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Edition 1.0 2024-12

INTERNATIONAL STANDARD



**Information technology – Home Electronic System (HES) gateway –
Part 4-1: Structure – Structural class and module requirements**

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Part 4-1: Structure – Structural class and module requirements

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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
0.1 Overview.....	6
0.2 Relation to existing work.....	7
1 Scope.....	8
2 Normative references.....	8
3 Terms, definitions and abbreviated terms.....	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	10
4 Conformance.....	10
5 HES gateway system structural classes.....	11
5.1 Summary of HES gateway system.....	11
5.2 HES gateway system baseline requirements.....	12
5.2.1 Rationale for baseline requirements.....	12
5.2.2 HES gateway system baseline requirements.....	12
5.2.3 HES gateway module baseline requirements.....	12
5.2.4 HAN interface module requirements.....	12
5.2.5 WAN interface module requirements.....	12
5.2.6 Binding map requirements.....	12
5.2.7 Service module requirements.....	12
5.2.8 Identification service requirements.....	13
5.3 HES gateway system structural implementation configurations.....	13
5.3.1 Rationale for HES gateway system configuration.....	13
5.3.2 Simple gateway configuration.....	13
5.3.3 Complex integral gateway configuration.....	14
5.3.4 Complex modular gateway system configuration.....	15
5.3.5 Interconnected gateway system configuration.....	15
Annex A (normative) Requirements of interfaces and services.....	16
A.1 HAN interface module requirements.....	16
A.2 WAN interface module requirements.....	17
A.2.1 General.....	17
A.2.2 WAN interface objects and actions.....	18
A.3 Binding map service requirements.....	18
A.4 Service module requirements.....	20
A.5 Identification service requirements.....	21
Bibliography.....	22
Figure 1 – ISO/IEC 15045-4-1 within the core interoperability and HES gateway standards.....	7
Figure 2 – HES gateway documents and HES gateway system.....	11
Figure 3 – Two HANs.....	13
Figure 4 – One WAN and one HAN.....	13
Figure 5 – Two or more WANs, one HAN.....	14
Figure 6 – One WAN, two or more HANs.....	14
Figure 7 – Three or more HANs.....	14

Figure 8 – Two or more WANs, two or more HANs 14

Figure 9 – Complex modular HES gateway system 15

Figure 10 – Interconnected HES gateway system 15

Figure A.1 – HAN interface module block diagram 16

Figure A.2 – HAN interface module handling of data exchange 17

Figure A.3 – WAN interface module block diagram..... 17

Figure A.4 – WAN interface module handling of data exchange 18

Figure A.5 – Binding map service block diagram 19

Figure A.6 – Binding map handling of data exchange 20

Figure A.7 – Service module block diagram 20

Figure A.8 – Service module handling of data exchange 21

Table A.1 – WAN interface module objects 18

Table A.2 – WAN interface module channel objects 18

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INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) GATEWAY –

Part 4-1: Structure – Structural class and module requirements

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The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1-SC25/3191/CDV	JTC1-SC25/3258/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, and the ISO/IEC Directives, JTC 1 Supplement available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

A list of all parts in the ISO/IEC 15045 series, published under the general title *Information technology – Home Electronic System (HES) gateway*, can be found on the IEC and ISO websites.

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INTRODUCTION

0.1 Overview

The Home Electronic System (HES) is a set of standards that supports communication, control, and monitoring applications for homes and buildings. However, homes and buildings present a heterogeneous and evolving networked environment, where many of these networks and applications (including some that are based on HES standards) are not directly interoperable with each other. HES standards achieve interoperability through the ISO/IEC 15045 series that relies on the ISO/IEC 18012 series to support functional interworking among the dissimilar home devices, applications, protocols, and networks found in this environment. The ISO/IEC 15045 series and ISO/IEC 18012 series were created to render all protocols interoperable.

The HES gateway enables an open and adaptable market for incompatible products by specifying a standardized modular system intended to provide interoperability among the diversity of networks found in homes and buildings. The HES interoperability process does not require modification of the various networks, applications, or protocols that use it. Appropriate interworking functions translate network messages through interface modules to a common lexicon expression that is then exchanged using a private internal network bus protocol. A protected application platform using a bus protocol supports an expanding array of services for both the applications and the network.

In summary, the ISO/IEC 15045 series specifies a standardized modular dedicated private internal network system that includes:

- interfaces (i.e. interface modules) for communication and semantic translation among dissimilar home area networks (HANs), and between a HAN and external wide area networks (WANs),
- a platform for supporting a variety of application services (i.e. service modules), and
- a secure communication path among these modular elements with access restricted to the appropriate elements in order to protect data, safety and privacy.

The purpose of this document is to define the structural classes of gateway modularity and to aid manufacturers in implementing consistent and interoperable HES gateway systems and HES gateway modules. Although the HES gateway system is based on the concept of logical modularity, this document allows distinct configuration choices for the implementation of gateway physical modularity and the corresponding internal communication pathways. These configurations include the following four classes (abbreviated names are in parentheses):

- a) Class 1: Simple gateway configuration ("Simple")
Manages and controls the communications between two HANs or one HAN and one WAN within one housing.
- b) Class 2: Complex integral gateway configuration ("Complex integral")
Manages and controls the communications among three or more HANs and WANs within one housing.
- c) Class 3: Complex modular gateway system configuration ("Complex modular")
Manages and controls the communications via a private internet event bus among interoperable modular components that are provided by multiple manufacturers enabling an unlimited expandability.
- d) Class 4: Interconnected gateway system configuration ("Interconnected")
Manages and controls the communications between more than one HES gateway system so that they operate equivalently to a single HES gateway system.

The primary differences among these four gateway classes are the degree of physical modularity or degree of integration (i.e. packaging) and the method of communications among the modular elements.

0.2 Relation to existing work

The HES gateway class configurations are introduced and briefly described in ISO/IEC 15045-1. In the case of physically separated HES gateway modules (i.e. complex modular gateway systems), communication among modular elements is provided by a dedicated private internet serial bus (i.e. Ethernet) as discussed in ISO/IEC 15045-2. The message content (protocol data unit, PDU) and set of standardized protocols and objects are specified in ISO/IEC 18012-3 and are known as home electronic system common language message exchange (HES-CLME). For serial communications between physical modular products, the home electronic system common language internal protocol (HES-CLIP) is used. For simple and integral gateway configurations, message communication is accomplished by the home electronic system common language direct PDU exchange (HES-CLDPE). In both cases, the same lexicon and event encoding are used.

Figure 1 shows the core interoperability and HES gateway series of standards and where this document fits into the HES gateway series.

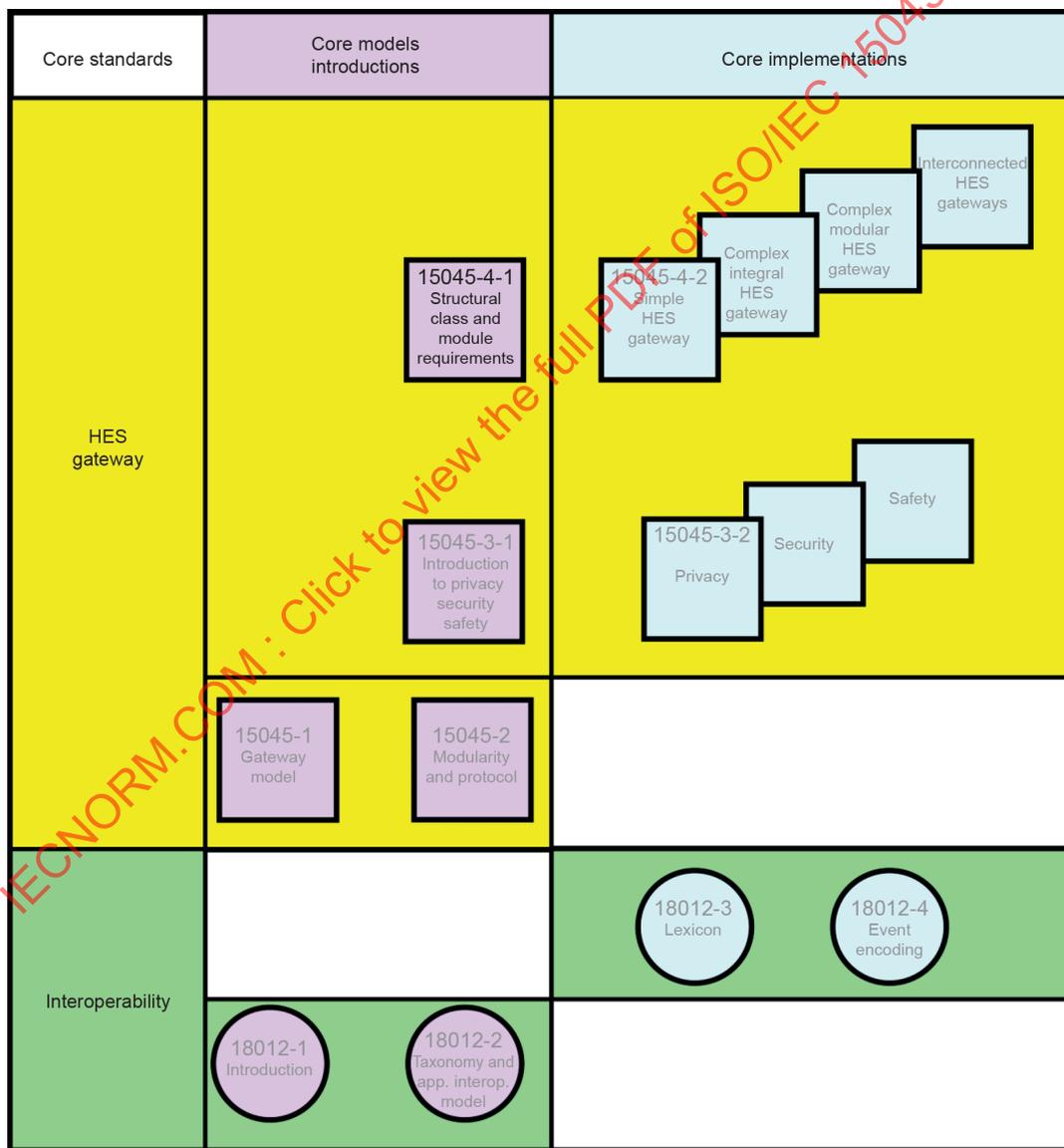


Figure 1 – ISO/IEC 15045-4-1 within the core interoperability and HES gateway standards

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) GATEWAY –

Part 4-1: Structure – Structural class and module requirements

1 Scope

This document specifies a set of physical classes for the HES gateway system. It also specifies the requirements of HES gateway modules including home area network interface modules, wide area network interface modules, binding map service and service modules for any class chosen.

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 15045-1, *Information technology – Home Electronic System (HES) gateway – Part 1: A residential gateway model for HES*

ISO/IEC 15045-2, *Information technology – Home Electronic System (HES) gateway – Part 2: Modularity and protocol*

ISO/IEC 15045-3-1, *Information technology – Home Electronic System (HES) gateway – Part 3-1: Privacy, security, and safety – Introduction*

ISO/IEC 18012-1, *Information technology – Home Electronic System (HES) – Guidelines for product interoperability – Part 1: Introduction*

ISO/IEC 18012-2, *Information technology – Home Electronic System (HES) – Guidelines for product interoperability – Part 2: Taxonomy and application interoperability model*

ISO/IEC 18012-3, *Information technology – Home Electronic System (HES) – Guidelines for product interoperability – Part 3: Lexicon*¹

ISO/IEC 18012-4, *Information technology – Home Electronic System (HES) – Guidelines for product interoperability – Part 4: Event encoding*²

¹ First edition under preparation. Stage at the time of publication: ISO/IEC CDV 18012-3:2024.

² First edition under preparation. Stage at the time of publication: ISO/IEC CDV 18012-4:2024.

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 terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1.1

binding

logical association between objects

3.1.2

event bus

message path within the interoperability domain for transferring events between source and destination interoperable objects

3.1.3

HAN interface module

HES gateway module that interfaces between a HAN and an event bus carrying HES-CLME messages

3.1.4

home area network

HAN

network serving nodes, devices, components and functions within a premises protected area

[SOURCE: ISO/IEC 15045-3-1:2024, 3.1.1]

3.1.5

home electronic system

HES

control and sensing system for homes and buildings based on home electronic system (HES) ISO/IEC standards

Note 1 to entry: The referenced ISO/IEC standards normally include HES in the title of each standard.

[SOURCE: ISO/IEC 15045-3-1:2024, 3.1.2]

3.1.6

home electronic system common language direct protocol data unit exchange

HES-CLDPE

protocol for messaging among logical HES gateway modules

3.1.7

home electronic system common language internal protocol

HES-CLIP

protocol for messaging among physical HES gateway modules

Note 1 to entry: This protocol is based on Ethernet on the lower OSI layers and IP on the middle layers.

3.1.8

home electronic system common language message exchange

HES-CLME

protocol for messaging among HES gateway modules

[SOURCE: ISO/IEC 15045-3-2:2024, 3.1.6]

**3.1.9
service module**

HES gateway module that provides a service inside the HES gateway system via HES-CLME communications on a bus

**3.1.10
WAN interface module**

HES gateway module that interfaces between a WAN and an event bus carrying HES-CLME messages

**3.1.11
wide area network
WAN**

network that connects communication devices in the environment external to the premises protected area

[SOURCE: ISO/IEC 15045-3-1:2024, 3.1.12]

3.2 Abbreviated terms

HAN	home area network
HES	home electronic system
HES-CLDPE	home electronic system common language direct protocol data unit exchange
HES-CLIP	home electronic system common language internal protocol
HES-CLME	home electronic system common language message exchange
IP	Internet Protocol
OSI	Open Systems Interconnection
PDU	protocol data unit
WAN	wide area network

4 Conformance

An HES gateway system conforming to this document shall implement those features required to cover the following subclauses:

- 5.2.2; and
- the subclause of 5.3 that aligns with one of the structural classes chosen for implementation.

NOTE The HAN interface module, WAN interface module, binding map and service module underlying requirements are specified in this document. The structural class documents (ISO/IEC 15045-4-2 series) specify the number and types of these modules, services, and binding maps that are required for each structural class (relying on the underlying requirements specified in this document).

A HAN interface module conforming to this document shall implement those features required to cover the following subclauses:

- 5.2.3; and
- 5.2.4.

A WAN interface module conforming to this document shall implement those features required to cover the following subclauses:

- 5.2.3; and
- 5.2.5.

A service module conforming to this document shall implement those features required to cover the following subclauses:

- 5.2.3; and
- 5.2.7.

5 HES gateway system structural classes

5.1 Summary of HES gateway system

The HES gateway system allows home area networks (HANs) supporting local users, devices and services, and external wide area networks (WANs) supporting remote users, devices and services to communicate, translate, and achieve interoperability among each other. The HES gateway system provides privacy, security and safety, and supports a platform for application services, all within the protected area of the premises as shown in Figure 2.

Figure 2 shows the structure of the HES gateway system within the premises. The HES gateway modules shown are specified in the HES gateway series (ISO/IEC 15045 series) and interoperability series (ISO/IEC 18012 series). Figure 2 also shows the portion of the gateway system specified by the HES gateway and interoperability standards (inside blue dotted box), and the portion of the gateway system that is network-dependent and product-dependent as specified by the manufacturer (outside the blue dotted box).

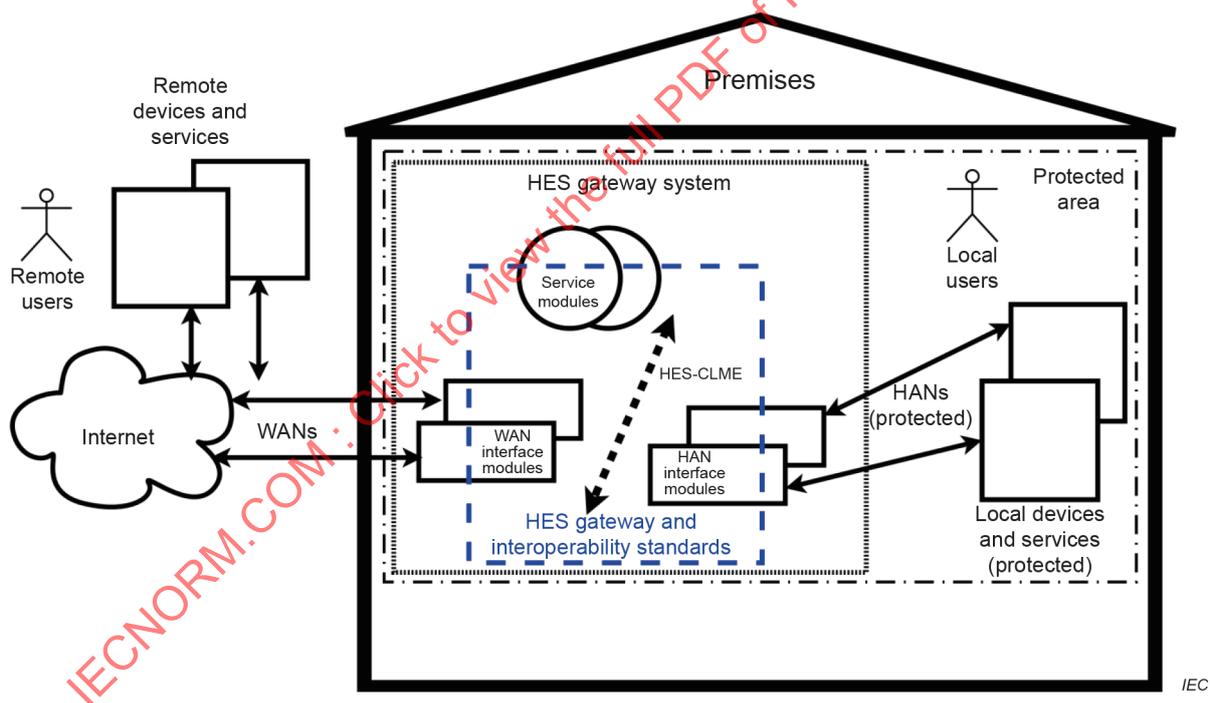


Figure 2 – HES gateway documents and HES gateway system

The HES gateway system consists of the following:

- HAN interface modules that access home area networks (HANs) within the premises;
- WAN interface modules that access wide area networks (WANs) external to the premises;
- service modules (within the HES gateway system) that provide the functionality of the HES gateway system and support application services, and that contain binding map service to link HES gateway modules together; and
- communications via the home electronic system common language message exchange (HES-CLME) between HES gateway modules.

5.2 HES gateway system baseline requirements

5.2.1 Rationale for baseline requirements

In order to ensure a flexible, interoperable, private, secure and safe HES gateway system, the baseline requirements given in 5.2.2 to 5.2.8 apply, regardless of implementation. Further specific requirements are given in Annex A.

5.2.2 HES gateway system baseline requirements

The overall HES gateway system shall meet the requirements and principles of:

- ISO/IEC 15045-1,
- ISO/IEC 15045-2,
- ISO/IEC 15045-3-1,
- ISO/IEC 18012-1,
- ISO/IEC 18012-2,
- future ISO/IEC 18012-3, and
- future ISO/IEC 18012-4.

NOTE Requirements for application services will be specified in a future International Standard: ISO/IEC 15045-5-1.

This document builds upon the principles of the underlying standards noted above and provides more specific requirements.

5.2.3 HES gateway module baseline requirements

An HES gateway module shall meet the requirements and principles of the module as specified in:

- ISO/IEC 15045-1,
- ISO/IEC 15045-2,
- ISO/IEC 15045-3-1,
- ISO/IEC 18012-1,
- ISO/IEC 18012-2,
- future ISO/IEC 18012-3, and
- future ISO/IEC 18012-4.

NOTE Requirements for application services will be specified in a future International Standard: ISO/IEC 15045-5-1.

5.2.4 HAN interface module requirements

A HAN network connecting to an HES gateway system shall use a HAN interface module as specified in Clause A.1 for each HAN.

5.2.5 WAN interface module requirements

A WAN network connecting to an HES gateway system shall use a WAN interface module as specified in Clause A.2.

5.2.6 Binding map requirements

An HES gateway system shall have at least one binding map as specified in Clause A.3.

5.2.7 Service module requirements

The requirements for service modules are specified in Clause A.4.

5.2.8 Identification service requirements

Each HES gateway system shall have one and only one identification service as specified in Clause A.5.

5.3 HES gateway system structural implementation configurations

5.3.1 Rationale for HES gateway system configuration

The HES gateway system can be implemented in one of four distinct configurations: simple (5.3.2), complex integral (5.3.3), complex modular (5.3.4) and interconnected (5.3.5).

These physical classes were introduced in ISO/IEC 15045-1:2004. This document enhances ISO/IEC 15045-1 and ISO/IEC 15045-2 by specifying the baseline requirements for these classes and by providing details for each class, such as manufacturing complexity, expandability and flexibility, so that manufacturers can choose the most appropriate implementation for their products and claim conformance.

The identity of the class of the HES gateway system that is implemented shall be stored in the "classGateway" centralOperations configurationData of the identification service as defined in ISO/IEC 18012-3.

5.3.2 Simple gateway configuration

The simple gateway provides a minimal configuration of connecting one WAN to one HAN, or one HAN to another HAN packaged within one housing. This configuration is minimal and non-expandable, likely dedicated to some single application while providing the basic HES gateway services of interoperability, privacy, security, and safety. It preserves the HES gateway modular internal structure and HES-CLME mechanisms by employing home electronic system common language direct PDU exchange (HES-CLDPE) to reduce complexity (for example, simplify addressing), rather than the serial event bus using the home electronic system common language internal protocol (HES-CLIP).

The simple gateway manages and controls the communications between two networks, either two HANs or one WAN and one HAN as illustrated in Figure 3 and Figure 4, respectively. The simple gateway does not support additional networks beyond two HANs (Figure 3) or one WAN and one HAN (Figure 4). The family of HES-CLPDE protocol is used for the internal communication within the HES gateway system. For further details, see ISO/IEC 15045-4-2.

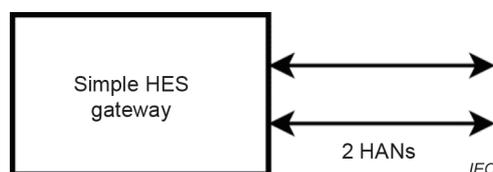


Figure 3 – Two HANs

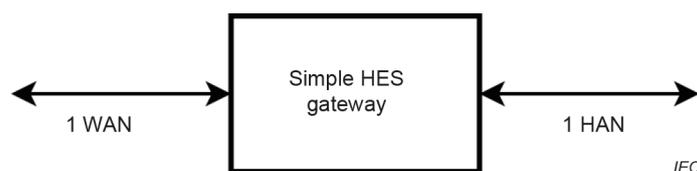


Figure 4 – One WAN and one HAN

5.3.3 Complex integral gateway configuration

The complex integral gateway provides an expanded configuration compared to the simple gateway by supporting multiple WANs and multiple HANs. It still offers reduced complexity by using HES-CLDPE for integration of the entire gateway packaged within one housing.

The complex integral gateway is packaged in one housing without any future modular expansion capabilities (such as described in the complex modular gateway system as specified in 5.3.4). The complex integral gateway manages and controls communications among three or more HANs and WANs in the following configurations:

- one HAN and two or more WANs (Figure 5), or
- one WAN and two or more HANs (Figure 6), or
- three or more HANs (Figure 7), or
- two or more WANs and two or more HANs (Figure 8).

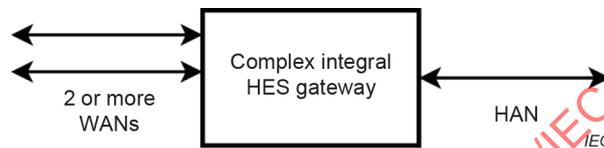


Figure 5 – Two or more WANs, one HAN

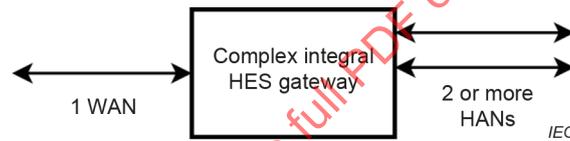


Figure 6 – One WAN, two or more HANs

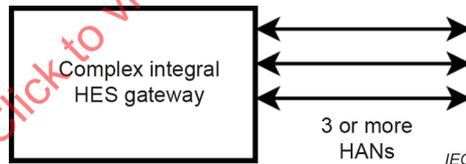


Figure 7 – Three or more HANs



Figure 8 – Two or more WANs, two or more HANs

The complex integral gateway configuration is appropriate for manufacturers that wish to supply a complete solution with reduced complexity and must support a specific HAN-to-HAN conversion or WAN-to-HAN conversion with more than two networks (such as one HAN accessing two or more WANs).

Internal PDU communication links, called HES-CLPDE, are used to communicate between the networks.

5.3.4 Complex modular gateway system configuration

The complex modular gateway system provides unlimited expandability over a private internet event bus within the HES gateway system using HES-CLIP to interconnect HES gateway modules. This configuration allows the gateway functions to be distributed among multiple physical units and still operate as a single gateway system.

The complex modular gateway system, as shown in Figure 9, is comprised of interoperable modular components that communicate with each other using HES-CLIP serial communications over a private internet event bus, and that are provided by multiple manufacturers.

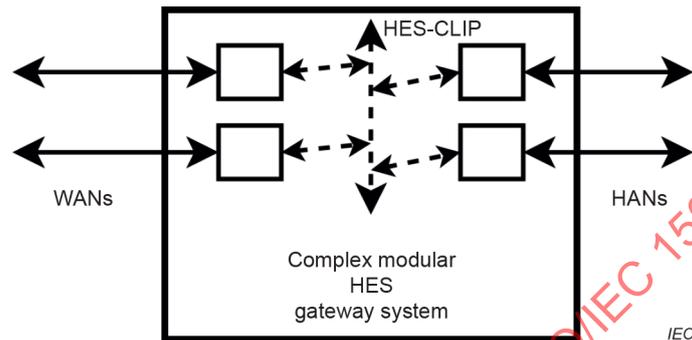


Figure 9 – Complex modular HES gateway system

The complex modular configuration is appropriate for manufacturers that wish to offer components or products for the HES gateway system instead of the complete system. Specific hardware and software components, and products can be supplied as HES gateway modules including HAN interface modules, WAN interface modules, service modules (e.g. time, cryptographic) or application support using the HES gateway (e.g. energy management).

5.3.5 Interconnected gateway system configuration

The interconnected gateway system consists of multiple interconnected HES gateway systems that perform as a single HES gateway system. The interconnected gateway system, as shown in Figure 10, consists of more than one HES gateway system installed in a premises that operate equivalently to a single HES gateway system.

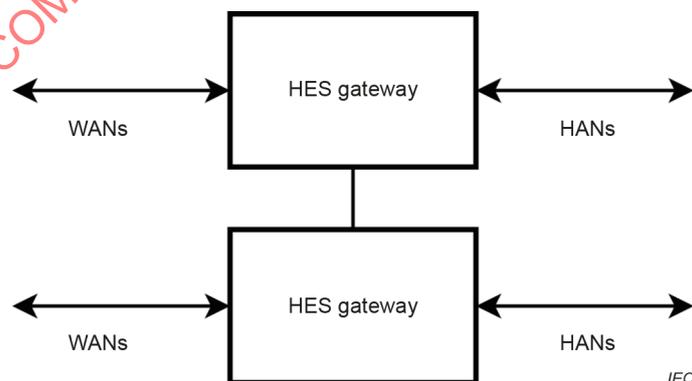


Figure 10 – Interconnected HES gateway system

The interconnected gateway system configuration is appropriate for system integrators who wish to support larger or more complex installations with multiple HES gateway systems.

The specifications and requirements for the interconnected HES gateway system will be given in a future International Standard: ISO/IEC 15045-4-5.

Annex A (normative)

Requirements of interfaces and services

NOTE It is possible that additional services will be specified in amendments to this standard by appending subclauses to this Annex A.

A.1 HAN interface module requirements

The main purpose of a HAN interface module is to translate between a HAN (protected network within the premises) and the standardized HES-CLME event bus.

Figure A.1 is a block diagram of the HAN interface module.

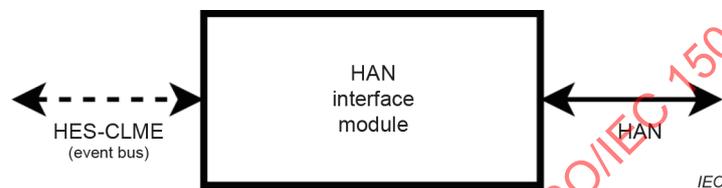


Figure A.1 – HAN interface module block diagram

A HAN interface module shall:

- interface to the event bus using the HES-CLME specified by ISO/IEC 18012-4;
- interface to a HAN communications system;
- translate messages from the HAN network to HES-CLME or from HES-CLME to the HAN network or both using the appropriate ISO/IEC 18012-3 user objects;
- receive and act upon HES-CLME messages only from the binding map service (see ISO/IEC 18012-3) or from service modules to handle the HAN interface module serviceData (see ISO/IEC 18012-3) exchanges;
- send HES-CLME messages only to the binding map service;
- not receive nor act upon any incoming messages coming directly from any HAN interface, other WAN interfaces, or any service other than the HES-CLME messages from the binding map service or from service modules to handle the HAN interface module serviceData exchanges; and
- contain the HAN interface object or action data or both and operate as specified in the "HAN interface objects" subclause of ISO/IEC 18012-3.

In summary, a HAN interface module handles data exchanges over HES-CLME as shown in Figure A.2.

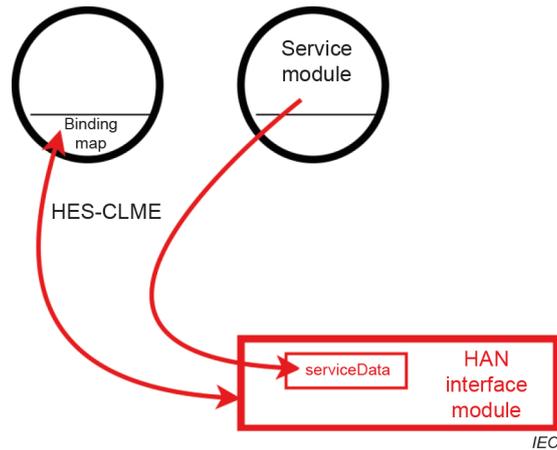


Figure A.2 – HAN interface module handling of data exchange

A.2 WAN interface module requirements

A.2.1 General

The main purpose of a WAN interface module is to translate between a WAN network (network outside the protected area, typically outside the premises) and the standardized HES-CLME network.

Figure A.3 is a block diagram of the WAN interface module.

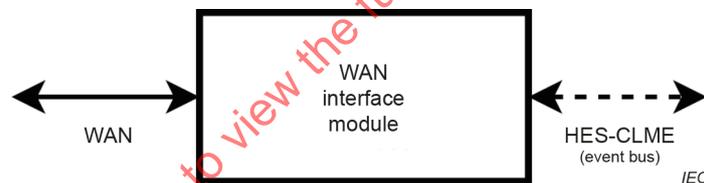


Figure A.3 – WAN interface module block diagram

A WAN interface module shall:

- interface to the event bus using the HES-CLME specified by ISO/IEC 18012-4;
- interface to a WAN communications system;
- translate messages from the WAN network to HES-CLME or from HES-CLME to the WAN network or both using the appropriate ISO/IEC 18012-3 remote objects;
- receive and act upon HES-CLME messages only from the binding map service (see ISO/IEC 18012-3) or from service modules to handle the WAN interface module serviceData (see ISO/IEC 18012-3) exchanges;
- send HES-CLME messages only to the binding map service;
- not receive nor act upon any incoming messages coming directly from any HAN interface, other WAN interfaces, or any service other than the HES-CLME messages from the binding map service or from service modules to handle WAN interface module serviceData exchanges; and
- contain the WAN interface object or action data or both and operate as specified in A.2.2.

In summary, a WAN interface module handles data exchanges over HES-CLME as shown in Figure A.4.

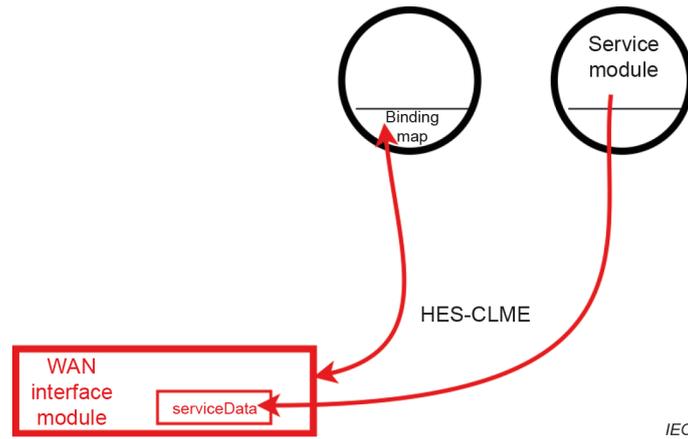


Figure A.4 – WAN interface module handling of data exchange

A.2.2 WAN interface objects and actions

The WAN interface module shall exchange via HES-CLME messaging for all the interactiveData, metaData and configurationData listed in the ISO/IEC 18012-3 WAN interface objects and actions given in Table A.1.

Table A.1 – WAN interface module objects

Object name	Description
discovery	Information related to discovery of HES gateway modules from a WAN interface module
centralOperations	Information related to the central operations of a WAN interface module
attachedNetwork	Information related to the attached network of the WAN interface module
privacySecuritySafetyTraffic	Information related to privacy, security, safety and traffic of the WAN interface module

The WAN interface module shall exchange via HES-CLME for each channel all the interactiveData, metaData and configurationData listed in the ISO/IEC 18012-3 WAN interface objects and actions given in Table A.2.

Table A.2 – WAN interface module channel objects

Object name	Description
channelServiceTable	Key factors and pertinent information for each channel in a WAN interface module
privacySecuritySafetyTrafficTable	Information related to privacy, security, safety and traffic for each channel in a WAN interface module

A.3 Binding map service requirements

Binding map service is a core function of every HES gateway system. This service specifies the source-end and the destination-end of an event connection between application objects.

A binding map resides in a service module to exchange HES-CLME messages with other HES gateway modules, and to translate messages from one interface module (HAN or WAN) to another interface module. A binding map can also exchange data with the customer-specific protected app (customer-specific applications contained in a service module of an HES gateway system) either directly or through service objects.