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TECHNICAL REPORT

colour inside

Smart grid user interface –
Part 1: Interface overview and country perspectives

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FOREWORD

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IEC TR 62939-1, which is a technical report, has been prepared by IEC project committee 118: Smart grid user interface.

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

Enquiry draft	Report on voting
118/40/DTR	118/42/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 62939 series, published under the general title *Smart grid user interface*, 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- withdrawn,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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0 Introduction

0.1 High-level definition of Smart Grid user interface (SGUI)

The Smart Grid user interface (SGUI) is a logical, abstract cross-domain interface that supports appropriately secure communications of information between an entity within the customer domain (e.g., home or building energy management system, electrical load, energy storage system or generation source) and an external service provider (e.g., utility, aggregator, market or customer energy service provider). Devices and applications will implement the SGUI between grid-side entities and customers for the purpose of facilitating machine-to-machine communications. The SGUI needs to meet the needs of today's grid interactions (e.g., demand response, grid-aware energy management, electric vehicle (EV) charging equipment interactions) and those of the future (e.g., retail market transactions).

In practice, the SGUI will potentially be one interface between multiple aggregation points, both inside and outside of the customer facility. Implementations will have variations arising from complex system inter-relationships: diverse customer business and usage models with different types of equipment in different types of customer facilities controlled by a range of energy management systems.

0.2 PC 118 history

In 2010, China proposed three new work proposals for IEC standards for Smart Grid user interface. There was a long process (refer to Annex A for details of the history of the establishment of Project Committee 118) of SMB and Strategy Group 3 (SG3) discussions and interaction with different TCs who each were working on some standards efforts related to the customer interface. Because many TCs have some connection to the SGUI, the Project Committee approach was chosen with the goal of coordinating between TCs to move forward toward effective standards. China was appointed secretary of PC 118 and the two Chinese work proposals became two working groups within PC 118, each tasked to produce a standard that would become deliverables of this temporary PC.

PC 118 members first met in Tianjin, China, in February 2012. At that meeting, representatives from different TCs and NCs each presented standards work related to the SGUI. Also at this meeting PC 118 members agreed to prepare a technical report covering the definition of the SGUI, the national requirements for SGUI communications (use cases), and an analysis of standards gaps between requirements and available standards. The end result would be acknowledgement of available international standards, recommendations for advancement of national standards and/or development of new standards to fill gaps.

PC 118 members recognized that standards exist for interactions between the traditional grid domain and the customer domain. There are international and national standards covering different parts of the interface. IEC TC 57 had just established a new working group (WG 21, Interfaces and protocol profiles relevant to systems connected to the electrical grid) and other TCs and WGs address meter interactions, industrial plant interactions, EV communications, market information models, etc. PC 118 adopted the approach of preparing this technical report, welcoming member countries and other IEC TCs to participate.

One may ask where Smart Grid stakeholders derive value. The industry will be best served by rapid progress which in turn is enabled by use of established technologies which meet Smart Grid user interface functional and quality requirements. This technical report presents the work of PC 118 members to gather and report the requirements for the customer interface, available standards, and identified standards gaps. Some national standards are recommended for advancement in IEC.

0.3 Relation of IEC PC 118 to other IEC technical committees

According to the PC 118 Strategic Business Plan (SBP) (SMB/4823/R, June 2012), the scope of PC 118 is to look at information exchange between the customer and the power grid from the user's point of view. PC 118 draws on the input of other IEC TCs to have a coherent IEC

perspective on the customer interface, developing a set of standards (or mapping to existing standards) to ensure that IEC standards meet the needs of customer Smart Grid interactions. In order to do this, PC 118 works with IEC TCs developing standards for the power grid and within the customer domain.

IEC TC 57 is the manager of the IEC Common Information Model (CIM) and 61850 standards that serve as the information models for power grid domain communications. TC 57/WG 21 is specifically focused on the customer interface from the power grid point of view. IEC TC 13 developed the standards of the IEC 62056 Device Language Message Specification (DLMS)/ Companion Specification for Energy Metering (COSEM) suite [1] [1] for the purposes of electricity metering.[2] The PC 118 SBP scope is, "Standardization in the field of information exchange for demand response and in connecting demand side equipment and/or systems into the Smart Grid." Also, "PC 118 will develop a harmonized and consistent suite of standards for the users." PC 118 will work with existing IEC, ISO standards and examine existing national standards in order to identify the collection of standards that together meet the needs of the Customer Smart Grid interface.

The PC 118 SBP specifically states, "Smart Grid user interface related standards prepared by other technical committees of the IEC (including IEC/ISO JTC1) shall be used where applicable. PC 118 shall apply analytical approach and Use Cases developed by IEC TC 8 for Smart Grid requirements. PC 118 shall use IEC CIM and IEC 61850, and will develop new information models in view of demand side needs and characteristics. PC 118 shall consider IEC TC 57, TC 13, TC 59, TC 69, TC 72, TC 100, IEC/ISO JTC1 SC 25, TC 56, TC 65, etc., related architectures and standards. PC 118 should also consider Smart Grid user interface related standards prepared by other organizations such as ISO and ITU."

0.4 Report overview

Clause 2 introduces the customer (the Smart Grid user) interface—an interface between separate and historically independent domains. Subclause 2.3 presents a high-level conceptual model for demand response interactions from loosely coupled market interactions down to direct load control interactions. Subclause 2.4 organizes the functional requirements that have been discussed in PC 118. The remainder of Clause 2 examines the SGUI architecture, actors, and quality requirements.

Clause 3 begins with an overview of PC 118 member country perspectives on SGUI and an overview of contributed use cases (details in Annex C). Subclause 3.4 presents an analysis of use cases organized according to the functional requirements in 2.4. Subclause 3.5 looks at the relationship of SGUI to advanced metering infrastructure (AMI) and electric vehicles.

Clause 4 examines existing standards relevant to the use case classes to identify standards that meet the needs of the SGUI, or alternatively to identify gaps in IEC standards. This in turn informs Clause 5 recommendations for IEC SGUI standards development work.

0.5 Key recommendations and findings

PC 118 has identified some gaps in international standards for each of the use case classes presented in 4.4. Several existing national standards are recommended for advancement in IEC. Discussion of recommendations can be found in 4.5 and Clause 5.

1 Numbers in square brackets refer to the Bibliography.

2 The COSEM data model is also used by other Technical Committees responsible for non-electricity metering.

SMART GRID USER INTERFACE –

Part 1: Interface overview and country perspectives

1 Scope

This part of IEC 62939, which is a technical report, presents an international consensus perspective on the vision for a Smart Grid user interface (SGUI) including: SGUI requirements distilled from use cases for communications across the customer interface (the SGUI); an analysis of existing IEC and other international standards that relate to the SGUI; and an identification of standards gaps that need to be filled and might become potential work items for IEC Project Committee 118.

The PC 118 scope is, *"*Standardization in the field of information exchange for demand response and in connecting demand side equipment and/or systems into the Smart Grid*"*. This report presents the information exchange and interface requirements leading to standards to support effective integration of consumer systems and devices into the Smart Grid.

2 Smart Grid user interface overview

2.1 SGUI – Consensus perspective

The title and scope of IEC PC 118 refers to a "user interface." This term can have multiple meanings and interpretations. In the context of the work of PC 118 a "user" is some entity (actor) that consumes electricity supplied by the electric grid, or some distributed energy resource, such as storage or local generation that might produce energy. A user can be considered as a home, a vehicle, a commercial building, an industrial plant, or some system/device within a customer facility[3]. A "user interface" is a means to exchange information between the electric grid service provider and the user.

This Smart Grid user interface (SGUI) is not designed to be a human-machine interface, but may supply information to aid such an interface. It does not presume any particular communication or control technology that might be deployed by the user within a facility to react or respond to the information exchanged, and does not presume a single communication mechanism between actors on the grid and facility sides. It provides a basis for information exchange between the energy service provider or other grid-side entity and the customer-side entity, and nothing more. A high-level view of the SGUI is shown in Figure 1. In this simple figure, "Grid operations" also includes markets and energy service providers (see also 2.4 for SGUI functional requirements, 2.5 for SGUI architecture and 2.6 for example of actors within grid operations and customer facility management and control).

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3 A "facility" is used in this report to refer to homes, buildings and industrial plants.

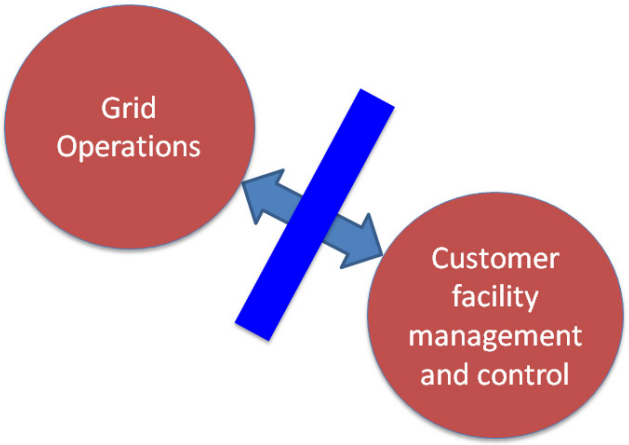

Figure 1 – High-level view of the SGUI architecture as interface (blue line) between different domains

The SGUI serves as an interface between two different domains that exist and evolve independently, and have developed over time with different information models and communication protocols. The SGUI serves to connect these domains: the “grid” domain (all those entities directly involved in the operation of the traditional electric grid) and the “customer facility” domain. The SGUI “user” is a more abstract term for the customer facility, since the “user” can be the same as the customer facility, or some system/device within the domain, or even an aggregation of systems.

The information communicated across the interface may include: demand response signals, price signals, load parameters (e.g., demand, forecast demand, storage availability), market transactions, energy usage (meter data), emergency signals broadcast by system operators, and other energy-related parameters such as power quality [2]. No single interface is required to communicate all of these things. For example, a simple residential gateway may possibly receive only price, or a meter may possibly report only energy usage information[4].

The SGUI may on the one hand be a high-level interface passing data such as price and DR event signals or meter usage data to be interpreted by the customer facility, or it may on the other hand be a low-level device interface which commands device operation based on the grid-side operational needs. In the first case, the interface is more abstract, with information communicated to enable any user devices, systems, or sub-systems within home or building to take actions. In the second case the interface is at the system or device level and may expose specific controls[5]. The kind of interface is determined by the specific requirements. In order to promote customer choice, scalability, flexibility and security, it is better in general to have a higher-level interaction.

In practice, the SGUI will be one interface within a hierarchy consisting of potentially multiple interfaces which may include aggregation, both inside and outside of the customer facility. Implementations will have variations arising from complex system inter-relationships: diverse customer business and usage models with different types of equipment in different types of customer facilities controlled by a range of energy management systems.

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4 The ISO/IEC 15045 series [3] specifies options for gateway features that extend beyond communications protocol translation between a wide area network and a local area network.

5 ISO/IEC 15067-3 [4] specifies these levels of interaction including the “abstract” level where price or event data are sent to a local Energy Management Agent that interacts with local devices.