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Household appliances network and grid connectivity - Part 1: General Requirements, Generic Data Modelling and Neutral Messages

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Household appliances network and grid connectivity - Part 1: General Requirements, Generic Data Modelling and Neutral Messages

Appareils domestiques connectés au réseau et réseau intelligent - Partie 1: Exigences générales, modélisation de données génériques et messages neutres génériques

Netzwerk- und Stromnetz-Konnektivität von Haushaltsgeräten - Teil 1: Allgemeine Anforderungen, allgemeine Datenmodellierung und neutrale Meldungen

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 50631-1:2017) has been prepared by the WG 7 "Smart Household Appliances" of CLC/TC 59X "Performance of household and similar electrical appliances".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2018-09-18
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2020-09-18

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Introduction

Energy management systems will more and more become necessary due to change from fossil and nuclear to renewable production and the associated decentralisation. Since an appropriate standard for a home & building maqnagement is in preparation this European Standard specifies how sets of products from multiple manufacturers are able to interoperate with Home & Building / Customer Energy Management Systems, located in a home network or in the cloud, in the most interoperable manner.

This standard focuses on interoperability of household appliances and describes the necessary control and monitoring. It defines a set of functions of household and similar electrical appliances. The functions in this standard cover next to energy-management main remote-control and – monitoring use cases.

This European Standard does not deal with safety and security requirements. Safety requirements have been set in IEC/EN 60335-x [17].

EN 50631 will provide interoperability on information exchange among various appliances in the home. The standard will be split into 4 parts:

EN 50631-1: *Household appliances network and grid connectivity — Part 1: General Requirements, Generic Data Modeling and Neutral Messages*

EN 50631-2-x: *Household appliances network and grid connectivity — Part 2: Product Specific Requirements and -Specifications*

EN 50631-3: *Household appliances network and grid connectivity — Part 3: General Test-Requirements & -Specifications*

EN 50631-4-x: *Household appliances network and grid connectivity — Part 4: Technology Specific Implementation and Test Requirements*

Data communication heavily depends on the environment of appliances. Sometimes low bitrate or energy efficient communication puts strict requirements to selected communication technologies. Therefore, popular and de facto standards had been and will be developed by the industry to fulfil such requirements. To not influence common data modeling for appliances because of such restrictions, the standardized data models and neutral message structures need to be applied to communication technologies.

This standard series therefore is intended to separate data modeling and neutral message structure from the attached communication.

Part 1 defines general requirements, generic data modeling and generic neutral messages without relation to any specific communiction technologoy or any product specific layout.

Part 2 lists and specifies product specific requirements and implementation guidance based on the generic data model and generic neutral messages.

Part 3 defines Test-Requirements and Test-Specifications.

Part 4 defines the mapping of neutral messages to examples of typical communication protocols like ZigBee, KNX, OIC, SHIP, Echonet light, Thread and so forth. These communication protocols are neither mandatory nor to be seen as complete spectrum of communication protocols. A few can be found at [6] - [13].

1 Scope

This document defines data models for Interoperable Connected Household Appliances. The data model is derived from a logical decomposition of use cases into functional blocks that themselves are realized by abstract actions on the data model itself.

2 Normative references

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

EN 60335 (all parts), *Household and similar electrical appliances – Safety*

RFC 2119, *Key words for use in RFCs to Indicate Requirement Levels,* March 1997

3 Terms, definitions and abbreviations

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

3.1
appliance
electrical apparatus intended for household or similar use

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

3.2
binding
concept for connecting functionally matching features

3.3
(standard or complex) class
set of SPINE functions used to describe a specific functionality. A class can be considered as a topic where functions are defined for. For example the SPINE class “Measurement” is a collection of SPINE functions that are used to describe measurement values

3.4
classifier
specifies whether a message serves to read, reply, write, etc.

3.5
client
role that specifies that a node uses data from a "server" or can request for change

3.6
command
functional part of a Message

3.7
complex class
SPINE class that is built up by parts of SPINE standard classes and combines them in a new, ordered way

3.8
Customer Connectivtiy Manager (CCM), see also 4.2
component or set of functions with the capability to:

1) Receive and process Grid Information, Appliance Information and User Instructions, and

2) Manage one or more Smart Appliances.

Note 1 to entry: A CCM may be integrated with a Smart Appliance, or may be physically separate.

Note 2 to entry: A CCM manages the energy-using behaviour as well as other aspects of device behaviour (e.g. setting of job status like starting, stopping, pausing, parameters like temperature, notifications...) of one or more Smart Appliances.

Note 3 to entry: in other documentation (e.g. see [4] and [5]) CCM is often called Customer Energy Manager (CEM) with a dedicated focus on energy management.

3.9
data model
definition of possible data (data structures, values) for the exchange of information (especially for communications systems)

3.10
Demand Response (DR) "EURELECTRIC Views on Demand-Side Participation" [5]
Demand Response (DR) 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

3.11
Demand Side Management (DSM), see "EURELECTRIC Views on Demand-Side Participation" [5]
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

3.12
device (specific node)
SPINE node that can include a set of entities. It has a "deviceType". With regards to the hierarchy of SPINE nodes a device is a root node for all functionalities offered by a device

3.13
"device" (address information)
SPINE address part for the (physical) device

3.14
Device Connectivity Manager (DCM), see also 4.2
component or set of functions with the capability to:

1) Receive and process information from a CCM,

2) Manage one appliance.

Note 1 to entry: A DCM may be integrated with an Appliance or be physically separate.

Note 2 to entry: A DCM enables an Appliance to become a Smart Appliance. It enables communication with a CCM. Thus, DCM and Appliance manage the behaviour of a Smart Appliance.

3.15
devicetype
specific type of physical device (e.g. "WashingMachine", "HeatPump", "FridgeFreezer", etc.)

3.16
discovery
process of finding appropriate partners for communication. Dependent on the context this can be either finding other devices or examination of a device's potential functionalities

3.17
element
item (or "attribute") of a SPINE function. Holds one information (e.g. "timestamp", "value", etc.) or contains further sub-elements

3.18
entity (specific node)
SPINE node that can include a set of (sub-)entities or features. It has an "entityType". With regards to the hierarchy of SPINE nodes an entity is a sub-element of a device

3.19
"entity" (address information)
SPINE address part for the (logical) entity

3.20
EntityType
specific type of logical device (e.g. "Freezer" is one logical part of a physical device "FridgeFreezer")

3.21
feature (specific node)
SPINE node that can include a set of functions (of a class). It has a "featureType". With regards to the hierarchy of SPINE nodes a feature is a sub-element (i.e. "child") of an entity

3.22
"feature" (address information)
SPINE address part for one feature

3.23
FeatureType
defines optional or mandatory rules and a general behaviour of the underlying Class (standard or complex)

3.24
function
smallest structure to model "actual data" ("functional data"). I.e. functions usually consist of child elements that each hold an information (e.g. "timestamp", "value", etc.). Information between communication partners is exchanged via the exchange of a function (as part of a so-called "payload")

3.25
header
SPINE Header, including elements for addressing, unique identification of messages, timestamp, etc

3.26
grid information
information received by a CCM directly from or relating to the electricity grid

Note 1 to entry: Such information may 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).

3.27
JWG (Joint Working Group)
Joint working Group Use Cases & Requirements is a working group under the roof of IEC TC57 WG21. It is a cross functional working group and develops Smart Grid and Smart Home&Building related user stories and use cases. See IEC TR 62746-2:2015 Use cases & requirements [2]

3.28
manual operation
operation of a Device under direct user control

Note 1 to entry: Includes operation under the influence of remote controls provided with the appliance or device.

Note 2 to entry: A Smart Device may default to Normal User Operation if the DCM is inactive, deactivated or removed.

3.29
manual over-ride
return to Normal User Operation that terminates or prevents a period of Smart Operation, that is initiated by the User

3.30
message
one SPINE transfer from a sender to a receiver

3.31
(XML) namespace
XML namespaces provide a simple method for qualifying element and attribute names used in XML documents by associating them with namespaces identified by URI references (source: www.w3.org)

3.32
neutral message
information exchange that is independent of any specific communication solution. Part 4 (EN 50631-4) describes the mapping of neutral messages to examples of typical communication protocols

3.33
node
common term for a SPINE instance that has a SPINE address. Dependent on the situation a node can be either a device or an entity (of a specific device) or a feature (of a specific device-entity)

3.34
payload
SPINE Payload, containing the functional SPINE data

3.35
power profile
any combination of one or more Power sequences over a specified time

3.36
power sequence
one or more Power slots of one entity. The power slots are executed in sequence. A power sequence reflects typically the power behaviour of an entity's process or program (e.g. washing program)

3.37
power slot
single step of a Power sequence. Each power slot is modelled with at least one constant power value for its duration

3.38
role
each Feature has a functional role, usually either "server" (data owner) or "client". For some special features (NodeManagement, e.g.) the role "special" is defined

3.39
scope (Type)
some feature types define scope types for identifying specific functionalities unambiguously (e.g. outsideAirTemperature)

3.40
server
role that specifies that a node offers own data to be read or written by a node with role client. A server can notify its data to other nodes (with role client)

3.41
smart appliance
appliance that:

1) incorporates or has been equipped with a DCM; and
2) is capable of Smart Operation.

Notwithstanding the possibly broader concept related to the term "smart appliance", a smart appliance under the framework of this standard needs to be understood as follows:

1) It is an appliance that is able to respond to an external stimulus initiated by a CCM and/or Remote Agent to provide activities amongst others like
    a. energy related demand response (supporting flexibility) or demand side management (adaptation of load)
    b. job status related functions like starting, stopping, pausing,
    c. content or level related functions like temperature, doorstatus,
2) The appliance will respond when user set conditions, and its status allow for a response,
3) The response is a change of the appliance's behavior like electricity consumption, job status and/or level or content pattern or a notification of,
4) The specific technical smart capabilities do not need to be activated when the product is placed on the market; the activation can be done at a later point of time by the consumer or a service provider.

Smart appliances in this context are able to communicate through a Customer Connectivity Manager (CCM) function processing external signals such as price information or Renewable Energy Sources availability (demand response) or direct control signals (demand side management), being able to take into account households' preferences or the behavior of the other home appliances.

Note 1 to entry: This definition is required for consistency with the logical architecture illustrated in 4.2. It is consistent with the definition in ISO/IEC 15067-3, “Smart Appliance - home appliance that exchanges command and control data with other units on a home area network” in that the presence of a DCM is taken to indicate the presence of such a capability.

3.42
smart operation
operation of an Appliance where the CCM or DCM has been set to modify operation automatically in response to Trigger Criteria

Note 1 to entry: Smart operation may be initiated by a CCM or a DCM. The trigger criteria for Smart Operation.

3.43
SpecificUsage
Specific usage of a functionality defined by a FeatureType (for example for a FeatureType “Measurement” the specific usage could be “Temperature”)

3.44
SPINE
Smart **P**remises **I**nteroperable **N**eutral-message **E**xchange

3.45
SPINE Data Model
SPINE Data Model describes the concepts and data model to ensure information exchange between devices like Smart Appliance and CCM, comprising

1) SPINE Protocol, defining a neutral message structure and neutral message exchange

2) SPINE Feature Types, describing the specific information to be exchanged

3.46
Standard Class
all basic/standard functions are defined in standard classes. Functions of standard classes follow very simple patterns and do not have deeply nested data structures

3.47
subscription
enables the receiving of messages of interest from another device without polling it

3.48
Use case
textual description of a re-usable functionality consisting of one or more messages of one or more participating actors. May be visualized with a sequence diagram. E.g. "A CCM shifts the energy usage of a washing machine."

3.49
Use Case Functions
Use Case Functions group basic functionalities that had been derived from use cases. These functions provide the entire information exchange required to implement the considered use cases and user stories

3.50
User story
complete (but specific) business case described from the perspective of a user. Can be separated into several use cases. E.g. "The user wants to get the laundry done by 8:00pm."