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Home and Building Electronic Systems (HBES) – Part 4-2: Media independent layers – Transport layer, network layer and general parts of data link layer for HBES Class 1

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Home and Building Electronic Systems (HBES) Part 4-2: Media independent layers - Transport layer, network layer and general parts of data link layer for HBES Class 1

Systèmes électroniques pour les foyers domestiques et les bâtiments (HBES) Partie 4-2: Couches indépendantes des media - Couches transport, réseau et parties générales de la couche données pour HBES Classe 1

Elektrische Systemtechnik für Heim und Gebäude (ESHG) Teil 4-2: Medienunabhängige Schicht - Transportschicht, Vermittlungsschicht und allgemeine Teile der Sicherungsschicht für ESHG Klasse 1

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 205, Home and Building Electronic Systems (HBES) with the help of CENELEC co-operation partner Konnex Association (formerly EHBESA).

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50090-4-2 on 2003-12-02.

This European Standard supersedes R205-008:1996.

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Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights other than those identified above. CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2004-12-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-12-01

EN 50090-4-2 is part of the EN 50090 series of European Standards, which will comprise the following parts:

Part 1: Standardisation structure
Part 2: System overview
Part 3: Aspects of application
Part 4: Media independent layers
Part 5: Media and media dependent layers
Part 6: Interfaces
Part 7: System management
Part 8: Conformity assessment of products
Part 9: Installation requirements

Introduction

This standard specifies the Media independent requirements for the data link layer and the requirements for the network layer and the transport layer for Home and Building Electronic Systems.

This standard provides the communication stack targeted for providing the services specified in EN 50090-3-2 “User Process” and EN 50090-4-1 “Application Layer for HBES Class 1”. It can be used as communication stack on the physical layers as specified in EN 50090-5.

1 Scope

This part of the EN 50090 specifies the services and protocol in a physical layer independent way for the data link layer and for the network layer and the transport layer for usage in Home and Building Electronic Systems

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 50090-1 [1)] *Home and Building Electronic Systems (HBES) – Part 1: Standardisation structure*

EN 50090-3-2:2004 *Home and Building Electronic Systems (HBES) – Part 3-2: Aspects of application – User process for HBES Class 1*

EN 50090-4-1:2004 *Home and Building Electronic Systems (HBES) – Part 4-1: Media independent layers – Application layer for HBES Class 1*

EN 50090-5 series *Home and Building Electronic Systems (HBES) – Part 5: Media and media dependent layers*

ISO 7498 series *Information technology - Open Systems Interconnection - Basic reference model*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this part the terms and definitions given in EN 50090-1 and the following apply.

3.1.1
individual address
IA
unique identifier for every device in a network. The individual address is a 2-octet value that consists of an 8-bit subnetwork address and an 8-bit device address

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1) At draft stage.

3.1.2
sub network address
SNA
part of the individual address, consists of a 4-bit line address and a 4-bit area address, that specifies the subnetwork in which the device is mounted

3.1.3
area address
part of the individual address that specifies the area in which the device is mounted

3.1.4
line address
part of the individual address that specifies the line in which the device is mounted

3.1.5
device address
unique identifier for every device in a subnetwork. The device address is an 8-bit value

NOTE Figure 1 shows the relationship between individual address, subnetwork address, area address, line address and device address.

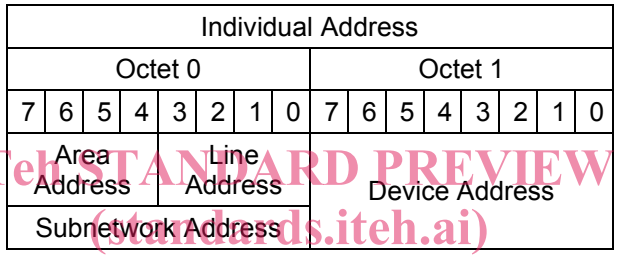

Figure 1 – Individual address

3.1.6
group address
GA
a 2-octet value

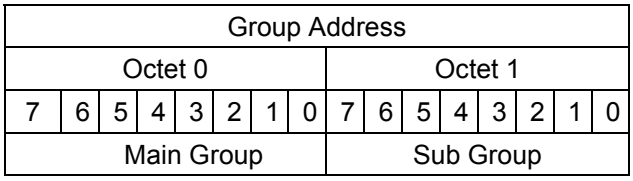

Figure 2 – Group address

3.1.7
datagram
full sequence of elements (physical symbols) transporting a frame on the physical medium

3.1.8
frame
sequence of octets exchanged between data link layers through the physical layer

3.2 Abbreviations

ack	Acknowledge
APDU	Application layer Protocol Data Unit
con	confirmation

GA	Group Address
HBES Class 1	refers to simple control and command.
HBES Class 2	refers to Class 1 plus simple voice and stable picture transmission
HBES Class 3	refers to Class 2 plus complex video transfers
IA	Individual Address
ind	indication
iack	Immediate Acknowledge
LPDU	Link layer Protocol Data Unit
LSDU	Link layer Service Data Unit
nack	Negative Acknowledge
NPDU	Network layer Protocol Data Unit
NSDU	Network layer Service Data Unit
PDU	Protocol Data Unit
req	request
SNA	Sub-Network Address
TSAP	Transport layer Service Access Point
TPDU	Transport layer Protocol Data Unit
UART	Universal Asynchronous Receiver Transmitter

4 Requirements for the physical layer and independent data link layer

4.1 Functions of the data link layer

The data link layer (also called "Layer-2") is the layer between the data link layer user and the physical layer. The data link layer conforms to the definitions of the ISO/OSI model (ISO 7498) data link layer. It provides medium access control and logical link control.

The data link layer is concerned with reliable transport of single frames between two or more devices on the same subnetwork.

When transmitting it is responsible for

- building up a complete frame from the information passed to it by the network layer,
- gaining access to the medium according to the particular medium access protocol in use, and
- transmitting the frame to the data link layer in the peer entity or entities, using the services of the physical layer.

If the transmission fails, the transmitting data link layer may decide to try again after a certain interval. In particular, if the remote device signals that its buffers are temporarily full, the data link layer will wait for a pre-determined time and then attempt to re-transmit the frame (flow control).

When receiving, data link layer is responsible for

- determining whether the frame is intact or corrupted,
- deciding after destination address check to pass the frame to upper layers, and
- issuing positive or negative acknowledgements back to the transmitting data link layer.

The data link layer shall provide some means to prevent from service duplication (in case of repetitions because of corrupted acknowledgement frames).

The services provided include individual, group and broadcast addressing options.

The data link layer uses the services of the physical layer and provides services to the data link layer user (see Figure 3).

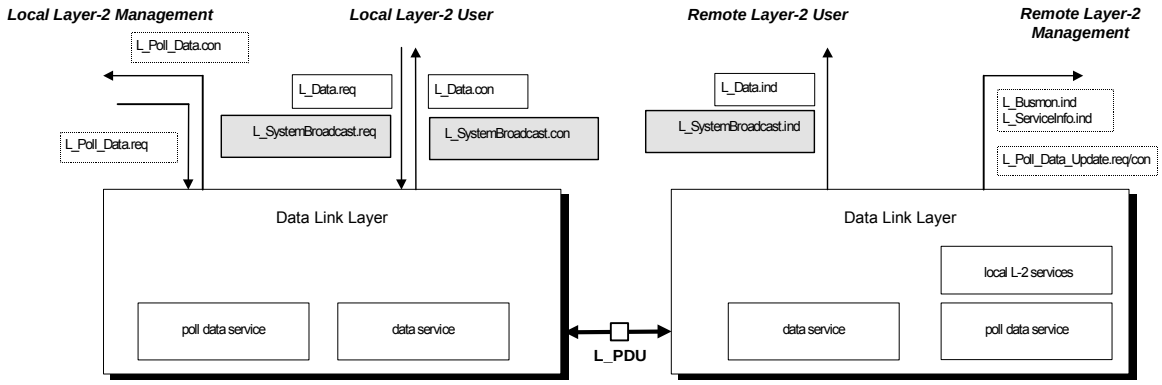

Figure 3 – Interaction of the data link layer

4.2 Possible media and their impact on Layer-2

The data link layer is defined for the following media:

Twisted Pair 0;

Twisted Pair 1;

Powerline 110;

Powerline 132;

Radio Frequency.

Data link layer will also be defined for the following media:

Infra-red;

Ethernet.

The data link layer is open for new media in the future.

Each medium needs a dedicated medium access control and a logical link control that adapts to the medium access control. This clause focuses on medium independent features, this is, mainly on the provided service interface to network layer.

The physical layer dependent requirements are specified in EN 50090-5.

4.3 Data link layer services

4.3.1 Data link layer modes

The data link layer mode defines which data link layer services shall be available to the data link layer user. There shall be 2 data link layer modes:

a) the normal mode;

b) the busmonitor mode.

In normal mode the remote L_Data service, the remote L_SystemBroadcast service, the remote L_Poll_Data service and the local L_Service_Information service shall be available to the data link layer user. In busmonitor mode only the local L_Busmon service shall be available. The data link layer mode is a parameter of Layer-2.

The frame effectively sent on the physical medium Link layer Protocol Data Unit (LPDU) is medium dependent. Therefore it is described in EN 50090-5.

4.3.2 L_Data service

4.3.2.1 General

The L_Data service is a frame transfer service. It transmits a single Link layer Service Data Unit (LSDU) to data link layer of one or several devices connected to the same subnetwork. The destination address may be an individual address or a group address (multicast or broadcast). The service is acknowledged or not, depending on the quality of service requested.

There shall be three service primitives:

a) L_Data.Req shall be used to transmit a frame;

b) L_Data.Ind shall be used to receive a frame;

c) L_Data.Con shall be used as a local primitive generated by the local Layer-2 for its own client to indicate that it is satisfied with the transmission.

Figure 4 – Exchange of primitives for the L_Data-Service

If the local user of Layer-2 prepares an LSDU for the remote user it shall apply the L_Data.req primitive to pass the LSDU to the local Layer-2. The local Layer-2 shall accept the service request and try to send the LSDU to the remote Layer-2 with the relevant frame format.

The local Layer-2 shall pass an L_Data.con primitive to the local user that indicates either a correct or erroneous data transfer. Depending if an L2-acknowledgement is requested or not, this confirmation is related to the reception of the L2-acknowledgement, or only to the transmission of the frame on the medium.

L_Data.req(source_address, destination_address, address_type, priority, octet_count, ack_request, frame_format, lsdu)

source_address	this parameter shall be used to indicate the source address of the requested frame; it shall be the individual address of the device that requests the service primitive
destination_address:	this parameter shall be used to indicate the destination address of the requested frame; it shall be either an individual address or a group address
address_type:	this parameter shall be used to indicate whether the destination_address of the requested frame is an individual address or a group address
priority:	this parameter shall be used to indicate the priority that shall be used to the transmit the requested frame; it shall be “system”, “urgent”, “normal” or “low”
octet_count:	this parameter shall be used to indicate the length information of the requested frame
ack_request:	this parameter shall be used to indicate whether a Layer-2 acknowledge is mandatory or optional
frame_format:	standard or extended frame format
lsdu:	this parameter shall be used to contain the user data to be transferred by Layer-2

L_Data.con(destination_address, address_type, priority, frame_format, lsdu, l_status)

destination_address:		this parameter shall be used to indicate the destination address of the transmitted frame; it shall be either an individual address or a group address
address_type:		this parameter shall be used to indicate whether the destination_address of the transmitted frame is an individual address or a group address
priority:		this parameter shall be used to indicate the priority that has been used to transmit the transmitted frame; it shall be “system”, “urgent”, “normal” or “low”
lsdu:		this parameter shall be used to indicate the length information of the transmitted frame
frame_format:		standard or extended frame format
l_status:	ok:	this value of this parameter shall be used to indicate that the transmission of the frame has been successful
	not_ok:	this value of this parameter shall be used to indicate that the transmission of the frame did not succeed

L_Data.ind(source_address, destination_address, address_type, priority, ack_request, octet_count, frame_format, lsdu)

source_address:	this parameter shall be used to indicate the source address of the received frame; it shall be the individual address of the device that has transmitted the service primitive
destination_address:	this parameter shall be used to indicate the destination address of the received frame; it shall be either an individual address or a group address
address_type:	this parameter shall be used to indicate whether the destination_address of the received frame is an individual address or a group address
priority:	this parameter shall be used to indicate the priority of the received frame; it shall be “system”, “urgent”, “normal” or “low”
ack_request:	this parameter shall be used to indicate whether a Layer-2 acknowledge is mandatory or optional
octet_count:	this parameter shall be used to indicate the length information of the received frame
frame_format:	standard or extended frame format
lsdu:	this parameter shall be used to contain the user data that has been received by Layer-2

4.3.2.2 Usage of priority

Table 1 – Usage of priority

Priority value	Priority	Usage
11	low	shall be used for long frames, burst traffic, …
01	normal	shall be used as the default for short frames
10	urgent	shall be used exclusively for urgent frames
00	system	shall be used for high priority, system configuration and management procedures

The usage conditions for these priorities are specified in EN 50090–4-1.

In a network, the frame traffic using urgent priority shall not exceed 5 % of the total traffic (integration period: 1 minute maximum).

4.3.2.3 Octet count

This service parameter shall contain the number of octets of the transported Application layer Protocol Data Unit (APDU).

The Octet Count parameter shall be used on each medium to encode the LPDU length field as follows:

- for standard frames, the length field shall contain the number of octets in the APDU coded in 4 Bit,
- for extended frames, the length field shall contain the number of octets in the APDU coded in 8 Bit except the value FFh. The value FFh (255) is used as an escape-code.

The escape-code (“ESC”) shall be available for future high speed media to enable larger lengths.

4.3.2.4 Ack_request

This service parameter shall be used to indicate whether a link layer acknowledge is requested or not.

4.3.2.5 Frame_format

This parameter shall be used to select the Standard or Extended Frame Format for Data Link Layer and shall include information for the used extended frame type.

If the frame_format parameter is 0 the Standard Frame Format shall be used. If this parameter is different from 0 it shall be used as the frame_format in the extended control field.

For the definition of the extended control field see the medium dependent layer description in EN 50090-5.

Octet 3								
7	6	5	4	3	2	1	0	
Frame type				Extended Frame Format				FT = Frame type (0 = Standard, 1 = Extended) (for standard the frame type bit in the control field is 1) EFF = Frame Format in case of FT=1 = Extended Frame Format
FT	0	0	0	t	t	t	t	
0	0	0	0	0	0	0	0	Standard Frame Format Standard Group or Individual
1	0	0	0	0	0	0	0	Extended Frame Format Standard Group or Individual
1	0	0	0	0	1	x	x	LTE-HEE extended address type
								All other codes are reserved for future use

Figure 5 – Frame_format Parameter

The Extended Frame Format from the frame_format parameter shall be placed in the extended control field. The position of the extended frame type is medium dependent.

The decision whether to use Standard or Extended Frame Format shall be made in the Application Layer and selected by the frame_format parameter in T_Data_.... services. The remote Application Layer shall be tolerant towards usage of long frames if short frames would be sufficient: example: A_PropertyValue_Read-PDU shall fit into Standard (short) Frame Format. But if received using Extended (long) Frame Format it shall be accepted anyway by the remote Application Layer and the corresponding A_PropertyValue_Response-PDU shall be transported using the appropriate short or long format.

Extended Frame Format (EFF)				
b_3 $CtrlE_3$	b_2 $CtrlE_2$	b_1 $CtrlE_1$	b_0 $CtrlE_0$	Usage
0	0	0	0	Standard messages enabling long APDU > 15 octets Standard usage of DA for peer to peer or group messages
0 0 0	0 0 0	0 1 1	1 0 1	Reserved
0	1	X	X	LTE-HEE extended message format $CtrlE_1$, $CtrlE_0$ containing extension of DA group address
1 1 1 1 1 1 1	0 0 0 0 1 1 1	0 0 1 1 0 0 1	0 1 0 1 0 1 0	Reserved
1	1	1	1	Escape

Figure 6 – Coding of Extended Frame Format

The Extended Frame Format shall not be used instead of Standard Frame Format if encoding capabilities of L_Data-Standard frame are sufficient (e.g. for short frames).

4.3.3 L_SystemBroadcast service

The L_SystemBroadcast service is a frame transfer service. It shall transmit a single link layer service data unit (LSDU) to the data link layer of all devices within the network. The destination address shall be the system broadcast address (Domain Address = 0000h and destination address = 0000h and address_type = “multicast”). The service may acknowledged or not, depending on the transmission medium.

There shall be three service primitives:

1. L_SystemBroadcast.req shall be used to transmit a frame;

2. L_SystemBroadcast.ind shall be used to receive a frame;

3. L_SystemBroadcast.con shall be a local primitive generated by the local Layer-2 for its own client to indicate the success of the transmission.

If the local user of Layer-2 prepares a LSDU for the remote user it shall apply the L_SystemBroadcast.req primitive to pass the LSDU to the local Layer-2. The local Layer-2 shall accept the service request and shall try to send the LSDU to the remote Layer-2 with the relevant frame format.

The local Layer-2 shall pass a L_SystemBroadcast.con primitive to the local user that shall indicate either a correct or erroneous data transfer. Depending if a L2-acknowledgement is requested or not, this confirmation shall be related to the reception of the L2-acknowledgement, or only to the transmission of the frame on the medium.

L_SystemBroadcast.req(destination_address, address_type, priority, octet_count, ack_request, lsdu)

destination_address:	this parameter shall be used to indicate the destination address of the requested frame; it shall be the system broadcast address 0000h
address_type:	this parameter shall be set to “multicast”
priority:	this parameter shall be used to indicate the priority that shall be used to the transmit the requested frame; it shall be “system”, “urgent”, “normal” or “low”
octet_count:	this parameter shall be used to indicate the length information of the requested frame
ack_request:	this parameter shall be used to indicate whether a Layer-2 acknowledge is mandatory or optional
lsdu:	this parameter shall be used to contain the user data to be transferred by Layer-2

L_SystemBroadcast.con(source_address, destination_address, address_type, priority, octet_count, lsdu, l_status)

source_address		this parameter shall be used to indicate the source address of the requested frame; it shall be the individual address of the device that requests the service primitive
destination_address:		this parameter shall be used to indicate the destination address of the requested frame; it shall be the system broadcast address 0000h
address_type:		this parameter shall be set to “multicast”
priority:		this parameter shall be used to indicate the priority that shall be used to the transmit the requested frame; it shall be “system”, “urgent”, “normal” or “low”
octet_count:		this parameter shall be used to indicate the length information of the requested frame
ack_request:		this parameter shall be used to indicate whether a Layer-2 acknowledge is mandatory or optional
l_status:	ok:	this value of this parameter shall be used to indicate that the transmission of the L_SystemBroadcast.req service has been successful
	not_ok:	this value of this parameter shall be used to indicate that the transmission of the L_SystemBroadcast.req service did not succeed