ISO/IEC 15067-3-3

Edition 1.0 2019-10

# INTERNATIONAL STANDARD

colour inside

## Information technology – Home electronic system (HES) application model – Part 3-3: Model of a system of interacting energy management agents (EMAs) for demand-response energy management



ISO/IEC 15067-3-3:2019-10(en)

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# INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) APPLICATION MODEL – Part 3-3: Model of a system of interacting energy management agents (EMAs) for demand-response energy management

## FOREWORD

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International Standard ISO/IEC 15067-3-3 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 15067 series, under the general title *Information technology – Home electronic system (HES) application model*, can be found on the IEC and ISO websites.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| JTC1-SC25/2899/FDIS | JTC1-SC25/2907/RVD |

Full information on the voting for the approval of this standard 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.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

# INTRODUCTION

This document specifies a high-level model of interacting energy management agents (EMAs). These EMAs provide automated demand-response services in a residential community or a building consisting of multiple apartments. This document extends the energy services for residential homes specified in ISO/IEC 15067-3.

Interacting EMAs provide coordination among EMAs to offer improved energy management and overall efficiency. Each EMA enables the allocation of energy among appliances and switching energy sources from grid to local generation or storage according to consumer preferences. This document specifies the structure and interfaces among EMAs. In this model, EMAs may have a hierarchical interacting structure and/or mesh interacting structure. One EMA connected to the home area network controls and coordinates with other EMAs connected to other home area networks or with supplemental EMAs in the cloud.

Typical smart energy services may include integrated energy management for multiple energy systems, energy sharing and trading within the community, energy information sharing for more efficient energy usage, etc. These energy services offer benefits in electrical energy management.

The intent of these models is to accommodate flexible and efficient energy management. Interacting EMAs enable the allocation of energy among houses in a community and appliances within houses, and the choice of energy supplies from local and/or external sources. External sources may be public utilities or other suppliers. Local sources may include local power generators and storage devices. Distributed EMAs extend these capabilities to an environment with multiple houses and apartments.



Based on this model, a specification of a mechanism for interoperability among EMA products from different manufacturers will be proposed as an additional subpart of ISO/IEC 15067.

# INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) APPLICATION MODEL –

# Part 3-3: Model of a system of interacting energy management agents (EMAs) for demand-response energy management

## 1 Scope

This part of ISO/IEC 15067 specifies a high-level architecture and a set of models for a demand-response energy management system with multiple interacting EMAs in a home or community housing (such as one or more apartment buildings or a campus of houses). These models specify the structure among multiple EMAs, which can be arranged in a mesh or hierarchical structure. This document builds upon ISO/IEC 15067-3.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.



ISO/IEC 15067-3:2012, *Information technology – Home electronic system (HES) application model – Part 3: Model of a demand-response energy management system for HES*



## 3 Terms, definitions and abbreviations

### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 15067-3:2012 and the following 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**
**client EMA**
EMA that acts as a client to another EMA

**3.1.2**
**service provider**
business that provides demand-response services as specified in ISO/IEC 15067-3

**3.1.3**
**distributed energy resources**
**DER**
energy generation and storage resources possibly supplied by non-utilities and customers

Note 1 to entry: As used in this document, this term applies to resources inside a home or building.

**3.1.4**
**energy management agent**
**EMA**
set of control functions that manage energy consumption as an agent for the customer

Note 1 to entry: An energy management agent (EMA) is specified in ISO/IEC 15067-3.

**3.1.5**
**HES gateway**
residential gateway that conforms to ISO/IEC 15045-1 and ISO/IEC 15045-2

**3.1.6**
**residential community**
one or more multi-dwelling buildings or housing units for the purpose of residence

Note 1 to entry: A typical residential community is an apartment building. The residential community may contain a public common use area with a community energy system and a private use area in homes, each with an HES energy system.

**3.1.7**
**server EMA**
EMA that acts as a server to other EMAs

**3.1.8**
**smart energy management appliance**
home appliance equipped with built-in energy management agent components that provide energy management capabilities for demand-response



**3.1.9**
**supplemental EMA**
EMA located outside of the home or building



### 3.2 Abbreviations

| | |
|---|---|
| iEMA | interacting energy management agent |
| EMA | energy management agent |
| EV | electric vehicle |
| DER | distributed energy resources |
| DR | demand reponse |
| HAN | home area network |
| HES | home electronic system |
| ID | identity |
| SP | service provider |
| SSL | secure sockets layer |
| TV | television |
| WAN | wide area network |

## 4 Conformance

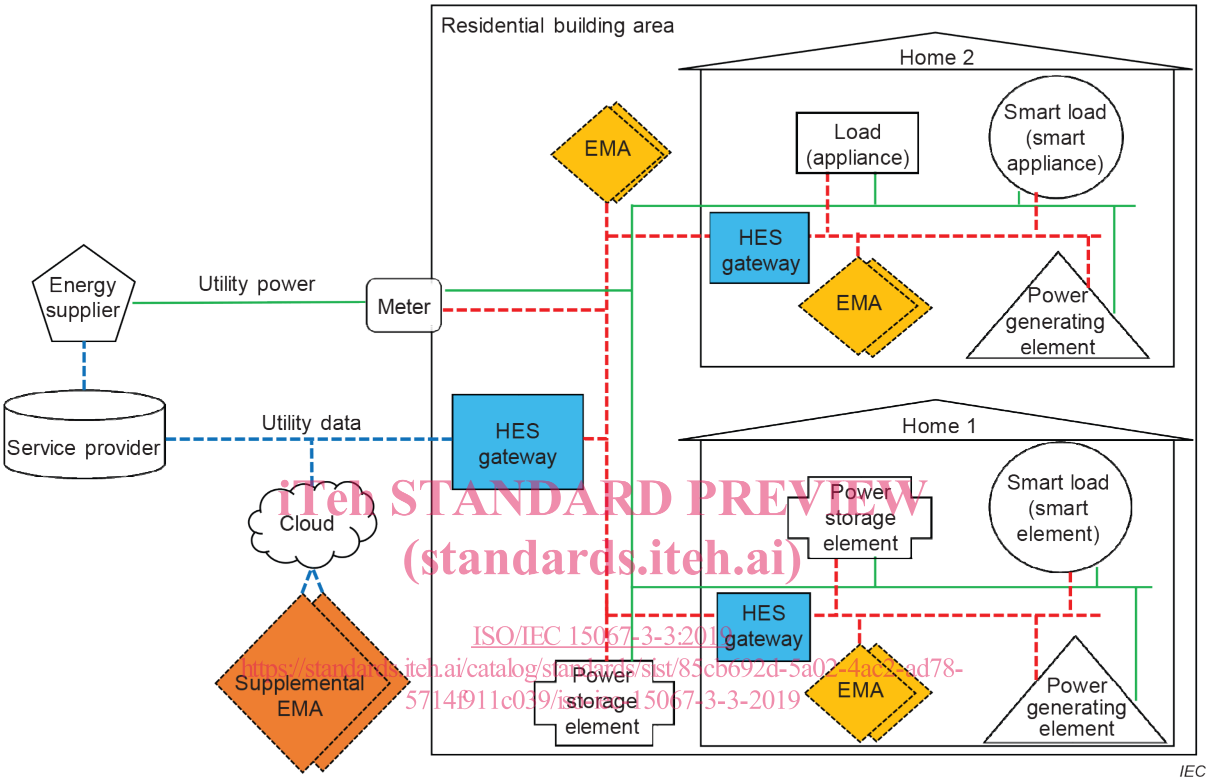
Implementations of an energy management system with multiple EMAs shall conform to one of the two logical models specified in Clause 5. The chosen model shall conform to one of the two topology models specified in Clause 6.

If there is a supplemental EMA in the cloud, all data flowing into the residential community from the supplemental EMA and/or from the residential community into the supplemental EMA shall pass through an HES gateway located in a residence or serving the entire community.

# 5 Energy management agent for home or residential community

## 5.1 Overview for home or residential community

Figure 1 shows an example of a physical energy management system in a single community domain that includes multiple private residential homes and common spaces in a residential community. In some cases, one or more EMAs may be physically located in a home and one or more supplemental EMAs in a cloud.






NOTE 1 The HAN networks are shown with a dashed line in red; the WAN network is shown with a dashed line in blue; the power line is shown in solid green.

NOTE 2 The shapes within Figure 1 are explained in 5.2.

**Figure 1 – Example of an energy management system in a building with two homes**

The configuration shown in Figure 1 consists of multiple interacting EMAs in the homes and supplemental EMAs in the cloud for two reasons.

1) One reason is that it may be advantageous to assign responsibilities for a subset of appliances to different EMAs within one home. For example, one EMA may be assigned to a washing machine, refrigerator and TV, another EMA assigned for lighting, heating and air-conditioning, and another EMA assigned to electric vehicles, local power generators and storage devices.
2) The other reason is that EMAs may coordinate energy management among multiple homes within a residential community to optimize desired parameters, such as cost and comfort.

## 5.2 System architecture for an energy management system with multiple EMAs

ISO/IEC 15067–3:2012, 5.1 introduces the HES energy management model. The model shows the system architecture and interrelationship among the elements.

This document extends ISO/IEC 15067-3 for installation of multiple EMAs within a house, multiple houses in a community, an apartment building or a campus of apartment buildings.

Figure 2 shows the extended model of a home or a community energy management system with multiple EMAs. The system may be extended to manage multiple EMAs in a home and supplemental EMAs in the cloud.

At least one EMA is located on a home area network. Supplemental EMAs may be located in the cloud.

The models specified in this document are organized into one of the following topologies:

- local EMA topology model (multiple EMAs within a home);
- hybrid EMA topology model (multiple EMAs in the home and supplemental EMAs in the cloud).

Figure 2 shows the system architecture and interrelationship among the elements. The framework is very similar to the HES model using an EMA. Within this figure, the rectangle box in blue represents the HES gateway. The circles represent power-using smart appliances that can communicate via a home area network (HAN). The rectangular shapes represent appliances that are not able to communicate. The octagonal shape represents a power conversion device. The cross shapes represent power storage devices. The triangle shapes represent DER power-generating devices. The rectangle with a curved corner represents the utility elements such as a meter. The diamond shape represents the controller element (e.g. EMA, sensor or DR switch). The pentagon shape represents the energy supplier, such as the utility, transmitters, and distributors.

NOTE Elements of the HES model are specified in ISO/IEC 15067-3.



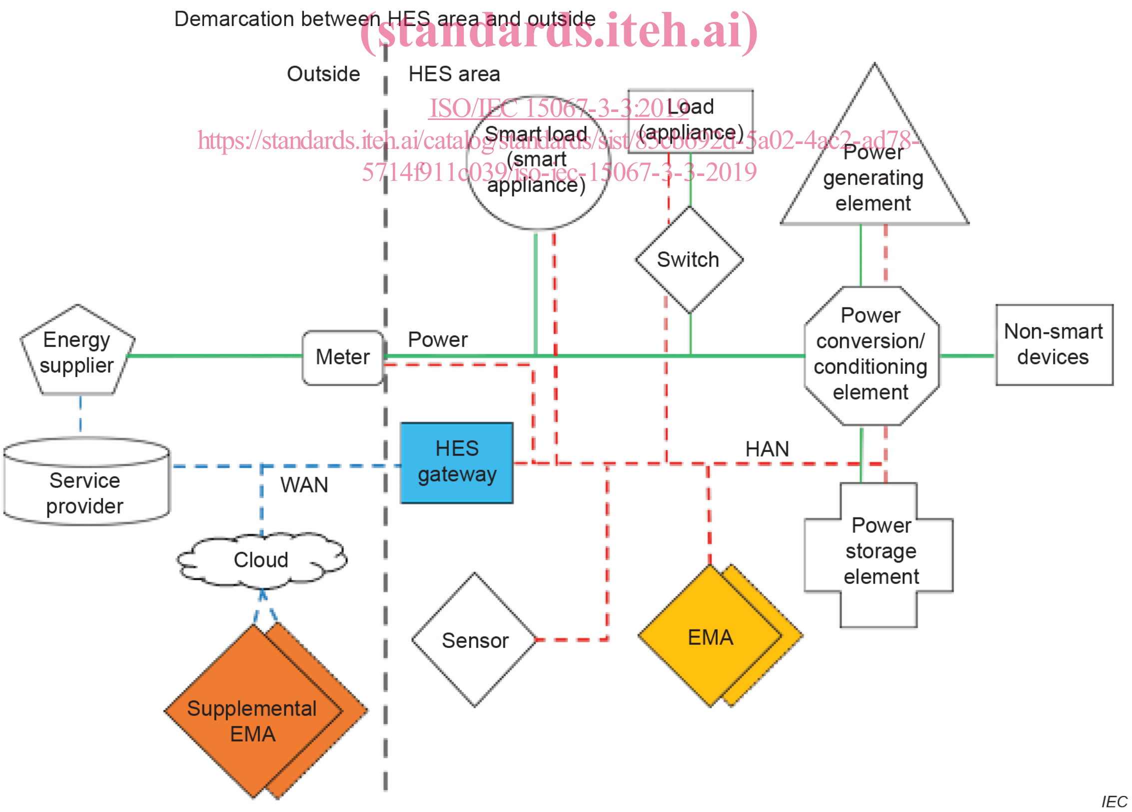



**Figure 2 – System architecture of an energy management system for a home with multiple EMAs**

### 5.3 Interacting energy management agents

ISO/IEC 15067–3:2012, 6.3.1 introduces the EMA. The EMA enables the allocation of limited energy (or a limited budget for energy) among appliances or the switching of energy sources from local generation or battery according to consumer preferences.

The EMA functions are extended from ISO/IEC 15067-3 to support multiple EMAs. An EMA allocates energy for appliances in the corresponding service area. The EMA can be extended to interact with other EMAs in different locations to optimize energy consumption and generation. The EMA performs specialized interacting functions by applying complex algorithms to exchange data among EMAs and devices, for example, for energy consumption targets, cost of energy, usage data, and budget for appliances, distributed energy resources (DER), and EMAs under the management of the community.

There are two options for the design of interacting functions among EMAs: hierarchical interacting design and mesh interacting design. In a hierarchical interacting design a centralized EMA coordinates and allocates energy consumption and generation among multiple EMAs in different locations. Among multiple EMAs within a domain, one becomes a server and the others remain clients in a distributed architecture. The server EMA provides demand-response optimization through the interaction of multiple client EMAs. The server and client EMAs are technically the same except for the logical relationships. A server or client EMA may supervise energy allocation among devices with or without an intervening EMA.

In a mesh interacting design, each EMA allocates energy consumption of appliances in the corresponding service area. Each EMA includes an algorithm to manage energy. EMAs are able to co-operate autonomously and interact with each other to optimize control. For instance, the optimization can be done by controlling the operation of smart appliances, local power generators and storage devices via interactions with other EMAs. To support these interactions, each EMA provides a common communications interface.



Figure 3 shows the model of hierarchical interacting EMAs, where EMAs can be divided into two types: the server EMA and the client EMA. The server EMA for energy management included in Figure 3 is a specialized controller that coordinates and allocates energy consumption and generation among multiple client EMAs. The client EMA enables the allocation of energy among smart appliances by switching energy sources from grid to local generation or modifying the operation of energy sources.

Figure 4 shows the model of mesh interacting EMAs, where each EMA can be a server EMA as well as a client EMA. The EMA interacts with other EMAs to coordinate energy consumption and generation.

Figure 5 shows a combination of hierarchical interacting and mesh interacting approaches to coordinate energy consumption among EMAs and/or to allocate energy consumption of smart energy management appliances.