Smart Grid Coordination Group Sustainable Process (EU M490)) [9]

NOTE 1 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.). This will be detailed via further examples.

The external actors A and B, identified in this functional architecture, represent (systems of) market roles that communicate through the Smart Grid Connection Point (SG CP). Examples of these roles are Grid operator, meter data collector, meter operator, aggregator, supplier, flexibility operator, etc.

The actual role of actor A or B depends on the local market organization in a member state and competition. In the scope of this report, actor A is defined as the external actor communicating with the energy management gateway while actor B is defined as the external actor communicating with the smart metering gateway.

For the sake of simplicity, the use cases in this technical report do not represent the energy management gateway and the smart metering gateway – when developing the use cases, it was assumed that the gateways do not provide functionalities contributing towards the goals of the use cases. These do however provide functionality in terms of routing information, translation of protocols, device management, security and service capabilities.

Within this architecture model, 3 main different interfaces (see Figure 7) are necessary to support Interoperability between:

1) Smart Grid Connection Point & Customer Energy Manager via Energy Management Gateway
2) Smart Grid Connection Point or Smart Meter & Customer Energy Manager via Smart Metering Gateway and Energy Manager Gateway
3) Customer Energy Manager and a smart device.

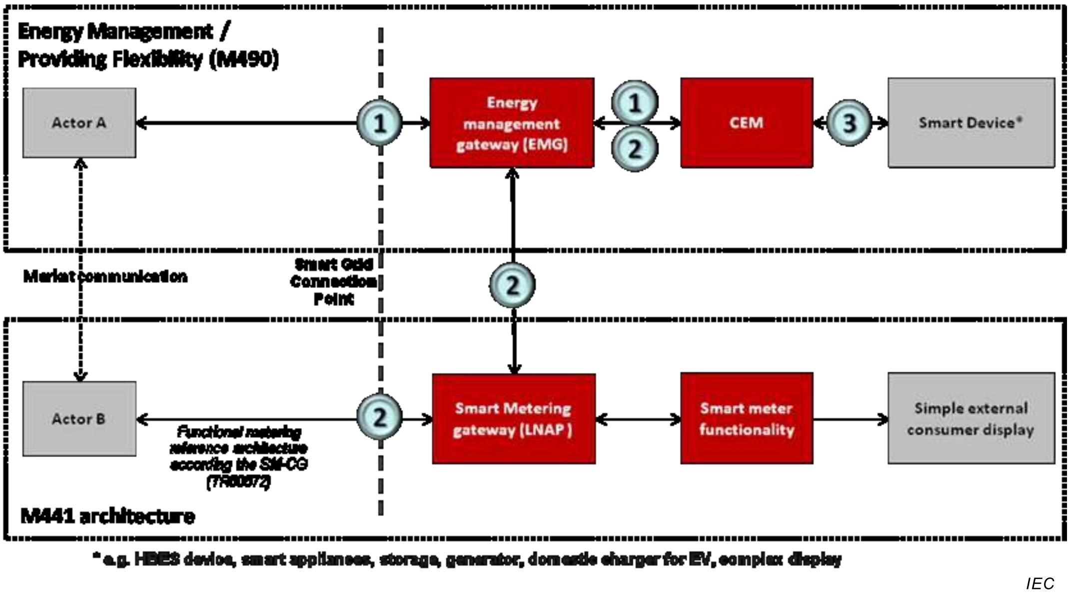


Figure 7 – Interfaces in the Functional Architecture Model

NOTE 2 A smart device can be in a range of very simple up to very complex devices.

The main target of this document is to enable Technical Committees to define messages and information exchange necessary to ensure interoperability between Smart Grid, CEM and smart devices.

These messages and information exchange are defined on a neutral basis (based on a technology independent neutral interface). This implies that we are talking about application level and do not describe specific protocol relevant messages on lower ISO/OSI levels

Therefore, this technical report neither intends to define the mapping onto domain-specific transmission technologies nor requests specific technologies for in-premises connectivity.

Mappings are the responsibility of domain specific protocol owners. However, this also implies that messages are transferred to mappings (types of devices, supported by domain specific protocols).

Figures 8 to 10 describe the end-point architecture.

NOTE 3 The equipment, messages and mapping of messages shown in the following diagrams (Figures 8 to 10) are examples.

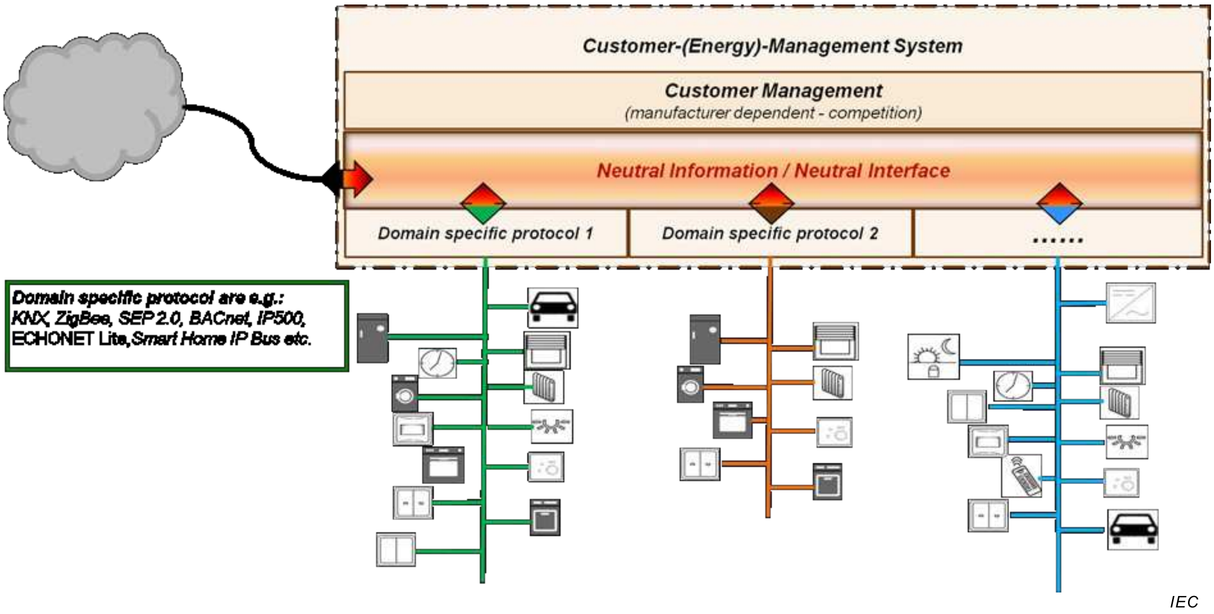


Figure 8 – Neutral interfaces

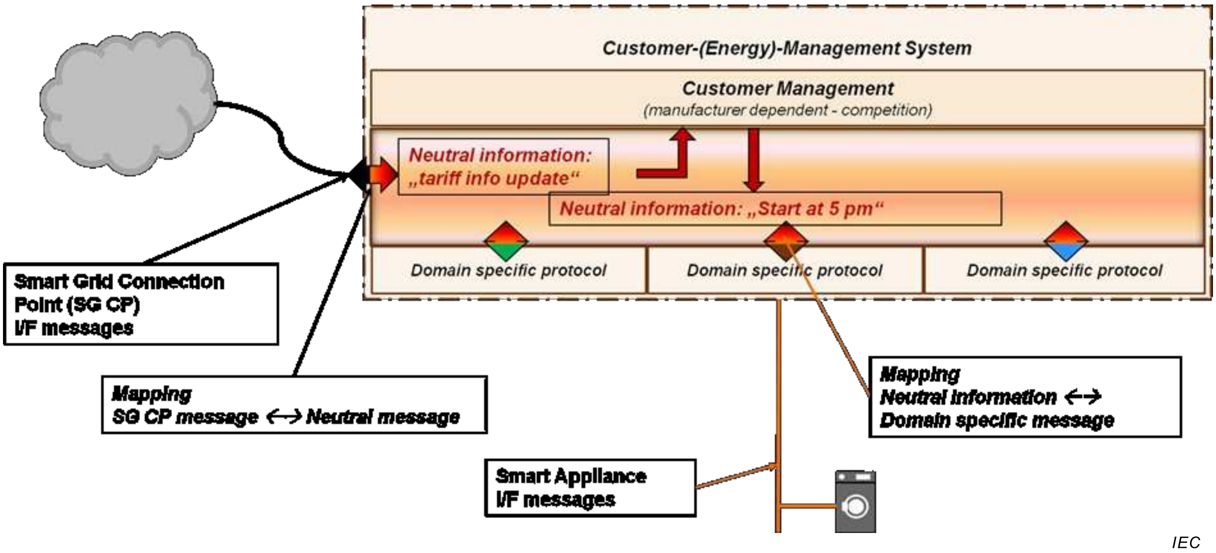


Figure 9 – Mapping I/F structure

In this context the CEM may use a different set of messages and information exchange to manage smart devices as for the exchange with the grid (see Figure 10).

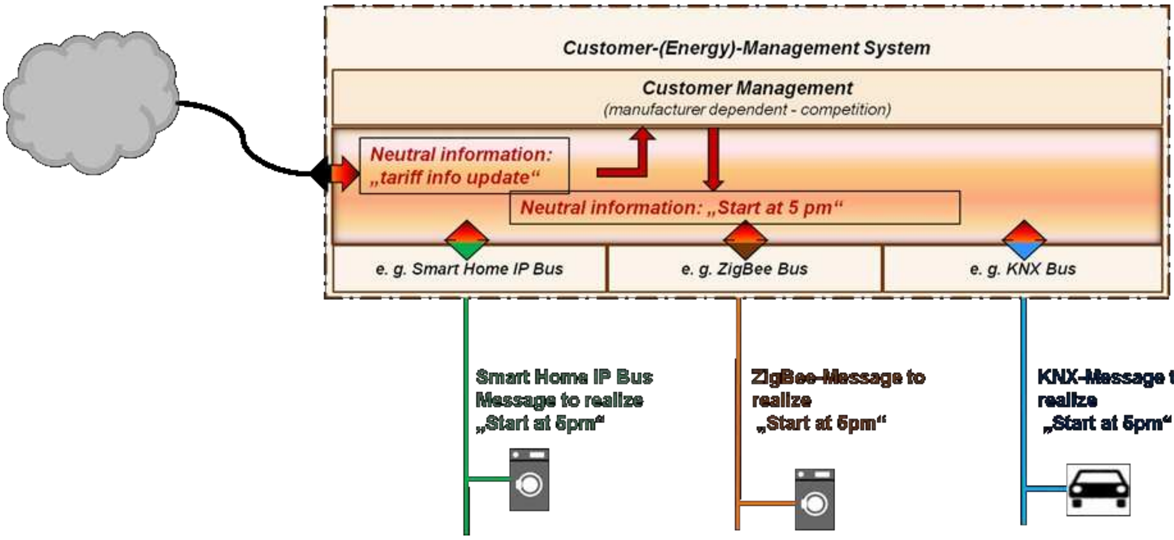
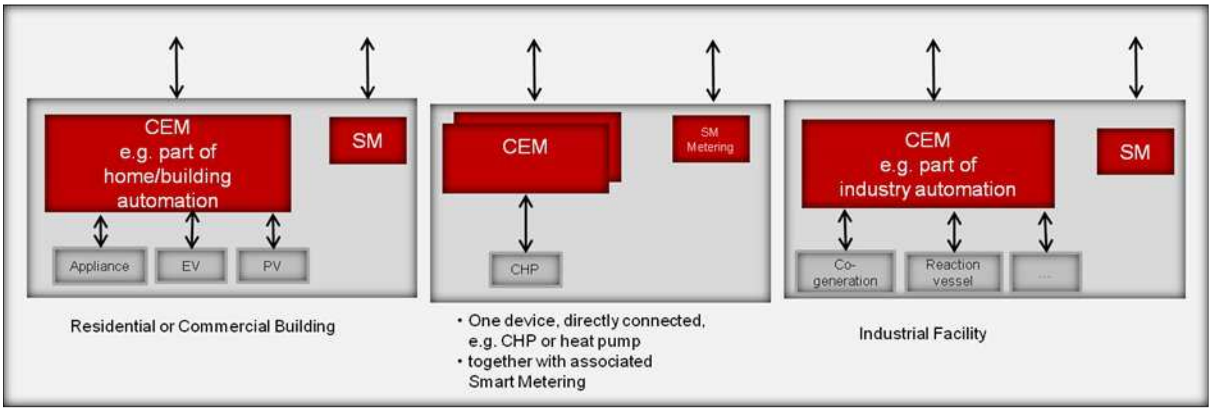


Figure 10 – Example of a mapping of messages

As mentioned above, the CEM may act as a central management system, while parallel working CEMs may also coexist, as shown in Figure 11.



NOTE Based on the SG CG picture [5 to 9], this figure also covers industrial applications.

Figure 11 – Different CEM configurations see SG-CG/M490 [5] to [9]

Figure 12 lists example mappings of “logical boxes” to physical device combinations.

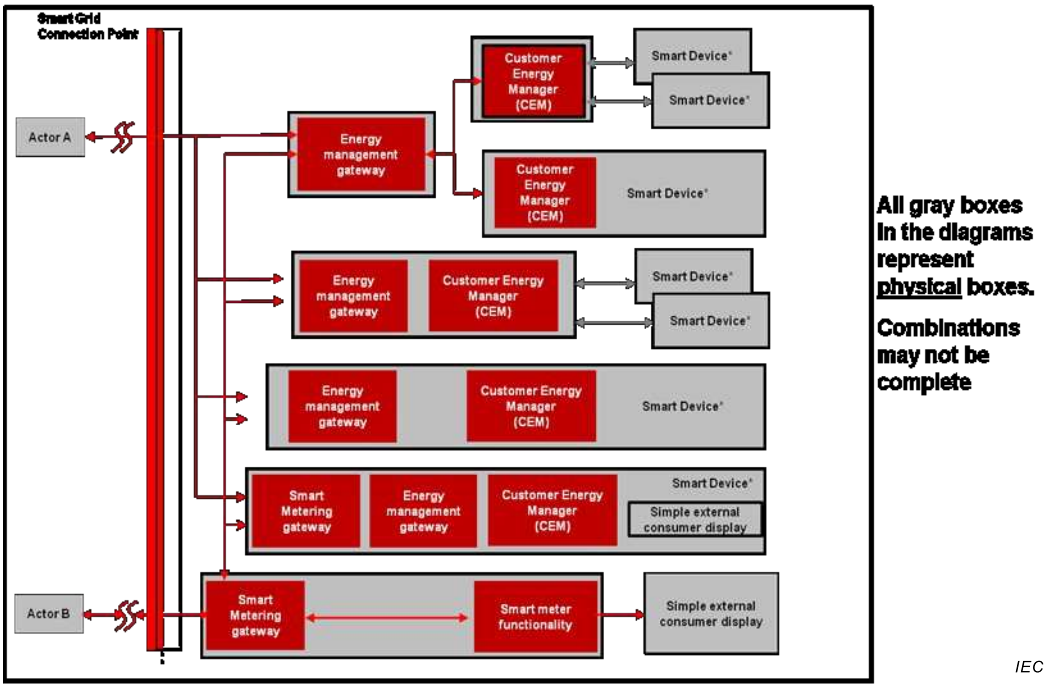


Figure 12 – Physical combinations

CEMs may be cascaded. An example of a cascaded CEM structure is shown in Figure 13.

Cascaded CEM structures however are not the subject of this technical report.

Interfaces between CEM and CEM Aggregator as well as CEM Aggregator and power plant are to be defined in other parts of IEC 62746-x. In addition, cascaded CEM structures inside premises (CEM – Sub CEM) are part of further discussion and may become part of upcoming versions of IEC 62746-2.

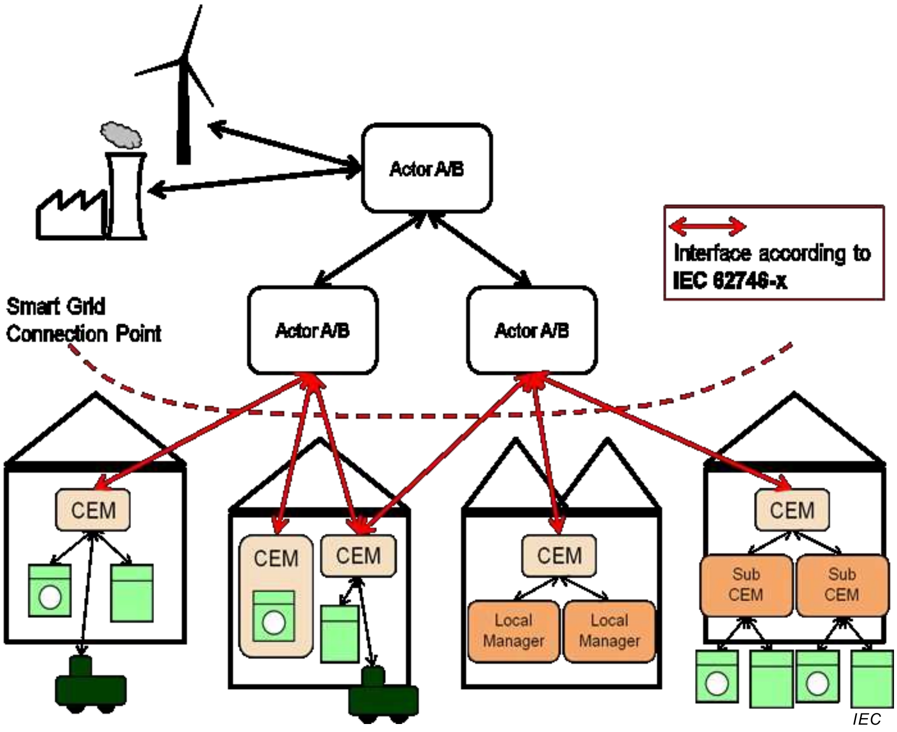


Figure 13 – Examples of CEM architecture

3.2 SG CP (Smart Grid Connection Point)

3.2.1 Scope

This section considers the interface between the “Group of Energy Supplier domains” and the “Group of Customer domains” as shown in Figure 14. Both domains are as defined in the Smart Grid Conceptual Model (see e.g. NIST Smart Grid Conceptual Model [3]).

NOTE In this document the NIST model is used as an example for the Smart Grid Connection Point although there are other models such as the ENTSO-E “Harmonized electricity market role model”.

Those actors of the Customer domain, such as DER, that have energy supply functions here belong to the “Group of Customer domains”.

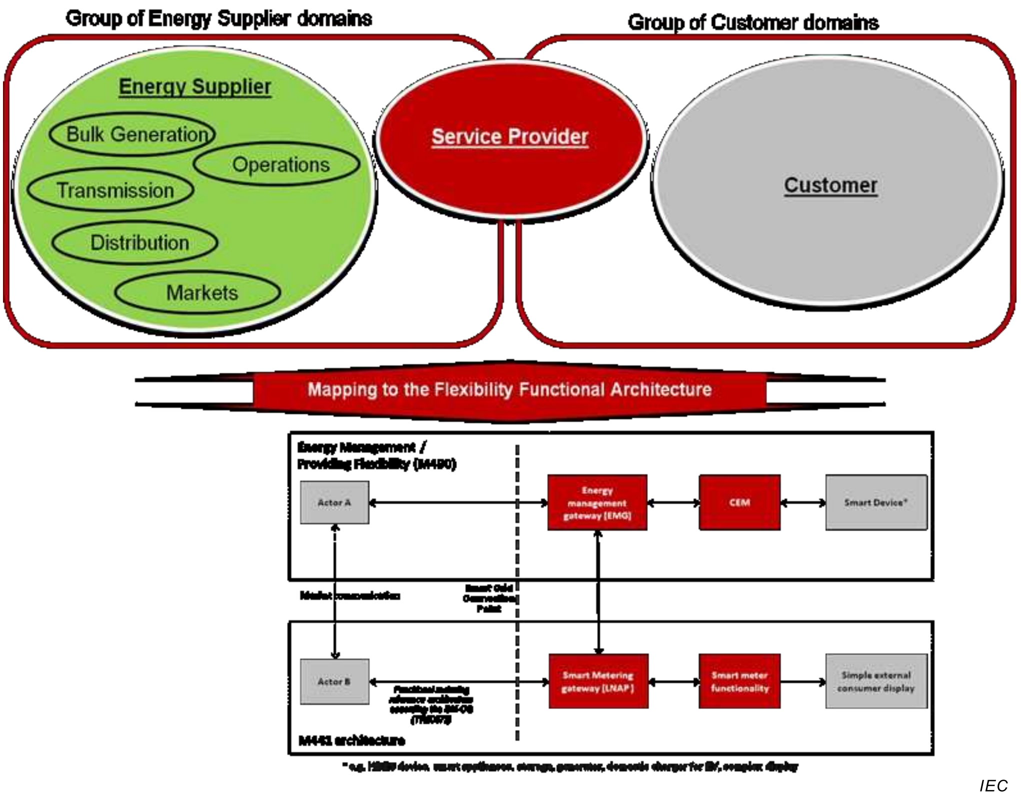


Figure 14 – “Group of domains” and “Functional Architecture Model”

3.2.2 Definition of SG CP (Smart Grid Connection Point)

The SG CP (Smart Grid Connection Point) is the interface over which the “Group of Energy Supplier domains” and the “Group of Customer domains” exchange information on the control of demand and supply power (see Figures 14 and 15).

In the case of an interruption of the electrical power supply from an energy supplier, the control of demand / supply power is realized with the cooperation between the service provider and the customers through the grid (see Figure 16). In this, the information for the control of demand / supply power is sent and received via the SG CP.

3.2.3 Purpose of definition of SG CP (Smart Grid Connection Point)

The purpose of defining SG CP is to clarify “the point of the interface for the demand / supply control of power between actors” and “the sending and receiving of information via the point of the interface”.

3.2.4 Target of demand / supply of power and information that is sent and received

On the control of demand / supply power between the “Group of Energy Supplier domains” and the “Group of Customer domain”, “the functions of the supplier and the customer that are implemented through the SG CP” realize “the marketing of power, the demand / supply adjustment of power, the power system stabilization (the ancillary service), the power optimum usage of the customer, the reduction of the greenhouse gas effect for environmental conservation, the acceleration of producing power by renewable sources of power, the disaster recovery, and so on.”

In order to realize those functions relevant to the demand and supply of power, information that is sent and received via the SG CP includes “the time-series data of the electrical energy, the demand (e.g. predictive values, results), the supply (e.g. supply capacity), the price, the amount of the emission of the greenhouse gas effect, the utility grid stability (e.g. transmission capacity, voltage, frequency), and so on. "This information is defined both logically and functionally so that the control of demand / supply may be realized under the system structure and devices in the Domains mentioned above.

3.2.5 Functional requirement of SG CP (Smart Grid Connection Point)

The SG CP implies a functional requirement as shown below.

The SG CP is the functional and logical point of the interface that realizes control of demand / supply power between the “Group of Energy Supplier domains” and the “Group of Customer domains”. The SG CP is independent of the function and physical structure of each actor. The SG CP is not for monitor control which is dependent on physical systems / devices (e.g. the start command, the stop command, the setting of command to control devices directly).

If the demand / supply control is realized by the energy supplier and the customer via the service provider, then the SG CP does not always correspond to the physical connection point for the power transmitting / receiving.

While responsibility for providing electrical power, services, and ownership of devices varies between countries, “the information that is sent and received via SG CP for the demand / supply control of power” is constant.

“The device that consumes power, stores power or supplies power” can be integrated into the CEM (Customer Energy Manager). The device can receive message from the “group of the energy supplier domains” and send message to the “group of the energy supplier domains” via the CEM.

If the customer with a power supply device needs to communicate with other customers (e.g. in the case of interruption of electrical power supply from energy supplier, see Figure 16), then the customer communicates with other customers via the SG CP.

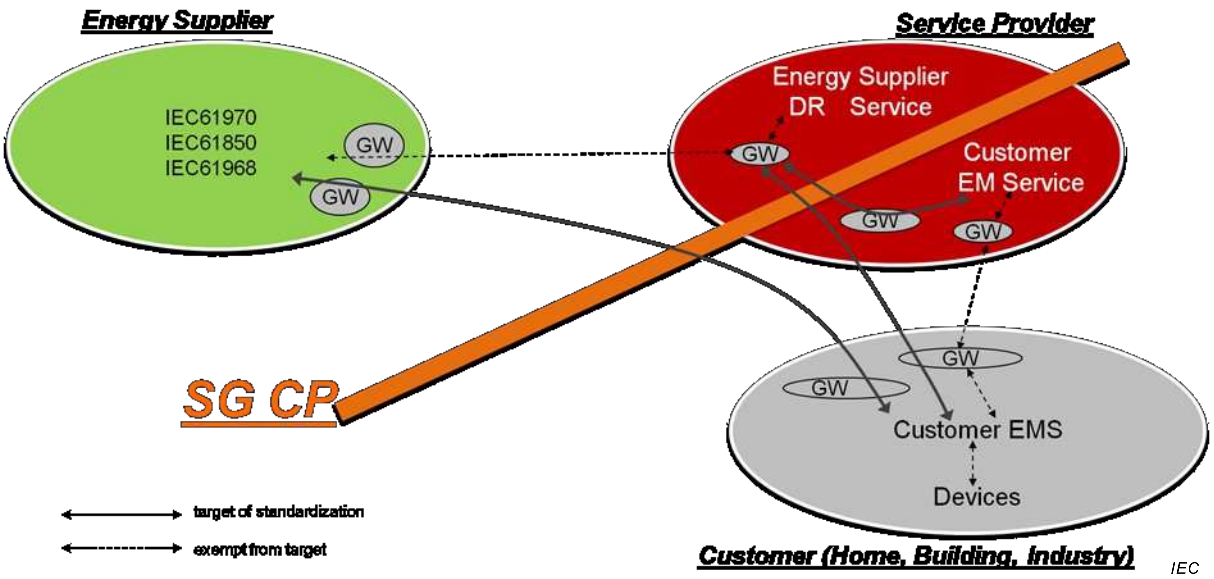


Figure 15 – Smart Grid Connection Point SG CP

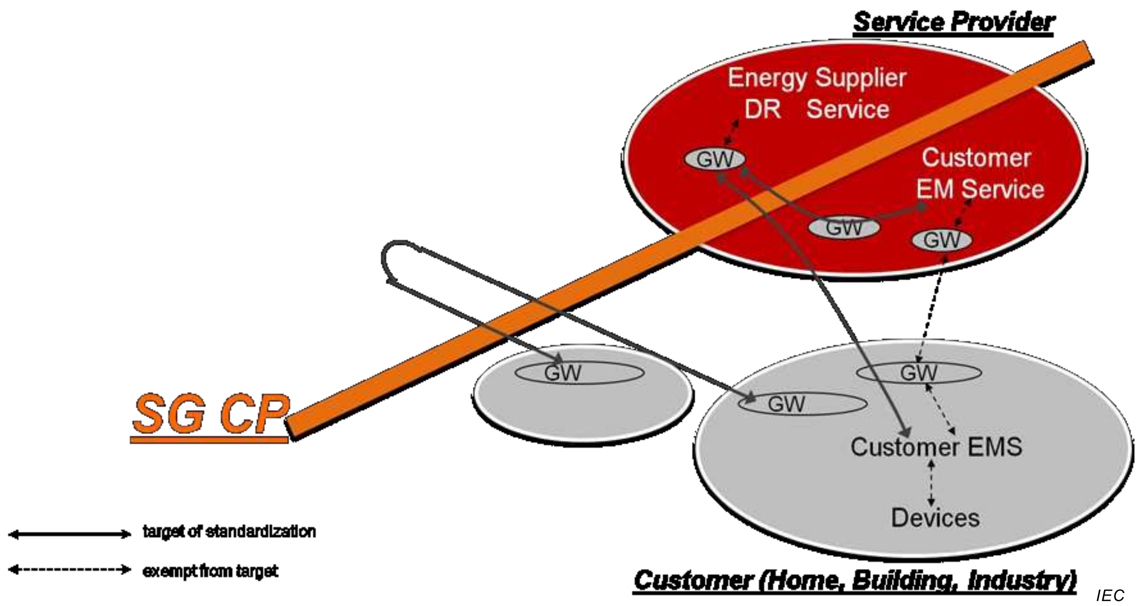


Figure 16 – SG CP (in the case of interruption of electrical power supply from energy supplier)

3.3 Communication requirements for the Smart Grid and the Smart Grid Connection Point (interface into the premises)

The communication system and protocol on the grid side for connecting the smart customers shall fulfil the following requirements:

- Many customers (resources) can be connected in parallel to a server (> 1 million).
- The system shall be optimized for a high volume of small data packets.
- Information about network availability (presence) is required.
- Notifications and messages shall be "just-in-time" (within seconds) without store-and-forward or continually polling.

- Resources shall have a unique, trusted identity. This identity may be used as a logical address for communications.
- Communication shall be encrypted and authenticated from both sides (trusted entities).
- The communication network must be decentralized with straightforward federation.
- Server-host to server-host communication shall be supported.
- Message content based on XML shall be extensible. If a message contains additional information not understood by a device, it shall be ignored and the sender must realize and accommodate for this fact. Shall be able to define new payload types without ‘breaking’ interfaces.
- Resources shall not be required to accept inbound connections, where there shall not be the need to open ports in firewalls to allow them to communicate over the internet. Resources will only make outbound connections to the communication infrastructure using their credentials.
- Resources shall be able to receive messages asynchronously, without the need to poll a controller.
- It shall be possible to address a message to a specific endpoint, whether the destination be a device that controls a resource or application software used to manage resources.
- Group communications (multi-party interactions) shall be supported, where a controller can address a message to all members of a group. Devices may have membership in zero or more groups. This means that each message shall have a single source, but potentially many destination addresses where a destination address may be a group address that is maintained and managed by the communication infrastructure.
- The protocol shall support publish and subscribe.
- The protocol shall support service discovery.
- The communication system shall support redundancy.
- The communication system shall protect against denial of service attacks and other types of attacks as appropriate for the communication mechanisms.

3.4 Common messages – information to be exchanged

3.4.1 General

As already mentioned the main intention of this technical report is to define requirements for the communication between grid side actors and CEM as well as between CEM and smart devices within premises. Common messages are the vehicle to understand each other. This section collects relevant information-requirements for these messages and describes the process used.

3.4.2 Intention of user stories and use cases

Why user stories and use cases? Standardization does not standardize use cases. The user may use different ways to get to a target or the manufacturer may implement different solutions, means different interpretations of use cases. However the definition of data and information exchanged between the different stake holders is essential to ensure interoperability. Use cases for this technical report do not exclude any stakeholder but define the information which needs to be exchanged to accomplish a certain task without favouring any specific stakeholder.

Use cases help to collect requirements for necessary information by describing possible scenarios.

This document defines a minimum set of information which is necessary to ensure interoperability. It also defines the requirements for this information is exchanged as well as a description of the functionality and information flow.

It is then up to the specific Technical Specification (e.g. IEC 62746-x) to standardize the data models and the structure with its content.

As Smart Grid, Smart Building and Smart Home are overlapping areas, this technical report describes the whole chain from the grid interface into the premises via in-home/-building distribution until the smart (end) devices and vice versa.

Figure 17 describes the process to define messages and data models structures while this technical report ends with the information requirements and concepts.

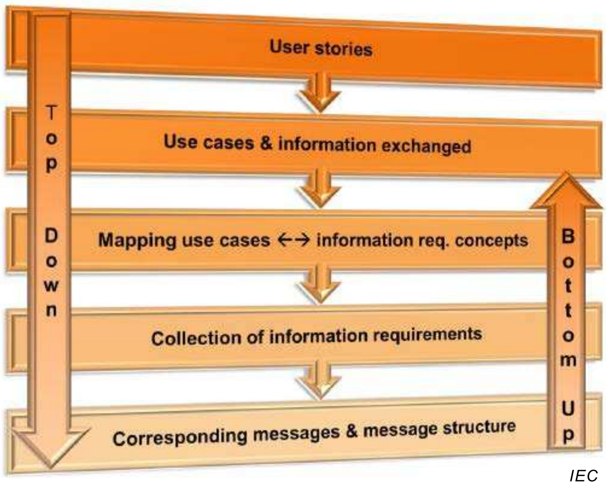


Figure 17 – User stories and use cases process

In order to define requirements for messages and related information to be exchanged, we have chosen a process described below.

The first step of the process is collecting “user stories”. Each ”user story” is a description of a specific scenario that a consumer may experience with Smart Grid and in the Smart Home/Building area. The user stories are derived from stakeholder brainstorming sessions. They do not follow a specific standardized format, use cases on the other hand compile information in a standardized format. They had been created out of these user stories or were taken from other sources, e.g. IEC Technical Committee 8. There are other standardization committees also working on use cases relevant to this technical report. Each user story is made from the consumer perspective and describes how consumers interact with Smart Grid and/or Smart Home/Building related scenarios in their premises.

The second step of the process is harmonization of use cases. Each use case as defined might not fit into the overall architecture and must be extended or slightly modified. It might also be possible to touch upon existing use cases and integrate them as a new one for this activity. A single use case can realize one service or multiple services described in User Stories. Use cases include messages transmitted between a smart device, a CEM and /or an actor on the power grid side through the Smart Grid Connection Point (SG CP). The SG CP is the information access point but does not consider the electrical grid connection point to the customer premises.

The last part of this step of the process is a verification step, checking the exhaustiveness of use cases with all user stories.

After confirming exhaustiveness of use cases, the consolidated information exchanged list shows the minimum requirements applicable to the selected user stories. The requirements for data for the messages are examined as the third and fourth step. This step of the process also ends with a verification step by checking the exhaustiveness of messages covering all use cases. The last step of this process is carried out by the technical specifications on the information exchange in the building (CEM to smart device) and on the information exchange between grid actors and the CEM.

3.4.3 Relationship of user stories and use cases

This document provides descriptions of user stories and use Cases.

User stories are produced from the consumer or grid side perspective and describe typical scenarios that a may be experienced in an unstructured way. The list of user stories is not exhaustive and represents the scenarios which had been considered for this technical report. Since user stories do not have a standardized format and do not structure its content, they are mapped to structured use cases. These use cases use a standardized template format to compile the information required for the scenarios described in user stories. It might be possible that one user story utilizes multiple use cases to accomplish a given task.

Depending on the level of detail and the content, use cases can be classified into various categories. The use case collection for this technical report makes usage of high level use cases and specialized use cases according to IEC specifications.

This is depicted in Figure 18.

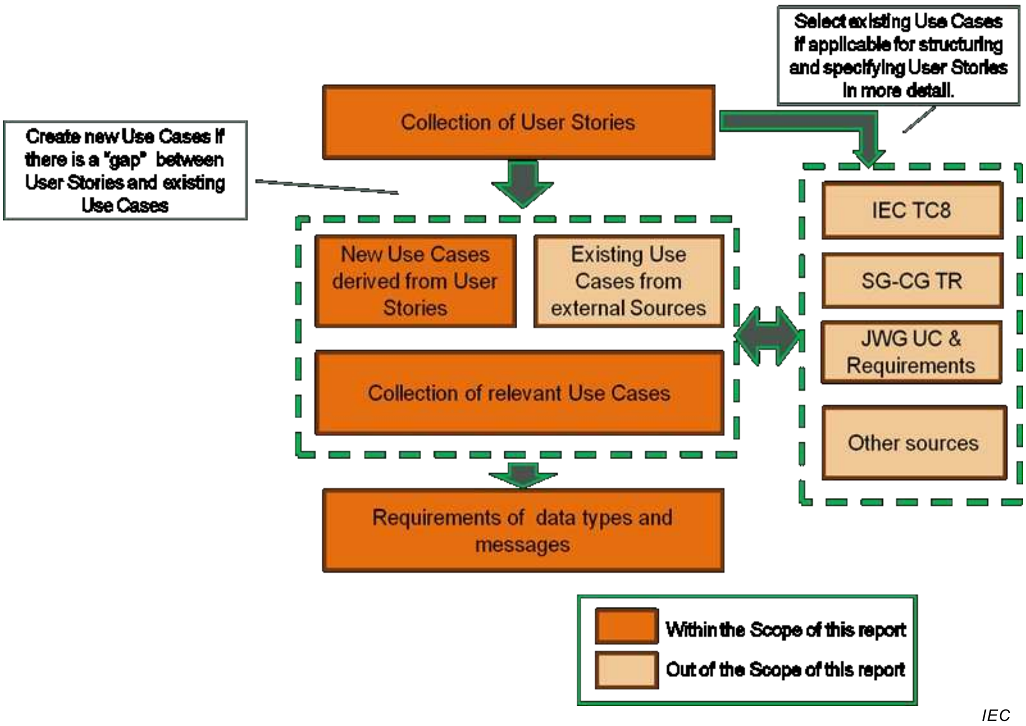


Figure 18 – Relationship user stories and use cases

3.4.4 Requirements for information exchange

According to the process described in 3.4.2, use cases are the basis for a collection of a numerous number of information to be exchanged between actors. Figure 19 lists high level examples for the interface between

- Smart Grid (Actor A and B) and CEM
- Smart device and CEM

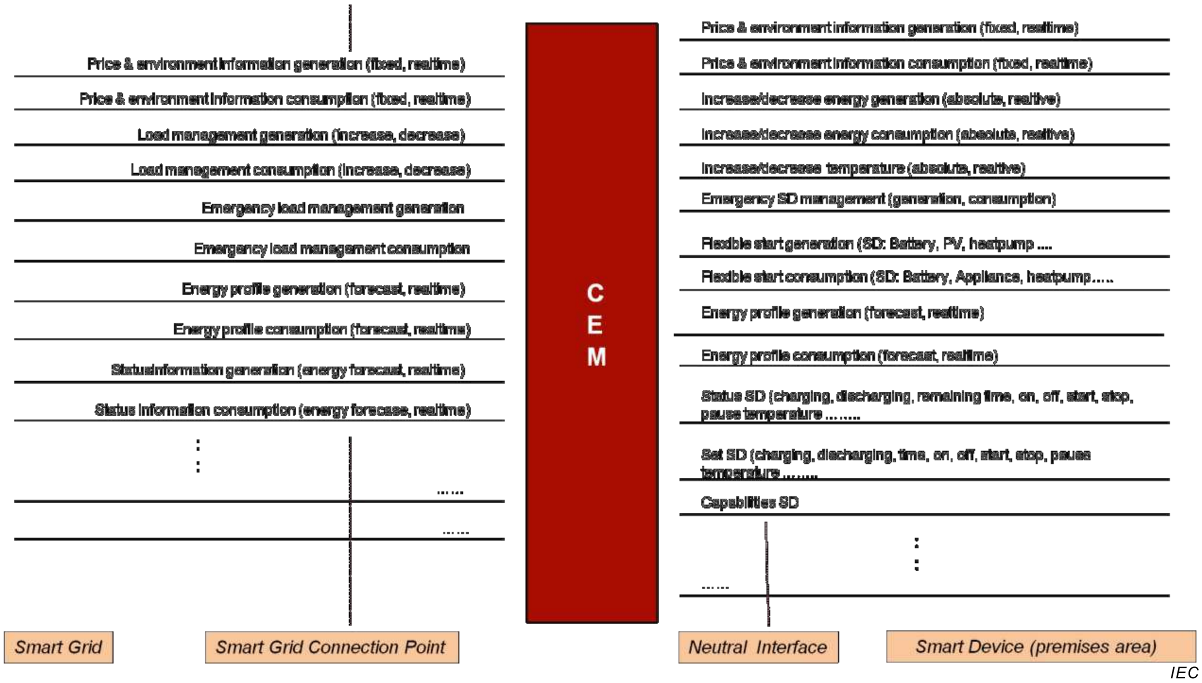


Figure 19 – Examples of information to be exchanged

As already described in 3.1, the CEM functions like an intelligent home or premises managing and mapping system between Smart Grid and smart devices.

The following example may help to understand the meaning of messages and behaviour of the CEM. Please refer to the user story Charging of an electric vehicle: A.1.3.

In this user story the user wants to drive a certain distance next morning (8 a.m.) and advises the car to take care of charging the battery until 8 a.m. The user has already programmed the CEM to use the cheapest price of electrical energy.

The car calculates the amount of lacking energy and asks the CEM to manage a flexible start. Attached parameters are in this case battery charging capacity, earliest starting time (e.g. now), latest end time (= 8 a.m.).

The messages on Figure 19 (interface CEM – Smart Device) are represented by

- Flexible start consumption (SD: Battery, Appliance, heatpump etc.
- Energy profile consumption (forecast, realtime)

An example of a sequence diagram could look as shown in Figure 20:

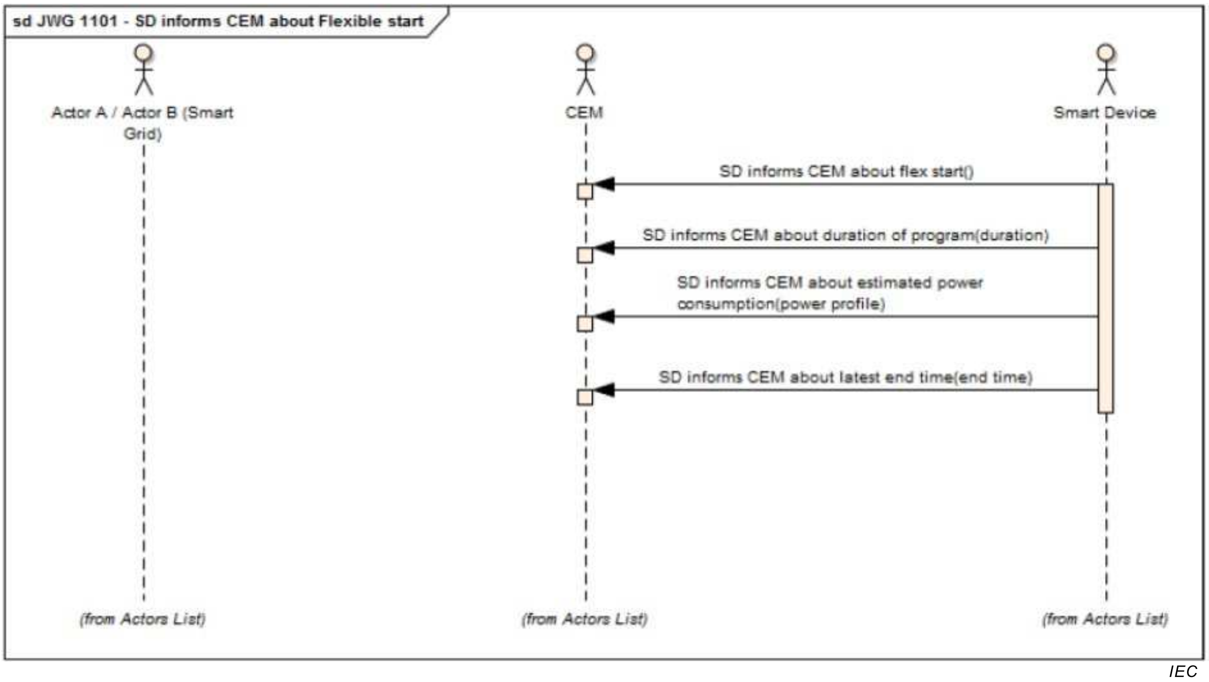


Figure 20 – Sequence Diagram Flexible Start

Independent from the request of the EV, the CEM regularly gets price information from the energy retailer, e.g. for the next 24 h in advance, the next 12 h with binding prices per time slot and the next 12 h as forecast.

The message on Figure 19 (interface Smart Grid – CEM) is represented by

- Price and environmental information consumption (fixed, realtime)

and an example of sequence diagram could look as shown in Figure 21:

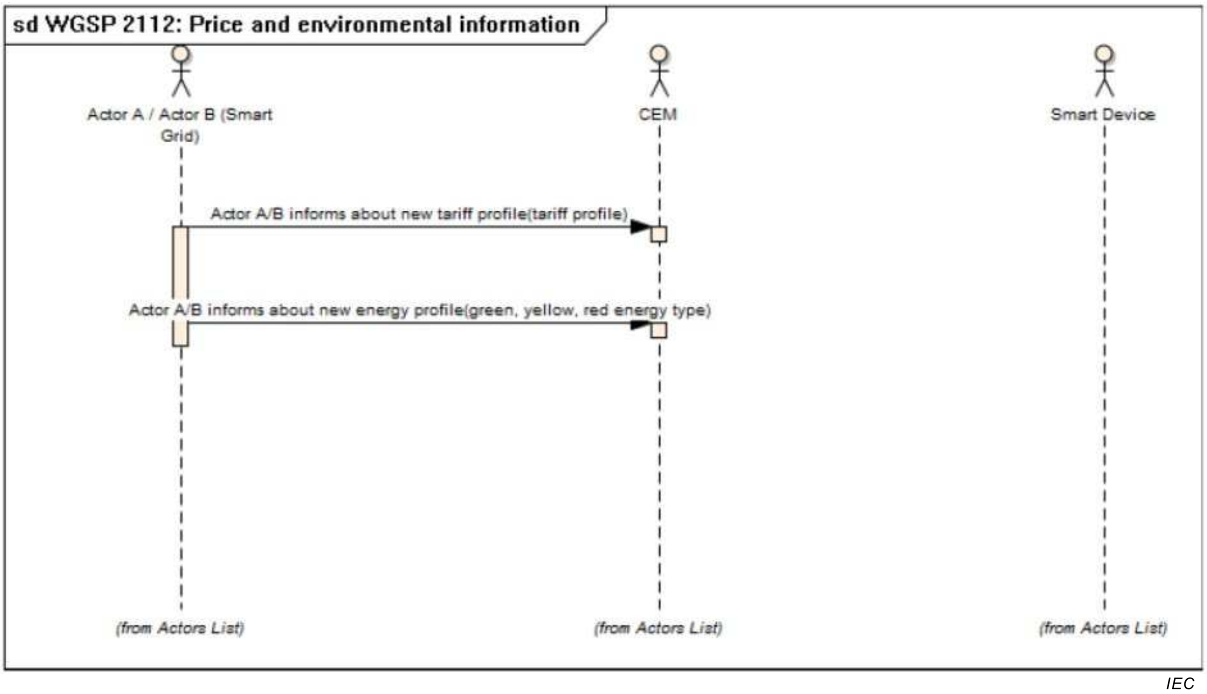


Figure 21 – Sequence diagram price and environmental information

Based on the request from the EV the CEM now calculates the best start time for EV charging. The CEM may also include already accepted flexible starts of other smart devices, behaviours of the users such as cooking at noon and so forth. Based on the outcome the CEM sends a proposed starting time to the EV.

The message in Figure 19 (interface CEM – smart device) is represented by

- Set SD (charging, discharging, time, on, off, start, stop, pause temperature etc.

and an example of sequence diagram could look as shown in Figure 22:

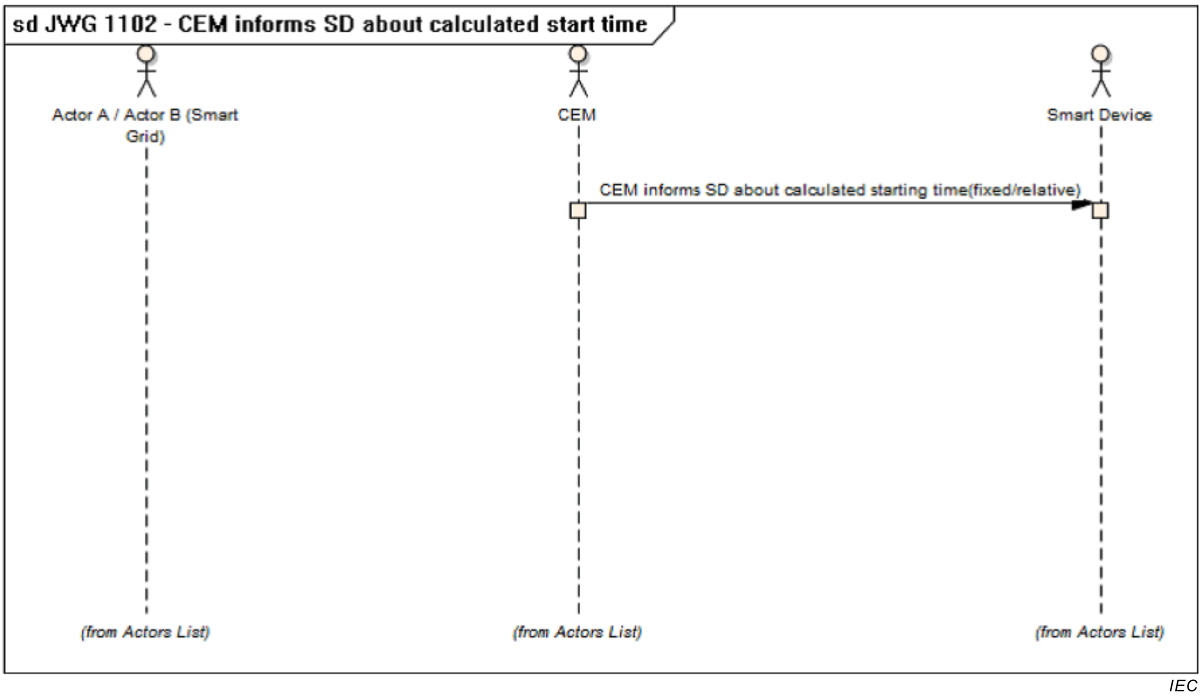


Figure 22 – Sequence diagram starting time

These mentioned and any other CEM algorithms are not the subject of this report as it affects competition. This technical report only focuses on the relevant messages and information to be exchanged between Smart Grid, CEM and smart devices.

The next level of detailed requirements is summarized in Table 1.

Table 1 – Information requirements collection

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Abort	Abort SD function	Direct load / generation management (Demand Side Management)	JWG111x, 112x
Capabilities	Capabilities tariff profile	Price & environmental information	JWG2112
Dispatch information	Battery ancillary service dispatch information	Direct load / generation management	JWG2121/WGSP 2121, JWG1130

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Dispatch request	Battery ancillary service dispatch	Direct load / generation management	JWG2121/WGSP 2121
Energy profile	Energy consumption profile actual	Power profile	JWG2111/WGSP 2111
Energy profile	Energy consumption profile forecast	Power profile	JWG 1103, JWG120x, JWG212x, JWG2111/WGSP 2111
Energy profile	Energy generation profile actual	Power profile	JWG2111/WGSP 2111
Energy profile	Energy generation profile forecast	Power profile	JWG121x, JWG202x, JWG120x, JWG2111/WGSP 2111
Estimated Power Consumption/Generation/Storage profile	Individual smart device consumption/Generation /Storage information estimated by the user	Estimated Power Profile	JWG2001, JWG2000
Estimated Power Consumption/Generation profile	Estimated energy profile consists of energy profile with respect to each power classification of smart devices(RE, non-RE, Load)	Estimated Power Profile	JWG2010
Amount of the power produced by User	Amount of the power produced using REs	Amount of the power produced by User	JWG2010
Power Consumption/Generation profile	Selected power consumption/generation profile at triage case provided by CEM in order to negotiate with Actor A	Power consumption/generation profile	JWG2001
Power Consumption/Generation Plan	Aggregated Power usage plan of the building	Aggregated Power consumption/generation plan	JWG2002
Power Consumption/Generation Plan	Demand curtailment ability of Group of Buildings	Aggregated Power consumption/generation plan	JWG2002
Power Consumption/Generation Plan	Aggregated selected proposal for group of building (Selected proposal is facility manager's selection of proposals for each building offered by CEM)	Aggregated Power consumption/generation plan	JWG2002
Power Consumption/Generation Profile	power profile for disaster situations at disaster situation in order to negotiate between CEM and Actor A	Power consumption/generation profile	JWG2042
Power Consumption/Generation Profile	aggregated power profile at disaster situation in order to negotiate between CEM and Actor A	Aggregated power consumption/generation profile	JWG2042
Power Consumption/Generation Profile	Power profile that includes incentive and re-created plans of consumption schedules, generation schedules of the customer's building	Power consumption/generation profile	JWG2001
Power Consumption/Generation Profile	Emergency Power Profile for the triage control	Power consumption/generation profile	JWG2001
Power distribution Plan	Power distribution plan provided by Actor A in order to negotiate with CEM	Power consumption/generation plan	JWG2010
Customer's battery operation plan	Customer's battery operation plan (one of the following form: Detail schedule, outline schedule or Surplus schedule) provided by CEM in order to negotiate with Actor A	Peak Shift Contribution by Battery Aggregation (PSCBA)	JWG202x

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Customer’s battery operation plan	Customer’s battery operation plan (surplus power usage) provided by Actor A in order to negotiate with CEM	Peak Shift Contribution by Battery Aggregation (PSCBA)	JWG202x
Fan setting	Mode automatic	Comfort, management and status information	JWG 111x, 112x
Fan setting	Mode non-automatic	Comfort, management and status information	JWG 111x, 112x
Fan setting	Level	Comfort, management and status information	JWG 111x, 112x
Grid status	Traffic light	Traffic light	WGSP 2112
Grid status	Time period information when no power will be provided by scheduled blackout	Blackout management at Customer	JWG2122
Grid status	Level of Emergency	Emergency management at Customer	JWG2122
Customer Status	Priority Information of the each smart devices	Degrees of importance, priorities	JWG2001
Customer Status	Aggregated priority information for the group of building	Degrees of importance, priorities	JWG2002
Increase/decrease	decrease absolute heat	Comfort, management and status information; Temperature profile; Direct load / generation management	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Increase/decrease	decrease relative heat	Comfort, management and status information; Temperature profile; Direct load / generation management	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Increase/decrease	increase absolute heat	Comfort, management and status information; Temperature profile; Direct load / generation management	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Increase/decrease	increase relative heat	Comfort, management and status information; Temperature profile; Direct load / generation management	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Increase/decrease	Request of reduce consumption based on the plan which is set before	Management of power consumption/reduction	JWG2001

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Increase/decrease	Request of accelerating the production or decelerating the production by Actor A	Management of power consumption/reduction	JWG2041
Log information	Log information fuel cell	Comfort, management and status information	WGSP 2114, JWG 1130
Log information	Log information heat pump	Comfort, management and status information	WGSP 2114, JWG 1130
Log information	Log information photovoltaic	Comfort, management and status information	WGSP 2114, JWG 1130
Log information	Log information storage battery	Comfort, management and status information	WGSP 2114, JWG 1130
Log information	Result of smart device control	Management of power consumption/reduction	JWG2010, JWG2041, JWG2042
Log information	Energy suppression performance report	Management of power consumption/reduction	JWG2001
Log information	Aggregated suppression performance report	Management of power consumption/reduction	JWG2002
Log request	log information fuel cell	Comfort, management and status information	WGSP 2114
Log request	log information heat pump	Comfort, management and status information	WGSP 2114
Log request	log information photovoltaic	Comfort, management and status information	WGSP 2114
Log request	log information storage battery	Comfort, management and status information	WGSP 2114
Metering	Metering data	Price & environmental information; simple data unit	WGSP 2111
Metering	Tariff profile	Price & environmental information	WGSP 2112
Metering	Tariff profile update	Price & environmental information; simple data unit	WGSP 2112
On/off	off fuel cell	Direct load / generation management; Comfort, management and status information; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
On/off	off heater	Direct load / generation management; Comfort, management and status information; simple data unit	WGSP 2121, JWG 1120
On/off	off heat pump	Direct load / generation management; Comfort, management and status information; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
On/off	off load	Direct load / generation management; Comfort, management and status information; simple data unit	WGSP 2121
On/off	off photovoltaic	Direct load / generation management; Comfort, management and status information; simple data unit	WGSP 2121
On/off	on fuel cell	Direct load / generation management; Comfort, management and status information; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
On/off	on heater	Direct load / generation management; Comfort, management and status information; simple data unit	WGSP 2121, JWG 1120
On/off	on heat pump	Direct load / generation management; Comfort, management and status information; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
On/off	on heat pump (water)	Direct load / generation management; Comfort, management and status information; simple data unit	JWG 1130, JWG 1120
On/off	on load	Direct load / generation management; Comfort, management and status information; simple data unit	WGSP 2121

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Pause/Resume	Pause SD function	Direct load / generation management; Comfort, management and status information; simple data unit	JWG111x, 112x
Control	Control signal for the smart devices in the customer premises in advance (e.x. one-day in advance)	Load/generation management	JWG2121
Control	Control signal for the smart devices in the Building or CES/CEP	Load/generation management	JWG2001, JWG2010, JWG2041, JWG2042
Control	Equipment operation schedule	Load/generation management	JWG2002
Control	Request for Schedule	Peak Shift Contribution by Battery Aggregation (PSCBA)	JWG202x
Control	Inquiry, Inquiry Acceptance, Inquiry Rejection	Peak Shift Contribution by Battery Aggregation (PSCBA)	JWG202x
Control	Execution Notification	Peak Shift Contribution by Battery Aggregation (PSCBA)	JWG202x
Request	Request of reduce consumption to CEM	Load/generation management	JWG2001
Request	Proposals for adjustment plan to CEM (These are created based on priority, power usage plan and consumption of buildings and equipments)	Load/generation management	JWG2002
Request	Suppression signals for Group of Buildings	Load/generation management	JWG2002
Request	Power usage plan of Group of Buildings	Load/generation management	JWG2002
Pause/Resume	Resume SD function	Direct load / generation management; Comfort, management and status information; simple data unit	JWG 111 x, 112x
Request exported power reduction	NA	Direct load / generation management; power profile; simple data unit	WGSP 2121
Request imported power reduction	NA	Direct load / generation management; power profile; simple data unit	WGSP 2121
Request store heat	Request store heat	Temperature profile; Direct load / generation management; simple data unit	WGSP 2121

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Set mode	Mode	simple data unit; Comfort, management and status information	JWG 1110
Shut off signal	Heat pump shut off signal profile	Direct load / generation management; simple data unit	WGSP 2121
Signal	Disaster Signal	Signal	JWG2042
Start/Stop	Start SD function	Direct load / generation management; simple data unit	JWG 1110
Start/Stop	Stop SD function	Direct load / generation management; simple data unit	JWG 1110
Status	charge storage battery successful/unsuccessful	Comfort, management and status information	WGSP 2112, 2121
Status	discharge storage battery successful/unsuccessful	Comfort, management and status information	JWG 1130, WGSP 0200, 2112, 2121
Status	flexible start for smart device	Comfort, management and status information	JWG 1103, JWG120x, JWG212x, JWG121x, JWG202x
Status	Latest end time of smart device	Comfort, management and status information	JWG 1103, JWG120x, JWG212x
Status	off/decrease heat pump successful/unsuccessful	Comfort, management and status information	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Status	off fuel cell successful/unsuccessful	Comfort, management and status information	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Status	off heater successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	off heat pump successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	off load successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	off photovoltaic successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	on/increase heat pump successful/unsuccessful	Comfort, management and status information	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Status	on fuel cell successful/unsuccessful	Comfort, management and status information	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Status	on heater successful/unsuccessful	Comfort, management and status information	WGSP 2121

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Status	on successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	Programme duration of smart device	Comfort, management and status information	JWG 1103, JWG120x, JWG121x, JWG212x
Status	PV Status data set	Comfort, management and status information	WGSP 2121
Status	set temperature successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	set timer successful/unsuccessful	Comfort, management and status information	JWG111x, 112x, JWG211x/WGSP 211x
Status	status fuel cell	Comfort, management and status information	WGSP 2114, 2121
Status	status heat pump	Comfort, management and status information	JWG 1130, WGSP 2114, 2121
Status	status photovoltaic	Comfort, management and status information	WGSP 2114, 2121
Status	status SD	Comfort, management and status information	WGSP 2114
Status	VAR mode successful/unsuccessful	Comfort, management and status information	WGSP 2121
Status	Building Information	Management and Status Information	JWG2010
Status	Aggregated Building Information	Management and Status Information	JWG2002
Status	Status Report of the CEM (Alive or Not)	Management and Status Information	JWG2042
Status request	status fuel cell	Comfort, management and status information	WGSP 2114
Status request	status heat pump	Comfort, management and status information	WGSP 2114
Status request	status photovoltaic	Comfort, management and status information	WGSP 2114
Status request	status storage battery	Comfort, management and status information	WGSP 2114
Storage	charge storage battery	Direct load / generation management; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x
Storage	discharge storage battery	Direct load / generation management; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x, JWG212x/WGSP212x

Information exchange			
Category	**Data**	**Concepts / data unit**	**UC references**
Storage	standby storage battery	Direct load / generation management; simple data unit	JWG111x, 112x, JWG211x/WGSP 211x
Storage	standby storage battery successful/unsuccessful	Comfort, management and status information	JWG111x, 112x, JWG211x/WGSP 211x
Tariff	Fixed tariff schedule	Price & environmental information	WGSP 2112
Tariff	Real-time tariff	Price & environmental information	JWG 1130, WGSP 2112
Tariff	Prices for each time in a period (e.g. Hourly prices in a day)	Direct load/generation management with Incentive	JWG2121
Tariff	Prices for each time in a period (e.g. Hourly prices in a day)	Demand-Supply Adjustment based on Prices for each time	JWG2000
Incentive	Incentive information	Demand reduction by Actor A	JWG2001, JWG2002, JWG2010
Bid	Customer bids Negawatt (Power reduction) with certain price	Demand Response with Negawatt	Section A.1.22
Telemetry data	Telemetry data	Power profile; temperature profile, simple data unit	WGSP 2121
Temperature	set temperature	Temperature profile; simple data unit	WGSP 2121
Threshold level	set tariff threshold	Comfort, management and status information	WGSP 2112
Time	set timer	Comfort, management and status information	JWG 1103, JWG120x, JWG212x, JWG121x, JWG202x, WGSP 2112
VAR mode information	VAR mode information	Power profile; temperature profile, simple data unit	WGSP 2121
Voltage support request	Voltage supports	Power profile; temperature profile, simple data unit	WGSP 2121

3.4.5 Energy management concepts

3.4.5.1 Traffic Light Concept

A good example of energy management service is the Traffic Light Concept (TLC), described in the report *WG Sustainable Processes* – CEN-CENELEC-ETSI Smart Grid Coordination Group (SG-CG) – Approval of SG-CG deliverables". EU Mandate M490, Dec. 2012, see SG-CG/M490/E_Smart Grid Use Case Management Process [9].

As functions like DSO, TSO, retailer and so forth are not used equivalent worldwide, the Smart Grid Coordination Group Report (SG-CG/M490/E_Smart Grid Use Case Management Process [9]) named these actors neutrally:

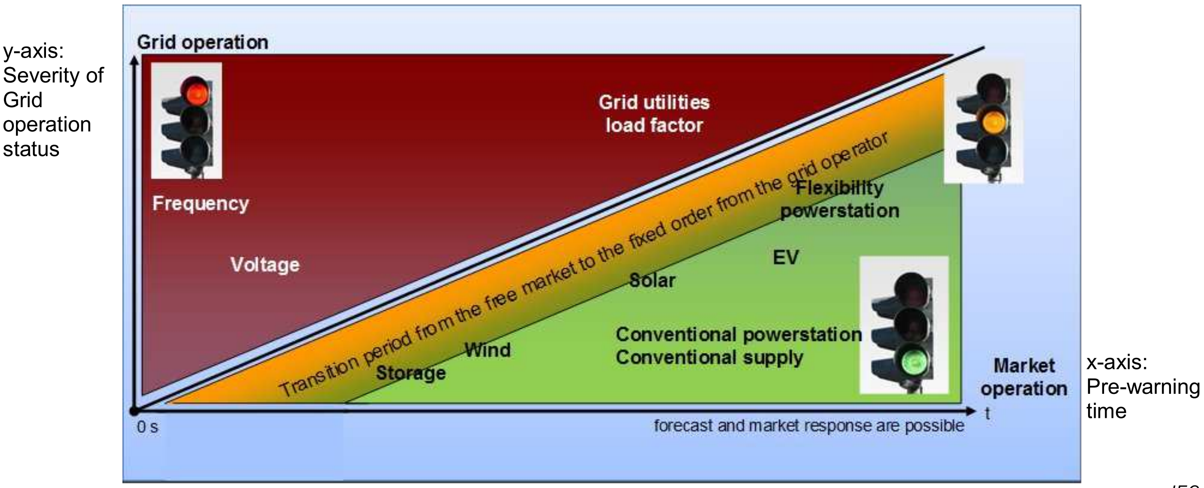
- Actor A typically references the market relevant actors like retailers

- Actor B typically references actors like “Meter Operator” or “DSO” that will interface to the customer domain by a smart metering infrastructure.

TLC does not imply any specific user stories and/or use cases. It only describes a concept with different types of situations in the Grid.

The energy management relevant user stories and use cases in this technical report support on a certain level the Traffic Light Concept (TLC) (see Figure 23) even if this is not in any case a prerequisite nor user stories and use cases are complete and covering all phases. Use cases can be found in the Use Case Management Repository (UCMR) [1].

Further Traffic Light Concept (TLC) related user stories and use cases may be included in future versions of this document.



IEC

NOTE See BDEW Roadmap – Realistic steps for the implementation of smart grids in Germany [4].

Figure 23 – Traffic Light Concept

NOTE The devices in the graph show examples of resources that can be used to support mitigation on Grid issues

The TLC differentiates between three areas:

The **green shaded** region defines the region where the ‘smart market’ competitively operates freely; the DSO may or may not interact with the market at this point. This should be seen as the ‘normal operating state.’

A typical function, used in this state, is “Flexibility or Demand Response”, as described in 3.4.5.2.

The yellow state indicates the state where the DSO actively engages with the market in order to keep the system from becoming unstable, it is therefore a temporary state preventing the grid from entering the red state. This could be by executing pre-agreed contracts or by stepping in to procure in real time at market prices. This does not mean that the customer has to accept any situation where a third party (DSO) decides when they can use what is in their home or business premise. Instead intelligent solutions and economic incentives should be provided to allow the customer to decide and accept some limits.

A typical function, used in this state, is “Load Management or Demand Side Management”, as described in 3.4.5.3.

In the **red state** the DSO needs to take control of market interactions in a certain area where the constraint has occurred. However, actions in this state must be specific and well defined and be temporary in nature. In this situation the DSO can override contracts existing in the market, execute dedicated emergency actions through flexibility operators, or execute direct controls over generation or demand in order to re-stabilize the system as far as a contract or regulation / legislation allows.

A typical function, used in this state, is “Emergency or Blackout prevention”, as described in 3.4.5.4.

For details please refer to the BDEW Roadmap – Realistic Steps for the Implementation of Smart Grids in Germany [4].

3.4.5.2 Flexibility (demand response)

Flexibility is a typical functionality in the green area. The market offers flexible energy based on prices and / or environment. This can be amongst other scenarios the retailer, offering time separated tariffs but also using the own PV energy and combinations of that.

The customer offers flexibility by letting a smart device to be started, paused, etc. based on specific conditions like price ranges, the availability of energy or specific environmental requirements (green power etc.).

The smart device can be a consumer or producer of energy.

3.4.5.3 Load management (demand side management)

As already mentioned in the definition (see [2]), demand side management reflects the Top Down approach. If the grid recognises stability issues like frequency is running out of bandwidth, the TSO and/or DSO may ask the attached CEMs for help. This can be a request to reduce or increase consumption or generation.

In case of a specific contract, load management can be seen as a management of Smart Devices, e.g. a heatpump is attached via an integrated CEM. In this case the message could be “increase/decrease to 100 % or 0 %”.

3.4.5.4 Emergency / blackout prevention

Emergency or blackout prevention management can be seen as a specific load management case. In case a blackout is in front of the door, the message from the TSO or DSO advises the CEM and smart devices to immediately go into a defined Standby Mode as a last chance to prevent the upcoming blackout.

3.4.6 Function-specific profiles

3.4.6.1 General

In order to create interoperable messages with the relevant information, specific concepts need to be explained to become the basis for these messages and information to be exchanged. These information requirements are listed in the corresponding Tables 2 to 5.

3.4.6.2 Power profile

Irrespective of whether the smart device is a consumer or producer it needs to announce a kind of expected energy consumption or generation (power profile – see Figure 24) to allow energy allocation within smart premises.

For example, a heat pump can ask for allocating two sequences per day, once in the morning, once in the afternoon, each sequence with different phases of power consumption.

Alternatively, a smart device can offer multiple sequences for the same time period, e.g. a battery pack can offer charging or discharging. The CEM can choose between these possibilities.

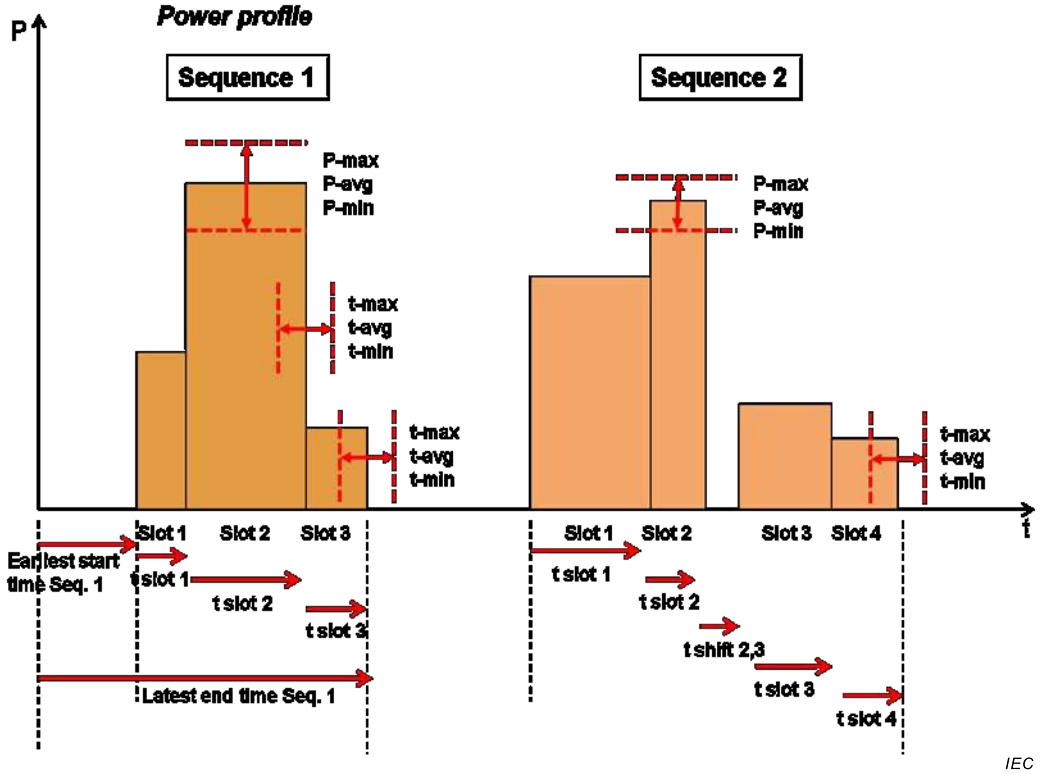


Figure 24 – Structure of a power profile

This power profile allows "generation" or "consumption" of energy to be distinguished. Figure 25 shows as example the energy direction of a storage battery during charging and discharging.

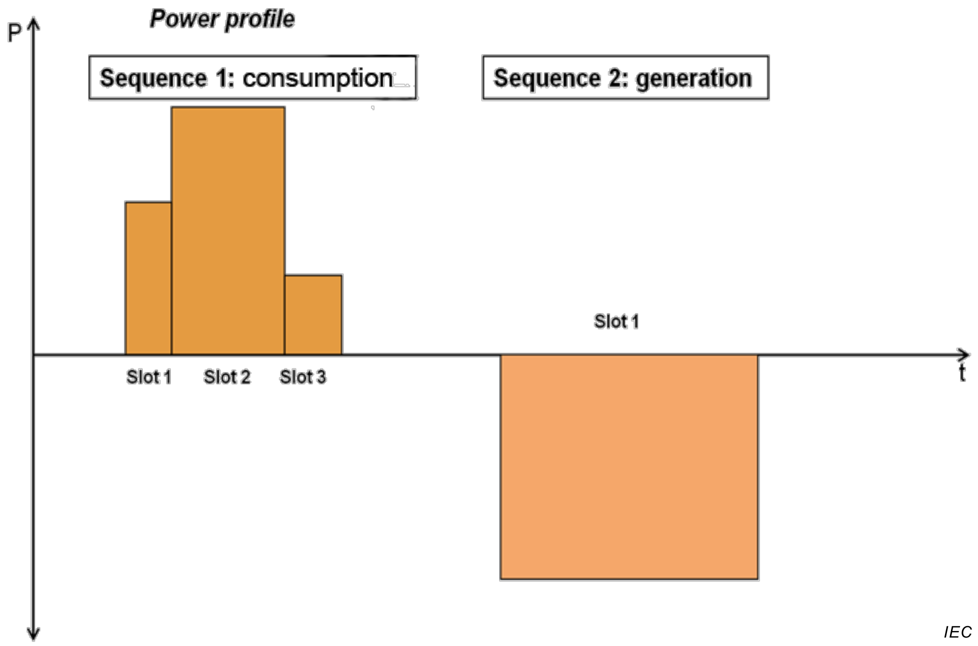


Figure 25 – Consumption and generation

The easiest way to express the expected energy consumption / generation is one sequence with one timeframe with one power value over timeslot (see Figure 26).

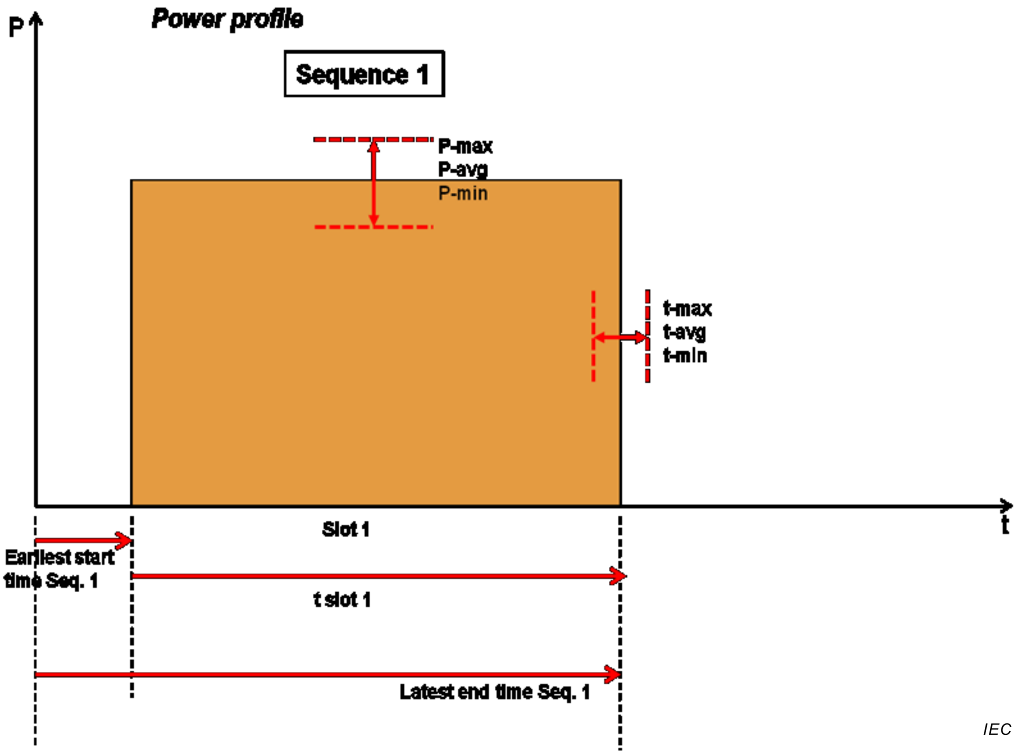


Figure 26 – Structure of an easy power profile

Table 2 – Information requirements "Energy Profile"

Name	Includes	UC references
power profile (power over time)		JWG1100, 1101, 1102, 1103, 120x, 212x, WGSP2110, 2111, 2112
	power quantity	
	type of energy sources and amount of energy from each source type	
	consumption / generation	
	time information (e.g. slots, actual time, start time, end time, …)	
	date information (e.g. weekday, date, …)	
	confidence level	
	devices	
instantaneous power information		JWG1103, 1130
	power quantity	
	time information (e.g. actual time, …)	
	date information (e.g. weekday, date, …)	
	confidence level	
	devices	

3.4.6.3 Price and environmental information profile (see Figure 27)

The price and environmental profile uses the same basic structure as shown in 3.4.6.2 within power profile. Herewith typical scenarios can be handled like the price table for certain time slots within a timeframe (e.g. the next 24 h).

Additionally benchmark conditions can be used to address more than one price per time-slot. The different price can be based on different conditions. Examples are:

- If energy consumption exceeds a certain amount of energy within the time-slot, the next price level will be activated
- The price levels reflect benchmarks, e.g. types of energy like renewables, yellow energy, CO^2 footprint etc., from which the customer can select

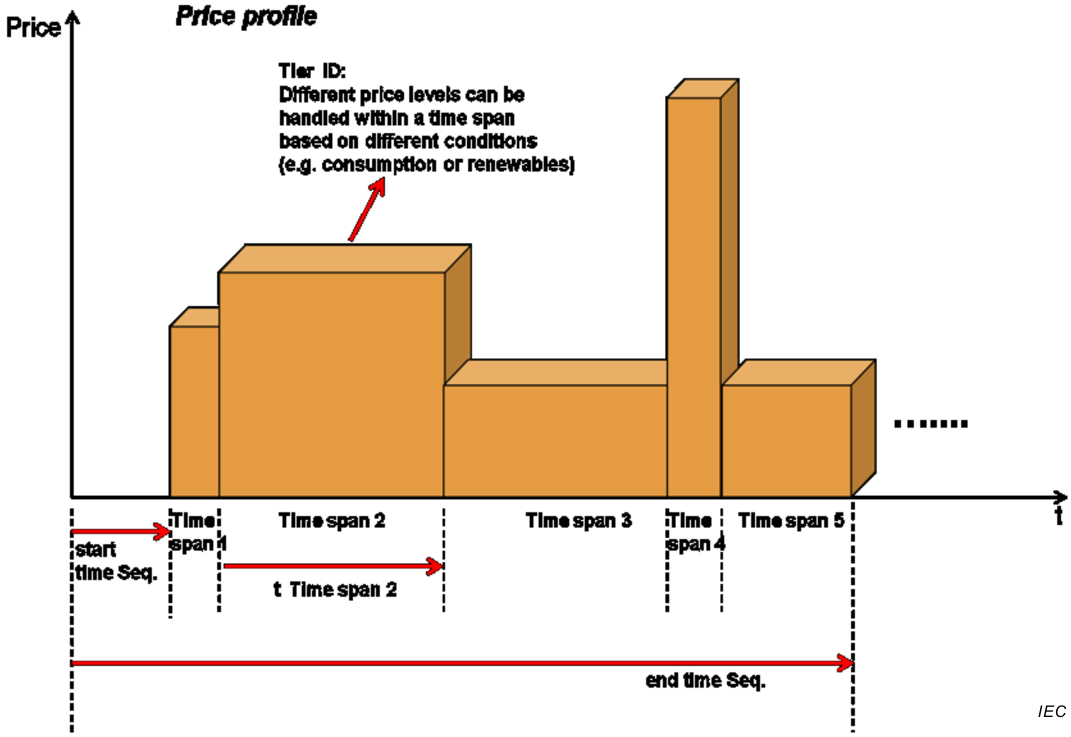


Figure 27 – Structure of a price profile

Table 3 – Information requirements "Price and Environment Profile"

Name	Includes	UC references
price & environment profile		JWG1100, 1130, 1110, 1111, WGSP 2110, 2111
	price quantity	
	environment description a/o quantity	
	variable price model (e.g. discount, quantity based etc.)	
	time information (e.g. slots, actual time, start time, end time, …)	
	date information (e.g. weekday, date, …)	
	binding level	

3.4.6.4 Load / generation / storage management profile

Load / generation management is used for expressing the need and quantity of power adjustment.The actor A/B is signalling stability issues in the grid and is asking for help. If the customer has offered support (e.g. as part of the contract or as part of an incentive program) the CEM can evaluate capabilities to increase or reduce energy consumption or generation inside premises.

Examples are:

- lack of energy in the grid due to a breakdown of a power station with a certain time to ramp up another backup power station
- energy overload due disproportional PV- and wind energy

In these examples the actor A/B asks the CEM to reduce or increase power consumption for a specific time period.

Nevertheless this load / generation management concept can also be used to manage specific CEM-smart devices directly (see Figure 28).

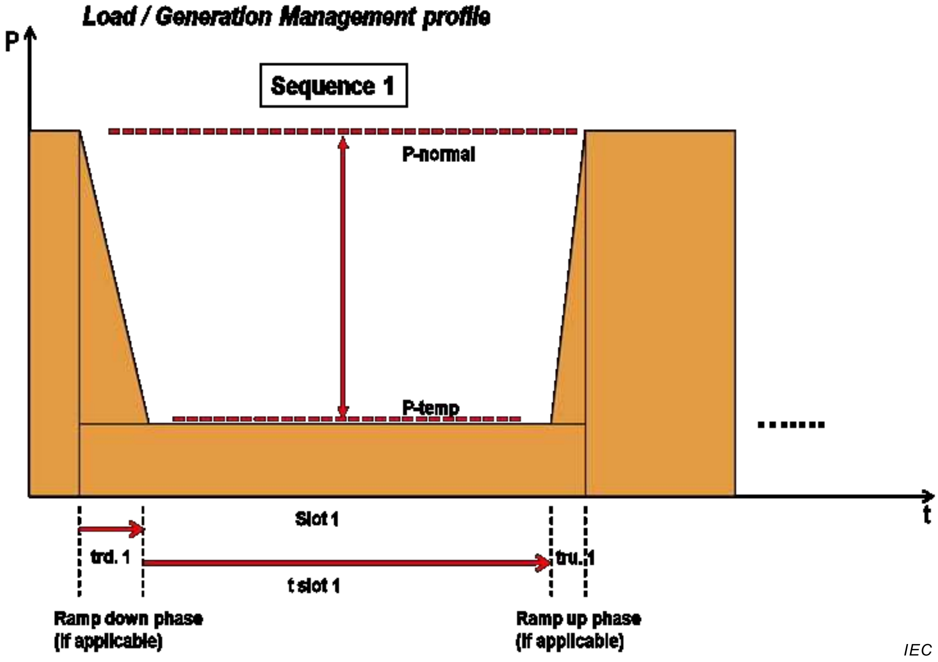


Figure 28 – Structure of a load / generation management profile

Table 4 – Information requirements "Direct Load / Generation Management Profile"

Name	Includes	UC references
load / generation management profile		JWG1130, 1111, 112x, 1110, 120x, 121x, 202x, 2002 WGSP2121, 2114, 2111, 2112
	time information (e.g. slots, actual time, start time, end time, ramp up time, ramp down time, etc.)	
	date information (e.g. weekday, date, etc.)	
	power quantity during ramp up / down (absolute / relative)	
	Urgency / criticality	
	confidence level	
	devices	

3.4.6.5 Emergencies / Blackout prevention profile

Emergencies / Blackout prevention management is a specific characteristic of load / generation management. The actor A/B is signalling an upcoming blackout situation in the grid. To prevent this blackout the actor A/B is advising the CEM to send all smart devices into a defined blackout prevention mode (minimal power consumption except safety relevant tasks).

The information exchange can be handled like the load / generation management profile.

3.4.6.6 Temperature profile

Instead of power management types smart devices can also be managed by a temperature profile (see Figure 29). The concept behind is comparable with the power profile concept.

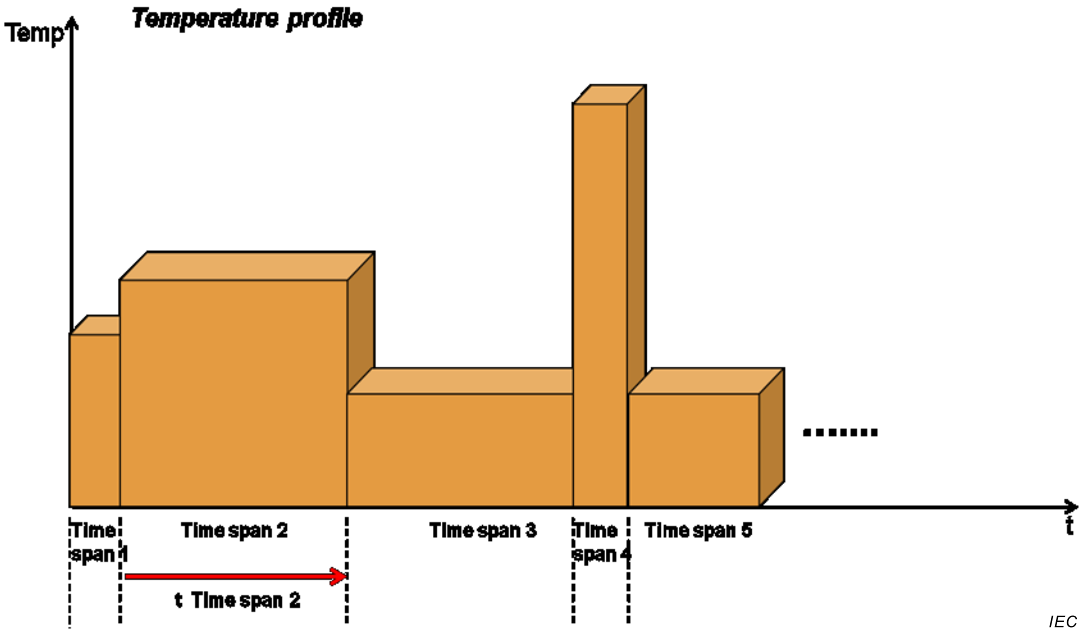


Figure 29 – Structure of a temperature profile

Table 5 – Information requirements "Temperature Profile"

Name	Includes	UC references
temperature profile		JWG202x, 120x, 121x, 1003, 212x, 1110, 1130, 1111 WGSP2112, 2121, 2114, 2111
	temperature quantity	
	time information (e.g. slots, actual time, start time, end time, etc.)	
	date information (e.g. weekday, date, etc.)	
	confidence level	
	devices	

3.4.7 Comfort, management and status information

Comfort, management and status information summarize information requirements for remote management as well as kinds of remote monitoring like notifications, alerts and status information.

The collection includes typical data like on, off, waiting for start, remaining time, pause, finished etc. The information to be exchanged is already referenced within Figure 19

3.4.8 Upcoming profiles for new service requirements

The function specific profiles, information to be exchanged (as described in this technical report) and corresponding messages are set up in a manner to allow easy definition and smooth harmonization of upcoming services like further energy related requirements, AAL, security, healthcare, and so forth.

Annex A
(informative)

User stories and use cases collection

A.1 User stories

A.1.1 General

This section describes a collection of user stories as a basis for necessary use cases. User stories describe the behaviour from the customers' / users' point of view. The main target of user stories are to narrate typical behaviors in own premises to validate the use cases used to accomplish the story. These user stories may apply to various scenarios and are not limited to specific home environments, building and industrial applications.

Figure A.1 lists typical user requirements.

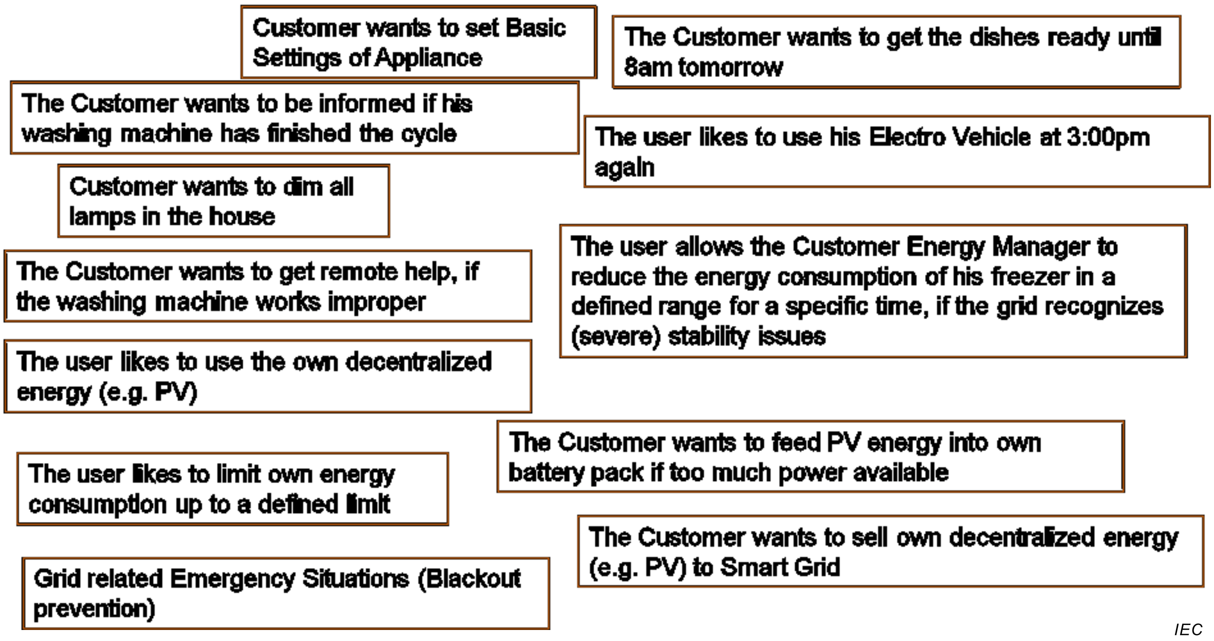


Figure A.1 – Kinds of user stories

NOTE The attached user stories are not categorized.

A.1.2 JWG1 Flex start washing machine

The user wants to get the laundry done by 8:00 p.m.

The user prepares the washing machine

Fills clothesSelects washing program

Pre-selects the end time (e.g. 8:00 p.m.)

Starts washing program

The washing machine now informs the CEM about

The start of the new program

The pre-selected end time

The expected power consumption profile with duration and (e.g. time related specific) energy consumption

The CEM calculates the operation plan and takes into account

The pre-selected end time

A pre-selected incentive program

The expected power consumption profile with duration and (e.g. time related specific) energy consumption

Tariff information

Expected energy consumption other smart devices

Expected local energy generation

Amount of locally stored energy

The CEM sends the calculated start time to the smart device (washing machine)

In case the situation changed, a CEM may send an updated starting time unless the smart device started

The smart device starts the cycle based on the calculated start time

A.1.3 JWG2 Flex start EV charging

The user wants to have his electro vehicle charged by 8:00 a.m.

The user prepares the EV

Selects charging level

Pre-selects the end time (e.g. 8:00 a.m.)

May pre selects the incentive program (e.g. cheapest tariff, greenest power etc.)

Starts charging cycle

The EV now informs the CEM about

The start of the new charging cycle

The pre-selected end time

The pre selected incentive program (if not already stored)

The expected charging consumption profile with duration and (e.g. time related specific) energy consumption

The CEM calculates the operation plan and takes into account

The pre-selected end time

The pre-selected incentive program (if not already stored)

Tariff information

Decentralized Energy forecast, if applicable

The expected power consumption profile of the requested EV charging

Expected energy consumption of other smart devices

Expected local energy generation

Amount of locally stored energy

The CEM sends the calculated start time to the EV

In case the situation changed, a CEM may send an updated starting time unless the smart device started

The EV starts the cycle based on the calculated start time

A.1.4 JWG3 Severe grid stability issues

The grid recognizes (severe) stability issues

The grid sends a load control message, requesting the CEM to adjust the load (by either increasing or decreasing consumption or generation). The load control message may include

- an incentive value and/or time frame for answering to the request
- an incentive value and/or time frame for acting on the request

Depending on user configurations, several options are possible, e.g.:

- The user allows the CEM to adjust the load of some of his devices (e.g. of the freezer for a defined/maximum time). The support of these capabilities may usually be part of a contract between Energy Supplier and customer. After receiving the request from the grid, the CEM checks the status of attached smart devices checking on the possibility of e.g. reducing consumption by xW, x % of consumption or alternatives which leads into a change in consumption / generation. The smart device may react so and may respond with the achieved details
- The CEM may send the response back to the grid.
  The CEM checks the status and may recalculate (e.g. postpone) the starting time of already planned upcoming cycles. The CEM updates starting time of smart devices
- CEM feeds own battery pack energy into own network or into the grid. The CEM checks status of battery pack. In case the battery pack can provide enough energy the CEM can decide to start feeding process
- CEM stores additional energy from the grid into own battery pack. The CEM checks status of battery pack. In case the battery pack has enough capacity and if the energy price plus the incentive value is better than the average cost of stored energy, the CEM starts feeding process

A.1.5 JWG4 Power limitation PV

The user wants to limit his consumption to his own local production (e.g. PV)

The user instructs the CEM to limit power consumption up to amount of own decentralized power. Along with this command, several additional parameters may be set, for example:

- At which time of the day this limit applies
- Which devices are exempt from this limit
- Etc.

The CEM is kept informed on total power consumption and generation through the smart meter.

When managing power consumption in the house, the CEM takes into account the above limits and parameters.

If the user wants to start a smart device, then the CEM is notified by the smart device and receives, amongst others, a load profile (see 3.1.1).

If, when based on the load profile and other parameters, the CEM concludes that the power limit will be exceeded, then it may send a warning message to the relevant device and to a display if one is available.

Based on the warning message, the user may decide to postpone his consumption or to manually overrule the power limit.

Furthermore there is the possibility that premises go in isolated (island) operation from the distribution system. Such premises will be isolated or "switched off" by the network operator or by the premise's own control facilities based on appropriate monitoring arrangements. The ability of island operation comes from the fact that they are able to cover their own power demand by the premise's own "distributed" generator and/or storage facilities, i.e. batteries. In such situations the distribution network can be in operation or out of service due to emergency situations and/or planned maintenance and/or repair activities. Premises with their own generation and storage facilities can cover their total demand or at least part of their total demand controlled by a CEM with or without being connected to the distribution network. In normal situations the surplus of energy generated by the premises can be delivered back to the distribution system. Reconnecting the premises to the distribution system after a period of island operation has to be arranged in a safe and coordinated manner. That can be arranged by a synchronizing facility/unit with build-in monitoring and control arrangements; the latter can be part of the afore-mentioned CEM.

A.1.6 JWG5 CEM manages devices

Switch on/off devices, dim devices

Examples are turning on/off devices such as lighting, smart plugs and dimming lighting etc.

A.1.7 JWG6 Customer sells flexibility

The Customer wants to sell his flexibility to the grid

Based on information on:

- Current consumption (received from smart meter)
- Currently running devices and their load profiles
- Device assignments to be ran and their load profile
- Tariff information
- Information on power limitations

The CEM may identify opportunities for flexibility.

The user may have set constraints on the flexibility that may be offered to the grid. These constraints may be:

- Which loads (or generators) and user specified conditions are available for providing flexibility
- Start time of the flexibility (start time within a certain time period)
- Duration of the flexibility
- Amount of flexible power at a point in time
- Amount of flexible energy

The CEM proposes this flexibility to the grid, by providing the following information:

- Start time of the flexibility (start time within a certain time period)
- Duration of the flexibility

- Amount of flexible power at a point in time
- Amount of flexible energy

These offerings are negotiated by a process of offering, accepting or rejecting, possibly. Reasons for accepting and rejecting include suitability of the offered flexibility (the expected value of the flexibility e.g. in a portfolio) and financial aspects.

If the grid wants to accept the offer, it sends a message indicating this and with the incentive that is related to the acceptance (this is the Flexibility Offer Acceptance)

A second message from the grid indicates how the flexibility should be allocated. This message comes in the form of a load profile, but stays within the constraints of the flexibility offer.

The CEM implements the flexibility allocation by adjusting the (time of the) consumption / generation of devices on the premise.

A.1.8 JWG7 Customer sells decentralized energy

The customer wants to sell own decentralized energy (e.g. PV) to Smart Grid

When the consumer wants to sell his own decentralized energy to the grid, several options are possible:

Based on a price message or load/generation control message, CEM may instruct local generators / storage to adjust output.

CEM offers to sell an amount of energy at a specified price. This corresponds to offering flexibility as described in user story JWG 6 Customer sells flexibility, see A.1.7

The CEM then releases stored energy and starts power generation if available.

A.1.9 JWG8 Grid-related emergency situations

Grid-related emergency situations (blackout prevention)

The grid is close to a black-out and will soon have to cut off sections of the grid.

As a means of preventing this by limiting the overall energy consumption to a certain minimum, the grid sends an emergency message to all connected households in order to instruct them to place their connected devices into “emergency connected off mode”.

Assumption: The CEM and smart devices are pre-configured with an “emergency connected off mode” profile. This profile defines which connected devices enter “emergency connected off mode” and what that mode entails (on a device by device basis). This profile is agreed by both the consumer and the energy provider and is likely to be included in a contract.

The CEM receives an emergency message (some low consumption, essential devices like gas boilers that require a minimum of electricity to run, may be allowed to stay operational – this will be defined within the profile).

This message may include the duration of the emergency period.

The CEM sends a message to all connected smart devices to switch to “emergency connected off mode”.

The devices switch to “emergency connected off mode”.

When the emergency period has ended (either because the predetermined emergency time has passed or because the grid sent a message that the emergency has passed), the CEM instructs the devices that they may resume operations as normal.

A.1.10 JWG9 Customer connects new smart device

The Customer wants to connect a new smart device to the CEM

Installer and/or “plug and play” consumer installation will be supported

Discovery, authentication etc. are handled by lower layers and are out of scope of this document

Communication messages and data used between the CEM and device concerning the capability (type and functionality) of the device are within the scope of this document

A.1.11 JWG10 Energy consumption information

The consumer wants to be informed on their historic and forecasted energy use

The consumer indicates on the CEM User Interface that they want information on their historic and forecasted energy use.

In case the CEM does not have the relevant historic information, it may request these data from the smart meter or other source.

Based on the information related to currently connected devices and their expected consumption and generation and based on the historic data, the CEM may build a short term energy forecast and informs the user.

A.1.12 JWG11 Unexpected disconnect

A smart device disconnects unexpectedly (failure)

The CEM and smart device exchange regular messages or status messages to keep each other informed of their connection (to the network) and of their operational status.

At a moment in time, the CEM does not receive such a message from a device when it expected one.

The CEM sends a status request to the device.

In case the CEM does not receive a response or when the device responds with an abnormal status, the CEM sends a warning message to an advanced display. The CEM may also send a warning to a third party (e.g. service provider) on the grid side.

A.1.13 JWG12 ExpectedYearlyCostsOfSmartDevice

The consumer wants to know an estimate of the yearly energy cost of a smart device

(This user story assumes that the CEM or the device stores information on time-of-use consumption of individual devices and that the CEM has a historic record of time-of-use buckets and their related tariffs in the relevant currency).

The consumer indicates on the CEM User Interface that they want information on the yearly cost of a specific device.

The CEM collects information of individual device's consumption from its memory or requests this information from the device.

The CEM collects information related to historic time-of-use buckets and tariff information expressed in financial units from its memory.

The CEM combines (estimated) consumption information with tariff information and sends the response to the consumer's query back to the CEM User Interface.

A.1.14 JWG13 Energy storage and feed in based on tariff

The consumer wants a storage device to feed energy to the grid once the tariff reaches a certain threshold

The consumer parameterizes the CEM to feed energy once the tariff for selling energy reaches a certain threshold. Additionally, the consumer may parameterize that local storage should not drop below a certain point

The CEM receives a new tariff from the grid (may be via the smart meter) and notices that this tariff exceeds the abovementioned threshold.

The CEM may check:

- Whether the amount of stored energy is not below a user specified point
- Whether releasing stored energy to the grid would be inconsistent with other user commands / settings (e.g. electric vehicle that must be charged by a specific time, flexibility assignments, load control messages requesting to increase consumption or lower generation, etc.)

When there is no conflict with the above mentioned points, the CEM instructs the storage device to feed energy in the grid.

A.1.15 JWG14 EnergyConsumptionManagementFromExternal

Manage energy consumption of smart devices by Smart Grid

This user story explains how on 15 July, a premises customer allows the supplier (or energy service provider) to raise the temperature setting of his air-conditioner in a defined range so as to curtail power demand for a specific time.

- On the 14 July, the supplier requests a reduction of power consumption by tomorrow, 15 July, from 10:00 a.m. to 2:00 p.m.
- The customer finds the request and confirms that he is willing to comply by e.g.
- Setting the temperature range to a specific one.
- Turning on the air-conditioner
- In the morning of 15 July, the supplier analyzes the power consumption data continuously delivered through data collectors which accumulate the power consumed by all customers via smart meters, and reconfirms the high demand forecast during the peak period considering the metrological data sent from the weather forecast system.
- At 11:00 a.m., given the estimated power demand for the coming hours, the supplier sends messages to the CEM and asks for the possibility to reduce power consumption by 300 W (Power I) from 12:00 a.m. to 2:00 p.m.
- The CEM informs the air-conditioner about the target of reduction including timeframe.
- At 12:00 a.m. the air-conditioner reduces power consumption and communicates this to the CEM. If the requested settings cannot be reached, the air conditioner informs what can be achieved.

A.1.16 JWG15 Manage in-premises battery system

Manage in-premises battery system

This user story explains how a battery owned by premises customers charges (buys) electricity during off-peak period, from 11:00 p.m. to 5:00 a.m., and discharges power to use appliances in the house during peak period, 10:00 a.m. to 2:00 p.m.

- The customer prepares the setting of the battery through the CEM:
  - Prioritizing the reduction of electricity cost by charging cheaper electricity at off-peak time and discharging power during the peak-period.
- The CEM calculates the operation plan based on:
  - Tariff information, for example;
    i) XX.XX cent/kWh, cheaper electricity, from 11:00 p.m. to 5:00 a.m.
    ii) XX.XX cent/kWh, expensive, from 10:00 a.m. to 2:00 p.m.
  - Expected power consumption based on;
    i) The past power consumption records;
    ii) The owner's today's schedule
  - The remaining battery charge
- Based on this operation plan, the CEM instructs the battery to charge and discharge in the most optimal way.

A.1.17 JWG16 Manage DER

Manage distributed energy resources (DER)

Alternative 1: this user story describes how a DER owned by a premises customer generates electricity in peak periods, from 10:00 a.m. to 2:00 p.m., to reduce electricity cost.

- The customer prepares the setting of the DER through the CEM:
- Select the plan that utilizes DER to generate electricity during peak period in a day.
- The CEM checks the status of the DER.
- The CEM starts the DER at 10:00 a.m. and stop it at 2:00 p.m.

Alternative 2: this user story describes how a DER owned by a premises customer generates electricity when a dynamic pricing message is provided from the supplier to the customer.

- The customer prepares the setting of the DER through the CEM:
- Select the plan, which initiates the DER operation when a tariff of XX.XX cent/kWh or more of electricity price is offered.
- The CEM checks the messages from the supplier and status of the DER.
- At 10:30am, the supplier offers XX.XX cent/kWh from 11:00 a.m. to 2:00 p.m.
- The CEM receives the message and compares the price with the set value.
- The CEM starts the DER if both that the price is equal to or higher than the set value and that the DER is ready are confirmed.
- The DER generates electricity from 11:00 a.m. to 2:00 p.m.
- If after 2:00 pm the tariff no longer exceeds the abovementioned threshold, the CEM instructs the DER to stop generation.

A.1.18 JWG17 Peak shift contribution by battery aggregation

Peak shift contribution by battery aggregation

The customer likes to participate in the peak shift contribution of battery aggregation (PSCBA) according to the conditions such as the maximum and minimum value of Customer’s battery output power that are specified by the customer. Under the contract between the electric company and the customer, battery SCADA and the CEM communicate with each other.

- The customer lets CEM participate in the PSCBA.
- Battery SCADA sends “request for Schedule” to the CEM.
- The CEM sends the requested schedule to battery SCADA. This includes Detail Schedule/ Outline Schedule/ Surplus Schedule of customer’s battery.
- Battery SCADA calculates the total surplus potential and the schedule of batteries.
- According to the plan for PSCBA set by grid operator, battery SCADA calculates the schedule of each battery for the plan.
- Battery SCADA sends “inquiry” command to CEM. This includes the plan for PSCBA corresponding to customer’s battery.
- CEM sends the response of “inquiry” message to battery SCADA. This includes “inquiry rejection” or “inquiry acceptance”
- In case of “inquiry acceptance”, battery SCADA sends “execution notification” to CEM.

CEM sends charging/discharging command to customer’s battery according to the customer’s detail schedule and the plan for PSCBA corresponding to customer’s battery.

A.1.19 JWG18 Control appliances based on price information

Control of smart home appliances based on price information by time slot

The user likes to use a water heater, air conditioner and other appliances such that total electricity charges are relatively less.

- The user instructs the CEM to program the water heater, air conditioner and other appliances following a number of conditions.
- The user inputs operating conditions of each appliance at CEM, e.g.:
  - Water heater temperature 90 °C, water level 50%
  - Air conditioner mode: cooling down, wind: auto, temperature: 27 °C
- The user inputs time conditions (desirable start time, desirable finish time) of each appliance at CEM, e.g.:
  - Water heater finish by AM7
  - Air conditioner finish cooling down by AM10
- The electricity tariff information is issued at noon every day for the following 24 hours.
- Based on the input conditions, time conditions and tariff, the user lets CEM calculate a program for the following day such that total electricity charges are relatively less
- CEM calculates an operating plan for those appliances considering operation time, power consumption during operation, electricity charges and so forth
- The user confirms the calculation results and commits the operating plan to be executed
  - CEM controls each appliance as programmed according to conditions of operating plan

A.1.20 JWG19 Control appliances based on energy savings signal

Control of smart home appliances in response to power saving request from Electric power supplier

The user likes to use a water heater, air conditioner and other appliances such that power saving request from electric power supplier is satisfied if possible.

- The user instructs the CEM to program the water heater, air conditioner and other appliances following a number of conditions.
- The user inputs operating conditions of each appliance at CEM, e.g.:
  – Water heater temperature 90 °C, water level 50 %
  – Air conditioner mode: cooling down, wind: auto, temperature: 27 °C
- The user inputs time conditions (desirable start time, desirable finish time) of each appliance at CEM, e.g.:
  – Water heater finish by AM7
  – Air conditioner finish cooling down by AM10
- At AM7, the CEM receives a request for power saving from PM1 to PM5.
- The user lets CEM calculate a program at AM8 with input conditions such that power saving request is satisfied as possible
- CEM calculates to program an operating plan for those appliances before, during and after the requested power saving, considering operation time, power consumption while in operation, electricity charges and so forth
- The user confirms calculation results and commits the operating plan to be executed
- The user activates the execution of operating plan at CEM
  – CEM controls each appliance as programmed according to conditions of operating plan

A.1.21 JWG20 Control appliances before power cut

Control of smart home appliance before power cut

The user likes to use a water heater, air conditioner and other appliances before power cut takes place

- The user instructs the CEM to program the water heater, air conditioner and other appliances following a number of conditions
- The user inputs operating conditions of each appliance at CEM, e.g.:
  – Water heater temperature 90 °C, water level 50 %
  – Air conditioner mode: cooling down, wind: auto, temperature: 27 °C
- The user inputs time conditions (desirable start time, desirable finish time) of each appliance at CEM, e.g.:
  – Water heater finish by AM7
  – Air conditioner finish cooling down by AM10
- The information is issued at AM7 that a power cut will occur from PM1 to PM5.
- The user lets CEM calculate a program at AM8 with input conditions considering power cut informed by electric power supplier
- CEM calculates to program an operating plan for those appliances before, during and after the scheduled power cut, considering operation time, power consumption while in operation and so forth
- The user confirms calculation results and commits the operating plan to be executed
- The user activates the execution of operating plan at CEM
  – CEM controls each appliance as programmed according to conditions of operating plan

A.1.22 JWG21 Control appliances in case of natural disaster

Control of smart home appliances in case of natural disaster

The user likes to use a water heater and storage battery at the highest priority in case that unstable electric power supply and/or power cut is expected due to natural disaster

- The user presets water heater and storage battery at CEM to program an emergency operation plan
- The user inputs operating conditions of each appliance at CEM
  - Water heater temperature 90 ºC, water level: 50 %
  - Storage battery mode: quick charge
- The user lets CEM calculates a program with input conditions in case CEM receives power alert from electric power supplier
- CEM calculates an operating plan for water heater, storage battery and all other appliances when CEM receives power alert. Such an operating plan could look like the following:
  - confirm the operating status of all appliances connected to CEM
  - execute normal shutdown process to all appliances in operation except Water heater and Storage battery
  - execute operation of water heater and storage battery with conditions set by the user
- The user inputs auto-execution of emergency operating plan as programmed at CEM in case CEM receives power alert from electric power supplier
- CEM receives power alert from electric power supplier at AM10
- CEM commences at AM10 + n to control each appliance as programmed according to conditions of operating plan, an example of which is:
  - continue operating water heater and storage battery and execute normal shutdown process to finish as far as CEM does not receive a message to call off power alert;
  - execute normal shutdown process of water heater to finish, and continue operating storage battery in case that CEM receives power saving request;
  - continue operating water heater and storage battery till start time of power cut and execute normal shutdown process to finish operating before start time of power cut in case that CEM receives power cut information;
  - execute normal shutdown process to water heater and storage battery to finish in case that CEM receives a message to call off power alert

A.1.23 JWG22 Bilateral DR-negawatt

Bilateral demand response (Negawatt transaction= Japanese related requirement)

This user story describes how an energy supplier asks for a demand responsive load from consumer on the day when tightness of electricity supply and demand is expected.

On the day before the event day (at which a supply tightness is expected), the energy supplier indicates a specification of demand reduction, to connected consumers / CEMs. The specification/flexibility request contains:

- The date,
- Time window (event start and event end),
- Amount in control area.

Based on information on forecasted energy use and user settings, the CEM tenders a bid. The consumer can also input this information manually. The resulting bid contains:

- Amount of demand responsive load (kW) and
- Bidding price (price/kWh).

The energy supplier ranks bids from consumers according to “merit order” and notifies execution results.

Consumers, who made a successful bid, reduce their load in the time window on the specified day.

A.1.24 JWG23 User story lighting

Lighting system

Facility manager wants to reduce lighting load and other loads in a building during a Demand Response (DR) event (e.g. tariff information too high or forecast of renewable energy too low) or a Demand Side Management event (e.g. stability issue in the grid with the request to reduce energy consumption).

(Background: Lighting system consists of large number of devices, which individually do not consume very much power but in total it could be a significant amount of the total building electricity consumption. The lighting devices are usually grouped to accomplish a desired illumination function for the spaces in the building. Not all lighting devices have same importance in the building, so priority scheduling may be needed)

- The facility manager conducts a survey to identify the importance and the constraints of the different loads. For the lighting load it determines:
  - Lighting that can be switched-off completely (e.g. decorative lighting in an open office space) is assigned lowest priority. Their minimum power consumptions are set to zero.
  - Lighting that can be dimmed, e.g. in open offices and private offices lighting can be assigned a medium priority and the minimum power consumption is set according the occupants requirements. Lighting in the most important spaces, e.g. the CEO or board room, is assigned highest priority and their minimum power consumption is configured.
- The facility manager programs the priority group and the minimum power constraints into lighting system controller.
- Building CEM receives a reduction request from the provider (e.g. utility provider or DSO) via DR or DSM message.
- Building CEM requests from lighting system controller:
  - The current consumption
  - The amount of power it can reduce. Multiple priority classes might exist when lights are grouped together based on specific constraints (e.g. emergency lights, office lights, floor lights, etc.)
- Lighting system controller submits the requested data to building CEM.
- Building CEM determines the reduction for each smart devices / sub-system based on:
  - The requested reduction
  - The consumption baseline
  - The amount of power each smart devices / sub-system can reduce for each class of priority, if multiple classes of priority exist.
- Building CEM communicates the reduction request to the lighting system controller.
- Lighting system controller executes the power reduction.

A.1.25 JWG24 Energy market flexibility management

Energy flexibility management

A building owner/operator wants to use the energy flexibility of its building(s) to optimize its energy procurement by adapting the consumption according to flexible energy tariffs and/or to achieve additional revenue at the ancillary service energy markets.

Such energy flexibility management can have different scenarios for long term demand planning, energy trade through day-ahead-market and energy trade through intra-day market.

Scenario 1: “Long term demand planning”

This scenario describes the process with the retailer business to procure a certain amount of energy needed by his customers based on long term contracts (1 week up to multiple years). The energy prices of such contract are typically lower than the process on the day-ahead market. To determine the optimal amount of energy to procure with long term contracts, the retailer is supported by load forecasts provided by his customers. This scenario utilizes a long-term planning phase.

Scenario 2: “Energy trade through day-ahead market”

This scenario illustrates the process of procuring the remaining amount of energy which is needed on top of the already procured energy by long term contracts. In terms of a building triggered approach, the customers (i.e. the building automation/management systems) provide an updated forecast for the next day. This forecast contains either only the deviation to the initial long term forecast or an updated total forecast. Then the retailer has to deduce the delta to obtain the energy amount for procurement. The retailer procures the needed energy at the exchange market and sends the information about the achieved energy prices back to the customer. In case of a price driven energy market triggered scenario the retailer receives the energy price schedule from the market, adds price information of eventually available long term contracts and forwards this information a VPP which aggregates a pool of end customers. The VPP generates an optimized price schedule for each of the connected buildings. The building automation system of the customers will utilize the price information for a cost minimization. This scenario considers a building triggered or energy market triggered day ahead planning.

Scenario 3: “Energy trade through intra-day market”

This scenario describes the process when a major deviation from the planned building energy scheduled is detected. This additional flexibility is placed at the intraday market through the VPP operator. According to the traded flexibility new consumption schedules are provided to the building operators. Depending on their contracts some customers might have the right to deny (opt out) a change in their energy consumption schedule. This scenario describes an operational intra-day market offering.

Scenario 4: “Providing secondary/tertiary reserves at the control reserve market”

This scenario describes the participation of Smart buildings/VPP at the secondary / tertiary reserve energy markets. Based on a prediction of available energy flexibility starting at the device level, the VPP operator may offer a certain amount of flexibility at the reserve energy markets one week or one day ahead for secondary and tertiary reserves, respectively. In case of a successful bidding provision of committed reserve energy is required. The transmission system operator who bought the reserve energy may at any time give an automated trigger signal (secondary reserve) or by phone call (tertiary reserves) to the VPP operator that he needs to provide reserve energy. The VPP operator than forwards the needed commands to the connected customers and the secondary or tertiary reserve is automatically activated by the BAS/BMS at a given time and for a given time period. For the sake of completeness it shall be mentioned that this use cases includes two separate contracts: energy supplier/retailer for regular energy procurement and a service provider utilizing a VPP system for flexibility commercialization. The legal clarification of this issue is out of scope of this document.

Scenario 5: “Reaction on grid congestions”

This use case describes the reaction of buildings on grid congestion events initiated by the distribution grid operator. This may be based on a forecasted grid outage or ad hoc triggering of predefined measures to relief the grid during emergency situations. It shall be mentioned that the regulatory framework currently in place does not support this use case. Hence this use case has the lowest priority.

A.1.26 Japanese building scenarios on energy management

A.1.26.1 General

Energy management inside the building manages capable devices in the building/home and interfaces to the power grid management. This user stories focuses an on the communication of building energy management with its interfaces.

In some cases there is interaction between the CEM and the corresponding power grid management entity. On this following scenarios are possible:

A.1.26.2 Demand-supply adjustment with cooperation between Supplier and Customer (Model 1)

1) An energy supplier determines prices after confirming the supply & demand situation and the wholesale electricity prices.
2) A Customer’s EMS receives pricing information from the energy supplier.
3) Customer’s equipment creates a power usage plan based on the pricing information received.
4) The energy supplier receives power usage plans from Customers.
5) The energy supplier reviews the prices according to the received power usage plans.
6) Go back to (1).

Steps (1) to (6) are performed multiple times and finally Customers receive the final pricing information from the supplier.

A.1.26.3 Energy saving, demand-supply control for individual buildings (Model 2)

For optimizing the power consumption and generation, the CEM provides functionality in coordinating loads and resources for an individual building.

1) The facility manager puts degrees of importance, priorities and consumption/generation schedules into terminal of the CEM.
2) The CEM registers these to the service provider.
3) The service provider creates adjustment plans based on uses of individual equipment, physical positions of individual equipment, consumption/generation schedules and trends of consumption/consumption result. Each adjustment plan includes an operation plan of equipment and a incentive. The service provider displays adjustment plans with a incentive information on the terminal of the customer’s CEM.
4) In case of the emergency, the Service Provider creates adjustment plans for the triage control based on “degrees of importance” and priorities on the above process.
5) The facility manager selects the adjustment plan based on the operation plan of equipment and the incentive.
6) The CEM of the service provider sends suppression signals to customers based on adjustment plans. Then the customer adjusts the usage plan based on suppression signals.

A.1.26.4 Energy saving, demand-supply adjustment for the district (Model 3)

1) The facility manager inputs the priority and the power usage plan of the building into the CEM. Then, the CEM registers these to the District Service Provider and Supplier.
2) The district service provider creates the “power usage plan” and the “equipment operation plan” for the town block (a group of buildings based on a contract). Then the district service provider registers these to his CEM.

3) When a suppression control of power is needed, the supplier calculates the demand curtailment ability of the district. Then the Supplier creates a new power usage plan of the district. Next, the supplier sends it to the district service provider.
4) After the district service provider receives it, he creates “proposal for adjustment plans” based on the priority, the power usage plan and the consumption of buildings and equipment. Each of these proposals includes an “equipment operation plan” and an incentive. Then the district service provider sends these proposals to the customers.
5) The facility manager checks these proposals at the CEM terminal in the customer’s building. Then the facility manager selects one of these proposals based on the “equipment operation plan” and incentive. The CEM sends the selected proposal to the district service provider.
6) After the district service provider receives the proposal selected by the customer, the district service provider sends signals according to the proposal.
7) The customer CEM adjusts the power usage plan based on signals received.

A.1.26.5 Self sustaining community (Model 4)

Acceleration of producing power by Res

1) Via the terminal of the CEM, “the facility manager of the building” registers his building to the “energy contribution service to the community” provided by the district service provider.
2) In a similar way, “the manager of the Community Energy Supplier owning REs (CES) / Community Energy saving Service Provider (CEP)” registers itself to the “energy contribution service” provided by the district service provider.
3) The district service provider estimates the production of electricity generated by renewable sources of power owned by CES/CEPs and customers (buildings). And the district service provider estimates the consumption of customers.
4) The district service provider creates a plan of the production using renewable sources of power, and a plan for the distribution to CES/CEPs and customers.
5) The district service provider provides these plans to CES/CEPs, to customers owning renewable sources of power, to other customers and to the supplier.
6) The CES/CEPs, the customers owning renewable sources of power, the other customers and the supplier confirm these plans.
7) The district service provider collects the results of production, using renewable sources of power owned by the customers.
8) The district service provider calculates the amount of electricity produced using renewable sources of power in the community and then calculates the individual production of each customer.
9) Next, the district service provider calculates the ratio of energy contribution to the community for the CES/CEP and customers owning renewable sources of power.
10) The district service provider gives the CES/CEP and Customers owning renewable sources of power an incentive based on their individual energy contribution to the community.
11) The manager of the customer’s building, which owns renewable sources of power, confirms the above incentive using the CEM terminal. The manager of the CES/CEP also confirms the above incentive.

Adjustment of energy production and consumption in normal conditions

In this scenario the power grid has neither an urgent or any other emergency event active or pending.

Action in case of a shortage of supply of electricity

1) The district service provider estimates future production of electricity using the weather information for the community. And when the district service provider decides that the production of electricity will be insufficient in the near future, the district service provider sends a signal to the CES/CEPs in order to accelerate the production.
2) After the CES/CEP received the above message, the CES/CEP updates the planning of the heat and electrical generation based on the market price of energy.
3) The CES/CEP sends the electricity suppression signal to each customer.
4) The customer confirms the suppression signal using the CEM terminal. Next the customer inputs the reply to the CES/CEP into the terminal.
5) The CES/CEP updates the planning of the heat and electrical generation based on replies from the customers and the market price of energy.
6) The CES/CEP sends a reply to the district service provider.

Action in case of an excess of supply of electricity

1) The district service provider estimates future production of electricity using the weather information for the community. And when the district service provider decides that the production of electricity will exceed the demand of electricity in the near future, the district service provider sends a signal for decelerating the production to the CES/CEPs.
2) The CES/CEP updates the plan for the supply of electric power to the supplier and the plan for the supply of thermal power to the customer based on the market price of energy.
3) The CES/CEP controls heat pumps in the customers' buildings to storage electric power in the heat pumps.

Energy accommodation in disaster conditions

1) Via the CEM terminal in the customer's building, the facility manager of the "disaster control center" registers its "power usage plan for disaster situations" to the district service provider through the CES/CEP.
2) The district service provider creates "power supply plans for disaster situations" for the CES/CEP based on this plan. Then the district service provider sends the "power supply plan for disaster situations" to the CES/CEPs.
3) The CEM in the CES/CEP receives the "power supply plan for disaster situations".
4) In case of a disaster situation, the supplier sends the disaster signal to the district service provider.
5) After the CEM in the CES/CEP received the disaster signal from the district service provider, it changes the "power supply plan for normal situations" to the "power supply plan for disaster situations".
6) The CEM in the CES/CEP supplies the electrical and the thermal power to the "disaster control center".
7) After the CEM in the "disaster control center" receives the disaster signal, the CEM changes the equipment plan.

A.2 User stories and use case mapping table

Table A.1 shows the relation between user stories and use cases.

The main intention of this mapping table is to support the verification of necessity of a new use case and to reduce the number of more or less equivalent use cases at all.

In the event of a new user story, this user story can be mapped to existing use cases, e.g. a flexible charging cycle of an electric vehicle uses the same use cases than a flexible start of a washing machine.

If the mapping shows a lack of use case, this use case and data model need to be added.

Table A.1 – User stories – Use case mapping table

User Story Use Case Mapping (Use Cases / User Stories)	FlexStartSD JWG1100 *v.0.5*	SDinformanCEMFlexibleStart JWG1101 *v.0.2*	CEMinformsSDaboutTime JWG1102 *v.0.2*	SlotShift JWG1103 *v.0.1*	TemperatureControlBasedOnPriceInformation JWG1110 *v.0.1*	FuelCellOperationWithFixSchedule JWG1111 *v.0.1*	MixedEnergySystem-HeatPumps-PV-StorageBattery JWG112x *v.0.2*	LogSystemEvents JWG113x *v.0.2*	LocalEnergyManagement JWG120x *v.0.1*	ProvideLocalPowerToTheGrid JWG121x *v.0.1*	DemandSupplyAdjustment JWG2000 *v.0.3*	CascadedCEM JWG2001 *v.0.2*	DistrictEnergyManagement JWG2002 *v.0.2*
JWG 1 *Flexible Start Washing Machine*	yes	yes	yes	yes	no	no	no	yes	yes	no	no	yes	yes
JWG 2 *Flexible Start EV charging*	yes	yes	yes	no	no	no	yes	yes	yes	no	yes	no	no
JWG 3 *SevereGridStabilityIssues*	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
JWG 4 *PowerLimitationPV*	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	no	yes
JWG 5 *CEMSimpleDevice*	yes	no	no	no	no	no	no	no	no	no	no	no	no
JWG 6 *CustomerSellsFlexibility*	yes	no	no	no	no	yes	yes	yes	yes	yes	yes	no	yes
JWG 7 *CustomerSellsDecentralizedEnergy*	no	no	no	no	no	yes	yes	yes	yes	yes	no	no	yes
JWG 8 *GridRelatedEmergencySituations*	no	no	no	no	no	no	yes	yes	yes	no	no	no	no
JWG 9 *CustomerConnectsNewSmartDevice*	no	no	no	no	no	no	no	yes	yes	no	no	no	no
JWG 10 *EnergyConsumptionInformation*	no	no	no	no	no	no	no	yes	yes	no	no	no	no
JWG 11 *UnexpectedDisconnect*	yes	no	no	no	no	no	yes	yes	yes	no	no	no	no

Use Cases *User Story Use Case Mapping* User Stories	AccelerateDistributedPowerGeneration JWG2010 *v.0.3*	PeakShiftBatteryAggregation JWG202x *v.0.91*	PowerAdjustment NormalConditions JWG2041 *v.0.3*	EnergyAccommodationForBuildings UnderDisasterConditions JWG2042 *v.0.3*	Tariff-ConsumptionInformationExchange JWG211x *v.0.6*	DirectLoad-GenerationManagement JWG212x *v.0.6*	DirectLoad-GenerationManagement WGSP212x *v.0.5*	TariffSynchronization WGSP214x *v.0.5*	MarketCommunicationFlexibility JWG30xx *v.2.1*	Energy Production / Storage Integration JWG3101 *v.0.2*	Local Power Loss JWG3102 *v.0.2*	Historical Data Visualization JWG3103 *v.0.2*
JWG 1 *Flexible Start Washing Machine*	no	no	yes	no	yes	yes	yes	yes	no	yes	No	No
JWG 2 *Flexible Start EV charging*	no	no	no	no	no	no	no	yes	no	yes	Yes	No
JWG 3 *SevereGridStabilityIssues*	yes	yes	yes	yes	no	yes	yes	no	yes	yes	Yes	No
JWG 4 *PowerLimitationPV*	yes	no	yes	no	yes	yes	yes	no	no	yes	Yes	No
JWG 5 *CEMSimpleDevice*	no	no	no	no	no	no	yes	no	no	no	No	No
JWG 6 *CustomerSellsFlexibility*	yes	yes	yes	yes	no	no	yes	yes	yes	yes	No	No
JWG 7 *CustomerSellsDecentralizedEnergy*	yes	no	yes	no	no	yes	no	yes	yes	yes	No	No
JWG 8 *GridRelatedEmergencySituations*	no	no	no	yes	no	no	no	no	no	yes	Yes	No
JWG 9 *CustomerConnectsNewSmartDevice*	no	no	no	no	no	no	no	no	no	yes	No	No
JWG 10 *EnergyConsumptionInformation*	no	no	no	no	no	no	no	no	no	yes	Yes	Yes
JWG 11 *UnexpectedDisconnect*	no	no	no	no	no	no	no	no	no	yes	Yes	No

User Story Use Case Mapping — **Use Cases** / **User Stories**	FlexStartSD **JWG1100** *v.0.5*	SDinformanCEMFlexibleStart **JWG1101** *v.0.2*	CEMinformsSDaboutTime **JWG1102** *v.0.2*	SlotShift **JWG1103** *v.0.1*	TemperatureControlBasedOnPriceInformation **JWG1110** *v.0.1*	FuelCellOperationWithFixSchedule **JWG1111** *v.0.1*	MixedEnergySystem-HeatPumps-PV-StorageBattery **JWG112x** *v.0.2*	LogSystemEvents **JWG113x** *v.0.2*	LocalEnergyManagement **JWG120x** *v.0.1*	ProvideLocalPowerToTheGrid **JWG121x** *v.0.1*	DemandSupplyAdjustment **JWG2000** *v.0.3*	CascadedCEM **JWG2001** *v.0.2*	DistrictEnergyManagement **JWG2002** *v.0.2*
JWG 12 *ExpectedYearlyCostsOfSmartDevice*	no	no	no	no	no	no	yes	no	no	no	no	no	no
JWG 13 *EnergyStorageAndFeedInBasedOnTariff*	no	no	no	no	no	no	yes	yes	yes	yes	no	no	no
JWG 14 *EnergyConsumptionManagementFromExternal*	no	no	no	no	no	yes	yes	yes	yes	yes	yes	no	yes
JWG 15 *ManageIn-PremisesBatterySystem*	no	no	no	no	no	no	yes	yes	yes	no	yes	no	no
JWG 16 *ManageDER*	no	no	no	no	no	yes	yes	yes	yes	yes	no	no	yes
JWG 17 *PeakShiftWithBatteryAggregation*	no	no	no	no	no	no	yes	yes	yes	yes	no	no	no
JWG 18 *ControlAppliancesBasedOnPriceInformation*	yes	yes	yes	yes	no	no	no	yes	yes	no	yes	yes	no
JWG 19 *ControlAppliancesBasedOnenergySavingsSignal*	yes	yes	yes	yes	no	no	no	yes	yes	no	yes	yes	no
JWG 20 *ControlAppliancesBeforePowerCut*	yes	yes	yes	yes	no	no	no	yes	yes	no	yes	yes	yes
JWG 21 *ControlAppliancesInCaseOfNaturalDisaster*	yes	yes	yes	yes	no	no	no	no	no	no	yes	yes	no
JWG 22 *BilateralDR-Negawatt*	no	no	no	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
JWG 23 *UseCaseLighting*	no	no	no	no	no	no	no	no	yes	no	yes	no	yes
JWG 24 *EnergyMarketFlexibilityManagement*	no	no	no	no	no	no	yes	yes	yes	yes	yes	no	yes

Use Cases / ***User Story Use Case Mapping*** / **User Stories**	AccelerateDistributedPowerGeneration **JWG2010** *v.0.3*	PeakShiftBatteryAggregation **JWG202x** *v.0.91*	PowerAdjustment NormalConditions **JWG2041** *v.0.3*	EnergyAccommodationForBuildings UnderDisasterConditions **JWG2042** *v.0.3*	Tariff-ConsumptionInformationExchange **JWG211x** *v.0.6*	DirectLoad-GenerationManagement **JWG212x** *v.0.6*	DirectLoad-GenerationManagement **WGSP212x** *v.0.5*	TariffSynchronization **WGSP214x** *v.0.5*	MarketCommunicationFlexibility **JWG30xx** *v.2.1*	Energy Production / Storage Integration **JWG3101** *v.0.2*	Local Power Loss **JWG3102** *v.0.2*	Historical Data Visualization **JWG3103** *v.0.2*
JWG 12 *ExpectedYearlyCostsOfSmartDevice*	no	no	no	no	yes	no	no	yes	yes	no	No	Yes
JWG 13 *EnergyStorageAndFeedInBasedOnTariff*	no	yes	no	no	yes	no	no	no	yes	yes	No	No
JWG 14 *EnergyConsumptionManagementFromExternal*	no	no	yes	no	yes	no	yes	no	yes	yes	No	No
JWG 15 *ManageIn-PremisesBatterySystem*	no	no	yes	yes	no	no	yes	no	no	yes	Yes	Yes
JWG 16 *ManageDER*	no	no	yes	no	yes	no	no	no	yes	yes	Yes	Yes
JWG 17 *PeakShiftWithBatteryAggregation*	no	yes	no	no	yes	no	no	no	yes	yes	No	No
JWG 18 *ControlAppliancesBasedOnPriceInformation*	no	no	yes	no	yes	yes	no	yes	yes	yes	No	No
JWG 19 *ControlAppliancesBasedOnenergySavingsSignal*	no	no	yes	no	no	yes	no	yes	yes	yes	Yes	Yes
JWG 20 *ControlAppliancesBeforePowerCut*	no	no	no	no	no	yes	yes	no	no	yes	Yes	No
JWG 21 *ControlAppliancesInCaseOfNaturalDisaster*	no	no	no	no	no	no	yes	no	no	no	Yes	No
JWG 22 *BilateralDR-Negawatt*	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	No	No
JWG 23 *UseCaseLighting*	no	no	yes	yes	yes	yes	yes	no	no	yes	No	No
JWG 24 *EnergyMarketFlexibilityManagement*	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	No	No

A.3 Use case descriptions

A.3.1 Overview

The following use cases are based on the above user stories and the architecture defined earlier in this technical report. Note that the use cases only describe communication between Actor A/B, the CEM, the smart meter and the smart devices. For sake of simplicity, these use cases do not represent the energy management gateway and the smart metering gateway – when developing the use cases we assumed that the gateways do not provide functionalities contributing towards the goals of the use cases. In reality, the gateway may provide functionality in terms of routing information, translation of protocols, device management, security and service capabilities .

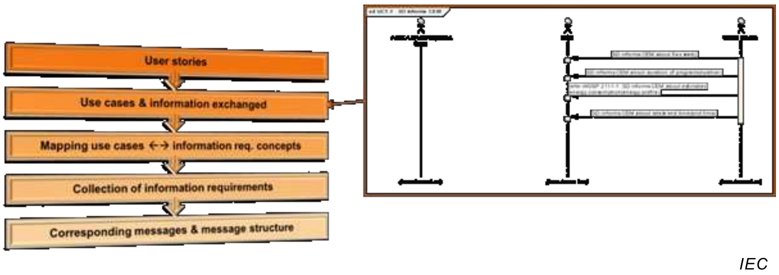


Figure A.2 – Use case and requirements process

NOTE 1 Several use case scenarios may work together in an iterative way. E.g. there might be a negotiation which uses the price (WGSP2112) to get a forecast (WGSP2111), then adapting the price, which might be binding from there on.

NOTE 2 Information can be transferred via different channels to actor A, B and to the consumer or in-home devices. This implies that the use case could effectively be split up into several sub-use cases, each with its own goal.

In all the use cases mentioned here, IEC 62559-2 actors list [15] is referred to and the IEC 62559-2 Use Case template [16] is followed.

For the definition of the use cases in this document, the already referenced SG-CG architecture model has been used as a basis (see Figure A.3).

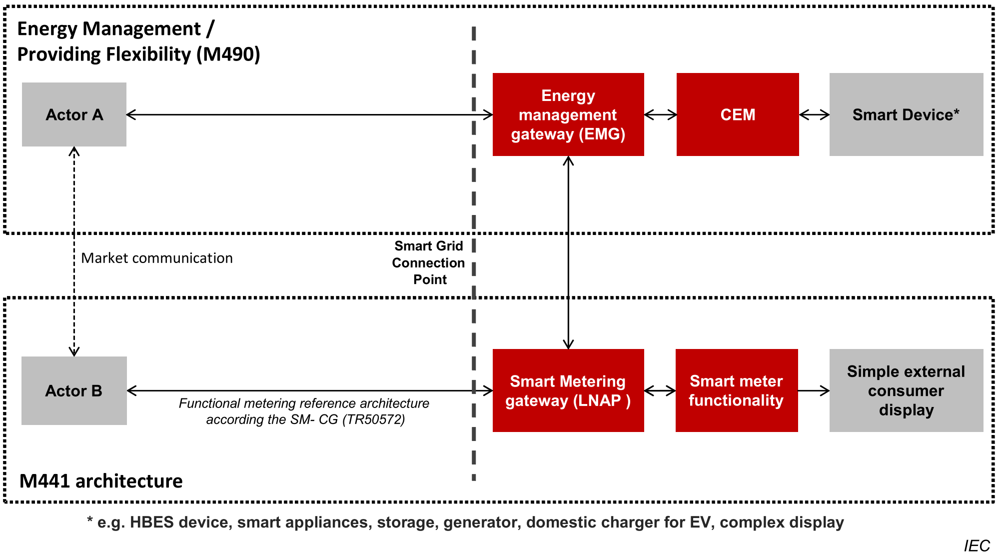


Figure A.3 – Smart Grid Coordination Group Architecture Model [9]

NOTE 3 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

A.3.2 High level use case (JWG1100) Flexible start of a smart device (SD)

A.3.2.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG1100	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	SD consumes / generates energy on a flexible basis (High Level Use Case or Generic Use Case)

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / domain / role**	**Title/changes**	**Approval status** **draft, for comments, for voting, final**
0.1	04/11/ 2013	Editor		Initial Draft	Draft
0.2	06/12/ 2013	Editor		Updated Version after CLC TC59x discussions	Draft
0.3	06/01/ 2014	Editor		Update HLUC to fit Joint Use Case Workshop description	Draft
0.4	07/03/ 2014	Editor		Added JWG-ID	Draft
0.5	16/12/ 2014	Editor		Added optional step 5 to calculate expected running costs	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	In some cases smart devices provide flexibility towards their time. The device can manage its flexible running times by itself and communicates them to the CEM on a negotiation basis. Utilizing flexibility by a CEM must be negotiated and confirmed with the smart device. The flexible operation of a smart device does not imply a specific optimization strategy. It depends on the control algorithm which the customer defines for its smart device and the CEM. The scope of that High Level Use Case deals with the basic information exchange between a smart device and the CEM to allow a flexible start. Also it covers the information exchange on the energy consumption during operation to allow an energy scheduling within the CEM.
Objective(s)	This use case defines the basic information which is required to offer flexible start of smart devices. There are various optimization targets possible for setting a flexible start time.

Scope and objectives of use case	
Related business case(s)	Demand Response (DR) Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
The User activates a specific profile on the smart device that allows a flexible start. The smart device then starts a negotiation process with the CEM to find the most suitable start time. The interaction between the SD and the CEM does not require user interaction and operates autonomously. The SD fulfils the job according to the activated profile and might ask the user for final confirmation. After job completion the end customer might get notified on successful or failed commissioning. – A smart device might have two basic operational modes: – Power Producing by generating electricity
Complete description
The User activates a specific action profile on the smart device. The smart device then negotiates a start time with the CEM based on the selected specification. Such specification might include user specific requirements like pre-defined end-time, maximum energy consumption, or something else and device specific capabilities. Such a profile can be very simple and defines a setting for a specific purpose. The interaction between the SD and the CEM does not require user interaction and operates autonomously. It is up to the SD to find the best possible solution according to the user defined operational mode. The SD visualizes relevant information to the User if possible and starts action in cooperation with the CEM. Once the User activates a profile on flexible start time of a smart device, the User hands over the control to the CEM or smart device. The SD fulfils the job according to the activated profile of the user and notifies the User on successful or failed commissioning. A notification and visualization method of relevant information varies on the appliances that are used. This use case comprises three primary use cases: **1) JWG1101: SD informs CEM about flexible start** The smart device informs the CEM about its flexibility and limitations. **2) JWG1102: CEM informs SD about starting time** The CEM coordinates an optimized starting according to the selected operational strategy. It might require consideration of more than one smart device for calculating a suitable start time. **3) JWG1103: CEM informs SD about slot shift** The calculated start which had been sent to the smart device by the CEM requires an update. There might be a change in the environment which requires the CEM to recalculate a new start time (within the pre-defined limits of the affected smart devices).

General remarks

General remarks
This high level use case or generic use case considers smart devices like home appliances (white goods, brown goods and consumer electronics). Any communication between SD and CEM must provide acknowledge handling on application level and basic failure detection. A broken communication link shall not lead to an unsecure and critical situation. Therefore, smart devices must provide device specific fail-safe mechanisms to prevent danger from the customer (e.g. a cleaning process of an oven with very high temperatures shall not lead to a critical situation in the home if communication fails).

A.3.2.2 Diagrams of use case

Diagram of use case
See detailed description of use cases

A.3.2.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.4 has been used as a basis.

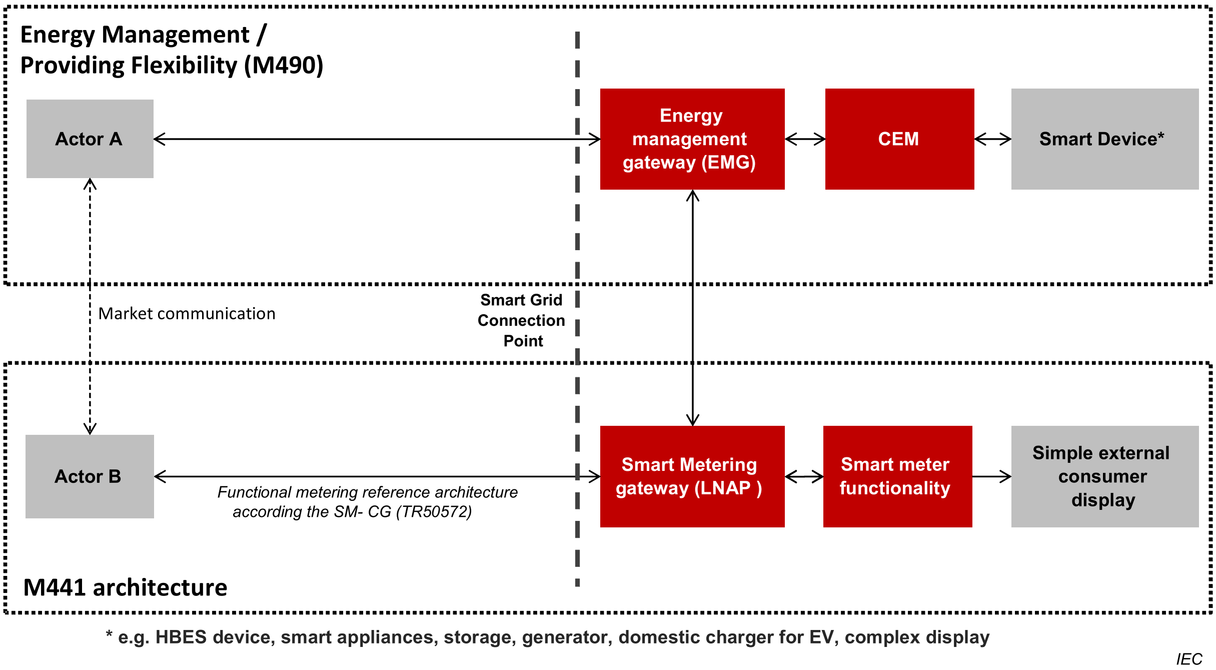


Figure A.4 – SG CG Architecture Model [9]

NOTE 2 The actors in the architecture shown in Figure A.4 are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. The following table shows involved actors.

Actors			
Grouping (Community)		Group description	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a home energy management (CEM) system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the energy provider, the energy services Provider, the aggregator, etc.	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
SD	Activation Message	SD is active and operational.	User has created or selected a profile before creating the event. SD starts negotiations with CEM based on the profile.

References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SustainableProcesses.pdf
2	Technical Report	User story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC / TC59x	-
3	Standard	Use case template	Draft (FDIS)	Template description	IEC TC8	-

Further Information on the use case for classification / mapping

Classification information
Relation to Other use cases
Level of Depth
High level use case
Prioritisation
Generic, Regional or National Relation
Generic high level use case which can be applied to any kind of smart device.
Viewpoint
This high level use case has the User perspective and the interaction of the SD with an overall customer energy management (CEM) system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further Keywords for Classification
Generic high level use case

A.3.2.4 Step by step analysis of use case

Steps – Scenario Name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

Scenario JWG1100 Flexible Start SD								
Scenario name:		**No. 1 – Flexible start time of appliance**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
1	-	Prepara-tion	User prepares SD for operation	Prepara tion	User	SD	Device Specific (Door Closed, Water tap connected, Gas burner connected, electrical heating connected, …)	
2	-	Operation mode prepara-tion	User enters settings for operational mode	Profile Genera-tion/Sel ection	User	SD	Device and Customer Specific Data	
3	Activa tion Messa ge	Operation Mode Activation	Pre-defined or manually entered setting become active on SD	Service Activa-tion	User	SD	General Device Data (Activation)	
4	SD Notifi-cation	SD informs CEM	SD sends activation profile to CEM	Notifica-tion of User request to CEM	SD	CEM	Profile	
5	Notifi-cation	Cost Calculati on	Either the CEM or the smart device calculates the expected running costs	Informa-tion delivery	SD/CEM	CEM/SD	Costs	
6	Nego-tiation	CEM/SD Negotia-tion	CEM and SD negotiate on flexible start time	Schedu-le Plan-ning	SD/CEM	CEM/SD	Device and Customer Specific Data	
7	User Infor-mation	Visualiza-tion	SD notifies the User on the schedule	Informa-tion delivery	SD	User	Profile	

A.3.2.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements to information data**
Device Specific Data (DSD)	Device specific data can be classified to each product family like dish washer, washing machine, heating unit, etc. This set of data is specific to the category of the SD. A SD might have multiple device specific data sets when combining multiple features.	Such information is sensitive in a way that any modification might change certain behaviour of a SD. That is crucial for CEM-SD negotiations. Therefore, the communication must be protected from misuse and external influences.

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements to information data**
Customer Specific Data (CSD)	The user who operates might be able to create a profile for customer specific information. Depending on the SD the data set might contain SLAs with energy providers, comfort settings, Customer habits, etc. A SD can maintain one or more customer specific data sets.	CSD contains sensitive information. Such a data set might contain SLAs and privacy relevant information. Therefore, such information must be handled with care and shall be accessible to relevant actors only. That includes, that the CEM shall not be able to access contract specific information which belong to third party service providers.
General Device Data (GDD)	Common information which is required from each SD like an ID, communication address, status information, etc. This set of data is not specific to white, brown, or consumer goods. GDD provide common standardized functionalities which are the lower limit for enabling.	Such information is sensitive in a way that any modification might turn on or off a SD. Therefore, the communication must be protected from misuse and external influences.
Energy Profile	An energy profile defines characteristics towards s specific operational mode which is applicable to the smart device. Such information can be used for power consumption but also power generation.	The energy profile does not contain sensitive data in a way that it gives indication on the used Energy for a specific operational mode.

A.3.2.6 Requirements (optional)

A.3.2.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**
Energy Profile	An energy profile defines the power consumption/generation over time. The power might vary on the smart device which will be captured and visualized by the energy profile. An energy profile might be split into multiple time slots. Such time slots have a fix amount of power to get a discrete power consumption/generation profile. A simple energy profile will contain only one power value and its duration.

A.3.2.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to section**

A.3.3 Specialized use case (JWG1101) SD informs CEM about flexible start

A.3.3.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG1101	**Domain:** Customer premises, DER **Zones:** Process, Field, Station	SD informs CEM about flexible star (specialized use case or primary use case)

Version Management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	06/01/ 2014	Editor		Initial draft	Draft
0.2	07/03/ 2014	Editor		Added use case ID	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	After a smart device was able to register at the CEM and works properly, it informs the CEM about its flexible start time.
Objective(s)	This use case defines the basic information which is required to inform the CEM on a flexible start time.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
Complete description

General remarks

General remarks

A.3.3.2 Diagrams of use case

Figure A.5 shows a diagram of use case.

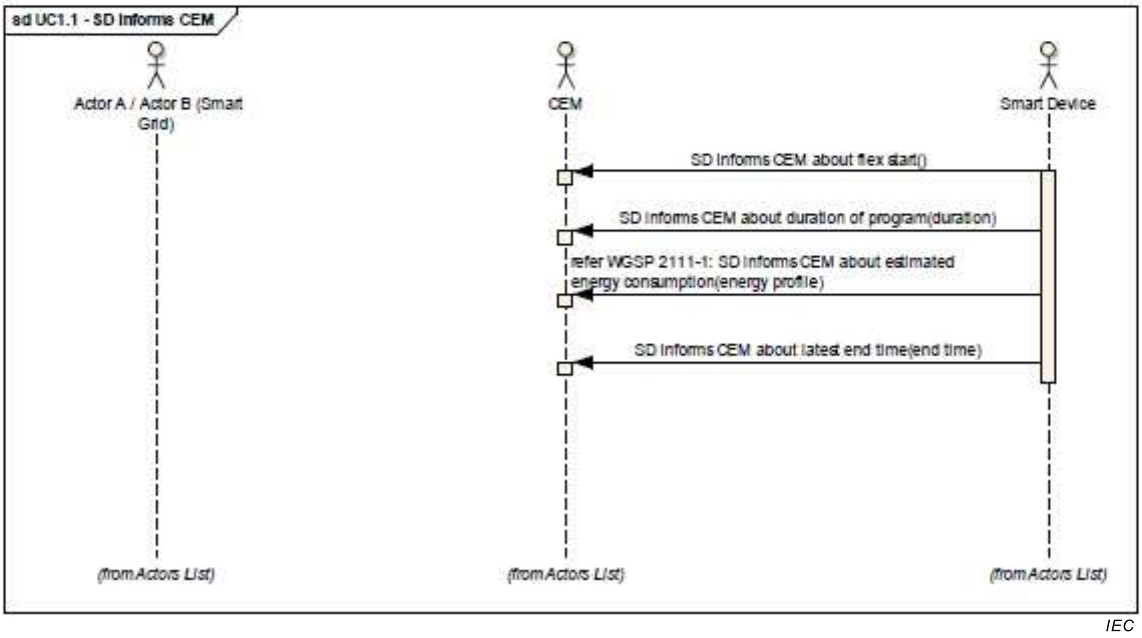
Diagram of use case


Figure A.5 – Sequence diagram

A.3.3.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.6 has been used as a basis.

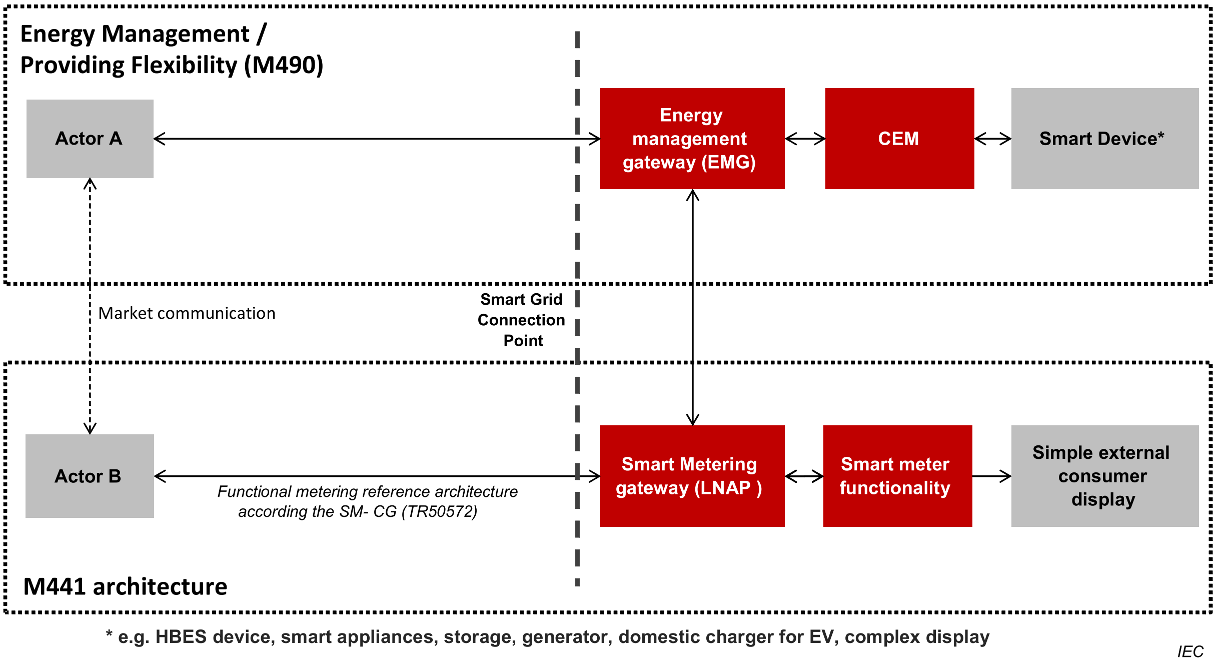


Figure A.6 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. Following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
SD	Activation Message	SD is active and operational.	User has created or selected a profile before creating the event. SD starts negotiations with CEM based on the profile.

References

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Generic use case	Additional information	Final	Additional information on Market communication	Smart Grid Coordination Group (SG-CG) Sustainable Processes WGSP2128	
3	High level use case	Direct relevance	Draft	Terms and definitions	Joint Use Case Working Group (IEC TC57 WG21/ CLC TC205 WG18 / CLC TC59x WG7)	

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
Specific level use case
Prioritisation
Generic, regional or national relation
Specific high level use case which can be applied to any kind of smart device.
Viewpoint
This specialized use case has the user perspective and the interaction of the SD with an overall customer energy management (CEM) system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Specialized use case

A.3.3.4 Step by step analysis of use case

Steps – Scenario Name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

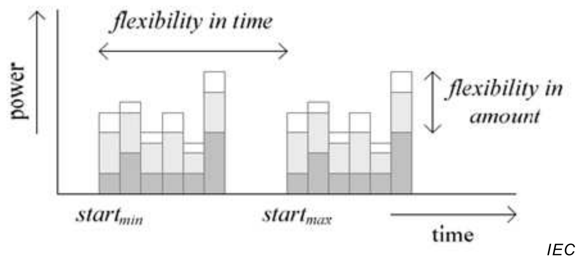
Scenario								
Scenario name:		**No. 1 – Flexible start time of appliance**						
Step No.	**Event**	**Name of process/ activity**	**Descrip-tion of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
1	Activa tion Mes-sage	Operation mode prepara-tion	The CEM or the User activate a specific operational mode on a smart device.	Prepara tion	User/CEM	SD	Device Specific (Button Pressed, Request from CEM to ask for flexibility, Timer on the SD, SD internal state change, …)	

Scenario								
Scenario name:		**No. 1 – Flexible start time of appliance**						
Step No.	**Event**	**Name of process/ activity**	**Descrip-tion of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
2	-	SD calculates its capabili-ties	There might be various possibilities depending on the state and its operational mode which must be evaluated of the SD.	Prepara tion	SD	SD	-	
3	SD Notifi cation	SD informs CEM	SD sends the information of the flexible start to the CEM.	Flexibili ty Service offering	SD	CEM	Start Time, End Time Energy Profile (estimated energy consume-tion)	

A.3.3.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements to information data**
Customer specific virtual energy counter.	Customer Specific Data (CSD)	As defined for CSD within JWG-HLUC1.1.
Customer Identification	Customer Specific Data (CSD)	As defined for CSD within JWG-HLUC1.1.
Latest possible end time	General Device Data (GDD)	As defined for GDD within JWG-HLUC1.1.
Latest possible start time	General Device Data (GDD)	As defined for GDD within JWG-HLUC1.1.
Estimated Energy Consumption	Energy Profile	As defined for the Energy Profile within JWG-HLUC1.1.

A.3.3.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**
Energy Profile	An energy profile defines the power consumption/generation over time. The power might vary on the smart device which will be captured and visualized by the energy profile. An energy profile might be split into multiple time slots. Such time slots have a fix amount of power to get a discrete power consumption/generation profile. A simple energy profile will contain only one power value and its duration. 

A.3.3.7 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.4 Specialized use case (JWG-SPUC1102) CEM informs SD about starting time

A.3.4.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG1102	**Domain**: Customer premises, DER **Zones:** Process, Field, Station	CEM informs SD about flexible start time (specialized use case or primary use case)

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of Expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	06/01/ 2014	Editor		Initial draft	Draft
0.2	07/03/ 2014	Editor		Added Use Case ID	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The CEM coordinates and calculates a best possible start time if a smart device offers flexibility. The strategy on how the optimization is not within the scope of this use case. Once a CEM has identified a suitable start time for a smart device, that information must be shared.
Objective(s)	The objective of that use case is to determine the required information exchange related to a start time delivery from CEM to SD.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
The information exchange to tell a smart device when to start has limited options. Therefore, the information exchange on the expected start time is limited to transmitting a timestamp with the corresponding.

Complete description
The smart device had sent all flexibility related information already to the CEM. The CEM coordinates with other devices and has the capability to optimize according to the user's need. The expected start time shall be enough in the future that the CEM can ensure proper operation. In case of having a CEM somewhere on the internet, delay times must be considered and fail safe operation shall not be harmed. The expected time to be transmitted might have absolute time format or relative time format. However, time synchronization is an important issue and the implementation has to take care that safety and security constraints are met.

General remarks

General remarks

A.3.4.2 Diagrams of use case

Figure A.7 shows a diagram of use case.

Diagram of use case

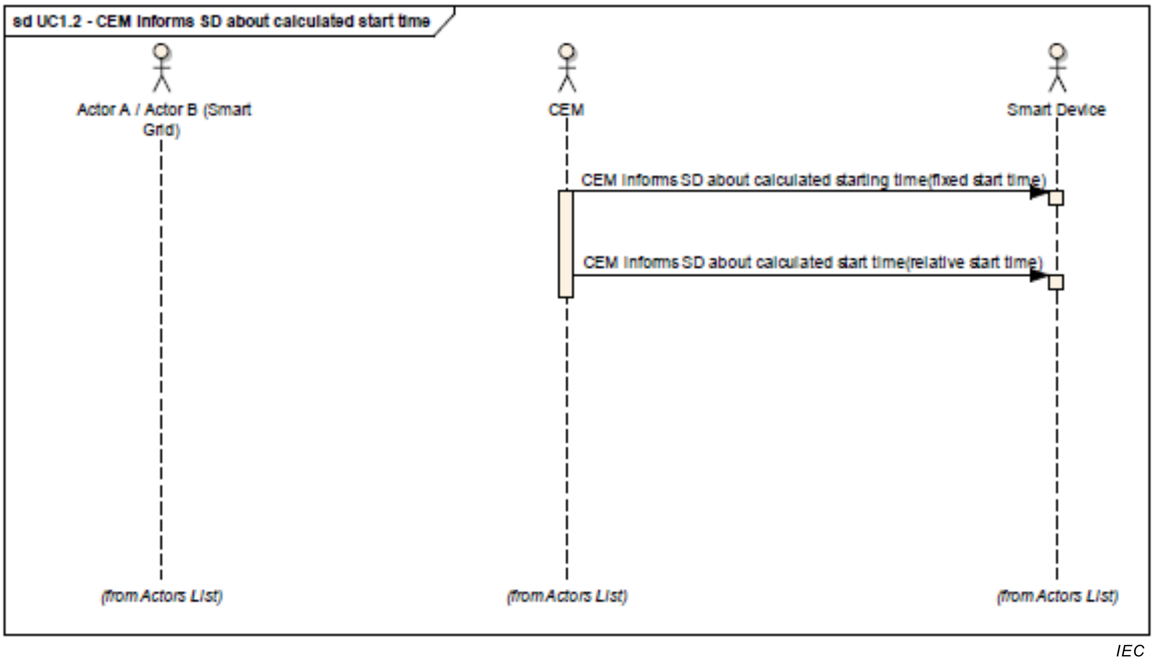


Figure A.7 – Sequence diagram

A.3.4.3 Technical details

Actors: People, Systems, Applications, Databases, the Power System, and Other Stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.8 has been used as a basis.

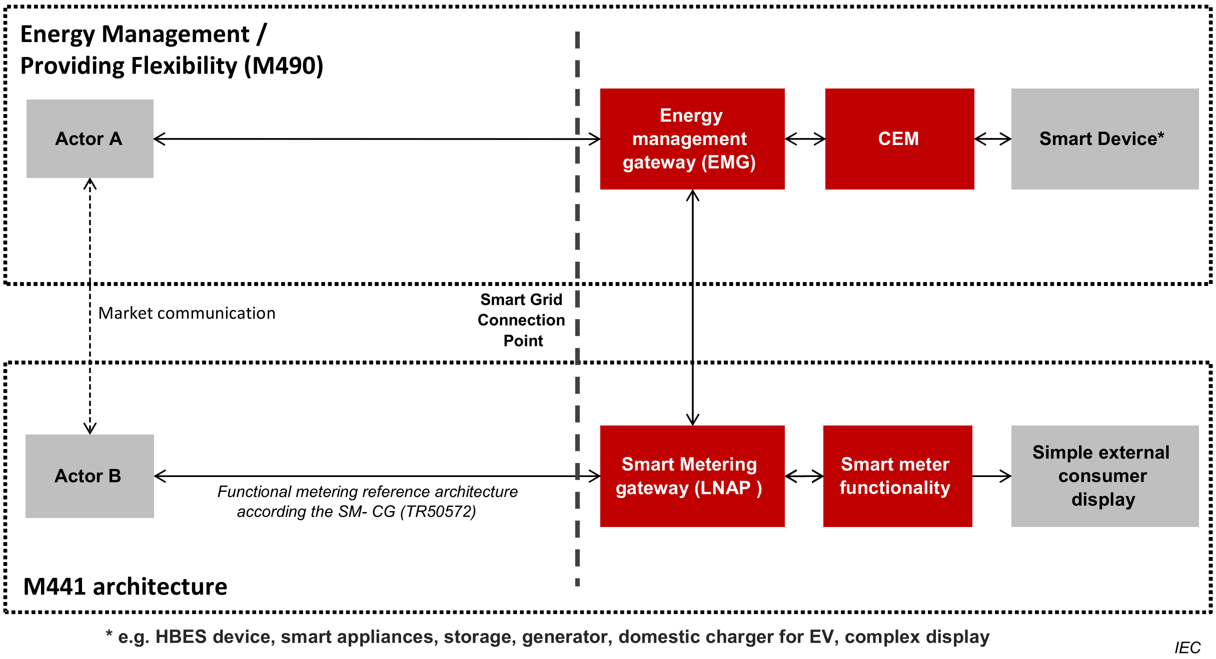


Figure A.8 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown in Figure A.8. The following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**

References

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedu-res	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Generic use case	Additional Informa-tion	Final	Additional informa-tion on Market communi-cation	Smart Grid Coordination Group (SG-CG) Sustainable Processes WGSP2128	-
3	High level use case	Direct relevance	Draft	Terms and definitions	Joint Use Case Working Group (IEC TC57 WG21/ CLC TC205 WG18 / CLC TC59x WG7)	

Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
Specific level use case
Prioritisation
Generic, regional or national relation
Specific high level use case which can be applied to any kind of smart device.
Viewpoint
This specialized use case has the User PERSPECTIVE and the interaction of the SD with an overall customer energy management (CEM) system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Specialized use case

A.3.4.4 Step by step analysis of use case

Steps – Scenario Name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

Scenario								
Scenario name:		**No. 1 – Flexible start time of appliance**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Informa-tion recei-ver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
1	Activa tion Mess age	Operation mode prepara-tion	The CEM or the User activates a specific operational mode on a smart device.	Prepara-tion	User/CEM	SD	Device Specific (Button Pressed, Request from CEM to ask for flexibility, Timer on the SD, SD internal state change, tec.)	
2	-	SD calculates its capabil-ties	There might be various possibilities depending on the state and its operational mode which must be evaluated of the SD.	Prepara-tion	SD	SD		
3	SD Notifi-cation	SD informs CEM	SD sends the information of the flexible start to the CEM.	Flexibi-lity Service offering	SD	CEM	Start Time, End Time Energy Profile (estimated energy consump-tion)	

A.3.4.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Assigned start time	General Device Data (GDD)	As defined for GDD within JWG-HLUC1100.

A.3.4.6 Common Terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.4.7 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.5 Specialized use case (JWG1103) CEM informs SD about slot shift

A.3.5.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG1101	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	CEM informs SD about slot shift by sending an updated energy profile

Version Management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertis e / domain / role**	**Title/changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Editor		Initial Draft	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	After a smart device was able to register at the CEM and works properly, it received a schedule from the CEM. The SD is configured properly and the CEM knows about it
Objective(s)	This use case defines the basic information which is required to inform the SD about a change in its running schedule. The CEM might recalculate the schedule due to whatever reason and might inform the SD on this outcome.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of Use Case

Narrative of use case
Short description
This use case shifts the running time of a smart device by updating the energy profile. The SD will the reconfigure and modify according to the information provided within the energy profile.
Complete description

Narrative of use case
The CEM receives from any external source information, which triggers a recalculation of the overall energy schedule. Triggering information can be a new selected energy optimization scheme selected by the User, updated tariff information, a demand response request from an external actor, or anything else. The overall energy schedule that the CEM manages includes all registered smart devices. Some of these devices might offer flexibility to the CEM. That capability must be available at the CEM to shuffle around power consumption at customer premises. After the CEM has estimated energy profiles for each smart device that has been registered to the CEM, it will send an update of the energy profile. The energy profile contains one or more slots which indicate a device specific running mode of each device. That specific running mode must not be known by the CEM but the power consumption shall not be exceeded. The smart device confirms the new energy profile after verifying its schedule.

General remarks

General remarks

A.3.5.2 Diagrams of use case

Diagram of use case

A.3.5.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.9 has been used as a basis.

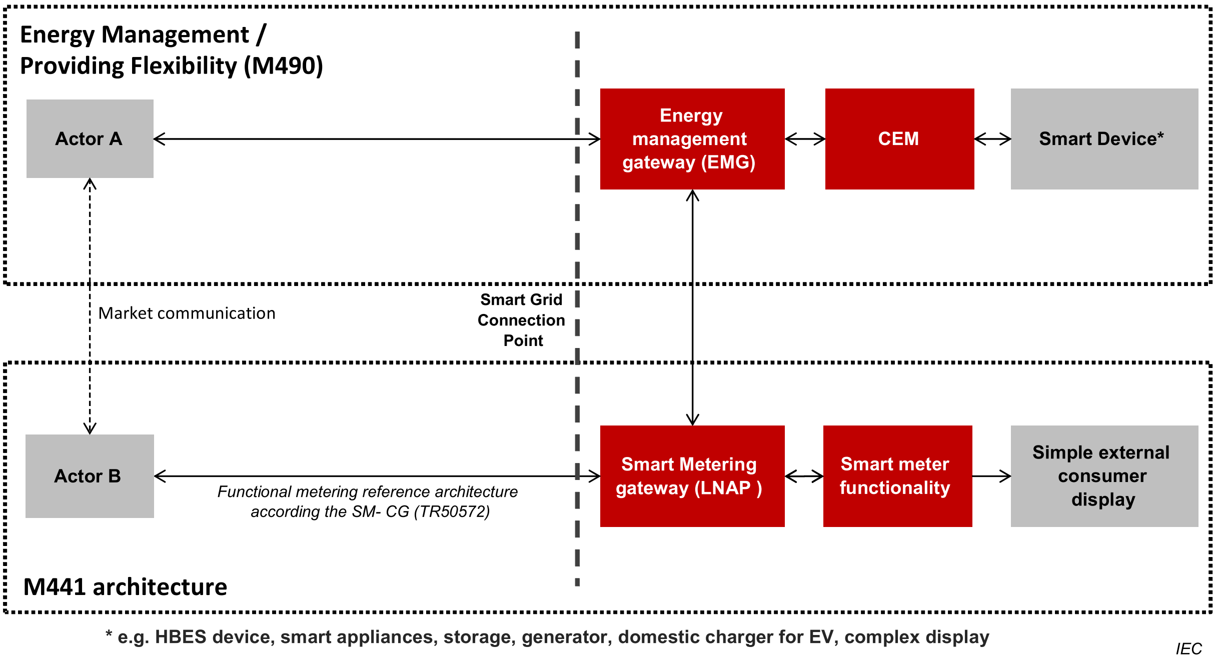


Figure A.9 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this specialized use case does not require all actors shown in Figure A.9. The following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
CEM	Rescheduling event	SD and CEM are active and operational.	User has created or selected a profile before creating the event. CEM starts negotiations with SD based on the profile.

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
2	Generic use case	Additional Information	Final	Additional informa-tion on Market communi-cation	Smart Grid Coordination Group (SG-CG) Sustainable Processes WGSP2128	-
3	High level use case	Direct relevance	Draft	Terms and definitions	Joint Use Case Working Group (IEC TC57 WG21/ CLC TC205 WG18 / CLC TC59x WG7)	

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
Specific level use case
Prioritisation
Generic, regional or national relation
Specific high level use case which can be applied to any kind of smart device.
Viewpoint
This specialized use case has the user perspective and the interaction of the SD with an overall customer energy management (CEM) system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Specialized use case

A.3.5.4 Step by step analysis of use case

Steps – Scenario Name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

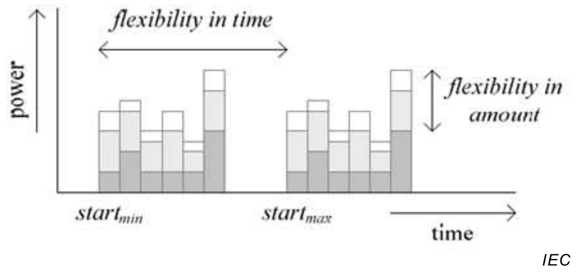
Steps – Scenarios

Scenario								
Scenario name:		No. 1 – Flexible start time of appliance						
Step No.	Event	Name of process/ activity	Description of process/ activity	Service	Informa-tion producer (Actor)	Informa-tion receiver (Actor)	Informa-tion exchanged	Require-ments, R-ID
1	Activa-tion Message	Recalcu-lation of an operatio-nal schedule	The CEM received an event on which it recalculates an optimal schedule for the smart devices that are registered to the CEM.	Preparation	User/Actor A/Actor B/SD	CEM	Device Specific (Button Pressed, DR event coming from the Grid, Tariff information, emergency signal,…)	
2	Upda-te	CEM send an updated schedule to the SD	The updated schedule is included in the energy profile.	Update Request	CEM	SD	-	
3	Confirmation	SD confirms new schedule	Since the CEM knows about the flexibility of the SD, the new proposed energy profile shall be accepted by the SD.	Confir-mation	SD	CEM	Confirmed Energy Profile (estimated energy consumption, slots, etc.)	

A.3.5.5 Information exchanged

Information Exchanged		
Name of information (ID)	Description of information exchanged	Requirements for information data
Updated Energy Profile	Energy Profile	As defined for the Energy Profile within JWG1100.

A.3.5.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**
Energy Profile	An energy profile defines the power consumption/generation over time. The power might vary on the smart device which will be captured and visualized by the energy profile. An energy profile might be split into multiple time slots. Such time slots have a fix amount of power to get a discrete power consumption/generation profile. A simple energy profile will contain only one power value and its duration. 

A.3.5.7 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.6 Specialized use case (JWG1110) Control of Smart home appliances based on price information by time slot

A.3.6.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG1110	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Control of Smart home appliances based on price information by time slot

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Home Appliances	Use Cases	Initial Draft	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	With proper management/instruction by CEM, Device such as water heater, air conditioner and other appliances can act smart. Smart device which reacts to some limited simple commands and messages or device which equips sophisticated thermostat, adopter (e.g. on/off tap) etc. fall within the scope of this use case.
Objective(s)	This use case defines the basic Message which is required to manage devices by CEM such that total electricity charges are relatively less.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
• The user inputs operating conditions of each appliance at CEM. • The electricity tariff information is issued at noon every day for the following 24 hours. • Based on the input conditions, time conditions and tariff, the user lets CEM calculate a program for the following day such that total electricity charges are relatively less • CEM controls each appliance as programmed according to conditions of operating plan
Complete description
The user likes to use a water heater, air conditioner and other appliances such that total electricity charges are relatively less. • The user instructs the CEM to program the water heater, air conditioner and other appliances following a number of conditions • The user inputs operating conditions of each appliance at CEM, e.g.: – Water heater temperature 90 °C, water level 50 % – Air conditioner mode: cooling down, wind: auto, temperature: 27 °C • The user inputs time conditions (desirable start time, desirable finish time) of each appliance at CEM, e.g.: – Water heater finish by AM7 – Air conditioner finish cooling down by AM10 • The electricity tariff information is issued at noon every day for the following 24 hours • Based on the input conditions, time conditions and tariff, the user lets CEM calculate a program for the following day such that total electricity charges are relatively less • CEM calculates an operating plan for those appliances considering operation time, power consumption during operation, electricity charges and so forth • The user confirms the calculation results and commits the operating plan to be executed – CEM controls each appliance as programmed according to conditions of operating plan

General remarks

General remarks

A.3.6.2 Diagram of use case

Figure A.10 shows a diagram of use case.

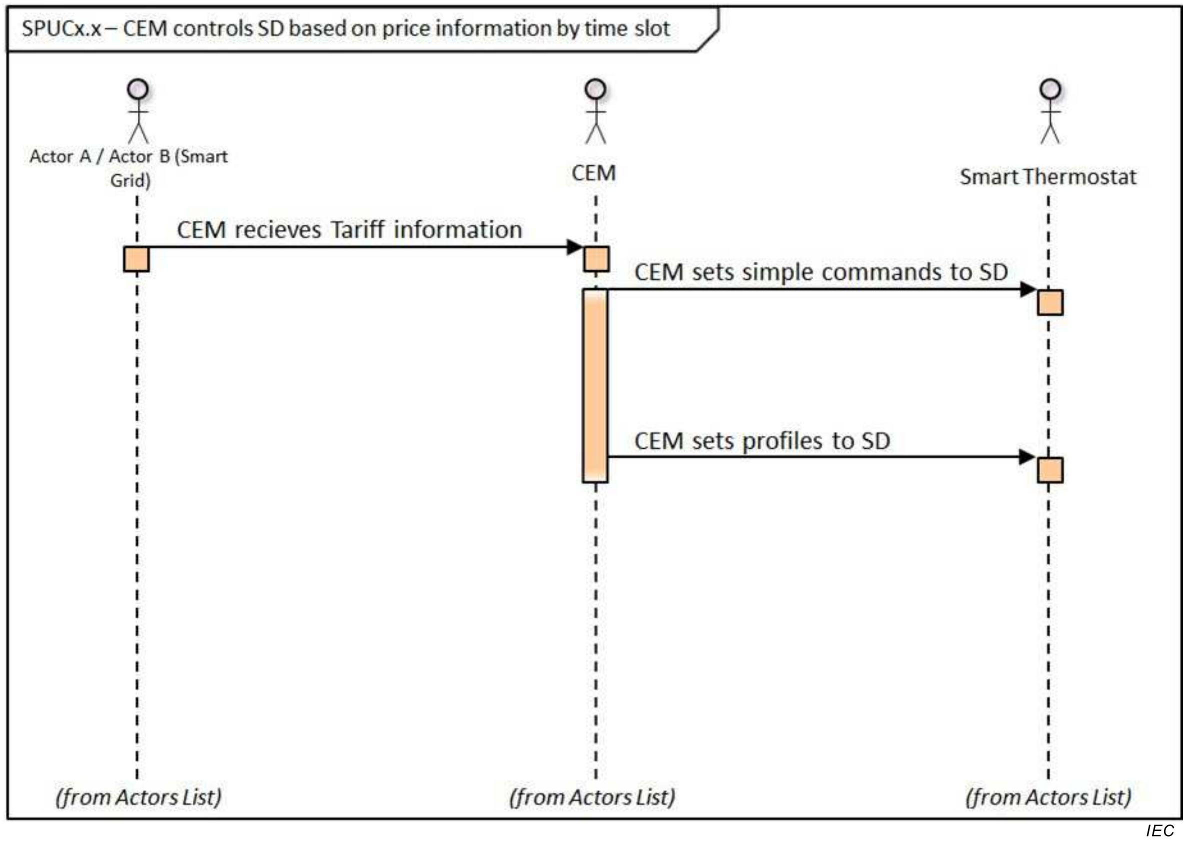
Diagram of use case


Figure A.10 – Sequence diagram

A.3.6.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture given in Figure A.11 has been used as a basis.

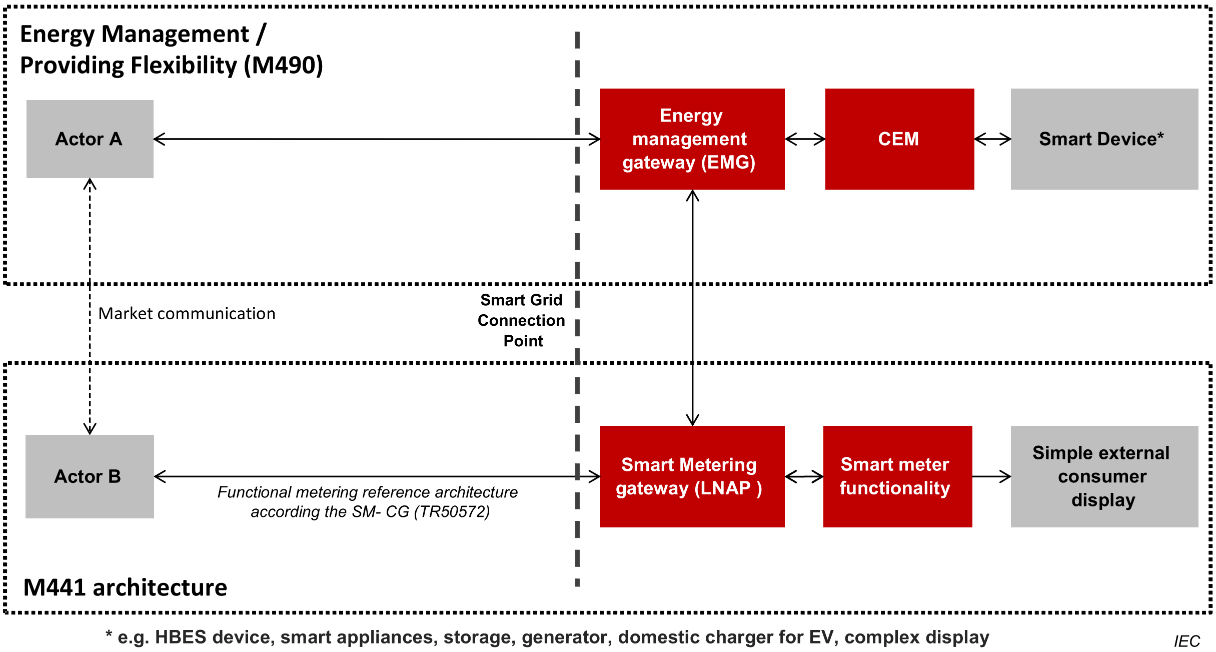


Figure A.11 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. The following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Smart Thermostat	External	Using a Smart or programmable thermostat, one can adjust the temperature settings or the times turn on the heating or air-conditioning according to a pre-set schedule. Smart or programmable thermostats can store and repeat multiple daily settings (six or more temperature settings a day) that one can manually override without affecting the rest of the daily or weekly program. One can access it via the web using your tablet, smart phone or computer. The Smart Thermostat can be a device which is connected to the CEM and is programmed its settings from the CEM.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc.)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system. The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc.	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	Tariff Information.		CEM controls each appliance as programmed according to conditions of operating plan or CEM controls appliance by setting profile (e.g. temperature profile, Timer) defined according to conditions of operating plan

References

References						
No.	**Referen-ces Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedu-res	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template descrip-tion	IEC TC8	-

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
High level use case
Prioritisation
Generic, regional or national relation
High level use case which can be applied to any kind of smart device. Once the regions agreed and confirmed correctness, that high level use case becomes a generic use case.
Viewpoint
This high level use case has the user perspective and the interaction of the SD with an overall customer energy management (CEM) system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Generic high level use case

A.3.6.4 Step by step analysis of use case

Steps – Scenario Name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

Scenario								
Scenario name:		**No. 1 – Flexible start time of appliance**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**

Scenario								
Scenario name:		**No. 1 – Flexible start time of appliance**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	Issued at noon every day	Tariff information	The CEM receives Tariff information.	Preparation	External Actor	CEM	Tariff	
2		User preference	The user inputs operating conditions of SD	Preparation	User/CEM	CEM/User		
3	-	CEM calculates an operating plan	The CEM calculates an operating plan based on the Tariff information and User input	Preparation	CEM	CEM	-	
3	CEM Notification	CEM sets profile to SD	CEM sets the simple command or profile (e.g. temperature profile) to SD	Simple SD management	CEM	SD	Set On/Off/Start/Stop/Pause/Resume/Abort/Dim Set Profile	

A.3.6.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Simple Commands	On/Off/Start/Stop/Pause/Resume/Abort/Dim Timer Air conditioner mode: cooling down, heating up, mode 1-n Wind: auto, high, low, etc. Other settings:	Such information is sensitive in a way that any modification might turn on or off a SD. Therefore, the communication data must be protected from misuse and external influences.
Temperature Profile	A temperature profile defines the temperature set point over time (e.g. set point of each room temperature). A temperature profile might be split into multiple time slots. Such time slots have a fix amount of temperature to set a discrete temperature profile. A simple temperature profile will contain only one temperature value and its duration and there might be weekly temperature profiles each of which contains weekdays (Monday to Friday) / weekend profile.	Temperature Profile is sensitive in a way that any modification might affect drastic room temperature change. Therefore, the communication data must be protected from misuse and external influences.

A.3.6.6 Requirements (optional)

A.3.6.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**
Temperature Profile	A temperature profile defines the temperature set point over time (e.g. set point of each room temperature). A temperature profile might be split into multiple time slots. Such time slots have a fix amount of temperature to set a discrete temperature profile. A simple temperature profile will contain only one temperature value and its duration and there might be weekly temperature profiles each of which contains weekdays (Monday to Friday) / weekend profile.

A.3.6.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.7 High level use case (JWG1111) fuel cell operation with fixed tariff profile

A.3.7.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG1111	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Control of Fuel Cell (FC) operation according to a fixed tariff schedule (profile).

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Home Applian-ces	Use Cases	Initial Draft	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	This use case describes the control of a fuel cell by a customer Energy Management (CEM) System based upon tariff schedule (a profile of price for a given set of intervals) information received from an Energy Supplier. The objective is to minimise the amount of electrical energy imported from the grid.

Objective(s)	Optimum operation (for energy efficiency and minimising carbon emissions) requires knowledge of forecast pricing for future tariff intervals, building characteristics (e.g. thermal mass), current conditions (e.g. temperature) and the occupant's desired system behaviour (e.g. future temperature profile). This may be considered in other compound/elaborated used cases.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

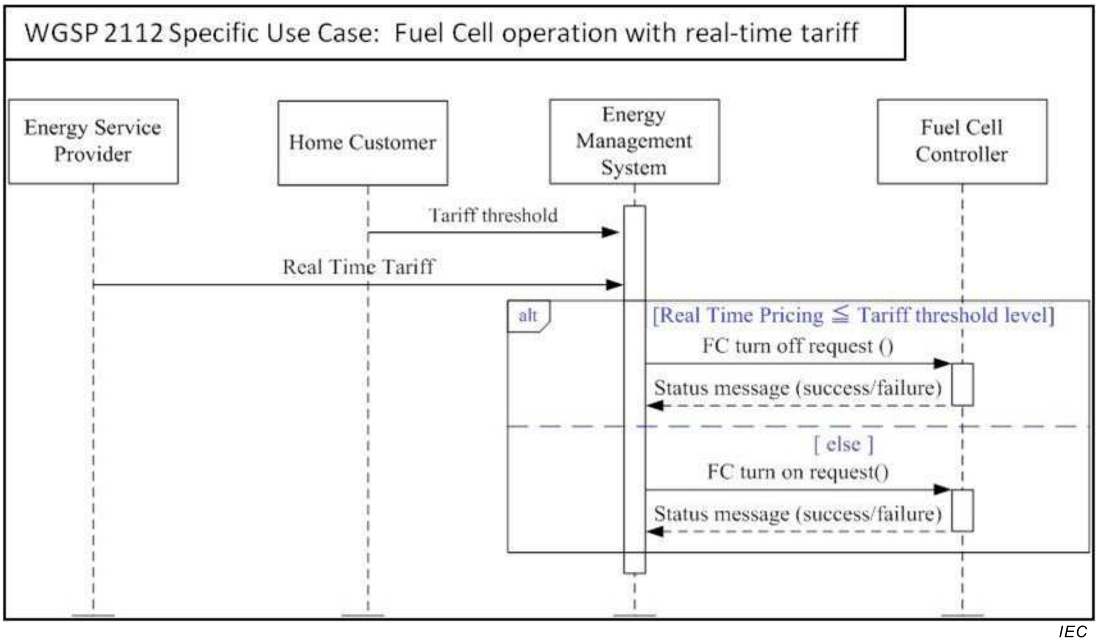
Narrative of use case

Narrative of use case
Short description
This use case describes the control of a domestic fuel cell by a Customer Energy Management (CEM) System based upon tariff schedule (a profile of price for a given set of intervals) information received from an Energy Supplier. The EMS requests the fuel to turn on/increase output or turn off/decrease output depending upon both the tariff schedule information received from the Energy Supplier and a tariff (price) threshold set by the Home Customer.
Complete description
This use case assumes that the EMS receives tariff schedule (a profile of price for a given set of intervals) information from the Energy Supplier. In this use case, an EMS sends requests to, and receives notifications from, a Fuel Cell Controller. The fuel cell controller has responsibility for controlling the operation of the Fuel Cell sub-system and may override the requests from the EMS if necessary. This use case assumes that the Home Customer has set a threshold for the real-time tariff (price) value, above which the fuel cell will normally be turned on. The Home Customer's EMS receives tariff schedule information from the energy supplier. The tariff schedule may be valid for a given period or until a new tariff schedule is provided. If the price of that interval exceeds the threshold, then at the beginning of that interval the EMS controller sends a fuel cell turn on request or a fuel cell increase output by x Watt request to the Fuel Cell Controller in order to turn on the Fuel Cell, or to increase the Fuel Cell output, for that interval. The Fuel Cell Controller sends a status message to the EMS controller in order to indicate that the command has been successfully implemented or not. If the price for an interval is below or equal to the threshold set by the Home Customer, then at the beginning of that interval the EMS controller sends a fuel cell turn off request or a fuel cell decrease output by y Watt request to the Fuel Cell Controller in order to turn off the Fuel Cell, or to decrease the Fuel Cell output, for that interval. The Fuel Cell Controller sends a status message to the EMS controller in order to indicate that the command has been successfully implemented or not.

General remarks

General remarks

A.3.7.2 Diagram of use case

Diagram of use case


A.3.7.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.12 has been used as a basis.

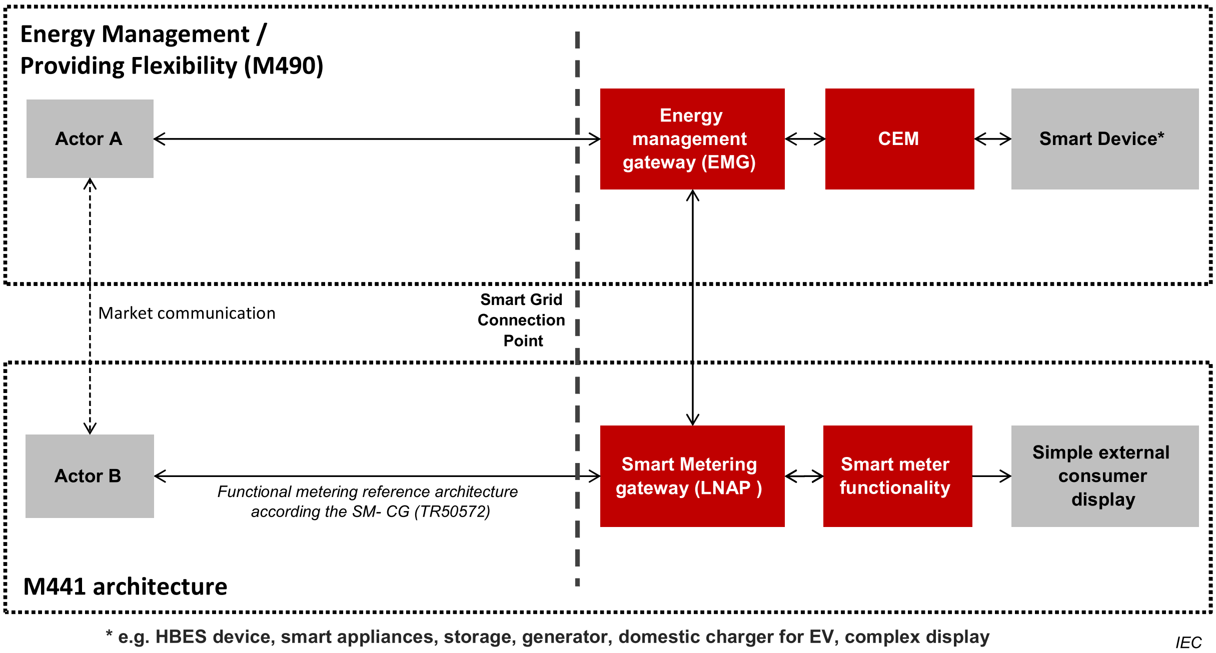


Figure A.12 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. Following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Smart Thermostat	External	Using a Smart or programmable thermostat, one can adjust the temperature settings or the times turn on the heating or air-conditioning according to a pre-set schedule. Smart or programmable thermostats can store and repeat multiple daily settings (six or more temperature settings a day) that one can manually override without affecting the rest of the daily or weekly program. One can access it via the web using your tablet, smart phone or computer. The Smart Thermostat can be a device which is connected to the CEM and is programmed its settings from the CEM.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc.	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information /Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	Tariff Information.		CEM controls each appliance as programmed according to conditions of operating plan or CEM controls appliance by setting profile (e.g. temperature profile, Timer) defined according to conditions of operating plan

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template description	IEC TC8	-

Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
High level use case
Prioritisation
Generic, regional or national relation
High level use case which can be applied to any kind of smart device. Once the regions agreed and confirmed correctness, that high level use case becomes a generic use case.
Viewpoint
This high level use case has the User perspective and the interaction of the SD with an overall customer energy management system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Generic high level use case

A.3.7.4 Step by step analysis of use case

Steps – Scenario name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

Scenario								
Scenario name:		No. 1 – Flexible start time of appliance						
Step No.	Event	Name of process/ Activity	Description of process/ Activity	Service	Informa-tion producer (Actor)	Informa-tion receiver (Actor)	Information exchanged	Require-ments, R-ID
1	Issued at noon every day	Tariff informa-tion	The CEM receives Tariff information.	Flexible Tariff	External Actor	CEM	Tariff	
2	-	Calculate schedule for smart device	Calculate the optimal running time for the smart device	Prepara tion	CEM	CEM		
3	New comm and for SD availa ble	Turn on/off smart device	The CEM send a command to the SD to turn it on/off/pause /etc.	Respon se to new tariff signal	CEM	SD	Set On/Off/Start /Stop/Pause /Resume/Ab ort/Dim Set Profile	
3	-	SD confirms command	The SD confirms the command by responding accordingly	Confir-mation	SD	CEM	-	

A.3.7.5 Information exchanged

Information exchanged		
Name of information (ID)	Description of information exchanged	Requirements for information data
Simple Commands	On/Off/Start/Stop/Pause/Resume/Abort/Dim Timer Air conditioner mode: cooling down, heating up, mode 1-n Wind: auto, high, low, etc. Other settings:	Such information is sensitive in a way that any modification might turn on or off a SD Therefore, the communication data must be protected from misuse and external influences.
Tariff Information	Tariff information might be split into multiple time slots. Such time slots have a fix value for a certain period of time to set a discrete profile. A simple temperature profile will contain only one temperature value and its duration and there might be weekly temperature profiles each of which contains weekdays (Monday to Friday) / weekend profile.	Temperature Profile is sensitive in a way that any modification might affect drastic room temperature change. Therefore, the communication data must be protected from misuse and external influences.

A.3.7.6 Requirements (optional)

A.3.7.7 Common terms and definitions

Common terms and definitions	
Term	Definition

A.3.7.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.8 High level use case (JWG112x) manage mixed energy system like heat pumps with pv, storage battery

A.3.8.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG112x	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Use cases that have various energy related devices like heat pumps and energy storage (taken from TR 62746-2 version 0.5.1).

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of exper-tise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Home Appliances	Use Cases	Initial Draft (taken from TR 62746-2 version 0.5.1)	Draft
0.2	17/12/ 2014	Home Appliances	Use Case	Added a comment to the “General Remarks Section” based on the discussion of the WS in September 2014.	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	With proper management/instruction by CEM, devices such as water heater, air conditioner and other appliances can act smart. Smart devices which react to some limited simple commands and messages or devices which equip sophisticated thermostat, adopter (e.g. on/off tap) etc. fall within the scope of this use case.
Objective(s)	This use case defines the basic information exchange which is required to heat up the water using a heat pump.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
This use case describes the operation of the Heat pump controller in different scenarios.
Complete description
JWG1121 – Request for extra hot water using a heat pump The Customer has the request to turn on the heat pump for heating up water. As long there is no emergency situation the customer overrules an existing configuration if active. Therefore, the user interface forwards the request to the CEM which then informs the heat pump controller. The heat pump controller activates the hot water generation and informs the CEM accordingly. **JWG1122 – Request for extra hot water using a heat pump and storage battery** This use case describes the operation of the Heat Pump, EMS and Storage Battery controllers when the customer requests additional hot water in an ad hoc manner (not a scheduled operation).The Heat Pump controller initiates operation of the heat pump to heat water and broadcasts its operation status. The EMS receives this information and requests the Storage Battery controller to initiate storage battery discharge. **JWG1123 – Request for extra hot water using a heat pump and storage battery** This use case describes the operation of the Heat Pump, EMS and Storage Battery controllers when the customer requests additional hot water in an ad hoc manner (not a scheduled operation).The Heat Pump controller initiates operation of the heat pump to heat water and broadcasts its operation status. The EMS receives this information and requests the Storage Battery controller to initiate storage battery discharge. **JWG1124 – Heat Pump Operation with Real-Time Tariff** This use case describes the control of a domestic heat pump by a Customer Energy Management (CEM) System based upon real time tariff (price) information received from an Energy Supplier. The EMS requests the heat pump to either turn on/increase operating power or turn off/decrease operating power depending upon both real time tariff (price) information received from the Energy Supplier and a tariff (price) threshold set by the Home Customer. **JWG1125 – Heat pump and Photovoltaic Operation with Real-Time Tariff** This use case describes the control of a domestic heat pump by a Customer Energy Management (CEM) System based upon real time tariff (price) information received from an Energy Supplier, when a Photovoltaic (PV) system is in operation. The EMS requests the heat pump to turn on or turn off depending upon both real time tariff (price) information received from the Energy Supplier and a tariff (price) threshold set by the Home Customer. The operation of the PV system does not affect the interaction of the EMS and Heat Pump Controller.

General remarks

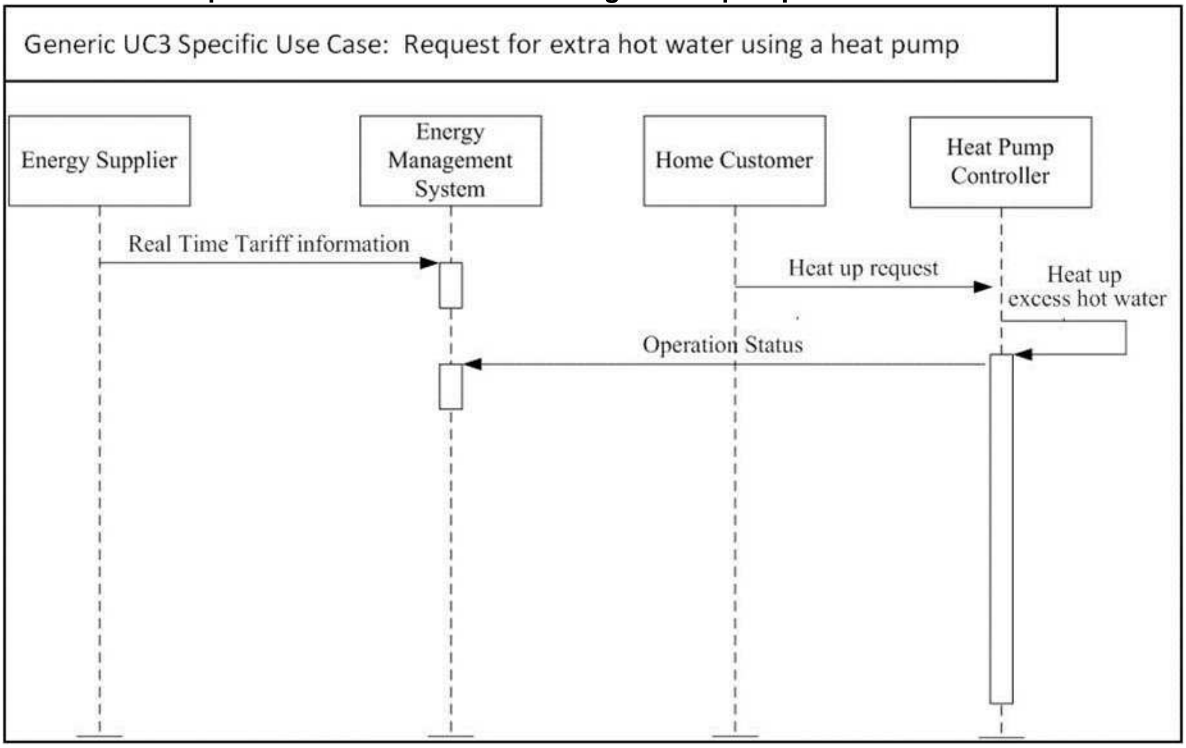
General remarks
The heat-pump, storage battery, and the hot water tank are placeholders only for a smart device. The use case gives some more explanation on the capabilities of these specific devices but in general it might be also extended to combined heat-power systems (CHP) and others as well.

A.3.8.2 Diagrams of use case

Figure A.13 shows diagrams of use case.

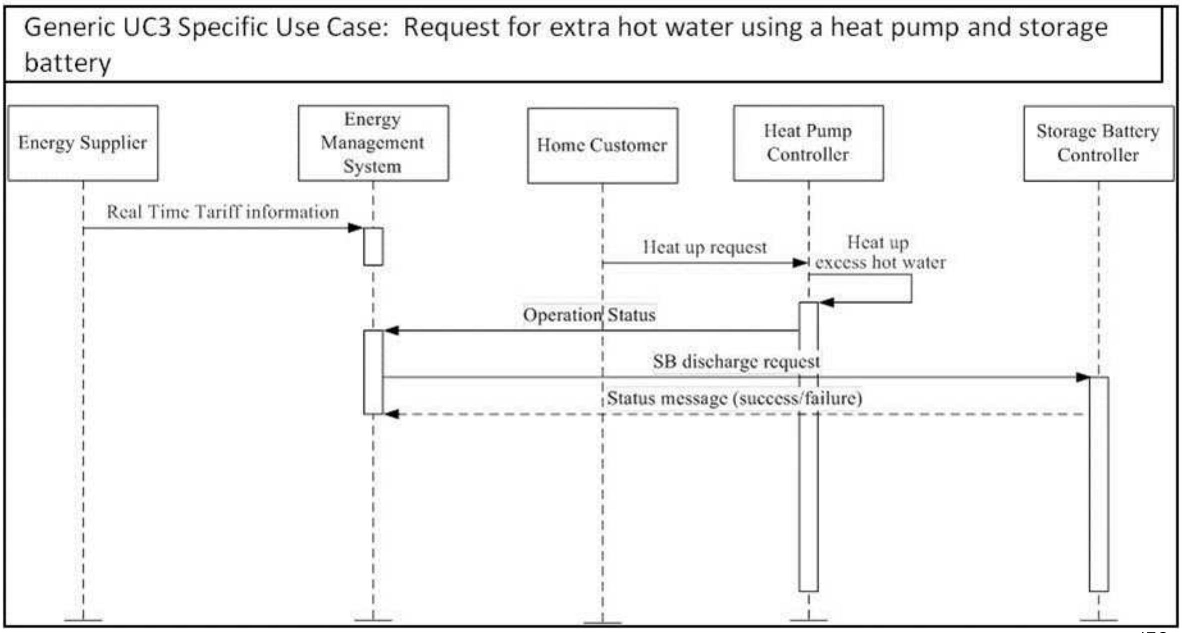
Diagram of use case

JWG1121 – Request for extra hot water using a heat pump



IEC

JWG1122 – Request for extra hot water using a heat pump and storage battery



IEC

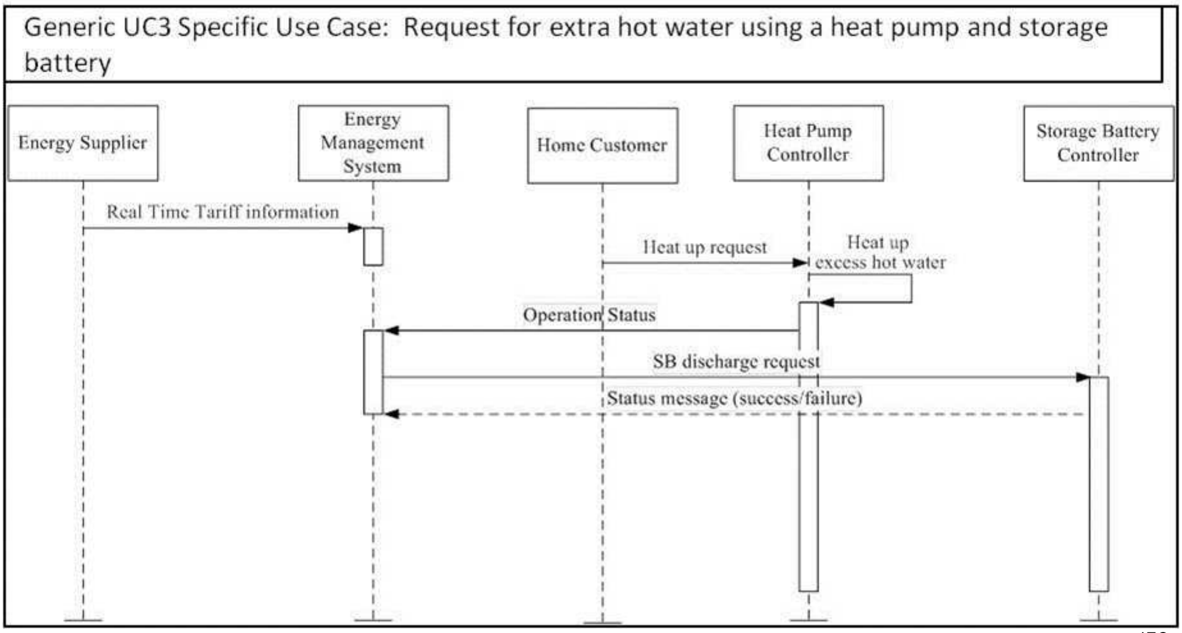
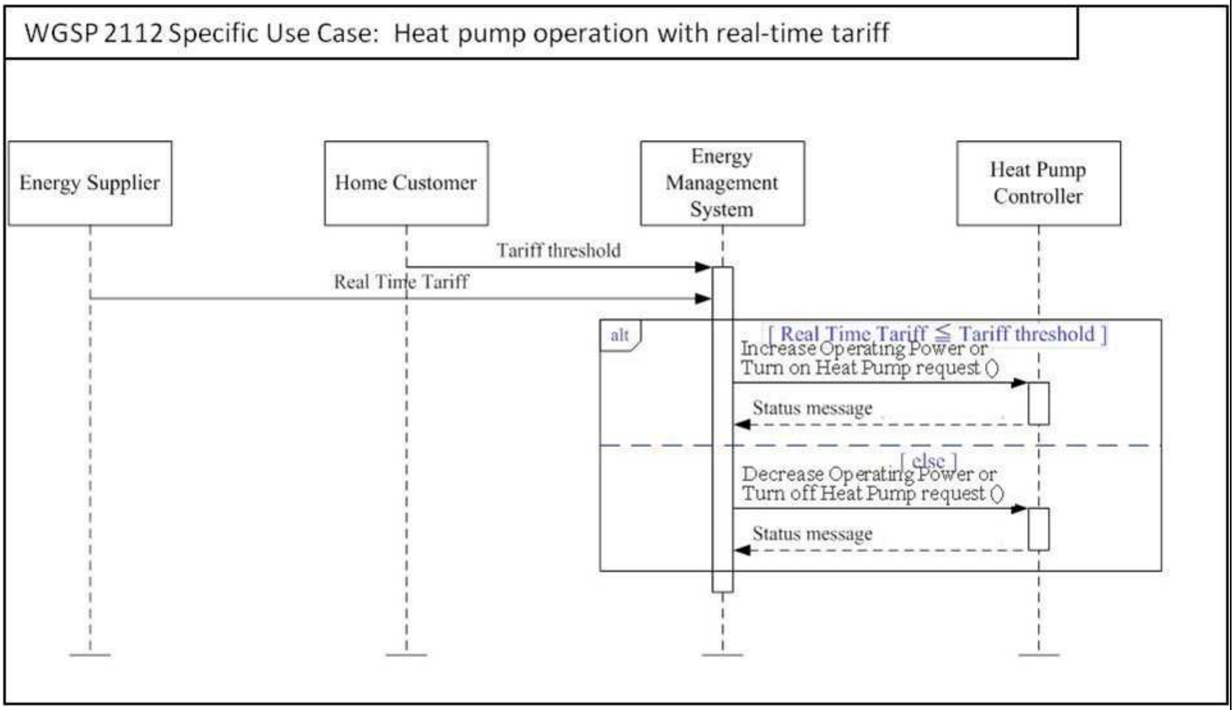
Diagram of use case
JWG1123 – Request for extra hot water using a heat pump and storage battery  IEC
JWG1124 – Heat Pump Operation with Real-Time Tariff  IEC

Diagram of use case
JWG1125 – Heat pump and photovoltaic operation with real-time tariff

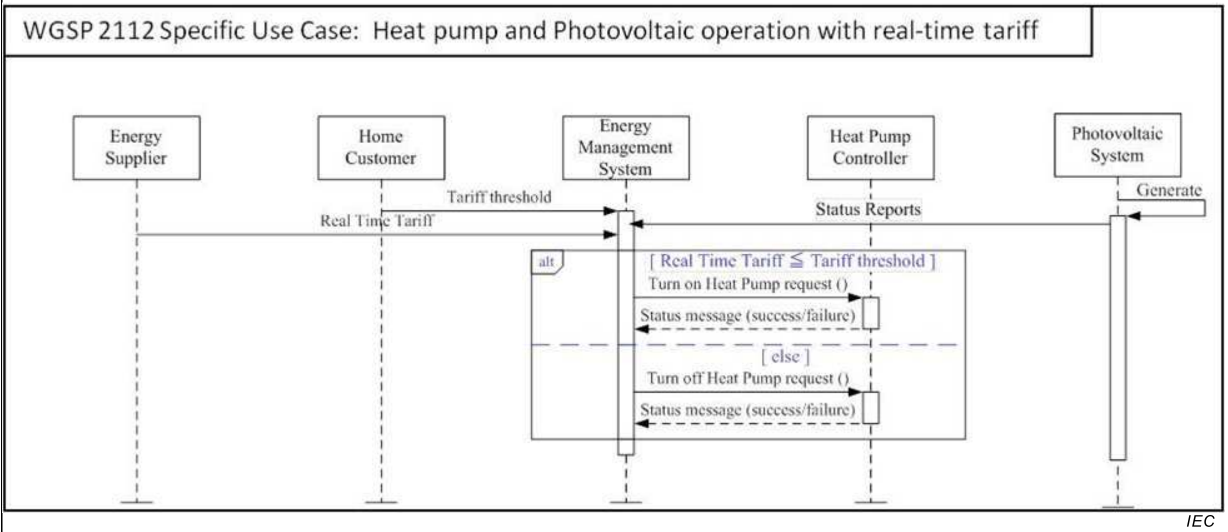


Figure A.13 – Sequence Diagram

A.3.8.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.14 has been used as a basis.

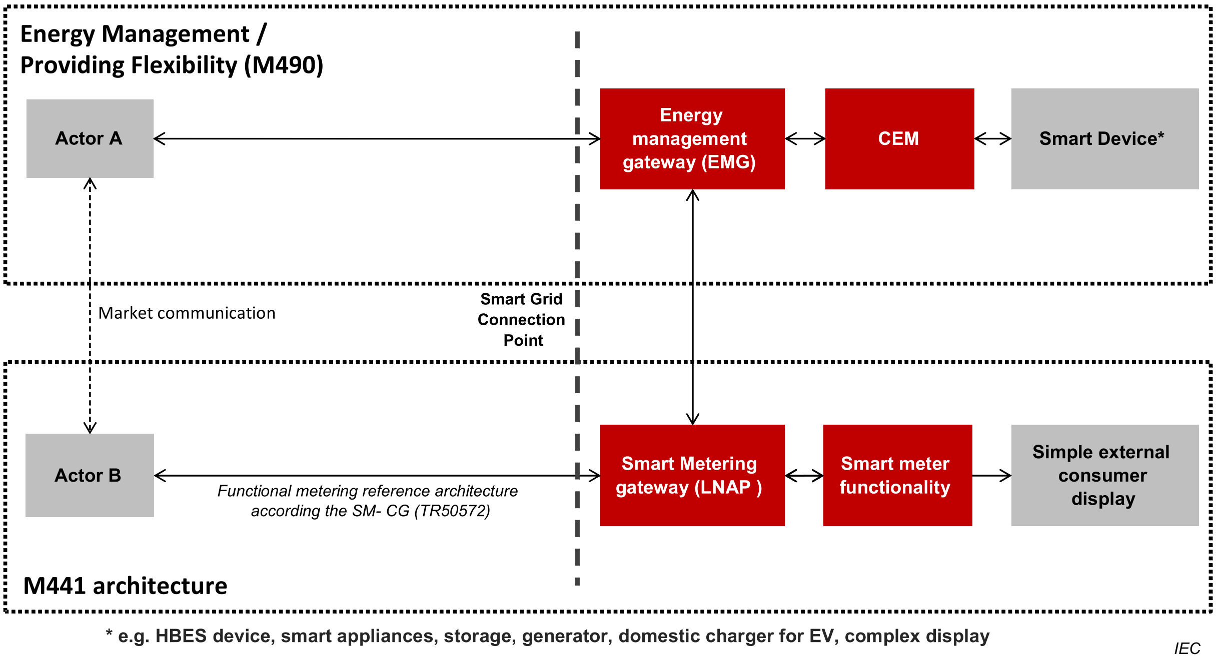


Figure A.14 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. Following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Smart Thermostat	External	Using a Smart or programmable thermostat, one can adjust the temperature settings or the times turn on the heating or air-conditioning according to a pre-set schedule. Smart or programmable thermostats can store and repeat multiple daily settings (six or more temperature settings a day) that one can manually override without affecting the rest of the daily or weekly program. One can access it via the web using your tablet, smart phone or computer. The Smart Thermostat can be a device which is connected to the CEM and is programmed its settings from the CEM.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc.	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	Tariff Information.		CEM controls each appliance as programmed according to conditions of operating plan or CEM controls appliance by setting profile (e.g. temperature profile, Timer) defined according to conditions of operating plan

References

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedu-res	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template description	IEC TC8	-

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
High level use case
Prioritisation
Generic, regional or national relation
High level use case which can be applied to any kind of smart device. Once the regions agreed and confirmed correctness, that high level use case becomes a generic use case.
Viewpoint
This high level use case has the user perspective and the interaction of the SD with an overall customer energy management system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Generic high level use case

A.3.8.4 Step by step analysis of use case

Steps – Scenario name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

A.3.8.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Simple Commands	On/Off/Start/Stop/Pause/Resume/Abort/Dim Timer Air conditioner mode: cooling down, heating up, mode 1-n Wind: auto, high, low, etc. Other settings:	Such information is sensitive in a way that any modification might turn on or off a SD Therefore, the communication data must be protected from misuse and external influences.
Temperature Profile	A temperature profile defines the temperature set point over time (e.g. set point of each room temperature). A temperature profile might be split into multiple time slots. Such time slots have a fix amount of temperature to set a discrete temperature profile. A simple temperature profile will contain only one temperature value and its duration and there might be weekly temperature profiles each of which contains weekdays (Monday to Friday) / weekend profile.	Temperature Profile is sensitive in a way that any modification might affect drastic room temperature change. Therefore, the communication data must be protected from misuse and external influences.
Tariff Information	An external actor send some tariff information to the CEM which then further processes this information.	

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Storage Battery Commands	The storage battery system can feed in power to the local power network or can be charged. That information must be exchanged between the CEM and the SD.	

A.3.8.6 Requirements (optional)

A.3.8.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.8.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.9 High level use case (JWG113x) log mixed energy system events of heat pumps with pv, storage battery

A.3.9.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG113x	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Show status and system events of various energy related devices like heat pumps and energy storage (taken from IEC TR 62746-2).

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Home Appliances	Use Cases	Initial Draft (taken from IEC TR 62746-2)	Draft
0.2	17/12/, 2014	Home Appliances	Use Cases	Changed the description and corrected copy&paste mistakes from JWG113x	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	With proper management/instruction by CEM, Devices such as water heater, air conditioner and other appliances can act Smart. Events might cause state changes and system behavior might depend on direct interaction. This use case describes different scenarios for system logging.
Objective(s)	This use case defines the basic information exchange which is required to track events and system changes for various needs.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
This use case describes various logging and status, event capturing scenarios.
Complete description
JWG1131 – Display status and log information: Storage Battery This use case describes the request for status and logged information from the customer EMS controller to a storage battery controller and the display of the received information. The EMS controller requests status or log information from the Storage Battery Controller. After the information is received from the Storage Battery controller it is displayed by the EMS controller. Log information may include measured cumulative charge/discharge electric power (Wh) and history of momentarily measured charge/discharge electric power (W), current (A), voltage (V) etc. Status information may include cumulative charge/discharge electric power (Wh), remaining electric power (kWh, %) and momentary charge/discharge electric power (W), current (A), voltage (V), etc. **JWG1132 – Display status and log information: Heat Pump** This use case describes the request for status and logged information from the customer EMS controller to a heat pump controller and the display of the received information. The EMS controller requests status or log information from the heat pump controller. After the information is received from the heat pump controller it is displayed by the EMS controller. Log information may include measured cumulative power consumption (Wh) and history of momentarily measured hot water temperature (C), hot water remaining value (l), electric power (W) etc. Status information may include momentary hot water temperature (C), hot water remaining value (l), electric power (W)) to the Customer EMS Controller etc. **JWG1133 – Display status and log information: Fuel Cell** This use case describes the request for status and logged information from the customer EMS controller to a fuel cell controller and the display of the received information. The EMS controller requests status or log information from the fuel cell controller. After the information is received from the fuel cell controller it is displayed by the EMS controller. Log information may include measured cumulative generated electric power (Wh), measured momentary gas consumption (m3), measured cumulative gas consumption (m3) and history of momentarily measured hot water temperature (C), heat quantity in the water tank (MJ), hot water remaining value (L), generated electric power (W) Status information may include momentary hot water temperature (C), heat quantity in the water tank (MJ), hot water remaining value (L), generated electric power (W), measured cumulative generated electric power (Wh), measured momentary gas consumption (m3), measured cumulative gas consumption (m3). **JWG1134 – Display status and log information: Photovoltaic** This use case describes the request for status and logged information from the customer EMS controller to a PV controller and the display of the received information. The EMS controller requests status or log information from the PV controller. After the information is received from the PV controller it is displayed by the EMS controller. Log information may include measured cumulative generated power (Wh), measured cumulative exported power (Wh) and history of momentarily measured generated power (W), measured momentary exported power (W) etc. Status information may include momentary generated power (W), momentary exported power (W), measured cumulative generated power (Wh), measured cumulative exported power (Wh) etc.

General remarks

General remarks

A.3.9.2 Diagrams of use case

Figure A.15 shows diagrams of use case.

Diagram of use case

JWG1131 – Display status and log information: Storage battery

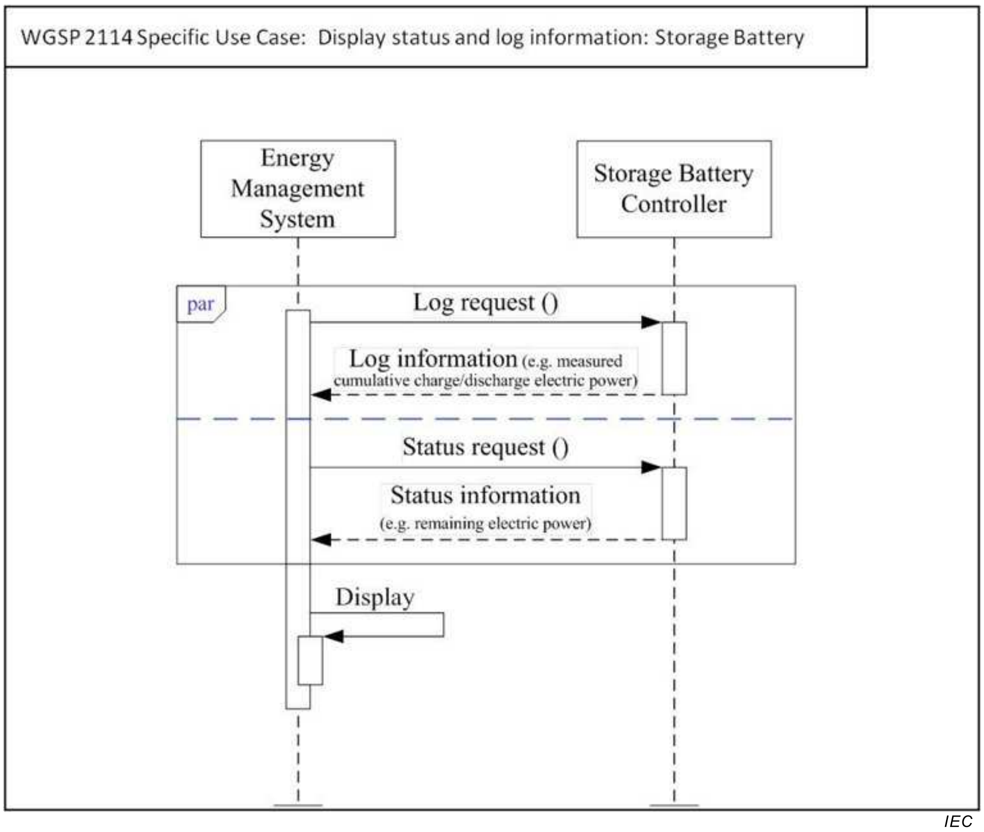
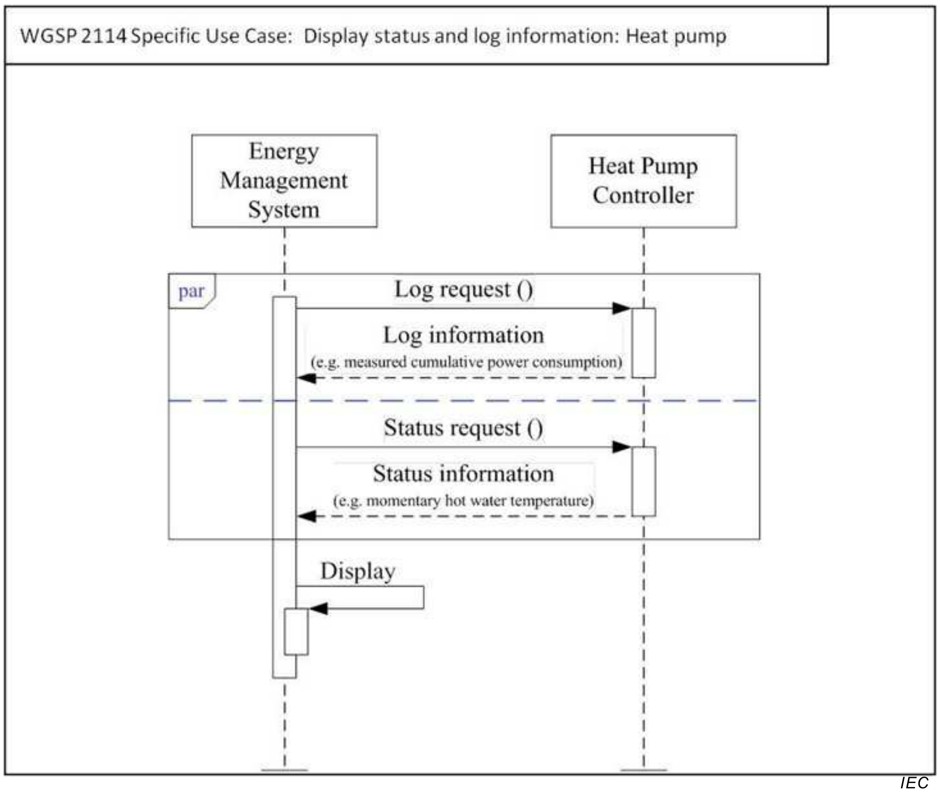


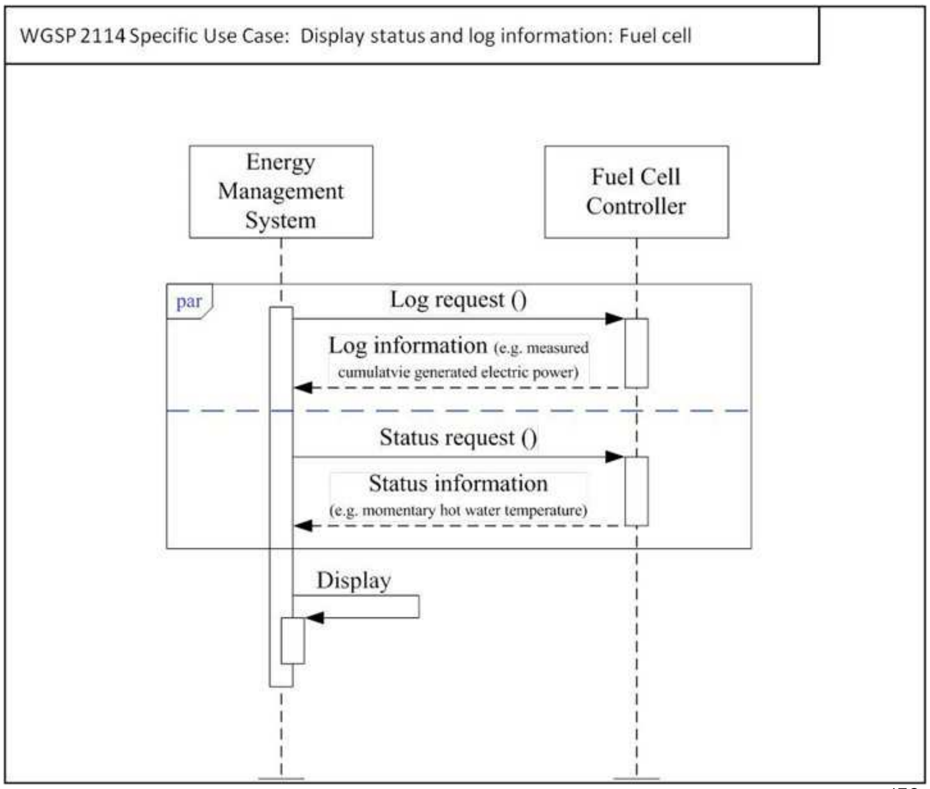
Diagram of use case

JWG1132 – Display status and log information: Heat pump



IEC

JWG1133 – Display status and log information: Fuel Cell



IEC

Diagram of use case
JWG1134 – Display status and log information: Photovoltaic

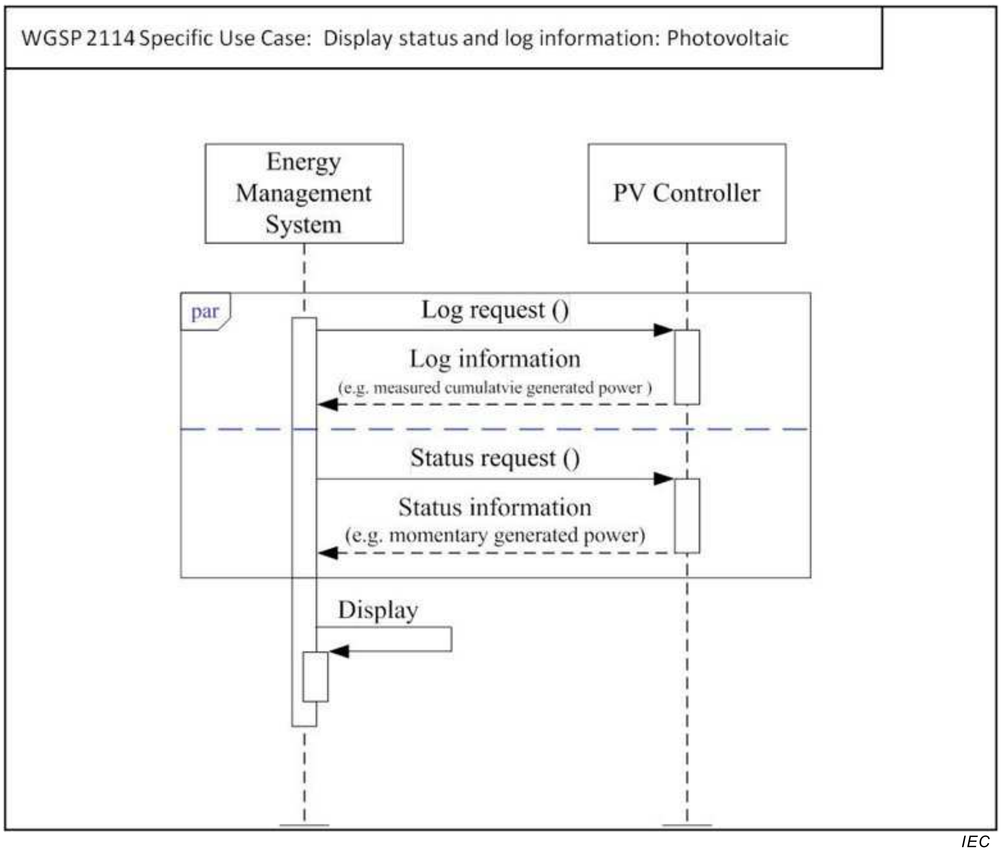


Figure A.15 – Sequence diagram

A.3.9.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.16 has been used as a basis.

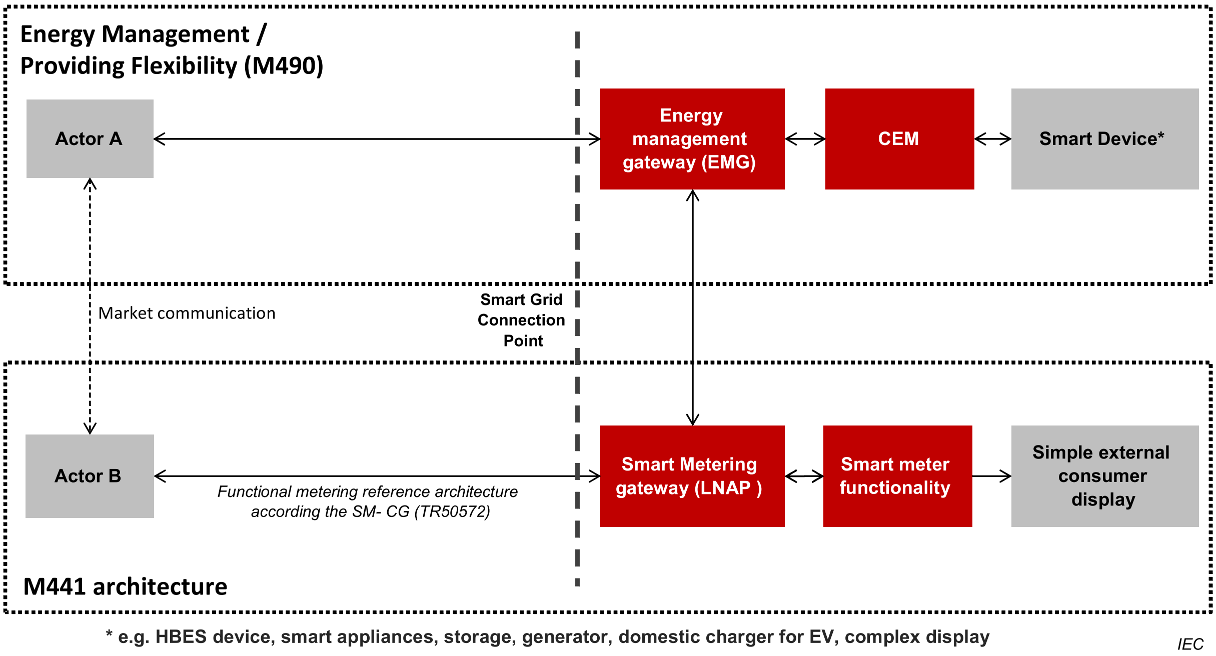


Figure A.16 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. the following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the “grid / market”. Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart Thermostat	External	Using a Smart or programmable thermostat, one can adjust the temperature settings or the times turn on the heating or air-conditioning according to a pre-set schedule. Smart or programmable thermostats can store and repeat multiple daily settings (six or more temperature settings a day) that one can manually override without affecting the rest of the daily or weekly program. One can access it via the web using your tablet, smart phone or computer. The Smart Thermostat can be a device which is connected to the CEM and is programmed its settings from the CEM.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc.	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	Tariff Information.		CEM controls each appliance as programmed according to conditions of operating plan or CEM controls appliance by setting profile (e.g. temperature profile, Timer) defined according to conditions of operating plan

References

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template description	IEC TC8	-

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
High level use case
Prioritisation
Generic, regional or national relation
High level use case which can be applied to any kind of smart device. Once the regions agreed and confirmed correctness, that high level use case becomes a generic use case.
Viewpoint
This high level use case has the user perspective and the interaction of the sd with an overall customer energy management system. it does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Generic high level use case

A.3.9.4 Step by step analysis of use case

Steps – Scenario name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

A.3.9.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Status Information and Events	Events that indicate system or smart device behaviour might be exchanged. In general, system relevant information shall be exchanged.	Such information is sensitive in a way that any modification might customer specific and confidential information. Therefore, the communication data must be protected from misuse and external influences.

A.3.9.6 Requirements (optional)

A.3.9.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.9.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to section**

A.3.10 High level use case (JWG120x) Provide local power managing capabilities

A.3.10.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG113x	**Domain**: Customer Premises, DER **Zones**: Process, Field, Station	Local energy management (taken from TR 62746-2 version 0.5.1).

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Home Appliances	Use Cases	Initial Draft (taken from TR 62746-2)	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	Local energy management can be implemented when combining loads with generators. There are various power generation devices possible and and power consuming device represents a load.
Objective(s)	This use case defines the basic information exchange which is required to provide local energy management.
Related business case(s)	– Demand Response (DR) – Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
Complete description
JWG1201 – Exported power control from Photovoltaic using a load This use case describes the operation of the PV and EMS controllers and loads when the PV is being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by using a proportion of the PV output to power loads which it turns on. **JWG1202 – Exported power control from Fuel Cell using a load** This use case describes the operation of the fuel cell and EMS controllers and loads when the fuel cell is being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by using a proportion of the fuel cell output to power loads which it turns on. **JWG1203 – Exported power control from PV using Heat Pump** This use case describes the operation of the PV, EMS and heat pump controllers when the PV is being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by using a proportion of the PV output to power the heat pump, by requesting the heat pump controller to either increase operating power or turn on and optionally requesting the heat pump controller to modify thermostat settings. **JWG1204 – Exported power control from PV using Heat Pump and Load(s)** This use case describes the operation of the PV, EMS and heat pump controllers when the PV is being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by using a proportion of the PV output to power the heat pump and by optionally requesting the heat pump controller to modify thermostat settings, additionally requesting that one or more loads turn on in the case that the heat pump storage tank is already at capacity.

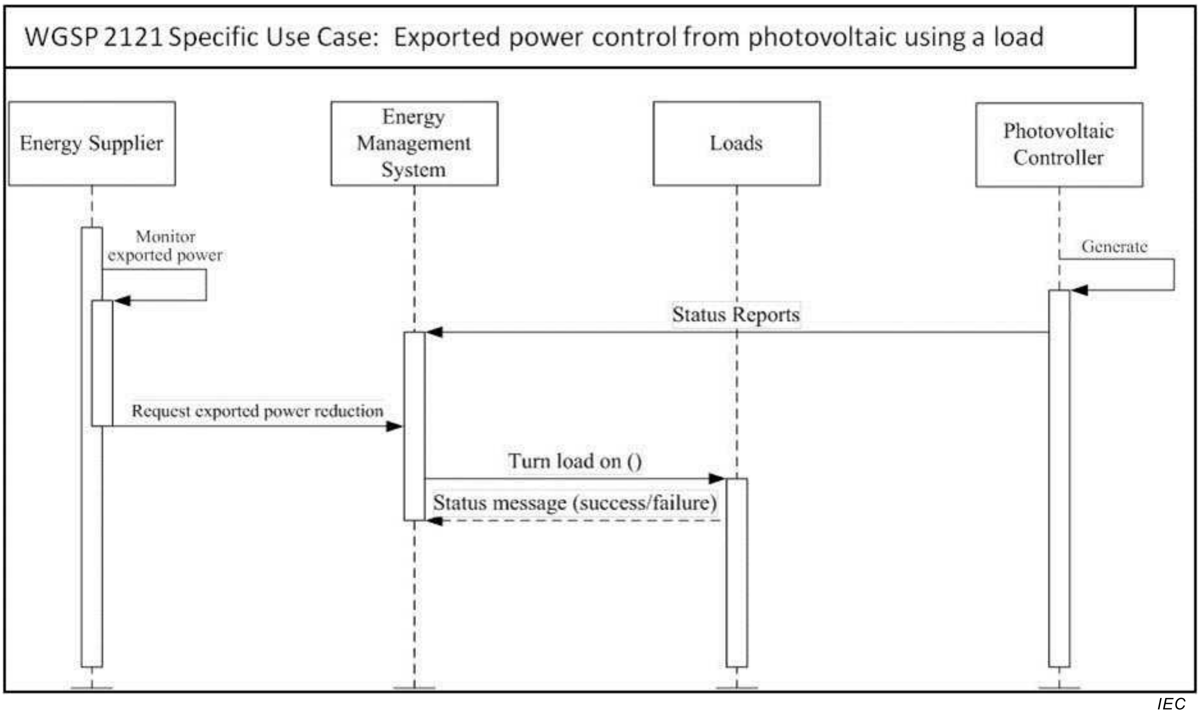
General remarks

General remarks

A.3.10.2 Diagrams of use case

Figure A.17 shows diagrams of use case.

Diagram of use case
JWG1201 – Exported power control from Photovoltaic using a load



JWG1202 – Exported power control from Fuel Cell using a load

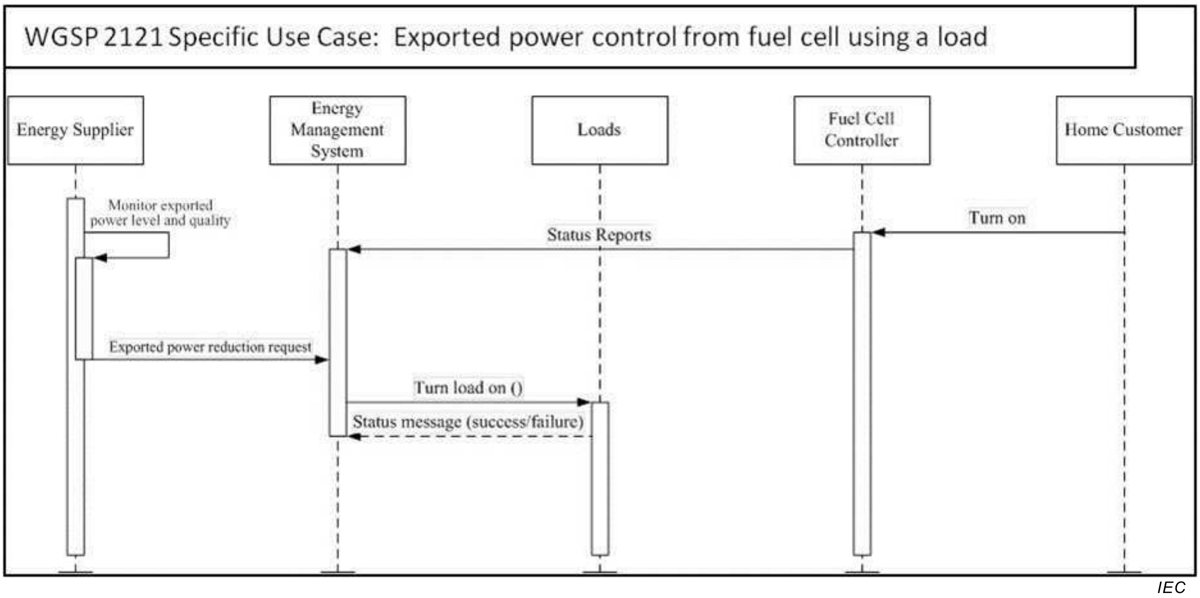
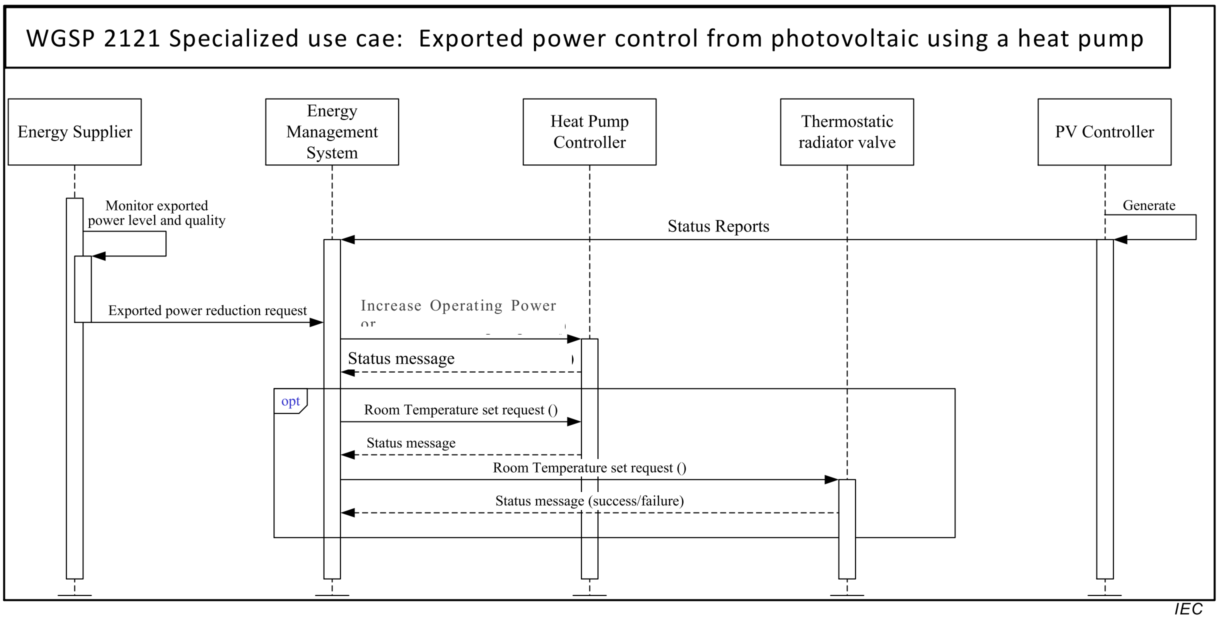


Diagram of use case

JWG1203 – Exported power control from PV using Heat Pump



JWG1204 – Exported power control from PV using Heat Pump and Load(s)

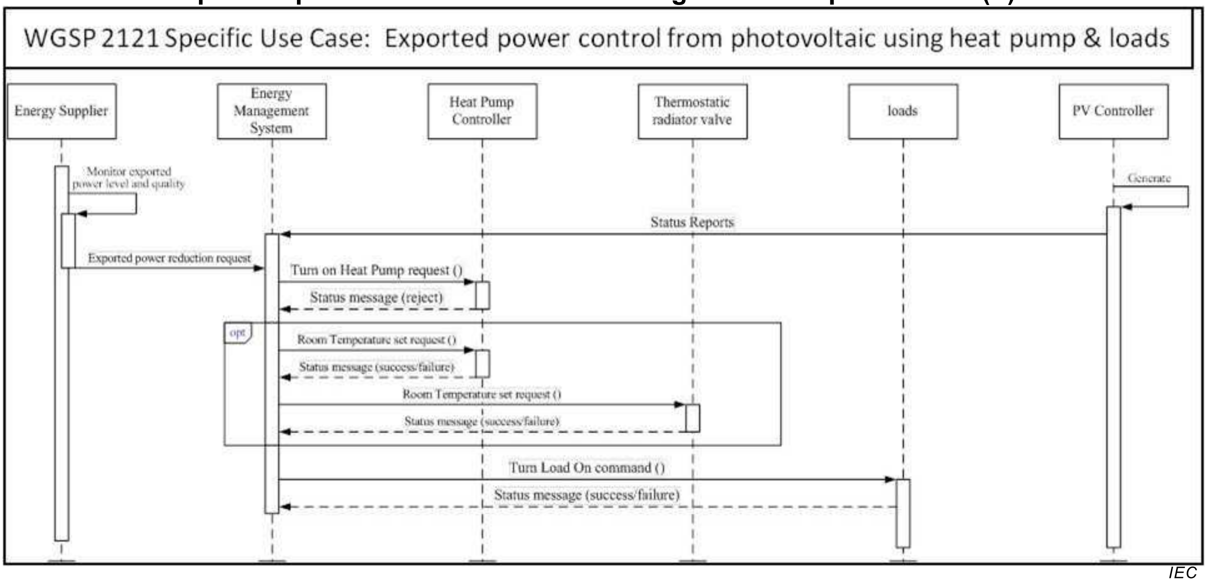


Figure A.17 – Sequence diagram

A.3.10.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.18 has been used as a basis.

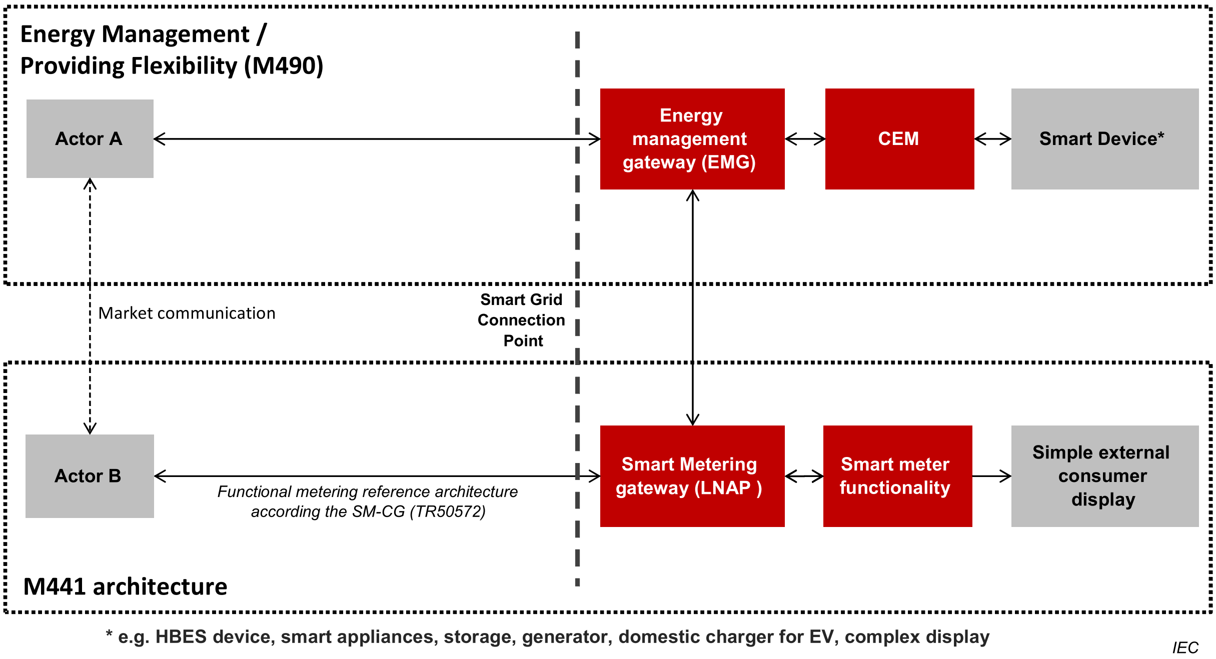


Figure A.18 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. The following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer’s settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the “grid / market”. Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Smart Thermostat	External	Using a Smart or programmable thermostat, one can adjust the temperature settings or the times turn on the heating or air-conditioning according to a pre-set schedule. Smart or programmable thermostats can store and repeat multiple daily settings (six or more temperature settings a day) that one can manually override without affecting the rest of the daily or weekly program. One can access it via the web using your tablet, smart phone or computer. The Smart Thermostat can be a device which is connected to the CEM and is programmed its settings from the CEM.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system. The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc…	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template description	IEC TC8	-

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
High level use case
Prioritisation
Generic, regional or national relation
High level use case which can be applied to any kind of smart device. Once the regions agreed and confirmed correctness, that high level use case becomes a generic use case.
Viewpoint
This high level use case has the User perspective and the interaction of the SD with an overall customer energy management system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Generic high level use case

A.3.10.4 Step by step analysis of use case

Steps – Scenario name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

A.3.10.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Status Information and Events	Events that indicate system or smart device behaviour might be exchanged. In general, system relevant information shall be exchanged.	Such information is sensitive in a way that any modification might customer specific and confidential information. Therefore, the communication data must be protected from misuse and external influences.
Simple Commands	On/Off/Start/Stop/Pause/Resume/Abort/Dim Timer Air conditioner mode: cooling down, heating up, mode 1-n Wind: auto, high, low, etc. Other settings:	Such information is sensitive in a way that any modification might turn on or off a SD Therefore, the communication data must be protected from misuse and external influences.

A.3.10.6 Requirements (optional)

A.3.10.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.10.8 Custom Information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.11 High level use case (JWG121x) Provide local power managing capabilities

A.3.11.1 Description of the use case

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG121x	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Local energy management (taken from IEC TR 62746-2).

Version management

Version management					
Changes /Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/03/ 2014	Home Appliances	Use Cases	Initial Draft (taken from TR 62746-2)	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	Providing local energy management to the power grid can be implemented with various energy devices. This use case captures various energy sources.
Objective(s)	This use case defines the basic information exchange which is required to provide local energy to the grid.
Related business case(s)	Demand Response (DR) Demand Side Management (DSM)

Narrative of use case

Narrative of use case
Short description
Complete description
JWG1211 – Exported power control from Fuel Cell This use case describes the operation of the fuel cell and EMS controllers when the fuel cell is being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by requesting the fuel cell controller to turn off the fuel cell. **JWG1212 – Exported power control from a photovoltaic system** This use case describes the operation of the PV and EMS controllers when the PV system is being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by requesting the PV controller to turn off the PV system. **JWG1213 – Exported power control from fuel cell and photovoltaic systems** This use case describes the operation of the fuel cell, PV and EMS controllers when fuel cell and PV systems are being used to export power and the energy supplier requests a reduction of exported power. The energy supplier monitors the exported power and requests the home customer's EMS to reduce the exported power level. The EMS responds by requesting the fuel cell and PV controllers to turn off the PV system.

General remarks

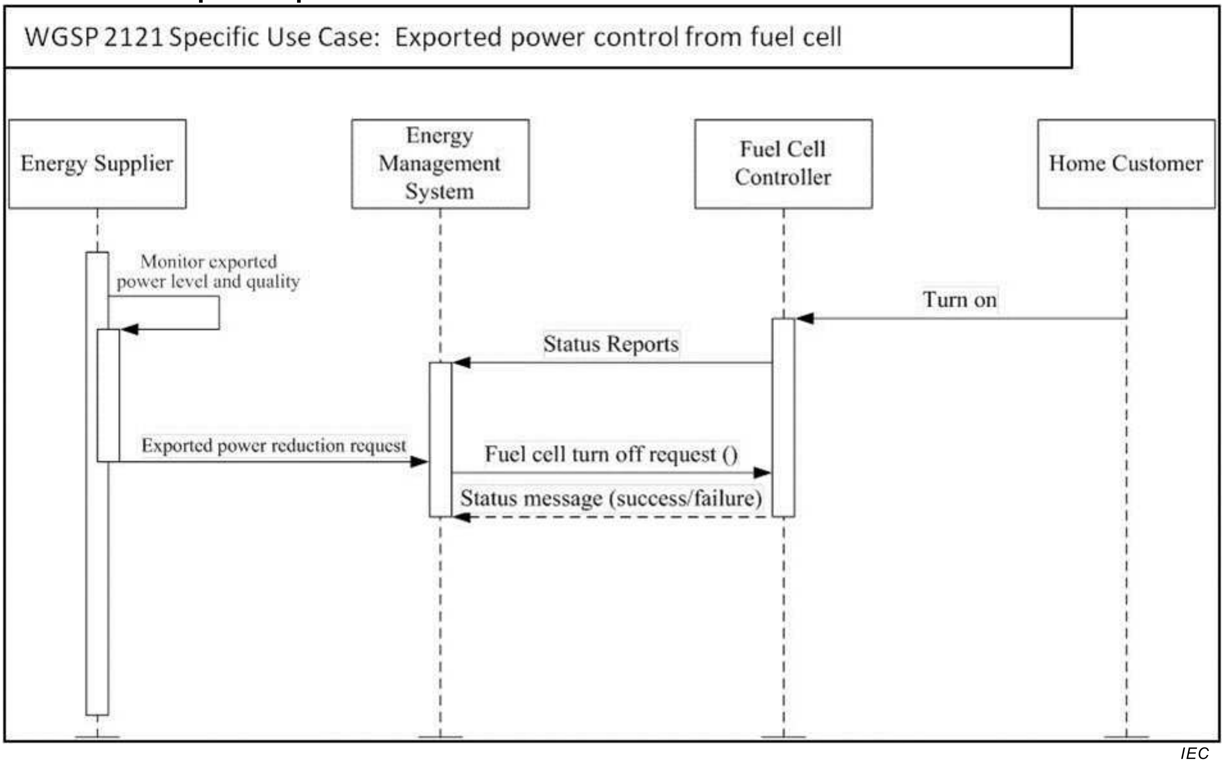
General remarks

A.3.11.2 Diagrams of use case

Figure A.19 shows diagrams of use case.

Diagram of use case

Diagram of use case
JWG1211 – Exported power control from Fuel Cell



JWG1212 – Exported power control from a photovoltaic system

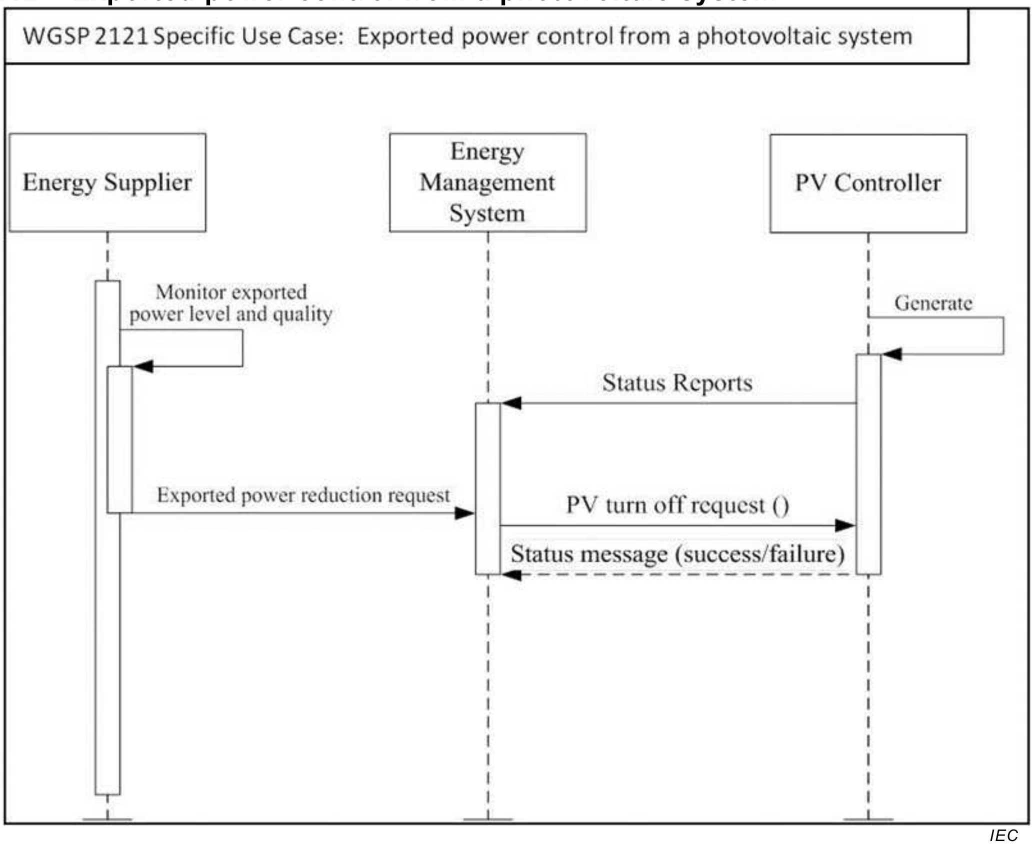


Diagram of use case
JWG1213 – Exported power control from fuel cell and photovoltaic systems

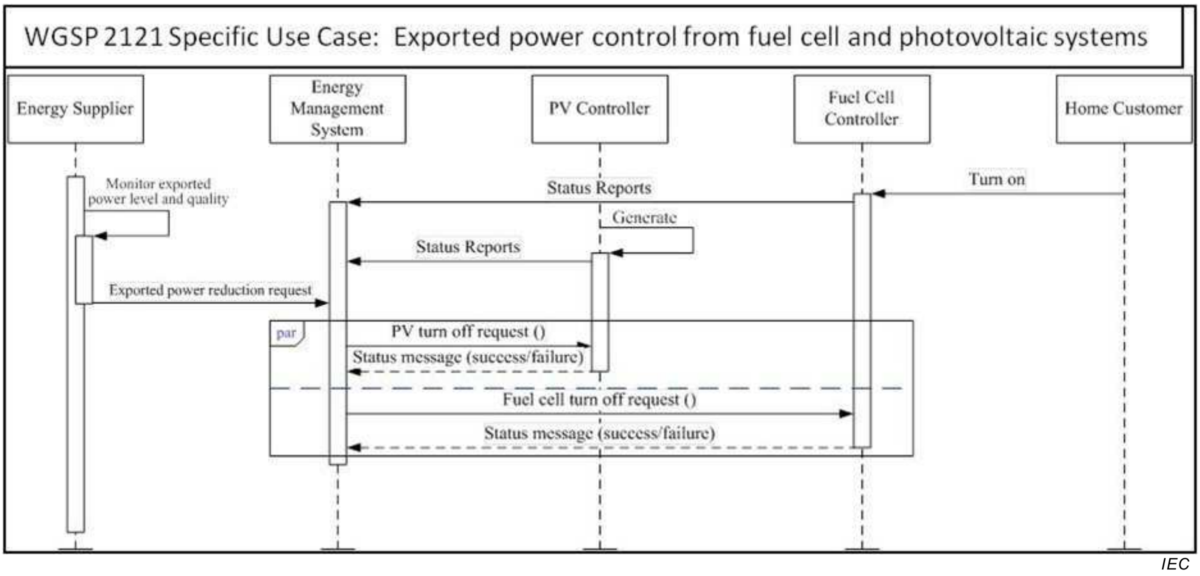


Figure A.19 – Sequence diagram

A.3.11.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.20 has been used as a basis.

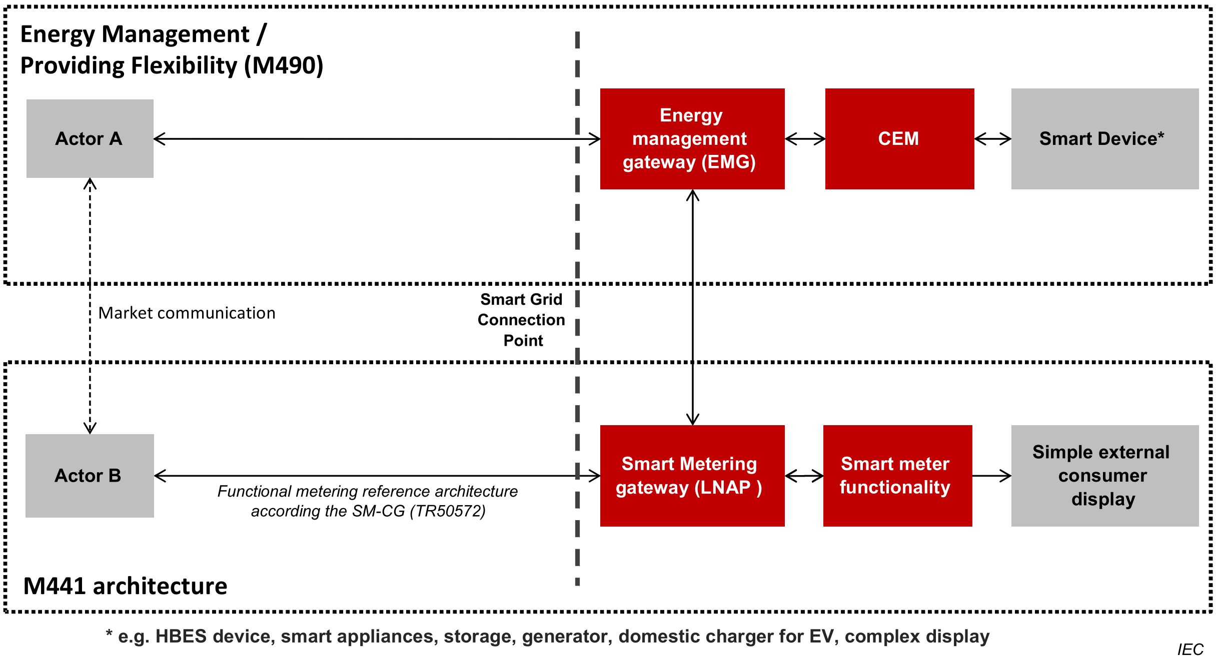


Figure A.20 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

NOTE 3 Please consider that the scope of this high level use does not require all actors shown on the figure above. The following table shows involved actors.

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS	
Smart Thermostat	External	Using a Smart or programmable thermostat, one can adjust the temperature settings or the times turn on the heating or air-conditioning according to a pre-set schedule. Smart or programmable thermostats can store and repeat multiple daily settings (six or more temperature settings a day) that one can manually override without affecting the rest of the daily or weekly program. One can access it via the web using your tablet, smart phone or computer. The Smart Thermostat can be a device which is connected to the CEM and is programmed its settings from the CEM.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc.)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc…	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	
User	External	The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the smart device.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**

References

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedu-res	Final	Terms and definitions	SG-CG Sustainable Processes WG	ftp://ftp.cen.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/Sustainable Processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template description	IEC TC8	-

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
High level use case
Prioritisation
Generic, regional or national relation
High level use case which can be applied to any kind of smart device. Once the regions agreed and confirmed correctness, that high level use case becomes a generic use case.
Viewpoint
This high level use case has the user perspective and the interaction of the SD with an overall customer energy management system. It does not consider market mechanisms for flexibility offering or power grid specific implementations.
Further keywords for classification
Generic high level use case

A.3.11.4 Step by step analysis of use case

Steps – Scenario name

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**

Steps – Scenarios

A.3.11.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Status Information and Events	Events that indicate system or smart device behaviour might be exchanged. In general, system relevant information shall be exchanged.	Such information is sensitive in a way that any modification might customer specific and confidential information. Therefore, the communication data must be protected from misuse and external influences.
Simple Commands	On/Off/Start/Stop/Pause/Resume/Abort/Dim Timer Air conditioner mode: cooling down, heating up, mode 1-n Wind: auto, high, low, etc. Other settings:	Such information is sensitive in a way that any modification might turn on or off a SD Therefore, the communication data must be protected from misuse and external influences.
Energy Profile	An energy profile defines characteristics towards s specific operational mode which is applicable to the smart device. Such information can be used for power consumption but also power generation.	The energy profile does not contain sensitive data in a way that it gives indication on the used Energy for a specific operational mode.

A.3.11.6 Requirements (optional)

A.3.11.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.11.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.12 High level use case (JWG2000) Demand Supply Adjustment

A.3.12.1 Description of the use case

Name of use case

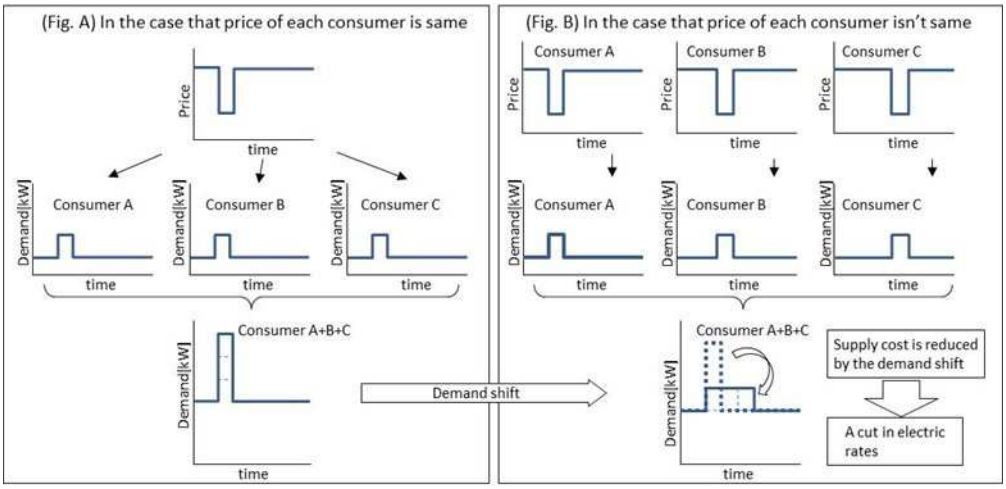
Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG2000	**Area:** Energy System **Domain:** Customer Premises **Zones:** Operation, Station, Field, Process	Demand-supply Adjustment of Cooperation between Supplier and Customer

Version management

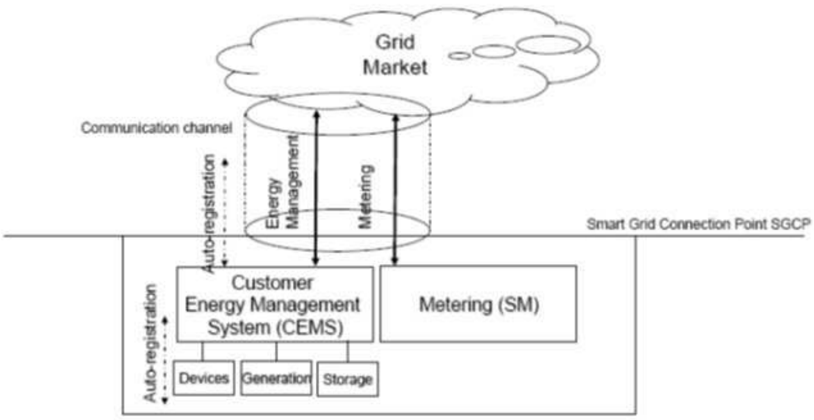
Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.1	23/02/2014	Initial Creation	Draft
0.2	06/03/2014	Minor Modifications towards style	Draft
0.3	07/03/ 2014	Added Use Case ID	Draft

Scope and objectives of use case

<table>
<tr><th colspan="2">Scope and objectives of use case</th></tr>
<tr><td>Scope</td><td>
The scope of this use case is the communication between the CEM and upstream actors. The communication between CEM, the consumer and smart devices is officially not in this scope of this report, but will be included in the use case description for the sake of clarity. Smart devices cover also smart appliances, generators and storage.
When the consumer has a price dependent energy tariff and/or a time dependent distribution tariff, price based demand response is enabled by creating an incentive for load management by consumers or a CEM in response to price changes (RTP, CPP, ToU).
That is, consumer suppresses energy consumption when a price is high and also increase consumption when a price is cheap on the basis of price incentive. However, if many consumers took same consumption of energy, demand will be suppressed more than necessary and increase more than expected (See Figure A). In order to avoid such problems, it is sufficient to assign a different energy price for each consumer. If prices among consumers were different, it is possible to disperse energy consumption and distribute demands (See Figure B). A supply cost is reduced if we adjust the informed price to customers for getting closer to the optimal demand curve with the minimum supply cost. Reduced supply cost can be repaid to consumers through a cut in electric rates.[2]



IEC
The diagram below shows the SG CP in its environment.



IEC
</td></tr>
</table>

2 Difference with other use cases.

Scope and objectives of use case	
Objective(s)	The objective of this use case is to exchange information between external actors and the premise in order to: Enable consumers or their Customer Energy Management System to react on (changes in) energy prices, thus supporting consumers to optimize their consumption to use cheaper energy (depending on personal preferences) Enable consumers to reduce the electricity tariff by receiving an appropriate price alert to avoid suppression of excessive energy use and the concentration of energy consumption[3] Enable external actors to retrieve the state of in smart devices
Related business case(s)	This use case is one of the generic use cases of the demand response services for the buildings using in some utilities, BEMS(Building Energy Management System) aggregators, domestic projects in Japan. (This use case is independent from the national or regional market design. It should be agreed on the 62746-2 use case & requirement discussion.)

Narrative of use case

Narrative of use case
Short description
This use case describes how information regarding price is sent from a upstream actor to CEM and how information regarding energy consumption or generation as well as smart device statuses is sent back to a upstream actor.
Complete description
This use case is intended to achieve lower total energy cost by means of cooperation between more than one consumer and an energy supplier. Every consumer makes a profile of energy consumption with reference to initial information on prices (e.g. Hourly prices in a day) from the energy supplier. The energy supplier aggregates a profile of energy consumption from each consumer and fixes the prices again with reference to a difference between an aggregated profile and a target profile of the energy supplier. Every consumer receives renewed price information from the energy supplier and reviews a power profile. By performing several times exchanging the information mentioned above, an aggregated profile gets closer to a target profile of the energy supplier. Thus the energy supplier can reduce total supply cost. An electricity charge of every consumer is discounted by a reduction of the total supply cost. Procedure 1) An energy supplier determines prices after confirming a supply & demand situation and market prices. 2) A CEM receives price information from the energy supplier. 3) Smart devices receive price information for planning a power profile. 4) The energy supplier receives a power profile from each consumer. 5) The energy supplier reviews the prices by reference to the received power profiles. 6) Go back to 1). 7) Is performed multiple times from 1) to 6) and each consumer receives final price information from the supplier. In addition, this use case comprises two different primary use cases: **1) WGSP 2111: Information regarding power consumption or generation** **2) WGSP 2112: Price and/or environmental information**

General remarks

General remarks

3 Difference with other use cases.

A.3.12.2 Diagram of use case

Figure A.21 shows a diagram of use case.

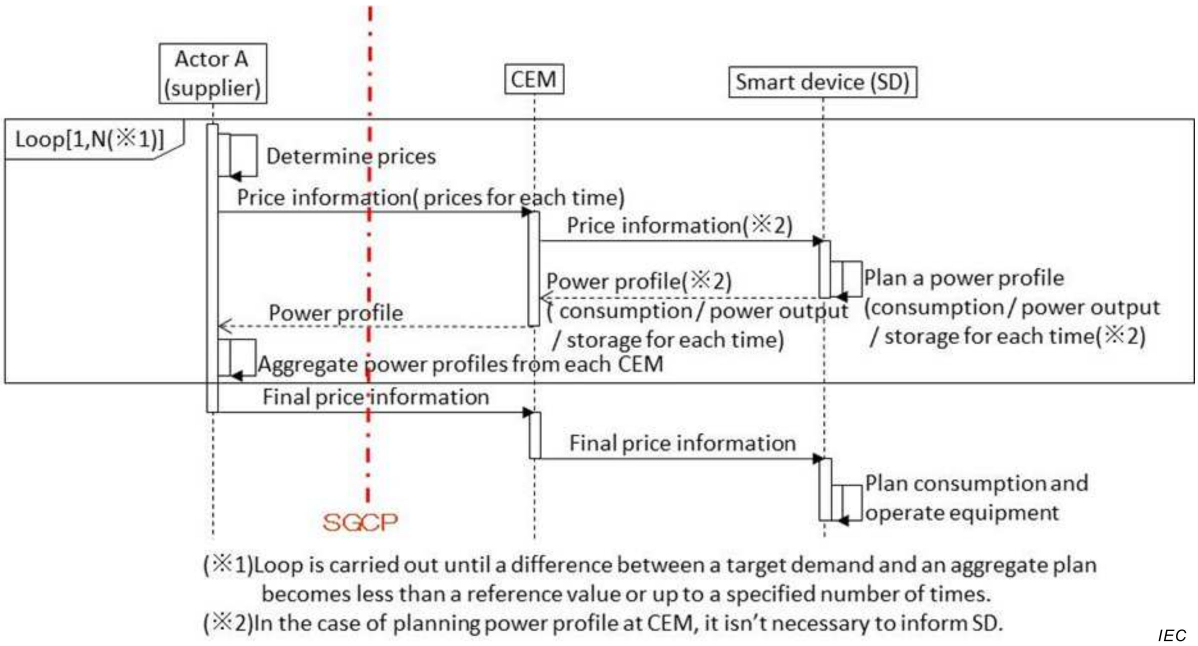
Diagram(s) of use case


Figure A.21 – Sequence diagram

A.3.12.3 Technical details

Actors

Actors			
Grouping		**Group Description**	
Actor Name see Actor List	**Actor Type see Actor List**	**Actor Description see Actor List**	**Further information specific to this use case**
Customer Energy Manager (CEM)	Internal	The CEM is a logical function optimising energy consumption and or production based on signals received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	

Actors			
Grouping		Group Description	
Actor Name see Actor List	Actor Type see Actor List	Actor Description see Actor List	Further information specific to this use case
Smart device Smart appliance (white goods)	External	A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, through an interface with the CEM and can react to commands and signals from the grid in an intelligent way.	
Actor A via SG CP	External	External actor (Smart Grid Market Role) is interacting with the system functions and components in the home/building through the energy management communication channel. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc…	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/ Information/ Contract	Triggering event	Pre-conditions	Assumption
Actor A Consumer		A mutual agreement in advance (Information content, fee settlement method)	
Actor A	Before price alert to a consumer from a supplier	In advance, Actor A determines prices by taking into consideration supply and demand situation, plans of energy consumption, an asking price from other suppliers and market.	
		In order to correctly bill demand/generation flexibility, the smart meter and CEM need to be time synchronized	

References

References						
No.	References type	Reference	Status	Impact on use case	Originator / Organisation	Link
	Example use cases to WGSP2111				SG-CG Sustainable Processes WG	
	Example use cases to WGSP2112				SG-CG Sustainable Processes WG	

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Distribution Management System
Level of depth
High Level use case

Classification information
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)
Viewpoint
Technical
Further keywords for classification
Cooperation, Demand response, Smart Grid

A.3.12.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Determine initial prices			Actor A has a schedule instructing it before sending price information to the CEM.	Actor A stores the determined prices.
WGSP 2112	Price information	Actor A	Price information is available in Actor A.	Communication connection between all consumers is established	Price information is received by smart devices
WGSP 2111	Information regarding energy consumption / generation	Smart devise	A power profile (consumption / power output / storage for each time) is available in the CEM.	Communication connection between all actors is established The smart device has a schedule instructing it when to send a power profile to the CEM. The CEM has a schedule instructing it when to send a power profile to the external actor.	A power profile is received by Actor A
2	Aggregate power profiles and review prices	CEM	Power profiles are available in Actor A.	Actor A receives a power profile from each CEM.	Actor A stores the reviewed prices.
3	Loop from No.1 to No.2[4]				An aggregated profile gets close to a target profile.
WGSP 2112	Final Price information	Actor A	An aggregated profile gets close to a target profile.	Communication connection between all consumers is established	Final price information is received by CEM or smart devices

Steps – Scenarios

4 Difference with other use cases.

Scenario								
Scenario Name:		**No.1 Price information**						
Step No.	**Event**	**Name of Process /Activity**	**Description of Process/ Activity**	**Serv ice**	**Informa-tion Produ-cer (Actor)**	**Informa-tion Receiver (Actor)**	**Information Exchanged**	**Require ments, R-ID**
1	CEM receives initial price information.		Actor A determines prices by taking into consideration supply and demand situation, plans of energy consumption, an asking price from other suppliers and market. Actor A sends price information to CEM.		Actor A	CEM	Price information (<u>The price information has prices for each time in a period in order to make a plan of energy consumption.</u>)	
3	Smart device receives initial price information. (In case of planning at CEM, it isn't necessary to send to smart devices)		CEM sends price information to smart devices.		CEM	Smart devices	Price information	

Scenario								
Scenario Name:		**No. 2 Information regarding energy consumption / generation**						
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Servi ce**	**Informa-tion Produ-cer (Actor)**	**Informa-tion Receiver (Actor)**	**Information Exchanged**	**Require ments, R-ID**
1	CEM or SD creates a power profile.		CEM or SD creates a power profile by using the received price information.		CEM / SD			
2	CEM receives a power profile. (In case of planning a power profile at SD)		SD sends a power profile to CEM.		SD	CEM	Power profile (The power profile has consumption / power output / storage for each time in a period.)	

Scenario								
Scenario Name:	**No. 2 Information regarding energy consumption / generation**							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Servi ce**	**Informa-tion Produ-cer (Actor)**	**Informa-tion Receiver (Actor)**	**Information Exchanged**	**Require ments, R-ID**
3	Actor A receives power profiles.		CEM aggregates a power profile from each SD and sends a power profile of a consumer.to Actor A.		CEM	Actor A	Power profiles	

Scenario								
Scenario Name:	**No. 3 Aggregate profiles and review prices**							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Servi ce**	**Informa-tion Produ-cer (Actor)**	**Informa-tion Receiver (Actor)**	**Information Exchanged**	**Require ments, R-ID**
1	Actor A aggregate s power profiles and reviews prices.		Actor A aggregates a power profile from each consumer. Actor A fixes prices again with reference to a difference between an aggregated profile and a target profile of Actor A. Actor A reviews prices.					

Scenario								
Scenario Name:	**No. 4 Loop**[5]							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Servi ce**	**Informa-tion Produce r (Actor)**	**Informa-tion Receiver (Actor)**	**Information Exchanged**	**Require ments, R-ID**
1	Actor A and CEM exchange information		Actor A and CEM exchange price information and a power profile several times until an aggregated profile gets closer to a target profile of Actor A.				Price information Power profile	

5 Difference with other use cases.

Scenario								
Scenario Name:		**No.5 Final price information**						
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Servi ce**	**Informa-tion Producer (Actor)**	**Informa-tion Receiver (Actor)**	**Information Exchanged**	**Require ments, R-ID**
1	CEM receives final price information		Actor A sends price information to CEM.		Actor A	CEM	Final price information	
2	Smart device receives final price information (In the case of planning a power profile at CEM, it isn’t necessary to send to smart devices)		CEM sends price information to smart devices.		CEM	smart device	Final price information	

A.3.12.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Price information (M1-1)	Prices for each time in a period (e.g. Hourly prices in a day)[6]	
Power profile (M1-2)	Consumption / power output / storage for each time in a period[7]	

A.3.12.6 Requirements (optional)

Requirements (optional)	
Categories for Requirements	**Category Description**
Requirement ID	**Requirement Description**

A.3.12.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

6 Difference with other Use Cases.

7 Difference with other Use Cases.

A.3.12.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.13 High level use case (JWG2001) Cascaded CEM

A.3.13.1 Description of the use case

Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG2001	Smart Grid/ Customer	“Building Energy Management (Model 2)〞 Energy saving, Demand-supply control for individual buildings

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.1	24/02/2014	Initial Draft	Draft
0.2	07/03/2014	Added Use Case ID	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication between Actor A and CEM. The CEM has the priority information as the triage information defined by the user who manages the facilities. In this case, SG CP is located between the Actor A and the CEM.
Objective(s)	The objective of this use case is the Energy saving, Demand-supply control for individual buildings. For the demand reduction requested by the Supplier, the Service Provider (Actor A) saves energy, and adjusts the energy usage plan based on these, below. – uses of individual smart devices – physical positions of individual smart devices – degrees of importance allocated to individual distribution line – priorities allocated to individual equipment – “consumption/generation schedules “ and – “trends of consumption/consumption result”
Related business case(s)	This use case is one of the generic use cases of the demand response services for the buildings using in some utilities, BEMS(Building Energy Management System) aggregators, domestic projects in Japan. <u>(This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)</u>

Narrative of use case

Narrative of use case
Short description
In advance, the building EMS (CEM) sends the estimated amount of curtailment, the priorities of smart devices and the area information of the building to the Actor A. So, the Actor A can perform the optimum suppression control. The Actor A calculates the consumption and generation of the electricity in individual buildings. Then Actor A executes energy suppression control to perform load reduction effectively. The Actor A adjusts the energy usage plan based on above energy suppression control.
Complete description
The Actor A received information of the degrees of importance, priorities and consumption/generation schedules from CEM. The Actor A calculates the consumption and generation of the electricity in individual buildings. When suppression power control is needed, the Actor A executes energy suppression control to perform load reduction effectively. The Actor A adjusts the energy usage plan based on above energy suppression control. 1) The user puts degrees of importance, priorities and consumption/generation schedules into terminal of the CM. 2) (The CEM registers these to Actor A. 3) The Actor A creates power profile based on uses of individual smart devices, physical positions of individual smart devices, consumption/generation schedules and trends of consumption/consumption result. Each power profile includes an operation plan of smart devices and incentive. And the Actor A displays power profile with incentive information to the CEM. In case of the emergency, the Actor A creates power profile for the triage control based on “degrees of importance” and “priorities” on the above process. 4) The user selects the power profile based on the operation plan of smart devices and the incentive. 5) (The Actor A sends the request of reduce consumption to the CEM based on the power profile. 6) Then the CEM adjusts the power profile based on suppression the request of reduce consumption.

General remarks

General remarks

A.3.13.2 Diagram of use case

Figure A.22 shows a diagram of use case.

Diagram(s) of use case

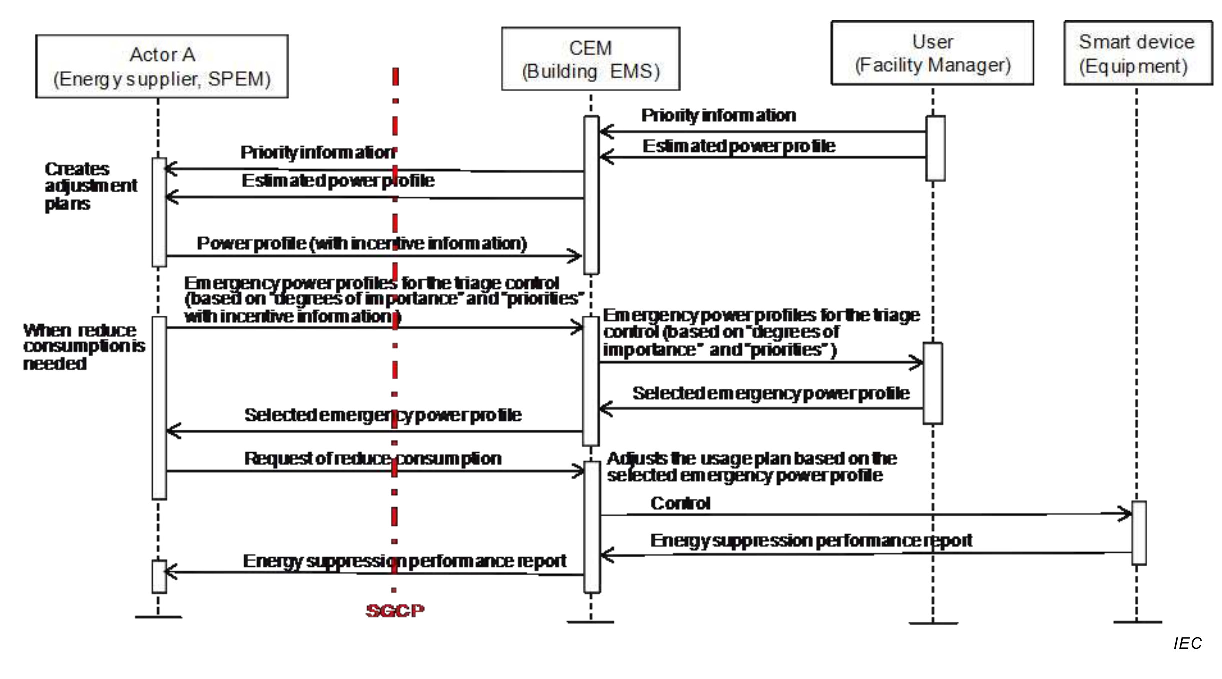


Figure A.22 – Sequence diagram

A.3.13.3 Technical details

Actors

Actors			
Grouping		**Group Description**	
Actor Name see Actor List	**Actor Type see Actor List**	**Actor Description see Actor List**	**Further information specific to this use case**
Actor A	External	A company that delivers electricity to end use customers. the Energy Provider, the Energy Services Provider, the aggregator, etc…	
Customer Energy Manager (CEM)	Internal	The CEM is a logical function optimizing energy consumption and or production based on signals received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled.	
User	Internal Role Person	Person responsible for the maintenance and operation of the facility. In the Residential market, this is the home owner, landlord, or building superintendent. (Facility Manager)	

Actors			
Grouping		**Group Description**	
Actor Name see Actor List	**Actor Type see Actor List**	**Actor Description see Actor List**	**Further information specific to this use case**
Smart device	External	A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and signals from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	

Triggering event, preconditions, assumptions

Use Case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
Actor A	Request reduce consumption		When reduce consumption is needed

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Example use cases to the reduce control in Model 2	WGSP2120: Direct load / generation management				

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Japanese use case Model 3
Level of depth
High level use case
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & Requirement discussion.)
Viewpoint
Technical

Classification information
Further keywords for classification
Demand side management, direct load control, Smart Grid, Building Energy Management

A.3.13.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	“Building Energy Management（Model 2）”Energy saving，Demand-supply control for individual buildings	Actor A	Request of reduce consumption	Communication connection between all actors is established The user configured the CEM and/or the participating smart devices. The user set the priorities of smart devices to the CEM. Information on total consumption or consumption per device is notified to the CEM	The power profile is negotiated between Actor A and CEM. The smart devices are controlled by the CEM based on the negotiated power profile.

Steps – Scenarios

Scenario								
Scenario name:		**“Building Energy Management（Model 2）” Energy saving，Demand-supply control for individual buildings**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
1	Set degrees of importance, priorities to the CEM		The User sets the degrees of importance, priorities to the CEM.	Field/ Building	User	CEM	degrees of importance, priorities for individual smart devices	
2	Set estimated power profile to the CEM		The User sets the estimated power profile to the CEM.	Field/ Building	User	CEM	estimated power profile	
3	Set degrees of importance, priorities to the Actor A		The CEM sets the degrees of importance, priorities to the Actor A.	Field/ Building	CEM	Actor A	degrees of importance, priorities for individual smart devices	
4	Set estimated power profile to the Actor A		The CEM sets the estimated power profile to the Actor A.	Field/ Building	CEM	Actor A	estimated power profile	

Scenario								
Scenario name:		**“Building Energy Management（Model 2）” Energy saving, Demand-supply control for individual buildings**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
5	Create power profile		Actor A creates power profile in consideration of degrees of importance, priorities and estimated power profile.	Field	--	--	--	
6	Send power profile to the CEM		Actor A sends power profile with a incentive information.	Field/ Building	Actor A	CEM	power profile with a incentive information	
7	Detect the need for reduce consump-tion		Actor A detects the need for reduce consumption	Field	--	--	--	
8	Notify the emergency power profiles		Actor A sends the Emergency power profiles for the triage control based on “degrees of importance” and “priorities” to the CEM.	Field/ Building	Actor A	CEM	Emergency power profiles for the triage control based on “degrees of importance” and “priorities”	
9	Notify the emergency power profiles		CEM sends the emergency power profiles for the triage control based on “degrees of importance” and “priorities” to User.	Building	CEM	User	Emergency power profiles for the triage control based on “degrees of importance” and “priorities”	
10	Selects the emergency power profiles		User sends the selected emergency power profile to the CEM.	Building	User	CEM	Selected emergency power profile	
11	Selects the emergency power profiles		CEM sends the selected emergency power profile to the Actor A.	Field/ Building	CEM	Actor A	Selected emergency power profile	

Scenario								
Scenario name:		**“Building Energy Management（Model 2）” Energy saving, Demand-supply control for individual buildings**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
12	Request of reduce consump-tion		Actor A sends the request of reduce consumption to the CEM.	Field/ Building	Actor A	CEM	Request of reduce consumption	
13	Load control		CEM controls to the equipment.	Building	CEM	Smart devices	Smart device control signal	
14	Report		Smart devices reports suppression performance	Building	Smart devices	CEM	Energy suppression performance report	
15	Report		CEM reports suppression performance	Field/ Building	CEM	Actor A	Energy suppression performance report	

A.3.13.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Priority information (M2-1)	Priority information (degrees of importance, priorities) of the each smart devices(loads) in the customer building for triage control.	
Estimated Power Profile (M2-2)	Individual smart device consumption/ Generation information estimated by the user.	
Power Profile (M2-3)	Power profile includes incentive and re-created plans of consumption schedules, generation schedules of the customer’s building.	
Request of reduce consumption (M2-4)	Emergency Notification includes the request information to reduce the power consumption in the customer building.	
Emergency Power Profile for the triage control (M2-5)	Adjusted Power Profile for the triage control includes the re-calculated power consumption/control plan based on the triage control with incentive information	
Selected Power Profile (M2-6)	Response to the Emergency Power Profile for the triage control, including the power profile selected by user.	
Request of reduce consumption (M2-7)	Request of reduce consumption is the suppression signal which is the request information to start suppression control of smart devices in the building based on the Selected Power Profile.	
Control (M2-8)	This signal is the control signal for the smart devices in the building.	

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Energy suppression performance report (M2-9)	Report of energy suppression performance.	

A.3.13.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category Description**
Requirement ID	**Requirement Description**

A.3.13.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.14 High level use case (JWG2002) District Energy Management

A.3.14.1 Description of the use case

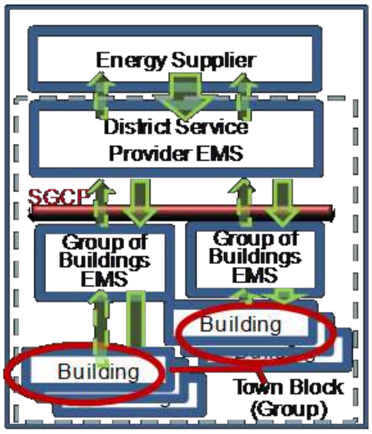
Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG2002	Smart Grid/ Customer	“Energy Management of Groups of Building in the District（Model 3）” Energy saving, Demand-supply control for group of buildings

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.1	21/02/2014	Initial Draft	Draft
0.2	07/03/2014	Added Use Case ID	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication between the District Service Provider EMS (D-SPEM) and the Groups of Building EMS (G-CEM). The Groups of Building EMS (G-CEM) has the group information (e.g. town block) in the district with gather energy information of each buildings defined by the facility manager. In this case, SG CP is located between the District Service Provider EMS (D-SPEM) and the Groups of Building EMS (G-CEM).  District Service Provider EMS (D-SPEM) Groups of Building EMS (G-CEM) Building EMS Groups of Buildings Energy Management IEC EMS: Energy Management System
Objective(s)	The objective of this use case is the Energy saving, Demand-supply control for groups of buildings. For the demand reduction request by the Energy Supplier, the District Service Provider EMS (D-SPEM) saves energy, and adjusts “demands of the district” based on these, below. – Uses of individual equipment – District Service Provider EMS (D-SPEM) creates “proposal for adjustment plans” based on the priority, the power usage plan and the consumption of buildings and equipment. – “consumption/generation schedules “and "trends of consumption/consumption result” – Calculates the demand curtailment ability of the district. Energy usage optimization – such as demand suppression, energy saving, emission reduction, renewable energy usage promotion – can be achieved by energy management of group of buildings (town block). So user benefits are obtained as follows: – Scalability: The amount of adjustable energy consumption can be Increases because of a total amount of energy consumption increases. – Diversity: Mutually complementary energy operation is attained by many Kinds of distributed energy resources and loads. It is easy to take energy balance.
Related business case(s)	This use case is one of the generic Use Cases of the demand response services for the buildings using in some utilities, BEMS(Building Energy Management System) aggregators, domestic projects in Japan. (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)

Narrative of use case

Narrative of use case
Short description
The energy supplier calculates the consumption and generation of the electricity in a district with gathering each building energy information. Then energy supplier executes energy suppression control to perform load reduction effectively. The district service provider EMS (D-SPEM) adjusts the energy usage plan based on above energy suppression control.
Complete description
The district service provider (D-SEPM) receives priority and power usage plan of the building, then creates power usage plan and equipment operation plan for group of the building. The energy supplier calculates the consumption and generation of the electricity in a district. Then energy supplier executes energy suppression control to perform load reduction effectively. The district service provider (D-SPEM) adjusts the energy usage plan based on above energy suppression control. 1) The facility manager inputs the priority and the power usage plan of the building into the Building EMS. G-CEM aggregates these information and add building information (e.g. apartment house, commercial building, public facilities, factory, ..). Then, the G-CEM registers these to the D-SPEM and Energy Supplier. 2) The D-SPEM creates the "power usage plan" and the "equipment operation plan" for the Town Block (a group of buildings based on a contract). G-CEM decomposes these information for each building and then registers these to his Building EMS. 3) When a suppression control of power is needed, the supplier calculates the demand curtailment ability of the district. Then the Supplier creates a new power usage plan of the district. Next, the supplier sends it to the D-SPEM. After the D-SPEM receives it, he creates "proposal for adjustment plans" based on the priority, the power usage plan and the consumption of buildings and equipment. Each of these proposals includes an "equipment operation plan" and an incentive. Then the D-SPEM sends these proposals to G-CEM. Then G-CEM decomposes them for each building and sends them to Building EMS. 4) The Facility manager checks these proposals at the Building EMS terminal in the Customer's building. Then the Facility manager selects one of these proposals based on the "equipment operation plan" and incentive. The Building EMS sends the selected proposal to G-CEM. G-CEM aggregates these proposals and sends to D-SPEM. 5) After the D-SPEM receives the proposal selected by the Customer, the D-SPEM sends signals according to the proposal. 6) The Building EMS adjusts the power usage plan based on signals received, and control equipments. 7) The Equipment reports energy suppression performance to Building EMS, G-CEM, D-SPEM and Energy Supplier.

General remarks

General remarks

A.3.14.2 Diagram of use case

Figure A.23 shows a diagram of use case.

Diagram(s) of use case

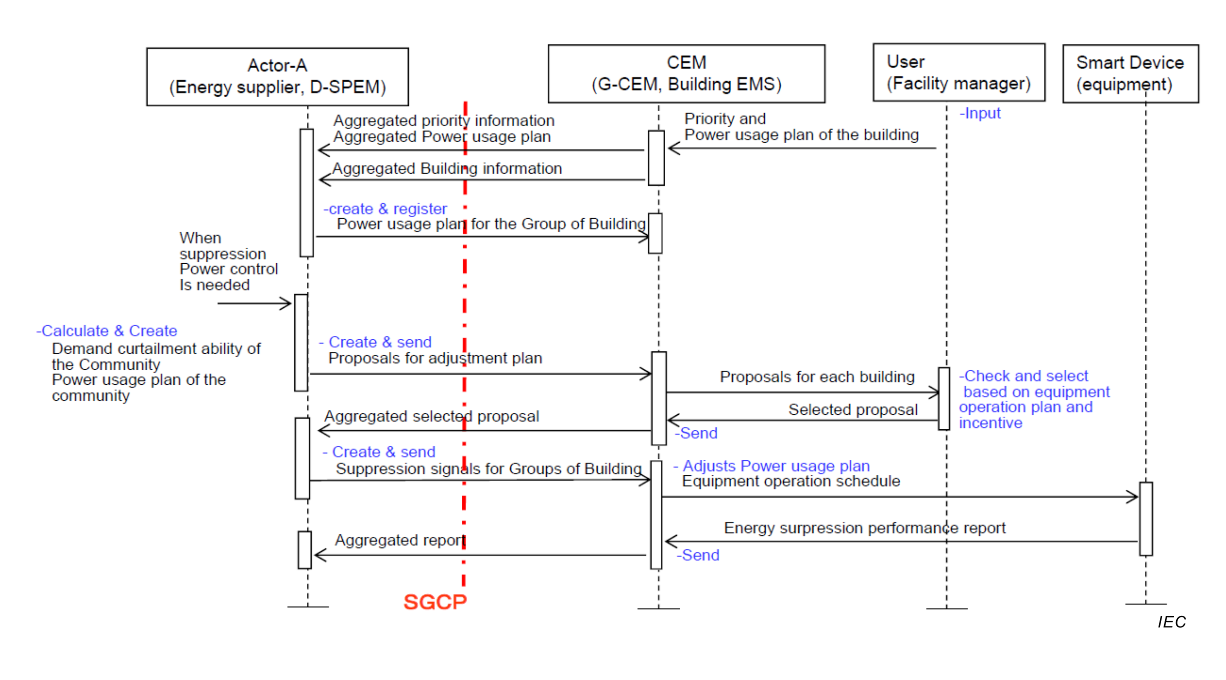


Figure A.23 – Sequence diagram

A.3.14.3 Technical details

Actors

Actors			
Grouping		**Group description**	
Actor name See Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home/building or home/building automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc… In addition in this use case Actor A consists of Energy Supplier and District Service Provider EMS (D-SPEM). Energy Supplier is a company that delivers electricity to end use customers. D-SPEM manages energy saving and demand-supply for the Groups of Buildings (e.g. town block) in the district.	

Actors			
Grouping		**Group description**	
Actor name See Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
CEM	Internal	The CEM is a logical function optimising energy consumption and or production based on signals received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS. In addition in this use case CEM consists of Group of Buildings EMS (G-CEM) and Building EMS. G-CEM manages energy saving and demand-supply for the Group of Buildings. Building EMS is a system used to monitor and control the energy consuming devices in a building.	
User	Internal Role Person	Facility manager responsible for the maintenance and operation of the facility. In the Residential market, this is the home owner, landlord, or building superintendent.	
Smart device	External	A smart device may be an load, generator or storage *device/equipment (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc.).* The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and signals from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
Actor A (Energy Supplier)	Request of Suppression power control		

References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Japanese use case Model 2, Model 4
Level of depth
High level use case
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)
Viewpoint
Technical
Further keywords for classification
Demand side management, Smart Grid, Building Energy Management. District

A.3.14.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
	“Group of Buildings in the District（Model 3）” Energy saving, Demand- supply adjustment for the district	Actor A (Energy Supplier)	Request of Suppression power control		

Steps – Scenarios

Scenario								
Scenario name:		**Energy saving, Demand-supply adjustment for the district**						
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1			Facility manager inputs the priority and the power usage plan of the building into the Building EMS. G-CEM aggregates these information and add building information (e.g. apartment house, commercial building, public facility, factory, ..). Then, the G-CEM registers these to the D-SPEM and Energy Supplier.		User (Facility Manager) CEM (Building EMS, Group of Buildings EMS (G-CEM))	CEM (Building EMS) Actor A (District Service Provider EMS (D-SPEM), Energy Supplier)	Aggregated Priority information (M3-1) Aggregated Power usage plan of the building (M3-2) Aggregated Building information (M3-3)	
2			The D-SPEM creates the “power usage plan” and the “equipment operation plan” for the Town Block (a group of buildings based on a contract). G-CEM decompose these information for each building and then registers these to his Building EMS.		Actor A (District Service Provider EMS (D-SPEM))	CEM (Group of Buildings EMS (G-CEM), Building EMS (CEM))	Power usage plan for the Group of Buildings (M3-4)	

Scenario								
Scenario name:	**Energy saving, Demand-supply adjustment for the district**							
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchan-ged**	**Require-ments, R-ID**
3	When a sup-pres-sion cont-rol of power is needed		The energy supplier calculates the demand curtailment ability of the district. Then the energy supplier creates a new power usage plan of the district. Next, the energy supplier sends it to the D-SPEM Provider. After the D-SPEM receives it, he creates "proposal for adjustment plans".. Then the D-SPEM sends these proposals to G-CEM. Then G-CEM decomposes them for each building and sends them to Building EMS and Facility manager.		Actor A (Energy Supplier, District Service Provider EMS (D-SPEM))	CEM (Group of Buildings EMS (G-CEM), Building EMS) User (Facility manager)	Proposals for adjustment plan (M3-7)	
4			The Facility manager checks these proposals at the Building EMS terminal in the Customer's building. Then the Facility manager selects one of these proposals based on the "equipment operation plan" and incentive. The Building EMS sends the selected proposal to G-CEM. G-CEM aggregates these proposals and sends to D-SPEM.		User (Facility manager) ,	CEM (Building EMS, Group of Buildings EMS (G-CEM)) Actor A (District Service Provider EMS (D-SPEM))	Aggrega-ted Selected proposal (M3-8)	
5			After the D-SPEM receives the proposal selected by the Customer, the D-SPEM sends suppression signals for groups of building according to the proposal.		Actor A (District Service Provider EMS (D-SPEM))	CEM (Group of Buildings EMS (G-CEM), Building EMS)	Suppres sion signal for group of building (M3-9)	

Scenario								
Scenario name:		**Energy saving, Demand-supply adjustment for the district**						
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
6			The Building EMS adjusts the power usage plan based on suppression signals received. Then Building EMS sends Equipment operation schedule and/or control to the equipment		CEM (Building EMS)	Smart device (Equipment)	Equipment operation schedule (M3-10)	
7			The Equipment reports the energy suppression performance		Smart device (Equipment)	CEM, (Building EMS, Group of Buildings EMS (G-CEM) Actor A (District Service Provider EMS (D-SPEM), Energy Supplier).	Aggregated report (M3-11)	

A.3.14.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of Information exchanged**	**Requirements for information data**
Aggregated Priority information (M3-1)	Aggregated Priority information for the group of building. Priority information is a power supply priority level for each equipment in a building (e.g. lighting, office equipment, air conditioner, ..). Priority level may be categorized such as Critical, Curtailable, and so on.	
Aggregated Power usage plan of the building (M3-2)	Time series of power consumption plan in the future (e.g. day ahead, week ahead, ..) for the group of building by aggregating each building declaration.	
Aggregated Building information (M3-3)	Aggregated Building information for the group of building. Building information includes building category and characteristic such as apartment house, store, public facilities, and so on.	
Power usage plan for the Group of Buildings (M3-4)	Time series of power consumption plan in the future (e.g. day ahead, week ahead, ..) for the group of building given by Actor A (District service provider EMS (D-SPEM)). Power usage plan includes equipment operation schedule (e.g. on/off, set-point, ..) correspondence with each power consumption plan.	

Information exchanged		
Name of information (ID)	**Description of Information exchanged**	**Requirements for information data**
Demand curtailment ability of the District (M3-5)	Power consumption curtailment margin for the district.	[Not Applicable, Information within Actor A at Step No.3]
Power usage plan of the district (M3-6)	Time series of power consumption plan in the future (e.g. day ahead, a week ahead, ..) for the district.	[Not Applicable, Information within Actor A at Step No.3]
Proposals for adjustment plan (M3-7)	Proposals for adjustment plan are created based on priority, power usage plan and consumption of buildings and equipments. These proposals include equipment operation plan and incentive.	
Aggregated Selected proposal (M3-8)	Aggregated selected proposal for group of building. Selected proposal is facility manager's selection of proposals for each building offered by CEM.	
Suppression signals for Groups of Building (M3-9)	Power consumption requirement to the group of building given by Actor A (District service provider EMS (D-SPEM)).	
Equipment operation schedule (M3-10)	Equipment operation schedule for each equipment in a building according with Actor A's Suppression signals for group of building.	
Aggregated report (M3-11)	Aggregated energy suppression performance report of group of building.	

A.3.14.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category Description**
Requirement ID	Requirement Description

A.3.14.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.14.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.15 High level use case (JWG2010) Information exchange on distributed power systems with RES

A.3.15.1 Description of the use case

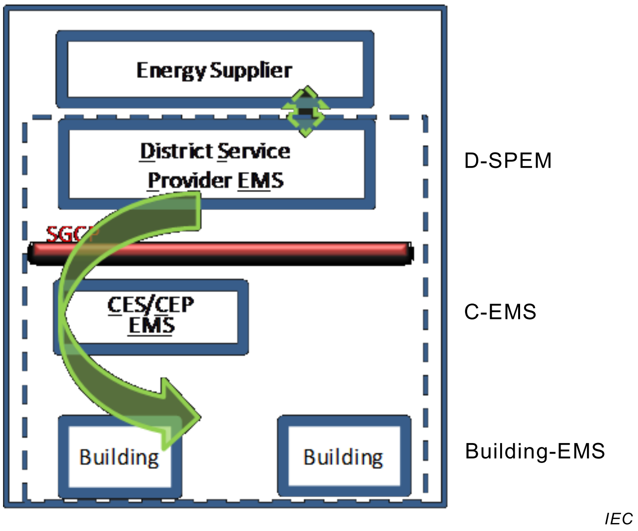
Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG2010	DER, Customer Premises	Information exchange on distributed power systems with RES

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.1	18/02/2014	Initial Draft	Draft
0.2	07/03/2014	Added Use Case ID	Draft
0.3	16/12/2014	Modified the objective and the name of the use case that it does not overlap with JWG2041	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication among the District Service Provider Energy Management System(D-SPEM), the"Community Energy Supplier owning Renewable sources(CES) / Community Energy saving service Provider (CEP)" Energy Management System (C-EMS) and the Building Energy Management System. In this case, SG CP is located among the D-SPEM, the C-EMS and the Building Energy Management System.  EMS: Energy Management System
Objective(s)	The objective of this use case is the information exchange between building owners an energy suppliers on registering for flexibility.
Related business case(s)	This use case is one of the generic use cases of the demand response services for the buildings using in some utilities, BEMS (Building Energy Management System) aggregators, domestic projects in Japan. (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)

Narrative of use case

Narrative of use case
Short description
The District Service Provider EMS (D-SPEM) calculates the ratio of energy contribution to the district by Customers owning Renewable sources of Power (REs). Then the District Service Provider EMS (D-SPEM) gives Customers owning REs an incentive based on their individual energy contribution to the district.
Complete description
1) The CEM (Building EMS, C-EMS) registers “the building id and estimated energy profile with respect to each power classification[8] of smart devices” to the Actor A(Energy supplier&D-SPEM). 2) The Actor A (Energy supplier&D-SPEM) estimates the power produced by REs and the consumption of Customers. 3) The Actor A (Energy supplier&D-SPEM) creates the plan for the distribution to Customers. 4) The Actor A (Energy supplier&D-SPEM) sends the plan for the distribution. 5) The CEM (Building EMS, C-EMS) receives confirmation from his terminal, and sends control signals to the SmartDevice. 6) The smart device sends results to the CEM(Building EMS, C-EMS). 7) The CEM (Building EMS, C-EMS] sends amount of the power produced by REs to the Actor A (Energy supplier&D-SPEM). 8) The Actor A (Energy supplier&D-SPEM) calculate incentive. 9) The Actor A (Energy supplier&D-SPEM) sends incentive information to the CEM (Building EMS, C-EMS). 10) The CEM (Building EMS, C-EMS) receives confirmation from his terminal.

General remarks

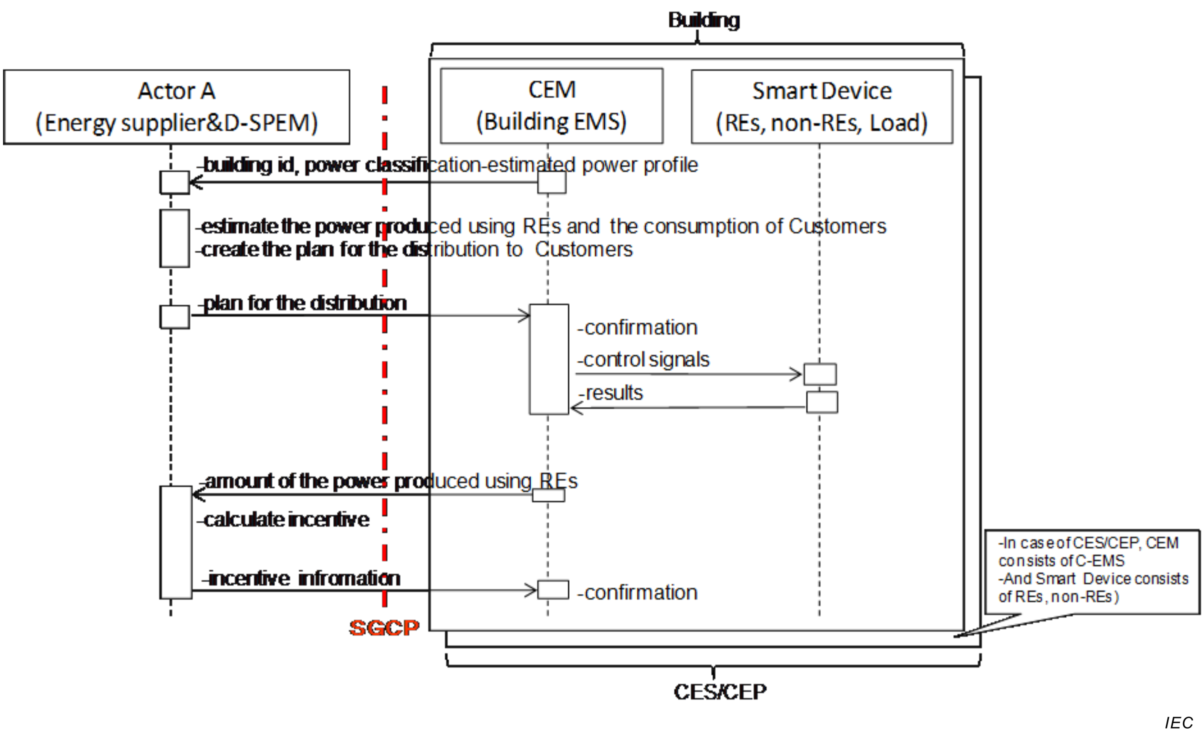
General remarks

A.3.15.2 Diagram of use case

Figure A.24 shows a diagram of use case.

8 i.e. RE, non-RE, Load.

Diagram(s) of use case



CES : Community Energy Supplier owning REs (e.g. Biomass Business), CEP : Community Energy saving service Provider
D-SPEM: District Service Provider EMS, C-EMS: CES/CEP EMS
Power classification : i.e. RE, non-RE, Load, RE : Renewable source of Energy (e.g. Solar Photovoltaic)

Figure A.24 – Sequence diagram

A.3.15.3 Technical details

Actors

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home/building or home/building automation network through the energy management communication channel. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc. In addition in this use case, Actor A consists of Energy Supplier and District Service Provider EMS (D-SPEM). Energy Supplier is a company that delivers electricity to end use customers. D-SPEM manages energy saving and demand-supply for Self-sustaining District/Disaster Recovery.	

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
CEM	Internal	The CEM is a logical function optimizing energy consumption and or production based on signals received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS. In addition in this use case, CEM consists of CES/CEP EMS(C-CEM) and Building EMS. C-CEM manages "adjustment of energy production & consumption in normal conditions" and "Energy accommodation in disaster conditions." Building EMS is a system used to monitor and control smart devices.	
Smart device	External	A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and signals from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor In addition in this use case, smart device consists of "REs, non-REs and load."	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ Contract	**Triggering event**	**Pre-conditions**	**Assumption**
CEM	Registration of information regarding the building and the Community Energy Supplier owning REs/Community Energy saving service Provider (CES/CEP)		

References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Japanese use case Model2, Model3
Level of depth
High level use case
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)
Viewpoint
Technical
Further keywords for classification
Smart Grid, Self-sustaining District, Disaster Recovery

A.3.15.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Acceleration of producing power by REs	CEM	registration of information regarding the building.		

Steps – Scenarios

Scenario								
Scenario Name:		**No. 1 Acceleration of producing power by REs**						
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1			The CEM (Building EMS, C-EMS) registers “the building id and estimated energy profile with respect to each power classification[9] of smart devices” to the Actor A(Energy supplier&D-SPEM).		CEM(Building EMS, C-EMS)	Actor A(Energy supplier&D-SPEM)	building id estimated energy profile with respect to each power classification[10] of smart devices	
2			The Actor A (Energy supplier&D-SPEM) estimates the power produced by REs and the consumption of Customers.		Actor A(Energy supplier&D-SPEM)			
3			The Actor A (Energy supplier&D-SPEM) creates the plan for the distribution to Customers.		The Actor A(Energy supplier&D-SPEM)			
4			The Actor A (Energy supplier&D-SPEM) sends the plan for the distribution.		The Actor A (Energy supplier&D-SPEM)	CEM (Building EMS, C-EMS)	plan for the distribution	
5			The CEM (Building EMS, C-EMS) receives confirmation from his terminal, and sends control signals to the SmartDevice.		CEM (Building EMS, C-EMS)	SmartDevice	control signals	
6			The smart device sends results to the CEM(Building EMS, C-EMS).		SmartDevice	CEM (Building EMS, C-EMS)	results	

9 i.e. RE, non-RE, Load.

10 i.e. RE, non-RE, Load.

Scenario								
Scenario Name:	**No. 1 Acceleration of producing power by REs**							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Servi ce**	**Informa-tion Producer (Actor)**	**Information Receiver (Actor)**	**Informa-tion Exchan-ged**	**Require-ments, R-ID**
7			The CEM (Building EMS, C-EMS] sends amount of the power produced by REs to the Actor A (Energy supplier&D-SPEM).		CEM (Building EMS, C-EMS)	Actor A (Energy supplier&D-SPEM)	amount of the power produced by REs	
8			The Actor A (Energy supplier&D-SPEM) calculate incentive.		-	-		
9			The Actor A (Energy supplier&D-SPEM) sends incentive information to the CEM (Building EMS, C-EMS)		Actor A (Energy supplier&D-SPEM)	CEM (Building EMS, C-EMS)	Incentive information	
10			The CEM (Building EMS, C-EMS) receives confirmation from his terminal		-	-		

A.3.15.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
building id (M4-1-1)	The building id is information to identify individual building.	
estimated energy profile with respect to each power classification[11] of smart devices (M4-1-2)	The estimated energy profile consists of energy profile with respect to each power classification of smart devices.	
plan for the distribution (M4-1-3)	The plan is planning information to distribute electrical power to Customers.	
control signals (M4-1-4)	The control signals consists signals for control smart devices.	
results(M4-1-5)	The results includes results of controlling smart device.	
amount of the power produced by REs (M4-1-6)	The amount of power is created by CEM as results of controlling smart device that produce power by REs.	
Incentive information (M4-1-7)	The information is calculated by Actor A(Energy supplier&D-SPEM)	

11 i.e. RE, non-RE, Load.

A.3.15.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.15.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.15.8 Custom information (optional)

Custom Information (optional)		
Key	**Value**	**Refers to Section**

A.3.16 High level use case (JWG202x) Peak Shift Contribution by Battery Aggregation

A.3.16.1 Description of the use case

Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG202x	**Domains:** Distributed Energy Resources (DER), Customer Premises, **Zones:** Station, Field	Peak Shift Contribution by Battery Aggregation (PSCBA)

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0	09/08/ 2011	Draft for Review (version 1)	
1	02/09/ 2011	Reviewed and revised (version 2)	
3	01/10/ 2011	Reviewed and revised 3	
4	04/10/ 2011	Reviewed and revised 4	

Version management			
Version No.	**Date**	**Changes**	**Approval status**
5	05/10 2011	Reviewed and revised 5	
6	06/10 2011	Reviewed and revised 6	
0.80	12/02/ 2014	Made IEC format version from the document in EPRI format	
0.85	17/02 2014	Revised with IEC UC Team discussion at Jan. 2014	
0.90	21/02/ 2014	Reviewed and revised	Draft for WG comments
0.91	12/03 2014	Minor modification towards JWG inclusion: – JWG Use Case IDs – Domains/Zones selected	

Scope and objectives of use case

Scope and Objectives of use case	
Scope	Peak Shift Contribution by Battery Aggregation (PSCBA)
Objective(s)	PSCBA realizes peak shift during peak hours by making a Virtual Battery from Stationary Batteries and customer's Batteries. Under a contruct, customer side EMS may participate the PSCBA service with surplus capacity of customer's batteries.
Related business case(s)	PSCBA therefore helps to improve efficiency of electric power supply and power supply stabilization.

Narrative of use case

Narrative of use case
Short description
This use case describes interactions between the Grid Operator, Grid EMS, Battery SCADA, Stationary Batteries and customer side EMS during Peak Shift Contribution by Battery Aggregation (PSCBA). Battery SCADA controls many Stationary Batteries as a Virtual Battery. Customer side EMS may participate PSCBA service under the control of Customer side EMS.
Complete description

Narrative of use case

1 Overview

Many batteries are being deployed in the smart grid. These batteries are small scale and distributed. These batteries can be aggregated and controlled as Virtual Energy Storage which can be used for peak shifting or load leveling. The control technology comprises a Grid EMS, Grid Operator, and communications via Battery SCADA. A scenario that describes control functions for Peak Shift Contribution by Battery Aggregation is introduced in this use case.

"Peak Shift Contribution by Battery Aggregation" (PSCBA) is the function for peak shifting or load levelling by the aggregated batteries. PSCBA supports a Grid Operator to make the plan for peak shifting. It encapsulates Stationary Batteries to control and customer's batteries to communicate with so that a Grid Operator can conduct the plan.

The interactions described in this scenario are as follows:

PSCBA calculates the total surplus potential of all batteries deployed in the grid and displays the calculated result as virtual energy storage to the Grid Operator. The Grid Operator can use the PSCBA to check whether a peak shifting plan can be realized or not. PSCBA calculates the total surplus potential of Stationary Batteries and customer's batteries and negotiates with a customer side EMS, such as HEMS or BEMS, about utilization of its battery surplus power. Then, PSCBA evaluates the peak shifting plan and displays the result to the Grid Operator.

Where there is no customer side EMS and the customer's battery is controlled directly from PSCBA, the customer's battery assumes the roles of both battery control and EMS in this use case.

Where there is no customer side EMS and the customer's battery is controlled directly from PSCBA, the customer's battery assumes the roles of both battery control and EMS in this use case.

2 Narrative Description

2.1 Overview of Functions

PSCBA is the function that supports peak shifting or load levelling plans for Grid Operators. PSCBA supports the Grid Operator's implementation of these plans by communicating with and controlling Stationary Batteries and customers' Stationary Batteries.

2.2 Functions of PSCBA

Function of PSCBA comprises eight sub functions:

1 Default Plans Setting for PSCBA

2 Displaying Potential for Default Plans of PSCBA

3 Making Plan for PSCBA

4 Execution Notification of the Plan for PSCBA

5 Control of the Stationary Battery

6 Operation of the Customer's battery

7 Collecting Original Operation Plan of Customer's Battery

8 Monitoring of PSCBA

JWG2021 – Default Plans Settings for PSCBA

Default plan is the typical pattern such as peak shift or reduction of power demand. A Grid Operator can set default plans based on power system load characteristics. Default plans are represented by a pattern of system load increased/decreased value (%) depending on the time as shown in Fig.1. A Grid Operator can add or delete default plans. For example, upon season change, a new default plan with regards to the specific season can be made and no changes would be required until the next season.

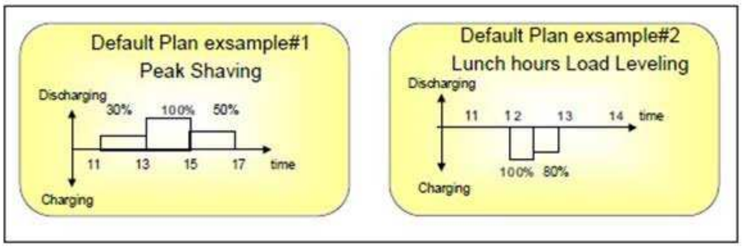


Fig.1 Default Plan

IEC

Narrative of use case
JWG2022 – Displaying Potential for Default plans of PSCBA PSCBA calculates the total surplus potential of all batteries corresponding to each default plan by using customer's original operation plan of their batteries. It then represents the result as if there is a virtual energy storage that has a virtual capacity nearly equal to the total surplus potential of all batteries. Upon a Grid Operator request, PSCBA displays the calculated result that is represented by a pattern of system load increased/decreased value (W) depending on the time for each default plan as shown Fig.2.

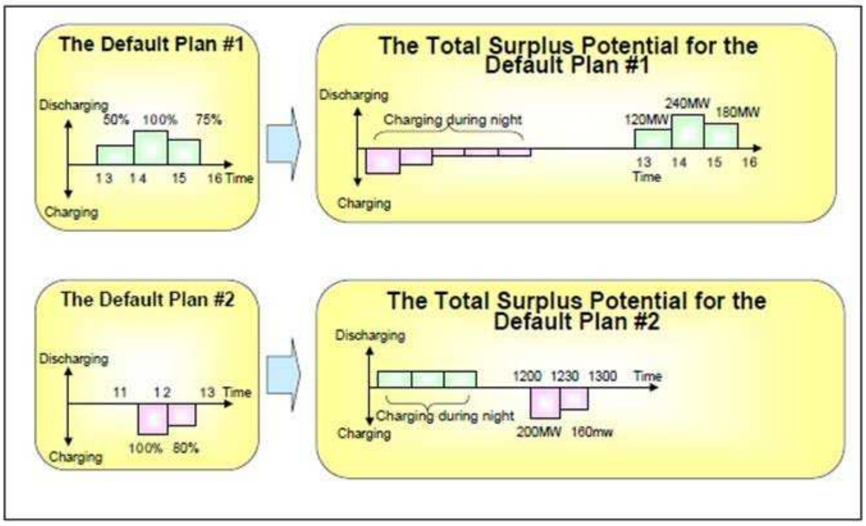


Fig.2 Total Surplus Potential for Default Plan

IEC

PSCBA also calculates Schedule of Batteries for the Default Plan as shown Fig.3 and displays to Grid Operator upon Request.

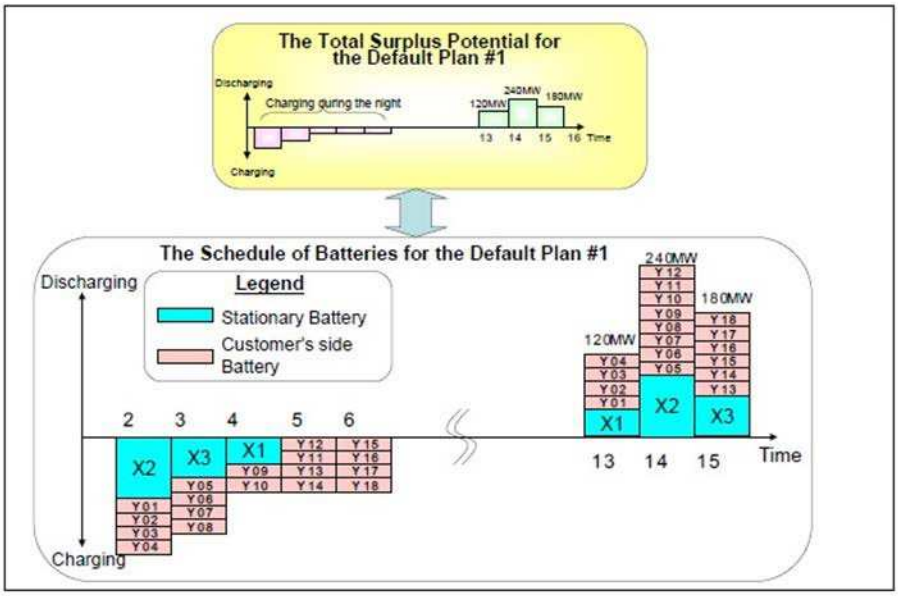


Fig.3 Schedule of Batteries for the Default Plan

IEC

Narrative of use case

JWG2023 – Plan for PSCBA

A Grid Operator can specify the plan for PSCBA, if necessary. The plan is represented by a pattern of system load increased/decreased value (W) depending on the time as shown in Fig.4. PSCBA calculates the total surplus potential of all batteries, and evaluates the plan whether the total surplus is greater than the plan. Continuously, PSCBA selects customer's batteries to make the schedule of batteries for the plan. At that time, the customer's batteries with the lower price are chosen. Then PSCBA displays the evaluation result as if there is one Virtual Battery that has a virtual capacity nearly equal to the total surplus potential of all batteries. The evaluation result includes schedules of Stationary Batteries and customer's batteries for the plan as shown in Fig 5.

The total surplus is the sum of all surpluses of Stationary Batteries and all customers' batteries. Before summing surplus of the customer's battery, Battery SCADA inquires acceptance or rejection of participation to peak shift to each customer side EMS. It sums surplus of the customer's battery, only when PSCBA get acceptance from the customer side EMS.

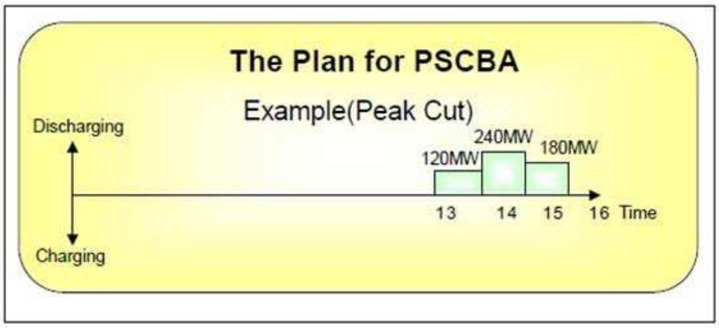


Fig.4 Example of the Plan for PSCBA requested by a Grid Operator

IEC

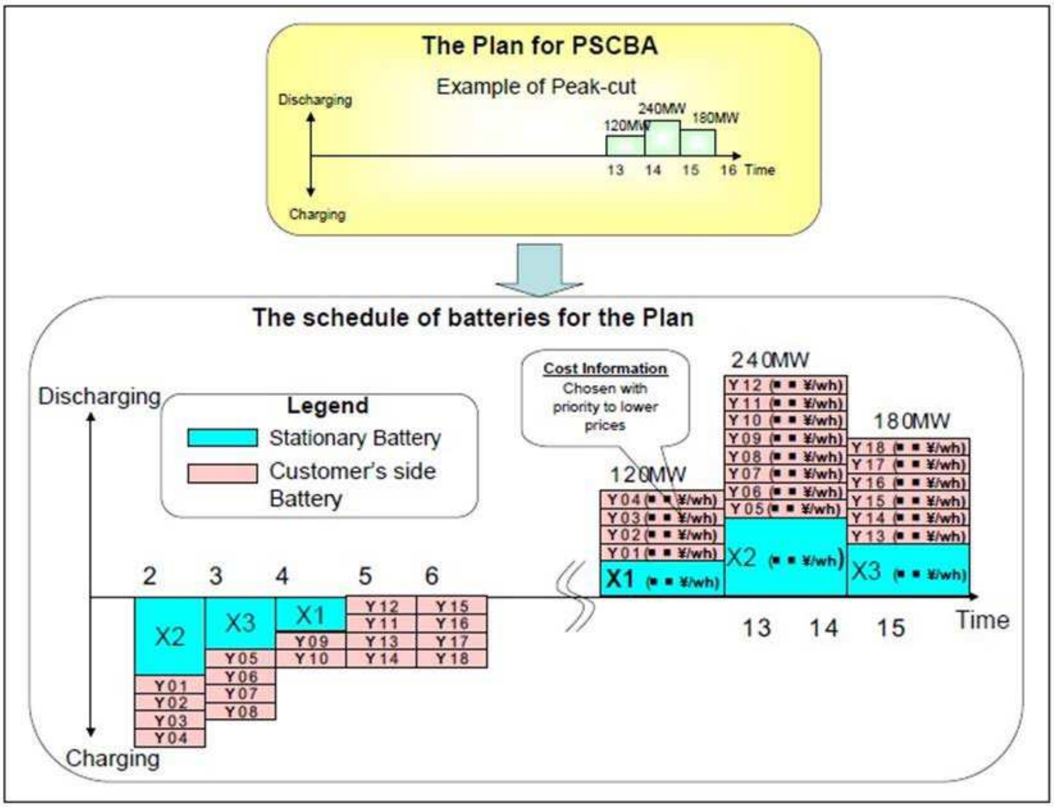


Fig.5 Schedule of Batteries for the Plan

IEC

Narrative of use case
JWG2024 – Execution Notification of Plan for PSCBA When the Grid Operator determines that the plan for PSCBA is possible, he notifies the execution of the plan via the terminal of PSCBA. Execution notification of the plan will be sent to respective customer side EMS (e.g. HEMS, BEMS, etc.). **JWG2025 – Control of the Stationary Battery** Upon execution notification of plan for PSCBA, the stationary battery is controlled according to the schedule of batteries for the plan. **JWG2026 – Control of the Customer's Battery** When the customer side EMS receives execution notification of the plan, it controls the customer's storage battery according to the electrical charge and discharge schedule sent from PSCBA. **JWG2027 – Collecting Original Operation Plan of Customer's Battery** The customer side EMS sends its Original Operation Plan of Customer's Battery to Battery SCADA to participate the plan conducted by PSCBA. PSCBA records and uses them to calculate the total surplus potential of all batteries. The Original Operation Plan of Customer's Battery is one of the following. – the detail schedule – the outline schedule – the surplus schedule The Customer selects one of the above depending on the management method of Customer's battery. **JWG2028 – Monitoring of PSCBA** PSCBA displays 'the plan for PSCBA' and 'the schedule of batteries for the plan'. It also calculates the sum total of charging/discharging of batteries which are listed in the plan, and displays them upon the Grid Operator's request. The Grid Operator can monitor the operation situation of PSCBA. **2.3 Activities/Services to realize PSCBA service** The following activities/services are required to realize PSCBA service. **2.3.1 Calculation of the total surplus potential for the default plan** The total surplus power of Stationary Batteries and customer side batteries are calculated based on each detail/outline/surplus schedule of battery and the default plan that is represented as % pattern as shown in Fig.6. The calculation result is displayed for a Grid Operator as shown below.

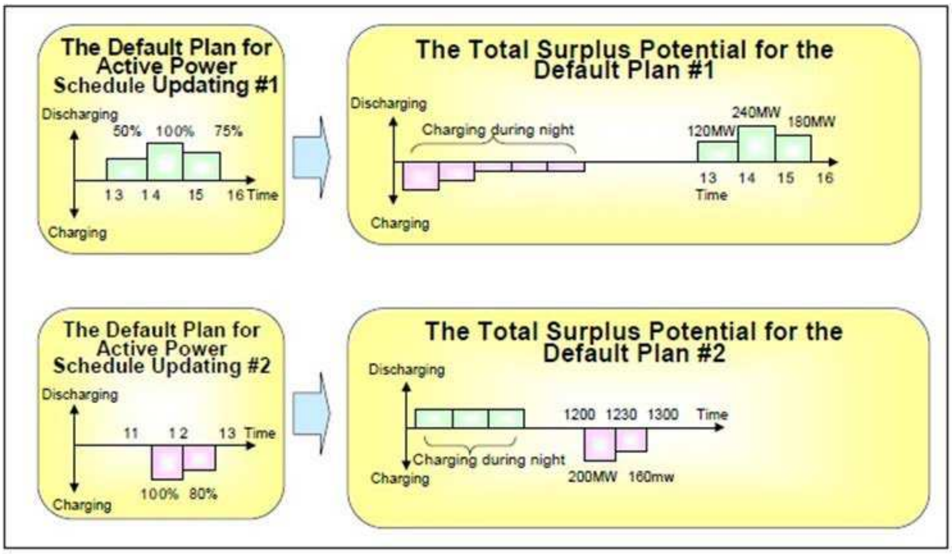


Fig.6 Calculation of the total surplus potential for the default plan

IEC

2.3.2 Calculation of the schedule of batteries for the default plan

From the result of calculated total surplus potential for the default plan, Battery SCADA makes the schedule of batteries for the default plan that is shown in Fig.7.

Narrative of use case

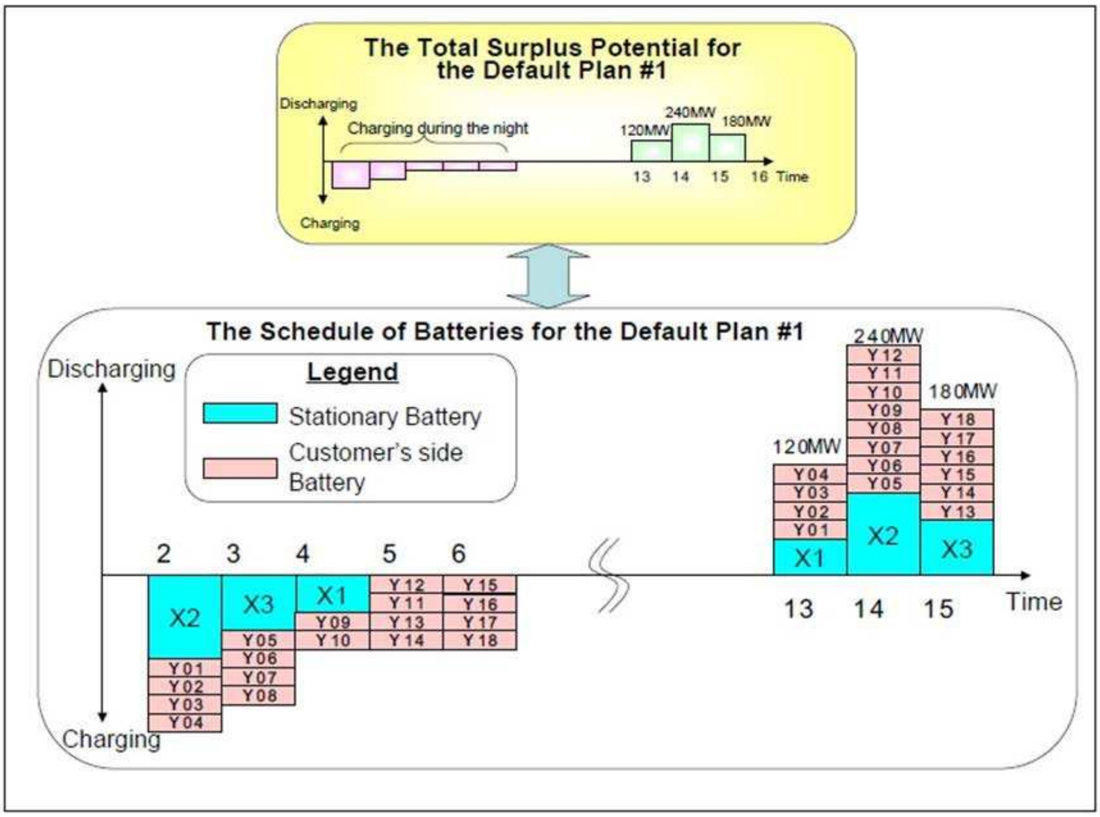


Fig. 7 Calculation of the schedule of batteries for the default plan

IEC

The schedule of batteries for the default plan includes the cost information that is derived from expenses, condition of electrical companies, the policy condition of electric power company and the customer collateral condition specified by each customer.

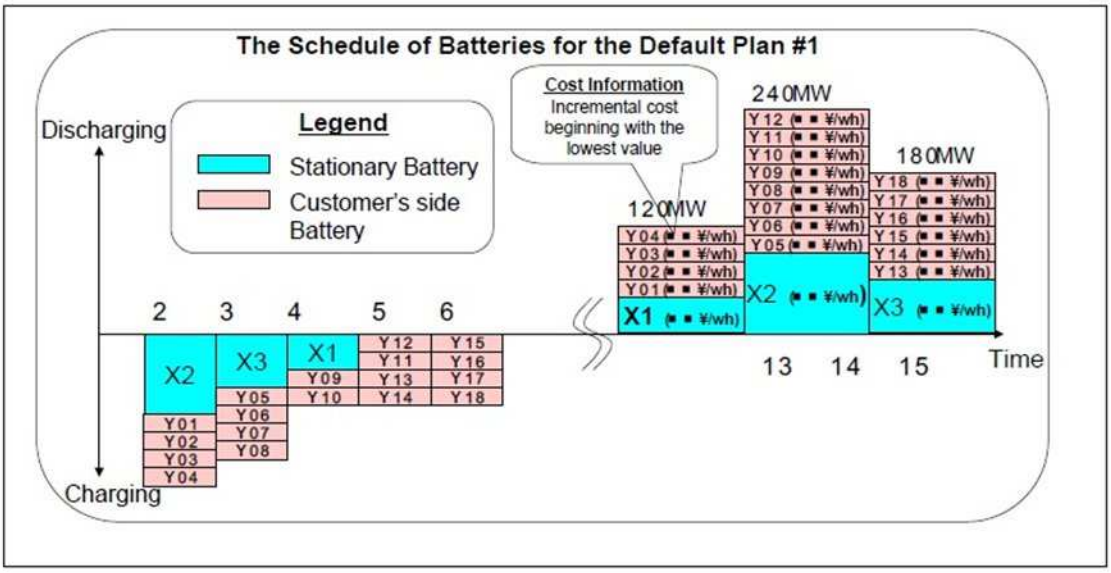


Fig.8 Calculation of the schedule of batteries for the default plan

IEC

Narrative of use case
2.3.3 Calculation of the schedule of batteries for the plan
The schedule of batteries is calculated based on each detail/outline/surplus schedule of battery and the plan that is represented as kW pattern as shown in Fig.9. The calculation result is displayed for a Grid Operator as shown below.

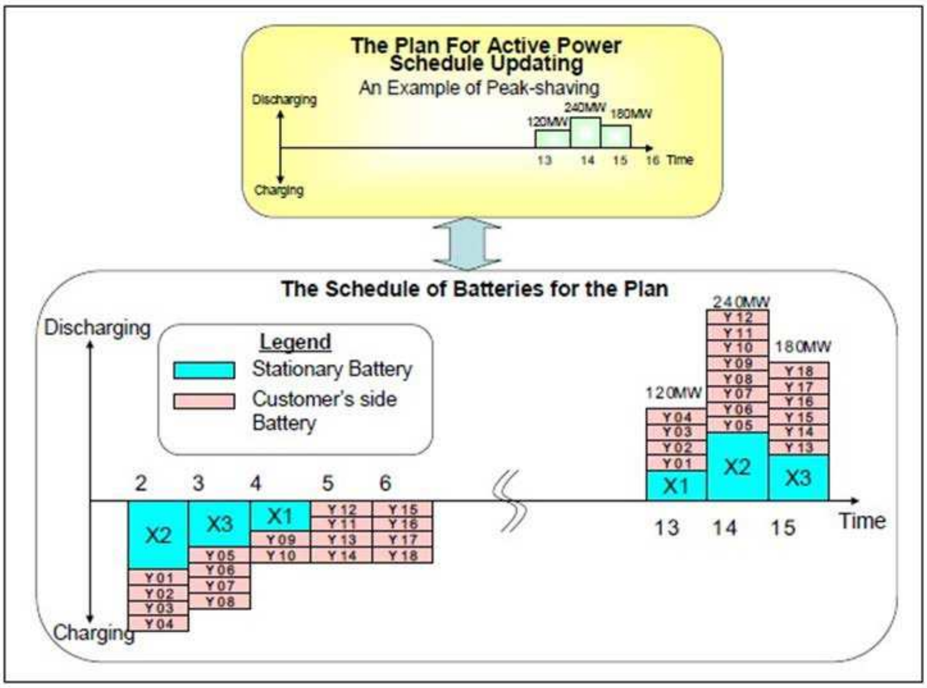


Fig.9 Calculation of the schedule of batteries for the plan

IEC

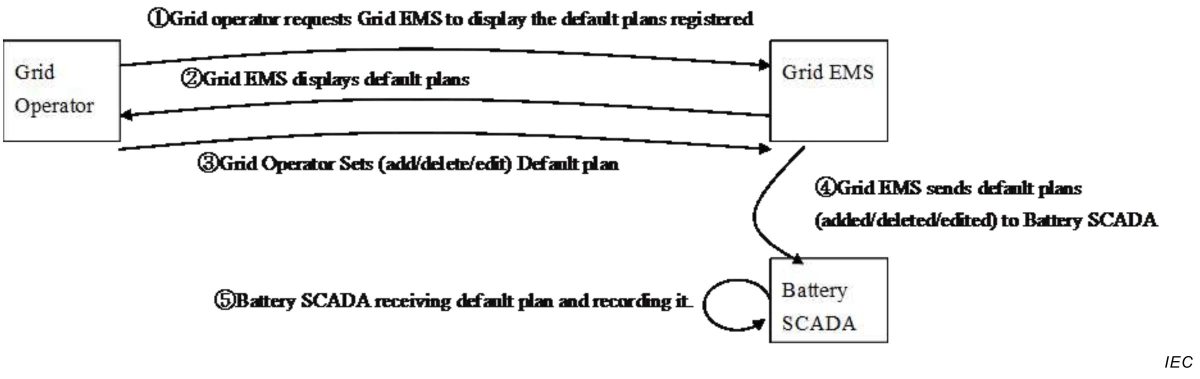
General remarks

General remarks

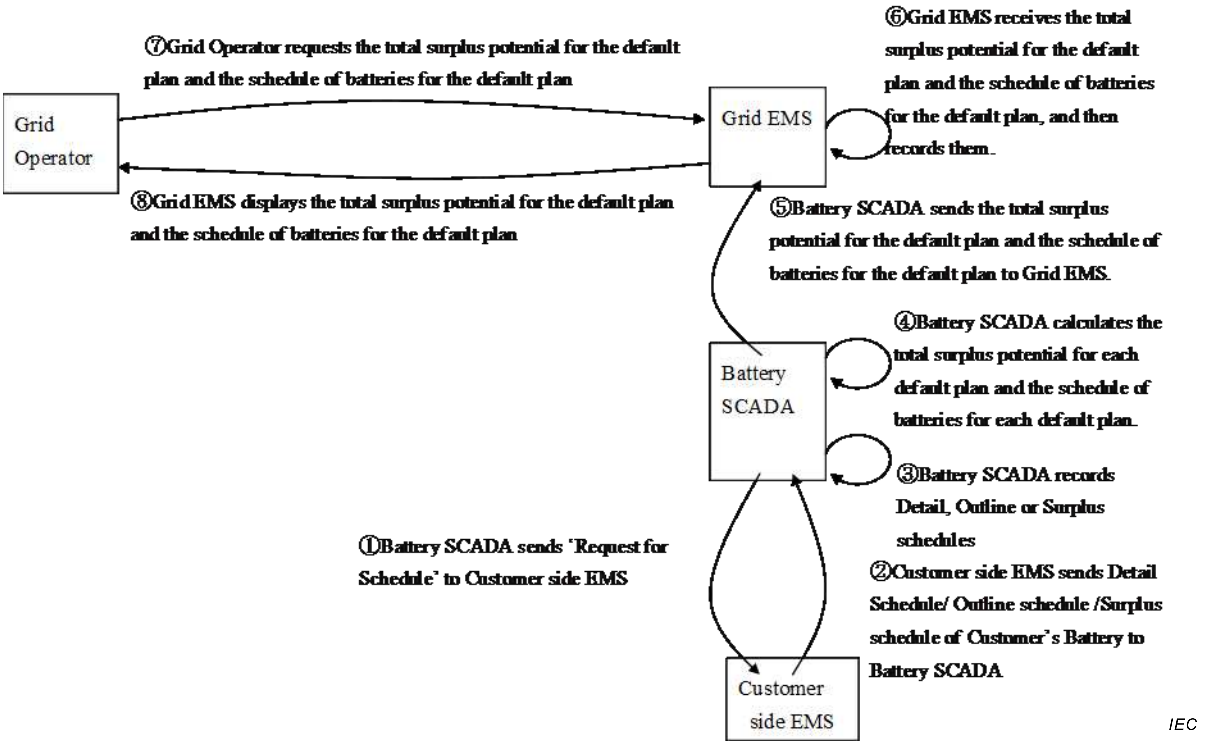
A.3.16.2 Diagrams of use case

Figure A.25 shows diagrams of use case.

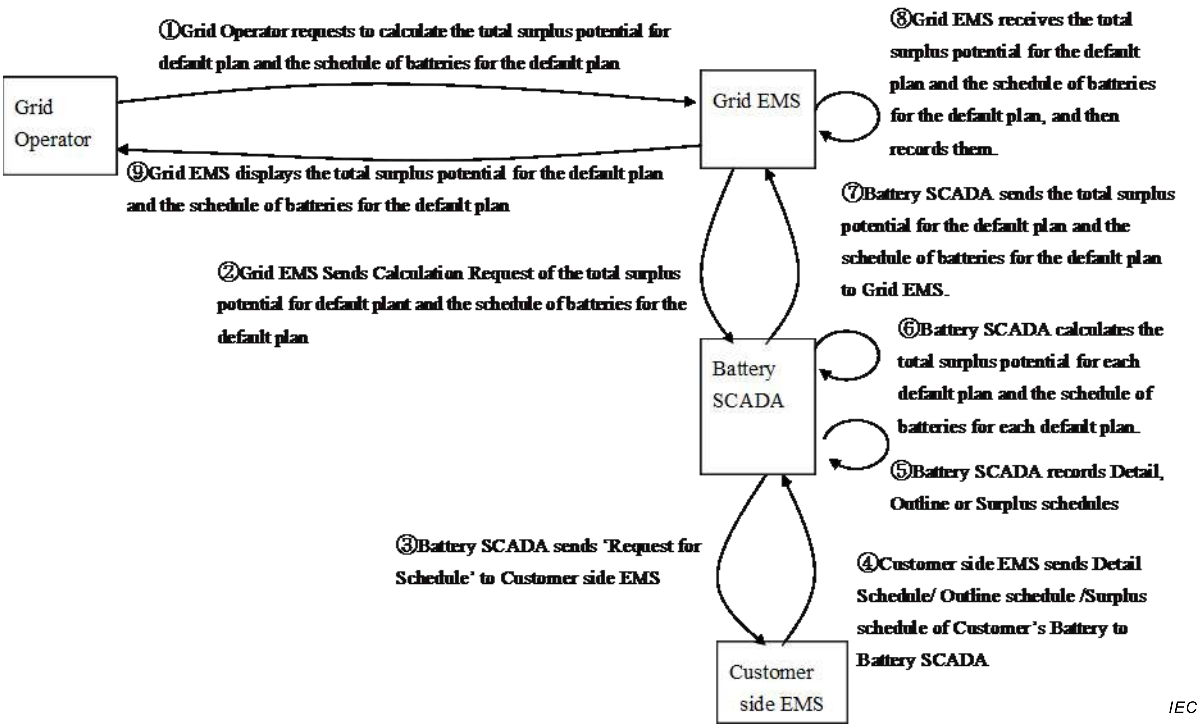
Diagram(s) of use case
(Communication Diagram 1) Default Plans Setting for PSCBA



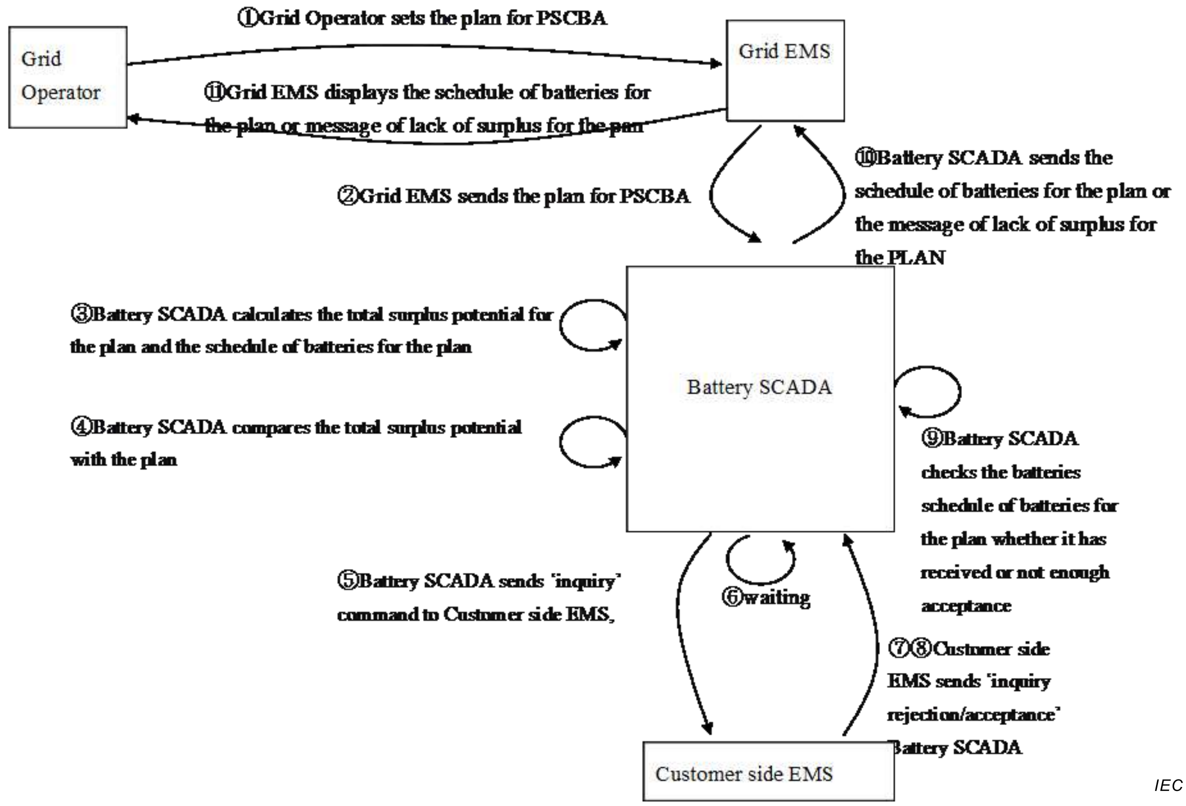
(Communication Diagram 2) Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery（case 1）



Diagram(s) of use case
(Communication Diagram 3) Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery（case2）

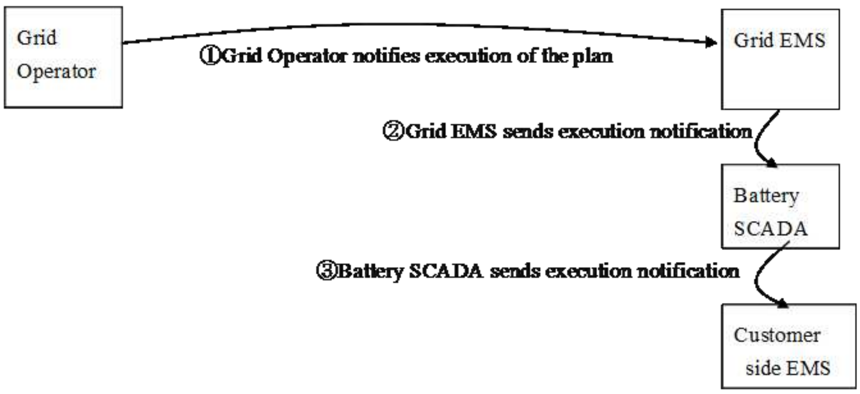


(Communication Diagram 4) Making Plan for PSCBA



Diagram(s) of use case

(Communication Diagram 5) Execution Notification of the Plan for PSCBA



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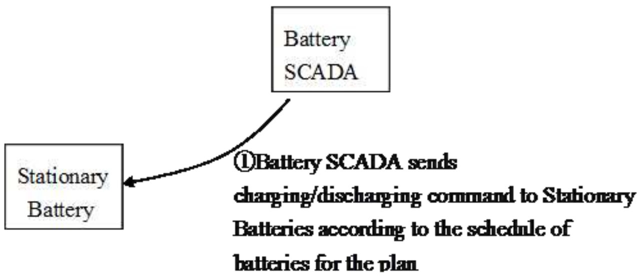
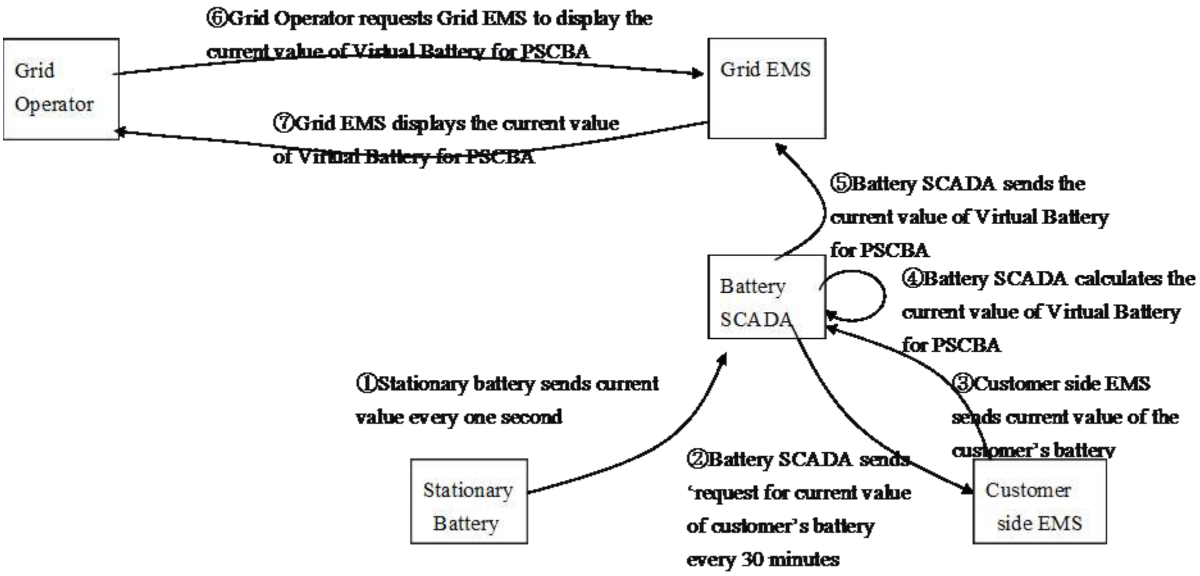
(Communication Diagram 6) Control of the Stationary Battery



IEC

(Communication Diagram 7) Monitoring the Virtual Battery of PSCAB



IEC

Figure A.25 – Use case diagram

A.3.16.3 Technical details

Actors

Actors			
Grouping		**Group Description**	
Actor Name see Actor List	**Actor Type see Actor List**	**Actor Description see Actor List**	**Further information specific to this use case**
Actor A via SG CP	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc. In this use case, the Actors shown below exist within Actor A	
Actors within Actor A from here			
Grid EMS	System	This actor possesses many functions with regards the monitoring and controlling of the grid. That includes frequency and voltage quality maintenance of the grid, economical operation and reliability of the grid. Grid EMS provides man-machine interface for a Grid Operator.	
Grid Operator	Person	Responsible for the maintenance of the grid's frequency and voltage quality, economic operation and grid reliability. The total demand will be forecasted 24 hours ahead, and the generation schedule designed to cover the total demand is made. Due to the considerable change in the forecast in the demand after making the plan for generation schedule, or due to outage of the power generator appointed for use, the Grid Operator has to make the plan of peak shift and conduct it. At this time, PSCBA (Peak shift contribution by Battery Aggregation) is required.	
Battery SCADA	System	Battery SCADA enables the Grid Operators to utilize Stationary Batteries and the surplus capability of the customers' batteries as one large Virtual Battery on its own. The Battery SCADA conducts the calculation of the total potential of the stationary battery's and the customer's battery's surplus power. And It edits calculated results for the Grid Operators as if they have a large Virtual Battery. Battery SCADA controls Stationary Batteries to carry out peak shift contribution by Battery Aggregation. It also sends demand request to use surplus of customer side EMS. Battery SCADA collects detail schedule or surplus schedule of customer's batteries based on which it calculates the total surplus of customer's batteries. Battery SCADA receives the real charging/discharging power corresponding to peak shift contribution by Battery Aggregation from customer side EMS.	

Actors			
Grouping		**Group Description**	
Actor Name see Actor List	**Actor Type see Actor List**	**Actor Description see Actor List**	**Further information specific to this use case**
Stationary Battery	Device	Stationary Battery charges and discharges according to the charging/discharging commands from Battery SCADA.	
Actors within Actor A to here			
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. In this use case, the Actor shown below is used as smart device.	
Actor used as smart device from here			
Customer’s battery	Device	Customer’s batteries are controlled by Customer side EMS.	
Actor used as smart device to here			
Customer Energy Manager (CEM)	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer’s settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the “grid / market”. Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS. In this use case, the Actor shown below is used as smart device.	
Actor used as CEM from here			
Customer side EMS	System	Customer side EMS determines participation in the unrestrictive Demand Response according to the conditions such as the collateral condition and the maximum and minimum value of the battery output power that are specified by the customer. Upon participation, Customer side EMS controls the Customer’s Battery according to the request from Battery SCADA.	
Actor used as CEM to here			

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
Contract between Electric Power Company and the Customer			Contract is made between the electric company and the customer. It includes following: – Battery SCADA and the customer side EMS communicate each other. – The electric company uses the surplus of customer's battery when the customer accepts. – In return, the customer gets a reward for operating its battery according to requests from Battery SCADA.
Grid Operator		Grid Operator is going to plan PSCBA such as peak shifting, load levelling, or smoothing the fluctuations of the power load during night hours.	
Grid EMS		Grid EMS provides man-machine interface for a Grid Operator.	
Battery SCADA		Battery SCADA is ready to control Stationary Batteries, communicate with customer side EMS and communicate with Grid EMS.	
Stationary Battery		Stationary Batteries can be controlled by Battery SCADA.	
Customer side EMS		Customer side EMS is ready to communicate with Battery SCADA and can control Customer's battery.	

References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Use case	Peak Shift Contribution by Battery Aggregation (Virtual Energy Storage)		Original of this UC	EPRI Use Case Repository	

Further information on the use case for classification / mapping

Classification information
Relation to other use cases

Classification information
Level of depth
Detailed use case
Prioritisation
Generic, regional or national relation
Generic
Viewpoint
Technical
Further keywords for classification
Smart Grid, Stationary Battery, Customer Battery, Battery Aggregation, Virtual Battery

A.3.16.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Default Plans Setting for PSCBA	Gird Operator in Actor A	With every seasonal change or a change in the demand	Grid Operator makes default plans to be assumed to execute PSCBA.	Grid EMS and Battery SCADA within Actor A recode the default plans.
2	Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 1)	Battery SCADA in Actor A	By a pre-defined time (e.x. 2 pm. 1 day ahead)	Under the contract, communication path with Customer-side EMS is active	Grid EMS records the total surplus potential for each default plan and the schedule of batteries for each default plan and displays them to Grid Operator upon request
3	Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 2)	Battery SCADA in Actor A	Upon Grid Operator request	Under the contract, communication path with Customer-side EMS is active	Grid EMS records the total surplus potential for each default plan and the schedule of batteries for each default plan and displays them to Grid Operator upon request
4	Making Plan for PSCBA	Gird Operator in Actor A	Upon Grid Operator Request	Grid Operator makes plans to be executed	Battery SCADA makes the schedule of batteries for the plan and sends it to Grid EMS and Grid Operator
5	Execution Notification of the Plan for PSCBA	Gird Operator in Actor A	When Grid Operator review and approve The Schedule of Batteries for the Plan	The schedule of batteries for the plan is sufficient	Battery SCADA controls Stationary Battery and Customer side EMS controls Customer Battery.

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
6	Control of Stationary Battery	Battery SCADA in Actor A	Every 1second during conducting the plan for PSCBA	Battery SCADA receives the execution notification	Battery SCADA calculates the current value of Virtual Battery for PSCBA
7	Monitoring the Virtual Battery of PSCBA, Customer Battery	Customer side EMS as CEM	Every 30 minutes	Customer side EMS receives the execution notification	Customer side EMS sends the current value of the customer's battery and Battery SCADA calculates the current value of Virtual Battery for PSCBA
8	Monitoring the Virtual Battery of PSCBA, Stationary Battery	Battery SCADA in Actor A	Every 1 second	Battery SCADA receives the execution notification	Battery SCADA calculates the current value of Virtual Battery for PSCBA

Steps – Scenarios

Scenario								
Scenario name:		**JWG2021 – Default Plans Setting for PSCBA**						
Step No.	**Event**	**Name of process/ activity**	**Descrip-tion of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchan-ged**	**Require-ments, R-ID**
1	With every seasonal change or a change in the demand	Requesting default plans registered	Grid operator requests Grid EMS to display the default plans registered, from the terminal of Grid EMS	CREATE	Grid Operator in Actor A	Grid EMS in Actor A	Display Request of Default plans	
2	Upon Grid Operator's request	Displaying default plans registered	Grid EMS displays default plans	GET	Grid EMS in Actor A	Grid Operator in Actor A	Default plan for PSCBA	
3	Completion of displaying	Default plan settings	Grid Operator Sets (add/delete/ edit) Default plan.	CHANGE	Grid Operator in Actor A	Grid EMS in Actor A	Display Request of Default plans	
4	Completion of setting default plan	Sending default plans	Grid EMS sends default plans (added/deleted/edited) to Battery SCADA	CHANGE	Grid EMS in Actor A	Battery SCADA in Actor A	Default plan for PSCBA	

Scenario								
Scenario name:		**JWG2021 – Default Plans Setting for PSCBA**						
Step No.	**Event**	**Name of process/ activity**	**Descrip-tion of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchan-ged**	**Require-ments, R-ID**
5	Receiving default plan	Recording default plan	Battery SCADA receives default plan and records it.	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Default plan for PSCBA	

Scenario								
Scenario name:		**JWG2022 – Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 1)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
1	By 2 pm. 1 day ahead	Sending Request for Schedule	Battery SCADA sends ‘Request for Schedule’ to Customer side EMS	CERATE	Battery SCADA in Actor A	Customer side EMS as CEM	Request for Schedule	
2a (cf)	Upon Receiving Request for Schedule	Sending Detail Schedule of Customer’s Battery	Customer side EMS sends Detailed Schedule of Customer’s Battery to Battery SCADA	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Detail Schedule of Customer’s Battery	
2b (cf)	Upon Receiving Request for Schedule	Sending Outline Schedule of Customer’s Battery	Customer side EMS sends Outline schedule of Customer’s Battery to Battery SCADA	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Outline Schedule of Customer’s Battery	
2c (cf)	Upon Receiving Request for Schedule	Sending Surplus schedule of Customer’s Battery	Customer side EMS sends Surplus schedule of Customer’s Battery to Battery SCADA	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Surplus schedule of Customer’s Battery	
3	Upon receiving Detail/Outline/Sur-plus schedules	Recording Detail / Outline / Surplus schedules	Battery SCADA records Detail, Outline or Surplus schedules	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Detail, Outline or Surplus Schedule of Customer’s Battery	

Scenario								
Scenario name:		**JWG2022 – Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 1)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
4	Upon receiving Detail/Outline/Sur-plus schedules from all Customer side EMS	Calcula-tion of the total surplus potential for each default plan and the schedule of batteries for each default Plans	Battery SCADA calculates the total surplus potential for each default plan and the schedule of batteries for each default plan.	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	The total surplus potential for the default plan and the schedule of batteries for the default plan	
5	Comple-tion of calcula-tion	Sending the total surplus potential for the default plan and the schedule of batteries for the default plan.	Battery SCADA sends the total surplus potential for the default plan and the schedule of batteries for the default plan to Grid EMS.	CHANGE	Battery SCADA in Actor A	Grid EMS in Actor A	The total surplus potential for the default plan and the schedule of batteries for the default plan	
6	Receiving the total surplus potential for the default plan and the schedule of batteries for the default plan.	Recording the total surplus potential for the default plan and the schedule of batteries for the default plan.	Grid EMS receives the total surplus potential for the default plan and the schedule of batteries for the default plan, and then records them.	CHANGE	Grid EMS in Actor A	Grid EMS in Actor A	The total surplus potential for the default plan and the schedule of batteries for the default plan	
7	Upon Grid Operator request	Reques-ting the total surplus potential for the default plan and the schedule of batteries for the default plan	Grid Operator requests the total surplus potential for the default plan	CREATE	Grid Operator	Grid EMS	Display Request of the total surplus potential for default plan and the schedule of batteries for the default plan	

Scenario								
Scenario name:		**JWG2022 – Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 1)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
8	Upon Receiving Grid Operator 's display request	Displaying the total surplus potential for the default plan and the schedule of batteries for the default plan	Grid EMS displays the total surplus potential for the default plan and/or the schedule of batteries for the default plan	GET	Grid EMS	Grid Operator	the total surplus potential for the default plan and the schedule of batteries for the default plan	
(cf)	As for “Detail Schedule”, “Outline Schedule” and “Surplus Schedule”, one of them shall be used according to the management method of Customer’s Battery.							

Scenario								
Scenario name:		**JWG2023 – Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 2)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion produce r (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
1	Upon Grid Operator request	Reques-ting to calculate the total surplus potential for default plan and the schedule of batteries for the default plan	Grid Operator requests to calculate the total surplus potential for default plan and the schedule of batteries for the default plan	CRE ATE	Grid Operator in Actor A	Grid EMS in Actor A	Calculation Request of the total surplus potential for default plan and the schedule of batteries for the default plan	
2	Upon Receiving Operator request	Sending Calcula-tion Request of the total surplus potential for default plan and the schedule of batteries for the default plan	Grid EMS Sends Calculation Request of the total surplus potential for default plan and the schedule of batteries for the default plan	CRE ATE	Grid EMS in Actor A	Battery SCADA in Actor A	Calculation Request of the total surplus potential for default plan and the schedule of batteries for the default plan	

Scenario								
Scenario name:		**JWG2023 – Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 2)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
3	Upon receiving calculation Request of the total surplus potential for default plant	Sending Request for Schedule	Battery SCADA sends 'Request for Schedule' to Customer side EMS	CERATE	Battery SCADA in Actor A	Customer side EMS as CEM	Request for Schedule	
4a (cf)	Upon Receiving Request for Schedule	Sending Detail Schedule of Customer's Battery	Customer side EMS sends Detail Schedule of Customer's Battery to Battery SCADA	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Detail Schedule of Customer's Battery	
4b (cf)	Upon Receiving Request for Schedule	Sending Outline Schedule of Customer's Battery	Customer side EMS sends Outline schedule of Customer's Battery to Battery SCADA	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Outline Schedule of Customer's Battery	
4c (cf)	Upon Receiving Request for Schedule	Sending Surplus schedule of Customer's Battery	Customer side EMS sends Surplus schedule of Customer's Battery to Battery SCADA	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Surplus schedule of Customer's Battery	
5	Upon receiving Detail/Outline/Surplus schedules	Recording Detail/Outline/Surplus schedules	Battery SCADA records Detail, Outline or Surplus schedules	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Detail, Outline or Surplus Schedule of Customer's Battery	
6	Upon receiving Detail/Outline/Surplus schedules from all Customer side EMSs	Calculation of the total surplus potential for each default plan and the schedule of batteries for each default Plans	Battery SCADA calculates the total surplus potential for each default plan and the schedule of batteries for each default plan.	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	The total surplus potential for each default plan and the schedule of batteries for each default plan	

Scenario								
Scenario name:		**JWG2023 – Displaying Potential for Default Plans of PSCBA with collecting Original Operation Plan of Customer's Battery (Case 2)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
7	Comple-tion of calculation the total surplus potential for each default plan	Sending the total surplus potential for each default plan and the schedule of batteries for each default Plans	Battery SCADA sends the total surplus potential for each default plan and the schedule of batteries for each default plans to Grid EMS	CHA NGE	Battery SCADA in Actor A	Grid EMS in Actor A	The total surplus potential for each default plan and the schedule of batteries for each default plans	
8	Upon Receiving the total surplus potential for each default plan	Recording the total surplus potential for each default plan the schedule of batteries for the default plan	Grid EMS receives the total surplus potential for each default plan and the schedule of batteries for each default plans and records them	CHA NGE	Grid EMS in Actor A	Grid EMS in Actor A	The total surplus potential for each default plan and the schedule of batteries for each default Plan	
9	Comple-tion Recording	Displaying the total surplus potential for each default plan and the schedule of batteries for the default plan	Grid EMS displays the total surplus potential for each default plan and the schedule of batteries for the default plan	GET	Grid EMS in Actor A	Grid Operator in Actor A	The total surplus potential for each default plan and the schedule of batteries for each default Plan	
(cf) As for “Detail Schedule”, “Outline Schedule” and “Surplus Schedule”, one of them shall be used according to the management method of Customer’s Battery.								

Scenario								
Scenario name:		**JWG2024 – Making Plan for PSCBA**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
1	Upon Grid Operator Request	Setting the Plan for PSCBA	Grid Operator sets the Plan for PSCBA	CHA NGE	Grid Operator in Actor A	Grid EMS in Actor A	The Plan for PSCBA	
2	Receiving Grid Operator’s request	Sending the Plan for PSCBA	Grid EMS sends the Plan for PSCBA to Battery SCADA	CHA NGE	Grid EMS in Actor A	Battery SCADA in Actor A	The Plan for PSCBA	

Scenario								
Scenario name:		**JWG2024 – Making Plan for PSCBA**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion produce r (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
3	Upon receiving the Plan for PSCBA	Calculating the total surplus potential for the plan and the schedule of Batteries for the plan	Battery SCADA calculates the total surplus potential for the plan and the schedule of batteries for the plan	CRE ATE	Battery SCADA in Actor A	Battery SCADA in Actor A	The total surplus potential for the plan The schedule of batteries for the plan	
4	Comple-tion of calculating ‘the total surplus potential for the plan’	Comparing the total surplus potential with the plan	Battery SCADA compares the total surplus potential with the plan IF [the total surplus potential for the plan]<[The Plan for PSCBA], Then, move on to step #10.a.1, IF NOT, move on to step #5	CRE ATE	Battery SCADA in Actor A	Battery SCADA in Actor A	The Plan for PSCBA The total surplus potential for the plan	
5	Comple-tion of comparing the total surplus potential with the plan	Sending ‘inquiry’ command to Customer side EMS	Battery SCADA sends ‘inquiry’ command to Customer side EMS,	CRE ATE	Battery SCADA in Actor A	Custome r side EMS as CEM	‘Inquiry’	
6	Comple-tion of sending ‘inquiry’ command to Customer side EMS,	Waiting for response to inquiry from Customer side EMS,	Battery SCADA waits for response to the inquiry from the Customer side EMS, If, time out occur during waiting, then move on to step #10a.1, IF NOT, move on to step #7.a.1 or step #7.b	EXE CUT E	Battery SCADA in Actor A	Battery SCADA in Actor A	‘Inquiry’	
7.a.1	Upon receiving ‘Inquiry’ command	Sending ‘Inquiry rejection’	Customer side EMS sends ‘inquiry rejection’ to Battery SCADA	CHA NGE	Custome r side EMS as CEM	Battery SCADA in Actor A	Inquiry Rejection	

Scenario								
Scenario name:		**JWG2024 – Making Plan for PSCBA**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
7.a.2	Upon receiving 'inquiry rejection'	Receiving 'Inquiry rejection' and updating the schedule of batteries for the plan	Battery SCADA receives 'Inquiry rejection' and updates the schedule of batteries for the plan (deleting rejecting customer's battery from the schedule)	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Inquiry Rejection The schedule of batteries for the plan	
7.a.3	Completion of receiving 'inquiry rejection'	Checking the batteries schedule of batteries for the plan to select another Customer's battery	Battery SCADA checks the battery schedule for the plan to select other Customer's battery If no, another customer's battery is selected, then move on to step #10.a.1, Else move on to step #7.a.4	EXECUTE	Battery SCADA in Actor A	Battery SCADA in Actor A	The schedule of batteries for the plan	
7.a.4	Completion of checking the batteries schedule of batteries for the plan to select other Customer's battery	Sending 'inquiry' command to Customer side EMS	Battery SCADA sends 'inquiry' command to Customer side EMS, Move on to step #6	CREATE	Battery SCADA in Actor A	Customer side EMS as CEM	'Inquiry'	
7.b	Upon receiving 'Inquiry' command	Sending 'Inquiry acceptance'	Customer side EMS sends acceptance to Battery SCADA	CHANGE	Customer side EMS as CEM	Battery SCADA in Actor A	Inquiry acceptance	
8	Upon receiving 'Inquiry acceptance	Receiving 'Inquiry acceptance	Battery SCADA receives 'Inquiry acceptance	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Inquiry acceptance	

Scenario								
Scenario name:		**JWG2024 – Making Plan for PSCBA**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion produce r (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
9	Comple-tion of receiving 'inquiry acceptan-ce	Checking the schedule of batteries for the plan whether or not receiving enough acceptances	Battery SCADA checks the schedule of batteries for the plan whether it has received or not received enough acceptances. If Battery SCADA has not enough acceptances, then move on to step #6, Else, move on to step #10.b1	EXE CUT E	Battery SCADA in Actor A	Battery SCADA in Actor A	Inquiry acceptance the schedule of batteries for the plan	
10.a.1	In step #4.4, the total surplus is not enough, or in step #4.6, time out occurs, or in step #4.7.a.3, no other customer's battery is selected	Sending Message of lack of surplus for the plan to Grid EMS	Battery SCADA Sends Message of lack of surplus for the plan and the schedule of batteries for the plan to Grid EMS	CHA NGE	Battery SCADA in Actor A	Grid EMS in Actor A	Message of lack of surplus for the plan and The schedule of batteries for the plan	
10.a.2	Upon receiving Message of lack of surplus for the plan	Receiving Message of lack of surplus for the plan and the schedule of batteries for the plan	Grid EMS receives Message of lack of surplus for the plan and the schedule of batteries for the plan	CHA NGE	Grid EMS in Actor A	Grid EMS in Actor A	Message of lack of surplus for the plan and The schedule of batteries for the plan	
10a.3	Comple-tion of receiving Message	Display Message of lack of surplus for the plan and the schedule of batteries for the plan	Grid EMS displays Message of lack of surplus for the plan and the schedule of batteries for the plan. Move on to Exit, Or move on to step #1 to retry with another plan	CHA NGE	Grid EMS in Actor A	Grid Operator in Actor A	Message of lack of surplus for the plan The schedule of batteries for the plan	
10.b.1	Upon all 'Inquiry acceptan-ce'	Sending the schedule of batteries for the plan	Battery SCADA sends the schedule of batteries for the plan	CHA NGE	Battery SCADA in Actor A	Grid EMS in Actor A	Schedule of batteries for the plan	

Scenario								
Scenario name:	**JWG2024 – Making Plan for PSCBA**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
10.b2	Upon receiving the schedule of batteries for the plan	Display the schedule of batteries for the plan	Grid EMS displays the schedule of batteries for the plan	GET	Grid EMS in Actor A	Grid Operator in Actor A	Schedule of batteries for the plan	

Scenario								
Scenario name:	**JWG2025 – Execution Notification of the Plan for PSCBA**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	When Grid Operator review and approve The Schedule of Batteries for the Plan	Notifying execution of the plan	Grid Operator notifies execution of the plan	CHANGE	Grid Operator in Actor A	Grid EMS in Actor A	Execution Notification	
2	Upon receiving Execution Notification	Sending Execution Notification	Grid EMS sends Execution Notification to Battery SCADA.	CHANGE	Grid EMS in Actor A	Battery SCADA in Actor A	Execution Notification	
3	Upon receiving Execution Notification	Sending Execution Notification	Battery SCADA sends Execution Notification to Customer side EMS	CHANGE	Battery SCADA in Actor A	Customer side EMS as CEM	Execution Notification	

Scenario								
Scenario name:	**JWG2026 – Control of Stationary Battery**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	Every 1second during conducting the plan for PSCBA	Sending Charging / Discharging command	Battery SCADA sends Charging/Discharge command to Stationary Battery according to the schedule of batteries for the plan	CHANGE	Battery SCADA in Actor A	Stationary Battery in Actor A	Charging / Discharging command	

Scenario								
Scenario name:	**JWG2026 – Control of Stationary Battery**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
2	Upon receiving Charging / Discharging command	Charging or Discharging Sending Current Status	Stationary Batteries charge or discharge according Charging/Discharge command And sends Current Status to Battery SCADA	CHANGE	Stationary Battery in Actor A	Battery SCADA in Actor A	Current Status of each stationary battery	
3	Upon receiving current Status of each stationary battery	Recording current Status of each stationary battery	Battery SCADA records current Status of each stationary battery	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Current Status of each stationary battery	

Scenario								
Scenario name:	**JWG2027 – Monitoring the Virtual Battery of PSCBA, Customer Battery**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
1	Every 30 minutes	Sending 'request for current status of Customer's Battery'	Battery SCADA sends 'request for current status of Customer's Battery' to customers' EMSs	CREATE	Battery SCADA in Actor A	Customer side EMS as CEM	request for current status of Customer's Battery	
2	Upon receiving 'request for current status of Custome r's Battery'	Sending current status of each Customer's Battery	Customers' side EMS sends current status of each Customer's Battery	GET	Customer side EMS as CEM	Battery SCADA in Actor A	Current status of each Customer's Battery	
3	Upon receiving current status	Receiving and recording current status of each Customer's Battery	Battery SCADA receives and records current status of each Customer's Battery	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Current status of each Customer's Battery	

Scenario								
Scenario name:	**JWG2028 – Monitoring the Virtual Battery of PSCBA, Stationary Battery**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	Every 1 second	Calculation of Current Status of Virtual Battery for PSCAB	Battery SCADA Calculates Current Status of Virtual Battery for PSCAB using Current Status of each Customer's Battery, Current Status of each Stationary Battery and the Schedule of Batteries for the Plan	CHANGE	Battery SCADA in Actor A	Battery SCADA in Actor A	Current Status of Virtual Battery for PSCAB	
2	Completion of calculating Current Status of Virtual Battery for PSCAB	Sending Current Status of Virtual Battery for PSCAB	Battery SCADA sending Current Status of Virtual Battery for PSCAB to Grid EMS	CHANGE	Battery SCADA in Actor A	Grid EMS in Actor A	Current Status of Virtual Battery for PSCAB	
3	Receiving Current Status of Virtual Battery for PSCAB	Recording Current Status of Virtual Battery for PSCAB	Grid EMS records Current Status of Virtual Battery for PSCAB	CHANGE	Grid EMS in Actor A	Grid EMS in Actor A	Current Status of Virtual Battery for PSCAB	
4	Upon Grid Operator request	Requesting Display of Current Status of Virtual Battery for PSCAB	Grid Operator request display of Current Status of Virtual Battery for PSCAB	CREATE	Grid Operator in Actor A	Grid EMS in Actor A	Display Request of Current Status of Virtual Battery for PSCAB	
5	Upon receiving Display Request	Displaying Current Status of Virtual Battery for PSCAB	Grid EMS displays Current Status of Virtual Battery for PSCAB	GET	Grid EMS in Actor A	Grid Operator in Actor A	Current Status of Virtual Battery for PSCAB	

A.3.16.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Request for Current Status of Customer's Battery	This is a request command for Current Status of Customer's Battery. Every 30 min, this command will be sent from the Battery SCADA to each customer side EMS.	This command includes ID for customer side EMS as the destination of this message
Current Status of each Customer's Battery	This is the response of the Request for Current Status of Customer's Battery.	This information includes active power, SOC and operation condition of Customer's battery which is controlled by the customer side EMS.
Current Status of each Stationary Battery	This information includes active power, SOC and operation condition, and Remote/local condition.	[Not Applicable, Information within Actor A]
Default Plan for PSCBA	Commonly used pattern for PSCBA. Time period is displayed by power in percentage. See Fig. 1 in section 1.4 for Default Plan for PSCBA.	[Not Applicable, Information within Actor A]
Display Request of Default plans	This is a display request of Default plan.	[Not Applicable, Information within Actor A]
Calculation Request of the total surplus potential for default plan	This is a calculation Request of the total surplus potential for default plan.	[Not Applicable, Information within Actor A]
Calculation Request of the total surplus potential for the plan	This is a calculation Request of the total surplus potential for the plan.	[Not Applicable, Information within Actor A]
Display Request of the total surplus potential for default plan	This is a display request of the total surplus potential for default plan.	[Not Applicable, Information within Actor A]
The total surplus potential for each default plan	Absolute value (in MW) pattern that showed how much contribution can be actually done to each default plan for PSCBA by summing up the surplus power of Stationary Batteries and customer's batteries. Unit is in MW per hour. See Fig.2 for the total surplus potential for each default plan.	[Not Applicable, Information within Actor A]
The total surplus potential for the plan	Absolute value (in MW) pattern that showed how much contribution can be actually done to the plan for PSCBA by summing up the surplus power of Stationary Batteries and customer's batteries.	[Not Applicable, Information within Actor A]
The schedule of batteries for each default plan	This schedule is provided for each default plan by Battery SCADA. This schedule includes schedules of all Stationary Batteries and all Customer side Batteries for the default plan. See Fig3 for the schedule of batteries for each default plan.	[Not Applicable, Information within Actor A]
Request for Schedule	Request command for schedule from the Battery SCADA to the customer side EMS. It will be stated as the next day schedule or the same day schedule. Upon receiving this request, the customer's battery sends the detail schedule, outline schedule or surplus schedule of it to Battery SCADA.	This command includes the followings. ID for customer side EMS as the destination of this message Indicator for the next day schedule or the same day schedule
Detail Schedule of Customer's Battery (cf)	This schedule is On-the-day-Schedule or the next-day-Schedule of each customer's battery, which is included in the response of Request for Schedule command.	This information includes the initial SOC, charging/discharging power of each period according to the customer's original schedule and the customer collateral condition which includes cost information.

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Outline schedule of Customer's Battery (cf)	This schedule is On-the-day-Schedule or the next-day-Schedule of each customer's battery, which is included in the response of Request for Schedule command.	This information includes the initial SOC, maximum charging/discharging power of each period according to the customer's original schedule charging/discharging power of each period according to the customer's original schedule, restriction of SOC of each period and the customer collateral condition which includes cost information.
Surplus schedule of Customer's Battery (cf)	This schedule is On-the-day-Schedule or the next-day-Schedule of each customer's battery, which is included in the response of Request for Schedule command.	This information includes the initial SOC, surplus of charging/surplus of discharging power of each period, restriction of SOC of each period and the customer collateral condition which includes cost information.
Plan for PSCBA	This is a pattern of the power values which a Grid Operator is going to cut or shift and is represented in MW per time period. See Fig 4 for example of the plan for PSCBA.	[Not Applicable, Information within Actor A]
Current Status of Virtual Battery for PSCAB	This is the sum total of the performance results of all batteries that are included in the Schedule of Batteries for the Plan. A Grid Operator can suppose this to be the performance result of the virtual energy storage.	[Not Applicable, Information within Actor A]
The Schedule of Batteries for the Plan	This schedule includes schedules of all Stationary Batteries and all Customer side Batteries for the plan and is provided by Battery SCADA. See Fig.5 for the Schedule of Batteries for the Plan.	[Not Applicable, Information within Actor A]
Message of lack of surplus for the plan	When Battery SCADA detects lack of surplus of the sum total of all batteries during calculation of The Schedule of Batteries for the Plan, it displays this message for the Grid Operator.	[Not Applicable, Information within Actor A]
Inquiry	Request for response on acceptance or rejection for surplus power usage of customer's battery. The surplus (kW for each period) of the customer's battery to be used by the plan for PSCBA is included in the inquiry. It is sent from the Battery SCADA to the customer side EMS.	This command includes the followings. ID for customer side EMS as the destination of this messageIdentifier for the type of the schedule (the required surplus of the Customer's battery corresponding to the CEM) The schedule which shows Charging/Discharging pattern, which is defined in IEC 61850-90-10 (IEC 61850 scheduling functions)
Inquiry Acceptance	Acceptance in response to the inquiry made. It is sent from the customer side EMS to the Battery SCADA.	This command includes the followings. ID for customer side EMS as the source of this message Indicator showing acceptance
Inquiry Rejection	Rejection in response to the inquiry made. It is sent from the customer side EMS to the Battery SCADA.	This command includes the followings. ID for customer side EMS as the source of this message Indicator showing rejection
Execution Notification	This is the notification of Executing the plan. Grid Operator determines the notification.	This command includes the followings. ID for customer side EMS as the destination of this message

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Charging/Discharging command	Command sent from the Battery SCADA to the Stationary Battery.	[Not Applicable, Information within Actor A]
(cf) As for "Detail Schedule", "Outline Schedule" and "Surplus Schedule", one of them shall be used according to the management method of Customer's Battery.		

A.3.16.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.16.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.16.8 Custom information (optional)

Custom Information (optional)		
Key	**Value**	**Refers to Section**

A.3.17 High level use case (JWG2041) Power Adjustment Normal Conditions

A.3.17.1 Description of the use case

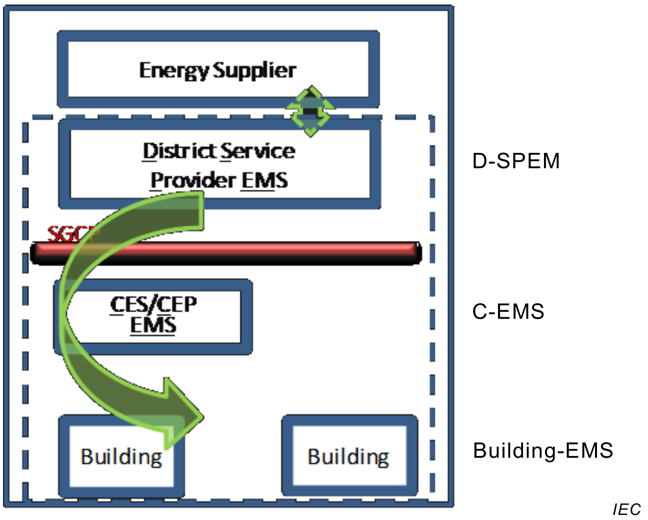
Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG2041	DER, Customer Premises	Adjustment of energy production & consumption in normal conditions

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.1	18/02/2014	Initial Draft	Draft
0.2	07/03/2014	Added Use Case ID	Draft
0.3	24/02/2014	Updated JWG Use Case ID from JWG2011 to JWG2041	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication among the District Service Provider Energy Management System(D-SPEM), the"Community Energy Supplier owning Renewable sources(CES) / Community Energy saving service Provider (CEP)" Energy Management System (C-EMS) and the Building Energy Management System. In this case, SG CP is located among the D-SPEM, the C-EMS and the Building Energy Management System.  EMS: Energy Management System
Objective(s)	The objective of this use case is the acceleration of producing power by Renewable sources of Energy. This is achieved by registration of information regarding the building and the Community Energy Supplier owning Renewable sources of Energy (CES) / Community Energy saving service Provider (CEP).
Related business case(s)	This use case is one of the generic use cases of the demand response services for the buildings using in some utilities, BEMS (Building Energy Management System) aggregators, domestic projects in Japan. (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)

Narrative of use case

Narrative of use case
Short description
The District Service Provider EMS (D-SPEM) manages the production of electricity using Renewable sources of Energy (REs) owned by Customers. Then, the District Service Provider EMS (D-SPEM) sends a signal to the CEM in order to accelerate the production or decelerate the production. Then, the CES/CEP EMS (C-CEM) updates the production plan.
Complete description

Narrative of use case	
1)	The Actor A (D-SPEM) estimates the future production of electricity using the weather information. Then, the Actor A (D-SPEM) decides that the production of electricity will be insufficient for the demand or exceed the demand in the near future.
2)	The Actor A (D-SPEM) sends the signal for accelerating the production(production plan) or decelerating the production(production plan) to the CEM (C-CEM).
3)	The CEM (C-CEM) updates the production plan. Then, The CEM (C-CEM) sends the control request (Smart device ID-power profile) to the CEM (Building CEM).
4)	The CEM (Building CEM) receives confirmation from its terminal. Then, The CEM (Building CEM) sends the reply to the CEM (C-CEM).
5)	The CEM (C-CEM) updates the production plan. Then, the CEM (C- CEM) sends the control signal (Smart device ID-power profile) to the CEM (Building CEM).
6)	The CEM (Building CEM) sends the control signal (power profile) to the smart device.
7)	The smart device sends the results to the CEM (Building EMS).
8)	The CEM sends the results to the CEM (C- CEM).
9)	The CEM (C- CEM) sends the control signal(power profile) to the smart device.
10)	The smart device sends the results to the CEM (C- CEM).
11)	The CEM (C- CEM) sends the results to the Actor A (D-SPEM).

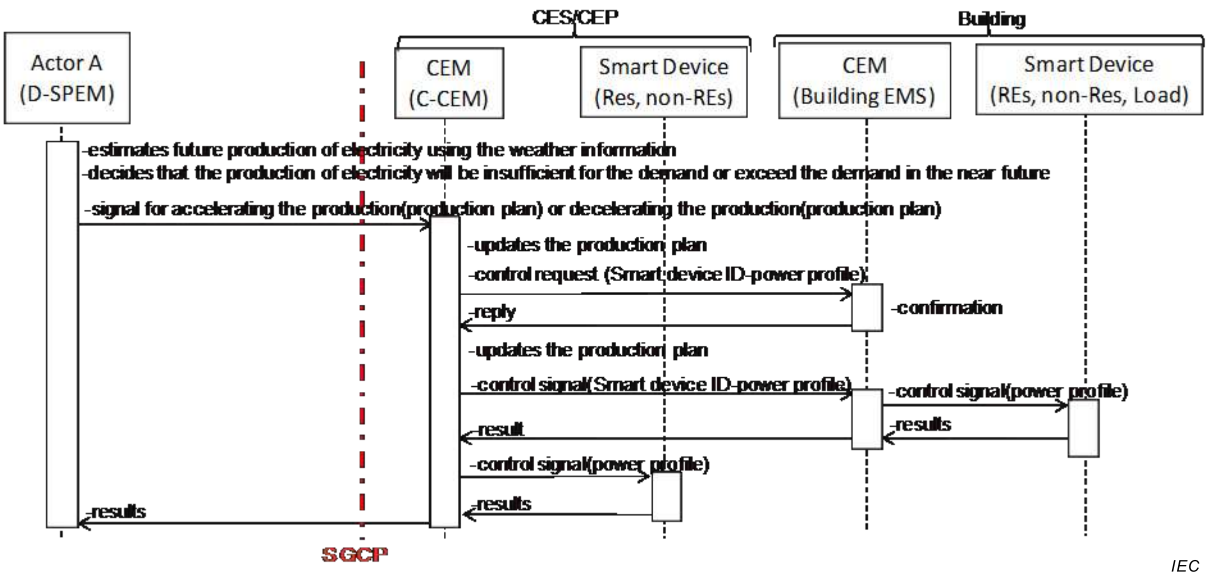
General remarks

General remarks

A.3.17.2 Diagram of use case

Figure A.26 shows a diagram of use case.

Diagram(s) of use case



CES : Community Energy Supplier owning REs (e.g. Biomass Business), CEP : Community Energy saving service Provider
D-SPEM: District Service Provider EMS, C-EMS: CES/CEP EMS
Power classification : i.e. RE, non-RE, Load, RE : Renewable source of Energy (e.g. Solar Photovoltaic)

Figure A.26 – Sequence diagram

A.3.17.3 Technical details

Actors

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home/building or home/building automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc. In addition in this use case, Actor A consists of District Service Provider EMS (D-SPEM). The D-SPEM manages energy saving and demand-supply for Self-sustaining District/Disaster Recovery.	
CEM	Internal	The CEM is a logical function optimizing energy consumption and or production based on signals received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS. In addition in this use case, CEM consists of CES/CEP EMS(C-CEM) and Building EMS. C-CEM manages "adjustment of energy production & consumption in normal conditions" and "Energy accommodation in disaster conditions." Building EMS is a system used to monitor and control Smart Devices	
Smart device	External	A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and signals from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor. In addition in this use case, smart device consists of "REs, non-REs and load."	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
Actor A	decides that the production of electricity will be insufficient for the demand or exceed the demand in the near future		

References

References						
No.	**References Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Japanese use case model2, Model3
Level of depth
High level use case
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)
Viewpoint
Technical
Further keywords for classification
Smart Grid, Self-sustaining District, Disaster Recovery

A.3.17.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Adjustment of energy production & consumption in normal conditions	Actor A	decides that the production of electricity will be insufficient for the demand or exceed the demand in the near future		

Steps – Scenarios

Scenario								
Scenario name:		**No. 1 Adjustment of energy production & consumption in normal conditions**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Ser vi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
1			The Actor A (D-SPEM) estimates the future production of electricity using the weather information. Then, the Actor A (D-SPEM) decides that the production of electricity will be insufficient for the demand or exceed the demand in the near future.		Actor A	-	-	
2			The Actor A(D-SPEM) sends the signal for accelerating the production(production plan) or decelerating the production(production plan) to the CEM (C-CEM).		Actor A (D-SPEM)	CEM (C-CEM)	signal for accelerating the production (production plan) or decelerating the production(production plan)	
3			The CEM (C-CEM) updates the production plan. Then, The CEM (C-CEM) sends the control request (smart device ID-power profile) to the CEM (Building CEM).		CEM (C-CEM)	CEM (Building CEM)	control request (smart device ID-power profile)	
4			The CEM (Building CEM) receives confirmation from its terminal. Then, The CEM (Building CEM) sends the reply to the CEM (C-CEM).		CEM (Building CEM)	CEM (C-CEM)	reply	
5			The CEM (C-CEM) updates the production plan. Then, the CEM (C-CEM) sends the control signal (smart device ID-power profile) to the CEM (Building CEM).		CEM (C-CEM)	CEM (Building CEM)	control signal (smart device ID-power profile)	
6			The CEM (Building CEM) sends the control signal (power profile) to the smart device.		CEM (Building CEM)	Smart device	control signal(power profile)	
7			The smart device sends the results to the CEM (Building EMS).		Smart device	CEM (Building EMS)	results	

Scenario								
Scenario name:		**No. 1 Adjustment of energy production & consumption in normal conditions**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Ser vi- ce**	**Informa- tion producer (Actor)**	**Informa- tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
8			The CEM sends the results to the CEM (C- CEM).		CEM (Building EMS)	CEM (C- CEM)	results	
9			The CEM (C- CEM) sends the control signal(power profile) to the smart device.		CEM (C- CEM)	Smart device	control signal	
10			The smart device sends the results to the CEM (C- CEM).		Smart device	CEM (C- CEM)	results	
11			The CEM (C- CEM) sends the results to the Actor A (D- SPEM).		CEM (C- CEM)	Actor A (D- SPEM)	results	

A.3.17.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
signal for accelerating the production (M4-2-1)	The signal includes production accelerating signal and production plan.	
signal for decelerating the production (M4-2-2)	The signal includes production decelerating signal and production plan.	
control request (M4-2-3)	The signal includes the request for control, the smart device id and the power profile.	
reply (M4-2-4)	The reply is the answer for the control request.	
control signal I(M4-2-5)	The signal consist of “the smart device id and the power profile” or only power profile.	
results (M4-2-6)	The results are created by the Smart Device as a result of controlling the CEM (Building EMS) or CEM (C-CEM).	

A.3.17.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.17.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.17.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.18 High level use case (JWG2042) Energy accommodation for buildings under disaster conditions

A.3.18.1 Description of the use case

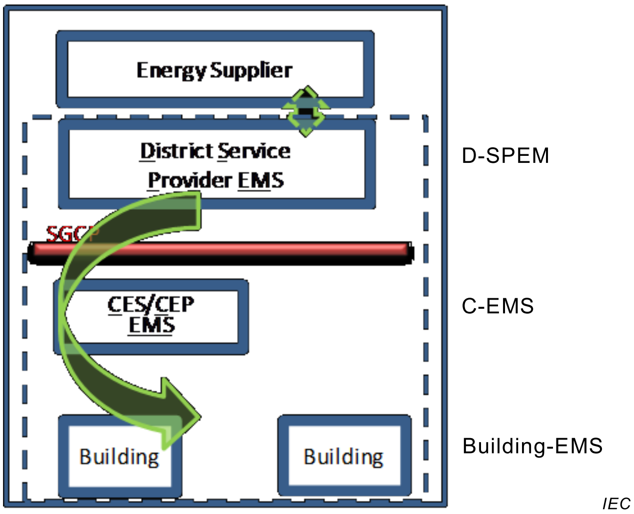
Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG2042	DER, Distribution, Customer Premises	Energy accommodation in disaster conditions

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.1	18/02/2014	Initial Draft	Draft
0.2	07/03/2014	Added Use Case ID	Draft
0.3	24/03/2014	Updated JWG use case ID from JWG2012 to JWG2042	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication among the District Service Provider Energy Management System(D-SPEM), the"Community Energy Supplier owning Renewable sources(CES) / Community Energy saving service Provider (CEP)" Energy Management System (C-EMS) and the Building Energy Management System. In this case, SG CP is located among the D-SPEM, the C-EMS and the Building Energy Management System.  EMS: Energy Management System
Objective(s)	The objective of this use case is the acceleration of producing power by Renewable sources of Energy. This is achieved by registration of information regarding the building and the Community Energy Supplier owning Renewable sources of Energy (CES) / Community Energy saving service Provider (CEP).
Related business case(s)	This use case is one of the generic use cases of the demand response services for the buildings using in some utilities, BEMS (Building Energy Management System) aggregators, domestic projects in Japan. (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement discussion.)

Narrative of use case

Narrative of use case
Short description
In case of a disaster, the Community Energy Supplier owning Renewable sources of Energy (CES) / Community Energy saving service Provider (CEP) changes the "power supply plan for normal situations" to the "power supply plan for disaster situations," in order to keep providing power to "disaster control centers." On the "power supply plan for disaster situations," the CES/CEP supplies the electrical and the thermal power to the "Disaster Control Center".
Complete description

Narrative of use case
1) The CEM (Building EMS) sends the power profile for disaster situation to the CEM (C-CEM).
2) The CEM (C-CEM) sends the aggregated power profile for disaster situation to the Actor A (Energy supplier&D-SPEM).
3) The Actor A (Energy supplier&D-SPEM) adjust the the aggregated power profiles for disaster situation. Then, the Actor A (Energy supplier&D-SPEM) sends the aggregated power profile for disaster situation to the CEM (C-CEM).
4) The CEM (C-CEM) sends the power profile for disaster situation to the CEM (Building EMS).
5) The CEM (C-CEM) and the CEM (Building EMS) send the status report to the Actor A (Energy supplier&D-SPEM).
6) The Actor A (Energy supplier&D-SPEM) sends disaster signal to the CEM (C-CEM).
7) The CEM (C-CEM) changes the plan (to power profile for disaster situation). Then, the CEM (C-CEM) sends discharge signal to the smart device.
8) The CEM (C-CEM) sends -accommodation report to the CEM (Building EMS).
9) The smart device sends the results to the CEM (Building EMS).
10) The CEM (Building EMS) sends the results to the CEM (C-CEM).

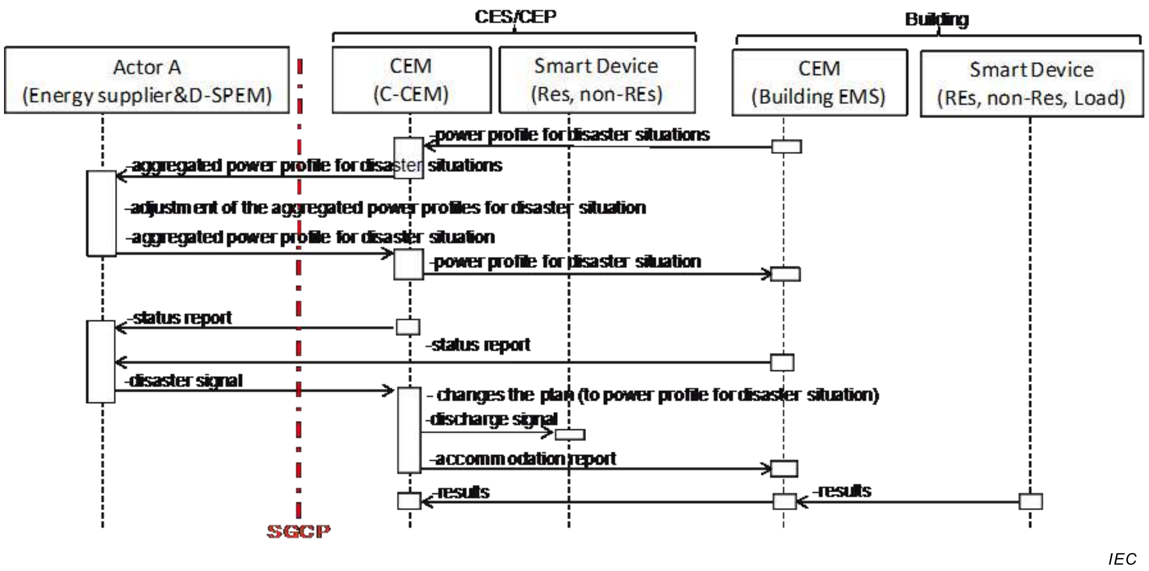
General remarks

General remarks

A.3.18.2 Diagram of use case

Figure A.27 shows a diagram of use case.

Diagram(s) of use case



CES : Community Energy Supplier owning REs (e.g. Biomass Business), CEP : Community Energy saving service Provider
D-SPEM: District Service Provider EMS, C-EMS: CES/CEP EMS
Power classification : i.e. RE, non-RE, Load, RE : Renewable source of Energy (e.g. Solar Photovoltaic)

Figure A.27 – Sequence diagram

A.3.18.3 Technical details

Actors

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home/building or home/building automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc. In addition in this use case, Actor A consists of District Service Provider EMS (D-SPEM). The D-SPEM manages energy saving and demand-supply for Self-sustaining District/Disaster Recovery.	
CEM	Internal	The CEM is a logical function optimising energy consumption and or production based on signals received from the grid, consumer’s settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the “grid / market”. Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS. In addition in this use case, CEM consists of CES/CEP EMS(C-CEM) and Building EMS. C-CEM manages “adjustment of energy production & consumption in normal conditions” and “Energy accommodation in disaster conditions.” Building EMS is a system used to monitor and control smart devices.	
Smart device	External	A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and signals from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor. In addition in this use case, smart device consists of “REs, non-REs and load.”	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ Contract	**Triggering event**	**Pre-conditions**	**Assumption**
CEM (Building EMS)	sends the power profile for disaster situation to the CEM (C-CEM)		

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Japanese use case Model2, Model3
Level of depth
High level use Case
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. It should be agreed on the 62746-2use case & requirement Meeting)
Viewpoint
Technical
Further keywords for classification
Smart Grid, Self-sustaining District, Disaster Recovery

Classification information
Relation to other use cases
Japanese use case Model2, Model3
Level of depth
High level use case
Prioritisation
High
Generic, regional or national relation
Generic (This use case is independent from the national or regional market design. of cause, it should be agreed on the 62746-2 use Case & Requirement discussion.)
Viewpoint
Technical
Further keywords for classification
Smart Grid, Self-sustaining District, Disaster Recovery

A.3.18.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Energy accommodation in disaster conditions	CEM (Building EMS)	sends the power profile for disaster situation to the CEM (C-CEM)		

Steps – Scenarios

Scenario								
Scenario name:	**No. 1 Energy accommodation in disaster conditions**							
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
1			The CEM (Building EMS) sends the power profile for disaster situation to the CEM (C-CEM).		CEM (Building EMS)	CEM (C-CEM)	power profile for disaster situation	
2			The CEM (C-CEM) sends the aggregated power profile for disaster situation to the Actor A (Energy supplier&D-SPEM).		CEM (C-CEM)	Actor A (Energy supplier&D-SPEM)	aggregated power profile for disaster situation	
3			The Actor A (Energy supplier&D-SPEM) adjust the the aggregated power profiles for disaster situation. Then, the Actor A (Energy supplier&D-SPEM) sends the aggregated power profile for disaster situation to the CEM (C-CEM).		Actor A (Energy supplier&D-SPEM)	CEM (C-CEM)	aggregated power profile for disaster situation	
4			The CEM (C-CEM) sends the power profile for disaster situation to the CEM (Building EMS).		CEM (C-CEM)	CEM (Building EMS)	power profile for disaster situation	

Scenario								
Scenario name:		**No. 1 Energy accommodation in disaster conditions**						
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Servi ce**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Require-ments, R-ID**
5			The CEM (C-CEM) and the CEM (Building EMS) send the status report to the Actor A (Energy supplier&D-SPEM)		CEM (C-CEM)	CEM (Building EMS)	status report	
6			The Actor A (Energy supplier&D-SPEM) sends disaster signal to the CEM (C-CEM).		Actor A (Energy supplier&D-SPEM)	CEM (C-CEM)	disaster signal	
7			The CEM (C-CEM) changes the plan (to power profile for disaster situation). Then, the CEM (C-CEM) sends discharge signal to the smart device.		CEM (C-CEM)	Smart device	discharge signal	
8			The CEM (C-CEM) sends -accommodation report to the CEM (Building EMS).		CEM (C-CEM)	CEM (Building EMS)	accommoda tion report	
9			The smart device sends the results to the CEM (Building EMS).		Smart device	CEM (Building EMS)	results	
10			The CEM (Building EMS) sends the results to the CEM (C-CEM).		CEM (Building EMS)	CEM (C-CEM)	results	

A.3.18.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
power profile for disaster situations (M4-3-1)	The profile consists of the power profiles of each disaster situation.	
aggregated power profile for disaster situation (M4-3-2)	First, the profile is created by aggregating the power profile for disaster situations of buildings. Second, the profile is adjusted by the Actor A (Energy supplier&D-SPEM) .	

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
status report (M4-3-3)	The report is the status of the CEM (C-CEM) or the CEM (Building EMS).	
disaster signal (M4-3-4)	The signal is created by the Actor A (Energy supplier&D-SPEM).	
discharge signal (M4-3-5)	The signal is created by the CEM (C-CEM) for the accommodation of power to the Building.	
results (M4-3-6)	The results is created by smart devices for reposting of accommodation.	

A.3.18.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.18.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.18.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.19 High level use case (JWG211x, *based on WGSP211x*) Tariff-Consumption information exchange

A.3.19.1 Description of the use case

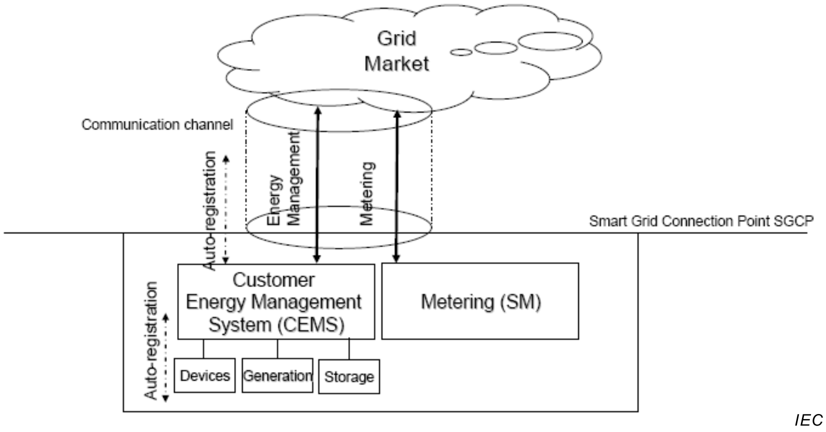
Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG- 211x	Smart Grid	Exchanging information on consumption, price and warnings with external actors and within the home

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.2	01/03/2012	Initial draft	Draft
0.4	11/07/2012	Reviewed version	Version after commenting phase
0.5	12/11/2012	Reviewed version	Version for final commenting
0.51	03/02/2014	Fit description into IEC format	
0.6	24/03/014	Modified to new JWG Use Case ID	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication between the CEM and "upstream"[12] actors. The communication between CEM, the consumer and (in-home) smart devices is officially not in this scope of this report, but will be included in the use case description for the sake of clarity. Smart devices cover also smart appliances, generators and storage (see table with actors). When the consumer has a price dependent energy tariff and/or a time dependent distribution tariff, price based demand response is enabled by creating an incentive for load management by consumers or a CEM in response to price changes (RTP, CPP, ToU). Note that multiple loads/generation resources (even from multiple premises) can be combined in the CEM to be mutually controlled. From an architectural point of view the Smart Grid Coordination Group introduced the "Smart Grid Connection Point" (SG CP) entity as an interface between Smart Grid actors (applications and/or organizations) and in-home/building systems or devices. The diagram below shows the SG CP in its environment.  Please note that the boxes in the diagram above are functional. The Smart Meter and CEM can be one or two separate physical boxes. The CEM can also be integrated in Smart in-home devices. The communication with the Grid market/applications can be through one or through separate infrastructures.

12 Upstream in this context means towards actor A or B (see actor definitions).

Scope and objectives of use case	
Objective(s)	The objective of this use case is to exchange information between external actors and the premise in order to: – Make consumers aware of their energy consumption – Providing external market roles with information on (forecasted) energy consumption – Enable consumers or their Customer Energy Management System to react on (changes in) energy prices, thus supporting consumers to optimize their consumption to use cheaper or greener energy (depending on personal preferences) – Send warnings to the consumer to keep consumption below a certain (contracted) level – Enable external actors to retrieve the state of in home smart devices
Related business case(s)	A combination of the functions described in this use support “Demand Response”, following the definition of Eurelectric, which is referenced in the Sustainable Processes workgroup’s report.

Narrative of use case

Narrative of use case

Short description

This use case describes how information regarding price and environmental aspects is sent from upstream actors to CEM and how information regarding energy consumption or generation as well as smart device statuses are being sent back to the consumer and upstream actors. Also the case that remote-controllable device is connected to CEM is described.

Complete description

This high level use case comprises four different primary use cases:

WG 2111: Information regarding power consumption or generation

The Smart Meter makes available the information on total power consumption or generation in the house. The CEM receives this information but can also receive consumption / generation information per smart device.[13] The rate of update of the information must be proportional to the rate of change in the power drawn.

This use case scenario consists of two scenarios:

– Sending information regarding (future) power consumption or generation of individual smart devices. This information is provided by the smart device to CEM, which may aggregate it and use it to forecast consumption/generation and send this to the display and external actors. As the CEM can be a function integrated in smart devices in the customer premises, more than one CEM in the house may execute this scenario. In this case, one CEM does not have the total house consumption, but only partial information.

– Sending information regarding total power consumption or generation. This information is provided by the smart meter, sent to the CEM that may use it to make a forecast of consumption/generation and forward this to the display and external actors.

Note that several use case scenarios may work together in an iterative way. E.g. there might be a negotiation which uses the price (WGSP2112) to get a forecast (WGSP2111), then adapting the price, which might be binding from there on.

Also note that the consumption information can be transferred via different channels to actor A, B and to the consumer or in-home devices. This implies that the use case could effectively be split up into three sub-use cases, each with its own goal (sending the information to Actor A, sending the information to Actor B and sending the information to the Simple External Consumer Display).

In case of Remote-controllable device is connected to CEM, CEM asks information regarding power consumption or generation to individual remote-controllable device if the remote-controllable device has the capability of showing such information.

JWG 2112: Price and/or environmental information

Actor A will send information (e.g. price, meteorological, environmental, cost related information, warning messages) to the consumer or his smart devices via the Energy management gateway; Actor B may do the same via the Smart Metering gateway. The goal is to make the consumer or his devices aware of the amount and cost of consumed energy and the amount and income for selling energy back to the grid, or of other elements relevant to energy management (e.g. the percentage amount of green power). The consumer can also receive a notification that the tariff has been changed.

To move out peak loads, an external actor can propose a tariff of electricity higher during certain periods of the day or during certain days in order to invite his customers to delete or shift various uses or lower their consumptions in its housing during these periods. These periods and days may not be fixed in advance, but rather determined on the flexibility needs of the smart grid. When such a higher cost period occurs, the customers are notified in advance, so that they can be ready to react to these price messages. Smart devices can be parameterised or managed by the CEM to start when the energy costs less or when the relative amount of green energy is over a set level or to temporarily lowers its power consumption and/or shifts its operation before or after a peak consumption period. The parameterization of the CEM and smart devices are the responsibility of the consumer.

The price information can be either real-time price, real time combined price and volume messages or a fixed tariff schedule. Note that dynamic pricing requires a metering system that is able to provide the information for, or to calculate the cost of energy based on, a flexible tariff scheme. This implies that price related changes in the CEM by actor A or B may be combined with a tariff update in the smart meter; this is described in use case BI.03. of the Smart Meters Coordination Group use case repository.

The communication functionalities described in this use case may also be used to send warning messages from an external actor to the consumer, warning him that emergency load control will happen within a certain period of time, unless changes in consumption / generation take place.

[13] Note that the CEM may be a function embedded in the smart device (having thus access to only partial consumption information), in which case the information on total consumption is provided to the CEM by a communication with a gateway or the smart meter.

Narrative of use case
Note that several use case scenarios may work together in an iterative way. E.g. there might be a negotiation which uses the price (WGSP2112) to get a forecast (WGSP2111), then adapting the price (WGSP2112), which might be binding from there on. Also note that the information may be provided by Actor A or Actor B alternatively, which implies that this use case could be effectively split up in two sub-use cases. In case of Remote-controllable device is connected to CEM, CEM interprets the Price and/or environmental information and controls this type of device remotely. **JWG 2113: Warning messages from CEM / smart device** This primary use case scenario consists of two scenarios: – A warning message is generated by the smart device after estimating that the power consumed during its next operation will exceed maximum contracted power. The smart device receives information from the CEM on total house consumption and maximum contracted power. The smart device estimates the maximum power that will be consumed during its next operation (ex: cycle). If there is a risk to exceed the threshold of the maximum contracted power, a warning is generated and displayed on the smart device or other customer interfaces (e.g. other devices or the simple external consumer display). The threshold is based on limits received from the CEM, which can be limits for instant power or accumulated energy consumption. In case of Remote-controllable device is connected to CEM, CEM makes the warning message if needed. In order to do this, CEM asks information regarding power consumption to individual remote-controllable device if the remote-controllable device has the capability of showing such information. – The warning message is generated by the CEM after noticing that contracted power is exceeded, based on information from the smart meter. Note that the CEM may also take action to lower the consumption of smart devices; since these actions are not in scope of this use case and the work of the SG-CG, this scenario only describes how the warning messages are being sent. The limits (for instant power) can include not only upper limits (for example, when the customer is close to the limit of his contracted power) but also lower limits (for example, the remaining usual instant power consumption when the customer is out or during night time). **JWG 2114: Retrieve status of smart devices** This use case describes how an external actor retrieves the state of a smart device directly from the CEM. This real time information may be retrieved by an external actor who has a business relationship to the customer, having guaranteed that some of his smart devices are (exclusively) controlled by the external actor. In case of Remote-controllable device is connected to CEM, CEM makes the status message if needed. In order to do this, CEM asks status information to individual remote-controllable device if the remote-controllable device has the capability of showing such information. Another alternative is that the customer himself retrieves the state of smart devices via the display, in which case the information is not necessarily sent to actor A or B.

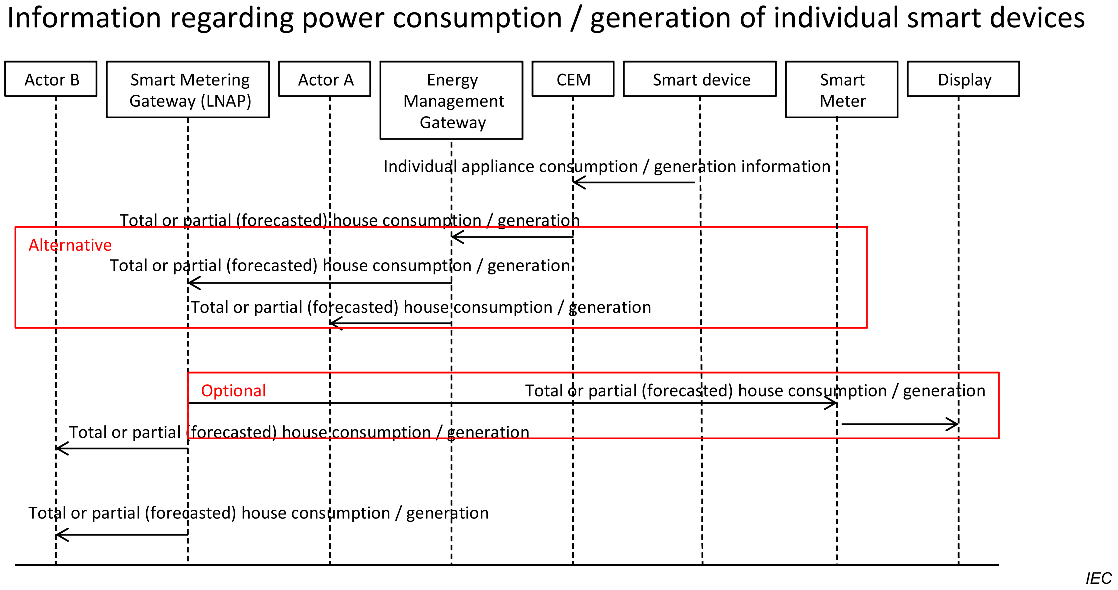
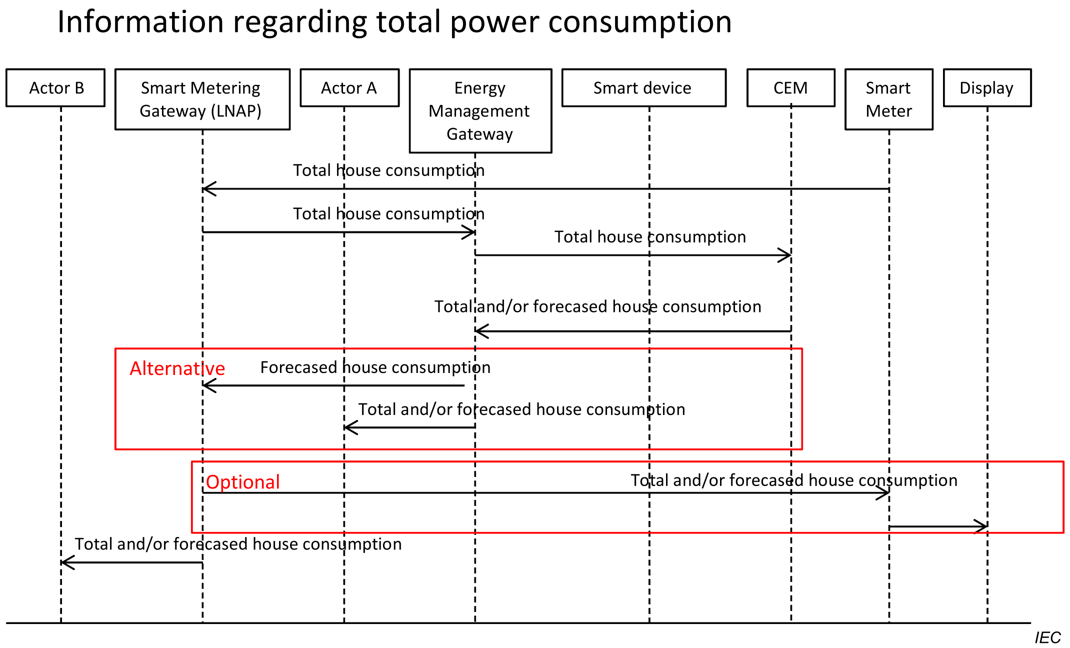
General remarks

General remarks

Notes and open issues	
Nr	**Note**
1.	This high level use case may in the future be split up in two high level use cases: – upstream communication (consumption, device status) – downstream and within home communication (price)
2.	Where relevant all primary use case (scenarios) may be split up according to external actors
3.	There is not yet a use case covering the situation where there would be multiple CEMs and the aggregation takes place in the grid side of the SG CP. (e.g. how is the user being informed that he is (going to) exceed his contractual power). Closing this gap would be a next step
4.	Next step: define additonal use cases using the top down method, considering the functional architecture as a black box and identifying which messages would go in / come out

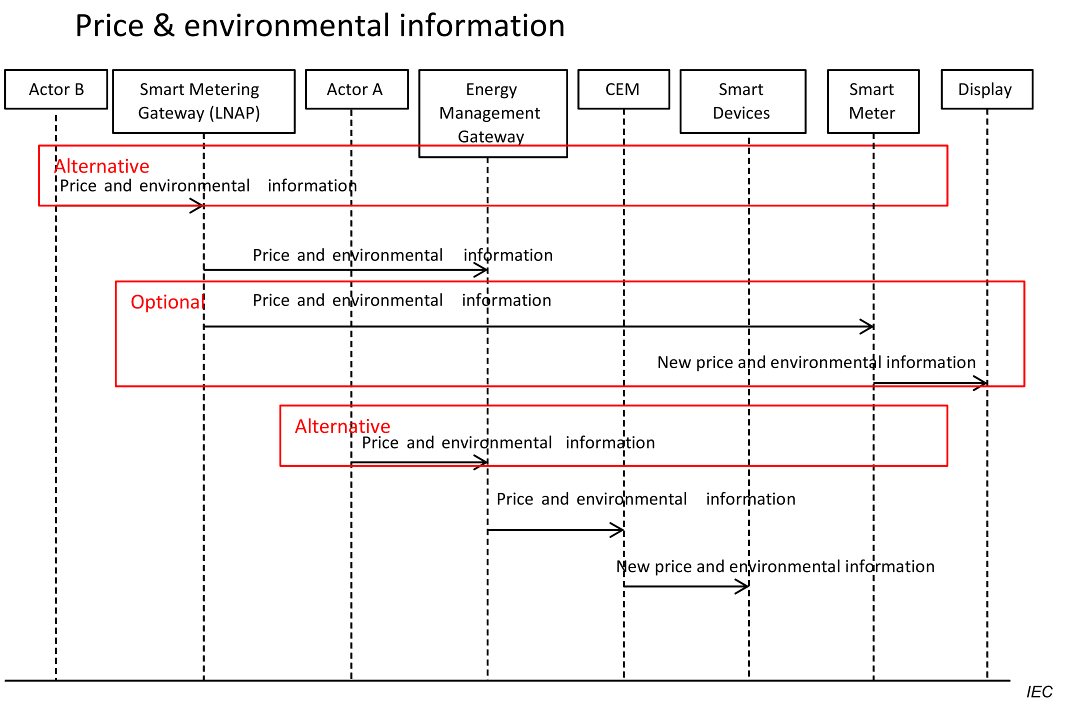
A.3.19.2 Diagrams of use case

Figure A.28 shows diagrams of use case.

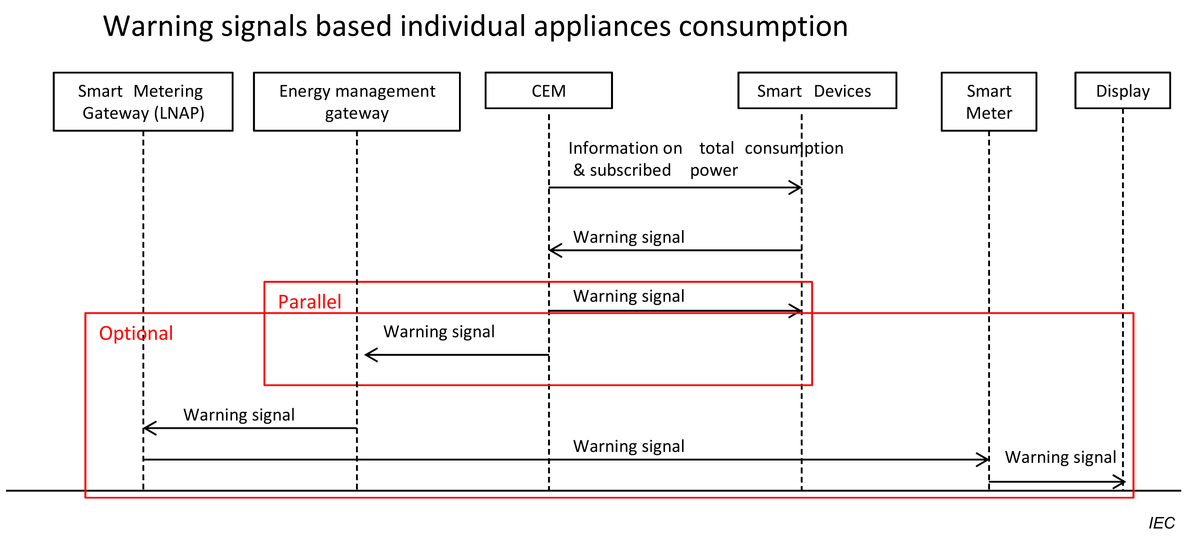
Diagram(s) of use case
JWG 2111: Use case scenario 1: Information regarding power consumption / generation / storage of individual smart devices 
JWG 2111: Use case scenario 2: Information regarding total power consumption or generation 

Diagram(s) of use case

JWG 2112: Price and environmental information

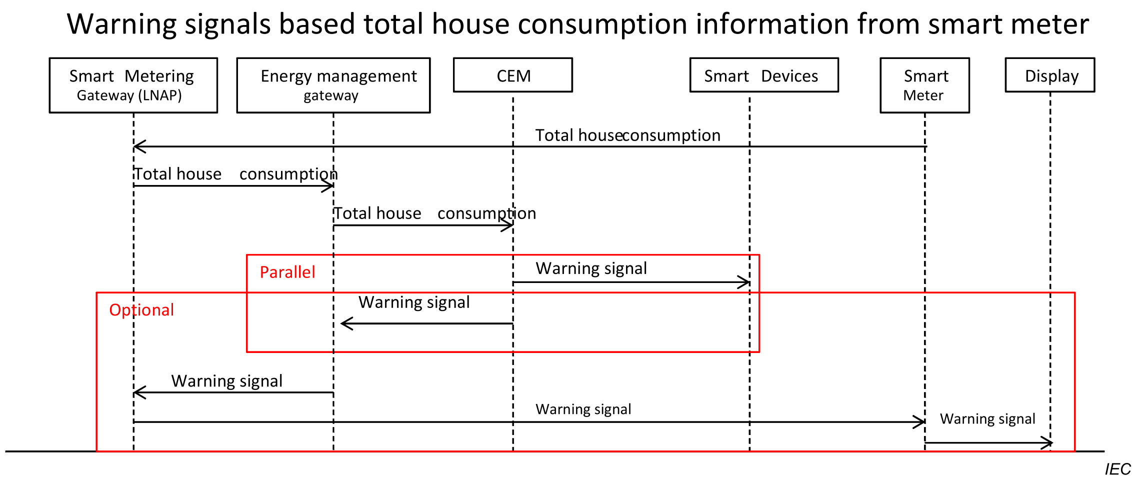


JWG 2113: use case scenario 1: Warning messages from smart devices



Diagram(s) of use case

JWG 2113: use case scenario 2: Warning messages from the CEM



JWG 2114: Retrieve status of smart devices

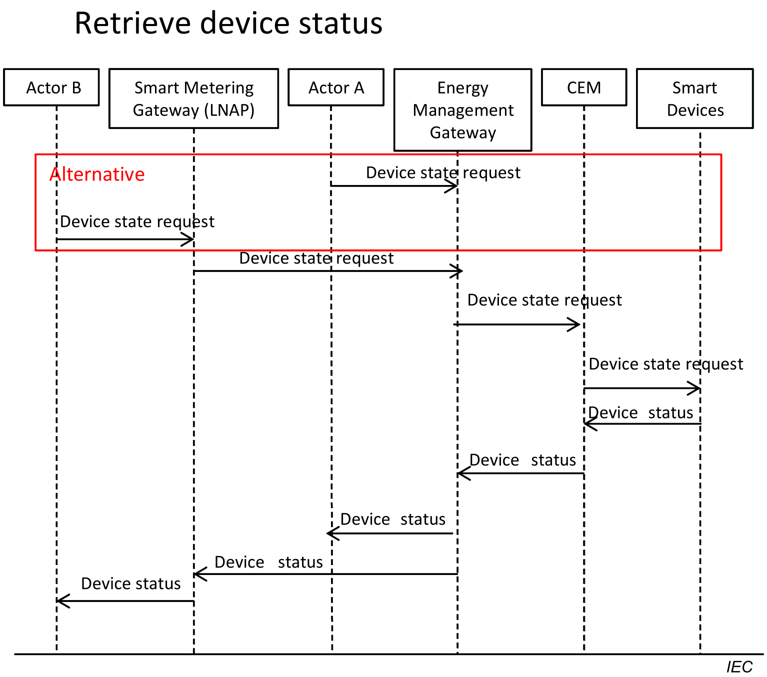


Figure A.28 – Sequence diagram

A.3.19.3 Technical details

For the definition of this use case, the architecture shown in Figure A.29 has been used as a basis.

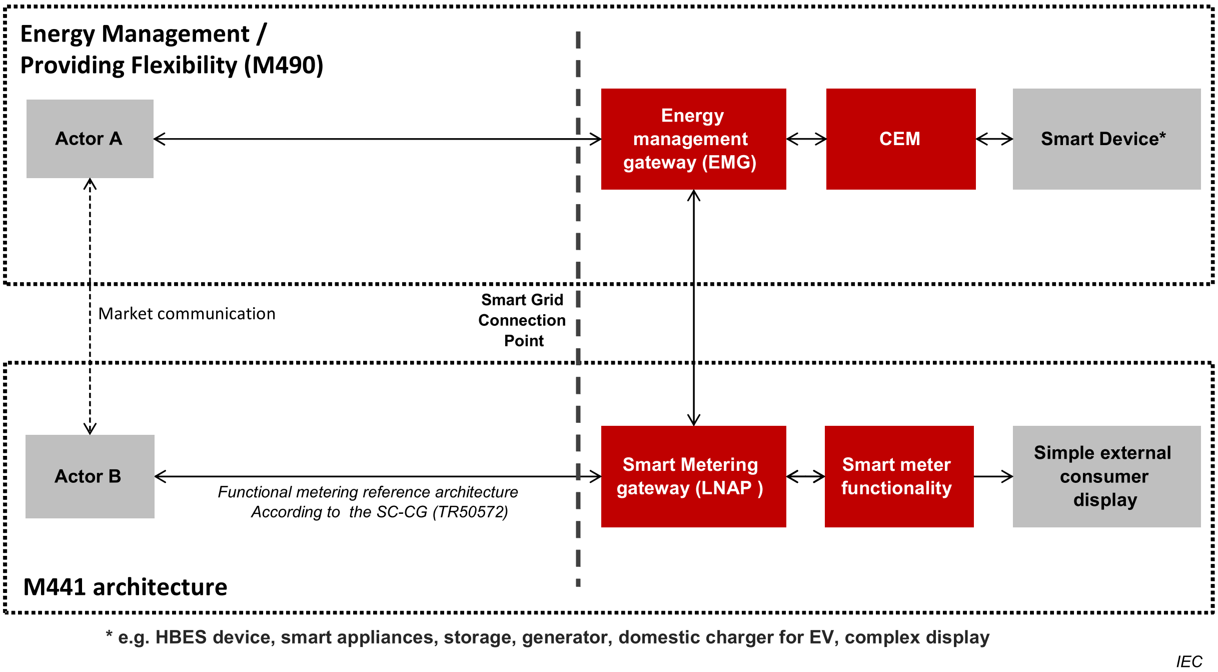


Figure A.29 – SG CG Architecture Model [9]

NOTE The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.)

Actors

<table>
<tr><th colspan="4">Actors</th></tr>
<tr><th colspan="2">Grouping</th><th colspan="2">Group description</th></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th>Actor name see Actor list</th><th>Actor type see Actor list</th><th>Actor description see Actor list</th><th>Further information specific to this use case</th></tr>
<tr><td>Customer Energy Manager (CEM)</td><td>Internal</td><td>The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer’s settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the “grid / market”. Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer’s settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the “grid / market”. Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled.

When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.</td><td></td></tr>
<tr><td>Energy management gateway</td><td>Internal</td><td>An access point (functional entity) sending and receiving smart grid related information and commands between actor A and the CEM, letting the CEM decide how to process the events. The communication is often achieved through an internet connection of through a wireless connection.

This gateway may also provide services including protocol conversion, device management, security and service capabilities.</td><td></td></tr>
<tr><td>Smart Metering gateway (LNAP)</td><td>Internal</td><td>An access point (functional entity) that allows access to one or more metering end devices and, when equipped with an interface, to advanced display / home automation end devices connected to the local network.

A LNAP also may allow data exchange between different functional entities connected to the same LN. The LNAP may act simply as a router transferring messages between the metering end device and/or display/home automation devices and the Neighbourhood network of wide area network.

It may also provide services including protocol conversion, device management, security and service capabilities. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the local network.</td><td></td></tr>
</table>

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart meter	Internal	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.	
NNAP	Internal	The Neighbourhood Network Access Point is a functional entity that provides access to one or more LNAP's, metering end devices, displays and home automation end devices connected to the neighbourhood network (NN). It may allow data exchange between different functional entities connected to the same NN.	
Simple external consumer display	External	Dedicated display screen in connection with the smart meter/SG CP available to the customer to check power consumption, planned load reductions and load reductions historical. Other not dedicated means also exist to deliver consumption information to the customer, such as the personal computer, the mobile phone or the TV set.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc…	
HES	Internal	Responsible for acquiring the reads from meters and/or from data concentrators Delivers the raw meter reads to MDM Repeats the reading for any missing reads Is the short-term interim data storage (1-3 months) for meter reads Pushes the event information upwards to MDM Supports the specific protocols of the concentrators and meters Contains some topology information and aggregation functionality for plug & play solutions	
MDM	Internal	Is the single meter data repository for all metering data Is the long-term storage for the metering data Ensures the data quality by VEE for the higher level business processes Connects all head-end systems Is the connection point for other systems to reach the smart meters i.e. a gateway to HES and back Delivers the meter reads to other business systems for further usage Acts as the critical security firewall between business and operational systems and the advanced metering infrastructure. Contains some topology information and aggregation functionality	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
		In order to correctly bill demand/generation flexibility, the smart meter and CEM need to be time synchronized	

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Example use cases to WGSP2111	EDF-0023, EDF-0024, EDF-0025, EDF-0026, CECED0003, ESMIG-0001, FINS0048 (3.4.2 p 25-26), FINS0077, FINS0081, FINS0082, FINS0089, FINS0090, TC205-0043, AK716.0.1_UC4, AK716.0.1_UC5		The original use cases that served as a basis for this use case		
2	Example use cases to WGSP2112	CECED-0001, CECED-0002, CECED-0003, DKE-0014, EDF-0003, EDF-0016, EDF-0021, EDF-0027, ESMIG-0006, ESMIG0013, ESMIG-0014, FINS-0070, FINS-0071, PMA-0001, SCE-0001, TC205-0002 through -0012, AK716.0.1_UC4, AK716.0.1_UC5		The original use cases that served as a basis for this use case		
3	Example use cases to WGSP2113	FINS0088		The original use cases that served as a basis for this use case		

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Flexibility cluster
Level of depth
Primary use case
Prioritisation
1
Generic, regional or national relation
Generic
Viewpoint
Technical
Further keywords for classification
Demand side management, demand response, Smart Grid

A.3.19.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
211 1.1	Information regarding power consumption / generation / storage of individual smart devices	Smart device	New consumption / generation / storage information is available in the smart device	Communication connection between all actors is established The smart device has a schedule instructing it when to send consumption information to the CEM. The CEM has a schedule instructing it when to send consumption information to the external actor / display.	(forecasted) consumption / generation is received by actor A and/or actor B and/or display
211 1.2	Information regarding total power consumption / generation	Smart Meter	New consumption / generation information is available in the Smart Meter	Communication connection between all actors is established The smart meter has a schedule instructing it when to send consumption information to the CEM. The CEM has a schedule instructing it when to send consumption information to the external actor / display.	(forecasted) consumption/generation information is received by actor A and/or or Actor B and/or display
211 2	Price and environmental information	Actor A or actor B	New price and environmental information is available in Actor A or Actor B	Communication connection between all actors is established	Price and environmental information is received by smart devices
211 3.1	Warning messages based on individual devices consumption	Smart device	The CEM received information on a new operation to be executed	The subscribed power limits are made known to the smart device Information on total consumption is available in the CEM	Warning message is received by display and/or smart devices
211 3.2	Warning messages based on total house consumption from smart meter	Smart meter	Smart meter is triggered to send consumption information to CEM	The subscribed power limits are know to the CEM Smart meter has a schedule indicating when to send consumption information to CEM	Warning message is received by display and/or smart devices
4	Retrieve status of smart devices	Actor A or actor B	Actor A or Actor B want to retrieve the state of a smart device	The external actor is authorized to retrieve the state of the selected smart device(s)	The external actor received the requested information

Steps – Scenarios

Scenario								
Scenario name:		**JWG 2111: Use case scenario 1: Information regarding power consumption / generation / storage of individual smart devices**						
Step No.	**Event**	**Name of process / activity**	**Descrip-tion of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require -ments, R-ID**
1	New consump-tion / generation / storage information is available in the smart device		Smart device sends information regarding consumption to the CEM		Smart device	CEM	Individual device consump-tion / generation / storage	
2	CEM received consump-tion / generation information per individual smart device		The CEM aggregates and/or forecasts consumption and sends this information to the Energy Management Gateway		CEM	Energy Management Gateway	*Total or partial (forecasted) house consump-tion / generation / storage*	
3a	Energy Manage-ment Gateway received (forecasted) consump-tion / generation		Energy Management Gateway forwards information Smart Metering Gateway *(alternative)*		Energy Management Gateway	Smart Metering Gateway	*Total or partial (forecasted) house consump-tion / generation / storage*	
3b	Energy Manage-ment Gateway received (forecasted) consump-tion / generation		Energy Management Gateway forwards information to Actor A *(alternative)*		Energy Management Gateway	Actor A	*Total or partial (forecasted) house consumption / generation / storage*	
4	Smart Metering Gateway (LNAP) receives (forecasted) consump-tion / generation		Smart Metering Gateway (LNAP) sends information to the Smart Meter *(optional)*		Smart Metering Gateway (LNAP)	Smart Meter	*Total or partial (forecasted) house consump-tion / generation / storage*	
5	Smart Meter receives (forecasted) consump-tion / generation		Smart Meter sends information to the Display *(optional)*		Smart Meter	Simple external consumer display	*Total or partial (forecasted) house consump-tion / generation / storage*	

Scenario								
Scenario name:	**JWG 2111: Use case scenario 1: Information regarding power consumption / generation / storage of individual smart devices**							
Step No.	**Event**	**Name of process / activity**	**Descrip-tion of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require -ments, R-ID**
6	Smart Metering Gateway (LNAP) receives (forecasted) consumptio n / generation		Smart Metering Gateway (LNAP) forwards information to Actor B *(via the metering channel)*		Smart Metering Gateway (LNAP)	Actor B	*Total or partial (forecasted) house consumption / generation / storage*	

Scenario								
Scenario name:	**JWG 2111: Use case scenario 2: Information regarding total power consumption or generation**							
Step No.	**Event**	**Name of process / activity**	**Descrip-tion of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
1	New consump-tion/ generation information is available in the Smart Meter		The Smart Meter forwards the consump-tion information to the Smart Metering Gateway (LNAP)		Smart Meter	Smart Metering Gateway (LNAP)	Consump-tion information	
2	Smart Metering Gateway (LNAP) receives the information		Smart Metering Gateway (LNAP) forwards the consump-tion information to Energy Manageme nt Gateway		Smart Metering Gateway (LNAP)	Energy Manageme nt Gateway	Consump-tion information	
3	Energy Manage-ment Gateway receives the information		Energy Manage-ment Gateway forwards the consump-tion information to CEM		Energy Manageme nt Gateway	CEM	Consump-tion information	

Scenario								
Scenario name:		**JWG 2111: Use case scenario 2: Information regarding total power consumption or generation**						
Step No.	**Event**	**Name of process / activity**	**Descrip-tion of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
4	New consump-tion information is available in the CEM		The CEM may forecast total consump-tion and sends (forecasted) consump-tion information to the Energy Manageme nt Gateway		CEM	Energy Manageme nt Gateway	Total and/or forecasted house consump-tion	
5a	Energy Manage-ment Gateway received (forecasted) consump-tion		Energy Manage-ment Gateway forwards information to Actor A (alternative)		Energy Manage-ment Gateway	Actor A	Total and/or forecasted house consump-tion	
5b	Energy Manage-ment Gateway received (forecasted) consump-tion		Energy Manage-ment Gateway forwards information to Smart Metering Gateway (LNAP) (alternative)		Energy Manage-ment Gateway	Smart Metering Gateway (LNAP)	Total and/or forecasted house consump-tion	
6	Smart Metering Gateway (LNAP) receives (forecasted) consump-tion		Smart Metering Gateway (LNAP) forwards information to Smart Meter (optional)		Smart Metering Gateway (LNAP)	Smart Meter	Total and/or forecasted house consump-tion	
7	Smart Meter receives (forecasted) consump-tion		Smart Meter forwards information to Display (optional)		Smart Meter	Simple external consumer display	Total and/or forecasted house consump-tion	
8	Smart Metering Gateway (LNAP) receives (forecasted) consump-tion		Smart Metering Gateway (LNAP) forwards information to Actor B (via metering channel)		Smart Metering Gateway (LNAP)	Actor B	Total and/or forecasted house consump-tion	

Scenario								
Scenario Name:	**JWG 2112: Price and environmental information**							
Step No.	**Event**	**Name of Process / Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1a	New price and/or environmental is available in actor B (alternative)		Actor B sends price and/or environmental information to Smart Metering Gateway (LNAP) *(via metering channel)*		Actor B	Smart Metering Gateway (LNAP)	Price and/or environmental information	
1b	Smart Metering Gateway (LNAP) receives information		Smart Metering Gateway (LNAP) forwards price and/or environmental information to Energy Management Gateway		Smart Metering Gateway (LNAP)	Energy Management Gateway	Price and/or environmental information	
1c	Smart Metering Gateway (LNAP) receives information		Smart Metering Gateway (LNAP) forwards price and/or environmental information to Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Price and/or environmental information	
1d	Smart Meter receives information		Smart Meter forwards price and/or environmental information to Display		Smart Meter	Simple external consumer display	Price and/or environmental information	
2	New price and/or environmental is available in actor A (alternative)		Actor A sends information to Energy Management Gateway		Actor A	Energy Management Gateway	Price and/or environmental information	
3	Energy Management Gateway received information		Energy Management Gateway forwards price and/or environmental information to CEM		Energy Management Gateway	CEM	Price and/or environmental information	
4	CEM received new price and/or environmental information		CEM identifies relevant Smart Devices and forwards the new price and/or environmental information to the smart devices		CEM	Smart Appliances	Price and/or environmental information	

Scenario								
Scenario Name:		**JWG 2113: use case scenario 1: Warning messages from smart devices**						
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1	The CEM received information on a new operation to be executed		The CEM sends information on total house consumption and subscribed power to the device involved		CEM	Smart device	Total house consumption and subscribed power	
2	The smart device received information on total house consumption and subscribed power to the device		The smart device estimates the maximum power to be consumed for the operation and deducts this from the available power. In case there is insufficient power available, it displays a warning message and sends a warning message to the CEM		Smart device	CEM	Warning message	
3a	The CEM received a warning message		The CEM sends the warning message to (other) smart devices		CEM	Smart device	Warning message	
3b	The CEM received a warning message		The CEM sends the warning message to the Energy Management Gateway		CEM	Energy Management Gateway	Warning message	
4	Energy Management Gateway receives the warning message		Energy Management Gateway forwards message to the Smart Metering Gateway (LNAP)		Energy Management Gateway	Smart Metering Gateway (LNAP)	Warning message	
5	The Smart Metering Gateway (LNAP) receives the warning message		Smart Metering Gateway (LNAP) forwards message to the Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Warning message	
6	The Smart Meter receives the warning message		Smart Meter sends the message to the Display		Smart Meter	Simple external consumer display	Warning message	

Scenario								
Scenario name:		**JWG 2113: use case scenario 2: Warning messages from the CEM**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Ser vice**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requi-re-ments, R-ID**
1	Smart meter is triggered to send consump-tion information to CEM		Smart meter sends information on total house consumption to smart metering gateway (LNAP)		Smart meter	Smart metering gateway (LNAP)	Total house consump-tion	
2	Smart metering gateway receives total house consump-tion		Smart metering gateway (LNAP) forwards information to energy management gateway		Smart metering gateway (LNAP)	Energy managemen t gateway	Total house consump-tion	
3	Energy managemen t gateway receives total house consump-tion		Energy management gateway forwards information to CEM		Energy manageme nt gateway	CEM	Total house consump-tion	
4a	CEM receives total house consump-tion and notices that maximum contracted power is being exceeded		The CEM sends warning message to smart devices		CEM	Smart device	Warning message	
4b	CEM receives total house consump-tion and notices that maximum contracted power is being exceeded		The CEM sends warning message to the Energy Management Gateway		CEM	Energy Manage-ment Gateway	Warning message	
5	Energy Manage-ment Gateway receives the warning message		Energy Management Gateway forwards message to the Smart Metering Gateway (LNAP)		Energy Manage-ment Gateway	Smart Metering Gateway (LNAP)	Warning message	

Scenario								
Scenario name:	**JWG 2113: use case scenario 2: Warning messages from the CEM**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Ser vice**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
6	The Smart Metering Gateway (LNAP) receives the warning message		Smart Metering Gateway (LNAP) forwards message to the Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Warning message	
7	The Smart Meter receives the warning message		Smart Meter sends the message to the Display		Smart Meter	Simple external consumer display	Warning message	

Scenario								
Scenario name:	**JWG 2114: Retrieve status of smart devices**							
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1a	Actor A wants to retrieve the state of a smart device (*Alternative)*		Actor A sends a device state request to the energy management gateway		Actor A	Energy management gateway	Device state request	
1b	Actor B wants to retrieve the state of a smart device (*Alternative)*		Actor B sends a device state request to the Smart Metering Gateway (LNAP) *(via metering channel)*		Actor B	Smart Metering Gateway (LNAP)	Device state request	
2	Smart Metering Gateway (LNAP) receives device state request		Smart Metering Gateway (LNAP) forwards device state request to Energy management gateway		Smart Metering Gateway (LNAP)	Energy management gateway	Device state request	
3	Energy management gateway receives device state request		Energy management gateway forwards device state request to CEM		Energy manage ment gateway	CEM	Device state request	

Scenario								
Scenario name:		**JWG 2114: Retrieve status of smart devices**						
Step No.	**Event**	**Name of process / activity**	**Description of process/ activity**	**Ser vi-ce**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Requi-re-ments, R-ID**
4	CEM receives device state request		The CEM retrieves the device state from its memory and sends it to the energy management gateway *Optionally, the CEM may interrogate the relevant appliances on their current status*		CEM	Energy management gateway	Device status	
5a	Energy manage-ment gateway receives device status		Energy management gateway forwards device status to Actor A (*Alternative)*		Energy manage ment gateway	Actor A	Device status	
5b	Energy manage-ment gateway receives device status		Energy management gateway forwards device status to A Smart Metering Gateway (LNAP) (*Alternative)*		Energy manage ment gateway	Smart Metering Gateway (LNAP	Device status	
6	Smart Metering Gateway (LNAP) receives device status		Smart Metering Gateway (LNAP) forwards device status to Actor B *(via metering channel)*		Smart Metering Gateway (LNAP)	Actor B	Device status	

A.3.19.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Consumption / generation / storage information	Total or partial, actual or forecasted	
Price and/or environmental information		
Confirmation		
Information regarding subscribed power		
Warning message		
Device state request		
Device status		

A.3.19.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.19.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.19.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.20 High level use case (WGSP 211x) Exchanging information on consumption, price device status, and warnings with external actors and within the home

A.3.20.1 Name of use case

Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
WGSP 2110	Smart Grid	Exchanging information on consumption, price and warnings with external actors and within the home

Version management

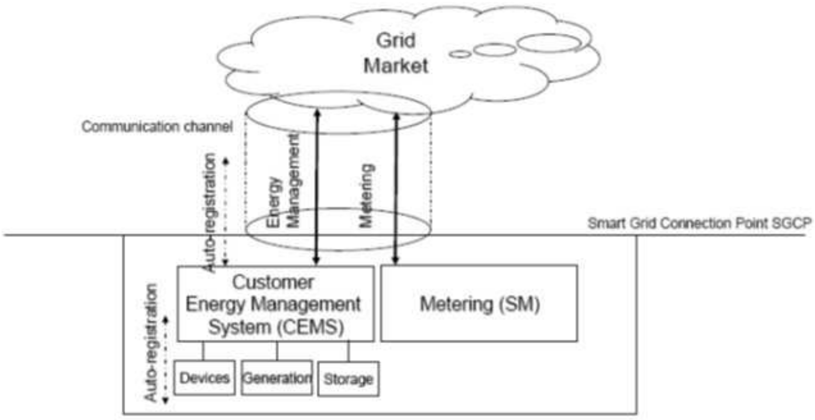
Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.2	01/03/ 2012	Initial draft	Draft
0.4	11/07/ 2012	Reviewed version	Version after commenting phase
0.5	12/11/ 2012	Reviewed version	Version for final commenting
0.51	03/02/ 2014	Fit description into IEC format	

Scope and objectives of use case

<table>
<tr><th colspan="2">Scope and objectives of use case</th></tr>
<tr><td>Scope</td><td>The scope of this use case is the communication between the CEM and "upstream"[14] actors. The communication between CEM, the consumer and (in-home) smart devices is officially not in this scope of this report, but will be included in the use case description for the sake of clarity. Smart devices cover also smart appliances, generators and storage (see table with actors).

When the consumer has a price dependent energy tariff and/or a time dependent distribution tariff, price based demand response is enabled by creating an incentive for load management by consumers or a CEM in response to price changes (RTP, CPP, ToU). Note that multiple loads/generation resources (even from multiple premises) can be combined in the CEM to be mutually controlled.

From an architectural point of view the Smart Grid Coordination Group introduced the "Smart Grid Connection Point" (SGCP) entity as an interface between Smart Grid actors (applications and/or organizations) and in-home/building systems or devices. The diagram below shows the SGCP in its environment.



IEC

Please note that the boxes in the diagram above are functional. The Smart Meter and CEM can be one or two separate physical boxes. The CEM can also be integrated in Smart in-home devices. The communication with the Grid market/applications can be through one or through separate infrastructures.</td></tr>
<tr><td>Objective(s)</td><td>The objective of this use case is to exchange information between external actors and the premise in order to:
– Make consumers aware of their energy consumption
– Providing external market roles with information on (forecasted) energy consumption
– Enable consumers or their Energy Management System to react on (changes in) energy prices, thus supporting consumers to optimize their consumption to use cheaper or greener energy (depending on personal preferences)
– Send warnings to the consumer to keep consumption below a certain (contracted) level
– Enable external actors to retrieve the state of in home smart devices</td></tr>
<tr><td>Related business case(s)</td><td>A combination of the functions described in this use support “Demand Response”, following the definition of Eurelectric, which is referenced in the Sustainable Processes workgroup’s report.</td></tr>
</table>

Narrative of use case

Narrative of use case
Short description
This use case describes how information regarding price and environmental aspects is sent from upstream actors to CEM and how information regarding energy consumption or generation as well as smart device statuses are being sent back to the consumer and upstream actors.
Complete description

14 Upstream in this context means towards actor A or B (see actor definitions).

Narrative of use case
This high level use case comprises four different primary use cases: **1. WGSP 2111: Information regarding power consumption or generation** The Smart Meter makes available the information on total power consumption or generation in the house. The CEM receives this information but can also receive consumption / generation information per smart device.[15] The rate of update of the information must be proportional to the rate of change in the power drawn. This use case scenario consists of two scenarios: – Sending information regarding (future) power consumption or generation of individual smart devices. This information is provided by the smart device to CEM, which may aggregate it and use it to forecast consumption/generation and send this to the display and external actors. As the CEM can be a function integrated in smart devices in the customer premises, more than one CEM in the house may execute this scenario. In this case, one CEM does not have the total house consumption, but only partial information. – Sending information regarding total power consumption or generation. This information is provided by the smart meter, sent to the CEM that may use it to make a forecast of consumption/generation and forward this to the display and external actors. Note that several use case scenarios may work together in an iterative way. E.g. there might be a negotiation which uses the price (WGSP2112) to get a forecast (WGSP2111), then adapting the price, which might be binding from there on. Also note that the consumption information can be transferred via different channels to actor A, B and to the consumer or in-home devices. This implies that the use case could effectively be split up into three sub-use cases, each with its own goal (sending the information to Actor A, sending the information to Actor B and sending the information to the Simple External Consumer Display). **2. WGSP 2112: Price and/or environmental information** Actor A will send information (e.g. price, meteorological, environmental, cost related information, warning messages) to the consumer or his smart devices via the Energy management gateway; Actor B may do the same via the Smart Metering gateway. The goal is to make the consumer or his devices aware of the amount and cost of consumed energy and the amount and income for selling energy back to the grid, or of other elements relevant to energy management (e.g.: the percentage amount of green power). The consumer can also receive a notification that the tariff has been changed. To move out peak loads, an external actor can propose a tariff of electricity higher during certain periods of the day or during certain days in order to invite his customers to delete or shift various uses or lower their consumptions in its housing during these periods. These periods and days may not be fixed in advance, but rather determined on the flexibility needs of the smart grid. When such a higher cost period occurs, the customers are notified in advance, so that they can be ready to react to these price messages. Smart devices can be parameterised or managed by the CEM to start when the energy costs less or when the relative amount of green energy is over a set level or to temporarily lowers its power consumption and/or shifts its operation before or after a peak consumption period. The parameterization of the CEM and smart devices are the responsibility of the consumer. The price information can be either real-time price, real time combined price and volume messages or a fixed tariff schedule. Note that dynamic pricing requires a metering system that is able to provide the information for, or to calculate the cost of energy based on, a flexible tariff scheme. This implies that price related changes in the CEM by actor A or B may be combined with a tariff update in the smart meter; this is described in use case BI.03. of the Smart Meters Coordination Group use case repository. The communication functionalities described in this use case may also be used to send warning messages from an external actor to the consumer, warning him that emergency load control will happen within a certain period of time, unless changes in consumption / generation take place. Note that several use case scenarios may work together in an iterative way. E.g. there might be a negotiation which uses the price (WGSP2112) to get a forecast (WGSP2111), then adapting the price (WGSP2112), which might be binding from there on. Also note that the information may be provided by Actor A or Actor B alternatively, which implies that this use case could be effectively split up in two sub-use cases. **3. WGSP 2113: Warning messages from CEM / smart device** This primary use case scenario consists of two scenarios: – A warning message is generated by the smart device after estimating that the power consumed during its next operation will exceed maximum contracted power. The smart device receives information from the CEM on total house consumption and maximum contracted power. The smart device estimates the maximum power that will be consumed during its next operation (ex: cycle). If there is a risk to exceed the threshold of the maximum contracted power, a warning is generated

15 Note that the CEM may be a function embedded in the smart device (having thus access to only partial consumption information), in which case the information on total consumption is provided to the CEM by a communication with a gateway or the smart meter.

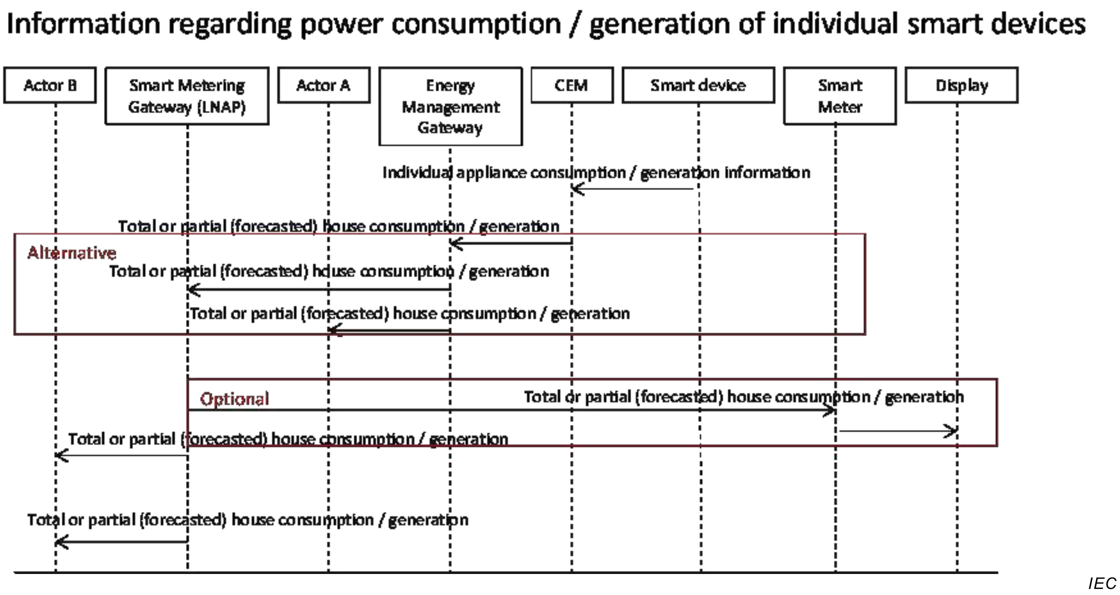
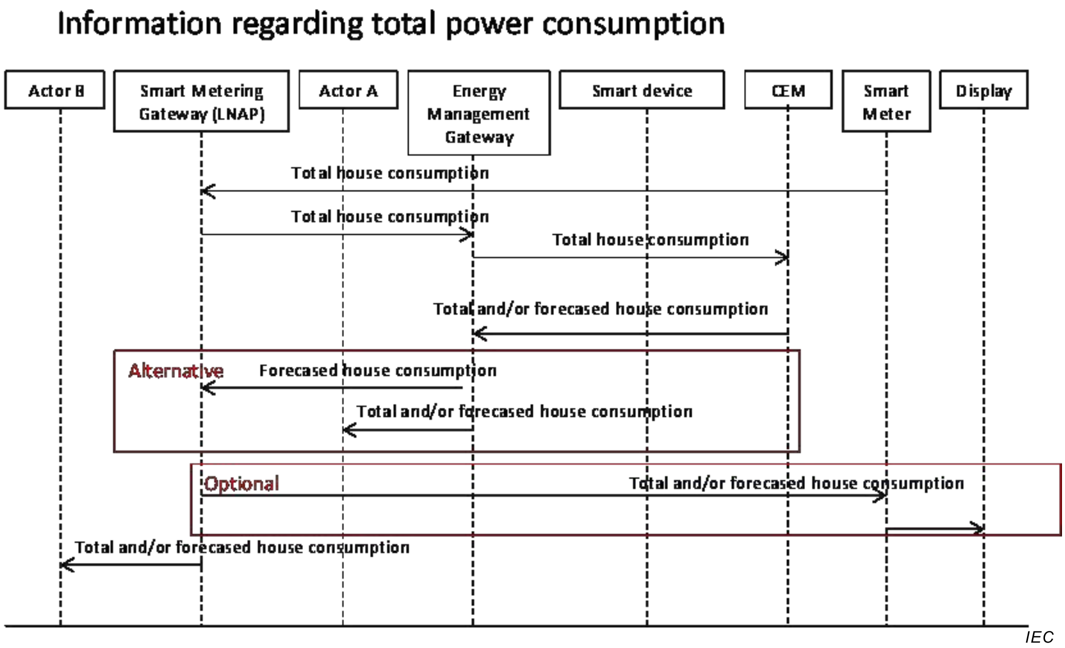
Narrative of use case
and displayed on the smart device or other customer interfaces (e.g. other devices or the simple external consumer display). The threshold is based on limits received from the CEM, which can be limits for instant power or accumulated energy consumption. – The warning message is generated by the CEM after noticing that contracted power is exceeded, based on information from the smart meter. Note that the CEM may also take action to lower the consumption of smart devices; since these actions are not in scope of this use case and the work of the SG-CG, this scenario only describes how the warning messages are being sent. The limits (for instant power) can include not only upper limits (for example, when the customer is close to the limit of his contracted power) but also lower limits (for example, the remaining usual instant power consumption when the customer is out or during night time). **4. WGSP 2114: Retrieve status of smart devices** This use case describes how an external actor retrieves the state of a smart device directly from the CEM. This real time information may be retrieved by an external actor who has a business relationship to the customer, having guaranteed that some of his smart devices are (exclusively) controlled by the external actor. Another alternative is that the customer himself retrieves the state of smart devices via the display, in which case the information is not necessarily sent to actor A or B.

General remarks

General remarks

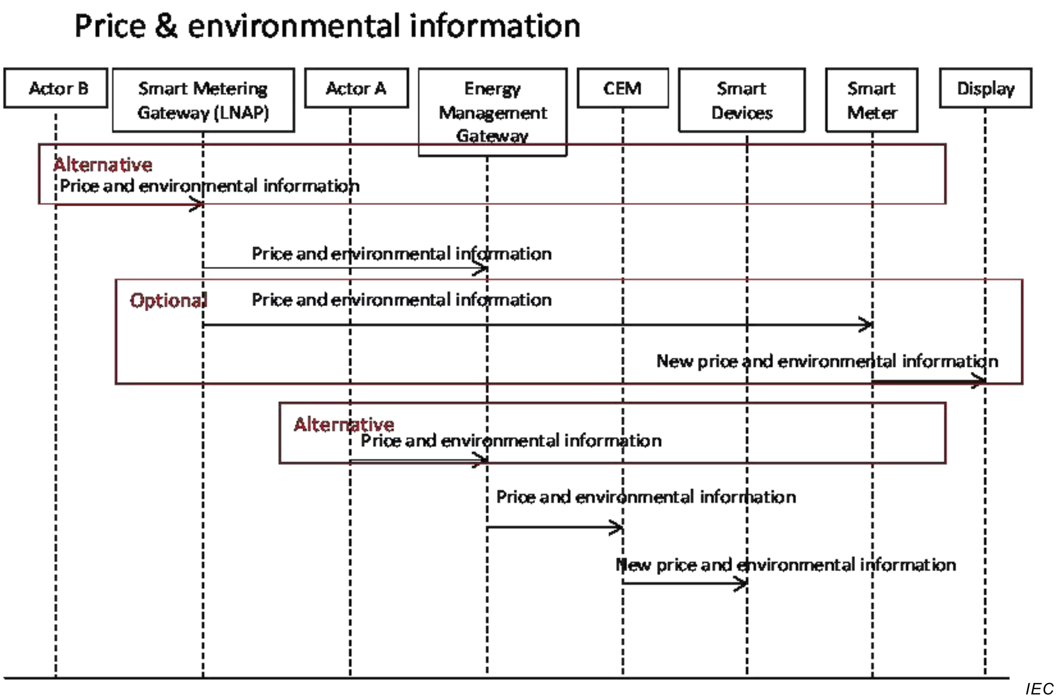
Notes and open issues	
Nr	**Note**
1.	This high level use case may in the future be split up in two high level use cases: – upstream communication (consumption, device status) – downstream and within home communication (price)
2.	Where relevant all primary use case (scenarios) may be split up according to external actors
3.	There is not yet a use case covering the situation where there would be multiple CEMs and the aggregation takes place in the grid side of the SGCP. (e.g. how is the user being informed that he is (going to) exceed his contractual power). Closing this gap would be a next step
4.	Next step: define additonal use cases using the top down method, considering the functional architecture as a black box and identifying which messages would go in / come out

Diagrams of use case

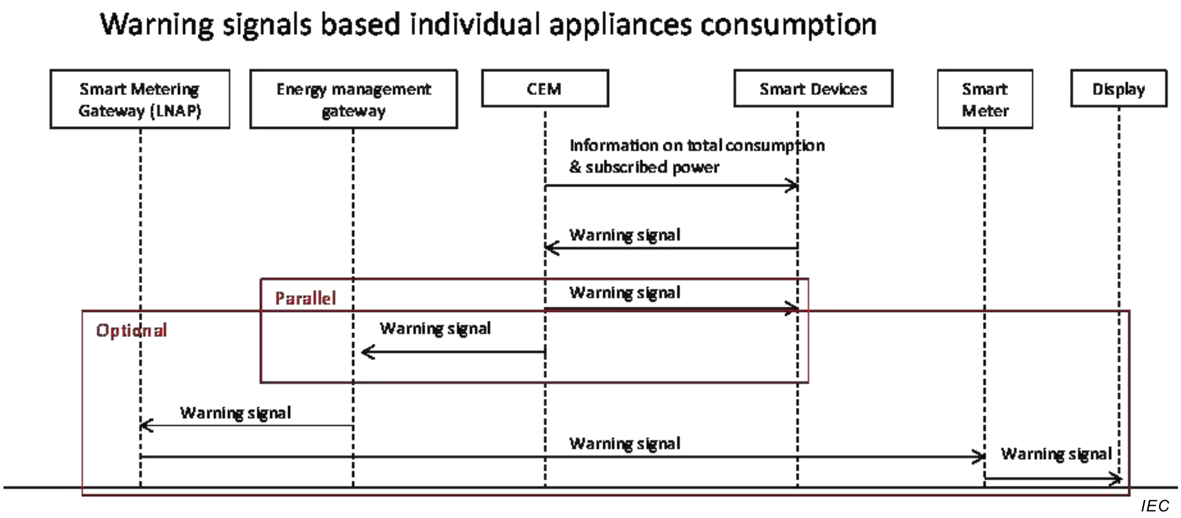
Diagram(s) of use case
WGSP 2111: Use case scenario 1: Information regarding power consumption / generation / storage of individual smart devices

WGSP 2111: Use case scenario 2: Information regarding total power consumption or generation


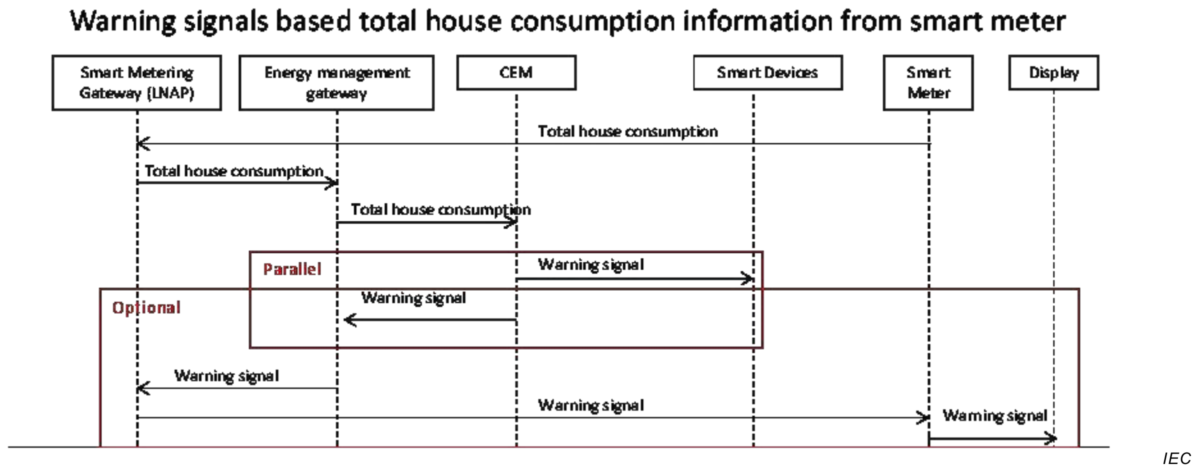
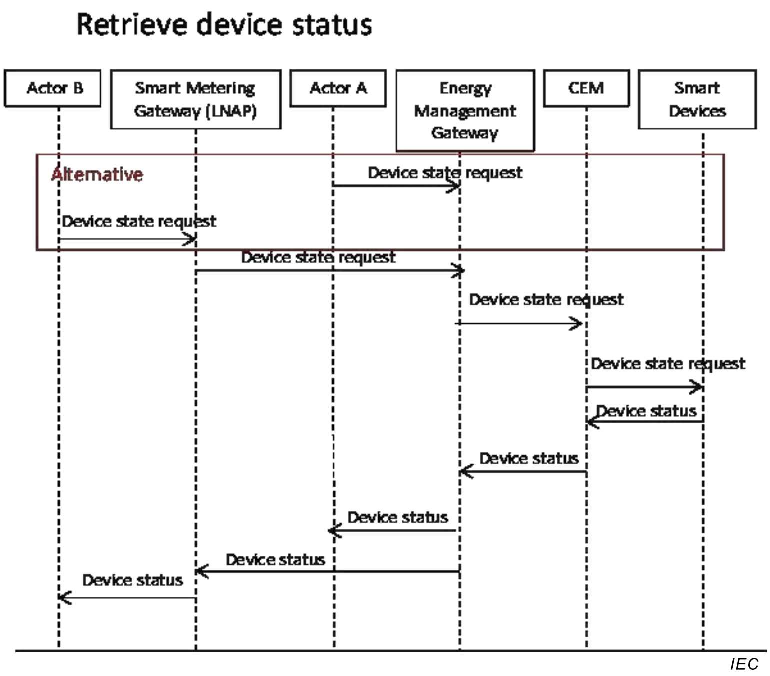
Diagram(s) of use case

WGSP 2112: Price and environmental information



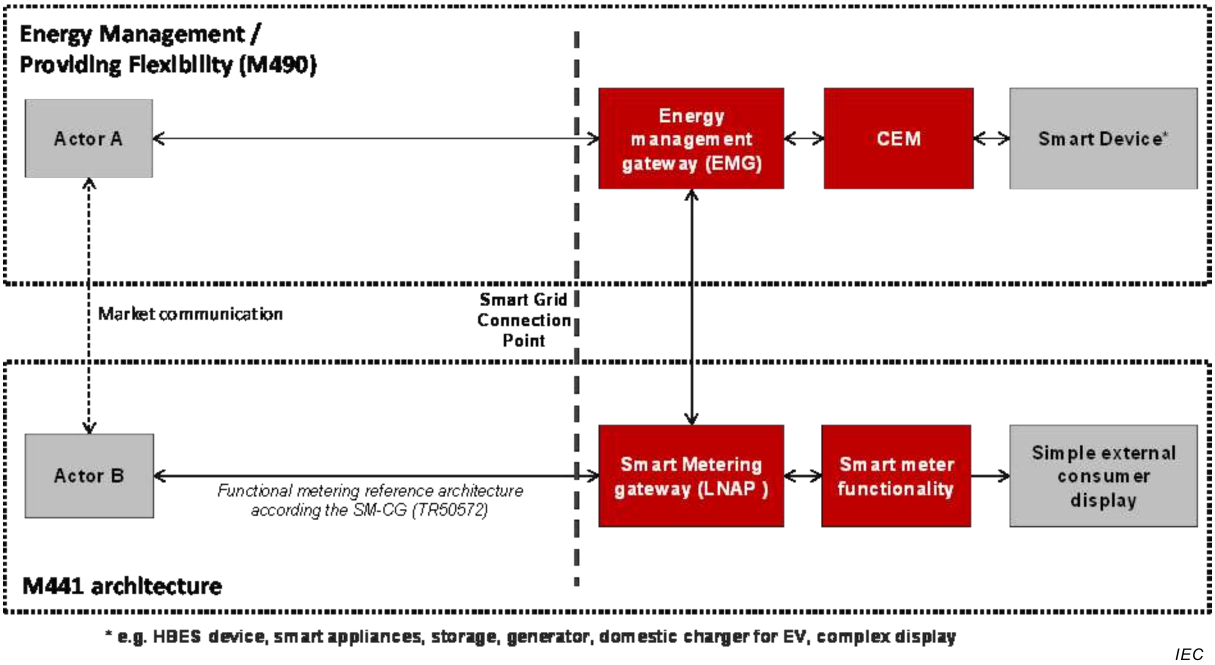
WGSP 2113: use case scenario 1: Warning messages from smart devices



Diagram(s) of use case
WGSP 2113: use case scenario 2: Warning messages from the CEM 
WGSP 2114: Retrieve status of smart devices 

A.3.20.2 Technical details

For the definition of this use case, the following architecture has been used as a basis.



Note that the actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.)

Actors

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager (CEM)	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Energy management gateway	Internal	An access point (functional entity) sending and receiving smart grid related information and commands between actor A and the CEM, letting the CEM decide how to process the events. The communication is often achieved through an internet connection of through a wireless connection. This gateway may also provide services including protocol conversion, device management, security and service capabilities.	
Smart Metering gateway (LNAP)	Internal	An access point (functional entity) that allows access to one or more metering end devices and, when equipped with an interface, to advanced display / home automation end devices connected to the local network. A LNAP also may allow data exchange between different functional entities connected to the same LN. The LNAP may act simply as a router transferring messages between the metering end device and/or display/home automation devices and the Neighbourhood network of wide area network. It may also provide services including protocol conversion, device management, security and service capabilities. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the local network.	

<table>
<tr><th colspan="4">Actors</th></tr>
<tr><th colspan="2">Grouping</th><th colspan="2">Group description</th></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th>Actor name
see Actor list</th><th>Actor type see Actor list</th><th>Actor description
see Actor list</th><th>Further information specific to this use case</th></tr>
<tr><td>Smart meter</td><td>Internal</td><td>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.</td><td></td></tr>
<tr><td>NNAP</td><td>Internal</td><td>The Neighbourhood Network Access Point is a functional entity that provides access to one or more LNAP's, metering end devices, displays and home automation end devices connected to the neighbourhood network (NN). It may allow data exchange between different functional entities connected to the same NN.</td><td></td></tr>
<tr><td>Simple external consumer display</td><td>External</td><td>Dedicated display screen in connection with the smart meter/SGCP available to the customer to check power consumption, planned load reductions and load reductions historical. Other not dedicated means also exist to deliver consumption information to the customer, such as the personal computer, the mobile phone or the TV set.</td><td></td></tr>
<tr><td>Smart device</td><td>External</td><td>A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way.
Since the smart device is outside the scope of the SGCG, it must be seen as an external actor</td><td></td></tr>
</table>

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a home energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc…	
HES	Internal	Responsible for acquiring the reads from meters and/or from data concentrators Delivers the raw meter reads to MDM Repeats the reading for any missing reads Is the short-term interim data storage (1-3 months) for meter reads Pushes the event information upwards to MDM Supports the specific protocols of the concentrators and meters Contains some topology information and aggregation functionality for plug & play solutions	

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
MDM	Internal	Is the single meter data repository for all metering data Is the long-term storage for the metering data Ensures the data quality by VEE for the higher level business processes Connects all head-end systems Is the connection point for other systems to reach the smart meters i.e. a gateway to HES and back Delivers the meter reads to other business systems for further usage Acts as the critical security firewall between business and operational systems and the advanced metering infrastructure. Contains some topology information and aggregation functionality	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
		In order to correctly bill demand/generation flexibility, the smart meter and CEM need to be time synchronized	

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Example use cases to WGSP2111	EDF-0023, EDF-0024, EDF-0025, EDF-0026, CECED0003, ESMIG-0001, FINS0048 (3.4.2 p 25-26), FINS0077, FINS0081, FINS0082, FINS0089, FINS0090, TC205-0043, AK716.0.1_UC4, AK716.0.1_UC5		The original use cases that served as a basis for this use case		
2	Example use cases to WGSP2112	CECED-0001, CECED-0002, CECED-0003, DKE-0014, EDF-0003, EDF-0016, EDF-0021, EDF-0027, ESMIG-0006, ESMIG0013, ESMIG-0014, FINS-0070, FINS-0071, PMA-0001, SCE-0001, TC205-0002 through -0012, AK716.0.1_UC4, AK716.0.1_UC5		The original use cases that served as a basis for this use case		
3	Example use cases to WGSP2113	FINS0088		The original use cases that served as a basis for this use case		

Further Information on the use case for classification / mapping

Classification information
Relation to other use cases
Flexibility cluster
Level of depth
Primary use case
Prioritisation
1
Generic, regional or national relation
Generic
Viewpoint
Technical
Further keywords for classification

Classification information
Demand side management, demand response, Smart Grid

A.3.20.3 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-Condition**	**Post-Condition**
211 1.1	Information regarding power consumption / generation / storage of individual smart devices	Smart device	New consumption / generation / storage information is available in the smart device	Communication connection between all actors is established The smart device has a schedule instructing it when to send consumption information to the CEM. The CEM has a schedule instructing it when to send consumption information to the external actor / display.	(forecasted) consumption / generation is received by actor A and/or actor B and/or display
211 1.2	Information regarding total power consumption / generation	Smart Meter	New consumption / generation information is available in the Smart Meter	Communication connection between all actors is established The smart meter has a schedule instructing it when to send consumption information to the CEM. The CEM has a schedule instructing it when to send consumption information to the external actor / display.	(forecasted) consumption/generation information is received by actor A and/or or Actor B and/or display
211 2	Price and environmental information	Actor A or actor B	New price and environmental information is available in Actor A or Actor B	Communication connection between all actors is established	Price and environmental information is received by smart devices
211 3.1	Warning messages based on individual devices consumption	Smart device	The CEM received information on a new operation to be executed	The subscribed power limits are made known to the smart device Information on total consumption is available in the CEM	Warning message is received by display and/or smart devices

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-Condition**	**Post-Condition**
211 3.2	Warning messages based on total house consumption from smart meter	Smart meter	Smart meter is triggered to send consumption information to CEM	The subscribed power limits are know to the CEM Smart meter has a schedule indicating when to send consumption information to CEM	Warning message is received by display and/or smart devices
4	Retrieve status of smart devices	Actor A or actor B	Actor A or Actor B want to retrieve the state of a smart device	The external actor is authorized to retrieve the state of the selected smart device(s)	The external actor received the requested information

Steps – Scenarios

Scenario								
Scenario name:		**WGSP 2111: Use case scenario 1: Information regarding power consumption / generation / storage of individual smart devices**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Requi-re-ments, R-ID**
1	New consum ption / genera-tion / storage informa tion is availa-ble in the smart device		Smart device sends information regarding consumption to the CEM		Smart device	CEM	Individual device consumption / generation / storage	
2	CEM recei-ved consum ption / genera-tion informa tion per indivi-dual smart device		The CEM aggregates and/or forecasts consumption and sends this information to the Energy Manage-ment Gateway		CEM	Energy Management Gateway	*Total or partial (forecasted) house consumption / generation / storage*	
3a	Energy Mana-gement Gate-way recei-ved (fore-casted) consum ption / generat ion		Energy Manage-ment Gateway forwards information Smart Metering Gateway *(alternative)*		Energy Manage-ment Gateway	Smart Metering Gateway	*Total or partial (forecasted) house consumption / generation / storage*	

Scenario								
Scenario name:		**WGSP 2111: Use case scenario 1: Information regarding power consumption / generation / storage of individual smart devices**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Requi-re-ments, R-ID**
3b	Energy Mana-gement Gate-way recei-ved (fore-casted) consum ption / genera-tion		Energy Manage-ment Gateway forwards information to Actor A *(alternative)*		Energy Manage-ment Gateway	Actor A	*Total or partial (forecasted) house consumption / generation / storage*	
4	Smart Mete-ring Gate-way (LNAP) recei-ves (fore-casted) consum ption / genera-tion		Smart Metering Gateway (LNAP) sends information to the Smart Meter *(optional)*		Smart Metering Gateway (LNAP)	Smart Meter	*Total or partial (forecasted) house consumption / generation / storage*	
5	Smart Meter recei-ves (fore-casted) consum ption / genera-tion		Smart Meter sends information to the Display *(optional)*		Smart Meter	Simple external consumer display	*Total or partial (forecasted) house consumption / generation / storage*	
6	Smart Mete-ring Gate-way (LNAP) recei-ves (fore-casted) consum ption / genera-tion		Smart Metering Gateway (LNAP) forwards information to Actor B *(via the metering channel)*		Smart Metering Gateway (LNAP)	Actor B	*Total or partial (forecasted) house consumption / generation / storage*	

Scenario								
Scenario name:		**WGSP 2111: Use case scenario 2: Information regarding total power consumption or generation**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	New consumption/ generation information is available in the Smart Meter		The Smart Meter forwards the consumption information to the Smart Metering Gateway (LNAP)		Smart Meter	Smart Metering Gateway (LNAP)	Consumption information	
2	Smart Metering Gateway (LNAP) receives the information		Smart Metering Gateway (LNAP) forwards the consumption information to Energy Management Gateway		Smart Metering Gateway (LNAP)	Energy Management Gateway	Consumption information	
3	Energy Management Gateway receives the information		Energy Management Gateway forwards the consumption information to CEM		Energy Management Gateway	CEM	Consumption information	
4	New consumption information is available in the CEM		The CEM may forecast total consumption and sends (forecasted) consumption information to the Energy Management Gateway		CEM	Energy Management Gateway	Total and/or forecasted house consumption	
5a	Energy Management Gateway received (fore-casted) consumption		Energy Management Gateway forwards information to Actor A (alternative)		Energy Management Gateway	Actor A	Total and/or forecasted house consumption	

Scenario								
Scenario name:		**WGSP 2111: Use case scenario 2: Information regarding total power consumption or generation**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
5b	Energy Mana-ge-ment Gate-way recei-ved (fore-casted) consum ption		Energy Managemen t Gateway forwards information to Smart Metering Gateway (LNAP) (alternative)		Energy Manage-ment Gateway	Smart Metering Gateway (LNAP)	Total and/or forecasted house consump-tion	
6	Smart Mete-ring Gate-way (LNAP) recei-ves (fore-casted) consum ption		Smart Metering Gateway (LNAP) forwards information to Smart Meter (optional)		Smart Metering Gateway (LNAP)	Smart Meter	Total and/or forecasted house consump-tion	
7	Smart Meter recei-ves (fore-casted) consum ption		Smart Meter forwards information to Display (optional)		Smart Meter	Simple external consumer display	Total and/or forecasted house consump-tion	
8	Smart Mete-ring Gate-way (LNAP) recei-ves (fore-casted) consum ption		Smart Metering Gateway (LNAP) forwards information to Actor B (via metering channel)		Smart Metering Gateway (LNAP)	Actor B	Total and/or forecasted house consump-tion	

Scenario								
Scenario name:		WGSP 2112: Price and environmental information						
Step No.	Event	Name of process/ activity	Description of process/ activity	Service	Informa-tion producer (Actor)	Information receiver (Actor)	Informa-tion exchanged	Require-ments, R-ID
1a	New price and/ or environ mental is avai-lable in actor B (alterna tive)		Actor B sends price and/or environ-mental information to Smart Metering Gateway (LNAP) *(via metering channel)*		Actor B	Smart Metering Gateway (LNAP)	Price and/or environ-mental information	
1b	Smart Mete-ring Gate-way (LNAP) recei-ves informa -tion		Smart Metering Gateway (LNAP) forwards price and/or environ-mental information to Energy Manage-ment Gateway		Smart Metering Gateway (LNAP)	Energy Management Gateway	Price and/or environ-mental information	
1c	Smart Mete-ring Gate-way (LNAP) recei-ves informa -tion		Smart Metering Gateway (LNAP) forwards price and/or environ-mental information to Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Price and/or environ-mental information	
1d	Smart Meter recei-ves informa -tion		Smart Meter forwards price and/or environ-mental information to Display		Smart Meter	Simple external consumer display	Price and/or environ-mental information	
2	New price and/ or environ mental is avai-lable in actor A (alterna tive)		Actor A sends information to Energy Manage-ment Gateway		Actor A	Energy Management Gateway	Price and/or environ-mental information	
3	Energy Mana-gement Gate-way recei-ved informa tion		Energy Manage-ment Gateway forwards price and/or environ-mental information to CEM		Energy Manage-ment Gateway	CEM	Price and/or environ-mental information	

Scenario								
Scenario name:	**WGSP 2112: Price and environmental information**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
4	CEM recei-ved new price and/or environ mental informa tion		CEM identifies relevant smart devices and forwards the new price and/or environment al information to the smart devices		CEM	Smart Appliances	Price and/or environ-mental information	

Scenario								
Scenario name:	**WGSP 2113: use case scenario 1: Warning messages from smart devices**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
1	The CEM recei-ved informa tion on a new opera-tion to be execu-ted		The CEM sends information on total house consumption and subscribed power to the device involved		CEM	Smart device	Total house consump-tion and subscribed power	
2	The smart device recei-ved informa tion on total house consum ption and subscri bed power to the device		The smart device estimates the maximum power to be consumed for the operation and deducts this from the available power. In case there is insufficient power available, it displays a warning message and sends a warning message to the CEM		Smart device	CEM	Warning message	

Scenario								
Scenario name:		**WGSP 2113: use case scenario 1: Warning messages from smart devices**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
3a	The CEM recei-ved a warning messa-ge		The CEM sends the warning message to (other) smart devices		CEM	Smart device	Warning message	
3b	The CEM recei-ved a warning messa-ge		The CEM sends the warning message to the Energy Manage-ment Gateway		CEM	Energy Management Gateway	Warning message	
4	Energy Mana-gement Gate-way recei-ves the warning messa-ge		Energy Manage-ment Gateway forwards message to the Smart Metering Gateway (LNAP)		Energy Manage-ment Gateway	Smart Metering Gateway (LNAP)	Warning message	
5	The Smart Mete-ring Gate-way (LNAP) recei-ves the warning messa-ge		Smart Metering Gateway (LNAP) forwards message to the Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Warning message	
6	The Smart Meter recei-ves the warning messa-ge		Smart Meter sends the message to the Display		Smart Meter	Simple external consumer display	Warning message	

Scenario								
Scenario name:		**WGSP 2113: use case scenario 2: Warning messages from the CEM**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
1	Smart meter is trigge-red to send consum ption informa tion to CEM		Smart meter sends information on total house consumption to smart metering gateway (LNAP)		Smart meter	Smart metering gateway (LNAP)	Total house consump-tion	
2	Smart mete-ring gate-way recei-ves total house consum ption		Smart metering gateway (LNAP) forwards information to energy manage-ment gateway		Smart metering gateway (LNAP)	Energy management gateway	Total house consump-tion	
3	Energy mana-gement gate-way recei-ves total house consum ption		Energy manage-ment gateway forwards information to CEM		Energy manage-ment gateway	CEM	Total house consump-tion	
4a	CEM recei-ves total house consum ption and notices that maxi-mum contrac ted power is being excee-ded		The CEM sends warning message to smart devices		CEM	Smart device	Warning message	

Scenario								
Scenario name:		**WGSP 2113: use case scenario 2: Warning messages from the CEM**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
4b	CEM recei-ves total house consum ption and notices that maxi-mum contrac ted power is being excee-ded		The CEM sends warning message to the Energy Manage-ment Gateway		CEM	Energy Management Gateway	Warning message	
5	Energy Manag ement Gate-way recei-ves the warning messa-ge		Energy Manage-ment Gateway forwards message to the Smart Metering Gateway (LNAP)		Energy Manage-ment Gateway	Smart Metering Gateway (LNAP)	Warning message	
6	The Smart Mete-ring Gate-way (LNAP) recei-ves the warning messa-ge		Smart Metering Gateway (LNAP) forwards message to the Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Warning message	
7	The Smart Meter recei-ves the warning messa-ge		Smart Meter sends the message to the Display		Smart Meter	Simple external consumer display	Warning message	

Scenario								
Scenario name:		**WGSP 2114: Retrieve status of smart devices**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Informa-tion producer (Actor)**	**Information receiver (Actor)**	**Informa-tion exchanged**	**Require-ments, R-ID**
1a	Actor A wants to retrieve the state of a smart device (*Alternative)*		Actor A sends a device state request to the energy manage-ment gateway		Actor A	Energy management gateway	Device state request	
1b	Actor B wants to retrieve the state of a smart device (*Alternative)*		Actor B sends a device state request to the Smart Metering Gateway (LNAP) *(via metering channel)*		Actor B	Smart Metering Gateway (LNAP)	Device state request	
2	Smart Mete-ring Gateway (LNAP) recei-ves device state request		Smart Metering Gateway (LNAP) forwards device state request to Energy manage-ment gateway		Smart Metering Gateway (LNAP)	Energy management gateway	Device state request	
3	Energy management gate-way recei-ves device state request		Energy manage-ment gateway forwards device state request to CEM		Energy manage-ment gateway	CEM	Device state request	
4	CEM recei-ves device state request		The CEM retrieves the device state from its memory and sends it to the energy man agent gateway *Optionally, the CEM may interrogate the relevant appliances on their current status*		CEM	Energy management gateway	Device status	

Scenario								
Scenario name:		**WGSP 2114: Retrieve status of smart devices**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
5a	Energy management gateway receives device status		Energy management gateway forwards device status to Actor A (*Alternative)*		Energy management gateway	Actor A	Device status	
5b	Energy management gateway receives device status		Energy management gateway forwards device status to A Smart Metering Gateway (LNAP) (*Alternative)*		Energy management gateway	Smart Metering Gateway (LNAP	Device status	
6	Smart Metering Gateway (LNAP) receives device status		Smart Metering Gateway (LNAP) forwards device status to Actor B *(via metering channel)*		Smart Metering Gateway (LNAP)	Actor B	Device status	

A.3.20.4 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Consumption / generation / storage information	Total or partial, actual or forecasted	
Price and/or environmental information		
Confirmation		
Information regarding subscribed power		
Warning message		
Device state request		
Device status		

A.3.20.5 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.20.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.20.7 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.21 High level use case (JWG212x, *based on WGSP212x*) Direct load-generation management (international)

A.3.21.1 Description of the use case

Name of use case

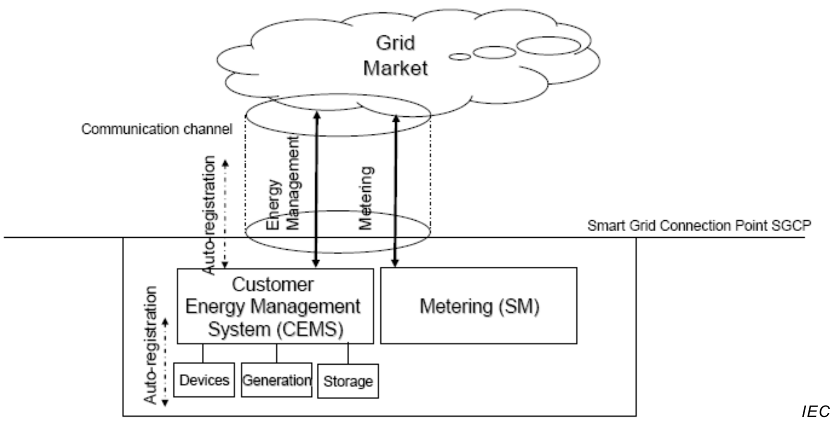
Use case identification		
ID	**Area / Domain(s)/ Zone(s)**	**Name of use case**
JWG212x-WGSP	Smart Grid	Direct load / generation management

Version management

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.2	01/03/2012	Initial draft	Draft
0.4	11/07/2012	Reviewed version	Version after commenting phase
0.5	13/11/2012	Reviewed version	Version for final commenting
0.51	03/02/2014	Fit description into IEC format	
0.51-JP0.8	28/02/2014	Marge JP requirements	Draft for Comment

Version management			
Version No.	**Date**	**Changes**	**Approval status**
0.6	12/03/2014	Minor changes to include this initial SPWG Use Case into JWG-UC activities with a new JWG-UC ID. Initial WGSP-UC had been extended with Japanese requirements for the JWG activity.	Draft

Scope and objectives of use case

Scope and objectives of use case	
Scope	The scope of this use case is the communication between the CEM and "upstream"[16] actors. The communication between CEM, the consumer and (in-home) smart devices (e.g. appliances / generators / storage) is officially not in this scope of this report, but will be included in the use case description for the sake of clarity. Smart devices cover also smart appliances, generators and storage (see table with actors). Note that multiple loads/generation resources (even from multiple premises) can be combined in the CEM to be mutually controlled. From an architectural point of view the Smart Grid Coordination Group introduced the "Smart Grid Connection Point" (SG CP) entity as an interface between Smart Grid actors (applications and/or organizations) and in-home/building systems or devices. The diagram below shows the SG CP in its environment.  Please note that the boxes in the diagram above are functional. The Smart Meter and CEM can be one or two separate physical boxes. The CEM can also be integrated in Smart in-home devices. The communication with the Grid market/applications can be through one or through separate infrastructures.
Objective(s)	The objective of this use case is to manage in-home devices in order to control power consumption or generation resources for example to: Avoid the risk of black out React to real time peak power messages Balance the load between consumption and local production Optimize the consumption to use cheaper and/or greener energy (depending on personal preferences) Maintain power quality

16 Upstream in this context means towards actor A or B (see actor definitions).

Scope and objectives of use case	
Related business case(s)	Demand Side Management messages are sent to the Consumer Energy Manager (CEM) to trigger a program that manages load by interacting with a number of in-home smart devices connected to the CEM. The functions described below can be labeled as a “Direct load control” use case, following the definition of Eurelectric, which is referenced in the Sustainable Processes Workgroup’s report The difference with Use Case 2110 (supporting Demand Response) is that the operator responsible for managing the load/generation flexibility actively asks to change consumption/generation with a specific amount. The consumer’s reaction to this request, however is depending on the contract between the consumer and the organisation sending out the message and the final decision made by the consumer or the device receiving the message.

Narrative of use case

Narrative of use case
Short description
Messages and metrological information are provided to the home/building via an interface called the Smart Grid Connection Point (SG CP). The following messages can be distinguished: 1) Direct – load / generation / storage management 2) Emergencies a) Emergency load control b) Announce end of emergency load control The functions described below can be labeled as a “Direct load control” use case, following the definition of Eurelectric, which is referenced in the Sustainable Processes workgroup’s report.
Complete description

Narrative of use case
This use case comprises three primary use cases: **JWG2121: Load / generation / storage management** A load/generation management message is sent by an upstream actor to increase, reduce or limit the load, generation or stored energy. A load/generation management message is sent from actor A or B to the CEM. The CEM can forward the message directly to the appliance/generator/storage or it may (based on a number of parameters) translate it into individual control messages to the smart devices that were found to best suited to fulfill the operation. A smart device may be an appliance, generator or storage device (e.g. storage batteries, heat pumps, fuel cells, etc.). Based on the load management message from the CEM, the smart device may change the power consumption, generation or storage depending on the kind of device, what the device is currently doing and the consumer settings. The start of the device may also be shifted in order to avoid taking energy during the peak time or to avoid exceeding a set power limit or may shift the activation of certain features. The CEM may provide feedback to the external actor requesting the load/generation change, so this actor can have an idea of which change in consumption/generation to expect and to update his demand/generation forecast. The feedback may also be used for billing purposes In case of Remote-controllable device is connected to CEM, CEM interprets the load/generation management message and controls this type of device remotely. In some case, Actor A or B sends a load/generation management message to the CEM in advance (for example, the night before the day) due to high demand forecast. It can be considered that a negotiation process between Actor A or B and CEM exists in order to negotiate the amount of power reduction. **JWG2122: Emergencies** When there is a risk of a blackout in a given area, an emergency message from actor A or B can request smart devices to turn to network standby according to a safe procedure set by the manufacturer. The message may or may not contain predefined time duration. The grid may also provide a message notifying the end of the emergency and the return to normal status. This use case describes the functionalities involved with emergencies from the home perspective. It shows how an emergency message is sent to the home and how the CEM reacts to this. Use case “WGSP-2300 Emergency Demand Messages – Load shedding” describes the emergency from the perspective of the external actor (e.g. DSO). Use case WGSP-2112 describes how warning messages may be sent from an external actor to the consumer, warning that emergency load control will happen within a certain period of time, unless changes in consumption / generation take place. This may typically precede WGSP-2122. The primary use cases consist of two scenarios: – “Emergency load control” describes how a load control message is sent through the CEM, to the devices. In case the emergency load control message already contains the duration of the load control period, the CEM may instruct the smart devices at the right moment that the emergency period has passed. This last instruction is not in scope of this use case and is not described in the detailed analysis. Confirmations may optionally be sent from the CEM to Actor A/B so this actor can have an idea of which change in consumption/generation to expect and to update his demand/generation forecast. The feedback may also be used for billing purposes. – “Announce end of emergency load control” describes how an external actor instructs the CEM that the emergency period is ended. Confirmation from the CEM may be requested by the external actor to ensure that all CEM’s have received the message. In case of Remote-controllable device is connected to CEM, CEM interprets the Emergency load control message/end of emergency signal and controls this type of device remotely. In some case, Actor A/B may use this message for notifying the period of scheduled-blackout to CEM in advance. Under the severe emergency case, the risk of blackout may be higher. When this happens CEM may change its operation plan (for example, set higher priority to charging battery).

General remarks

General remarks

Notes and open issues

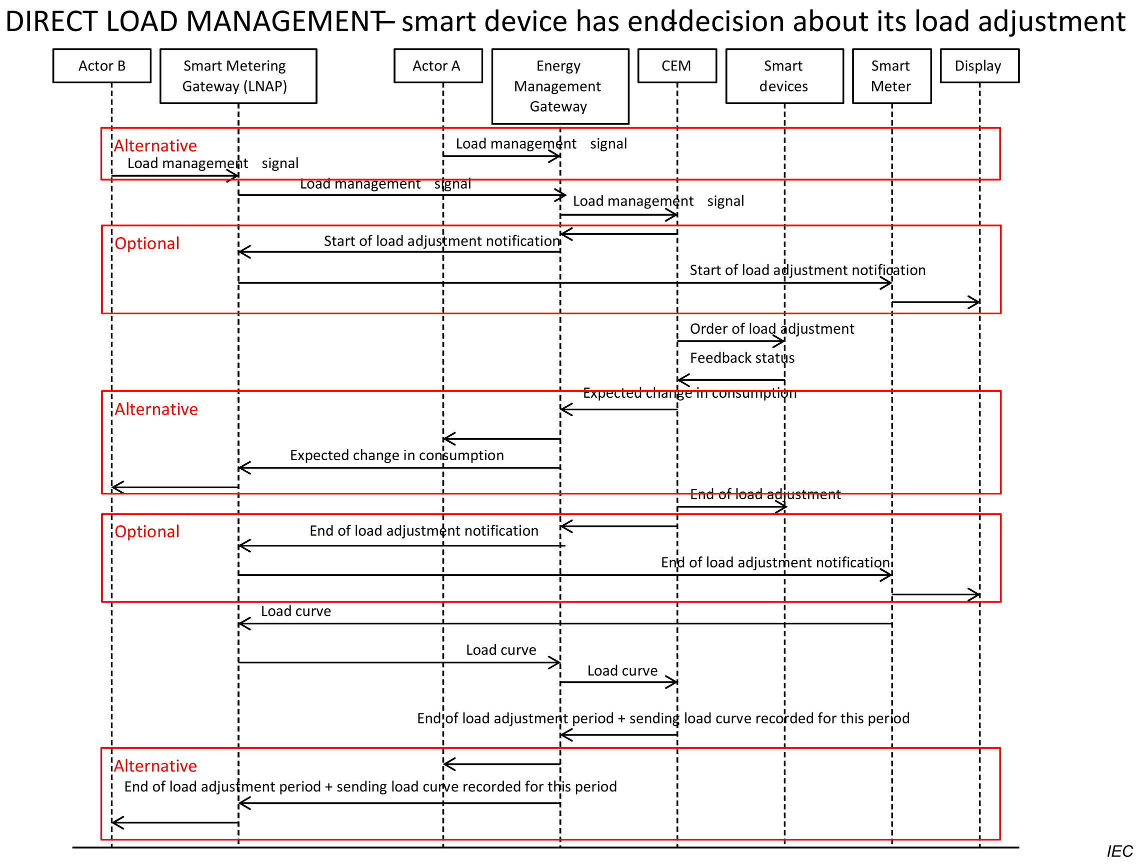
Notes and open issues	
Nr	**Note**
1.	A possible new primary use case on direct load control could describe how the grid asks which CEMs are willing to change consumption; grid receives offers and chooses which ones to accept. Developing this further may be a next step.
2.	Where relevant all primary use case (scenarios) may be split up according to external actors
3.	There is not yet a use case covering the situation where there would be multiple CEMs and the aggregation takes place in the grid side of the SG CP. (e.g. how is the user being informed that he is (going to) exceed his contractual power). Closing this gap would be a next step
4.	Next step: define additional use cases using the top down method, considering the functional architecture as a black box and identifying which messages would go in / come out

A.3.21.2 Diagrams of use case

Figure A.30 shows diagrams of use case.

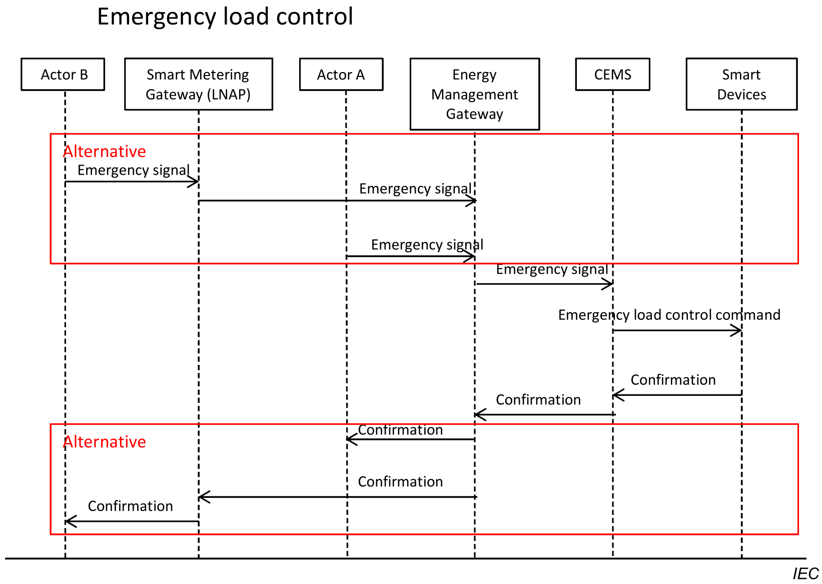
Diagram(s) of use case

JWG 2121: Load / generation / storage management



JWG 2122: Emergencies

JWG 2122: Use case scenario 1: Emergency load control



JWG 2122: Use case scenario 2: Announce end of emergency load control

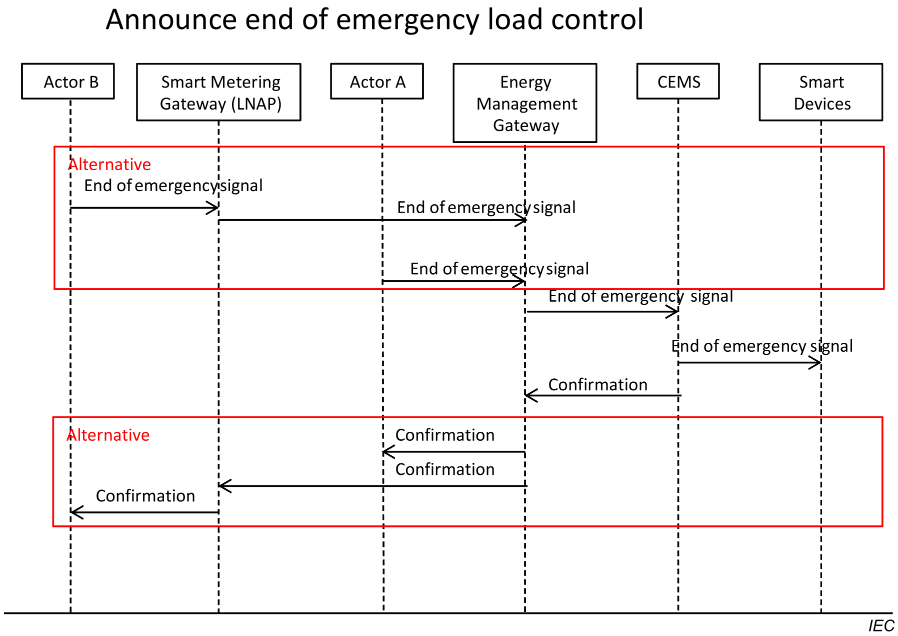
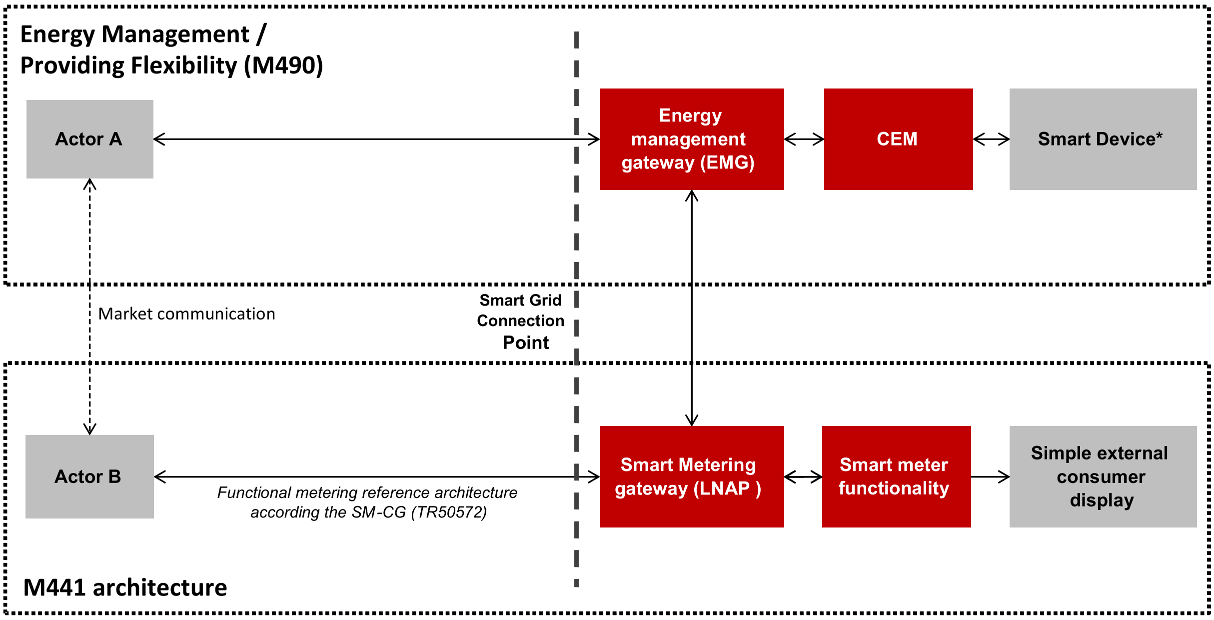


Figure A.30 – Sequence diagram

A.3.21.3 Technical details

For the definition of this use case, the architecture shown in Figure A.31 has been used as a basis.



* e.g. HBES device, smart appliances, storage, generator, domestic charger for EV, complex display, remote-controlled device

IEC

Figure A.31 – SG CG Architecture Model [9]

NOTE The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.)

Actors

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS	
Energy management gateway	Internal	An access point (functional entity) sending and receiving smart grid related information and commands between actor A and the CEM, letting the CEM decide how to process the events. The communication is often achieved through an internet connection of through a wireless connection. This gateway may also provide services including protocol conversion, device management, security and service capabilities.	

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart Metering gateway (LNAP)	Internal	An access point (functional entity) that allows access to one or more metering end devices and, when equipped with an interface, to advanced display / home automation end devices connected to the local network. A LNAP also may allow data exchange between different functional entities connected to the same LN. The LNAP may act simply as a router transferring messages between the metering end device and/or display/home automation devices and the Neighbourhood network of wide area network. It may also provide services including protocol conversion, device management, security and service capabilities. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the local network.	
Smart meter	Internal	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.	
NNAP	Internal	The Neighbourhood Network Access Point is a functional entity that provides access to one or more LNAP's, metering end devices, displays and home automation end devices connected to the neighbourhood network (NN). It may allow data exchange between different functional entities connected to the same NN.	
Simple external consumer display	External	Dedicated display screen in connection with the smart meter/SG CP available to the customer to check power consumption, planned load reductions and load reductions historical. Other not dedicated means also exist to deliver consumption information to the customer, such as the personal computer, the mobile phone or the TV set.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Remote-Controllable device	External	Example of Remote-Controllable device is air-condition or which has capability of remote-control. When CEM controls this type of device, messages from the grid is interpreted by CEM and the CEM controls this type of device remotely. Since the Remote-controllable Device is outside the scope of IEC/TC57/WG21, it must be seen as an external actor	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc…	
HES	Internal	Responsible for acquiring the reads from meters and/or from data concentrators Delivers the raw meter reads to MDM Repeats the reading for any missing reads Is the short-term interim data storage (1-3 months) for meter reads Pushes the event information upwards to MDM Supports the specific protocols of the concentrators and meters Contains some topology information and aggregation functionality for plug & play solutions	

Actors			
Grouping		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
MDM	Internal	Is the single meter data repository for all metering data Is the long-term storage for the metering data Ensures the data quality by VEE for the higher level business processes Connects all head-end systems Is the connection point for other systems to reach the smart meters i.e. a gateway to HES and back Delivers the meter reads to other business systems for further usage Acts as the critical security firewall between business and operational systems and the advanced metering infrastructure. Contains some topology information and aggregation functionality	
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	

Triggering event, preconditions, assumptions

Use case conditions			
Actor/System/Information/ contract	**Triggering event**	**Pre-conditions**	**Assumption**
		In order to correctly bill demand/generation flexibility, the smart meter and CEM need to be time synchronized	

References

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Example use cases to WGSP2121	DKE-0015, DKE0019 through DKE0021,EDF-0002, EDF-0003, EDF-0007, EDF0008, EDF-0009, EDF-0017, EDF-0022, ESMIG-0012, ESMIG-0013, ESMIG-0014, ESMIG-0017, FINS0048, FINS0074, FINS0078, FINS0080, FINS0083, FINS0084, FINS0085, FINS0086, FINS0087, PMA-0001, TC205-0019 through 0038, TC205-0044 through 0046, TC205-0048, AK716.0.1_UC1, AK716.0.1_UC3; CECED load shedding.		The original use cases that served as a basis for this use case		
2	Example use cases to WGSP2122	FINS0048, FINS0085		The original use cases that served as a basis for this use case		
3	JP use cases contributed at May 2012 and JP user stories contributed at Feb. 2013 to IEC/TC57/WG21	JPUC#1, JPUC#2, JPUC#3, JPUC#4, JPUC#5, JPUC#6, JPUC#8, JPUC#9, JPUC #10, JPUC #11 and user stories related to above UCs.		These use cases show additional actor and requirements on data elements of messages		

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Flexibility cluster
Level of depth
Primary use case
Prioritisation
1
Generic, regional or national relation
Generic
Viewpoint
Technical
Further keywords for classification
Demand side management, direct load control, Smart Grid

A.3.21.4 Step by step analysis of use case

Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2121	Direct – load / generation / storage management	Actor A or Actor B	Actor A or Actor B wants to send a load management message to the market	Communication connection between all actors is established The consumer configured the CEM and/or the participating devices. The consumer configured the device settings and thresholds Information on total consumption or consumption per device is available in the CEM	The smart device[17] executed the load management message and Actor A or Actor B received feedback with a load curve recorded for this period. In case of Remote-controllable device is connected to CEM, the CEM interprets the load management message and controls this type of device remotely.
2122.1	Emergency load control	Actor A or Actor B	The need for an emergency reduction of power consumption / feed-in is identified	Communication between all actors can be established	The CEM ordered all smart devices to switch off and sent confirmation back to actor A or to the HES. In case of Remote-controllable device is connected to CEM, the CEM interprets the Emergency load control message and controls this type of device remotely following the message.
2122.2	Announce end of emergency load control	Actor A or Actor B	There is no more need for an emergency reduction of power consumption / feed-in	Communication between all actors can be established	The CEM informed all smart devices that the emergency load control period has ended and sent confirmation back to actor A or to the HES. In case of Remote-controllable device is connected to CEM, the CEM interprets the end of Emergency message and controls this type of device remotely following the message.

17 Smart device may be an appliance, generator or storage device (e.g. battery).

Steps – Scenarios

Scenario								
Scenario name:		**JWG 2121: Load / generation / storage management**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1a	Actor A wants to send a load management message to the market (alternative)		Actor A sends a load management message to Energy Management Gateway		Actor A	Energy Management Gateway	Load management message	
1b	Actor B wants to send a load management message to the market (alternative)		Actor B sends a load management message to Smart Metering Gateway (LNAP) *(via the metering channel)*		Actor B	Smart Metering Gateway (LNAP)	Load management message	
2	Smart Metering Gateway (LNAP) receives the load management message		Smart Metering Gateway (LNAP) forwards the load management message to the Energy Management Gateway		Smart Metering Gateway (LNAP)	Energy Management Gateway	Load management message	
3	Energy Management Gateway receives a load management message		Energy Management Gateway forwards the load management message to CEM		Energy Management Gateway	CEM	Load management message	
4	CEM receives load management message		*Optionally, when a notification needs to be displayed on the simple external consumer display,* the CEM sends a notification to the Energy Management Gateway		CEM	Energy Management Gateway	Start of load adjustment notification	
5	Energy Management Gateway receives the load management message		Energy Management Gateway sends the notification to Smart Meter		Energy Management Gateway	Smart Metering Gateway (LNAP)	Start of load adjustment notification	

Scenario								
Scenario name:	**JWG 2121: Load / generation / storage management**							
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
6	Smart Metering Gateway (LNAP) receives the load manage-ment message		Smart Metering Gateway (LNAP) sends the notification to Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	Start of load adjustment notification	
7	Smart Meter receives the load manage-ment message		Smart Meter sends the start of load management notification to the Display		Smart Meter	Simple external consumer display	Start of load adjustment notification	
8	CEM received the load managemen t message		CEM decides which smart devices need to be adjusted and sends an order of load adjustment to them		CEM	Smart devices	Order of load adjustment	
9	Smart devices receive the order of load adjustment		The Smart devices decide to switch on/off based on the consumer's settings and send feedback to CEM		Smart devices	CEM	Load adjustment feedback	
10	CEM receives feedback from smart devices		CEM informs Energy Management Gateway on which change in consumption to expect.		CEM	Energy Manageme nt Gateway	Change in consumption	
11a	Energy Manage-ment Gateway receives the change in consumptio n		Energy Management Gateway forwards the change in consumption to Actor A (alternative)		Energy Managem ent Gateway	Actor A	Change in consumption	
11b	Energy Manage-ment Gateway receives the change in consump-tion		Energy Management Gateway forwards the change in consumption to Smart Metering Gateway		Energy Managem ent Gateway	Smart Metering Gateway (LNAP)	Change in consumption	

Scenario								
Scenario name:		**JWG 2121: Load / generation / storage management**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
12	Smart Metering Gateway receives the change in consumptio n		Smart Metering Gateway forwards the change in consumption to Actor B (via the metering channel)		Smart Metering Gateway (LNAP)	Actor B	Change in consumption	
13	Load adjustment period is finished		CEM sends an end of load adjustment to Smart devices		CEM	Smart devices	End of load adjustment	
14	Smart devices receive the end of load adjustment from CEM		The smart devices switch on/off and send feedback to CEM		Smart devices	CEM	End of load adjustment feedback	
15	CEM receives the feedback from smart devices		CEMS sends load adjustment notification to the Energy Management Gateway		CEM	Energy Manageme nt Gateway	End of load adjustment feedback	
16	Energy Managemen t Gateway receives feedback		Energy Management Gateway sends the end of load adjustment notification to the Smart Metering Gateway (LNAP)		Energy Managem ent Gateway	Smart Metering Gateway (LNAP)	End of load adjustment notification	
17	Smart Metering Gateway (LNAP) received notification		Smart Metering Gateway (LNAP) sends end of load adjustment notification to Smart Meter		Smart Metering Gateway (LNAP)	Smart Meter	End of load adjustment notification	
18	Smart Meter received notification		Smart Meter sends the end of load adjustment notification to Display		Smart Meter	Display	End of load adjustment notification	
19	Smart Meter received notification		Smart Meter sends the load curve recorded for this period to Smart Metering Gateway (LNAP)		Smart Meter	Smart Metering Gateway (LNAP)	Load curve	

Scenario								
Scenario name:		**JWG 2121: Load / generation / storage management**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Require -ments, R-ID**
20	Smart metering gateway (LNAP) receives load curve		Smart metering gateway (LNAP) sends load curve to Energy Management Gateway		Smart Metering Gateway (LNAP)	Energy Manage-ment Gateway	Load curve	
21	Energy Manage-ment Gateway receives load curve		Energy Management Gateway sends load curve to CEM		Energy Manage-ment Gateway	CEM	Load curve	
22	CEM receives load curve from smart meter		CEM sends the end of load adjustment period to Energy Management Gateway and sends a load curve recorded for this period		CEM	Energy Manage-ment Gateway	Load adjustment feedback	
23a	Energy Manage-ment Gateway receives the feedback		Energy Management Gateway forwards the feedback to Actor A (alternative)		Energy Managem ent Gateway	Actor A	Load adjustment feedback	
23b	Energy Manage-ment Gateway receives the feedback		Energy Management Gateway forwards the feedback to Smart Metering Gateway (LNAP) (alternative)		Energy Manage-ment Gateway	Smart Metering Gateway (LNAP)	Load adjustment feedback	
24	Smart Metering Gateway (LNAP) receives the feedback		Smart Metering Gateway (LNAP) forwards the feedback to Actor B *(via the metering channel)*		Smart Metering Gateway (LNAP)	Actor B	Load adjustment feedback	

Scenario								
Scenario name:		**JWG 2122: Emergencies – 1, Emergency Load Control**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Requi-re-ments, R-ID**
1a	The need for an emergen-cy reduction of power consump-tion / feed-in is identified		Actor A sends an emergency message to the Energy Management Gateway (alternative)		Actor A	Energy Manage ment Gateway	Emergency message	
1b	The need for an emergen-cy reduction of power consump-tion is identified		Actor B sends an emergency message to the Smart metering gateway (LNAP (alternative) (via the metering channel)		Actor B	Smart metering gateway (LNAP	Emergency message	
2	Smart Metering Gateway (LNAP) receives the emergen-cy message		Smart Metering Gateway (LNAP) sends emergency message to Energy Management Gateway		Smart metering gateway (LNAP)	Energy Manage ment Gateway	Emergency message	
3	Energy Manage-ment Gateway receives the emergen-cy message		Energy Management Gateway forwards the emergency message to CEM		Energy Manageme nt Gateway	CEM	Emergency message	
4	CEM receives the emergen-cy message		CEM orders all smart devices to switch to network standby		CEM	Smart devices	Emergency load management message	
5	Smart devices received emergen-cy message		Smart devices switch to network standby and *optionally* send confirmation back to CEM		Smart devices	CEM	Confirmation *(optional)*	
6	CEM receives confirma-tion		CEM *optionally* sends confirmation to Energy Management Gateway		CEM	Energy Manage ment Gateway	Confirmation *(optional)*	

Scenario								
Scenario name:	**JWG 2122: Emergencies – 1, Emergency Load Control**							
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Information exchanged**	**Requi-re-ments, R-ID**
5a	Energy Manage-ment Gateway receives confirma-tion		Energy Management forwards confirmation to Actor A (Alternative)		Energy Manage-ment Gateway	Actor A	Confirmation *(optional)*	
5b	Energy Manage-ment Gateway receives confirma-tion		Energy Management forwards confirmation to Smart metering gateway (LNAP) (Alternative)		CEM	Smart metering gateway (LNAP)	Confirmation *(optional)*	
6	Smart Metering Gateway (LNAP) receives confirma-tion		Smart metering gateway forwards confirmation to Actor B (Alternative) (via the metering channel)		Smart metering gateway (LNAP)	Actor B	Confirmation *(optional)*	

Scenario								
Scenario name:	**JWG 2122: Emergencies – 2,Announce end of Emergency Load Control**							
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchan-ged**	**Requi-re-ments, R-ID**
1a	There is no more need for an emergency reduction of power consump-tion / feed-in		Actor A sends an end of emergency message to the Energy Management Gateway (alternative)		Actor A	Energy Manage-ment Gateway	End of emergen-cy message	
1b	There is no more need for an emergency reduction of power consump-tion / feed-in		Actor B sends an end of emergency message to the Smart metering gateway (LNAP (alternative) (via the metering channel)		Actor B	Smart metering gateway (LNAP	End of emergen-cy message	
2	Smart Metering Gateway (LNAP) receives the message		Smart Metering Gateway (LNAP) sends end of emergency message to Energy Management Gateway		Smart metering gateway (LNAP)	Energy Manage-ment Gateway	End of emergen-cy message	

Scenario								
Scenario name:		**JWG 2122: Emergencies – 2,Announce end of Emergency Load Control**						
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Servi-ce**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchan-ged**	**Requi-re-ments, R-ID**
3	Energy Manage-ment Gateway receives the emergency		Energy Management Gateway forwards the end of emergency message to CEM		Energy Mange-ment Gateway	CEM	End of emergen-y message	
4	CEM receives the end of emergency message		CEM sends a message to smart devices, allowing them to operate in normal mode		CEM	Smart devices	End of emergen-cy message	
5	CEM receives the end of emergency message		CEM *optionally* sends confirmation to Energy Management Gateway		CEM	Energy Manage-ment Gateway	Confirma-tion *(optional)*	
6a	Energy Manage-ment Gateway receives confirmation		Energy Management forwards confirmation to Actor A (Alternative)		Energy Managem ent Gateway	Actor A	Confirma-tion *(optional)*	
6b	Energy Manage-ment Gateway receives confirmation		Energy Management forwards confirmation to Smart metering gateway (LNAP) (Alternative)		CEM	Smart metering gateway (LNAP)	Confirma-tion *(optional)*	
7	Smart Metering Gateway (LNAP) receives confirmation		Smart metering gateway forwards confirmation to Actor B (Alternative) (via the metering channel)		Smart metering gateway (LNAP)	Actor B	Confirma-tion *(optional)*	

A.3.21.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Load management message	This may include an economic value for the flexibility requested by Actor A/B User Story named "Manage energy consumption of smart devices by Smart Grid" requires in-advance notification of load management. Also, this User Story requires a negotiation process for the amount of power reduction between Actor A/B and CEM. User Story named "Control of Smart home appliances in response to power saving request from Electric power supplier" requires tariff information at each time slot in advance as one type of incentive.	The time period for power reduction in advance "(date, time, window)" for in-advance notification. The response status of CEM which is accept or reject or not-sufficient for a negotiation process. Tariff information (24 hours in advance, for example) as one type of incentive
Start of load adjustment notification		
Announcement of load adjustment		
Order of load adjustment		
Load adjustment feedback		
Change in consumption		
End of load adjustment		
End of load adjustment feedback		
End of load adjustment notification		
Load curve		
Load adjustment feedback		
Emergency message	User Story named "Control of Smart home appliance before power cut" requires time period information when no power will be provided by scheduled blackout. User Story named "Control of Smart home Appliances in case of natural disaster" requires level of Emergency so that CEM may change its operation under the severe emergency case.	Time period of power cut (date, time, window) Level of alert: for example normal or severe
Emergency load management message		
Confirmation	A confirmation sent back to an external actor after receiving a load management message may include: an indication of the amount of load / generation that will be shifted an indication that the CEM will comply with the request, without an estimate	
End of emergency message		

A.3.21.6 Requirements (optional)

Requirements (optional)	
Categories for requirements	**Category description**
Requirement ID	**Requirement description**

A.3.21.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.21.8 Custom information (optional)

Custom information (optional)		
Key	**Value**	**Refers to Section**

A.3.22 High level use case (WGSP2120) Direct load / generation management (European)

A.3.22.1 Description of the use case

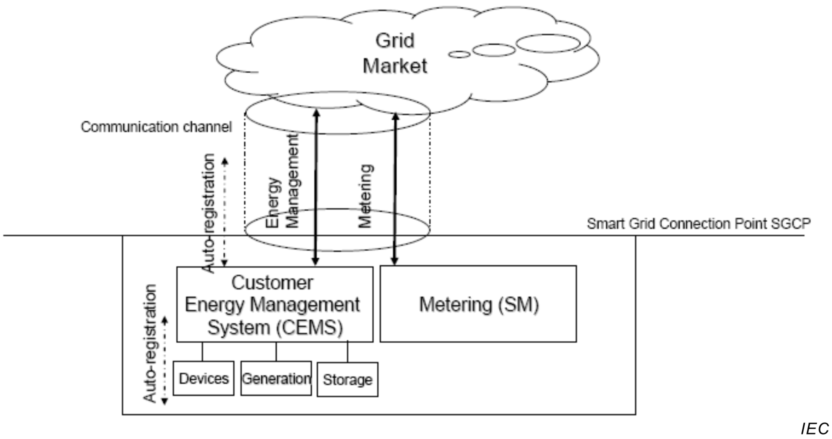
Name of use case

Use case identification		
ID	**Domain(s)**	**Name of use case**
WGSP 2120	Smart Grid	Direct load / generation management

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title**	**Approval status draft, for comments, for voting, final**
0.2	01/03/2012	Domain expert		Initial draft	Draft
0.4	11/07/2012	Editor		Reviewed version	Version after commenting phase
0.5	13/11/2012	Editor		Reviewed version	Version for final commenting

Scope and objectives of use case

Scope and objectives of use case	
Related business case	Demand Side Management messages are sent to the Consumer Energy Manager (CEM) to trigger a program that manages load by interacting with a number of in-home smart devices connected to the CEM. The functions described below can be labeled as a “Direct load control” use case, following the definition of Eurelectric, which is referenced in the Sustainable Processes Workgroup’s report The difference with Use Case 2110 (supporting Demand Response) is that the operator responsible for managing the load/generation flexibility actively asks to change consumption/generation with a specific amount. The consumer’s reaction to this request, however is depending on the contract between the consumer and the organisation sending out the message and the final decision made by the consumer or the device receiving the message.
Scope	The scope of this use case is the communication between the CEM and "upstream"[18] actors. The communication between CEM, the consumer and (in-home) smart devices (e.g. appliances / generators / storage) is officially not in this scope of this report, but will be included in the use case description for the sake of clarity. Smart devices cover also smart appliances, generators and storage (see table with actors). Note that multiple loads/generation resources (even from multiple premises) can be combined in the CEM to be mutually controlled. From an architectural point of view the Smart Grid Coordination Group introduced the "Smart Grid Connection Point" (SG CP) entity as an interface between Smart Grid actors (applications and/or organizations) and in-home/building systems or devices. The diagram below shows the SG CP in its environment.  Please note that the boxes in the diagram above are functional. The Smart Meter and CEM can be one or two separate physical boxes. The CEM can also be integrated in Smart in-home devices. The communication with the Grid market/applications can be through one or through separate infrastructures.
Objective	The objective of this use case is to manage in-home devices in order to control power consumption or generation resources for example to: – Avoid the risk of black out – React to real time peak power messages – Balance the load between consumption and local production – Optimize the consumption to use cheaper and/or greener energy (depending on personal preferences) – Maintain power quality

Narrative of use case

[18] Upstream in this context means towards actor A or B (see actor definitions).

Narrative of use case
Short description – max 3 sentences
Messages and metrological information are provided to the home/building via an interface called the Smart Grid Connection Point (SG CP). The following messages can be distinguished: 1) Direct – load / generation / storage management 2) Emergencies a) Emergency load control b) Announce end of emergency load control The functions described below can be labeled as a “Direct load control” use case, following the definition of Eurelectric, which is referenced in the Sustainable Processes workgroup’s report.
Complete description
This use case comprises three primary use cases: **WGSP 2121: Load / generation / storage management** A load/generation management message is sent by an upstream actor to increase, reduce or limit the load, generation or stored energy. A load/generation management message is sent from actor A or B to the CEM. The CEM can forward the message directly to the appliance/generator/storage or it may (based on a number of parameters) translate it into individual control messages to the smart devices that were found to best suited to fulfill the operation. A smart device may be an appliance, generator or storage device (e.g. storage batteries, heat pumps, fuel cells, etc.). Based on the load management message from the CEM, the smart device may change the power consumption, generation or storage depending on the kind of device, what the device is currently doing and the consumer settings. The start of the device may also be shifted in order to avoid taking energy during the peak time or to avoid exceeding a set power limit or may shift the activation of certain features. The CEM may provide feedback to the external actor requesting the load/generation change, so this actor can have an idea of which change in consumption/generation to expect and to update his demand/generation forecast. The feedback may also be used for billing purposes **WGSP 2122: Emergencies** When there is a risk of a blackout in a given area, an emergency message from actor A or B can request smart devices to turn to network standby according to a safe procedure set by the manufacturer. The message may or may not contain predefined time duration. The grid may also provide a message notifying the end of the emergency and the return to normal status. This use case describes the functionalities involved with emergencies from the home perspective. It shows how an emergency message is sent to the home and how the CEM reacts to this. Use case “WGSP-2300 Emergency Demand Messages – Load shedding” describes the emergency from the perspective of the external actor (e.g. DSO). Use case WGSP-2112 describes how warning messages may be sent from an external actor to the consumer, warning that emergency load control will happen within a certain period of time, unless changes in consumption / generation take place. This may typically precede WGSP-2122. The primary use cases consist of two scenarios: – “Emergency load control” describes how a load control message is sent through the CEM, to the devices. In case the emergency load control message already contains the duration of the load control period, the CEM may instruct the smart devices at the right moment that the emergency period has passed. This last instruction is not in scope of this use case and is not described in the detailed analysis. Confirmations may optionally be sent from the CEM to Actor A/B so this actor can have an idea of which change in consumption/generation to expect and to update his demand/generation forecast. The feedback may also be used for billing purposes. – “Announce end of emergency load control” describes how an external actor instructs the CEM that the emergency period is ended. Confirmation from the CEM may be requested by the external actor to ensure that all CEMs have received the message.

General remarks

General remarks

A.3.22.2 Diagram of use case

Diagram of use case
See detailed description of use cases

A.3.22.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.32 has been used as a basis.

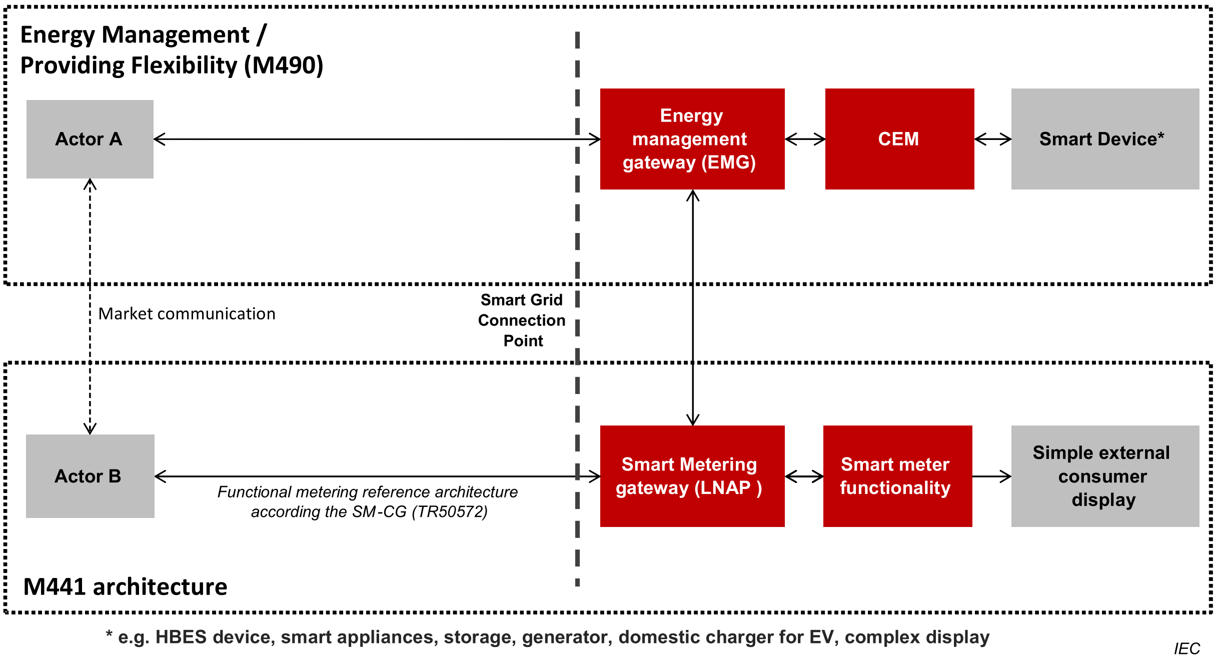


Figure A.32 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.).

Actors			
Grouping (Community)		Group description	
Actor name see Actor list	Actor type see Actor list	Actor description see Actor list	Further information specific to this use case
Customer Energy Manager	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	

<table>
<tr><th colspan="4">Actors</th></tr>
<tr><th colspan="2">Grouping (Community)</th><th colspan="2">Group description</th></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th>Actor name see Actor list</th><th>Actor type see Actor list</th><th>Actor description see Actor list</th><th>Further information specific to this use case</th></tr>
<tr><td>Energy management gateway</td><td>Internal</td><td>An access point (functional entity) sending and receiving smart grid related information and commands between actor A and the CEM, letting the CEM decide how to process the events. The communication is often achieved through an internet connection of through a wireless connection.

This gateway may also provide services including protocol conversion, device management, security and service capabilities.</td><td></td></tr>
<tr><td>Smart Metering gateway (LNAP)</td><td>Internal</td><td>An access point (functional entity) that allows access to one or more metering end devices and, when equipped with an interface, to advanced display / home automation end devices connected to the local network.

A LNAP also may allow data exchange between different functional entities connected to the same LN. The LNAP may act simply as a router transferring messages between the metering end device and/or display/home automation devices and the Neighbourhood network of wide area network.

It may also provide services including protocol conversion, device management, security and service capabilities. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the local network.</td><td></td></tr>
<tr><td>Smart meter</td><td>Internal</td><td>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.</td><td></td></tr>
<tr><td>NNAP</td><td>Internal</td><td>The Neighbourhood Network Access Point is a functional entity that provides access to one or more LNAP’s, metering end devices, displays and home automation end devices connected to the neighbourhood network (NN). It may allow data exchange between different functional entities connected to the same NN.</td><td></td></tr>
<tr><td>Simple external consumer display</td><td>External</td><td>Dedicated display screen in connection with the smart meter/SG CP available to the customer to check power consumption, planned load reductions and load reductions historical. Other not dedicated means also exist to deliver consumption information to the customer, such as the personal computer, the mobile phone or the TV set.</td><td></td></tr>
<tr><td>Smart device</td><td>External</td><td>A smart device may be an appliance, generator or storage device (Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…). The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way.

Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor.</td><td></td></tr>
</table>

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc.	
HES	Internal	Responsible for acquiring the reads from meters and/or from data concentrators Delivers the raw meter reads to MDM Repeats the reading for any missing reads Is the short-term interim data storage (1 to 3 months) for meter reads Pushes the event information upwards to MDM Supports the specific protocols of the concentrators and meters Contains some topology information and aggregation functionality for plug & play solutions	
MDM	Internal	Is the single meter data repository for all metering data Is the long-term storage for the metering data Ensures the data quality by VEE for the higher level business processes Connects all head-end systems Is the connection point for other systems to reach the smart meters i.e. a gateway to HES and back Delivers the meter reads to other business systems for further usage Acts as the critical security firewall between business and operational systems and the advanced metering infrastructure. Contains some topology information and aggregation functionality	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	

Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
		In order to correctly bill demand/generation flexibility, the smart meter and CEM need to be time synchronized	

References / Issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Example use cases to WGSP2121	DKE-0015, DKE0019 through DKE0021,EDF-0002, EDF-0003, EDF-0007, EDF0008, EDF-0009, EDF-0017, EDF-0022, ESMIG-0012, ESMIG-0013, ESMIG-0014, ESMIG-0017, FINS0048, FINS0074, FINS0078, FINS0080, FINS0083, FINS0084, FINS0085, FINS0086, FINS0087, PMA-0001, TC205-0019 through 0038, TC205-0044 through 0046, TC205-0048, AK716.0.1_UC1, AK716.0.1_UC3; CECED load shedding.		The original use cases that served as a basis for this use case		
2	Example use cases to WGSP2122	FINS0048, FINS0085		The original use cases that served as a basis for this use case		

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Flexibility cluster
Level of depth

Primary use case
Prioritisation
1
Generic, regional or national relation
Generic
View
Technical
Further keywords for classification
Demand side management, direct load control, Smart Grid

A.3.22.4 Step by step analysis of use case

WGSP 2121- Direct – load / generation / storage management

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2121	Direct – load / generation / storage management	Actor A or Actor B	Actor A or Actor B wants to send a load management message to the market	Communication connection between all actors is established The consumer configured the CEM and/or the participating devices. The consumer configured the device settings and thresholds Information on total consumption or consumption per device is available in the CEM	The smart device[19] executed the load management message and Actor A or Actor B received feedback with a load curve recorded for this period

A.3.22.5 Diagram of use case

Figure A.33 shows a diagram of use case.

[19] Smart device may be an appliance, generator or storage device (e.g. battery).

Diagram of use case

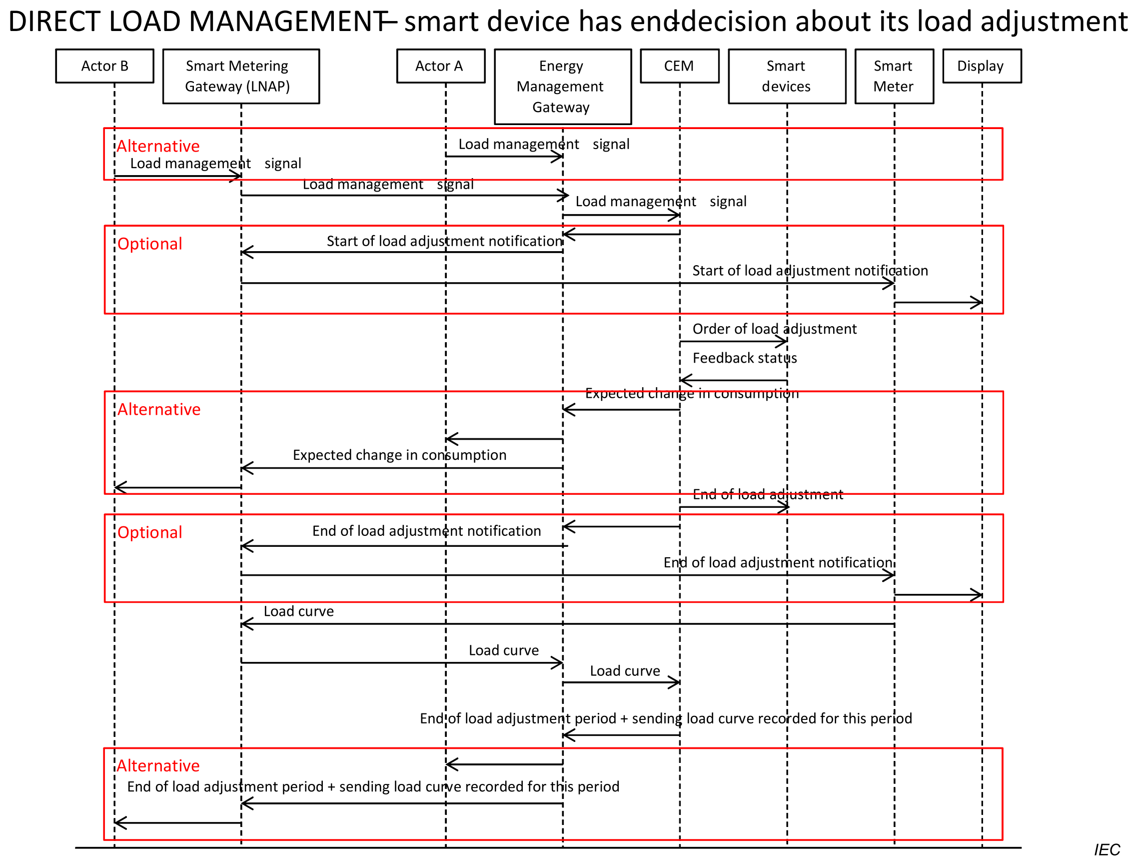


Figure A.33 – Sequence diagram

Steps – Normal

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1a	Actor A wants to send a load management message to the market (alternative)		Actor A sends a load management message to Energy Management Gateway	Enterprise – field / Customer premise	Actor A	Energy Management Gateway	Load management message	
1b	Actor B wants to send a load management message to the market (alternative)		Actor B sends a load management message to Smart Metering Gateway (LNAP) *(via the metering channel)*	Enterprise – Field / Customer premise	Actor B	Smart Metering Gateway (LNAP)	Load management message	

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Requirements, R-ID**
2	Smart Metering Gateway (LNAP) receives the load management message		Smart Metering Gateway (LNAP) forwards the load management message to the Energy Management Gateway	Field/ Custo-mer premise	Smart Metering Gateway (LNAP)	Energy Manage ment Gateway	Load manage-ment message	
3	Energy Management Gateway receives a load management message		Energy Management Gateway forwards the load management message to CEM	Field/ Custo-mer premise	Energy Manage ment Gateway	CEM	Load manage-ment message	
4	CEM receives load management message		*Optionally, when a notification needs to be displayed on the simple external consumer display,* the CEM sends a notification to the Energy Management Gateway	Field/ Custo-mer premise	CEM	Energy Manage ment Gateway	Start of load adjustment notification	
5	Energy Management Gateway receives the load management message		Energy Management Gateway sends the notification to Smart Meter	Field/ Custo-mer premise	Energy Manage ment Gateway	Smart Metering Gateway (LNAP	Start of load adjustment notification	
6	Smart Metering Gateway (LNAP) receives the load management message		Smart Metering Gateway (LNAP) sends the notification to Smart Meter	Field/ Custo-mer premise	Smart Metering Gateway (LNAP	Smart Meter	Start of load adjustment notification	
7	Smart Meter receives the load management message		Smart Meter sends the start of load management notification to the Display	Field/ Custo-mer premise	Smart Meter	Simple external consumer display	Start of load adjustment notification	
8	CEM received the load management message		CEM decides which smart devices need to be adjusted and sends an order of load adjustment to them	Field/ Custo-mer premise	CEM	Smart devices	Order of load adjustment	

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require ments, R-ID**
9	Smart devices receive the order of load adjustment		The smart devices decide to switch on/off based on the consumer's settings and send feedback to CEM	Field/ Custo-mer premise	Smart devices	CEM	Load adjustment feedback	
10	CEM receives feedback from smart devices		CEM informs Energy Management Gateway on which change in consumption to expect.	Field/ Custo-mer premise	CEM	Energy Manage ment Gateway	Change in consump-tion	
11a	Energy Management Gateway receives the change in consumption		Energy Management Gateway forwards the change in consumption to Actor A (alternative)	Field – enterpri-se/ Custo-mer premise	Energy Manage ment Gateway	Actor A	Change in consump-tion	
11b	Energy Management Gateway receives the change in consumption		Energy Management Gateway forwards the change in consumption to Smart Metering Gateway	Field – enterpr-ise/ Custo-mer premise	Energy Manage ment Gateway	Smart Metering Gateway (LNAP)	Change in consump-tion	
12	Smart Metering Gateway receives the change in consumption		Smart Metering Gateway forwards the change in consumption to Actor B (via the metering channel)	Field – Enterpri-se/ Custo-mer premise	Smart Metering Gateway (LNAP)	Actor B	Change in consump-tion	
13	Load adjustment period is finished		CEM sends an end of load adjustment to Smart devices	Field/ Custo-mer premise	CEM	Smart devices	End of load adjustment	
14	Smart devices receive the end of load adjustment from CEM		The smart devices switch on/off and send feedback to CEM	Field/ Custo-mer premise	Smart devices	CEM	End of load adjustment feedback	
15	CEM receives the feedback from smart devices		CEMS sends load adjustment notification to the Energy Management Gateway	Field/ Custo-mer premise	CEM	Energy Manage ment Gateway	End of load adjustment feedback	

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Requirements, R-ID**
16	Energy Management Gateway receives feedback		Energy Management Gateway sends the end of load adjustment notification to the Smart Metering Gateway (LNAP)	Field/ Custo-mer premise	Energy Manage ment Gateway	Smart Metering Gateway (LNAP)	End of load adjustment notification	
17	Smart Metering Gateway (LNAP) received notification		Smart Metering Gateway (LNAP) sends end of load adjustment notification to Smart Meter	Field/ Custo-mer premise	Smart Metering Gateway (LNAP)	Smart Meter	End of load adjustment notification	
18	Smart Meter received notification		Smart Meter sends the end of load adjustment notification to Display	Field/ Custo-mer premise	Smart Meter	Display	End of load adjustment notification	
19	Smart Meter received notification		Smart Meter sends the load curve recorded for this period to Smart Metering Gateway (LNAP)	Field/ Custo-mer premise	Smart Meter	Smart Metering Gateway (LNAP)	Load curve	
20	Smart metering gateway (LNAP) receives load curve		Smart metering gateway (LNAP) sends load curve to Energy Management Gateway	Field/ Custo-mer premise	Smart Metering Gateway (LNAP)	Energy Manage ment Gateway	Load curve	
21	Energy Management Gateway receives load curve		Energy Management Gateway sends load curve to CEM	Field/ Custo-mer premise	Energy Manage ment Gateway	CEM	Load curve	
22	CEM receives load curve from smart meter		CEM sends the end of load adjustment period to Energy Management Gateway and sends a load curve recorded for this period	Field/ Custo-mer premise	CEM	Energy Manage ment Gateway	Load adjustment feedback	

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchanged**	**Require ments, R-ID**
23a	Energy Management Gateway receives the feedback		Energy Management Gateway forwards the feedback to Actor A (alternative)	Field – enterpri-se/ Custo-mer premise	Energy Manage ment Gateway	Actor A	Load adjustment feedback	
23b	Energy Management Gateway receives the feedback		Energy Management Gateway forwards the feedback to Smart Metering Gateway (LNAP) (alternative)	Field/ Custo-mer premise	Energy Manage ment Gateway	Smart Metering Gateway (LNAP)	Load adjustment feedback	
24	Smart Metering Gateway (LNAP) receives the feedback		Smart Metering Gateway (LNAP) forwards the feedback to Actor B *(via the metering channel)*	Field –- Enterpri-se/ Custo-mer premise	Smart Metering Gateway (LNAP)	Actor B	Load adjustment feedback	

WGSP 2122: Use case scenario 1: Emergency load control

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2122.1	Emergency load control	Actor A or Actor B	The need for an emergency reduction of power consumption / feed-in is identified	Communication between all actors can be established	The CEM ordered all smart devices to switch off and sent confirmation back to actor A or to the HES

Diagram of use case

Figure A.34 shows a diagram of use case.

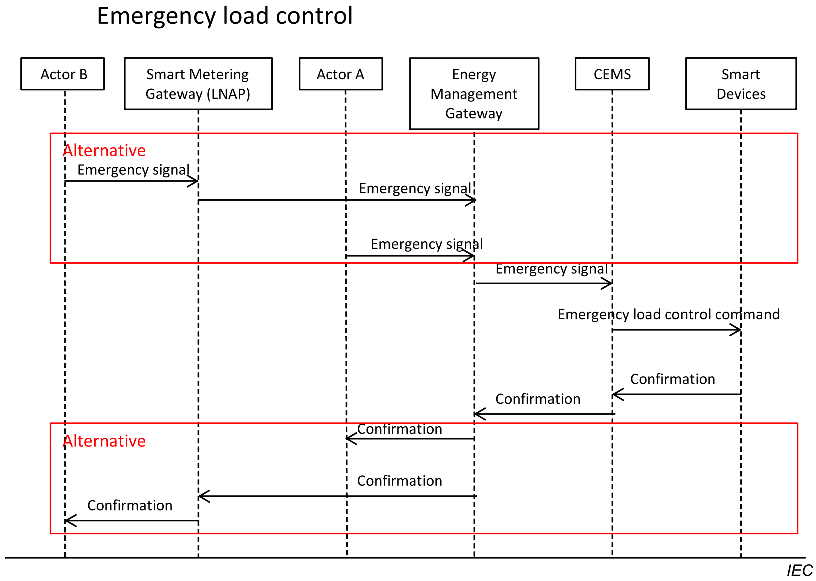
Diagram of use case


Figure A.34 – Sequence diagram

Steps – Normal

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion produ-cer (Actor)**	**Informa -tion receiv-er (Actor)**	**Information exchanged**	**Requi-rements, R-ID**
1a	The need for an emergency reduction of power consumption / feed-in is identified		Actor A sends an emergency message to the Energy Management Gateway (alternative)	Enterprise – field/ Custo-mer premise	Actor A	Energy Manage ment Gateway	Emergency message	
1b	The need for an emergency reduction of power consumption is identified		Actor B sends an emergency message to the Smart metering gateway (LNAP (alternative) (via the metering channel)	Enterprise – Field/ Custo-mer premise	Actor B	Smart metering gateway (LNAP	Emergency message	
2	Smart Metering Gateway (LNAP) receives the emergency message		Smart Metering Gateway (LNAP) sends emergency message to Energy Management Gateway	Field/ Custo-mer premise	Smart metering gateway (LNAP)	Energy Manage ment Gateway	Emergency message	
3	Energy Management Gateway receives the emergency message		Energy Management Gateway forwards the emergency message to CEM	Field/ Custo-mer premise	Energy Manage ment Gateway	CEM	Emergency message	

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process /activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion produ-cer (Actor)**	**Informa -tion receiv-er (Actor)**	**Information exchanged**	**Requi-rements, R-ID**
4	CEM receives the emergency message		CEM orders all smart devices to switch to network standby	Field/ Custo-mer premise	CEM	Smart devices	Emergency load management message	
5	Smart devices received emergency message		Smart devices switch to network standby and *optionally* send confirmation back to CEM	Field/ Custo-mer premise	Smart devices	CEM	Confirmation *(optional)*	
6	CEM receives confirmation		CEM *optionally* sends confirmation to Energy Management Gateway	Field/ Custo-mer premise	CEM	Energy Manage ment Gateway	Confirmation *(optional)*	
5a	Energy Management Gateway receives confirmation		Energy Management forwards confirmation to Actor A (Alternative)	Field – enterpri se/ Custo-mer premise	Energy Manage ment Gateway	Actor A	Confirmation *(optional)*	
5b	Energy Management Gateway receives confirmation		Energy Management forwards confirmation to Smart metering gateway (LNAP) (Alternative)	Field – enterpri se/ Custo-mer premise	CEM	Smart metering gateway (LNAP)	Confirmation *(optional)*	
6	Smart Metering Gateway (LNAP) receives confirmation		Smart metering gateway forwards confirmation to Actor B (Alternative) (via the metering channel)	Field – Enterpri se/ opera-tion Custo-mer premise	Smart metering gateway (LNAP)	Actor B	Confirmation *(optional)*	

WGSP 2122: Use case scenario 2: Announce end of emergency load control

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2122.2	Announce end of emergency load control	Actor A or Actor B	There is no more need for an emergency reduction of power consumption / feed-in	Communication between all actors can be established	The CEM informed all smart devices that the emergency load control period has ended and sent confirmation back to actor A or to the HES

Diagram of use case

Figure A.35 shows a diagram of use case.

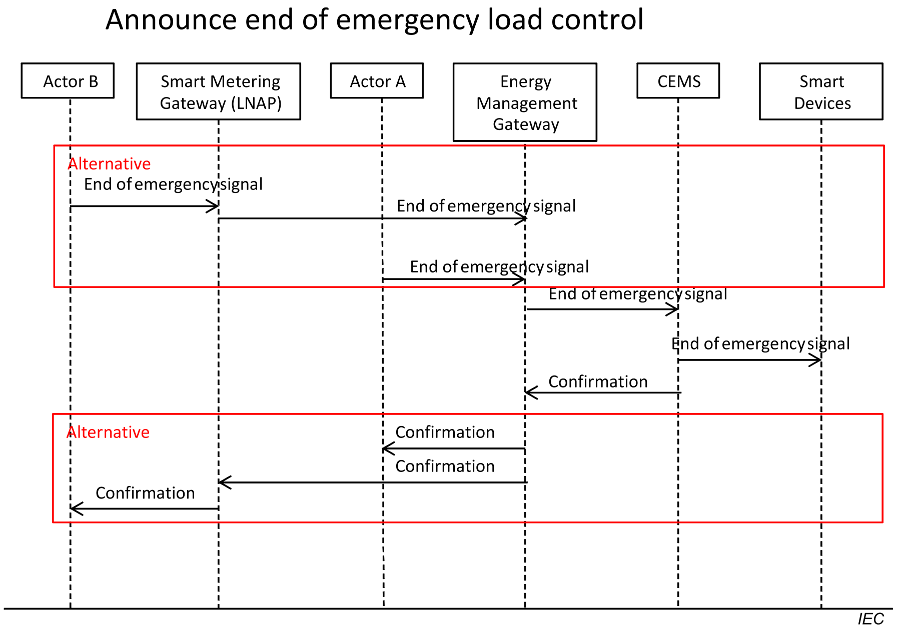
Diagram of use case


Figure A.35 – Sequence diagram

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchan-ged**	**Require ments, R-ID**
1a	There is no more need for an emergency reduction of power consumption / feed-in		Actor A sends an end of emergency message to the Energy Management Gateway (alternative)	Enterprise – field/ Customer premise	Actor A	Energy Manage ment Gateway	End of emergen-cy message	
1b	There is no more need for an emergency reduction of power consumption / feed-in		Actor B sends an end of emergency message to the Smart metering gateway (LNAP (alternative) (via the metering channel)	Enterprise – Field/ Customer premise	Actor B	Smart metering gateway (LNAP	End of emergen-cy message	

Scenario								
Scenario name Provide flexibility:								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchan-ged**	**Require ments, R-ID**
2	Smart Metering Gateway (LNAP) receives the message		Smart Metering Gateway (LNAP) sends end of emergency message to Energy Management Gateway	Field/ Customer premise	Smart metering gateway (LNAP)	Energy Manage ment Gateway	End of emergen-cy message	
3	Energy Manage-ment Gateway receives the emergency		Energy Management Gateway forwards the end of emergency message to CEM	Field/ Customer premise	Energy Manage ment Gateway	CEM	End of emergen-cy message	
4	CEM receives the end of emergency message		CEM sends a message to smart devices, allowing them to operate in normal mode	Field/ Customer premise	CEM	Smart devices	End of emergen-cy message	
5	CEM receives the end of emergency message		CEM *optionally* sends confirmation to Energy Management Gateway	Field/ Customer premise	CEM	Energy Manage ment Gateway	Confirma-tion *(optional)*	
6a	Energy Manage-ment Gateway receives confirmation		Energy Management forwards confirmation to Actor A (Alternative)	Field – enterprise/ Customer premise	Energy Manage ment Gateway	Actor A	Confirm-ation *(optional)*	
6b	Energy Manage-ment Gateway receives confirmation		Energy Management forwards confirmation to Smart metering gateway (LNAP) (Alternative)	Field – enterprise/ Customer premise	CEM	Smart metering gateway (LNAP)	Confirma-tion *(optional)*	
7	Smart Metering Gateway (LNAP) receives confirmation		Smart metering gateway forwards confirmation to Actor B (Alternative) (via the metering channel)	Field – Enterprise / operation Customer premise	Smart metering gateway (LNAP)	Actor B	Confirma-tion *(optional)*	

Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Scenario								
Scenario name: Provide flexibility:								
Step No.	**Event**	**Name of process/ activity**	**Description of process /activity**	**Servi-ce**	**Informa-tion producer**	**Informa-tion receiver**	**Informa-tion exchan-ged**	**Requi-rements, R-ID**

A.3.22.6 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements for information data R-ID**
Load management message	This may include an economic value for the flexibility requested by Actor A/B	
Start of load adjustment notification		
Announcement of load adjustment		
Order of load adjustment		
Load adjustment feedback		
Change in consumption		
End of load adjustment		
End of load adjustment feedback		
End of load adjustment notification		
Load curve		
Load adjustment feedback		
Emergency message		
Emergency load management message		
Confirmation	A confirmation sent back to an external actor after receiving a load management message may include: an indication of the amount of load / generation that will be shifted an indication that the CEM will comply with the request, without an estimate	
End of emergency message		

A.3.22.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3.22.8 Notes and open issues

Notes and open issues	
Nr	**Note**
1.	A possible new primary use case on direct load control could describe how the grid asks which CEMs are willing to change consumption; grid receives offers and chooses which ones to accept. Developing this further may be a next step
2.	Where relevant all primary use case (scenarios) may be split up according to external actors
3.	There is not yet a use case covering the situation where there would be multiple CEMs and the aggregation takes place in the grid side of the SG CP (e.g. how is the user being informed that he is (going to) exceed his contractual power). Closing this gap would be a next step
4.	Next step: define additional use cases using the top down method, considering the functional architecture as a black box and identifying which messages would go in / come out

A.3.23 high level use case (WGSP2140) Tariff synchronization

A.3.23.1 Description of the use case

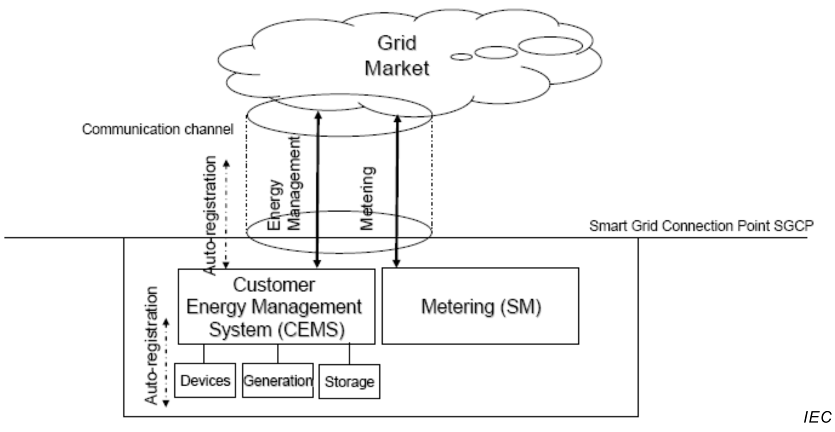
Name of use case

Use case identification		
ID	**Domain(s)**	**Name of use case**
WGSP 2140	Smart Grid	Time synchronization

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title**	**Approval status draft, for comments, for voting, final**
0.1	27/08/2012	Domain expert		Initial draft	Draft
0.5	12/11/2012	Editor		Initial draft	Draft

Scope and objectives of use case

Scope and objectives of use case	
Related business case	Time synchronization between the CEM and the Smart meter is a prerequisite for billing of the CEM's response to flexible tariffs.
Scope	The scope of this use case is the communication between the CEM and "upstream"[20] actors. The communication between CEM, the consumer and (in-home) smart devices is officially not in this scope of this report, but will be included in the use case description for the sake of clarity. Smart devices cover also smart appliances, generators and storage (see table with actors). From an architectural point of view the Smart Grid Coordination Group introduced the "Smart Grid Connection Point" (SG CP) entity as an interface between Smart Grid actors (applications and/or organizations) and in-home/building systems or devices. The diagram below shows the SG CP in its environment.  Please note that the boxes in the diagram above are functional. The Smart Meter and CEM can be one or two separate physical boxes. The CEM can also be integrated in Smart in-home devices. The communication with the Grid market/applications can be through one or through separate infrastructures.
Objective	The objective of this use case is to exchange information between the CEM and smart meter in order the keep the active tariff in the CEM and smart meter synchronized.

Narrative of use case

20 Upstream in this context means towards actor A or B (see actor definitions).

Narrative of use case
Short description – max 3 sentences
This use case describes how tariff synchronization between a CEM and a smart meter takes place
Complete description
Since the CEM can manage local consumption / generation based on flexible tariffs while the billing will take place based on information in the smart meter, both the smart meter and the CEM need to have the same tariff schedule and need to know when a new tariff applies. This can be achieved by: – Time synchronicity between the CEM and the smart meter; – The smart meter notifying the CEM when the active tariff changes. WGSP 2112 describes how this tariff schedule (price information) is sent from an external actor to the CEM and to the smart meter. **WGSP-2141 describes how time synchronicity between CEM and Smart Meter is maintained.** The CEM may get time-stamped messages from the smart meter on regular intervals. Based on the time information in these messages, the CEM will keep its clock synchronized with the smart meter. The above process is not described in a separate use case since it works on top of existing information exchanges. Next to the process described above, WGSP-2141 consists of two scenarios describing how time synchronization may also be achieved: 1) The CEM may request the time from the smart meter, based on which the CEM will synchronize its clock. Such a request may be sent on a regular basis (e.g. when there would be no other regular communication between smart meter and CEM) or it may be sent after the CEM has noticed that it may be out of synch (e.g. after an event like a power outage). 2) Based on time stamped messages from the CEM, the smart meter may notice the former is out of synch, after which the smart meter will send a synchronization parameters to the CEM, forcing it to synchronize. This use case assumes that the smart meter has the correct time. A use case from the Smart Meters Coordination Group (INCO.02) describes how the time in the smart meter may be synchronized with the LNAP / NNAP / HES. If the time difference between smart meter and CEM exceeds a certain level an alarm can be raised as described in **in primary use case WGSP2142**. In this case, a manual intervention will often be required since these larger variations from the time standard may indicate a faulty time clock which may need follow-up. Another way to maintain tariff synchronicity if for the CEM and the Smart Meter to have the same tariff list, where the tariff list in the CEM contains the tariff identifier and the price, but does not contain a schedule indicating which tariff is applicable at which time. In this case the smart meter will send a notification to the CEM when the active tariff has changed. This notification identifies the active tariff. **WGSP 2143 describes how the Smart Meter notifies the CEM when the active tariff changes.**.

General remarks

General remarks

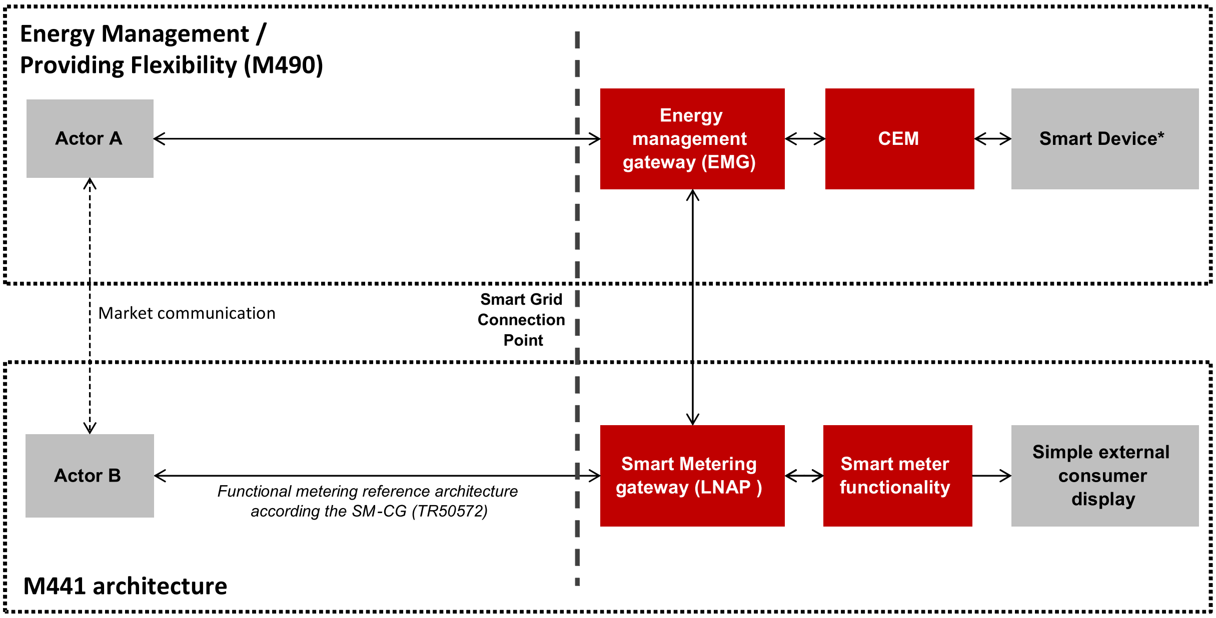
A.3.23.2 Diagrams of use case

Diagram of use case
See detailed description os use cases

A.3.23.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

NOTE 1 For the definition of this use case, the architecture shown in Figure A.36 has been used as a basis.



* e.g. HBES device, smart appliances, storage, generator, domestic charger for EV, complex display

IEC

Figure A.36 – SG CG Architecture Model [9]

NOTE 2 The actors in the above architecture are functional entities, which means that some of them may be part of the same physical device (e.g. CEM functionality may be part of a smart device, the smart meter might also encompass the smart metering gateway and CEM, etc.)

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager (CEM)	Internal	The CEM is a logical function optimising energy consumption and or production based on messages received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Energy management gateway	Internal	An access point (functional entity) sending and receiving smart grid related information and commands between actor A and the CEM, letting the CEM decide how to process the events. The communication is often achieved through an internet connection of through a wireless connection. This gateway may also provide services including protocol conversion, device management, security and service capabilities.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart Metering gateway (LNAP)	Internal	An access point (functional entity) that allows access to one or more metering end devices and, when equipped with an interface, to advanced display / home automation end devices connected to the local network. A LNAP also may allow data exchange between different functional entities connected to the same LN. The LNAP may act simply as a router transferring messages between the metering end device and/or display/home automation devices and the Neighbourhood network of wide area network. It may also provide services including protocol conversion, device management, security and service capabilities. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the local network.	
Smart meter	Internal	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.	
NNAP	Internal	The Neighbourhood Network Access Point is a functional entity that provides access to one or more LNAP's, metering end devices, displays and home automation end devices connected to the neighbourhood network (NN). It may allow data exchange between different functional entities connected to the same NN.	
Simple external consumer display	External	Dedicated display screen in connection with the smart meter/SG CP available to the customer to check power consumption, planned load reductions and load reductions historical. Other not dedicated means also exist to deliver consumption information to the customer, such as the personal computer, the mobile phone or the TV set.	
Smart device	External	A smart device may be an appliance, generator or storage device *(Local storage devices include direct and functional electricity storages such as electrochemical batteries, heat pumps and micro CHP such as fuel cells with heat buffers, air conditioning and cooling devices with thermal inertia, etc…)*. The smart device can receive data directly from the grid, though an interface with the CEM and can react to commands and messages from the grid in an intelligent way. Since the smart device is outside the scope of the SG-CG, it must be seen as an external actor	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart appliance (white goods)	External	An example of a smart device is a *smart white goods appliance* which is an appliance that has the capability to act in response to a message from the grid and thereby optimize its behaviour towards the energy supply network. The message can be received from a utility or a third party energy service provider directly or via a customer energy management system, The message can be information like the cost of energy or the amount of available renewable energy, or it can be a Demand Respond message (delay load message or other related information) that the appliance must receive, interpret and react upon based on pre-set or active consumer input. The smart appliance is not guaranteed to respond, but will do so based on its status and user settings in order to ensure the expected performance. The consumer has the ultimate control of the appliance and can override any specific mode (e.g. override a delay to allow immediate operation, limit delays to no more than a certain number of hours, or maintain a set room temperature). Any appliance operation settings or modes shall be easy for an average, non-technical consumer to activate or implement.	
Actor A	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the energy management communication channel.. Examples of such market roles are the Energy Provider, the Energy Services Provider, the aggregator, etc.	
HES	Internal	Responsible for acquiring the reads from meters and/or from data concentrators Delivers the raw meter reads to MDM Repeats the reading for any missing reads Is the short-term interim data storage (1-3 months) for meter reads Pushes the event information upwards to MDM Supports the specific protocols of the concentrators and meters Contains some topology information and aggregation functionality for plug & play solutions	
MDM	Internal	Is the single meter data repository for all metering data Is the long-term storage for the metering data Ensures the data quality by VEE for the higher level business processes Connects all head-end systems Is the connection point for other systems to reach the smart meters i.e. a gateway to HES and back Delivers the meter reads to other business systems for further usage Acts as the critical security firewall between business and operational systems and the advanced metering infrastructure. Contains some topology information and aggregation functionality	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Actor B	External	External actor (Smart Grid Market Role) interacting with the system functions and components in the home or home automation network through the metering communication channel. This actor is responsible for collecting metering data. Examples of such market roles are the DSO, metering company, etc.	

Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**

References / issues

References						
No.	**References Type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1.	Use case	SMCG use case: INCO.02 – Time synchronization	Draft		Smart Meters Coordination Group	

Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Flexibility cluster
Level of depth
Primary use case
Prioritisation
1
Generic, regional or national relation
Generic
View
Technical
Further keywords for classification
Demand side management, demand response, Smart Grid

A.3.23.4 Step by step analysis of use case

WGSP 2141 – scenario 1: CEM requests time

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2141	CEM requests time	CEM	CEM is triggered to request time from smart meter	Communication between all actors can be established There is a rule base laying down the rules based on which the CEM will be triggered to request the time	CEM received the correct time and has synchronized its clock

Diagram of use case

Figure A.37 shows a diagram of use case.

Diagram of use case

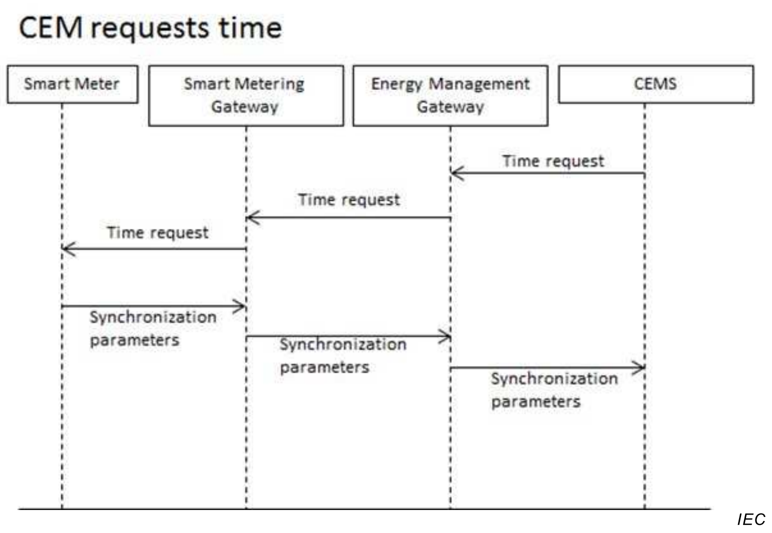


Figure A.37 – Sequence diagram

Steps – Normal

Scenario								
Scenario name **Provide flexibility:**								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchan-ged**	**Require ments, R-ID**
1	CEM is triggered to request time from smart meter		CEM requests time from smart meter		CEM	Energy manage ment gateway	Time request	
2	Energy management gateway receives time request		Energy management gateway forwards request to smart metering gateway		Energy manage ment gateway	Smart metering gateway	Time request	

Scenario								
Scenario name **Provide flexibility:**								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
3	Smart metering gateway receives time request		Smart metering gateway forwards request to smart meter		Smart metering gateway	Smart meter	Time request	
4	Smart meter receives time request		Smart Meter sends synchronization parameters to the smart metering gateway		Smart meter	Smart metering gateway	Synchronization parameters	
5	Smart metering gateway receives synchronization parameters		Smart metering gateway sends the synchronization parameters to the energy management gateway		Smart metering gateway	Energy management gateway	Synchronization parameters	
6	Energy management gateway receives synchronization parameters		Energy management gateway sends the synchronization parameters to the CEM.		Energy management gateway	CEM	Synchronization parameters	

WGSP 2141 – scenario 2: Smart meter sends time

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2141	Smart meter sends time	Smart meter	Smart meter notices that CEM is out of synch	Communication between all actors can be established There is a rule base laying down the rules based on which the Smart meter will be triggered to send the time	CEM received the correct time and has synchronized its clock

Diagram of use case

Figure A.38 shows a diagram of use case.

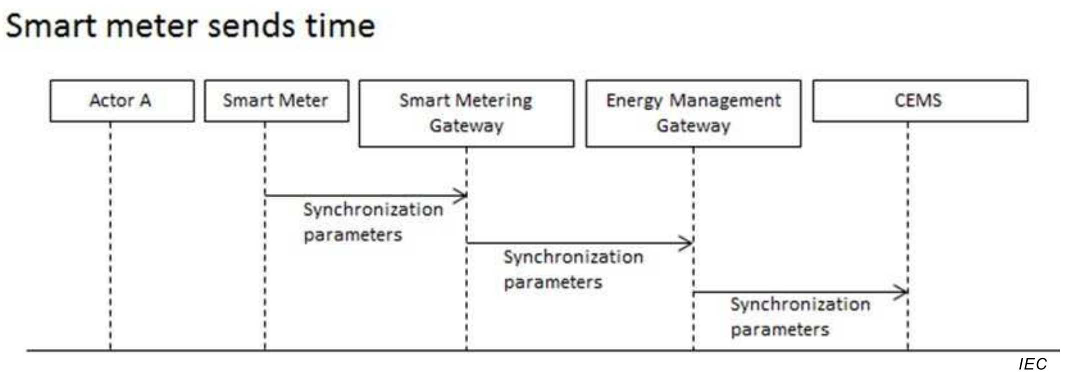
Diagram of use case


Figure A.38 – Sequence diagram

Steps – Normal

Scenario								
Scenario name **Provide flexibility:**								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Informa-tion producer (Actor)**	**Informa-tion receiver (Actor)**	**Informa-tion exchan-ged**	**Requi-rements, R-ID**
1	Smart meter notices that CEM is out of synch		Smart meter sends synchronization parameters		Smart Meter	Smart metering gateway	Synchronization parameters	
2	Smart metering management gateway receives information		Smart metering gateway forwards information to energy management gateway		Smart metering gateway	Energy management gateway	Synchronization parameters	
3	Energy management gateway receives information		Energy management gateway forwards synchronization parameters to CEM		Energy management gateway	CEM	Synchronization parameters	

WGSP 2142: CEM sends out-of-synch alarm

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2142	CEM sends out of synch alarm	CEM	The CEM notices a time difference exceeding the alarm level	Communication between all actors can be established There is a rule base laying down thresholds identifying what to do depending on the time difference that has been identified	The alarm has been received by an external actor

Diagram of use case

Figure A.39 shows a diagram of use case.

Diagram of use case

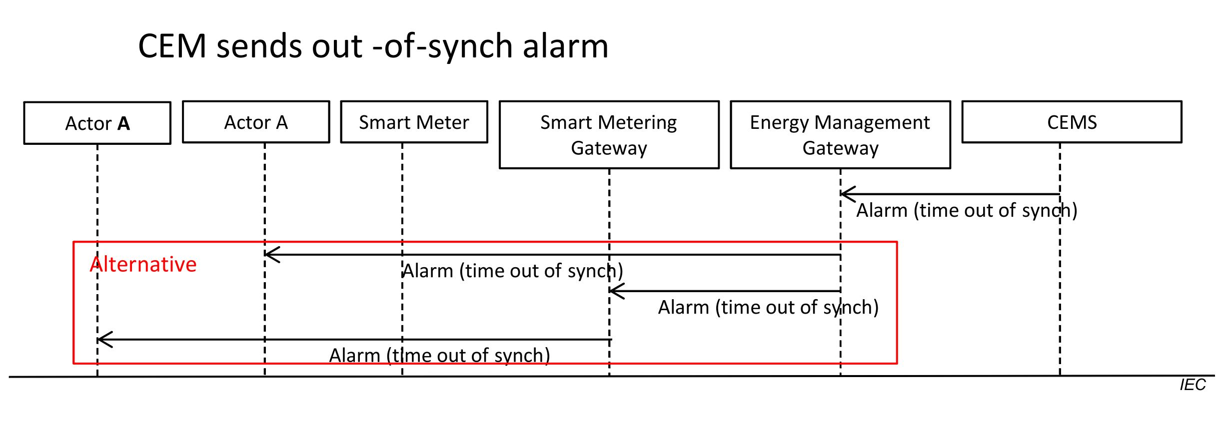


Figure A.39 – Sequence diagram

Steps – Normal

Scenario								
Scenario name **Provide flexibility:**								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	The CEM notices a time difference exceeding the alarm level		CEM sends alarm to energy management gateway		CEM	Energy management gateway	Alarm (large time difference)	
2a	Energy management gateway receives alarm		Energy management gateway forwards alarm to actor A		Energy management gateway	Actor A	Alarm (large time difference)	
2b	Energy management gateway receives alarm		Energy management gateway forwards alarm to smart metering gateway		Energy management gateway	Smart metering gateway	Alarm (large time difference)	
3	Smart metering gateway receives alarm		Smart metering gateway forwards alarm to actor B		Smart metering gateway	Actor B	Alarm (large time difference)	

WGSP 2143: Smart meter notifies active tariff change

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
2143	Smart meter notifies active tariff change	Smart Meter	The smart meter changed the active tariff	Communication between all actors can be established	The CEM is informed of the new active tariff

Diagram of use case

Figure A.40 shows a diagram of use case.

Diagram of use case

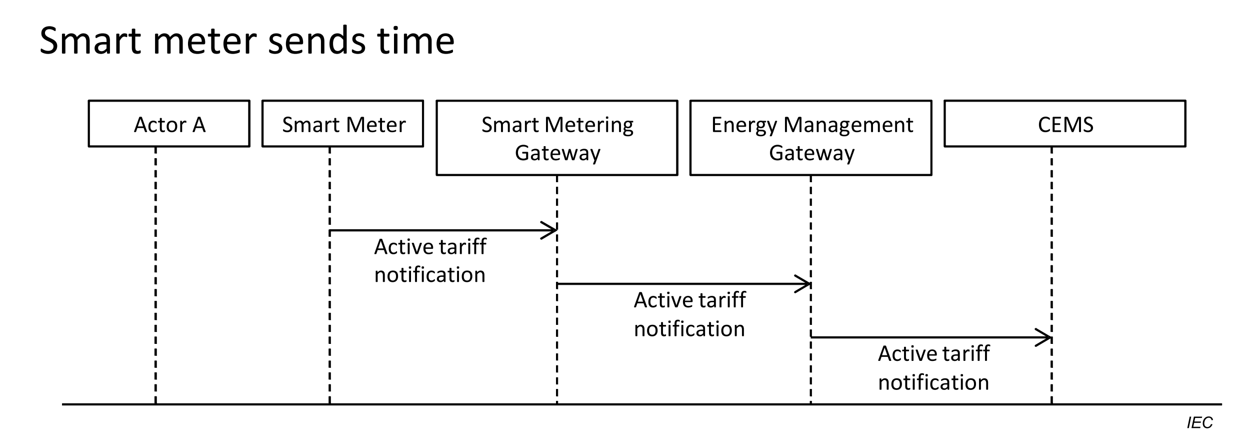


Figure A.40 – Sequence diagram

Steps – Normal

Scenario								
Scenario name **Provide flexibility:**								
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Zones / Domains**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**	**Requirements, R-ID**
1	The smart meter changed the active tariff		Smart meter sends an active tariff notification to the smart metering gateway		Smart Meter	Smart metering gateway	Active tariff notifica-tion	
2	Smart metering gateway receives notification		Smart metering gateway sends notification to energy management gateway		Smart metering gateway	Energy management gateway	Active tariff notifica-tion	
	Energy management gateway receives notification		Energy management gateway sends notification to CEM		Energy management gateway	CEM	Active tariff notifica-tion	

Steps – Alternative, Error Management, and/or Maintenance/Backup Scenario

Scenario								
Scenario name: Provide flexibility:								
Step No.	Event	Name of process/ activity	Description of process /activity	Servi-ce	Informa-tion producer	Informa-tion receiver	Informa-tion Exchan-ged	Require ments, R-ID

A.3.23.5 Information exchanged

Information exchanged		
Name of information exchanged	Description of information exchanged	Requirements for information data R-ID
Time request		
Synchronization parameters	The COSEM Clock Object provides the means to set and synchronize the clock. Parameters may be: Absolute time Time relative to tariff schedule	
Alarm (large time difference)		
Active tariff notification		

A.3.23.6 Common terms and definitions

Common terms and definitions	
Term	Definition

A.3.23.7 Notes and open issues

Notes and open issues	
Nr	Note
1.	Where relevant all primary use case (scenarios) may be split up according to external actors
2.	Next step: define additional use cases using the top down method, considering the functional architecture as a black box and identifying which messages would go in / come out

A.3.24 High level use case (JWG30xx) Energy Flexibility Management

A.3.24.1 Description of the use case

Name of the use case

ID	Domain see Annex A selection list	Name of use case	Level of depth cluster, high level use case, detailed use case
JWG30xx	Smart Building in Smart Grid	Energy Flexibility Management	High level use cases

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title**	**Approval status draft, for comments, for voting, final**
0.9	29/11/12	Smart Grid			draft
1.0	08/01/13	Smart Grid			1st review
1.1	21/01/13	Smart Grid			Final draft version (content)
2.0	25/02/14	Smart Grid			Alignment for IEC TC57 JWG use case
2.1	07/03/2014	Home Appliances	Use Cases	Integration into JWG activity: – Use Case IDs – Basic information section	Draft

Basic information on use case

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Guideline	Basic definitions and common procedures	Final	Terms and definitions	SG-CG Sustainable Processes WG (SGTF EG1)	http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group1_sustainable_processes.pdf
2	Technical Report	User Story and Sequence diagrams	Draft	Major impact on Scenario	IEC TC57 / CLC TC205 / CLC /TC59x	-
3	Standard	Use Case Template	Draft (FDIS)	Template description	IEC TC8	-
4	Guideline	Smart Grid Reference Architecture	Final	Terms and definitions	SG-CG Architecture Working Group (SGTF EG1)	http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group1_reference_architecture.pdf

Relation to higher level use case	
Cluster	**Higher level use case**

Maturity of use case – in business operation, realized in demonstration project, , realised in R&D, in preparation, visionary
Prioritisation
Generic, regional or national relation
View – technical / business
Further keywords for Classification

Scope and objectives of use case

Scope and objectives of function
The purpose is to define the use cases for the automated operation of energy flexibility management in the area of Smart Buildings in Smart Grids

Narrative of use case

Narrative of use case
Short description – max 3 sentences
An energy flexibility request may be initiated by a power system operator in response to a reliability event, e.g., loss of a generating station causing a lack of supply to meet demand, or an uncontrolled set of PEVs overloading of a distribution transformer. An energy flexibility request event may also be initiated by system operator based on economic considerations, e.g., reducing or shifting peak load at the system level or at specific feeder or facility. Energy flexibility may also be used by a customer in response to a market pricing signal or information about the “green index” of the supplied energy. The green index specifies the share of renewable energy in the actual energy mix. Energy flexibility management is often named also Demand Response.
Complete description
Demand Response is deployed for economic or a reliability purposes. At high penetration levels, demand response has to be integrated with the power supply scheduling process, and it may impact the distribution grid operation and reliability, and perhaps the transmission grid operation and reliability. Thus it is important to include the required considerations for the grid and system level operations when developing DR use cases and DR signal standards. Such impacts may not be significant at low penetration levels; however, proper considerations must be given to support scalability and expandability for future deployments. Power system operates based on a real-time balancing of supply and demand. To economically schedule the supply, an accurate load forecast is needed. Traditionally, load forecast was generated using the historical consumption patterns, weather forecast and other similar parameters. With the potential of high-penetration of DR, it will be necessary to incorporate the planned or forecasted DR levels into the load forecast. Also, DR capabilities can be used to support the power system capacity or emergency supply (ancillary service) needs. Such services require proper scheduling and monitoring capabilities. A demand response event may be initiated by a power system operator in response to a reliability event, e.g., loss of a generating station causing a lack of supply to meet demand, or an uncontrolled set of PEVs overloading of a distribution transformer. A demand response event may also be initiated by system based on economic considerations, e.g., reducing or shifting peak load at the system level or at specific feeder or facility. Demand response may also be initiated by a customer in response to a market pricing signal. Considering that the distribution grid in a number of countries is a three-phase imbalance circuit, i.e., many customers are on a single-phase or two-phase of the three-phase system. Thus significant changes in customer load patters could result in undesirable imbalanced conditions on a feeder. Also, load pickup following the termination of a major DR event could possibly cause overloads and other operational problems, if the load pickup is not properly scattered/managed. **Dynamic Price-based DR or Real-Time Pricing (RTP)** Traditionally, retail tariff has based on a fixed or tiered rate structure with possible considerations of static rates for pre-established time of use (TOU) conditions. Real time or dynamic pricing (RTP) represent retail electricity rate that could vary as a function of time and is intended to modify demand. It requires interval metering for accurate billing based on time-varying prices. A number of countries have implemented RTP or other dynamic

Narrative of use case
pricing tariffs for large customers. With a broader deployment of advanced meters, RTP rates may become more common world-wide also for smaller customers. The scenario presented here includes the case where a location-dependent real-time retail pricing for energy is established based on the wholesale Locational Marginal Price (LMP) for that location. LMP values are typically established by an ISO (for regions covered by an ISO/RTO) on a day-ahead (hourly resolution) and real-time basis, typically on a five minute resolution. For the RTP, it will be appropriate to use the real-time LMP as the basis for computing the retail dynamic tariff. However, decisions should be made on the time and the spatial resolution of the RTP. For example, an hourly RTP averaging the five minute pricing values, or a Critical Peak Pricing model to reflect the extreme conditions only, may be adopted. In addition to the wholesale energy price, the retail RTP rate may also include the appropriate uplift charges to cover for distribution wire/services charges and for the power loss compensations. Note that the uplift charges are typically subject to a regulatory review and approval. Special care must be given to the RTP rate design to ensure customer acceptance and adaptation. Also grid operational issues may have to be addressed. For example, during low LMP (RTP) periods (e.g., at night), certain distribution circuits may get over loaded (congested), with customers shifting consumption, e.g., charging PEVs, to that period. This improves the overall system economy, but may cause circuit congestion. To combat this, some have proposed use of demand charges or an additional incentive payment for load reduction, a locational incentive to relief congestion. **Notification Based DR Execution** Notification-based DR is mostly used for economic purposes based on a day-ahead or hour-ahead basis. Notification-based DR may also be used for reliability events when the system operator expects a contingency or operating condition (e.g., congestion or planned outage) on the distribution or the transmission grid that requires a reduction (or an increase in case of too much distributed generation) on the load at a given location. Considering that the business processes for demand response have not yet been standardized across the nations, the following is a representative scenario that captures some of the interactions between the key stakeholders (actors). At high penetration levels, the DR operation, especially on a day-ahead or hour ahead basis, need to be coordinated with the overall operations and supply scheduling process. This may require a timely update of the “locational” load forecast and an up-to-date nomination of the DR capabilities. This information may be supplied to the “system” and/or market operator to be incorporated in the overall supply and demand scheduling process. The DR capabilities are specified by the DR Provider (VPP operator) to the System Operator based on a DR Program, a price curve, or other nomination protocol. The DR Provider may also inform the energy retailer of the locational available DR capabilities. The notification-based DR dispatch process is typically initiated by the System or Market Operator; the process may also be initiated by the retailer or the DSO. It is also possible that the DR Provider (VPP operator) be the initiator of the DR process based on a market opportunity (economic operation) or based on a pre-established program. At high DR penetration levels, it is expected that the DR provider will need to clear the DR schedule with the Distribution Grid Operator. This is to insure that the high penetration DR has no adverse impact on the distribution grid reliability and power quality, e.g., cause of excessive imbalances, voltage violation, or an overload during load pickup period. The DSO, in a timely fashion, will inform the DR Provider, if the schedule is cleared or requires an adjustment. Please note that if the DR deployed by a utility company that includes both, retailer and DSO functions, such coordination is performed within the company’s operational systems (e.g., DRMS, DMS, etc.), or it can be an integral part of the DR scheduling application. Following the clearing the DR schedule, notifications are sent to customers for DR operation. Under this scenario, the Market Operator and the retailer are also informed of the final DR schedule. **Direct Load Control (DLC)** Direct-Load Control is typically used for reliability-based events such as contingency and emergency support, supply of balancing energy or other ancillary service. Many of these programs require quick response time, e.g., five minutes or faster, that is practically only possible through a DLC capability. Direct-Load Control may also be used for economic operations, e.g., water heater programs to reduce or shift peak load. Considering that the business processes for demand response have not yet been standardized across the nations, the following is a representative DLC scenario that captures the interactions between the key stakeholders (actors). Direct Load Control is typically called by a system operator, a transmission or distribution operator. It could be also issued by a Market Operator based on an ancillary service DR award, or by a retailer or DR operator (VPP operator) for an economic purpose. At high penetration levels, DLC operation needs to be coordinated with the distribution grid operator. The customer DR capabilities are aggregated by location and specified/nominated to the Distribution Grid Operator, retailer, and/or to the System/Market Operator. In addition to location, the capabilities may also be aggregated by the DR response time, e.g., four seconds, five minutes, 30 minutes, etc. The DLC Dispatch process is typically initiated by the Transmission or Distribution Operator. The process may also be initiated by the Market Operator of the retailer. The actual control of the DR resources may be done by the DR provider (VPP provider) based on the dispatch signal received. At high DR penetration levels, it is expected that the DLC activation schedule to be coordinated with the

Narrative of use case

Distribution Grid Operator. This is to insure that there are no adverse impact on the distribution grid reliability and power quality, e.g., voltage violation, excessive phase imbalances, or an overload during load pickup period. If the DLC deployed by a utility company such coordination can be accomplished within the company's DR and distribution management systems, or performed as an integral part of the DR control functions.

For a "fast" DR, e.g., provision of ancillary services, a telemetry capability is required to enable the real-time monitoring of the resource condition and its response to the DR control signal.

Taking the above described base principles into consideration, the following use cases will be described in this document.

Some of these use cases are split in a planning an a operational phase, the corresponding mapping is shown in the table below:

Use case:	Phases:
▪ Long term demand planning	JWG3011
▪ Energy trade through day-ahead market	JWG3012a,b
▪ Energy trade through intra-day market	JWG3021
▪ Providing secondary / tertiary reserves at the control reserve market	JWG3013, JWG3022
▪ Reaction on grid congestions (emergencies)	JWG3014, JWG3031-3

JWG3011-SPUC Long term energy procurement:

This scenario describes the process with the retailer business to procure a certain amount of energy needed by his customers with longer lasting contract (1 week up to multiple years). The energy prices of such contract are typically lower than the process on the day-ahead market. To determine the optimal amount of energy to procure with long term contracts, the retailer might be supported by load forecast information from his customers.

JWG3012-SPUC Day ahead planning:

Scenario a – Building Triggered

This scenario describes the process to procure the remaining amount of energy which is needed on top of the already procured energy by long term contracts (see JWG3011). Therefore the customers (practically the building automation/management systems) are providing an updated forecast for the next day. This forecast contains either only the delta to the initial long term forecast or an updated total forecast. Than the retailer has to deduce the delta to obtain the energy amount for procurement. The retailer buys the needed energy at the market and sends the information about the achieved energy prices back to the customer.

Scenario a – Market triggered

This scenario describes a pure price driven process. The retailer receives the energy price schedule from the market, adds price information of eventually available long term contracts and forwards this information to his customers. The building automation/management system of the customers will consider the price information for a cost minimization.

JWG3013-SPUC Reserve energy market:

This scenario prepares the participation in the reserve energy markets. Based on a prediction of available energy flexibility starting at the device level, the VPP operator may over a certain amount of flexibility to the reserve energy markets. Since reacting on demands from the reserve energy market my cause unpredicted deviations from the energy plans derived in the scenarios JWG3011 & 2, special commercial consideration needs to be done to avoid losses from the retailer for reacting on reserve energy market requests.

JWG3014-SPUC Grid congestion management:

This scenario describes the announcement of a grid congestion by the distribution grid operator due to a planned grid outage. Typically the regional regulations grant the distribution grid operator to overrule any commercial planning during grid emergencies. The regulations might define commercial compensation for this intervention.

JWG3021-SPUC Intra-day market offer:

This scenario describes the process when someone detects a major deviation from the planned energy scheduled. This might occur on generation as well as on the consumption side. The responsible party will place an offer to compensate the deviation at the intraday market. In the scenario it is assumed the offer is awarded to the retailer and he is using the available energy flexibility to fulfil the commitments. Depending on their contracts with the retailer some customers might have the right to deny (opt out) a change in their energy consumption schedule.

JWG3022-SPUC Provision of committed reserve energy:

This scenario is the operational continuation of JWG3013. The transmission system operator who bought the reserve energy may at any time give a trigger signal to the VPP operator that he needs reserve energy. Depending on the kind of procured reserve energy (secondary or tertiary), this might be a set point signal for a certain amount of reserve energy transmitted by communication means (SCR) or the trigger to provide a predefined amount of energy (plus or minus) typically transmitted by a telephone call (TCR). The VPP operator than issued the needed commands to his customers to supply the demanded reserve energy.

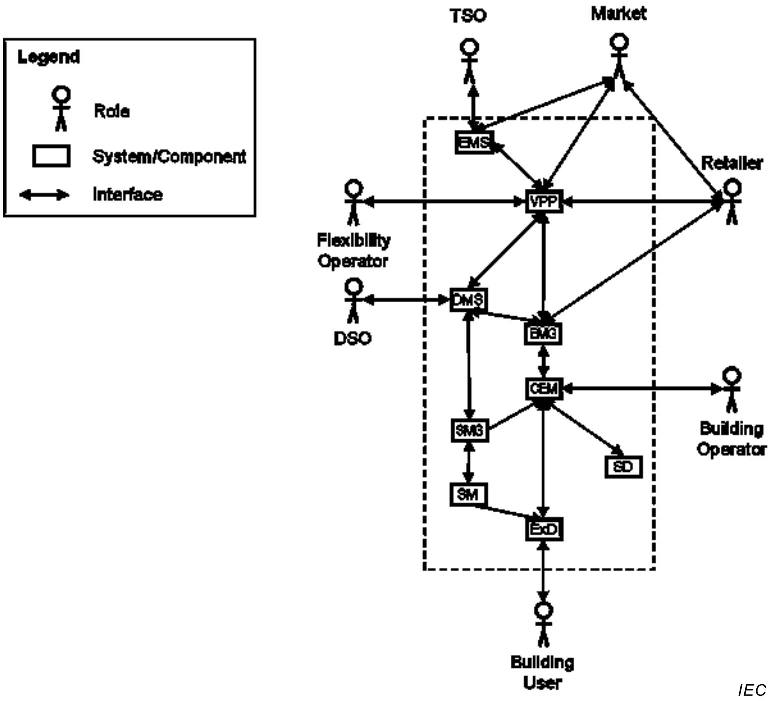
Narrative of use case
JWG3031-SPUC, JWG3032-SPUC, JWG3033-SPUC: Grid emergency:
These scenarios describe the ad hoc triggering of predefined measures to relief the grid during emergency situations. These measures may include also voltage stabilization by providing a suitable amount of reactive power. Depending on regional regulations and existing infrastructure the trigger signal may send via different ways.

General remarks

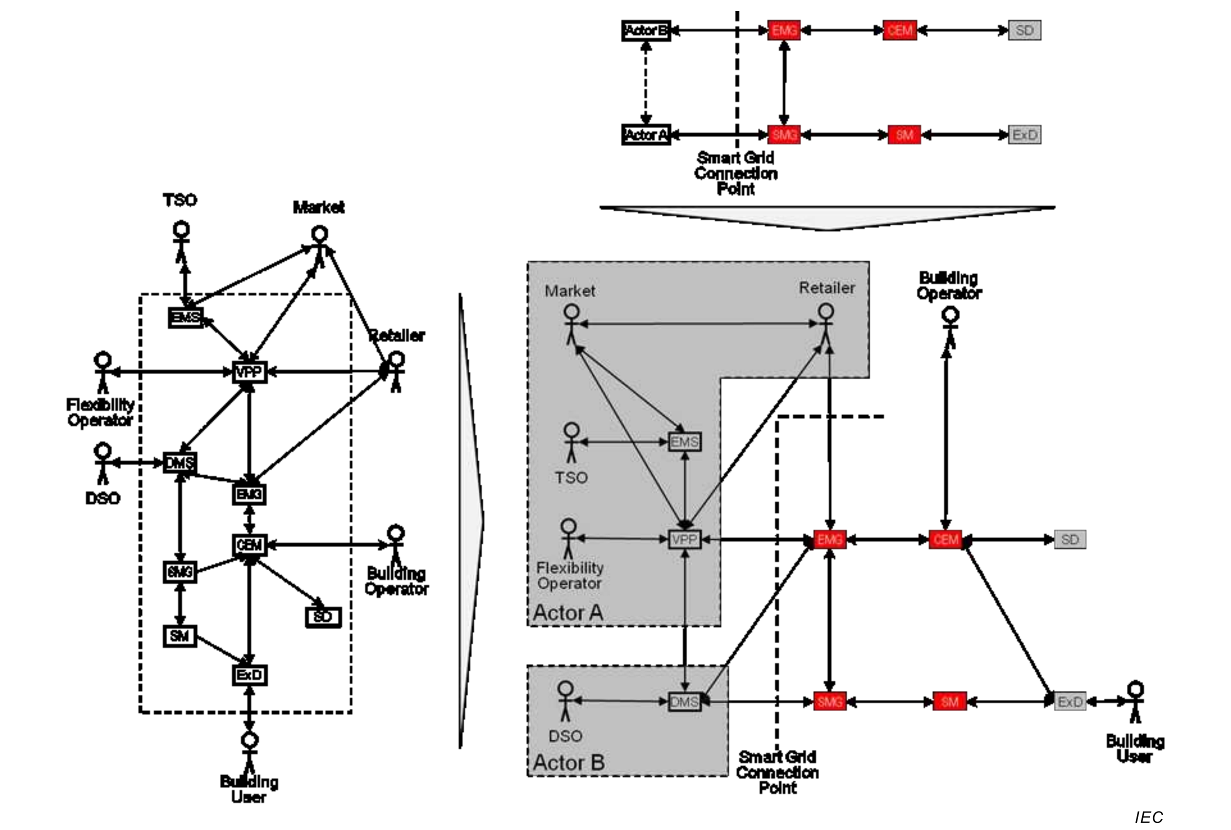
General Remarks
See related cluster document

A.3.24.2 Diagram of use case

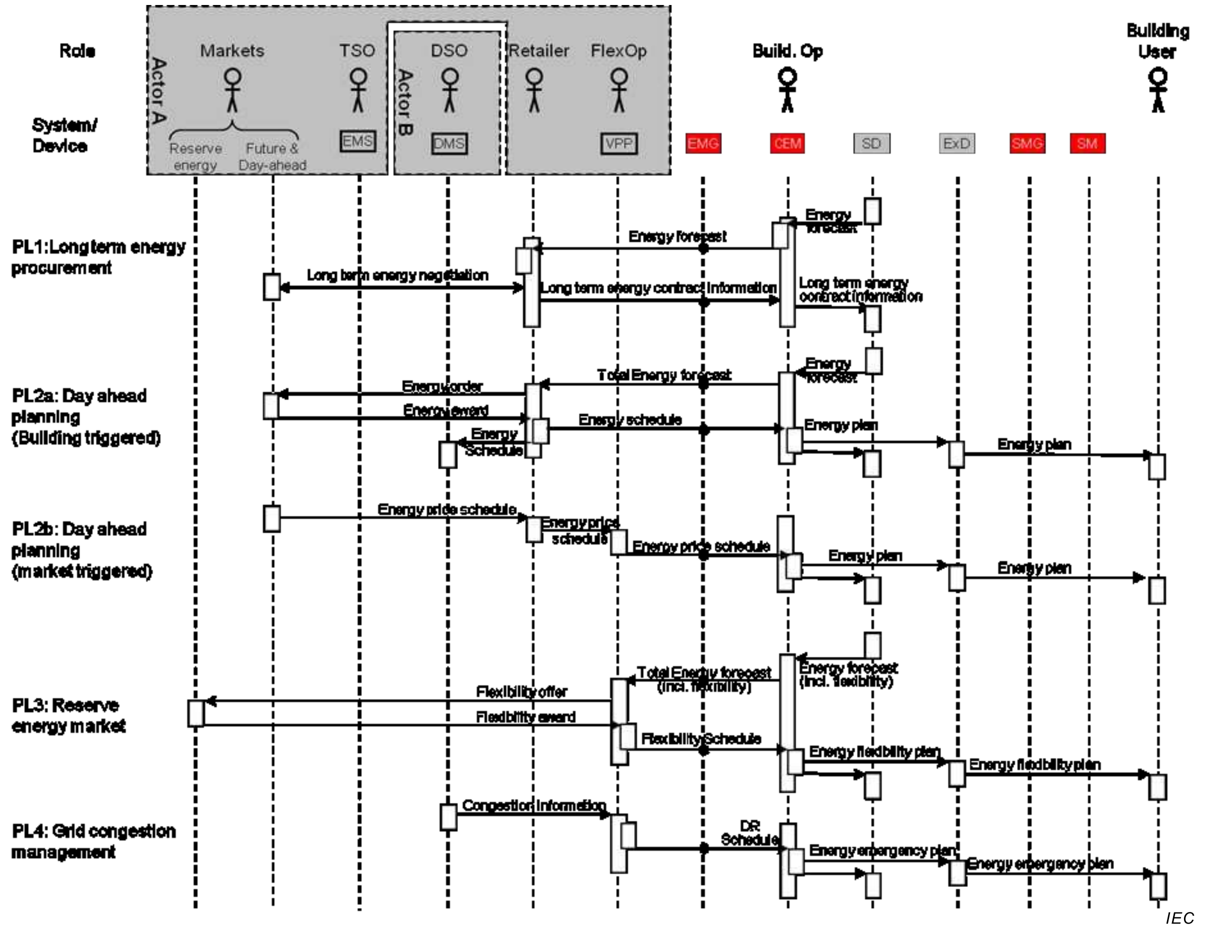
Drawing or Diagram of use case – recommended "context diagram" and "sequence diagram" in UML



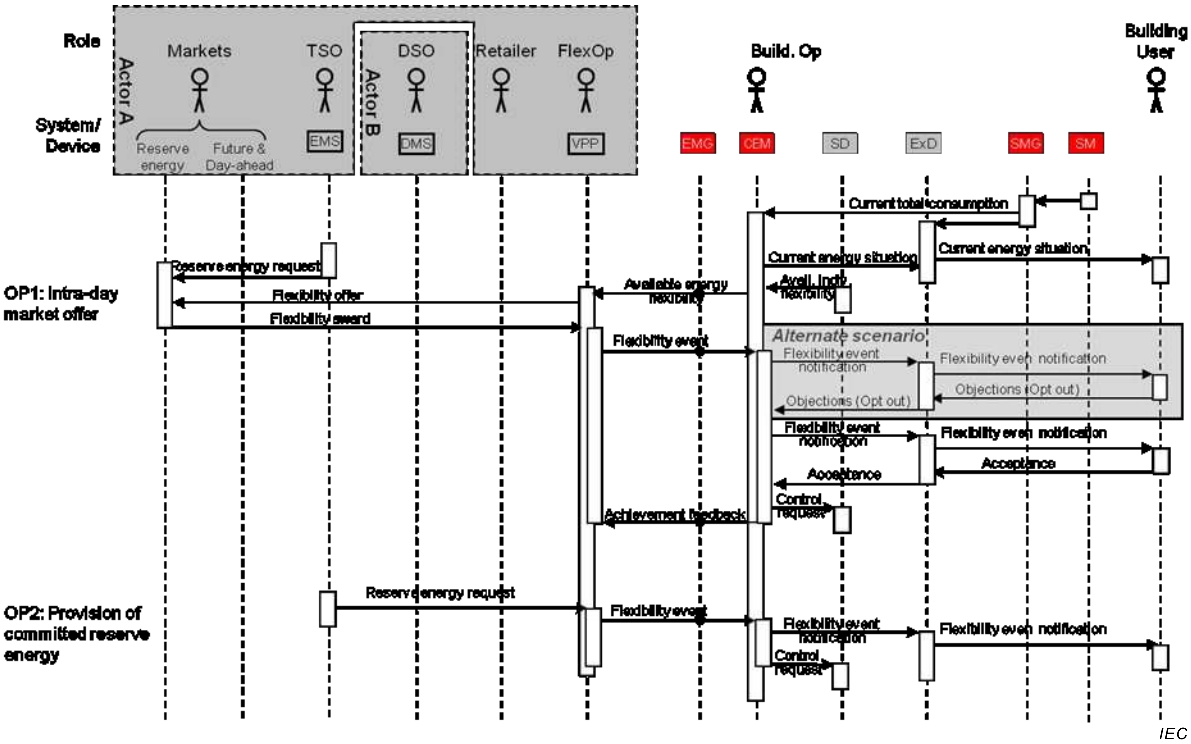
Use case context diagram



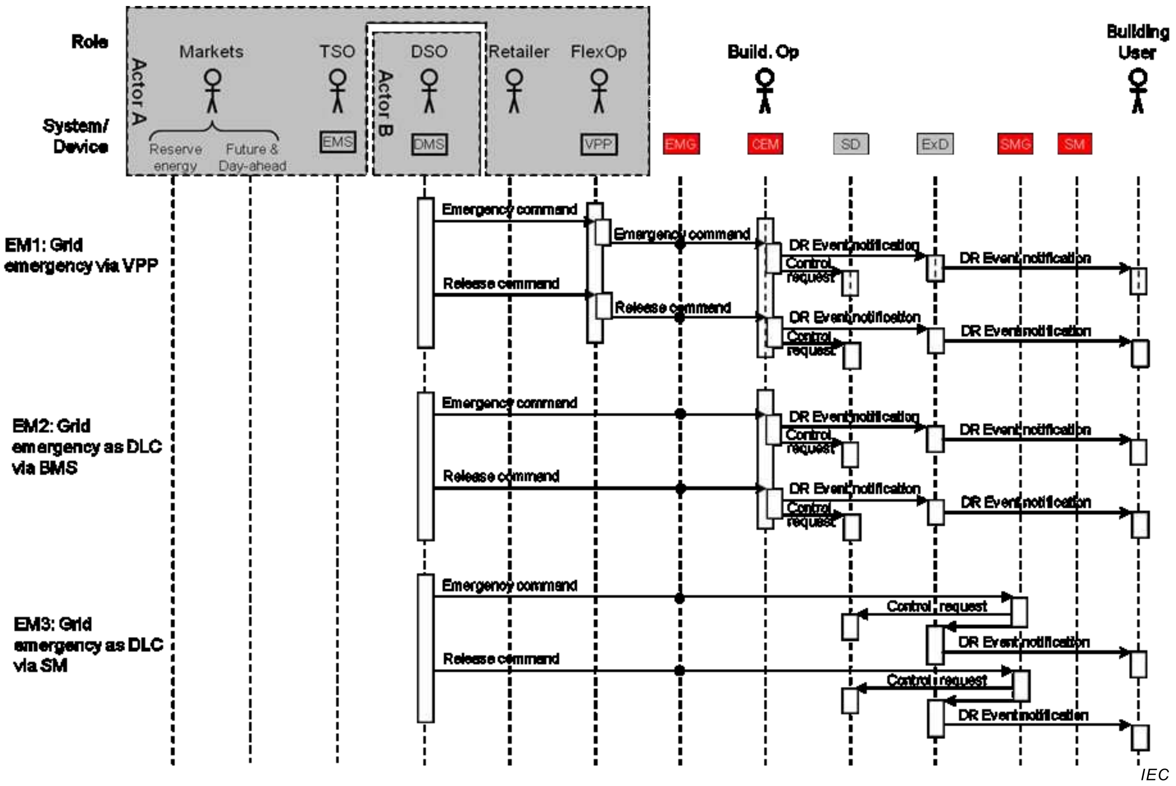
Mapping of the detailed architecture to the generic M490/M441 architecture



Use cases sequence diagrams for planning phase



Use cases sequence diagrams for operational phase



Use cases sequence diagrams for grid emergency situation

A.3.24.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

Actor name see Annex A Selection List	Actor type see Annex A Selection List	Actor description see Annex A Selection List	Further information specific to this use case
Market Operator	Role	Market operator is the authority which manages the energy markets	In the generic M490/M441 architecture the market is considered as an internal part of Actor B
Transmission System Operator (TSO)	Role	The Transmission System Operator is responsible for the transport of electricity on the extra high or high voltage network with a view to its delivery to final customers or to distributors. Operation of transmission includes as well the tasks of system operation concerning its management of energy flows, reliability of the system and availability of all necessary system services".	In the generic M490/M441 architecture the market is considered as an internal part of Actor B
Distribution System Operator (DSO)	Role	Distribution System Operator have the responsibility for a faultless delivery of energy from suppliers to end-users and to maintain the distribution networks. DSOs also have to enable competitive retail markets by facilitating transparent and non-discriminatory access to network and customer information.	In the generic M490/M441 architecture the market is considered as an internal part of Actor A
Energy retailer	Role	The energy retailer has a supply contracts with customers, e.g. building operator, building tenants and is responsible to procure sufficient energy at the wholesale energy market to satisfy the energy demand of its customers	In the generic M490/M441 architecture the market is considered as an internal part of Actor B
Flexibility operator	Role	A company that offers to reduce a client's energy cost, often by taking a share of such reduced costs as repayment for installing and financing such upgrades.	In the generic M490/M441 architecture the market is considered as an internal part of Actor B
Building operator	Role	Operates a building and is responsible to assure the agreed comfort level for the building users	
Building user	Role	Lives/works in a building	
Energy Management Gateway (EMG)	System	An access point (functional entity) sending and receiving smart grid related information and commands between actor A and the CEM, letting the CEM decide how to process the events. The communication is often achieved through an internet connection of through a wireless connection. This gateway may also provide services including protocol conversion, device management, security and service capabilities.	In the following use case the EMG is considered as transparent, i.e. the content of the transmitted information is not altered, there might only a translation between different communication protocols.

Actor name see Annex A Selection List	Actor type see Annex A Selection List	Actor description see Annex A Selection List	Further information specific to this use case
Smart Meter Gateway (SMG)	System	An access point (functional entity) that allows access to one or more metering end devices and, when equipped with an interface, to advanced display / home automation end devices connected to the local network. A LNAP also may allow data exchange between different functional entities connected to the same LN. The LNAP may act simply as a router transferring messages between the metering end device and/or display/home automation devices and the Neighbourhood network of wide area network. It may also provide services including protocol conversion, device management, security and service capabilities. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the local network	In the generic M490/M441 architecture the Smart Meter Gateway is also known as Local Network Access Point (LNAP)
Customer Energy Manager (CEM)	System	The CEM is a logical function optimising energy consumption and or production based on signals received from the grid, consumer's settings and contracts, and devices minimum performance standards. The Customer Energy Manager collects messages sent to and received from connected devices; especially the in-home/building sector has to be mentioned. It can handle general or dedicated load and generation management commands and then forwards these to the connected devices. It provides vice versa information towards the "grid / market". Note that multiple loads/generation resources can be combined in the CEM to be mutually controlled. When the CEM is integrated with communication functionalities it is called a Customer Energy Management System or CEMS.	
Energy Management System (EMS)	System	A TSO operated system in charge of energy management within the transmission grid	In the generic M490/M441 architecture the market is considered as an internal part of Actor A
Distribution Management System (DMS)	System	A DSO operated system in charge of distribution management.	In the generic M490/M441 architecture the market is considered as an internal part of Actor B
Virtual Power Plant (VPP)	System	A system operated by a flexibility operator to manage distributed energy resources.	In the generic M490/M441 architecture the market is considered as an internal part of Actor A

Actor name see Annex A Selection List	Actor type see Annex A Selection List	Actor description see Annex A Selection List	Further information specific to this use case
Smart Device (SD)	Component	A primary devices controlled by the CEM which can be used to perform load management. Might have so local intelligence.	For simplicity the smart devices in this context may also represent smart applications
Simple external consumer display (ExD)	Component	Dedicated display screen in connection with the smart meter/SG CP available to the customer to check power consumption, planned load reductions and load reductions historical. Other not dedicated means also exist to deliver consumption information to the customer, such as the personal computer, the mobile phone or the TV set.	
Smart Meter (SM)	Component	Revenue grade meter device capable to perform interval metering	

Preconditions, assumptions, post condition, events

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

Referenced standards and / or standardization committees (if available)

Relevant Standardization Committees	Standards supporting the use case	Standard Status

Issues: Legal contracts, legal regulations, constraints and others

Issue – here specific ones	Impact of issue on use case	Reference – law, standard, others

A.3.24.4 Step by step analysis of use case

S.No	Primary actor	Triggering event	Pre-condition	Post-condition
JWG 3011	Retailer	Long term energy procurement by retailer	Retailer knows typical energy consumption behaviour (forecast) of his customers	Retailer has procured a certain percentage of the expected customer consumption using long term energy contracts. The remaining demand must be satisfied by procuring at the day-ahead or intra-day market.

S.No	Primary actor	Triggering event	Pre-condition	Post-condition
JWG 3012a	CEM	Day ahead planning phase triggered by building automation/management	Energy consumption for the next day determined	Energy consumption plan calculated by CEM and distributed within building automation
JWG 3012b	Market	Day ahead planning phase triggered by energy market	Energy price schedule for next day settled	Energy consumption plan calculated by CEM and distributed within building automation
JWG 3013	CEM	CEM determines available energy flexibility for the next day or week	Building is qualified for participation at the reserve energy market via a VPP	Available energy flexibility is sold either at the secondary or tertiary energy market.
JWG 3014	DSO	DSO detects congestion when verifying energy flow schedules for next day	Energy flow schedules known by DSO	Energy consumption plan calculated by CEM and distributed within building automation
JWG 3021	CEM	Cyclic execution	Energy flexibility is available to be offered to the intra-day market	The available energy flexibility is sold at the market and the current consumption adjusted accordingly
JWG 3022	TSO	Cyclic execution	Build has contract to provide energy flexibility on demand	The building has fulfilled its committed energy flexibility response
JWG 3031	DSO	DSO's grid monitoring detects unexpected congestion	The DSO has the right (either bought or by regulation) to send out emergency requests	The available energy flexibility is used to mitigate congestion
JWG 3032	DSO	DSO's grid monitoring detects unexpected congestion	The DSO has the right (either bought or by regulation) to send out emergency requests	The available energy flexibility is used to mitigate congestion
JWG 3033	DSO	DSO's grid monitoring detects unexpected congestion	The DSO has the right (either bought or by regulation) to send out emergency requests	The available energy flexibility is used to mitigate congestion

Steps – Normal sequence

Scenario name:		JWG 3011 Long term energy procurement				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informatio n receiver**	**Information exchanged**	**Technical requirements ID**
1a	Determina-tion of long term energy demand	Smart device devices determine their long term energy demand	SD	CEM	Energy demand forecast schedule	
1b		The CEM calculates a forecast of the long term energy demand of the whole building				
2	Sending forecast information	The CEM sends the calculated forecast information to the retailer	CEM	Retailer	Energy demand forecast schedule	

Scenario name:		JWG 3011 Long term energy procurement				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informatio n receiver**	**Information exchanged**	**Technical requirements ID**
3	Optimizing energy procure-ment	The retailer aggregates the energy demand for his customer and derives an optimal procurement strategy				
4	Procure-ment at long term energy markets or similar	The retailer procures a certain amount of energy by long term energy supply contracts	Retailer/ Market	Market/Ret ailer	Long term energy contract information	
5a	Information of long term energy contract	The retailer informs his customers about the conditions of the long term energy contracts	Retailer	CEM	Long term energy contract information	
5b		The energy procurement information is forwarded to the intelligent loads	CEM	SD	Long term energy contract information	

Scenario name:		JWG 3012a Day ahead planning (building triggered)				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
1a	Determina-tion of energy demand	Smart device devices determine their energy demand for the next day	SD	CEM	Energy demand forecast schedule	
1b		The building automation system determines the total energy demand forecast for the next day	CEM	Retailer	Energy demand forecast schedule	
2a	Procure-ment of energy at day ahead market	The retailer places a energy order at the day ahead market to cover the gap between the real demand and the long term supply contracts	Retailer	Market	Energy order information	
2b		The retailer gets the awards for his energy orders from the market	Market	Retailer	Energy award information	
3a	Energy dispatch	The retailer dispatches the available energy to his customers	Retailer	CEM	Energy schedule including price information	

Scenario name:		JWG 3012a Day ahead planning (building triggered)				
Step No.	**Event**	**Description of process/ activity**	**Information producer**	**Information receiver**	**Information exchanged**	**Technical requirements ID**
3b		Retailer sends the energy consumption plan to DSO	Retailer	DMS	Energy schedule	
4	Energy optimization	The CEM optimizes the building operation according to the received energy schedule and distributes the energy plan	CEM	SD	Energy consumption plan	
5a	Energy plan visualization	CEM visualizes energy plan for building user	CEM	ExD	Energy consumption plan visualization	
5b		Building user notices energy plan	ExD	Building user	Rendered Energy consumption plan visualization	

Scenario name:		JWG 3012b Day ahead planning(energy market triggered)				
Step No.	**Event**	**Description of process/ activity**	**Information producer**	**Information receiver**	**Information exchanged**	**Technical requirements ID**
1	Announcement of market energy prices	Market distributes wholesale energy prices schedule to market participants	Market	Retailer	Wholesale energy price schedule	
2	Distribution of customer energy prices	Retailer distributes end customer energy prices to his customer	Retailer	VPP (Flexibility operator)	Customer energy price schedule	
3	Distribution of VPP internal incentive information	VPP distributes internal incentive information to its participants	VPP (Flexibility operator)	CEM	Incentive information schedule	
4	CEM optimization	CEM optimizes energy consumption profile(s) according to given criteria (Economical, ecological, etc.)				
5	Energy consumption profile distribution	CEM send out optimized energy consumption profile to loads under control	CEM	SD	Energy consumption profile	
6a	Energy plan visualization	CEM visualizes energy plan for building user	CEM	ExD	Energy consumption plan visualization	

Scenario name:		JWG 3012b Day ahead planning(energy market triggered)				
Step No.	**Event**	**Description of process/ activity**	**Information producer**	**Information receiver**	**Information exchanged**	**Technical requirements ID**
6b		Building user notices energy plan	ExD	Building user	Rendered Energy consumption plan visualization	

Scenario name:		JWG 3013 Reserve energy market				
Step No.	**Event**	**Description of process/ activity**	**Information producer**	**Information receiver**	**Information exchanged**	**Technical requirements ID**
1	Collection of individual energy demands	All devices under control of CEM send their own energy demand and flexibility to CEM	SD	CEM	Energy consumption and flexibility profile	
2	Sending of aggregated energy demand and flexibility	CEM send the aggregated energy demand profile to VPP	CEM	VPP (Flexibility operator)	Energy flexibility profile	
3	Offering of available energy flexibility	Flexibility operator offers available energy flexibility at the market	VPP (Flexibility operator)	Market	Energy flexibility schedule	
4	Award of energy flexibility	Market sends award for offered energy flexibility to Flexibility operator	Market	VPP (Flexibility operator)	Energy flexibility award information	
5	Demand response dispatching	Flexibility operator dispatches awarded energy consumption change to its participants	VPP (Flexibility operator)	CEM	Energy consumption change schedule	
6	CEM optimization	CEM optimizes energy consumption profile(s) according to change request				
7	Energy consumption profile distribution	CEM send out optimized energy consumption profile to loads under control	CEM	SD	Energy consumption profile	
8a	Energy plan visualization	CEM visualizes energy plan for building user	CEM	ExD	Energy consumption plan visualization	
8b		Building user notices energy plan	ExD	Building user	Rendered Energy consumption plan visualization	

Scenario name:		JWG 3014 Grid congestion management				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
1	DSO detects congestion	DSO sends out information about detected congestion	DSO	VPP (Operator)	Congestion information (schedule)	
2	VPP determines suitable participants	The VPP checks which of its participants might help to mitigate the grid problem				
3	Grid emergency notification	VPP sends out grid emergency signal to selected participants	VPP (Operator)	CEM	Emergency notification (schedule)	
4	CEM optimiza-tion	CEM optimizes energy consumption profile(s) according to emergency request				
5	Energy consump-tion profile distribution	CEM send out optimized energy consumption profile to loads under control	CEM	SD	Energy consumption profile	
6a	Energy plan visualiza-tion	CEM visualizes energy plan for building user	CEM	ExD	Energy consumption (emergency) plan visualization	
6b		Building user notices energy plan	ExD	Building user	Rendered energy (emergency) consumption plan visualization	

Scenario name:		JWG 3021 Intra-day market offer				
Step No.	**Event**	**Description of process/ activity**	**Informatio n producer**	**Informatio n receiver**	**Information exchanged**	**Technical requirements ID**
1a	Ongoing	The current consumption is metered	SM	SMG	Energy consumption	
1b		The current consumption is monitored	SMG	CEM	Energy consumption	
1c		The current consumption is visualized	SMG	ExD	Energy consumption	
1d		Additional energy consumption information is visualized	CEM	ExD	Energy situation report	
1e		The building user notices the current energy situation	ExD	Building user	Rendered energy consumption and situation report	

Scenario name:		**JWG 3021** **Intra-day market offer**				
Step No.	**Event**	**Description of process/ activity**	**Informatio n producer**	**Informatio n receiver**	**Information exchanged**	**Technical requirements ID**
2	Cyclic	Smart device send current available energy flexibility to CEM	SD	CEM	Energy flexibility information (incl. costs)	
3	Cyclic	CEM controls current consumption according to the exiting plan and derives remaining energy flexibility				
4	Cyclic	CEM send information about current available energy flexibility to VPP	CEM	VPP (Flexibility operator)	Energy flexibility information (incl. costs)	
5	Cyclic	VPP aggregates current available energy flexibility of its participants and sends corresponding offer to the market	VPP (Flexibility operator)	Market		
6	Flexibility request from TSO or other utility	The TSO or another utility with balancing responsibility places an energy flexibility request at the market	TSO	Market		
7	Flexibility demand at market, e.g. tertiary reserve	The market sends an award for energy flexibility to the VPP	Market	VPP (Flexibility operator)	Energy flexibility award information (incl. price)	
8	VPP determines suitable participants	The VPP determines which of its participants can satisfy the demand according given criteria (Economical, ecological, etc.)				
9	Flexibility event notification	VPP sends out Flexibility event signal to selected participants	VPP (Flexibility Operator)	CEM	Flexibility event notification	
10	CEM optimiza-tion	CEM adapts energy consumption setpoints according to Flexibility request				

Scenario name:		JWG 3021 Intra-day market offer				
Step No.	**Event**	**Description of process/ activity**	**Informatio n producer**	**Informatio n receiver**	**Information exchanged**	**Technical requirements ID**
11a	Flexibility event visualiza-tion	CEM visualizes emergency event actions to building user	CEM	ExD	Impact on building functionality caused be executing flexibility event	
11b		Building user notices emergency event actions	ExD	Building user	Rendered impact on building functionality caused be executing DR event	
12	Emergency event acceptance	Building user has no objections against flexibility event action				
13	Energy consump-tion setpoint distribution	CEM send out consumption setpoints to loads under control	CEM	SD	Energy consumption schedule/setpoint	
14	Achieve-ment feedback	CEM send back achieved flexibility response to VPP	CEM	VPP (Flexibility operator)	Energy consumption change	

Scenario name:		JWG 3022 Provision of committed reserve energy				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
1	TSO requests reserve energy	The TSO notifies the contracted reserve energy provider about the actual the demand	DSO	VPP (Flexibility Operator)	Reserve energy demand information	
2	VPP determines suitable participants	The VPP determines which of its participants can mitigate the congestion according its obligations				
3	Reserve event notification	VPP sends out reserve event signal to selected participants	VPP (Flexibility Operator)	CEM	Reserve event notification	
4	CEM reaction	CEM adapts energy consumption setpoints according to DR request				
5	Energy consump-tion setpoint distribution	CEM send out consumption setpoints to loads under control	CEM	SD	Energy consumption setpoint	

Scenario name:		JWG 3022 Provision of committed reserve energy				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
6a	Reserve event visualiza-tion	CEM visualizes reserve event actions to building user	CEM	ExD	Impact on building functionality caused be executing reserve event	
6b		Building user notices reserve event actions	ExD	Building user	Rendered impact on building functionality caused be executing reserve event	

Scenario name:		JWG 3031 Grid emergency-event send to VPP (Operator)				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
1	Grid problem detected	The DSO notifies the VPP about an detected congestion in the grid	DSO	VPP (Flexibility Operator)	Grid congestion information	
2	VPP determines suitable participants	The VPP determines which of its participants can mitigate the congestion according its obligations				
3	Emergency event notification	VPP sends out emergency event signal to selected participants	VPP (Flexibility Operator)	CEM	Emergency event notification	
4	CEM reaction	CEM adapts energy consumption setpoints according to DR request				
5	Energy consump-tion setpoint distribution	CEM send out consumption setpoints to loads under control	CEM	SD	Energy consumption setpoint	
6a	Emergency event visualiza-tion	CEM visualizes emergency event actions to building user	CEM	ExD	Impact on building functionality caused be executing emergency event	
6b		Building user notices emergency event actions	ExD	Building user	Rendered impact on building functionality caused be executing emergency event	
7	Grid problem cleared	The DSO notifies the grid user about an emergency clearance	DSO	VPP (Flexibility Operator)	Grid congestion clearance information	

Scenario name:		JWG 3031 Grid emergency-event send to VPP (Operator)				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
8	VPP determines suitable participants	The VPP determines which of its participants were involved to mitigate the congestion				
9	Emergency event notification	VPP sends out DR clearance signal to selected participants	VPP (Flexibility Operator)	CEM	Emergency clearance notification	
10	CEM reaction	CEM adapts energy consumption setpoints according to normal operation				
11	Energy consump-tion setpoint distribution	CEM send out consumption setpoints to loads under control	CEM	SD	Energy consumption setpoint	
12a	Emergency event visualiza-tion	CEM visualizes DR event clearance to building user	CEM	ExD	Emergency clearance information	
12b		Building user notices DR event clearance	ExD	Building user	Rendered emergency clearance information	

Scenario name:		JWG 3032 Grid emergency-event sent directly to CEM				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
1	Grid problem occurs	DSO sends out emergency command	DSO	CEM	DLC command	
2	CEM response	The CEM derives necessary/possi ble emergency counteractions				
3	Local response	DMS sends out emergency command	CEM	SD	DLC command	
4a	Emergency visualiza-tion	CEM visualizes emergency for building user	CEM	ExD	Emergency visualization	
4b		Building user notices emergency	ExD	Building user	Rendered emergency visualization	
5	Grid problem cleared	DSO sends out emergency clearance command	DSO	CEM	DLC command	

Scenario name:		JWG 3032 Grid emergency-event sent directly to CEM				
Step No.	Event	Description of process/ activity	Informa-tion producer	Informa-tion receiver	Information exchanged	Technical requirements ID
6	CEM response	The CEM determines turn back to normal operation				
7	Local response	CEM forwards DLC command to inhouse device	CEM	SD	DLC command	
8a	Emergency clearance visualiza-tion	CEM visualizes emergency clearance for building user	CEM	ExD	Emergency clearance visualization	
8b		Building user notices emergency clearance	ExD	Building user	Rendered emergency clearance visualization	

Scenario name:		JWG 3033 Grid emergency event-sent directly to dedicated smart device via smart meter				
Step No.	Event	Description of process/ activity	Informa-tion producer	Informa-tion receiver	Information exchanged	Technical requirements ID
1	Grid problem occurs	DSO sends out emergency command	DSO	SMG	DLC command	
2	Local response	SMG forwards DLC command to dedicated smart device	SMG	SD	DLC command	
3a	Emergency visualiza-tion	SMG visualizes emergency for building user	SMG	ExD	Emergency visualization	
3b		Building user notices emergency	ExD	Building user	Rendered emergency visualization	
4	Grid problem cleared	DSO sends out emergency clearance command	DSO	SMG	DLC command	
5	Local response	SMG forwards DLC command to dedicated smart device	SMG	SD	DLC command	
6a	Emergency clearance visualiza-tion	SMG visualizes emergency clearance for building user	BACS	ExD	Emergency clearance visualization	
6b		Building user notices emergency clearance	ExD	Building user	Rendered emergency clearance visualization	

Steps – Alternative, error management, and/or maintenance/backup scenario

Scenario name:		JWG 3021a with building user objection against DR event action Intra-day market offer				
Step No.	**Event**	**Description of process/ activity**	**Informa-tion producer**	**Informa-tion receiver**	**Information exchanged**	**Technical requirements ID**
1-11		Same as base scenario.				
A1a	DR event disagree-ment	Building user enters his objections against flexibility event action at the ExD	Building user	ExD	User input	
A1b		ExD sends user input to CEM	ExD	CEM	User input	
A2	CEM re-optimiza-tion	CEM looks for alternative energy consumption adaptation to satisfy flexibility request				
A3a	Flexibility event visualiza-tion	CEM visualizes alternative flexibility event actions to building user	CEM	ExD	Impact on building functionality caused be executing flexibility event	
A3b		Building user notices alternative flexibility event actions	ExD	Building user	Rendered impact on building functionality caused be executing flexibility event	
A4	Flexibility event acceptance	Building user has no objections against alternative flexibility event action				
13-14		Same as base scenario.				

A.3.25 Specialized use case (JWG3101) Energy production/storage integration

A.3.25.1 General

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG3101	**Domain**: Customer Premises, DER **Zones**: Process, Field, Station	Energy production/storage integration

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
0.1	07/05/2014	Metering	Use Cases	Initial Draft	Draft
0.2	17/12/2014	Home Appliances	Use Cases	Minor changes on formatting towards IEC JWG-UC	Draft

Basic information on use case

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Technical Report	Use Cases 3.0	Draft	UC initial version	Energy@home Association	

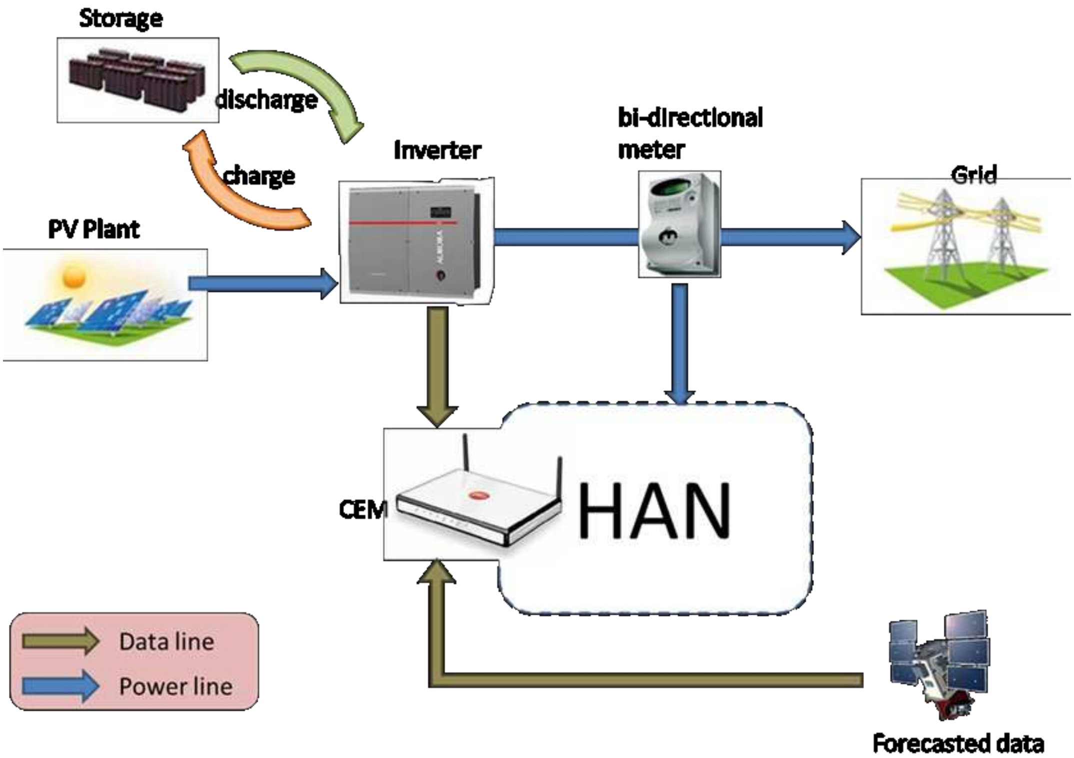
Relation to higher level use case	
Cluster	**Higher level use case**

Maturity of use case – in business operation, realized in demonstration project, , realised in R&D, in preparation, visionary
Prioritisation
Generic, regional or national relation
View – technical / business
Further keywords for classification

Scope and objectives of use case

Scope and objectives of use case	
Scope	Integrate the production from domestic photovoltaic (PV) plants and the storage systems into home area network management.
Objective(s)	Monitoring system for all the significant quantities that regard the production system.
Related business case(s)	

Narrative of use case

Narrative of use case
Short description
The aim of this use case is to provide customer with information on the current situation of the production plant, including suggestions about when an appliance should be used based not only on the current and forecasted consumptions, but also on the current and forecasted production of the photovoltaic plant This use case describes the request for status and logged information from the customer EMS controller to a storage battery controller and the display of the received information. The EMS controller requests status or log information from the Storage Battery Controller. After the information is received from the Storage Battery controller it is displayed by the EMS controller.
Complete description
The integration of the domestic photovoltaic (PV) plants and the storage systems aims to have a dual benefit for the final user: on the one hand user will be able to monitor from a user-friendly interface all the significant quantities that regard the production system: current power, energy production, battery state of charge, forecast data, etc… On the other hand information about current and forecasted energy production will be used inside the algorithm that defines the best execution time in which an appliance should start. Storing energy in a battery system allow the system to release electric power in a different period and so the system can achieve cost optimization/peak consumption reduction. On the other hand a scenario could be executed where the excess energy from PV plant could be stored into a DHW (Domestic Hot Water) storage, buffer primary water (for heating or cooling) sometimes present into house's hydraulic circuit or directly feed into the circuit. In this case storing energy into a thermal storage allow the system to limit use of electric energy coming from the grid maximizing autoconsumption. For example the CEMS, receiving information about how much electricity is exported into the grid can adopt an algorithm able, as a target, to reduce to zero the value of energy given to the grid itself. Electric energy autoconsumption can be allowed according to economic reasons. In fact it could be cheaper to store energy into battery/thermal storage rather than sell electric energy coming from PV plant even if it could reduce the global system energy efficiency.  IEC The storage component could be installed, if a battery storage will be used, inside the inverter and it is managed by inverter controller, otherwise could be installed in the hydraulic circuit as DHW buffer or CH/Cooling buffer primary water managed by heating controller The inverter/storage system will communicate PV plant and storage information to the CEMS through a zigbee module. The CEMS will be able to retrieve forecast information invoking a remote Web Service.

Issues: Legal contracts, legal regulations, constraints and others

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
HAN user	User starts to fill the plant registration form in the CEM GUI		
CEMS	CEM periodically starts to request plant production values to the PV inverter		Connection between CEM and inverter has to be establish before executing this step
CEMS	CEM periodically starts to request plant production forecast to the Forecast Web Service	Step 1 (Plant Forecast registration)	
HAN user	User accesses to the CEM GUI to monitor PV plant variables	Step 2 (Inverter data acquisition) & 3 (Forecast data acquisition)	

Preconditions, assumptions, post condition, events

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

Referenced standards and / or standardization committees (if available)

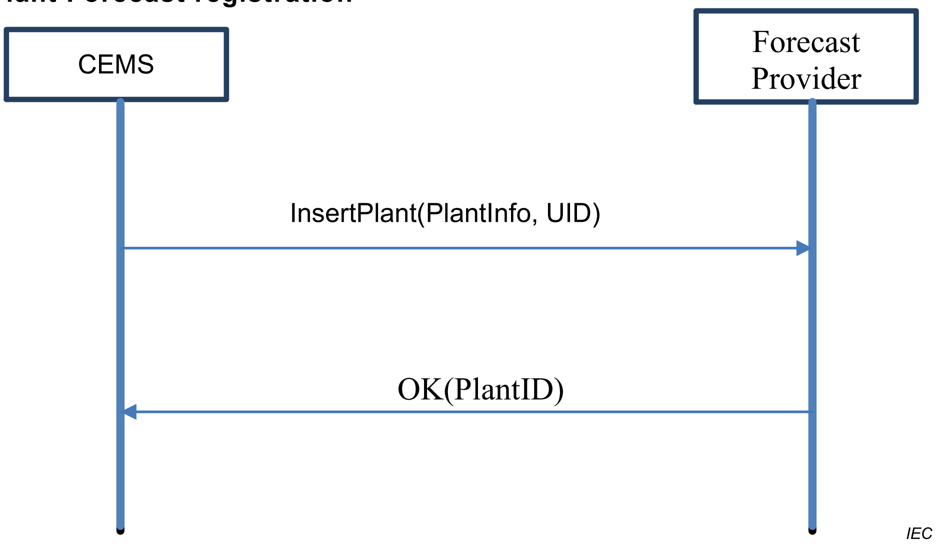
Relevant Standardization Committees	Standards supporting the use case	Standard status

General remarks

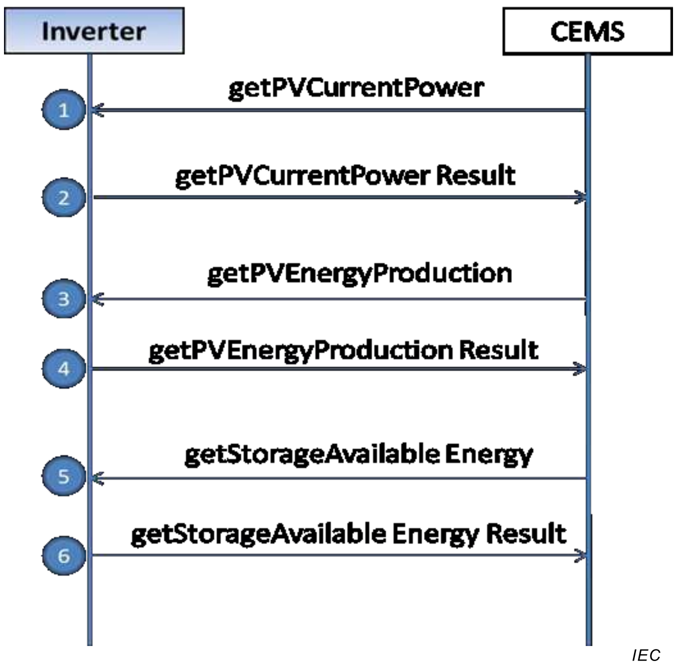
General remarks
See related cluster document

A.3.25.2 Drawing or Diagram of use case

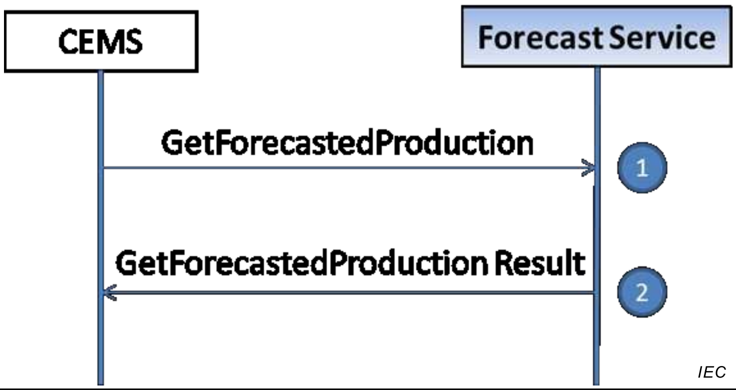
Diagram of use case
Step 1: Plant Forecast registration



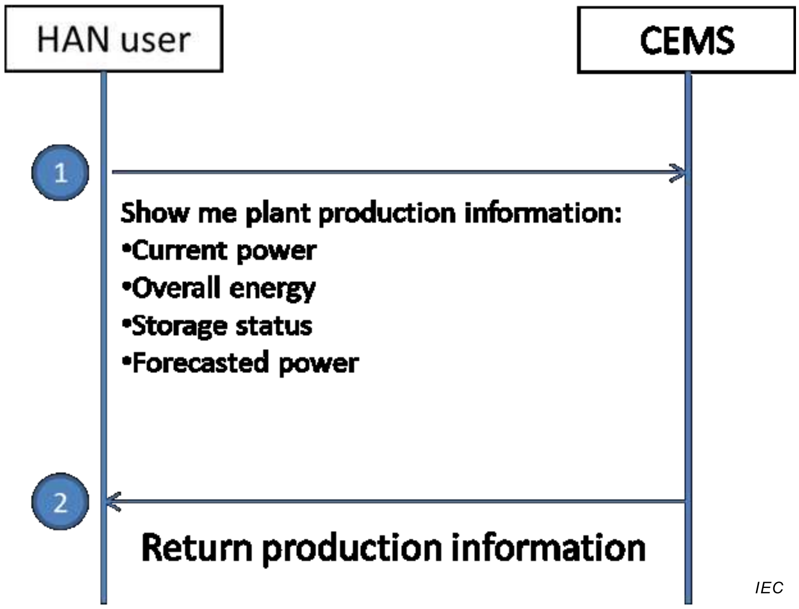
Step 2: Inverter data acquisition



Step 3: Forecast data acquisition



Step 4: User visualization



A.3.25.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Customer Energy Manager	Internal	Hosts a Web application that collects data from Inverter and forecast service and organizes them for a user-friendly presentation. Data collection will be triggered by the CEMS periodically every a certain amount of time, depending on the component to query (e.g. once a day for the forecast, once a minute for the inverter).	
Inverter/Storage system	External	Provides a set of data retrieved by photovoltaic plant production status and, possibly, by the storage system. The storage system is could be included inside the inverter or inside the hydraulic circuit, so there is direct communication between the storage and the CEM. Data are dispatched upon request. Data sent by inverter represents exclusively current values, so CEM will store these data to keep historical data.	
Forecast Web Service	External	Forecast provider makes available a service that, when invoked, returns a collection of expected plant power values for the plant installed in a specific home. The service provides 72 power values, once an hour for the next 72 hours.	
HAN user	External	It's the home user that interacts with CEMS GUI to get information about production and storage system	

A.3.25.4 Step by step analysis of use case

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-Condition**	**Post-Condition**
1	Production and storage information	HAN user, CEMS	User accesses to the CEMS GUI to monitor PV plant variables	Inverter and forecast data acquisition is running. PV plant has been registered in the forecast service	User accesses to the plant production and forecast information

Scenario							
Scenario name:	**Production and storage information**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
1	None	Plant forecast registra-tion	CEMS provides a registration form to the user to fill PV plant data. After submission, data are sent to the forecast web service, that stores them and provides an ID to be used for forecast requests	CREATE	CEMS	Forecast Service	Plant info
2	None	Inverter data acquisition	Periodically the CEMS starts the inverter data acquisition process: the CEMS makes 4 requests asking for the main four variables. The inverter responds to these requests with 4 values that are stored by CEMS in a database to let them be available by user when he/she requests the plant production information.	GET	Inverter/ Storage system	CEMS	• Current PV power • Overall energy produced by the plant • Current energy available in storage (if present) • Instantaneous power available from the battery
3	Step 1	forecast data acquisition	Periodically the CEMS starts the forecast data acquisition process: the CEMS makes a request to the Forecast Web Service asking for the expected plant power of the next hours. Forecast service returns a sequence of expected powers in a specific date time that is stored by CEMS in a database to let it be available by user when he/she requests the expected plant production information.	GET	Forecast Web Service	CEMS	72 power values, once an hour for the next 72 hours

Scenario							
Scenario name:	**Production and storage information**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
4	Step 2/3	User visualiza-tion	User requests information about his/her Energy Production System to the CEMS through the Home Gateway web application. CEMS shows this information in a user-friendly interface.	REPORT	CEMS	HAN User	No information exchanged (information about Energy Production System are only shown)

A.3.25.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Plant info	Vital statistics and general information about PV plant	
Total Energy production (kWh)	CEMS queries the Inverter for the PV Energy production. Inverter returns the current PV Energy production	
Storage available energy (kWh)	CEMS queries the Inverter for the Storage available energy. Inverter returns the Storage available energy (if any)	
Peak power from the battery	CEMS Asks for the instantaneous power available from the battery (if any). Inverter returns the Peak power deliverable from the battery	
Plant forecast power	CEMS asks the forecast service for the current PV power. Forecast service returns the expected plant power	Must be 72 forecast values, once per hour (3 days)

A.3.26 Specialized use case (JWG3102) Power loss notification and analysis

A.3.26.1 General

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG3102	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Power loss notification and analysis

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
1.0	08/05/2014		Use Cases	Initial Draft	Draft
0.2	17/12/2014	Home Appliances	Use Cases	Minor changes on formatting towards IEC JWG-UC	Draft

Basic information on use case

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Technical Report	Use Cases 3.0	Draft	UC initial version	Energy@home Association	

Relation to higher level use case	
Cluster	**Higher level use case**

Maturity of use case – in business operation, realized in demonstration project, , realised in R&D, in preparation, visionary
Prioritisation
Generic, regional or national relation
View – technical / business
Further keywords for classification

Scope and objectives of use case

Scope and objectives of use case	
Scope	In case of energy black out the CEMS, equipped with an UPS, is able to guarantee the correct activity for a minimum time (< 60 sec.). It can alert the customer about the event with an alarm (e.g. SMS, phone call). If an UPS is not present, this is typically the "ex-post" scenario of the Overload Management use case.
Objective(s)	The aim of following use case is to help the customer to understand the cause of a power loss event and to manage proper load recovery after it.
Related business case(s)	

Narrative of use case

Narrative of use case
Short description
The Customer Energy Management sends an SMS to the customer to inform him that a power loss event occurred. At the end of the event the CEM restarts sending to the customer a report about home and appliances consumption before the event; the user can eventually choose to do something to reduce the loads.
Complete description
Before the power loss measurable loads routinely send consumption data to the CEMS. Also SmartInfo routinely sends global consumption and alerts. The Customer Energy Management System if has UPS capabilities switches to UPS and sends an SMS to the customer. If UPS capability is not available or fail, power loss detection could be performed by an external server, e.g. after ½ hour of gateway inactivity. At the end of the power loss event , the customer has to be informed about the type and cause of the power loss and can make appropriate choices to avoid e.g. a new trip of the circuit breaker. The loads restart following their own procedures. Smart Appliances will restart in the same state they were when black out occurred. The CEM restarts, receives from the SmartInfo the alert occurred before the event, and calculate the duration and type of the event (blackout on the grid/circuit breaker trip) and sends to the customer a report containing also home and appliances consumption before power loss .The user can eventually choose to do something to reduce the loads.

Issues: Legal contracts, legal regulations, constraints and others

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
HAN user	User starts to fill the plant registration form in the CEM GUI		
CEMS	CEM periodically starts to request plant production values to the PV inverter		Connection between CEM and inverter has to be establish before executing this step
CEMS	CEM periodically starts to request plant production forecast to the Forecast Web Service	Step 1 (Plant Forecast registration)	
HAN user	User accesses to the CEM GUI to monitor PV plant variables	Step 2 (Inverter data acquisition) & 3 (Forecast data acquisition)	

Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
SmartInfo	Overload Warning notification	Consumption above contractual power	Before the event Smart Info notifies the CEM that there is an overload warning

Referenced standards and / or standardization committees (if available)

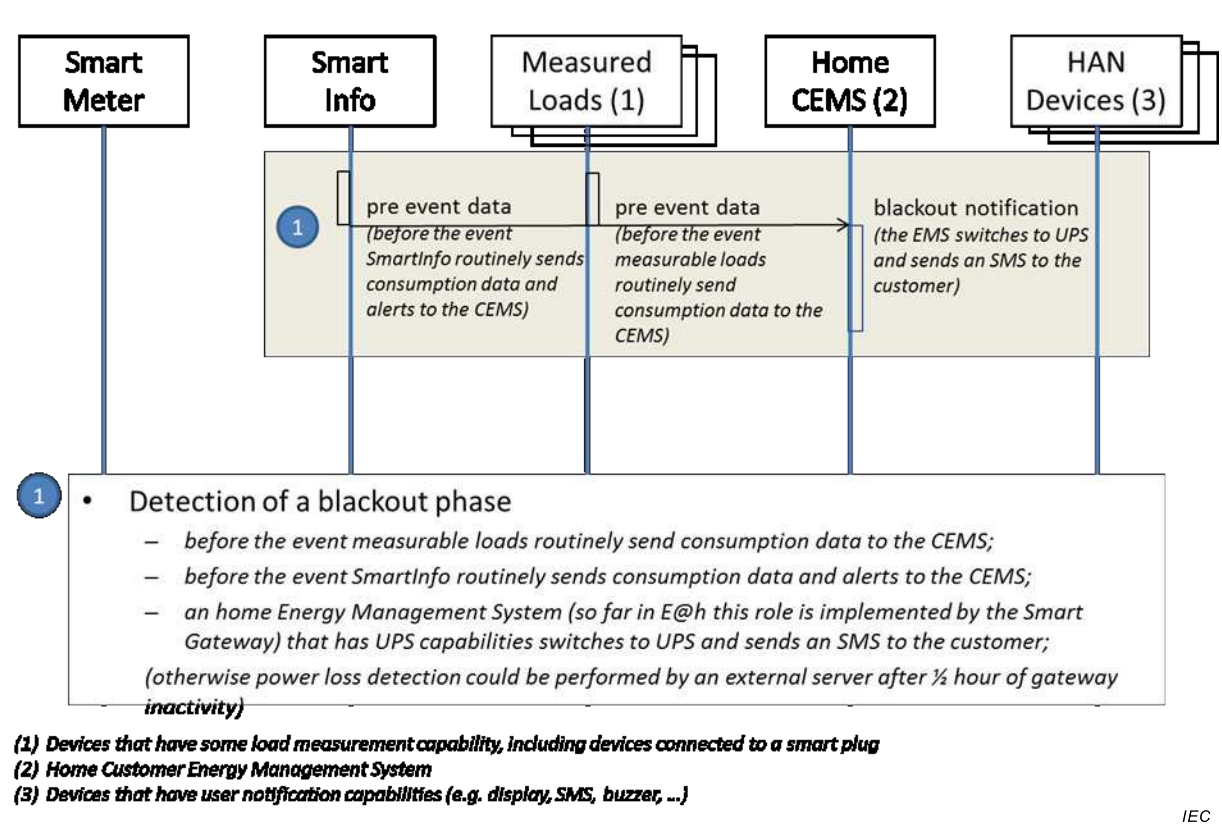
Relevant Standardization Committees	Standards supporting the use case	Standard status

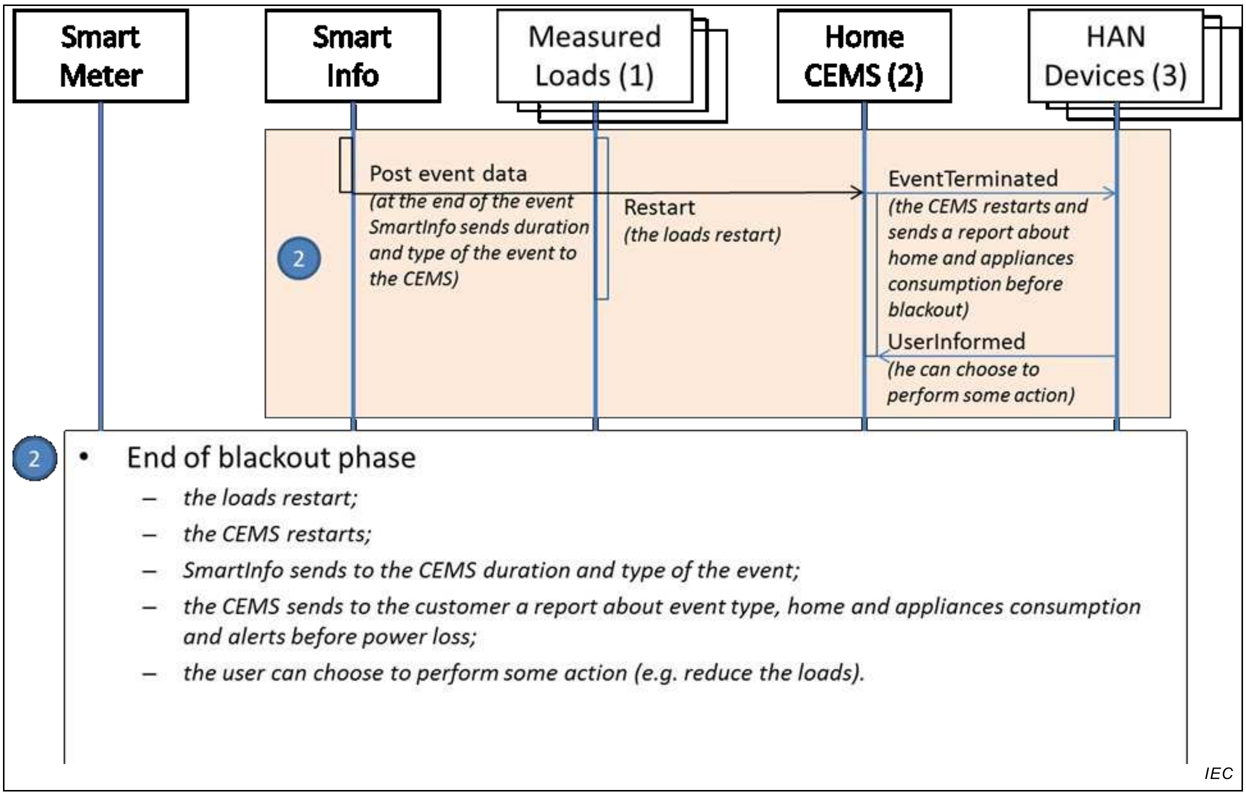
General remarks

General remarks
See related cluster document

A.3.26.2 Drawing or Diagram of use case

Diagram of use case





A.3.26.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart Info	TBD	The Smart Meter uses the Smart Info as a communication bridge to the user devices in the home premises. The Smart Info is not active during the power loss event At the end of the event the Smart Meter, by means of the Smart Info, provides to the CEMS the alert occurred before the event. In case of black out the Smart Info will not be able to reach the Meter, hence it shall not emit any dedicated message toward the HAN.	
CEM	TBD	The Customer Energy Management System sends an SMS to the customer if it has UPS capabilities otherwise power loss detection could be performed by an external server, e.g. after ½ hour of gateway inactivity. At the end of the event the CEMS will have the possibility to calculate the duration and and type of the event (blackout on the grid/circuit breaker trip). CEMS could activate a SMS or a voice call alarm	
Smart Appliances	TBD	The Smart Appliances: – before the event routinely send consumption data to the CEMS – at the end of the event return to the status they were before the event.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
User		The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the CEM, smart device.	

A.3.26.4 Step by step analysis of use case

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-Condition**	**Post-Condition**
1	Power loss notification and analysis	CEM, SmartInfo	Consumption above contractual power	Overload Warning notification	Premises black out

Scenario							
Scenario name:		**Power loss notification and analysis**					
Step No.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Informa-tion Exchan-ged**
1	1	Blackout notification	The CEM switches to UPS and sends an SMS to the customer		CEM	User	Pre event data
	2	Smart Device restart	CEM and smart device restart following their own procedures.		Smart device	CEM	
	3	Post event	Smart Info sends to the CEM duration and type of the event		Smart Info	CEM	Post event data
	4	Report about the event	The CEM sends to the user a report about event type, home and appliances consumption and alert before power loss		CEM	User	EventTer minated
	5	Action performed by user	The user can choose to perform some action to reduce the loads		User	Smart device	

A.3.26.5 Information exchanged

Information exchanged		
Name of information (ID)	**Description of information exchanged**	**Requirements for information data**
Blackout notification	SMS to the customer	
Post event data	Duration and type of the event	
Event Terminated	Report	

A.3.27 Specialized use case (JWG3103) Historical data visualization (external data processing and storage)

A.3.27.1 General

Name of use case

Use case identification		
ID	**Domain(s)/ Zone(s)**	**Name of use case**
JWG3103	**Domain:** Customer Premises, DER **Zones:** Process, Field, Station	Historical data viewing (external data processing & storage)

Version management

Version management					
Changes / Version	**Date**	**Domain expert**	**Area of expertise / Domain / Role**	**Title/Changes**	**Approval status draft, for comments, for voting, final**
1.0	21/10/2014			Initial Draft	Draft
0.2	17/12/2014	Home Appliances	Use Cases	Minor changes on formatting towards IEC JWG-UC	Draft

Basic information on use case

References						
No.	**Referen-ces type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
1	Technical Report	Use Cases 3.0	Draft	UC initial version	Energy@home Association	

Relation to higher level use case	
Cluster	**Higher level use case**

Maturity of use case – in business operation, realized in demonstration project, , realised in R&D, in preparation, visionary
Prioritisation

Generic, regional or national relation
View – technical / business
Further keywords for classification

Scope and objectives of use case

Scope and Objectives of use case	
Scope	Export historical data from CEMS toward external (private) server
Objective(s)	The end user choose to set-up the uploading of own data toward an internet server for post process and storage. The server owner will provide processing as agreed with the end-user (i.e. data aggregation, historical consumption graphs etc.).
Related business case(s)	

Narrative of use case

Narrative of use case
Short description
-
Complete description
On CEMs the user will find configurable set up related to “destination server”, authentication mode, timer/events to trigger, data list to be flag for export. Once the setup is complete, when the trigger occurs the CEMS opens a secure connection with the destination server and using the authentication establishes the secured session, during whom CEMS uploads data (i.e. using SFTP protocol, CEMS can send an XML file)

Issues: Legal contracts, legal regulations, constraints and others

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
CEMS		It collects the status notification , events, alarms sent from the devices over the HAN It receives from the Remote GUI the request to modify the status of the devices (e.g. selection of a cycle, ON/OFF of the device, start/stop commands) It sends the modification request to the devices over the HAN It sends the device status notification to the Remote GUI Depending on the adopted technical solution, the CEMS can act as a simple tunnel between the device and the Remote GUI or can implement some type of parsing of the data received. It can also parse and store, for a small amount of time, historical data ready for export.	
Dest. Server		It provides the secure session with CEMS(s) and collect/store/process data retrieved as agreed with end-users (service subscribers).	

Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
User	The user parks the EV near the EVSE and fits the charging preferences.		

Referenced standards and / or standardization committees (if available)

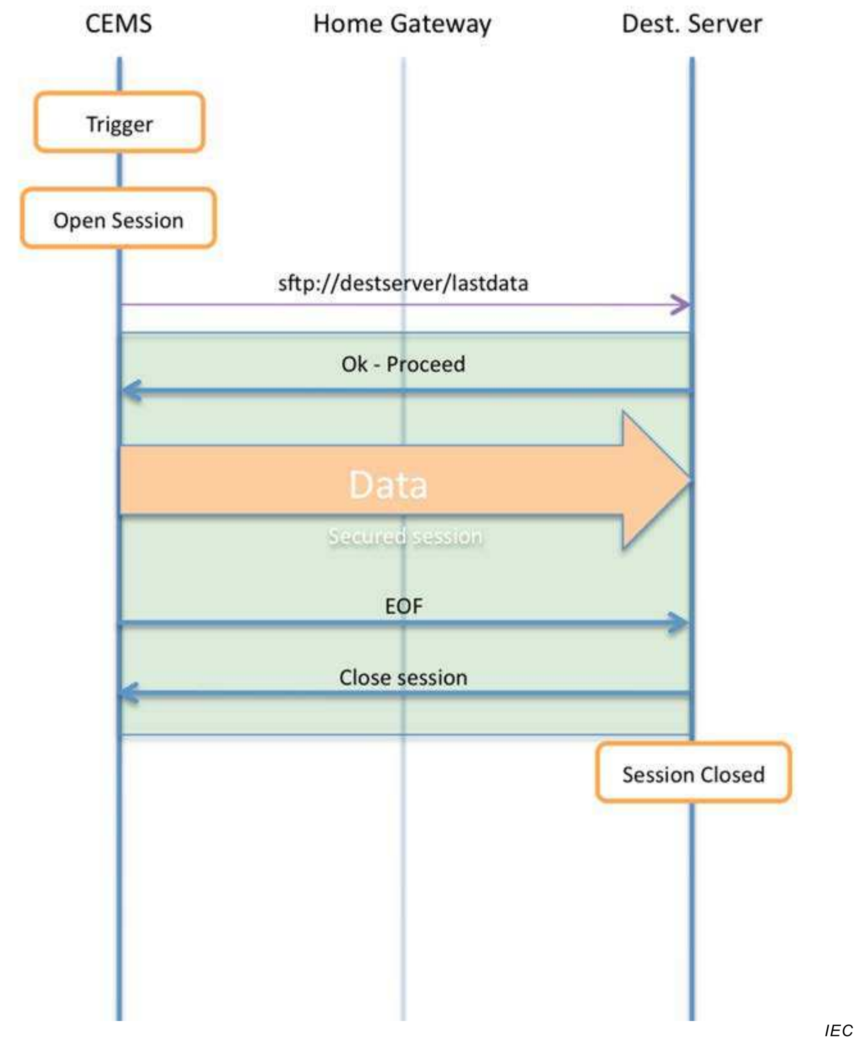
Relevant Standardization Committees	Standards supporting the use case	Standard status

General remarks

General remarks
The proposal to let the CEMS initiate the secure session toward an external server is due to the fact that not all end users are able to configure “port forwarding” or “firewalls rules” on their own home connection modem/routers. Moreover, the ask for “port openings” or the use of automatic provisioning as upnp exposes the end user to unnecessary security risks, and the consortium could be considered “responsible” by the users community in case of any intrusion detection. On the contrary, if the CEMS establishes the connection and data uploading, the only responsibilities are end-user for the “destination server” setup and the server owners for data management/protection.

A.3.27.2 Drawing or Diagram of use case

Diagram of use case



A.3.27.3 Technical details

Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
Smart Info	TBD	The Smart Meter uses the Smart Info as a communication bridge to the user devices in the home premises. The Smart Info is not active during the power loss event At the end of the event the Smart Meter, by means of the Smart Info, provides to the CEMS the alert occurred before the event. In case of black out the Smart Info will not be able to reach the Meter, hence it shall not emit any dedicated message toward the HAN.	

Actors			
Grouping (Community)		**Group description**	
Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**	**Further information specific to this use case**
CEM	TBD	The Customer Energy Management System sends an SMS to the customer if it has UPS capabilities otherwise power loss detection could be performed by an external server, e.g. after ½ hour of gateway inactivity. At the end of the event the CEMS will have the possibility to calculate the duration and and type of the event (blackout on the grid/circuit breaker trip). CEMS could activate a SMS or a voice call alarm	
Smart Appliances	TBD	The Smart Appliances: – before the event routinely send consumption data to the CEMS – at the end of the event return to the status they were before the event.	
User		The end customer who has acquired a smart device. The end customer is responsible for configuring and setting operation mode of the CEM, smart device.	

A.3.27.4 Step by step analysis of use case

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-Condition**	**Post-Condition**

Scenario							
Scenario name:		**Power loss notification and analysis**					
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**

A.3.27.5 Information exchanged

Information exchanged		
Name of Information (ID)	**Description of information exchanged**	**Requirements for information data**

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