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TECHNICAL REPORT

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- withdrawn,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).

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).

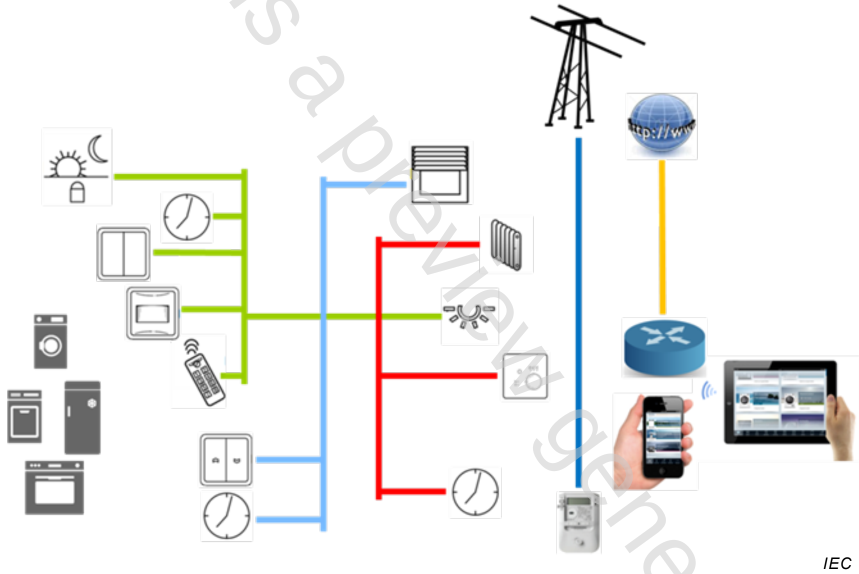

Figure 2 – Smart environment as of today

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).

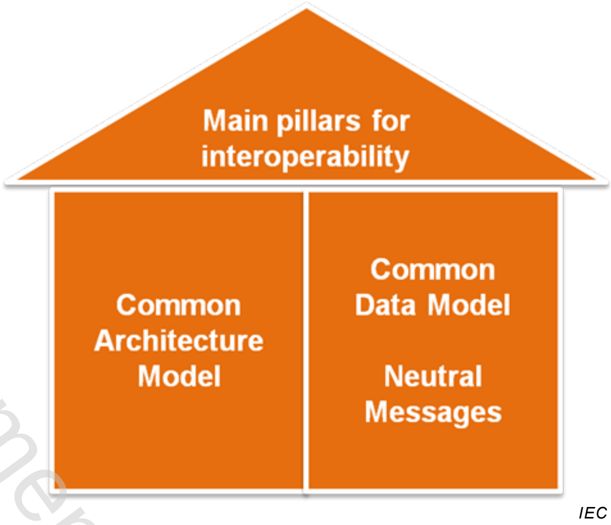

Figure 3 – Requirements for interoperability

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]