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TECHNICAL SPECIFICATION

Household and similar electrical appliances – Specifying smart capabilities, of appliances and devices – General aspects

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SPECIFYING SMART CAPABILITIES, OF APPLIANCES AND DEVICES– GENERAL ASPECTS

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62950, which is a technical specification, has been prepared by Working Group 15: Connection of household appliances to smart grids and appliances interaction, of IEC technical committee 59: Performance of household and similar electrical appliances.

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

Enquiry draft	Report on voting
59/666/DTS	59/673/RVDTS

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

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

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

• reconfirmed,

• withdrawn,

• replaced by a revised edition, or

• amended.

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

INTRODUCTION

Technologies related to "smart grids" have been emerging for some time, for a range of reasons, including the need to reduce greenhouse gas emissions, utilise renewable energy resources and increase the overall resilience and efficiency of the electricity supply system as a whole. The electricity usage of the residential sector, especially household appliances, is a significant contributor to total energy consumption and peak demand. At the same time, consumers expect that innovations in the field of information technology will enhance user experiences in the context of "smart" home systems and "smart" appliances.

IEC TC 59 has considered the needs of the appliance market from a technology point of view and has identified products that will benefit from the potential for state-of-the-art technologies to add smart capabilities to household appliances, different architectures that may give rise to smart capabilities at a system-wide level, and the available protocols to control smart capabilities in household appliances and other devices.

This Technical Specification is intended to develop:

- a common architecture to apply to different use cases and to a wide range of appliance and product types, both inside and outside the scope of IEC TC59 (in this document where the term 'device' is used, it covers both appliances and products outside the scope of TC59); and

- the principles of defining and measuring smart operating modes and performance within the context of the common architecture.

The use cases considered in this document relate to the consumption (and possible discharge to the grid) of electrical energy, but future revisions of this document may not be limited to these aspects.

Appliances that are capable of exchanging information with each other, with the electricity grid and with other agents, and capable of altering their behaviour because of those interactions, are sometimes called "smart appliances". While it is not the task of this Technical Specification to define what constitutes a "smart appliance" in all circumstances, it is however possible to describe and test specific capabilities and modes of operation. Therefore, in this document, the term "smart" is used in conjunction with other terms (as in "smart appliance") in a limited sense, to describe an appliance or other product with the specific capabilities described.

A major driver for building-in such capabilities is to increase the overall resilience and economic efficiency of the electricity supply system as a whole, and its ability to accommodate more variable and distributed sources of generation (especially renewables).[1]

There are several possible approaches to describing smart capabilities and smart operation:

1) in relation to an absolute indicator (e.g. if an appliance can pass a series of tests it may be described as "smart") – this is analogous to meeting a minimum energy performance standard;

2) on a comparative scale (e.g. one appliance may be "smarter" than another) – this is more difficult to demonstrate because it may require essentially subjective judgements of the relative importance of different criteria and different smart operating modes;

3) in terms of the trade-offs between smart capabilities and other performance criteria (e.g. an increase in energy consumption or reduction in wash performance that may occur as a result of smart operation).

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[1] It is expected that consumers will receive a share of the economic benefits created by smart appliances, but it is not the role of standards to anticipate or limit the business arrangements that might transfer such benefit to the consumer (e.g. tariff structures or cash incentive payments).

These approaches are beyond the scope of this document.

The goal of this document is to support the development of a global market for appliances with smart capabilities by:

- defining the terms associated with smart capabilities and smart operation so that appliances and devices might be described in their specific performance standards as having 'smart capabilities in accordance with IEC standard NNNNN';

- clarifying the points where information is exchanged between smart appliances and devices and the electricity grid;

- defining the smart operating modes of appliances and devices in response to specific conditions;

- describing the general conditions for testing the smart operating modes of appliances and devices; and

- supporting sub-committees within TC59, and other technical committees and standardisation bodies, to include in their product specific performance standards descriptions of relevant smart capabilities and procedures for testing them and for measuring how other aspects of appliance performance might be affected by smart operation.

This document is also intended to assist manufacturers of home energy management systems, customer energy managers and similar products, and energy utilities and other remote agents wishing to encourage user response to variable energy prices or supply situations or wishing to offer direct load control services.

Some products may be capable of responses that are rapid enough to offer frequency and voltage management services to the grid. This is not the main scope of the smart operating modes described in this document, but manufacturers are free to offer such capabilities.

As smart operation usually depends on the integration of the appliance into a larger system, issues of inter-connection and inter-operability are likely to arise. Therefore, the overall 'architecture' of the system (as defined in this document and by other standards) will need to be considered. Any departures from standard architecture should be avoided.

Since the products covered by this document are likely to be widely traded, the inclusion of smart capabilities and operating modes in specific appliance and device performance standards should be flexible with regard to the presence of other equipment (e.g. "smart metering") or specific communication pathways and protocols, as these may not be present at all locations where the product will ultimately be purchased and installed.

It is recognised that the definition and standardisation of smart capabilities is at an early stage of development, and other approaches will emerge. Standardisation bodies and technical committees are urged to document the reasons for adopting alternative or modified approaches, so that they may be taken into account in future revisions of this document.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SPECIFYING SMART CAPABILITIES, OF APPLIANCES AND DEVICES – GENERAL ASPECTS

1 Scope

This Technical Specification (TS) sets out a reference framework for defining and testing smart capabilities and smart operating modes of appliances, small scale energy supplies (SSESs) and other devices (ODs) (collectively termed 'smart devices' if they have the defined capabilities). This document does not set minimum requirements for appliances, SSESs or ODs.

This document focuses on electricity consumption but the principles and general architecture can be applied to other types of energy and other services. This document focuses on appliances, SSESs and ODs, but the principles and general architecture can also be applied to other products that are capable of being equipped with a device (energy) manager (DEM).

This document:

1) defines terms that describe the smart capabilities and smart operating modes of appliances, SSESs and ODs;

2) describes the way in which such products respond to certain standard instructions and conditions that are likely to arise in the operation of smart grids;

3) describes various approaches to measuring how the products respond in particular smart operating modes.

Although many examples are given in relation to particular product types, this document is not intended to fully describe these matters for any particular product type. This document is intended for use by IEC and other standardisation bodies who wish to address smart capabilities and smart operating modes in the performance standards for the products for which they are responsible.

The smart device architecture and configurations described in this document, as illustrated in Figure 1 and Figure 2, are intended to guide but not necessarily limit the architecture for each specific product.

This document is relevant to testing interactions between the customer energy manager (CEM) and the device energy manager (DEM) in configurations 1 and 2, insofar as they are relevant to determining the smart operation of a device. It does not cover the interactions between the DEM and a separate DEM-ready device (in configurations 2 and 3). For the time being, these interactions may be the subject of separate standards.

This document does not cover configuration 4, in which the CEM-DEM interaction cannot be externally manipulated or observed in testing. In configuration 4, only the response of the product as a whole to grid information or remote agent instructions can be tested. This is beyond the scope of this document for the time being.

NOTE: Communications methods and protocols are not within the scope of this document, but their consideration can be useful when applying this document in the development of specific product performance standards. The methods of communication are expected to be either left open, or limited to one or more existing methods and protocols, and be capable of supporting the configurations in Figure 1 and Figure 2, and the capabilities and smart operating modes in Table 1 and Table 2.

2   Normative references

There are no normative references in this document.

3   Terms, definitions and abbreviated terms

3.1   Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

* IEC Electropedia: available at http://www.electropedia.org/

* ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
activation
completion of connections, communications pathways and/or settings necessary to enable smart operation

3.1.2
appliance
electrical apparatus intended for household or similar use

EXAMPLE   Refrigerators, dishwashers, clothes washers, clothes dryers, air conditioners, water heaters, circulation pumps, etc.

Note 1 to entry: An appliance can only act as a load.

3.1.3
automatic override
termination or prevention of a period of smart operation, that is not initiated by the user or by a remote agent

3.1.4
constrain or reduce load
operation in which a smart device constrains or reduces its load while still performing its primary function

EXAMPLE 1   An air conditioner that continues to cool while limiting its electrical power to half its rated capacity.

EXAMPLE 2   A fridge freezer that defers defrost and ice-making, while continuing to maintain storage temperature within safe limits.

Note 1 to entry: The constraint or reduction can be achieved by limiting operating power, avoiding or delaying energy-intensive functions that are ancillary to the main function or by other means.

3.1.5
customer energy manager
CEM
component or set of functions with the capability to:

1)   receive and process grid information, device information and user instructions, and

2)   manage one or more smart devices.

Note 1 to entry: A CEM can be integrated with a smart device, or can be physically separate.

Note 2 to entry: A CEM manages the energy-using behaviour of a smart device. There can be other managers for other aspects of device behaviour.

Note 3 to entry: While the CEM requirements are outside the scope of this document, IEC 62746-2 provides examples.

3.1.6
defer cycle
operation in which a smart device brings forward or delays a cycle or function compared with the timing that would have occurred under user operation

Note 1 to entry: Defer cycle operation is considered "smart" if it occurs as a result of information transmitted via a CEM or DEM or if it involves trigger criteria programmed into a CEM or DEM. A deferment where the user programs an unconditional delayed start using the controls is not a smart defer cycle mode within the meaning of this document.

3.1.7
device
appliance, small scale energy supply (SSES) or other device (OD)

Note 1 to entry: A device can consist of more than one physical element.

3.1.8
DEM-ready device
device that is capable of being equipped with a DEM

3.1.9
device energy manager
DEM
component or set of functions with the capability to:

1) receive and process information from a CEM;

2) manage one appliance, SSES or other device.

Note 1 to entry: A DEM can be integrated with a CEM and/or a device or be physically separate.

Note 2 to entry: A DEM manages the energy-using behaviour of a device. There can be other managers for other aspects of device behaviour.

3.1.10
device information
information received by a CEM directly from or relating to a device

Note 1 to entry: Such information can include (but is not restricted to) the following categories:

– status (e.g. whether an appliance or OD is on or off; whether an appliance is heating, spinning etc.; whether an SSES is fully charged or generating electricity);

– electricity load (kW) or energy used over a specified period (e.g. kWh per 30 min);

– expected end time of current operating cycle or expected/programmed start/end time of the next cycle;

– expected power profile of the programme selected by the user.

3.1.11
device information transmission
operation in which a smart device communicates device information from the DEM to the CEM

Note 1 to entry: This mode can be a permanent operating mode, and can coexist with other smart operating modes.

3.1.12
device performance standard
standard that covers the performance of a device under user operation and/or under smart operation

Note 1 to entry: A device performance standard that covers smart operation can set rules for defining and testing smart operating modes for that device, and can include methods for comparing the performance of the device in smart operation with performance in user operation.

3.1.13
direct load control operation
operation in which a remote agent is able to initiate smart operation

Note 1 to entry: It is expected that the user would enter into a prior contract with a remote agent, and agree conditions and limitations on direct load control.

3.1.14
emergency off
operation in which the smart device enters off/standby mode, and which cannot be over-ridden by the user

Note 1 to entry: While in emergency off mode, the smart device should remain capable of receiving and acting on instructions from the CEM to resume user operation.

Note 2 to entry: Emergency off mode is intended for situations of major difficulty with the grid or with local electricity supply to the premises.

3.1.15
energy management gateway
EMG
access point for sending and receiving information and commands between a remote agent or other entity and a CEM

3.1.16
grid information
information received by a CEM directly from or relating to the electricity grid

Note 1 to entry: Such information can include (but is not restricted to) the following categories:

– current and future energy prices;
– current and future network constraints;
– emissions-intensity of electricity supply;
– level of renewable energy generation;
– requests or instructions for load modification;
– directly sensed information (e.g. frequency and voltage).

3.1.17
modular smart device
combination of a DEM-ready device and a DEM in which the DEM may be physically removed

3.1.18
no supply
operation in which a smart SSES does not supply energy to the grid even though user settings call for such operation.

Note 1 to entry: No supply operation can be required during periods of electricity network congestion or for the safety of those working on the network.

3.1.19
off/standby
operation in which the smart device minimises its electricity load, while still remaining capable of receiving instructions from the CEM, the user or a remote agent

Note 1 to entry: While in off/standby mode, the smart device does not perform its primary function (e.g. heating, cooling, washing, pumping) but its control circuits may remain energised.

Note 2 to entry: This mode may also be called networked standby.

3.1.20
one-way communications
arrangement where data and instructions can flow in one direction only

EXAMPLE   From the remote agent to the CEM, and from the CEM to the smart device.