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Edition 1.0 2016-04

INTERNATIONAL STANDARD

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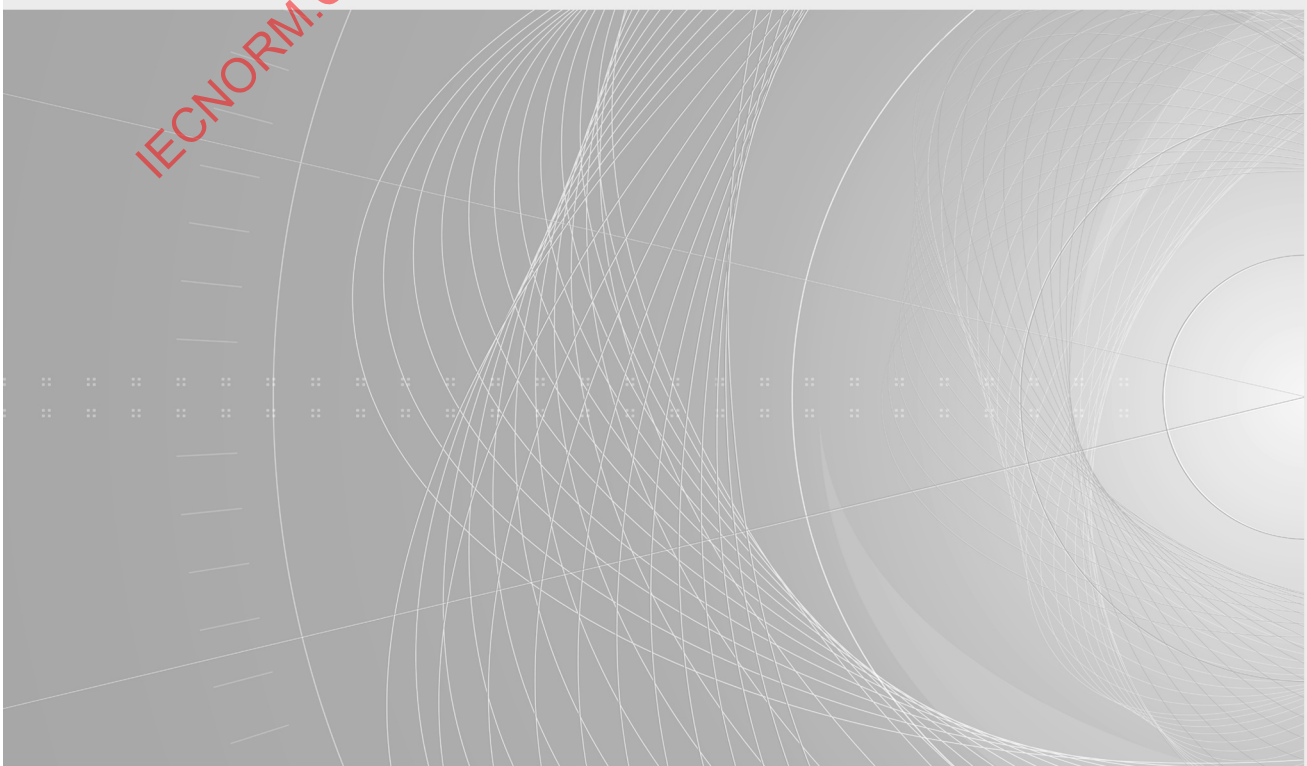
Information technology – Home network resource management – Part 1: Requirements



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INTERNATIONAL STANDARD

Information technology – Home network resource management – Part 1: Requirements

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INFORMATION TECHNOLOGY – HOME NETWORK RESOURCE MANAGEMENT –

Part 1: Requirements

FOREWORD

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International Standard ISO/IEC 30100-1 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

A list of all parts in the ISO/IEC 30100 series, published under the general title *Information technology – Home network resource management*, can be found on the IEC website.

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.

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

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INTRODUCTION

Products and services based on a variety of technologies are being installed and connected to existing home networks. Figure 1 illustrates the range of products being adapted to home networks: broadband, low power and high computing processors, reliable networking technology, high quality content services, e-health care, sensing technology, smart grid and robotics technology. These devices, providing a diversity of services and functions, may co-exist on a home network. Such a home network may need to support a multi-protocol environment. Some of these network protocols are based on standards and others use industry-developed specifications. In spite of this complex technology, users want simple, uniform and transparent services from all home network entities.

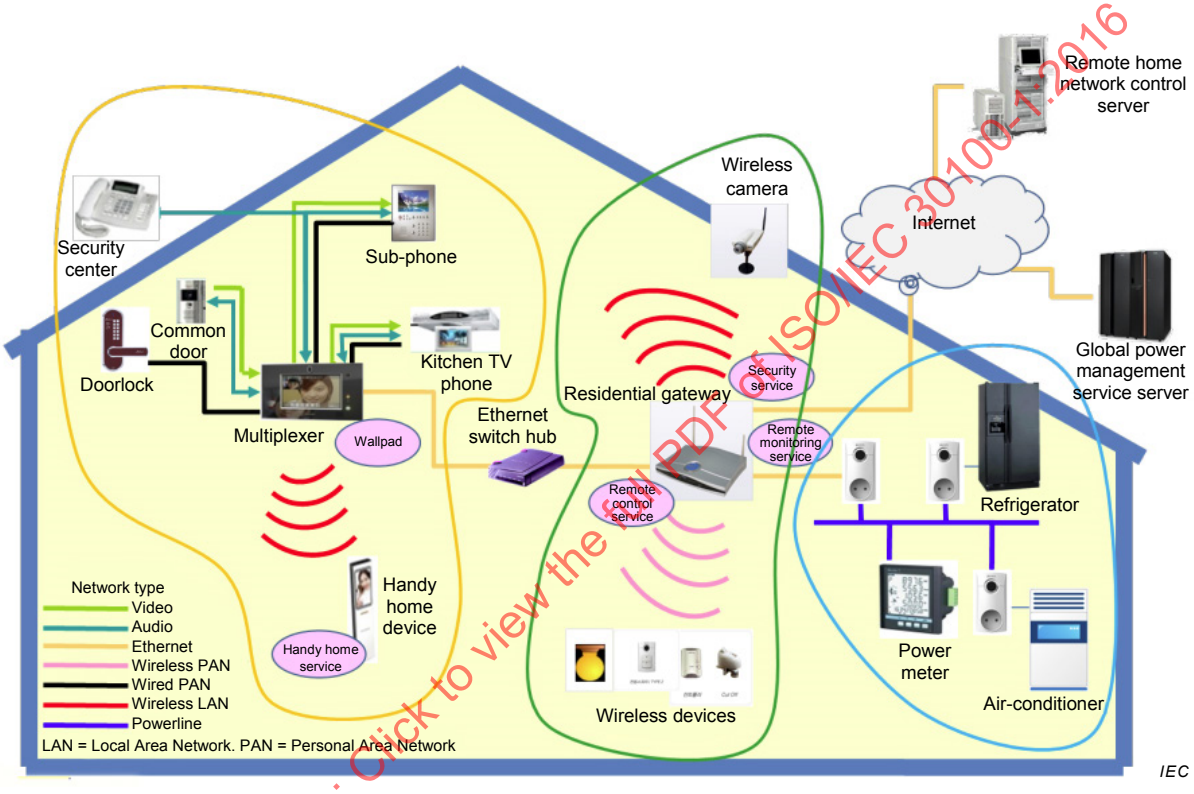

Figure 1 – Some examples of home networking devices and services

Interoperability among devices complying with these protocols is essential. The ISO/IEC 18012 series addresses product interoperability. The ISO/IEC 30100 series extends interoperability to the management of network resources. These management services may support fault diagnosis and remote management, and thus require that all available information be integrated. For example, when an audio/video (AV) streaming service has a problem, a diagnostic program should check all related information for the service plus the usage status of physical devices, network connectivity and traffic condition. The collection of this information may involve multiple information types and multiple protocols within each information type. Since home network information is collected and maintained independently for each data type and each protocol, it is very difficult to get access to all required data and to determine the relationship among various data types and protocols. This standard specifies a method for automatically maintaining information about HES entities poly-synthetically. This information provides the precise status of all available home network entities enabling the delivery of intelligent management services.

The ISO/IEC 30100 series of standards specifies an abstract model that accesses and manages home network information for various home network services including remote management and fault diagnosis. To handle different types of information, HES abstracts all HES elements as logical resources and provides a uniform architectural management method for them. Basic resource information for HES is defined as a collection of physical space,

devices, network and service, with optional extensions. The ISO/IEC 30100 series defines an interface to collect this information from all data types and protocols, and to abstract it as logical resource information. The series defines a relationship among the elements of this information. It also provides a uniform interface for representing this information and the relationship among all HES entities. This enables the development of various home network services including remote maintenance and fault diagnosis in multi-domain and multi-protocol home network environments.

This standard specifies the requirements for home resource management to support applications that may span multiple different HESs. Home resource management allows uniform fault processing, diagnostics and configuration management of HES elements in a home environment. This standard

- defines home resources to key elements of a home network such as device, network, service and so on,
- specifies an information model of the relationship among home resources,
- specifies management application procedures based on an information resource model with home resources, and
- specifies privacy methods for network management data to avoid releasing personal user data to external networks.

This standard specifies requirements for a home network resource management model. This standard defines new terminology for home resources (abstraction of device, network, service and location) on a home area network. It also specifies the general information model and relationship among home resources.

There are some standards that include management functions. However, it is impossible to discover, monitor, detect, diagnose, recover and configure all functions across a variety of protocols that may be used with a home network. Even if a service administrator could access a home network remotely, it would be difficult to manage problems. The ISO/IEC 30100 series enables the management of an entire home network without an administrator or technician.

Security and privacy protection should be considered when a user applies this standard. Countermeasures are needed to protect the security and privacy of information from home devices. The management of use cases corresponding to application categories is specified. Therefore, when implementing this standard, security standards and regulations should be applied. Also, some applications such as health data require higher levels of security and/or privacy than others (i.e. control systems). The ISO/IEC 30100 series of standards provides XML schemas as “generic data” that require some methods for security and privacy.

NOTE Some examples of security/privacy requirements are provided in NIST Interagency Report 7628 (smart grids), HIPAA law (health), PCI-DSS (Credit card) and the OECD Guidelines on the protection of privacy and transborder flows of personal data.

INFORMATION TECHNOLOGY – HOME NETWORK RESOURCE MANAGEMENT –

Part 1: Requirements

1 Scope

This part of ISO/IEC 30100 specifies the minimum requirements of a home network resource management architecture to deliver applications in a safe and future-proof way without being prescriptive. The purpose of this standard is to collect all available home network information from different types of home network elements and protocols, and to provide the inter-relationships among the elements of this information. This standard also describes user requirements and functional requirements for the management of home network entities as a resource.

This part of ISO/IEC 30100 specifies management requirements with respect to

- device management
- network topology
- auto-configuration
- device diagnosis and
- software management
- defines resources of a home network such as devices, networks and services,
- specifies an information model of the relationship among home network resources and
- specifies management application procedures based on a home resource model.

This standard defines new terminology and specifies a general information model and relationships for resources (abstraction of device, network, service and location) in the home area network.

This standard specifies how a home resource management system defines, organises, diagnoses, manages and combines these resources. This standard does not specify what kind of resources will be defined.

The architecture of this standard is targeted for generic usage. Countermeasures are needed to protect the security and privacy of information from home devices. For example, there are laws and regulations for smart grids, health care, credit card solutions, etc. Corresponding security and privacy policies are needed for each application. A suitable data structure (XML schema) for security policies is needed in each usage category.

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.

ISO/IEC 30100-2:2016, *Information technology – Home network resource management – Part 2: Architecture*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
application
field of use of home resource management process

3.1.2
device
distinct physical unit on a network that performs a (set of) specific function(s) in a particular context

Note 1 to entry: A device can either be an end node on the network or an intermediate node (as in the case of a network gateway device connecting two distinct physical networks).

3.1.3
HES entity
logical component that has a defined functionality in the HES architecture

Note 1 to entry: The HES architecture is specified in ISO/IEC 14543-2-1.

3.1.4
home resource
managed object that can be used for home network services

3.1.5
home resource management process
element that performs information processing for a particular management application

3.1.6
home resource model
abstract, formal representation of resource objects in a home environment

Note 1 to entry: Resource objects include resource properties, relationships and the operations that can be performed on them.

3.1.7
network
distinct interconnection of devices that share a single physical layer implementation in terms of the OSI layered network model

3.1.8
object
abstract element representing device functions and data stored within the device

Note 1 to entry: The functions and data contained within an object (referred to as "properties") can be executed, read or modified as appropriate for the property by "messages" sent from other objects. A message causes a "method" within the object to be invoked. This may result in access to an internal data structure or the execution of a subroutine or both. A value may be returned by the recipient object.

3.1.9
service
field of use of an HES

3.2 Abbreviations

ACN	Architecture for Control Networks
ACS	Auto-Configuration Service
AECOO	Architecture, Engineering, Construction, Owner and Operations
AFM	Automatic Fault Management
BIM	Building Information Model
CAD	Computer-Aided Design
ConnMo	Connectivity Management objects
DM	Device Management
CPE	Customer Premises Equipment
FUMO	Firmware Update Management Object
HES	Home Electronic System
HAN	Home Area Network
IFC	Industry Foundation Class
IP	Internet Protocol
LLTD	Link Layer Topology Discovery
OMA DM	Open Mobile Alliance Device Management
OSGi	Open Service Gateway initiative
PLC	Power Line Carrier
RDM	Remote Device Management
RDP	Remote Desktop Protocol
RM	Remote Management
RMP	Remote Management Protocol
SCOMO	Software COmponent Management Object
SNMP	Simple Network Management Protocol
SVC	SerVice objeCt
SyncML	Synchronisation Mark-up Language
TR-069	CPE WAN Management Protocol
UPnP DM	Universal Plug and Play Device Management

4 Conformance

In order to claim conformance to this International Standard, the network management software written for managing the home network resources specified in ISO/IEC 14543-2-1, shall meet the requirements specified in Clauses 5, 6 and 7 of this standard.

5 Usage model

5.1 Overview

The term resource management has been used to describe a variety of problem-determination procedures and fault processing, including easy configuration. The logical description of a home resource shall present descriptions of the HES entities to be managed and the relationships among them. There are a lot of standards and technologies for the management of HES in home network, as listed in Annex B. All of them focus on procedures for selected devices or networks. Instead of specifying yet another management procedure, this standard specifies the general architecture and procedure for management in a heterogeneous home network environment. This standard specifies the requirements for a logical information model for the management of the resources of an HES entity. This logical information model shall be available for management applications such as fault diagnosis and easy configuration. Network management functions may be administered locally or remotely.

5.2 Usage scenarios

5.2.1 Easy configuration of the HES entity

Because there might be no administrator or remote administrator, a method for easy configuration with remote access is enabled by implementing a network management function in an HES home network environment. This standard specifies the requirements and ISO/IEC 30100-2 specifies the architecture for this network management function. Easy configuration enables the end-user to connect the HES entity to a HAN and to specify the minimum information for required operation of the HES entity. The end-user does not need to understand specific information about the HES entity in order to configure it correctly.

5.2.2 Management of the HES

The HES entity might be complex according to the customer's service requirements. The HES resource information model requirements specified in this standard and architecture specified in ISO/IEC 30100-2 describe unambiguously how to manage an HES entity. These management functions enable improved performance compared to individual device management even if the HES entity were not configured properly during installation.

5.2.3 Smart services with the HES entity

The resource management provides a uniform model for the HES entities. This includes status and properties of HES entities. Also, when resource management is combined with device management protocols, it is possible to control and manage all HES entities. So, various smart services can be developed using the detailed information of HES entities.

5.2.4 Fault processing of the HES entity

Fault processing can be described as fault diagnostics. Fault processing shall be provided that can monitor the home environment uniformly and detect faults, status, performance and configuration of each HES entity. Because HES networks may be complex, many minor problems may arise, especially when several systems are interconnected. These situations may increase maintenance costs significantly and make fault processing the main hindrance for wide-scale home system market development.

5.2.5 Privacy protection principle

Basic privacy protection principles shall be met as specified in 6.6 by exchanging only abstract information for network management between a home and external networks. Abstract information excludes personal, family, and address data, called *personally indentifyable data*. More information about privacy principles is available in NIST IR 7628.

6 Functional requirement

6.1 Overview

ISO/IEC 18012-1 specifies the general interoperability requirements of an HES entity. However, it specifies the requirements only for HES devices. Beyond device interoperability, additional requirements including network and service information are needed for management applications. The Industry Foundation Class (IFC), ISO 16739, for the Building Information Model (BIM) is defined to describe building and home information. This information model was developed primarily for architecture, engineering and construction, and is extensible and has been extended beyond static information. However, it does not yet define control and device management information for buildings and homes.

A significant difference between this standard and BIM is the provision for dynamic updating of the information database for network resource management. For this reason this standard specifies an information database different from BIM.

Whenever problems occur in an HES entity, it is often necessary to investigate related elements other than the HES entity. For example, if an intermediate network-switching device has a problem, some attached sensor devices may not respond at all. In this case, the problem can be resolved by fixing the intermediate switching device rather than the sensor devices. Therefore, sufficient and timely information about all the home networks are required.

Figure 2 illustrates a resource management model that describes the relationship with other home network elements. The home network resource management function gathers information from various information sources (devices on the home network), converts the data as needed and maintains these data in a database of common information data. Since the home network resource management function maintains all information related to HES entities, any information needed is available and may be requested from this home network management resource rather than from each information source directly.

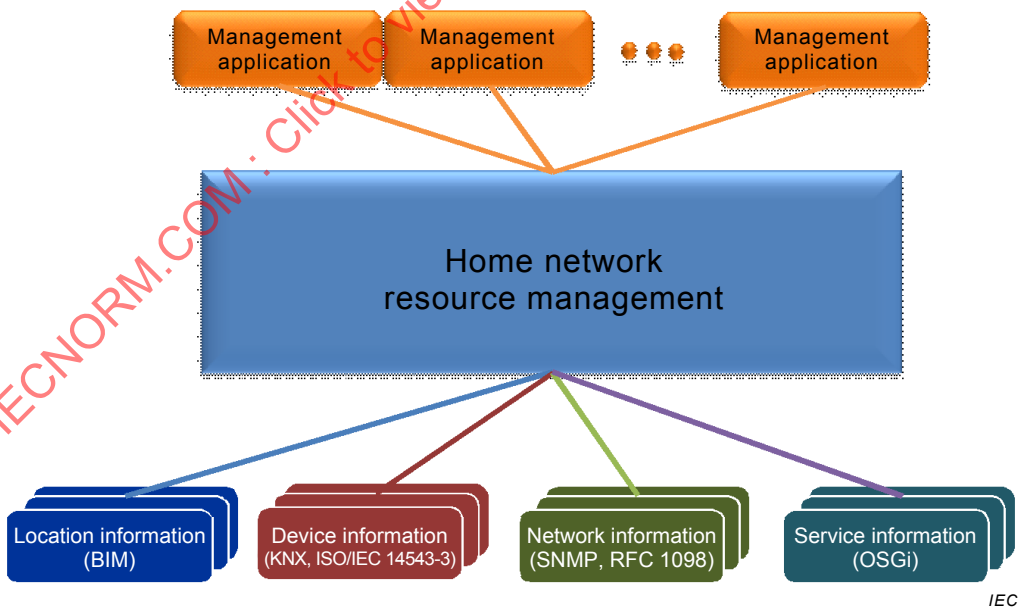

Figure 2 – Home network resource management model

NOTE The names in parentheses are examples of data in each information category. BIM is described in Annex A, KNX is specified in the ISO/IEC 14543-3 series, SNMP (Simple Network Management Protocol) is specified in RFC 1098 and OSGi is a specification for middleware for applications and services from the OSGi Alliance (www.osgi.org).

This standard specifies a general home network resource management model. This standard shall be combined with security standards and regulations as explained in ISO/IEC 30100-2. Also this model includes protection of private information of the users. Security and privacy protection shall be implemented using access control, encryption and signature data (XML schema) as specified in 5.5 of ISO/IEC 30100-2:2016.

6.2 Description of an HES entity

6.2.1 General

The model of an HES entity shall include four types of information as a minimum requirement: location, device, network and service. This information provides an HES administrator with descriptions of the HES entities and the relationships among these entities. The following Figure 3 illustrates these four types of information for a home network.

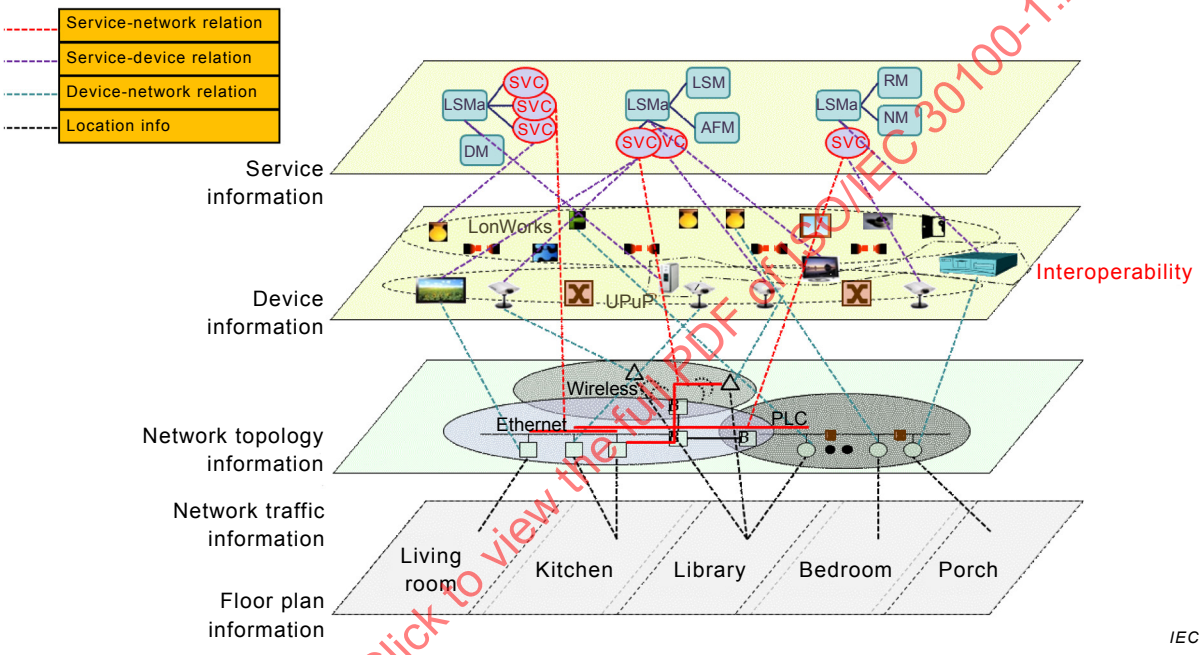

Figure 3 – Logical concept of home resource management architecture

6.2.2 Location information

The location information identifies where an HES entity is placed. Since the same types of HES entities may co-exist, but the role of each HES entity may differ based on where it is located, the physical location of an HES entity is important for control and management. The physical location may include the building number, apartment number, room number and wall identifier if necessary.

One approach to collect the HES location information is to make use of a BIM (Building Information Model, see Annex A). BIM provides the building structure information and device location based on the CAD information.

6.2.3 Device information

The information for device management, monitoring and control shall be provided. The device management information includes the device properties and basic information such as manufacturer information, device type, version, etc. The device control information includes the functions that the device provides. Also, the device status information shall be provided to check the current status of the device.

Since many types of devices may exist on home networks, interoperability shall be used for device control and management.

6.2.4 Network information

An HES may consist of multiple different types of networks. Also, there are many network devices such as hubs, access points and gateways. The topology information for each network shall be provided and the current network status information shall be collected.

The network information shall be collected by some underlying network protocols and tools such as LLTD and SNMP. These protocols are targeted for Ethernet and IP-based networks respectively. For other networks, a method for collecting network information shall be provided.

6.2.5 Service information

In a home system, many types of HES applications are available. Therefore all available service information shall be provided for the benefit of applications. To make use of these services, each service shall provide basic information such as software version, service type, etc. Also, information to configure, execute and control the services shall be provided. Finally, the service status shall be provided to monitor the status of each service.

6.3 Abstraction

Since many different types of technologies may co-exist in a home network, a home network could be very complex. The information provided by an HES entity shall be independent of the underlying technologies and platforms.

6.4 Extensibility

Device, network, services and physical information can be represented as HES entities. The customer or administrator may extend it with additional information such as a vehicle domain, Internet cloud service, a new end-user profile or other information models. The information models shall be easily extendable with other information.

6.5 Consistency

The information model shall guarantee consistency. There might be several ambiguities or inconsistent attributes describing resource models in an HES entity. This standard provides functionality to confirm the validity of the HES entity description.

6.6 Privacy protection principle

Privacy information such as individual device information shall not be sent to networks outside directly. Individual devices also shall not be controlled by control information from outside the home without any protection means including privacy. Privacy information shall be terminated in a home gateway, and shall be sent to outside networks as abstracted information as specified in 5.2.5. For this, the gateway may provide an interface to protect the privacy. The gateway privacy requirements are planned to be specified in ISO/IEC 15045-3 [1]. If the protection of internal data communications is desired, ISO/IEC 24767-2 may be applied.

The home gateway shall process all information from outside and inside the house, and shall process all these pieces of information with privacy protection means. Manual anonymous protection means shall be added to send home information to outside networks from the home network, and shall be added for a home network to receive control information from outside networks.

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1 ISO/IEC 15045-3, *Information technology – Home electronic system (HES) gateway – Part 3* (Under consideration).

7 Information model requirements

7.1 General

The home resource model is a logical information model with object descriptions. It shall support management information of HES entities. The home resource information model may be used for the management diagnostics, easy configuration and other management tasks. The home resource model is not bound to a particular technology or implementation. This flexibility allows different systems and applications to access management information.

This clause defines the requirements of:

- resource description;
- relation description;
- information description;
- management procedure to information models.

Management applications extract resource information from the home resource models of HES entities. It may also utilise additional information sources, e.g. ISO 16739 (Industry Foundation Classes) that shall act as an information source for physical resource location (floor plan). A home resource management application requires identification of home resources and an understanding the relationship among them. It can provide an optimised plan for utilisation of resources. The resource objects and their relations shall be represented using the home resource description schema specified in ISO/IEC 30100-2 that are used to export resource information to management applications. These schemas provide the actual model descriptions along with sets of classes containing properties and relations. All home resources such as devices, networks and services shall be described as resource objects.

7.2 Resource description

The resource description shall describe a fully logical object derived from HES. This requires that a resource object represents the minimum common information such as an identifier, a name and a type that can be described about the specification of the HES entity.This common information can be expended to the detailed domain-specific description (e.g. a network or service).

7.3 Relation description

The relation description shall describe a fully logical relationship among different logical objects derived from HES. This requires that a relation object has minimum common information such as an identifier, a name, a type, a source object and a list of target objects. This common information may also describe the hierarchy of relation types (e.g. how a device can be mapped to a physical domain).

7.4 Information description

The information description is used for describing external information such as weather information, energy cost, TV channel guide, etc. The information description shall describe logical information about additional information that can be combined with resource description. This information is usually defined and provided by external experts or external service providers.

7.5 Management procedure description

Management procedure means configuration and verification of the object models of HES entities. The management procedure description shall describe how the information is processed in the specified resource management architecture. This requires a processing flow that specifies the steps of object identification, object relationship mapping and relation verification. These will be defined procedures of resource management applications.

7.6 Privacy protection principle

Outgoing information from homes and incoming information from networks shall not be directly transmitted without security and privacy protection processing at a home gateway. Also, home information provided to destinations outside the home network shall be delivered using security and privacy protection, as specified in 5.5 of ISO/IEC 30100-2:2016.

Annex A
(informative)

Building information model (BIM)

A.1 General

Building information modelling is utilised especially in architecture, engineering, construction, owner and operations (AECOO) to produce digital models of construction, fabrication, procurement and maintenance activities to realise a building. BIM helps to manage the building lifecycle data, enhance building processes, decrease construction costs and manage project team members' roles and relationships (contractor, supplier, customer, legal counsellors, etc.) for example.

In general, BIMs can be characterised by:

- **Building components**, i.e. it contains entities (or objects) with data attributes and parametric rules. Building components have computer graphics representation or close association with other components.
- **Components that include data and that describe how they behave**. This enables the analysis of model behaviour such as energy efficiency, heat capacity or airflow.
- **Consistent and non-redundant data** ensures that components changed in one part of the model are updated and represented in a same way in every other view.

Because BIM is closely related to computer-aided design (CAD), it can be differentiated from a generic 3D CAD-model by inspecting the objects it is utilising. These objects are parametric objects and have the following characteristics:

- Geometrically defined and associated with data and rules.
- Geometries are non-redundant and inconsistencies are not allowed.
- Parametric rules for objects modify associated geometries within building models.
- Objects can be defined within their relative types and be utilized within their level of aggregation. Objects can be managed at any hierarchy level.
- Object rules identify when a change violates object feasibility.
- Objects have the ability to link or to receive sets of attributes to other applications and models.

BIM standardisation concentrates on the information exchange, where IFC schema or EXPRESS based information models (see the ISO 10303 series) are utilised when defining different aspects of AECOO data. ISO 16739 provides the information model for sharing data in the construction and facilities management industries. Content is currently exchanged between IFC-compliant software applications using the clear text encoding of the exchange structure, the STEP part 21 physical file (ISO 10303-21:1994) or by database access using the Standard Data Access Interface, the SDAI (ISO 10303-22:1998).

A.2 Relation between BIM and home network resource management

One important data source for HES management is BIM (Building Information Model). BIM data is utilised to understand HES physical topology information such as the location of a logical HES component in an apartment. BIM data is not modified, but only used as a source to provide required information for intelligent context aware services as well as usage scenarios explained in 5.2.

The extensibility of information domains in the case of BIM is further explained in Figure 2, which illustrates the logical concept of the home resource management with different information layers. In Figure 2 the bottom layer represents a real world building information that will be combined with service information, device information, network information etc. This will enable the resource management process to work effectively and to support the next generation of intelligent context aware services.

Annex B
(informative)

Home network management protocols

B.1 General

A home network may consist of multiple devices running a diversity of communications protocols resulting in a complex configuration. Furthermore, this configuration may be changed dynamically. There are many requirements for managing all these components (device, network, and services). Because there is no administrator (technical expert) running a home network, auto-configuration, self-recovery and remote management is needed. Many technologies could be candidates for this purpose, such as TR-069, UPnP DM, OSGi, OMA DM, RDP, SNMP and others. The capabilities and limitations of each are compared. None meet the needs of a home network management system without local expertise. The intent of the ISO/IEC 30100 series is to specify a complete network management system that functions autonomously.

B.2 TR-069 (ITU-T Recommendation G.9971)

TR-069, CPE WAN Management Protocol, is a protocol for managing a device from the Broadband Forum. This protocol is intended for communications between customer premises equipment (CPE) and an Auto-Configuration Server (ACS). The CPE wide area network (WAN) management protocol defines a mechanism that encompasses secure auto-configuration of CPE, and also incorporates other CPE management functions into a common framework. Many supplemental specifications are available to define device and protocol specifications. Through TR-069, the service provider can manage CPE devices directly, as shown in Figure B.1.

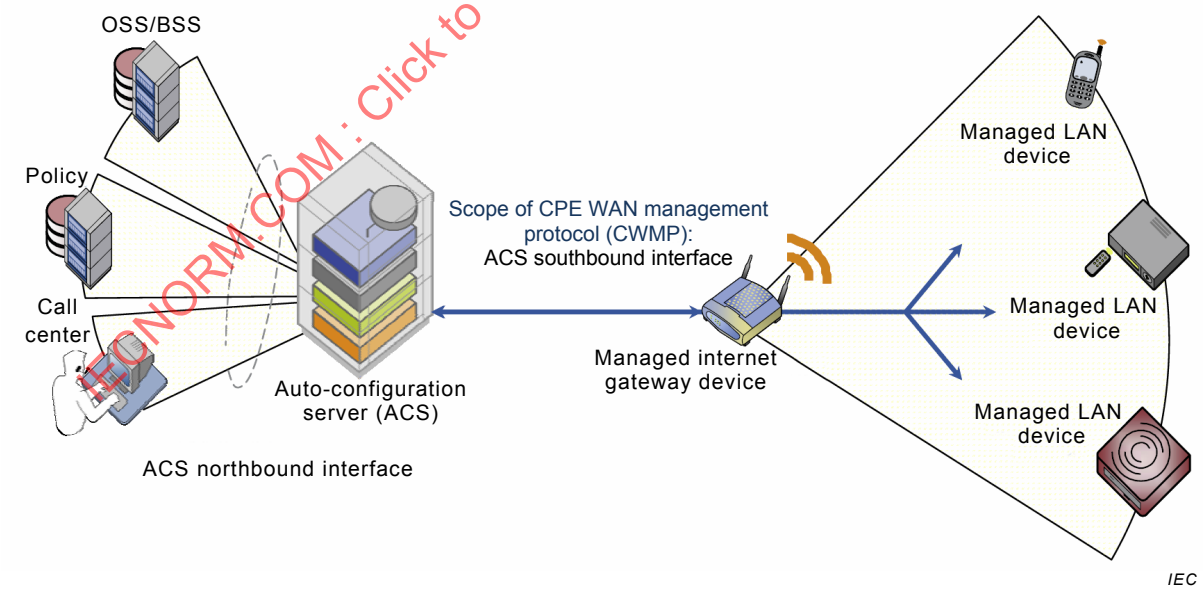


Figure B.1 – TR-069 positioned as an end-to-end architecture

B.3 UPnP DM (UPnP Device Management)

UPnP DM, is an extension of the UPnP Device Architecture. Although UPnP is a powerful standard for peer-to-peer communications, there is no management protocol. Since October

2007, device manufacturers and service providers have been defining UPnP device profiles for device management inside the UPnP Device Management (UPnP DM) Working Committee. UPnP DM also includes basic management, configuration management and software management. Figure B.2 shows the management mechanism of UPnP.

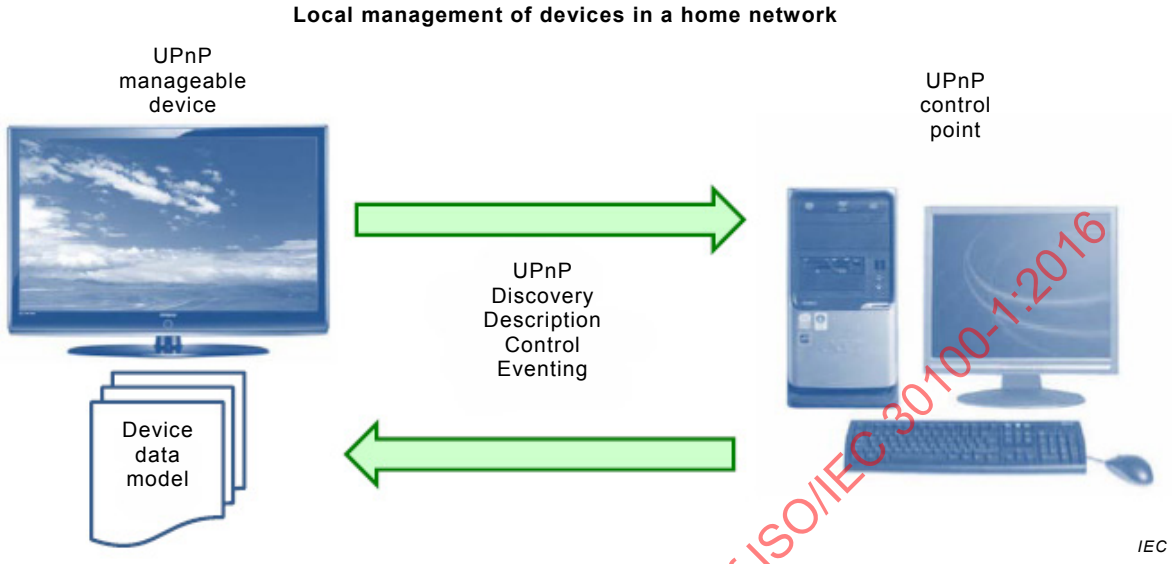


Figure B.2 – Management mechanism of UPnP

B.4 OSGi RMP (Remote Management Protocol)

OSGi, the Open Services Gateway initiative framework, is a modular system and service platform for the Java programming language that implements a complete and dynamic component model, see Figure B.3. Applications or components, commonly called *bundles*, can be remotely installed, started, stopped, updated and uninstalled without requiring a reboot. These remote management protocol specifications and APIs can be used for managing home devices.

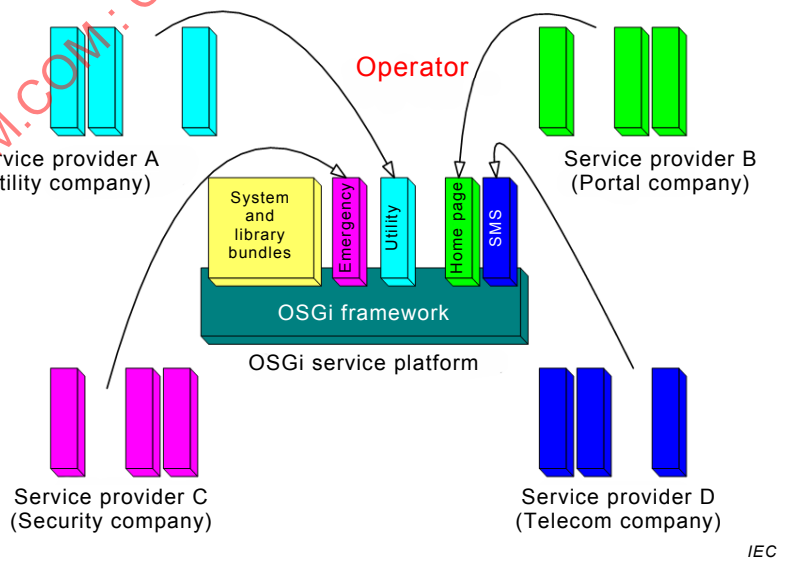


Figure B.3 – OSGi remote management protocol

B.5 OMA DM

OMA, Open Mobile Alliance, is an open specification for the mobile phone industry. The mission is to provide interoperable service enablers working across countries, operators and mobile terminals. OMA DM, OMA device management, is a device management protocol for management of small mobile devices such as mobile phones, PDAs and palm top computers. Figure B.4 shows a model of OMA DM protocol stacks.

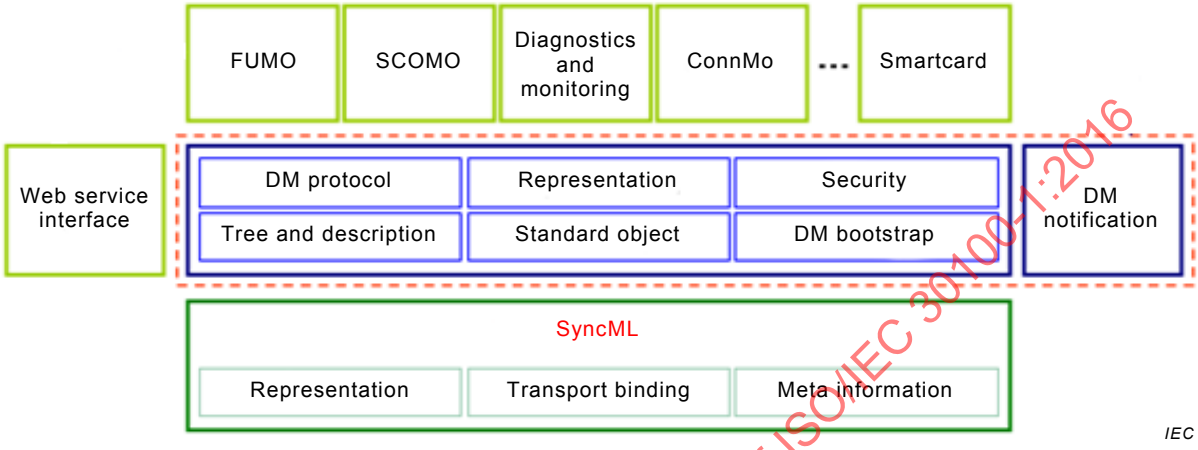
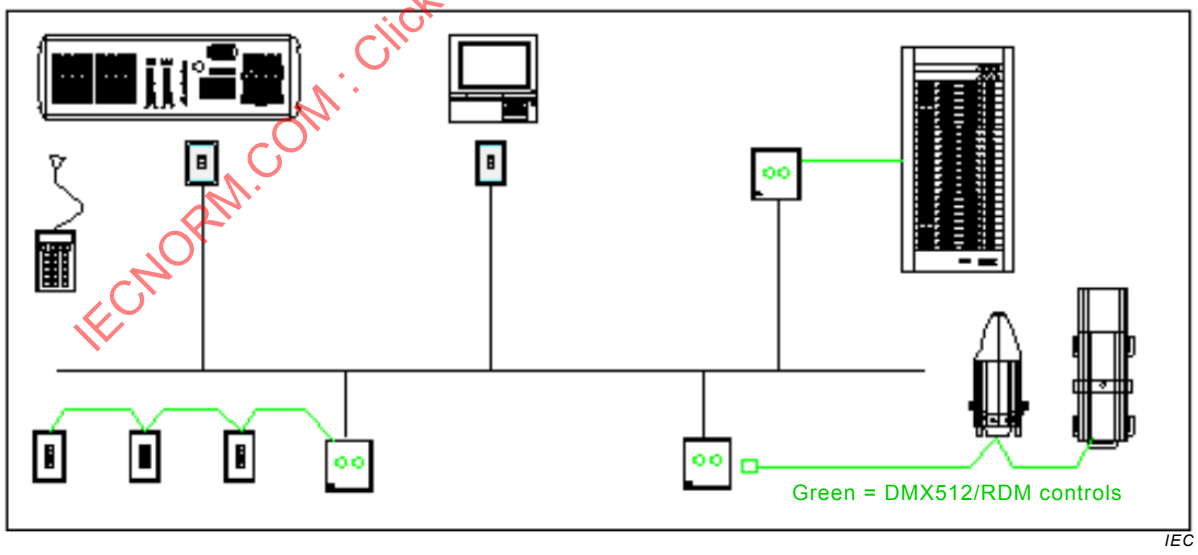


Figure B.4 – OMA DM protocol stacks

B.6 RDM

RDM, Remote Device Management is a protocol enhancement that allows bi-directional communication between a lighting or system controller and attached compliant devices over a standard DMX line. This protocol enables configuration, status monitoring and management of these devices, as illustrated in Figure B.5.



NOTE DMX-5120-A is a DMX controller. DMX is a multi-drop bus topology with nodes connected serially. DMX is an American National Standard, "E1.11 – 2008, USITT DMX512-A."

Figure B.5 – DMX-5120-A/RDM to ACN over TCP/IP gateways with RDM