



DPC: 22 / 30454223 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 13 April 2022

Origin: International

Latest date for receipt of comments: 14 April 2022

Project No. 2022/00722

Responsible committee: IST/6/-/12 Home Electronic Systems

Interested committees:

Title: BS ISO/IEC 18012-3 Information Technology–Home Electronic System–Guidelines for
product interoperability Part 3: Lexicon

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

**WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD.
THIS DRAFT IS NOT CURRENT BEYOND 14 April 2022**

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com>
or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com.
British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from
<http://standardsdevelopment.bsigroup.com>

Responsible Committee Secretary: Ms Sophie Erskine (BSI)
Direct tel: 0208 996 7254
E-mail: sophie.erskine@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



JTC1-SC25/3088/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

ISO/IEC 18012-3 ED1

DATE OF CIRCULATION:

2022-03-18

CLOSING DATE FOR COMMENTS:

2022-05-13

SUPERSEDES DOCUMENTS:

JTC1-SC25/3017/NP, JTC1-SC25/3040A/RVN

IEC ISO/IEC JTC 1/SC 25 : INTERCONNECTION OF INFORMATION TECHNOLOGY EQUIPMENT

SECRETARIAT:

Germany

SECRETARY:

Mr Marco Peter

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 23, SyC AAL, SEG 9, ISO/IEC JTC 1/SC 41

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☒ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Information Technology—Home Electronic System—Guidelines for product interoperability—Part 3: Lexicon

NOTE FROM TC/SC OFFICERS:

The working parties supplied comments, which have been included.

The SC 25 WG 1 experts were also asked for comments according to the WG 1 action items from last September 2021.

No additional changes were proposed.

National Committees are kindly requested to submit their comments via the IEC Voting System before **2022-05-06** in view of the next JTC1 SC25 WG1 web meeting which will take place from 9th to 18th of May 2022.

CONTENTS

FOREWORD	6
INTRODUCTION	8
1 Scope.....	10
2 Normative references	10
3 Terms, definitions, abbreviated terms and conventions.....	10
3.1 Terms and definitions	10
3.2 Abbreviated Terms	12
3.3 Conventions - Defined Data Formats	13
3.3.1 countrySubdivision	14
3.3.2 dateTime Format	14
3.3.3 nanosecondsSinceEpoch	14
3.3.4 secondsSinceEpoch	15
3.3.5 latitudeLongitude Format.....	15
3.3.6 timeDuration Format.....	15
3.3.7 timeInterval Format	16
3.4 Memory storage/access types.....	16
3.4.1 RAM	16
3.4.2 ROM	16
3.4.3 Operational.....	16
3.4.4 Database	16
3.4.5 Secret.....	16
3.4.6 General.....	16
3.4.7 Summary	16
3.5 Address/data types.....	17
4 Conformance requirements.....	18
5 Lexicon concepts, principles	18
5.1 Communicating “lexicon” on media	18
6 Object concepts	18
6.1 Overview of object concepts	18
6.2 User object concepts.....	20
6.3 Binding map object concepts	20
6.4 Service object concepts	20
6.5 Interface object concepts	20
6.6 Remote object concepts	20
7 Action concepts	20
7.1 Communicating “action” on media.....	21
8 Objects - Detailed Lexicon.....	21
9 User Objects - Detailed Lexicon	21

41	9.1	User Objects; introduction to components	21
42	9.2	Common Objects and Structures	21
43	9.2.1	currentValue	21
44	9.2.2	previousValue.....	25
45	9.2.3	compareValue	25
46	9.2.4	Other Properties	26
47	9.3	Application Domains.....	26
48	9.3.1	Energy Management Domain	27
49	9.3.2	Lighting Domain	32
50	9.3.3	Utility Domain	39
51	9.3.4	HVAC Domain	76
52	9.3.5	Convenience Domain	77
53	9.3.6	User Interface Domain	78
54	9.3.7	Audio/Video Domain.....	79
55	9.3.8	Telecommunications Domain	80
56	9.3.9	Security Domain	81
57	9.3.10	Appliance Domain	82
58	9.3.11	Common User Interface Domain	83
59	9.3.12	Safety Cluster Domain	84
60	9.3.13	Electric Vehicle Domain	85
61	9.3.14	General Domain	86
62	10	Binding map objects – Detailed Lexicon	87
63	10.1	Binding map introduction.....	87
64	10.2	Mathematical/logical operations	87
65	10.3	Conditioning	88
66	10.4	Adjustment	88
67	10.5	Operation table.....	88
68	10.6	Addressing Table	90
69	10.7	Binding Map Discovery.....	95
70	10.8	Binding Map Discovery of HAN Interface Objects	95
71	10.9	Binding Map Discovery of WAN Interface Objects	96
72	11	Service Objects – Detailed Lexicon	97
73	11.1	Service Module.....	97
74	11.2	Services	97
75	11.2.1	Identification Service (Foundational).....	98
76	11.2.2	Time Service (Foundational)	101
77	11.2.3	Authorization Service (Foundational)	112
78	11.2.4	Cryptographic Service (Foundational).....	117
79	11.2.5	Common User Interface Service.....	117
80	11.2.6	Cluster To Cluster Service	117
81	11.2.7	Artificial Intelligence Service	117
82	11.2.8	Energy Management Service	117

83	11.2.9 Electrical Energy Measuring System Service	117
84	11.2.10 Web-based Energy Service	117
85	11.2.11 Audio Gateway Service	117
86	11.2.12 IGRS RA Agent Service	117
87	12 Interface Objects - Detailed Lexicon	118
88	12.1 General Interface Objects	118
89	12.2 HAN Interface Objects	118
90	12.2.1 Overview	118
91	12.2.2 HAN Interface Module General Characteristics	118
92	12.2.3 HAN Interface Module Application Characteristics	124
93	12.2.4 HAN Interface Module Examples	125
94	12.3 WAN Interface Objects and Actions	128
95	12.3.1 WAN Discovery of Modules	128
96	12.3.2 WAN Central Operations	129
97	12.3.3 WAN Attached Network	130
98	12.3.4 Privacy/Security/Safety/Traffic for WAN interface module	131
99	12.3.5 Overall WAN channel services	133
100	12.3.6 Channel service table for WAN channel	134
101	12.3.7 Privacy/Security/Safety/Traffic for WAN channel	136
102	13 Remote Objects - Detailed Lexicon	140
103	13.1 Remote Objects; introduction	140
104	13.2 Common Objects and Structures	140
105	13.2.1 currentValue	140
106	13.2.3 previousValue	142
107	13.2.4 compareValue	142
108	13.2.5 Other properties	143
109	13.3 Remote Object Domains	143
110	13.3.1 Environmental Domain	144
111	13.3.2 Common Area Domain	145
112	14 Actions - Detailed Lexicon	146
113	15 XML	146
114	Annex A – Binding Map Service	147
115	A.1 Binding Map Introduction	147
116	A.2 Value Operation	150
117	A.2.1 Mathematical/logical Operations	151
118	A.2.2 Table of operations	152
119	A.2.3 Conditioning	153
120	A.2.4 Adjustment	153
121	A.2.5 Examples of using the “Value Operation”	153
122	A.2.6 Address Redirection	154
123	Annex B – Example of Operation Group	160

124	Annex C – WAN Interface Module.....	163
125	C.1 WAN Interface Objects and Actions	163
126	C.2 WAN Interface Module Objects	163
127	C.3 WAN Interface Channel Objects.....	164
128	C.4 WAN communication with other HES gateway systems	167
129	Annex D – Authorization Service Examples	169
130	D.1 Parent/kid authorization example	169
131	D.2 Limit incoming packets example	173
132		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) – GUIDELINES FOR PRODUCT INTEROPERABILITY -

Part 3: Lexicon

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 15045-3-1 has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information Technology.

This edition includes the following significant technical changes with respect to the previous edition:

- a) ...;

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

183

184 Full information on the voting for the approval of this International Standard can be found in the
185 report on voting indicated in the above table.

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

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

- 190 ☐ reconfirmed,
191 ☐ withdrawn,
192 ☐ replaced by a revised edition, or
193 ☐ amended.

194

195 The National Committees are requested to note that for this document the stability date is 20XX..

196 This text is included for the information of the national committees and will be deleted at the
197 publication stage.

198

199

INTRODUCTION

The *Home Electronic System* (HES) is a set of standards that support communication, control, and monitoring applications for homes and buildings. However, homes and buildings present a heterogeneous and changing networking environment, and many of these networks and applications (including some HES standards) are not directly interoperable with each other. HES standards achieve interoperability through the ISO/IEC 15045 *HES gateway* standards which rely on ISO/IEC 18012 *Guidelines for product interoperability* standards to support functional interworking among the dissimilar home devices, applications, protocols, and networks found in this environment.

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 are used for translating network messages through interface modules to a common lexicon expression which is then exchanged on a private internal network bus protocol. A protected application platform using the bus protocol supports an expanding array of services for both the applications and the network.

In summary, the HES gateway standard 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 and building area networks (HANs), as well as with external wide area networks (WANs), and
- a platform for supporting an expanding array 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.

Interworking is achieved with a translation process by which a message between devices on two networks that use different protocols (including different application languages) are first converted into a common HES (internal) linguistic expression and then back into an equivalent message for the other network. This conversion is accomplished by an *interworking function* (IWF) residing in interface modules for each network. These messages are initiated by changes-of-state relating to objects associated with devices connected to the networks, and are known as *events*. The HES *common language message exchange* (HES-CLME) event messages employ a standardized syntax and semantic expressions defined by the HES *Lexicon* specified in this Part 3 *Lexicon*. The format of the messages, (i.e., the message protocol data unit (PDU) is defined in a subsequent Part 4 *Event encoding*.

Relation to existing work

The HES gateway is described in ISO/IEC 15045-1 *Home Electronic System (HES) gateway – Part 1: A residential gateway model for HES*. Several structural configurations of the HES gateway are described in ISO/IEC 15045-4-1 *HES gateway – Part 1: Physical structural classes*. All classes use the HES interoperability system described above, however in some that use physically separated modules, communications among modular elements is provided by a dedicated private internet serial bus (based on Ethernet, see RFC 1918) and utilizes a set of protocols described in ISO/IEC 15045-2 *HES gateway – Part 2: Modularity and protocol*, which is now known as common language messaging exchange (HES-CLME). The interworking function (IWF) is described in ISO/IEC 18012-2 *Guidelines for product Interoperability – Part 2: Taxonomy and application interoperability model*. The message content (protocol data unit or PDU) is defined in ISO/IEC 18012-3 *Guidelines for product Interoperability – Part 3: Lexicon* and in ISO/IEC 18012-4 *Guidelines for product Interoperability – Part 4: Event encoding*. All HES gateway structural class configurations use the same interworking functions, including lexicon, and event encoding.

Lexicon and event encoding

This Part 3 *Lexicon* specifies the standardized HES application objects, functions (actions), and variables, as well as their expression (symbolic encoding), their semantic meaning, and their syntactic usage. These are the elements needed to construct IVFs for each specific network. Because of the dynamic heterogeneous nature of the home and building networking environment, it is intended that these elements, including the IVFs for each network be maintained in a standardized online metadata registry. Part 4 *Event encoding* defines the specific format of the PDUs for various events to be utilized in data packets (e.g., HES-CLIP) or direct API exchanges (e.g., HES-CLPDE) within a gateway.

Figure 1 shows the core interoperability and HES gateway series of standards and where this ISO/IEC 18012-3 standard fits into series.

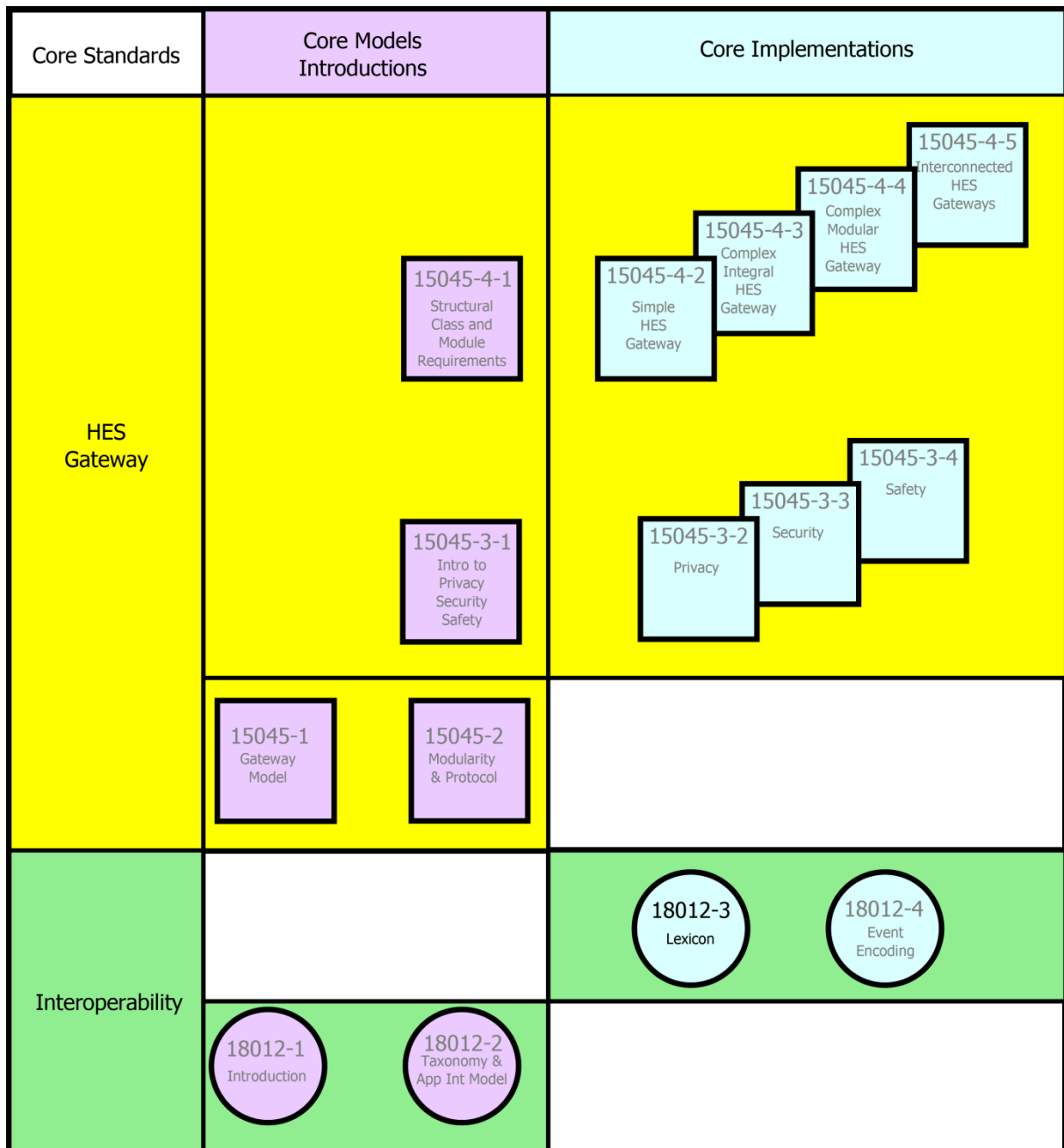


Figure 1 – ISO/IEC18012-3 Standard within the Core Interoperability and HES Gateway Standards

**INFORMATION TECHNOLOGY –
HOME ELECTRONIC SYSTEM (HES) –
GUIDELINES FOR PRODUCT INTEROPERABILITY –**

Part 3: Lexicon

1 Scope

[Editor's note: Will be defined in the future.]

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 15045-1:2004, *Information technology – Home Electronic System (HES) gateway – Part 1: A residential gateway model for HES*

ISO/IEC 15045-2:2012, *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: Introduction to privacy, security, and safety [In progress]*

ISO/IEC 15045-3-2, *Information technology – Home Electronic System (HES) gateway – Part 3-2: Privacy framework [In progress]*

ISO/IEC 15045-4-1, *Information technology – Home Electronic System (HES) gateway – Part 4-1: HES gateway structural class and module requirements [In progress]*

ISO/IEC 18012-1:2004, *Information technology – Home Electronic System (HES) – Guidelines for product interoperability – Part 1: Introduction*

ISO/IEC 18012-2:2012, *Information technology – Home Electronic System (HES) – Guidelines for product interoperability – Part 2: Taxonomy and application interoperability model*

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

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

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

3.1.1

atomic data

data at the lowest level of detail that cannot be further divided

3.1.2

binding

specification of the source-end and the destination-end of an event connection between application objects

[SOURCE: ISO/IEC 18012-2:2012, definition 3.1.6]

- 307 **3.1.3**
 308 **binding map**
 309 table that links inputs to outputs
- 310 **3.1.4**
 311 **bus**
 312 common or shared path for communications or power
- 313 **3.1.5**
 314 **channel**
 315 subdivision of WAN connection
- 316 **3.1.6**
 317 **configuration data**
 318 data that is setup for the controller service (see *ISO/IEC 15045-3-2*) in anticipation of real-time
 319 operations
- 320 **3.1.7**
 321 **event**
 322 change of state relating to an object (including user object, remote object, interface object and
 323 service object)
- 324 **3.1.8**
 325 **field**
 326 (field name, data type) pair
 327 Note 1 to entry: A value of a field is a value of its data type
 328 [SOURCE: ISO/IEC 9075]¹
- 329 **3.1.9**
 330 **HES lexicon**
 331 list of known HES application objects and actions, and structured information about them
 332 Note 1 to entry: Lexicon in linguistics is an inventory of words and information about them. The term lexicon here is
 333 used to represent listing of known HES application objects and structured information about them. This part of the
 334 standard provides the structure to be used for the full compilation of the lexicon.
- 335 **3.1.10**
 336 **home area network**
 337 electronic network specifically serving nodes, devices, components and functions within a home
 338 or premises
 339 Note 1 to entry: For a HES gateway, a HAN is a network within the protected area.
- 340 **3.1.11**
 341 **interactive data**
 342 data that is typically transferred between objects for the processor service (see *ISO/IEC 15045-*
 343 *3-2*) for real-time operation
- 344 **3.1.12**
 345 **lexicon**
 346 vocabulary, i.e., the words and their definitions, of a language
- 347 **3.1.13**
 348 **metadata**
 349 data that defines and describes other data
 350 [SOURCE: ISO/IEC 11179-1]

¹ Terminology of SQL from ISO/IEC 9075 is used for convenience only, any underlying data management system may be used

- 351 **3.1.14**
 352 **null value**
 353 special value that is used to indicate the absence of any data value
- 354 [SOURCE: ISO/IEC 9075]²
- 355 **3.1.15**
 356 **object**
 357 program or unit of software that includes code and data
- 358 **3.1.16**
 359 **object address**
 360 address uniquely identifying an object
- 361 **3.1.17**
 362 **object reference code**
 363 code that references the specific name within an object
- 364 **3.1.18**
 365 **post-market**
 366 product after being shipped to market
- 367 **3.1.19**
 368 **pre-market**
 369 product before being shipped to market
- 370 **3.1.20**
 371 **row**
 372 value of a row type, i.e., a sequence of field values; for rows in a table, a sequence of column
 373 values
- 374 [SOURCE: ISO/IEC 9075]³
- 375 **3.1.21**
 376 **service module**
 377 module that provides a service inside the HES gateway via HES-CLME communications on a
 378 bus
- 379 **3.1.22**
 380 **table**
 381 collection of zero or more rows
- 382 [SOURCE: ISO/IEC 9075]⁴
- 383 **3.1.23**
 384 **wide area network**
 385 electronic network that connects communication devices in the environment external to the
 386 premises
- 387 Note 1 to entry: For a HES gateway, a WAN is a network outside the protected area.
- 388
- 389 **3.2 Abbreviated Terms**
 390 *[Editor's note: Text will be added in the future.]*

² Terminology of SQL from ISO/IEC 9075 is used for convenience only, any underlying data management system may be used

³ Terminology of SQL from ISO/IEC 9075 is used for convenience only, any underlying data management system may be used

⁴ Terminology of SQL from ISO/IEC 9075 is used for convenience only, any underlying data management system may be used

3.3 Conventions - Defined Data Formats

The following data formats are defined in this section using EBNF format (ISO/IEC 14977) as is generally used within the XML standard (W3C Nov 26, 2008, see Section 6, Notation). These data formats are used throughout this document for data related specifications and will be formatted with ***bold italics***.

The short forms, as listed in the table below, are the data that are sent in a communications packet. They are used to maximize efficiency in communications and in the use of memory.

Summary of symbols used below:

? - optional; zero or one

* - zero or more

+ - one or more

Table 1 – Defined types of dataFormat

dataFormat Name	Definition	Short Form	Example #1	Example #2	Example #3
<i>arrayDecimals</i>	decimal (' decimal)*	ad	3	2.5,-4	2,5,2
<i>arrayIntegers</i>	integer (' integer)*	ai	-42	-56,89	-20,55,25
<i>arrayIPAddresses</i>	ipaddress (' ipaddress)	aa	192.168.0.3,198.27.76.102		
<i>arrayKeyValue Pairs</i>	keyValuePair (' (keyValuePair))+	ak	ne	nw, sm=size	ag=23, ld, um=test
<i>arrayPosIntegers</i>	posInteger (' posInteger)*	ap	3	2,4	2,5,2
<i>arrayShortLetters</i>	shortLetters (' shortLetters)*	as	no	ma,ea	ir,ic,ma
<i>arrayTime Intervals</i>	timeInterval (' timeInterval)*	at			
<i>country Subdivision</i>	[A-Z] [A-Z] '-' [A-Z] [A-Z] [A-Z]?	cs	US-CA	KR-11	GB-LND
<i>dateTime</i>	{according to ISO 8601-1:2019}; see "dateTime format" in Section 3.3.1	dt	20210304	20210609 T122104	T15212 .234
<i>decimal</i>	'-'? [0-9]+ (' [0-9])+)?	de	2.5	-32.19	729
<i>integer</i>	'-'? [0-9]+	in	25	-321	0
<i>ipaddress</i>	[0-255].[0-255].[0-255].[0-255]	ip	192.168.0.3		
<i>latitudeLongitude General</i>	{according to ISO 6709:2008}; see "latitudeLongitude format" in Section 3.3.5	ll	"-39.345 +120.546	" +46 -105	-2.0123 +14.2347
<i>lowerCaseString</i>	[a-z]+	ls	a	temp	light
<i>posInteger</i>	[1-9] [0-9]*	pi	1	5	327
<i>nonNegDecimal</i>	[0-9]+ (' [0-9])+)?	nd	34	32.6	0.46
<i>nonNegInteger</i>	[0-9]+	nn	0	3	231
<i>nanoseconds Since Epoch</i>	nonNegDecimal {up to 4294967295 (unsigned 32 bits) units; fractional of nanoseconds} {see Section 3.3.3}	ns	17012 28967. 453	32563 32953. 32567 2145	
<i>secondsSince Epoch</i>	nonNegDecimal {up to 4294967295 (unsigned 32 bits) units} {see Section 3.3.3}	ss	17012 28967	32563 52933	41023 84561
<i>shortLetters</i>	[a-z] [a-z]	sl	va	mx	dt
<i>string</i>	[ascii]*	st	light	dfj344*&	/L9(P{
<i>stringLetterDec</i>	[a-zA-Z] [a-zA-Z0-9]*	sn	door	Lock4	low2dim
<i>stringLetters</i>	[a-zA-Z]+	se	cool	Heat	power
<i>stringLexicon</i>	'/' shortLetters (' shortLetters)* [Editor's note: check if '/' is appropriate and to be sent in packets]	sx	/lx	/lx/ob	/lx/ob/uo

dataFormat Name	Definition	Short Form	Example #1	Example #2	Example #3
timeDuration	{according to ISO 8601-1:2019}; see “timeDuration format” in Section 3.3.6	td	P2Y	P6DT3H	P1Y3D
timeInterval	{according to ISO 8601-1:2019}; see “timeInterval format” in Section 3.3.7	td	20210923 T1400/ PT1H	20211123 /P1W1D	2021/ P1Y
zeroOne	‘0’ ‘1’	zo	0	1	

3.3.1 countrySubdivision

Country code uses Alpha-2 code and subdivision codes defined in ISO 3166.

3.3.2 dateTime Format

The “dateTime” format is used to express instantaneous point in time, durations, and time intervals useful for human-related activities. The “dateTime” format is based upon the ISO 8601-1:2019 standard. In certain cases, the ISO 8601 standard provides options, such as extended and basic formats. This ISO/IEC 18012-3 standard specifies the necessary detail beyond ISO 8601 standard to clarify usage, ensure interoperability and simplify implementations.

A key aspect of ISO 8601 is that the order is from largest to smallest, allowing for predictable and consistent sorting. The order is year (4 digits), month (2 digits), date (2 digits), hour (2 digits), minutes (2 digits) and seconds (2 digits). The basic format of ISO 8601 is used. In other words, the “-” and “:” are not used for delimiters for dates and times. For example, “20210304” refers to March 4, 2021.

“T” must be used with times. For example, “T0323” refers to the time of 3:23 am.

Dates and times are zero padded. For example, “20210102” represents Jan 2, 2021.

24 hour time is used, so no “am” or “pm” is used. For example, “T2134” means the time of 9:34 pm.

The time zone follows the time with a ‘+’ or ‘-’. For example, “T130912-04” means 12 seconds after 1:09 pm using a time zone that is – 4 hours from UTC. A time zone should be used (i.e., after the time with a positive or negative hour/minutes. If a time zone is not included, it shall be interpreted as the UTC time zone. For UTC time, “+00” or “+0000” shall be used, and not “Z” or “-00” or “-0000”. Therefore, “T1121” and “T1121+00” both represent 11:21 UTC.

Imprecise values are allowed where appropriate. For example, “2021” refers to any event within the year 2021. Of special note, 6 digits are interpreted as the first 4 digits representing the year and are allowed for consistency purposes, with a caution to programmers that YYMMDD or other formats are not being used. For example, “201104” is April in the year 2011.

Skipped date values are marked with a ‘-’. For example, “2021-02” (skipping month) means 2nd day of any month in 2021. “- - 08” means the 8th day in any month.

Skipped time values are marked with a ‘:’. For example, “T0205” means 2:05 am, and “T:06” means 6 minutes after any hour. Decimal places are only allowed after seconds and refer to decimal fractions of seconds. For example, “T210802.45” means 2.45 seconds after 9:08 PM.

3.3.3 nanosecondsSinceEpoch

The nanosecondsSinceEpoch format is appropriate for timestamping messages being transferred on the event bus, HES-CLME. This format uses the Precision Time Protocol (PTP) truncated timestamp format (IEEE 1588v1, also see RFC 8877 Section 4.3) which is 32 unsigned bits for seconds that rolls over in 2106. Many older embedded systems use signed 32 bits for unix time (which starts Jan 1, 1970) that rolls over in 2038 (maximum value of 2147483647) and do not meet this standard. The PTP format also has fractional nanoseconds, which is based on 32 bits (10⁹ -1). PTP enables Ethernet devices to be precisely synchronized with very accurate timestamping. The event bus for the HES gateway does not normally require the same level of accuracy or precision, but using the PTP timestamp format allows for higher

precision if needed.

ASCII decimal is used to express this format. The number of decimal places should be consistent with the resolution of the timestamps and should not include extra zeros, which also conserves communications time. For example, if a device is capable of measuring timestamps in milliseconds, it should output 3 decimals such as “.325” and not “.325000000”.

3.3.4 secondsSinceEpoch

This format is appropriate for the majority of human-related activities such as schedules and meetings. This format uses the Precision Time Protocol (PTP) truncated timestamp format for seconds (IEEE 1588v1, also see RFC 8877 Section 4.3) which is 32 unsigned bits that rolls over in 2106. Many older embedded systems use signed 32 bits for unix time (which starts Jan 1, 1970) that rolls over in 2038 (maximum value of 2147483647) and does not meet this standard.

3.3.5 latitudeLongitude Format

The “latitudeLongitudeGeneral” format is used for identifying locations anywhere on earth. The “latitudeLongitudeGeneral” format is based upon the ISO 6709:2008 standard. In certain cases, the ISO 6709 standard provides options, such as using decimal degrees or minutes. While the range of formats in ISO 6709 is uniquely represented, allowing multiple formats for transmitting increases the complexity. Therefore, this ISO/IEC 18012-3 standard specifies the necessary detail beyond ISO 6709 standard to clarify usage, ensure interoperability and simplify implementations.

The degrees and decimal degrees format of ISO 6709 will only be used (H.2.2 and H3.2)). The height or depth may be included, but cannot be expected to be interpreted and used (H.4).

The most common map projection including for GPS systems and on the Internet is CRSWGS_84, which is used in most GPS systems. Therefore the Coordinate Reference Identification of CRSWGS_84 shall be used. In other words, an example of a valid expression of coordinates is “-39.345+120.546CRSWGS_84” (H.5).

The number of digits for latitude, longitude and height (depth) shall indicate the precision of available data (H.6.2).

No terminator characters shall be used (H.6.4).

3.3.6 timeDuration Format

The “timeDuration” format is used to express to human users the amount of time in a time interval. The “timeDuration” format is based on ISO 8601-1:2019. In certain cases, ISO 8601 provides options, such as extended and basic formats. This ISO/IEC 18012-3 standard specifies the necessary detail beyond ISO 8601 standard to clarify usage, ensure interoperability and simplify implementations.

The basic format of ISO 8601 shall be used. In other words, the “-” and “:” shall not be used for delimiters for dates and times.

A prefix of ‘P’ is used with date designators for year (‘Y’), month (‘M’), week (‘W’), day (‘D’). For example, “P2Y3M” refers to a duration of 2 years and 3 months.

A prefix of ‘T’ is used with time designators for hour (‘H’), minute (‘M’) and second (‘S’). For example, “PT4H3M” refers to a duration of 4 hours and 3 minutes.

Designators may be omitted if their value is zero. For example, “P3DT4M” refers to a duration of 3 days and 4 minutes.

Decimal fraction values may be used on the smallest element only using a ‘.’. Therefore, it is not appropriate to use 2.5 hours and 10 minutes (“PT2.5H10M”. Instead “PT2H40M”) should be used (2 hours and 40 minutes).

Date and time values may not exceed their moduli. Therefore, it is not appropriate to use 25 hours (“PT25H”). Instead “P1DT1H” should be used (1 day and 1 hour).

3.3.7 timeInterval Format

The “timeInterval” format is used to express to human users the amount of time in a time interval. The “timeInterval” format is based upon the ISO 8601-1:2019 standard. In certain cases, the ISO 8601 standard provides options, such as extended and basic formats. This ISO/IEC 18012-3 standard specifies the necessary detail beyond ISO 8601 standard to clarify usage, ensure interoperability and simplify implementations.

The basic format of ISO 8601 shall be used. In other words, the “-” and “:” shall not be used for delimiters for dates and times. The interval designator will be delimiter character ‘/’ will be used with a start time and duration. For example, “20211002T1100/PT1H” refers to a start time of Oct 2, 2021 at 11:00 running for 1 hour in duration (finishing at 12:00).

3.4 Memory storage/access types

There is a range of ways in which data is stored and accessed for objects throughout the HES gateway system. The types below specify the characteristics of each type.

3.4.1 RAM

“RAM” is volatile memory that can be changed and modified.

3.4.2 ROM

“ROM” is hard-coded preset data that does not change.

3.4.3 Operational

“Operational” is data that is modified via the system operations.

3.4.4 Database

“Database” is data that can be changed and modified from HES-CLME messaging, but remains after a power cycle (.e.g, flash memory).

3.4.5 Secret

“Secret” is information that is to be kept secret.

3.4.6 General

“General” is memory in which the specifics are not important.

3.4.7 Summary

Table 2 summarizes each memory storage/access type (memoryType) and specifies their characteristics. These memory types are allocated to data definitions throughout this standard and are to be followed as stated in this standard to ensure predictable and reliable HES gateway operations.

Table 2 – Memory Storage/Access Types (memoryType)

Memory Types	Trans Code	Initialized	Power Cycle	Changeable	Readability
RAM	‘ra’	-	lost	HES-CLME changeable	viewable
ROM	‘ro’	-	remains	preset	viewable
ROM-pre	‘pr’	pre-market	remains	preset	viewable
ROM-post	‘po’	post-market	remains	preset	viewable
Operational	‘op’	-	-	operational changeable	viewable
Database	‘db’	-	remains	HES-CLME changeable	viewable
Secret Programmed	‘sp’	pre-market	remains	preset	obscured
Secret Real Time	‘sr’	-	lost	changeable	obscured
Secret Database	‘sd’	-	remains	changeable	obscured
General	‘ge’	-	-	-	-

Initialized: how the information is initialized

- pre-market (e.g., manufacturer, developer)
- post-market (e.g., system integrator, installer)

Power Cycle: what happens to the data upon a power cycle; loss of power, and return of power

- lost: information is lost after a power cycle
- remains: information remains after a power cycle

Changeable: how the information is changed

- HES-CLME changeable: information may be changed via HES-CLME
- operation changeable: information may be changed via system operations (it cannot be changed directly via HES-CLME)
- preset: information is pre-set and cannot be changed via HES-CLME or due to operations

Readability: can information be read correctly or is it prevented from being viewed without proper keys via HES-CLME

- viewable
- obscured

3.5 Address/data types

To ensure communication links deal with messages reliably, predictably and consistently, three parameters are specified, dataPurpose, addrPoint and storageType, are specified. Other standards, such as the ISO/IEC 18012-4 event encoding standard, use these parameters to affect messaging.

The purpose for data used throughout this standard is identified in the “dataPurpose” parameter as shown below:

dataPurpose ('dp'):

Type	Trans Code	Description
configurationData	'cd'	Data to configure the modules or system, or to provide information about the modules or system (note: these data are initiated at time of manufacturing or through the customer specific “protected app”)
interactiveData	'id'	Real time interactive data that is subsequently used by the binding map for conversions
metaData	'md'	Data about interactiveData
serviceData	'sd'	Data transferred between service modules

The “addrPoint” parameter specifies whether noted addresses in this standard point to addressing information or point to data:

addrPoint ('ap'):

Type	Trans Code	Description
addrPoint ToAddr	'pa'	Address points to address only (not data)
addrPoint ToData	'pd'	Address points to data (configurationData, interactiveData, metaData or serviceData)

The type of data storage, whether atomic data or table, is specified in the “storageType” parameter. All data is atomicData unless otherwise specified.

storageType ('st'):

Type	Trans Code	Description
atomicData	'ad'	Atomic data
generalTable ⁵	'gt'	General table consisting of a number of rows
indexedTable ⁶	'it'	Table consisting of a number of rows with an unique key used to identify each row in table

4 Conformance requirements

[Editor's note: Will be defined in the future.]

5 Lexicon concepts, principles

In the field of linguistics, a lexicon is an inventory of words of a language and information about them. The term lexicon here is used to represent a listing of known HES application objects and actions, and structured information about them. This standard applies the structure specified in ISO/IEC 18012-2 *Taxonomy and application interoperability model* to establish a full compilation of the HES lexicon, including HES objects and actions (i.e., the nouns and verbs of the HES language) as well as their attributes.

The HES gateway relies on this lexicon to implement its internal translation processes (interworking function), operations, and management to achieve interoperability among networks and related application services. HES-CLME provides a complete linguistic construct (i.e., lexicon, syntax, and semantics) needed to express any function found in home and building electronic systems (for internal use within the HES gateway). It establishes an inclusive set of all relevant electronic systems and products used in practice to achieve interoperability among them.

5.1 Communicating “lexicon” on media

When data are exchanged on communications media, short forms of the information (see **shortLetters** format defined above) are used as much as possible. To reference the overall lexicon, the short form ‘**lx**’ is used.

6 Object concepts

6.1 Overview of object concepts

An object is a software model of a well-defined device for sensing or control, or a system operating task. The HES lexicon specifies five types of objects:

- 1)user objects,
- 2)remote objects,
- 3)binding map objects,
- 4)interface objects
- 5)and service objects.

These objects include associated properties or attributes such as state variables or parameters and associated data-types, properties, units, and ranges, depending on usage or functionality.

The diagram in Figure 2 shows the types of objects in relation to the HES gateway.

⁵ Terminology of SQL from ISO/IEC 9075 developed by JTC 1 SC32 is used for convenience only, any underlying data management system may be used

⁶ Terminology of SQL from ISO/IEC 9075 developed by JTC 1 SC32 is used for convenience only, any underlying data management system may be used

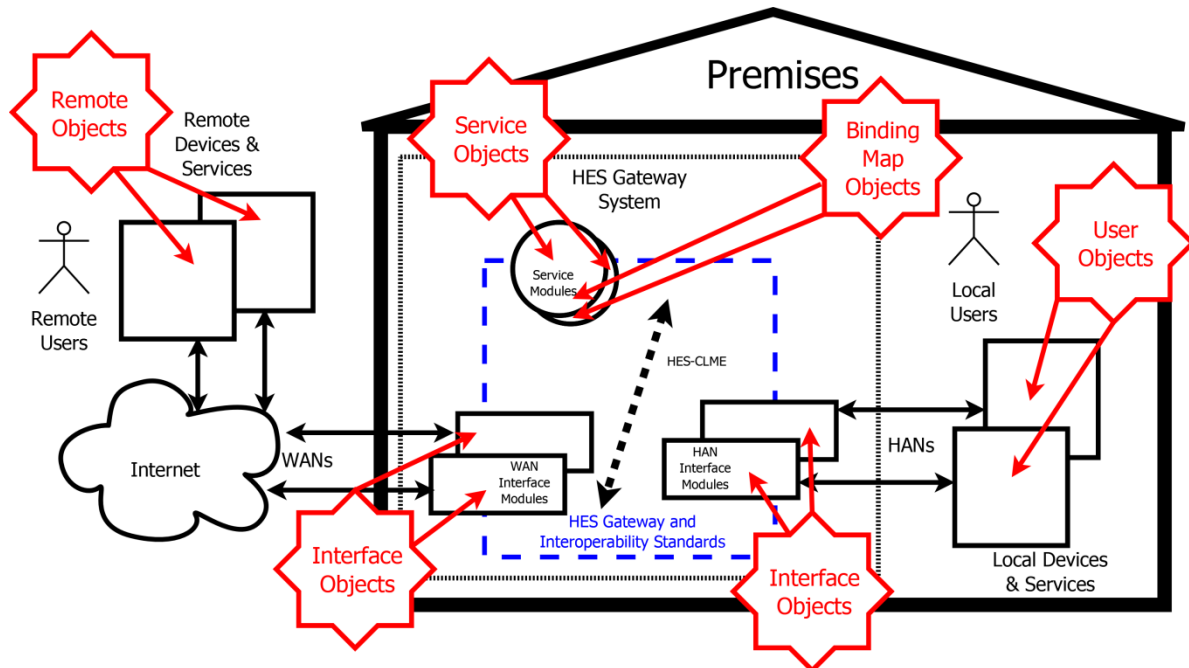


Figure 2 – Types of Objects in the HES Gateway

To reference an “object” in communications through HES-CLME, the short form ‘**ob**’ is used, whereas the short form of “action” is ‘**ac**’. As shown in Figure 3, the short form for “user objects” is ‘**uo**’, “remote objects” is ‘**ro**’, “binding map” is ‘**bo**’, “interface objects” is ‘**io**’ and “service objects” is ‘**so**’. See ISO/IEC 18012-4.

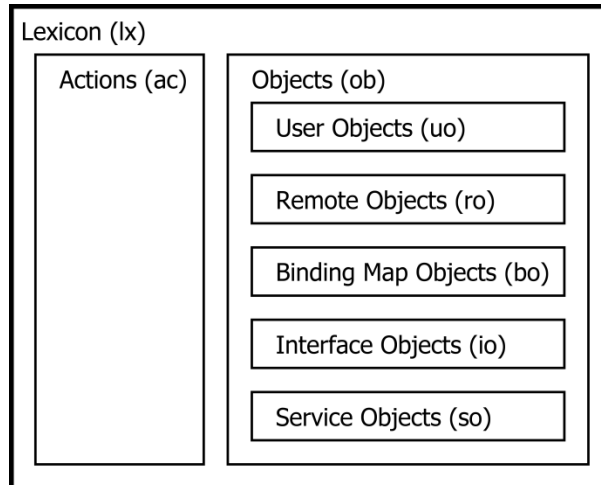


Figure 3 – Short forms formats for Actions and Objects in Lexicon

The hierarchical structure is communicated using a format similar to a file structure with a separator delineating the levels. As discussed in ISO/IEC 18012-4, Annex A, the separator used depends on the communications technique. Annex A specifies for HES-CLIP that the separator used is the character ‘/’. This results, for example, that the string “/lx/ob/ou” is used to convey user objects. This ‘/’ separator will be used throughout this ISO/IEC 18012-3 standard to make the documentation of the lexicon easier to understand.

For example, the string “/lx/ob/ou” shown within the Lighting Domain in this ISO/IEC 18012-3 document is the actual string for the HES-CLIP communications technique. For other communications techniques the string “/lx/ob/ou” means “**separator** lx **separator** ob **separator** ou” in which the separator is defined in ISO/IEC 18012-4.

For cases in which lexicon information is actually stored in the module as data, the ‘/’ separator will be used for all communication techniques to ensure interoperability. For example, valid data

to be stored in the lexiconToDiscover parameter in the Binding Map might be “/lx/ob/uo/”, in which case this data would be stored regardless of the communications technique (whether HES-CLIP or not).

ISO/IEC 18012-4, Annex A.1, specifies how lists or arrays are addressed, resulting in strings addresses such as “/lx/ob/bm/ot1” and “/lx/ob/bm/ot2”.

6.2 User object concepts

User objects ('uo') relate to local user devices and services within the premises.

As described in the ISO/IEC 18012-2 Standard (Section 7) and shown in Figure 4, the user objects are classified in a hierarchical structure using:

- Application Domains
- Functional Objects
- Application Objects

Application Domains group together functions that are closely aligned in the residential and small office environment. Typical Application Domains include lighting, heating and appliances.

A functional object may be composed of a logical grouping of objects to implement a higher level device or set of tasks. An example of a functional object might be a thermostat.

Application objects are objects associated with an end device application in a specific HAN or WAN network. An example of an application object might be a temperature sensor.

A common lexicon is defined in this standard to ensure that products from different networks can interoperate with a consistent and expected operation.

6.3 Binding map object concepts

Binding map objects ('bo') are associated with the binding map tables relating to applications. The tables provide the addressing connections and translations between objects.

6.4 Service object concepts

Service objects ('so') reside within the gateway but are associated with managing or servicing a network application residing on a HAN or WAN. Such application service functions include controller functions, processor functions, and other application-specific functions. Some service objects are not application-specific, but rather may be dedicated to gateway system management functions (e.g., system ID service, system clock, encryption key generation and management, etc.).

6.5 Interface object concepts

Interface objects ('io') are associated with an interface (module) between the gateway and a specific network (HAN or WAN). The interface modules carry out the transfer between the HES-CLME and a specific HAN or WAN protocol, including management of the interworking function (IWF), protocol, addressing, local memory, and other network management functions.

6.6 Remote object concepts

Remote objects ('ro') relate to remote user devices and services external to the premises.

7 Action concepts

The HES lexicon also includes a set of actions that may be carried out on or by application objects. Actions are composed of atomic action primitives (i.e., get, set, event-report, subscribe, etc.). Actions may be combined to form functional actions devoted to some high-level task or functionality. In other words, a functional action is a composite of one or more primitive actions from or to one or more application objects contained in a single functional object.

An example of an action might be to get a temperature reading from a sensor. Likewise, an example of a functional action might be to control the temperature in a room.

7.1 Communicating “action” on media

To reference “action”, usually initiated by events that occur in the system and communicated on the same media, the short form ‘**ac**’ is used.

8 Objects - Detailed Lexicon

As mentioned above, to reference Object in communications, the short form ‘**ob**’ is used.

9 User Objects - Detailed Lexicon

As mentioned above, to reference a “User Object” in communications, the short form ‘**uo**’ is used.

9.1 User Objects; introduction to components

User Objects are structured in a hierarchical structure, as shown below in Figure 4, consisting of:

- Application Domain
- Functional Object
- Application Object
- Property

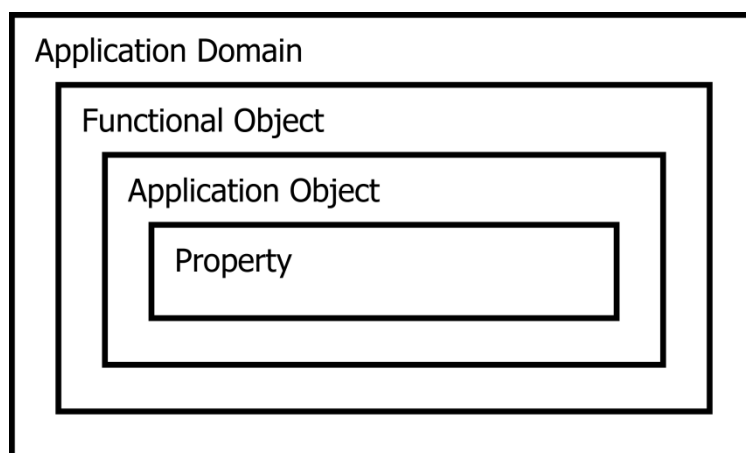


Figure 4 – Overview of User Objects

9.2 Common Objects and Structures

9.2.1 currentValue

“currentValue” is used for instantaneous information of properties.

The tables below show the DescriptiveNames and “Transmitted Codes” (TransCode) for the currentValue (‘cv’) metadata.

The TransCodes are unique within each table to ensure that there is only one way to signify each metadata expression. Default or initial values shown are applicable for all instances of currentValue, except where indicated within individual objects.

Table 3 – Pre-Market currentValue metaData

Pre-Market currentValue metaData (memoryType = 'pr')			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
dataType	'dt'	shortLetters 'de': decimal 'in': integer 'ls': lowerCaseString	Data type for value
numberOf Elements	'ne'	posInteger 1: single variable (default) >1: integers for arrays, arrays for matrix	Number of elements
positions	'po'	arrayInteger, nonNegInteger 0: nil or not applicable (default) >0: integers for arrays, arrays for matrix	Number of positions for switch
momentary	'mm'	zeroOne ": not applicable (default) 0: persistent 1: momentary	Indicates whether switch is persistent or momentary
radio	'rd'	zeroOne ": not applicable (default) 0: non-radio 1: radio	Indicates whether buttons are radio type
unitsOf Measure	'um'	shortLetters 'no': none (default) 'vt': volts 'wh': watt-hours 'wt': watts	The units of measure used for "Value"
measured Preset	'mp'	shortLetters ": not applicable (default) 'me': measured 'ca': calculated 'pr': preset 'fc': forecast	Indicates whether value is measured, calculated, preset (expected or nominal) or forecast
accuracy	'ar'	nonNegDecimal ": not applicable (default)	percentage accuracy of measurement (closeness to true value)
precision	'pr'	nonNegDecimal ": not applicable (default)	percentage precision of measurement (closeness to each other)
requirement	'rq'	shortLetters 'co': conditional 'ma': mandatory 'op': optional	Requirement for property within the Application Object
property Type	'pt'	shortLetters 'ep': electricpower 'hu': humidity 'li': light 'ms': mass 'no': none (default) 'tp': temperature 'ui': userinteface	Property Unit type
access	'ac'	shortLetters 'in': In 'io': In/Out 'ou': Out	Access direction of property in regards to application (e.g., "Out" for sensors, "In" for actuators)

Pre-Market currentValue metaData (memoryType = 'pr')			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
collected DataType	'cd'	shortLetters 'ni': not initialized (default) 'no': no collection of data 'pu': erased after intended purpose 'ti': timed erasing of data	Indicates the type of collection of data to support "privacy best practice" and "privacy next best practice" in ISO/IEC 15045-3-1, and to support the "Use, retention and disclosure limitation" privacy principle in ISO/IEC 15045-3-2
collected Data Parameter	'cp'	nonNegInteger 0: not applicable or not initialized (default) >0: seconds before erasing	Parameter related to CollectedDataType to support "privacy next best practice" in ISO/IEC 15045-3-1, and to support the "Use, retention and disclosure limitation" privacy principle in ISO/IEC 15045-3-2

Explanatory notes:

access:

The direction of "access", in or out, is related to the direction of the property in regard to the application.

As shown in Figure 5, access of "Out" is used for a sensor and access of "In" (Figure 6) is used for an actuator.

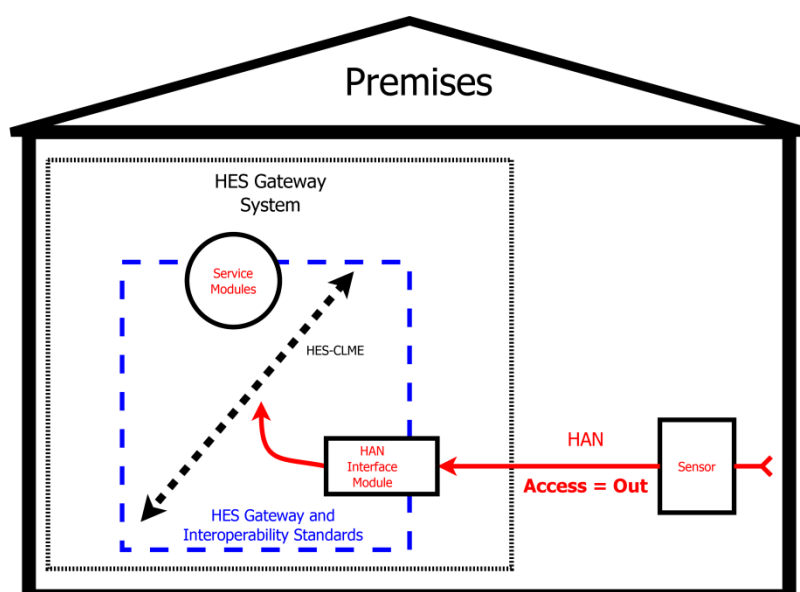


Figure 5 – Access direction of "Out" (Sensor)

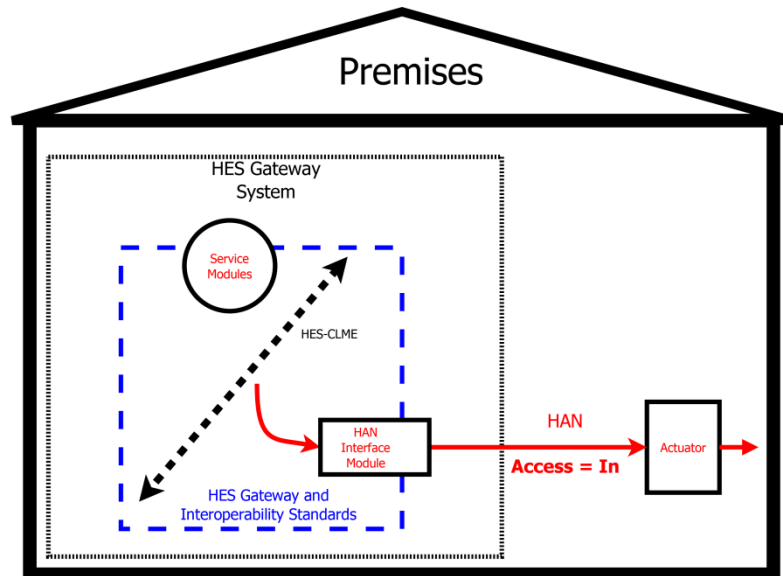


Figure 6 – Access direction of “In” (Actuator)

Table 4 – Post-Market currentValue metaData

Post-Market currentValue metaData (memoryType = ‘po’)			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
default	‘df’	type same as value ”: not applicable (default)	Default value of the property (also known as “rated” or “nominal” especially for sensors)
minimum	‘mn’	type same as value ”: not applicable (default)	Minimum that value can obtain
maximum	‘mx’	type same as value ”: not applicable (default)	Maximum that value can obtain
vulnerability	‘vl’	nonNegInteger 0: not initialized (default) >0: vulnerability weakness (higher numbers are more vulnerable)	Vulnerability or weakness that could be exploited or triggered by a threat source to support risk assessment in ISO/IEC 15045-3-1
adverse ImpactLevel	‘il’	nonNegInteger 0: not initialized (default) >0: impact level (higher values are higher impacts)	Adverse impact level of using attached HAN network and devices
likelihood Level	‘ll’	nonNegInteger 0: not initialized (default) >0: likelihood level (higher values are more likely to occur)	Likelihood of adverse impact occurring on the attached HAN network and devices

Post-Market currentValue metaData (memoryType = 'po')			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
riskLevel	'rl'	nonNegInteger 0: not initialized (default) >0: risk level (higher values are higher risk)	Calculated risk level of using attached HAN network and devices based upon a formula
privacy Purpose	'pp'	arrayShortLetters	Purpose in regards to privacy to support the "User, retention and disclosure" privacy principle in ISO/IEC 15045-3-2
privacy Audience	'pa'	arrayShortLetters	Intended Audience in regards to privacy to support the "Data minimization" privacy principle in ISO/IEC 15045-3-2

693

694

Table 5 – currentValue interactiveData

currentValue interactiveData (memoryType = 'ra')			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
value	'va'	any data type; dependent on application	Value of the property at the current time

695

696 9.2.2 previousValue

697 *[Editor's note: Will be defined in the future.]*

698 9.2.3 compareValue

699 "compareValue" is used for information of properties over a period of time, such as the watt-
700 hours over the last day.

701 The tables below show the DescriptiveNames and "Transmitted Codes" (TransCode) for the
702 compareValue ('cp') metaData.

703 All properties of currentValue (see Section 10.3.1) are included in compareValue with the
704 following additions:

705

Table 6 – Pre-Market compareValue metaData

Pre-Market compareValue Metadata (memoryType = 'pr')			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
compare Type	'ct'	shortLetters 'li': last interval 'no': now (default) 'ti': this interval	how to measure consumption by comparing values (final value) compared to last complete time interval (if 3:15; hour is from 2:00 to 3:00) compared to now (if 3:15; hour is from 2:15 to 3:15) compared to this complete time interval (if 3:15; hour is from 3:00 to 3:15)

706

707

Table 7 – Post-Market compareValue metaData

Post-Market compareValue metaData (memoryType = 'po')			
Descriptive Name	Trans Code	dataFormat and Preassigned Values	Description
second	'sc'		compared to 1 second ago
minute	'mi'		compared to 1 minute ago
hour	'ho'		compared to 1 hour ago
day	'dy'		compared to 1 day ago
week	'wk'		compared to 1 week ago
month	'mo'		compared to 1 month ago
year	'ye'		compared to 1 year ago

708

9.2.4 Other Properties

709

9.3 Application Domains

710

Below is a table of the application domains (which originates in the ISO/IEC 18012-2 standard), which may expand in the future. Entries in the “Descriptive Name” column are meaningful words to aid programmers in their development and transmitted codes used in reference to these application domains.

713

714

Application Domains:

List of Application Domains		
Descriptive Name	Transmitted Code	Description
energy Management	'em'	Energy Management: premises energy management and measurement (EMMA)
lighting	'li'	Lighting: controlling and sensing of lights
utility	'ut'	Utility: ancillary service such as electricity, gas or water
hvac	'hv'	HVAC (Heating, Ventilation, Air Conditioning): tba
userInterface	'ui'	User Interface: basic user interface functions such as button pushes etc.
audioVideo	'av'	Audio/Video: tba
telecommunications	't'	Telecommunications: tba
security	'se'	Security: tba
appliance	'ap'	Appliance: tba
convenience	'cn'	Convenience: applications involving windows, doors, garage, pool, pump etc.
commonUser Interface	'cu'	Common User Interface: enables one local human user interface to be used for multiple clusters
safetyCluster	'sc'	Safety Cluster: deals with overall safety concerns with the premises, such as sensing fire, water etc. and providing advisory and critical warnings
electricVehicle	'ev'	Electric Vehicle: supports mobile/stationary operations such as electric vehicle charging, reverse flow (V2G)
general	'ge'	General: not supported by other application domains

715

716

The application domain tables below are listed with the standardized lexicon of each application domain which ensures interoperability among different manufacturers. Each application domain included in this section include a summary hierarchical table and detailed object tables (such as 10.3.2 for the Lighting Domain).

718

719

The “preamble” shows the top level addressing which precedes the subsequent portions described in the tables. For example, the Lighting Domain section shows a preamble of “/lx/ob/uo”. The summary table specifies the “lighting” application domain as ‘li’. Therefore, the string “/lx/ob/uo/li” would be used to reference lighting.

In the summary table, the unshaded areas relate to the addressing of the objects (addrData of “address”) and are called “object reference codes”, no matter what level there are at. The codes for the names of the characteristics are also object reference codes. For example, in the Lighting Domain, object reference codes include ‘li’, ‘ll’, ‘da’, ‘cv’, and ‘dt’.

The shaded areas contain the data itself within the objects (addrData of “data”), either as preassigned values as noted, or using the data types as noted (described in the “Defined dataFormats” table in Table 1). If a characteristic is not shown, the default value as noted is to be used.

The light orange shaded areas labelled “interactiveData” contain the data that is transferred in real-time during the operation of the system (see “processor service” in the ISO/IEC 15045-3-2 standard), and is of “data” type (within addrData above) and is “interactiveData” (within dataPurpose above).

The light blue shaded areas labelled “metaData” point to more detailed information of “individual objects”. “metaData” are characteristics of data that are programmed either in the pre-market (e.g., by the manufacturer before shipping to customer) or post-market (e.g., by a dealer or integrator before or during installation at a customer site). (In some cases, a manufacturer may decide to implement characteristics listed as post-market before shipping to the customer.) These configuration data are not changed during the real-time operation (processing), and are of “data” type (described in addrData above) and constitute “metaData” (described in dataPurpose above).

The “individual objects” follow the summary and contain the full list of detailed information for each object. If a characteristic is not shown, the default value as noted (such as noted in the currentValue table, Section 11.2.1) is to be used.

9.3.1 Energy Management Domain

The Energy Management domain is used to support applications relating to energy management. Energy in relation to homes and buildings most often takes the form of electricity, but management may apply to any form of energy applied on the premises.

Each device shall contain basic information of its connections to power buses (e.g., AC, DC) and how it interacts to those power buses as described in this section. Figure 7 shows the range of interactions of the device to the power buses.

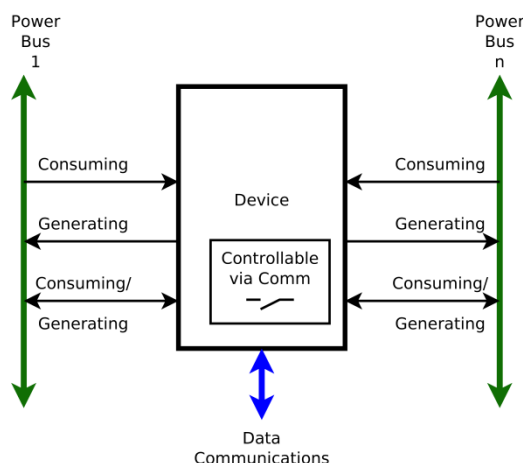


Figure 7 – Device interaction to Power Buses

A table within the object (called “elementTable”) contains the list of power bus connections for a device. It is stored in a database table⁷ consisting of a “row” entry for each power bus as shown below in Figure 8 and is a storageType of “indexedTable”.

power bus group #1
power bus group #2
power bus group #n

Figure 8 - List of Power Bus Groups

Each power bus group identifies the power bus (using index) (“powerBus”), indicates whether the device consumes or generates power (or both) (“consumeGenerate”) and indicates whether the device has the ability to be controlled via the communications link (“commControllable”). A device may contain multiple power buses.

These features are for information purposes to allow an energy management system to discover the devices it can control or that can generate power.

Figure 9 below shows the components within the power bus group:

power Bus 'pb'	consume Generate 'cg'	comm Controllable 'cc'
----------------------	-----------------------------	------------------------------

Figure 9 – Components within a Power Bus Group

A description of each component of the power bus group is listed below:

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
powerBus	Power bus identifier	'pb'	nonNegInteger	0: no power bus >0: unique reference to each power bus, starting at 1 and increasing for each subsequent power bus
consume Generate	Consuming, generating or both	'cg'	shortLetters	'co': consuming power (e.g., appliance or load) 'ge': generates power (e.g., solar panel) 'cg': can consume and generate power (e.g., battery)
comm Controllable	Can be controlled via communications link	'cc'	shortLetters	'no': operations relating to power cannot be controllable via communications 'ye': operations relating to power can be controllable via communications

⁷ Terminology of SQL from ISO/IEC 9075 developed by JTC 1 SC32 is used for convenience only, and the underlying data management system may be used

776 Top Level Object Address preamble: “/Ix/ob/uo”

Summary – Energy Management Domain

Object Address				interactive Data	Pre-market metaData	Post-market metaData
Application Domain	Functional Object	Appl Object	Property	Value ('va')	see individual objects	see individual objects
Supports applications relating to energy management						
energy Management 'em'	Structure of energy management					
	structure 'st'	element Table 'et'	current Value 'cv'	list of arrays: nonNegInteger, shortLetters, shortLetters	see individual objects	see individual objects

777

778 **elementTable – within Energy Management Domain**

779 **Description:** Retrieve characteristics of power buses for devices

780 **Object Address:**

Type	Trans Code	Descriptive Name
overallProcess	'lx'	lexicon
lexiconType	'ob'	object
objectType	'uo'	userObject
applicationDomain	'em'	energyManagement
functionalObject	'st'	structure
applicationObject	'et'	elementTable
property	'cv'	currentValue

781 **Pre-Market currentValue metaData (memoryType = 'pr'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
dataType	Data type for value	'dt'	array ShortLetters	'nn,sl,sl': corresponds to data types of 'pb', 'cg' and 'cc' variables (see power bus group in previous section)
numberOf Elements	Number of elements	'ne'	nonNegInteger	>=0: number of power buses
positions	Number of positions for switch	'po'	nonNegInteger	3: to include three variables ('pb', 'cg', 'cc')
Requirement	Requirement for property within the Application Object	'rq'	shortLetters	'ma': mandatory
collected DataType	Indicates the type of collection of data to support "privacy best practice" and "privacy next best practice" in ISO/IEC 15045-3-1	'cd'	shortLetters	Enumerated as indicated below: 'ni': not initialized 'no': no collection of data 'pu': erased after intended purpose 'ti': timed erasing of data
collected Data Parameter	Parameter related to Collected DataType to support "privacy next best practice" in ISO/IEC 15045-3-1	'cp'	nonNegInteger	Enumerated as indicated below: 0: not applicable or not initialized >0: seconds before erasing

782 **Post-Market currentValue metaData (memoryType = 'po'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
minimum	Minimum that value can obtain	'mn'	nonNegInteger, shortLetters, shortLetters	'0,,': index should not be below zero
vulnerability	Vulnerability or weakness that could be exploited or triggered by a threat source to support risk assessment in ISO/IEC 15045-3-1	'vl'	nonNegInteger	Range of values allowed: 0: not initialized >0: vulnerability weakness (higher numbers are more vulnerable)

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
adverse ImpactLevel	Adverse impact level of using attached HAN network and devices	'il'	nonNegInteger	0: not initialized >0: impact level (higher values are higher impacts)
likelihood Level	Likelihood of adverse impact occurring on the attached HAN network and devices	'll'	nonNegInteger	0: not initialized >0: likelihood level (higher values are more likely to occur)
riskLevel	Calculated risk level of using attached HAN network and devices	'rl'	nonNegInteger	0: not initialized >0: risk level (higher values are higher risk)
privacy Purpose	Purpose in regards to privacy to support the "User, retention and disclosure" privacy principle in ISO/IEC 15045-3-2	'pp'	arrayShortLetters	'ni': not initialized
privacy Audience	Intended Audience in regards to privacy to support the "Data minimization" privacy principle in ISO/IEC 15045-3-2	'pa'	arrayShortLetters	

783 **currentValue interactiveData (memoryType = 'po'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
value	Value of the property at the current time; corresponding to arrays of 'pb', 'cg', and 'cc'	'va'	list of arrays: nonNegInteger, shortLetters, shortLetters	

784

785

9.3.2 Lighting Domain

ISO/IEC TR 15067-2 describes the HES lighting model.

Top Level Object Address preamble: “/lx/ob/uo”

Summary - Lighting Domain

Object Address				interactive Data	Pre-market metaData	Post-market metaData
Application Domain	Functional Object	Appl Object	Property	Value ('va')	see individual objects	see individual objects
Supports applications relating to lighting						
Lighting 'li'	On/off Light Controller					
	Light Lamp 'll'	Digital Actuator 'da'	Current Value 'cv'	zeroOne type	see individual objects	see individual objects
		Digital Sensor 'ds'	Current Value 'cv'	zeroOne type	see individual objects	see individual objects

790 **Individual object – within Lighting Domain**

791 **Description:** Turn off or on a light

792 **Object Address:**

Type	Trans Code	Descriptive Name
overallProcess	'lx'	lexicon
lexiconType	'ob'	object
objectType	'uo'	userObject
applicationDomain	'li'	lighting
functionalObject	'll'	lightLamp
applicationObject	'da'	digitalActuator
property	'cv'	currentValue

793 **Pre-Market currentValue metaData (memoryType = 'pr'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
dataType	Data type for value	'dt'	shortLetters	'zo': zeroOrOne data type
numberOfElements	Number of elements	'ne'	posInteger	1: single variable
positions	Number of positions for switch	'po'	nonNegInteger	2: 2 position switch (off/on)
momentary	Indicates whether switch is persistent or momentary	'mm'	zeroOne	0: persistent
radio	Indicates whether buttons are radio type	'rd'	zeroOne	0: non-radio
unitsOfMeasure	The units of measure used for "Value"	'um'	shortLetters	'no': none
measuredPreset	Indicates whether value is measured, calculated, preset (expected or nominal) or forecast	'mp'	shortLetters	Enumerated as indicated below: '': not applicable (default) 'me': measured 'ca': calculated 'pr': preset 'fc': forecast
accuracy	Percentage accuracy of measurement (closeness to true value)	'ar'	nonNegDecimal	'': not applicable (default)
precision	Percentage precision of measurement (closeness to each other)	'pr'	nonNegDecimal	'': not applicable (default)
requirement	Requirement for property within the Application Object	'rq'	shortLetters	'ma': mandatory
propertyType	Property Unit type	'pt'	shortLetters	'li': light
access	Access direction of property in regards to application	'ac'	shortLetters	'in': direction of "in" in regards to application (e.g., actuator)
collectedDataType	Indicates the type of collection of data to support "privacy best practice" and "privacy next best practice" in ISO/IEC 15045-3-1	'cd'	shortLetters	Enumerated as indicated below: 'ni': not initialized 'no': no collection of data 'pu': erased after intended purpose 'ti': timed erasing of data
collectedDataParameter	Parameter related to Collected DataType to support "privacy next best practice" in ISO/IEC 15045-3-1	'cp'	nonNegInteger	Enumerated as indicated below: 0: not applicable or not initialized >0: seconds before erasing

794

Post-Market currentValue metaData (memoryType = 'po'):

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
default	Default value of property	'df'	zeroOne	Enumerated as indicated below: 0: default off 1: default on

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
minimum	Minimum that value can obtain	‘mn’	zeroOne	0: value cannot go below 0
maximum	Maximum that value can obtain	‘mx’	zeroOne	1: value cannot go above 1
vulnerability	Vulnerability or weakness that could be exploited or triggered by a threat source to support risk assessment in ISO/IEC 15045-3-1	‘vl’	nonNegInteger	Range of values allowed: 0: not initialized >0: vulnerability weakness (higher numbers are more vulnerable)
adverse ImpactLevel	Adverse impact level of using attached HAN network and devices	‘il’	nonNegInteger	0: not initialized >0: impact level (higher values are higher impacts)
likelihood Level	Likelihood of adverse impact occurring on the attached HAN network and devices	‘ll’	nonNegInteger	0: not initialized >0: likelihood level (higher values are more likely to occur)
riskLevel	Calculated risk level of using attached HAN network and devices	‘rl’	nonNegInteger	0: not initialized >0: risk level (higher values are higher risk)
privacy Purpose	Purpose in regards to privacy to support the “User, retention and disclosure” privacy principle in ISO/IEC 15045-3-2	‘pp’	arrayShortLetters	
privacy Audience	Intended Audience in regards to privacy to support the “Data minimization” privacy principle in ISO/IEC 15045-3-2	‘pa’	arrayShortLetters	

795

currentValue interactiveData (memoryType = ‘ra’):

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
value	Value of the property at the current time	‘va’	zeroOne	0, 1

796 **Individual object – within Lighting Domain**

797 **Description:** Detect presence of a light

798 **Object Address:**

Type	Trans Code	Descriptive Name
overallProcess	'lx'	lexicon
lexiconType	'ob'	object
objectType	'uo'	userObject
applicationDomain	'li'	Lighting
functionalObject	'll'	Light Lamp
applicationObject	'ds'	Digital Sensor
property	'cv'	Current Value

799 **Pre-Market currentValue metaData (memoryType = 'pr'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
dataType	Data type for value	'dt'	shortLetters	'zo': zeroOrOne data type
numberOfElements	Number of elements	'ne'	posInteger	1: single variable
positions	Number of positions for switch	'po'	nonNegInteger	2: 2 position switch (off/on)
momentary	Indicates whether switch is persistent or momentary	'mm'	zeroOne	0: persistent
radio	Indicates whether buttons are radio type	'rd'	zeroOne	0: non-radio
unitsOfMeasure	The units of measure used for "Value"	'um'	shortLetters	'no': none
measuredPreset	Indicates whether value is measured, calculated, preset (expected or nominal) or forecast	'mp'	shortLetters	Enumerated as indicated below: '': not applicable (default) 'me': measured 'ca': calculated 'pr': preset 'fc': forecast
accuracy	Percentage accuracy of measurement (closeness to true value)	'ar'	nonNegDecimal	'': not applicable (default)
precision	Percentage precision of measurement (closeness to each other)	'pr'	nonNegDecimal	'': not applicable (default)
requirement	Requirement for property within the Application Object	'rq'	shortLetters	'op': optional
propertyType	Property Unit type	'pt'	shortLetters	'li': light
access	Access direction of property in regards to application	'ac'	shortLetters	'ou': direction of "out" in regards to application (e.g., sensor)
collectedDataType	Indicates the type of collection of data to support "privacy best practice" and "privacy next best practice" in ISO/IEC 15045-3-1	'cd'	shortLetters	Enumerated as indicated below: 'ni': not initialized 'no': no collection of data 'pu': erased after intended purpose 'ti': timed erasing of data
collectedDataParameter	Parameter related to Collected DataType to support "privacy next best practice" in ISO/IEC 15045-3-1	'cp'	nonNegInteger	Enumerated as indicated below: 0: not applicable or not initialized >0: seconds before erasing

800 **Post-Market currentValue metaData (memoryType = 'po'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
default	Default value of property	'df'	zeroOne	Enumerated as indicated below: 0: default off 1: default on
minimum	Minimum that value can obtain	'mn'	zeroOne	0: value cannot go below 0
maximum	Maximum that value can obtain	'mx'	zeroOne	1: value cannot go above 1
vulnerability	Vulnerability or weakness that could be exploited or triggered by a threat source to support risk assessment in ISO/IEC 15045-3-1	'vl'	nonNegInteger	Range of values allowed: 0: not initialized >0: vulnerability weakness (higher numbers are more vulnerable)
adverse ImpactLevel	Adverse impact level of using attached HAN network and devices	'il'	nonNegInteger	0: not initialized >0: impact level (higher values are higher impacts)
likelihood Level	Likelihood of adverse impact occurring on the attached HAN network and devices	'll'	nonNegInteger	0: not initialized >0: likelihood level (higher values are more likely to occur)
riskLevel	Calculated risk level of using attached HAN network and devices	'rl'	nonNegInteger	0: not initialized >0: risk level (higher values are higher risk)
privacy Purpose	Purpose in regards to privacy to support the "User, retention and disclosure" privacy principle in ISO/IEC 15045-3-2	'pp'	arrayShortLetters	
privacy Audience	Intended Audience in regards to privacy to support the "Data minimization" privacy principle in ISO/IEC 15045-3-2	'pa'	arrayShortLetters	

801 **currentValue interactiveData (memoryType = 'ra'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
value	Value of the property at the current time	'va'	zeroOne	

802 **9.3.3 Utility Domain**

803 Top Level Object Address preamble: “/lx/ob/ou”

804 *[Editor’s note: It is anticipated that future editions will likely go to 4th level numbering in this*
805 *section to improve readability.]*

Summary - Utility Domain

Object Address				interactive Data	Pre-market metaData	Post-market metaData
Application Domain	Functional Object	Appl Object	Property	Value ('va')	see individual objects	see individual objects
Ancillary service such as electricity, gas or water						
utility 'ut'	Sensor for amount of power being consumed by an appliance or premises, or generated by an energy resource such as a solar panel or battery					
	power Sensor 'ps'	analog Sensor 'as'	current Value 'cv'	decimal type	see individual objects	see individual objects
	Sensor of current flowing into an appliance or out of energy resource such as a solar panel or battery					
	elecCurrent Sensor 'cs'	analog Sensor 'as'	current Value 'cv'	decimal type	see individual objects	see individual objects
	Sensor of DC voltage being presented to an appliance or premises or power bus					
	dcVoltage Sensor 'dv'	analog Sensor 'as'	current Value 'cv'	decimal type	see individual objects	see individual objects
	Sensor of AC voltage being presented to an appliance or premises or power bus					
	acVoltage Sensor 'av'	analog Sensor 'as'	current Value 'cv'	nonNeg Decimal type	see individual objects	see individual objects
	Sensor of electrical energy consumed or generated by a device at this time					
	energy Sensor 'es'	analog Sensor 'as'	current Value 'cv'	decimal X 3 type	see individual objects	see individual objects
	Sensor of electrical energy consumed or generated over a time period					
	energy Sensor 'es'	analog Sensor 'as'	compare Value 'cp'	decimal X 3 type	see individual objects	see individual objects
	Sensor of frequency of a power bus					
	freq Sensor 'fs'	analog Sensor 'as'	current Value 'cv'	nonNeg Decimal type	see individual objects	see individual objects
	Sensor of power factor of a power bus					
	powerFactor Sensor 'pf'	analog Sensor 'as'	current Value 'cv'	decimal type	see individual objects	see individual objects
	Mode of energy storage operation (e.g., consuming, generating)					
	energy StorageMode 'em'	digital Actuator 'da'	current Value 'cv'	short Letters type	see individual objects	see individual objects
	Energy storage remaining					
	energy StorageMode 'em'	analog Sensor 'as'	current Value 'cv'	short Letters type	see individual objects	see individual objects

Description: Sensor for amount of electrical power being consumed by an appliance or premises, or generated by an energy resource such as a solar panel or battery.

Diagram: The diagram below in Figure 10 shows how the measurements are made.

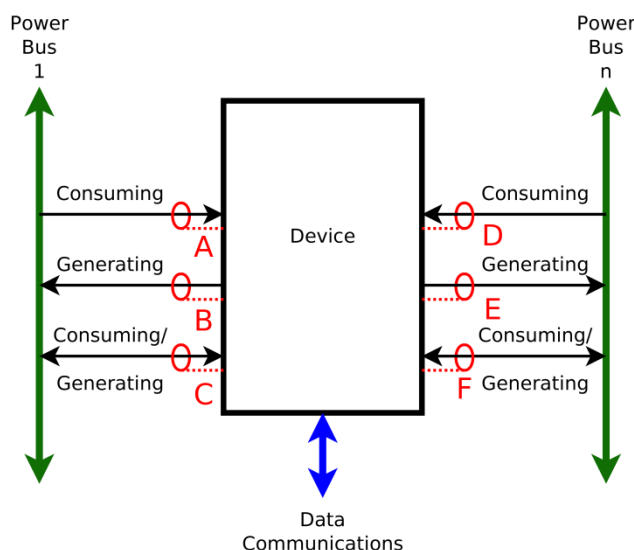


Figure 10 – Electrical Power Sensor Element Model

In Figure 10, the red ovals (labelled 'A' to 'F') represent current sensors. The black arrows represent current draw into or out of the devices. The green arrows represent power buses. The blue arrows represent data communication.

As shown in Figure 10, a device that only consumes power uses sensor "A". A device that only generates power uses sensor "B". A device that consumes or generates power uses sensor "C" for the overall power. Positive values are used to denote consumption and negative values for generation.

If more than one power bus is used, then the sensors "D", "E" and "F" are used.

Object Address:

Type	Trans Code	Descriptive Name
overallProcess	'lx'	lexicon
lexiconType	'ob'	object
objectType	'uo'	userObject
applicationDomain	'ut'	utility
functionalObject	'ps'	powerSensor
applicationObject	'as'	analogSensor
property	'cv'	currentValue

Note: To designate Power Bus 2, 3 etc., 'cv2', 'cv3' etc. is used in place of 'cv' for property.

Pre-Market currentValue metaData (memoryType = 'pr'):

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
dataType	Data type for value	'dt'	array ShortLetters	'nd,nd,de': nonNegDecimal data type X 2, decimal
numberOf Elements	Number of elements	'ne'	posInteger	1: single variable
positions	Number of positions for switch	'po'	nonNegInteger	": n/a

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
momentary	Indicates whether switch is persistent or momentary	'mm'	zeroOne	": n/a
radio	Indicates whether buttons are radio type	'rd'	zeroOne	": n/a
unitsOf Measure	The units of measure used for "Value"	'um'	shortLetters	'wa': watts (<i>note: conversion to volt-amps will need to take power factor into account</i>)
measured Preset	Indicates whether value is measured, calculated or preset	'mp'	shortLetters	'me': measured 'ca': calculated 'pr': preset 'fc': forecast
accuracy	Accuracy of measurement	'ar'	nonNegDecimal	percentage accuracy of measurement (closeness to true value)
precision	Precision of measurement	'pr'	nonNegDecimal	percentage precision of measurement (closeness to each other)
requirement	Requirement for property within the Application Object	'rq'	shortLetters	'op': optional
property Type	Property Unit type	'pt'	shortLetters; [da, ad, md]	'el': electricity
access	Access direction of property in regards to application	'ac'	shortLetters	'ou': direction of "out" in regards to application (e.g., sensor)
collected DataType	Indicates the type of collection of data to support "privacy best practice" and "privacy next best practice" in ISO/IEC 15045-3-1	'cd'	shortLetters	Enumerated as indicated below: 'ni': not initialized 'no': no collection of data 'pu': erased after intended purpose 'ti': timed erasing of data
collected Data Parameter	Parameter related to Collected DataType to support "privacy next best practice" in ISO/IEC 15045-3-1	'cp'	nonNegInteger	Enumerated as indicated below: 0: not applicable or not initialized >0: seconds before erasing

824

Post-Market currentValue metaData (memoryType = 'po'):

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
default	Default value of property (also known as "rated" or "nominal")	'df'	arrayDecimal	
minimum	Minimum that value can obtain	'mn'	arrayDecimal	
maximum	Maximum that value can obtain	'mx'	arrayDecimal	

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
vulnerability	Vulnerability or weakness that could be exploited or triggered by a threat source to support risk assessment in 15045-3-1	‘vl’	nonNegInteger	Range of values allowed: 0: not initialized >0: vulnerability weakness (higher numbers are more vulnerable)
adverse ImpactLevel	Adverse impact level of using attached HAN network and devices	‘il’	nonNegInteger	0: not initialized >0: impact level (higher values are higher impacts)
likelihood Level	Likelihood of adverse impact occurring on the attached HAN network and devices	‘ll’	nonNegInteger	0: not initialized >0: likelihood level (higher values are more likely to occur)
riskLevel	Calculated risk level of using attached HAN network and devices	‘rl’	nonNegInteger	0: not initialized >0: risk level (higher values are higher risk)
privacy Purpose	Purpose in regards to privacy to support the “User, retention and disclosure” privacy principle in ISO/IEC 15045-3-2	‘pp’	arrayShortLetters	
privacy Audience	Intended Audience in regards to privacy to support the “Data minimization” privacy principle in ISO/IEC 15045-3-2	‘pa’	arrayShortLetters	

825 **currentValue interactiveData (memoryType = ‘ra’):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
value	Value of the property at the current time	‘va’	arrayDecimal	positive value for consuming; positive value for generating; decimal value for overall

Electrical Current Sensor

Description: Sensor of electrical current flowing into an appliance or out of energy resource such as a solar panel or battery.

Diagram: The diagram below in Figure 11 shows how the measurements are made.

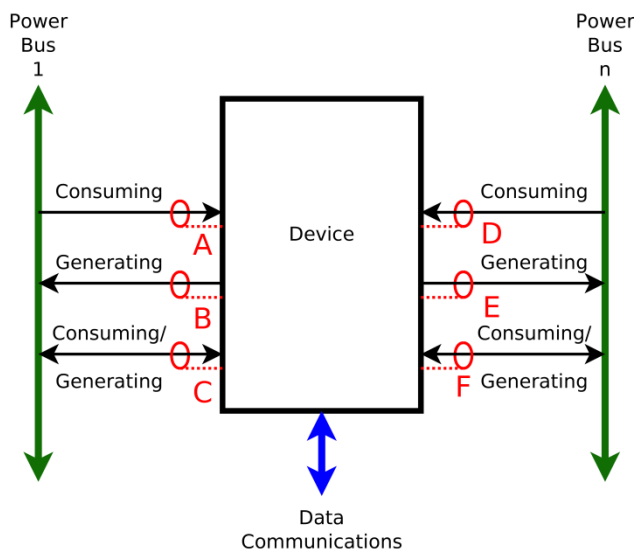


Figure 11 – Electrical Current Sensor Element Model

As shown in Figure 11, a device that only draws current from the power bus uses sensor “A”. A device that only outputs current uses sensor “B”. A device that draws or outputs current uses

834 sensor “C” for the overall current. Positive values are used to denote consumption and negative
835 values for generation.

836 If more than one power bus is used, then the sensors “D”, “E” and “F” are used.

837 **Object Address:**

Type	Trans Code	Descriptive Name
overallProcess	‘lx’	lexicon
lexiconType	‘ob’	object
objectType	‘uo’	userObject
applicationDomain	‘ut’	utility
functionalObject	‘cs’	currentSensor
applicationObject	‘as’	analogSensor
property	‘cv’	currentValue

838 *Note: To designate Power Bus 2, 3 etc., ‘cv2’, ‘cv3’ etc. is used in place of ‘cv’ for property.*

839 **Pre-Market currentValue metaData (memoryType = ‘pr’):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
dataType	Data type for value	'dt'	shortLetters	'de': decimal data type
numberOfElements	Number of elements	'ne'	posInteger	1: single variable
positions	Number of positions for switch	'po'	nonNegInteger	": n/a
momentary	Indicates whether switch is persistent or momentary	'mm'	zeroOne	": n/a
radio	Indicates whether buttons are radio type	'rd'	zeroOne	": n/a
unitsOfMeasure	The units of measure used for "Value"	'um'	shortLetters	'am': amperes
measuredPreset	Indicates whether value is measured, calculated or preset	'mp'	shortLetters	'me': measured 'ca': calculated 'pr': preset 'fc': forecast
accuracy	Accuracy of measurement	'ar'	nonNegDecimal	percentage accuracy of measurement (closeness to true value)
precision	Precision of measurement	'pr'	nonNegDecimal	percentage precision of measurement (closeness to each other)
requirement	Requirement for property within the Application Object	'rq'	shortLetters	'op': optional
propertyType	Property Unit type	'pt'	shortLetters	'el': electricity
access	Access direction of property in regards to application	'ac'	shortLetters	'ou': direction of "out" in regards to application (e.g., sensor)
collectedDataType	Indicates the type of collection of data to support "privacy best practice" and "privacy next best practice" in ISO/IEC 15045-3-1	'cd'	shortLetters	Enumerated as indicated below: 'ni': not initialized 'no': no collection of data 'pu': erased after intended purpose 'ti': timed erasing of data
collectedDataParameter	Parameter related to Collected DataType to support "privacy next best practice" in ISO/IEC 15045-3-1	'cp'	nonNegInteger	Enumerated as indicated below: 0: not applicable or not initialized >0: seconds before erasing

840

Post-Market currentValue metaData (memoryType = 'po'):

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
default	Default value of property (also known as "rated" or "nominal")	'df'	decimal	
minimum	Minimum that value can obtain	'mn'	decimal	

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
maximum	Maximum that value can obtain	'mx'	decimal	
vulnerability	Vulnerability or weakness that could be exploited or triggered by a threat source to support risk assessment in ISO/IEC 15045-3-1	'vl'	nonNegInteger	Range of values allowed: 0: not initialized >0: vulnerability weakness (higher numbers are more vulnerable)
adverse ImpactLevel	Adverse impact level of using attached HAN network and devices	'il'	nonNegInteger	0: not initialized >0: impact level (higher values are higher impacts)
likelihood Level	Likelihood of adverse impact occurring on the attached HAN network and devices	'll'	nonNegInteger	0: not initialized >0: likelihood level (higher values are more likely to occur)
riskLevel	Calculated risk level of using attached HAN network and devices	'rl'	nonNegInteger	0: not initialized >0: risk level (higher values are higher risk)
privacy Purpose	Purpose in regards to privacy to support the "User, retention and disclosure" privacy principle in ISO/IEC 15045-3-2	'pp'	arrayShortLetters	
privacy Audience	Intended Audience in regards to privacy to support the "Data minimization" privacy principle in ISO/IEC 15045-3-2	'pa'	arrayShortLetters	

841 **currentValue interactiveData (memoryType = 'ra'):**

Descriptive Name	Description	Trans Code	dataFormat	Preassigned Values or Enumerated Values or Valid Range
value	Value of the property at the current time	'va'	decimal	positive values for consuming, negative values for generating

DC Voltage Sensor

Description: Sensor of DC voltage being presented to an appliance or premises or power bus.

Diagram: The diagram below in Figure 12 shows how the measurements are made.

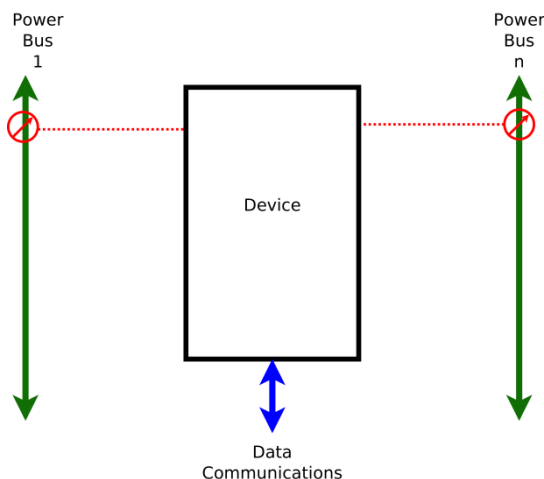


Figure 12 – DC Voltage Sensor Element Model

As shown in Figure 12 through the use of the red symbol, the device measures the DC voltage on power bus 1. If more than one power bus is used, then the appropriate sensor is used. The device itself may or may not draw power.

Object Address:

Type	Trans Code	Descriptive Name
overallProcess	'lx'	lexicon
lexiconType	'ob'	object
objectType	'uo'	userObject
applicationDomain	'ut'	utility
functionalObject	'dv'	dcVoltageSensor
applicationObject	'as'	analogSensor
property	'cv'	currentValue

Note: To designate Power Bus 2, 3 etc., 'cv2', 'cv3' etc. is used in place of 'cv' for property.

Pre-Market currentValue metaData (memoryType = 'pr'):