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Information technology – Home electronic system (HES) architecture – Part 3-2: Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1

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Part 3-2: Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1

FOREWORD

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International Standard ISO/IEC 14543-3-2 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This International Standard together with ISO/IEC 14543-3-1 cancels and replaces ISO/IEC TR 14543-3, published in 2000. It constitutes a complete revision of the principles outlined in ISO/IEC TR 14543-3 and provides the specifications essential for an international standard.

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

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

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 Electronic Systems.

This standard provides the communication stack targeted for providing the services specified in ISO/IEC 14543-3-3 (EN 50090-3-2) “User Process” and ISO/IEC 14543-3-1 “Application Layer for networked based control of HES Class 1”. It can be used as communication stack on the physical layers as specified in ISO/IEC 14543-3-5, ISO/IEC 14543-3-6 and ISO/IEC 14543-3-7 (EN 50090-5-x).

Currently, ISO/IEC 14543, *Information technology – Home Electronic System (HES) architecture*, consists of the following parts:

Part 2-1:	*Introduction and device modularity*
Part 3-1:	*Communication layers – Application layer for network based control of HES Class 1*
Part 3-2:	*Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1*
Part 3-3:	*User process for network based control of HES Class 1 (under consideration)*
Part 3-4:	*System management – Management procedures for network based control of HES Class 1 (under consideration)*
Part 3-5:	*Media and media dependent layers – Power line for network based control of HES Class 1 (under consideration)*
Part 3-6:	*Media and media dependent layers – Twisted pair for network based control of HES Class 1 (under consideration)*
Part 3-7:	*Media and media dependent layers – Radio frequency for network based control of HES Class 1 (under consideration)*
Part 4:	*Home and building automation in a mixed-use building (technical report)*
Part 5-1:	*Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Core ptotocol*
Part 5-2:	*Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Device certification*
	Additional parts may be added later.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 3-2: Communication layers – Transport, network and general parts of data link layer for network based control of HES Class 1

1 Scope

This part of ISO/IEC 14543 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 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.

ISO/IEC 7498 (all parts), *Information technology – Open Systems Interconnection – Basic reference model*

ISO/IEC 14543-2-1, *Information technology – Home Electronic System (HES) Architecture – Part 2-1: Introduction and device modularity*

ISO/IEC 14543-3-1 *Information technology – Home Electronic System (HES) Architecture – Part 3-1: Communication layers – Application layer for network based control of HES Class 1*

NOTE 1 The provisions of the referenced specifications, as identified in this subclause, are valid within the context of this International Standard. The reference to a specification within this International Standard does not give it any further status within ISO/IEC; in particular, it does not give the referenced specification the status of an International Standard.

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

NOTE 2 Reference to EN 50090-5-x is to be considered as deleted as soon as ISO/IEC 14543-3-5, ISO/IEC 14543-3-6 and ISO/IEC 14543-3-7 are approved.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this part the terms and definitions given in ISO/IEC 14543-2-1 and the following apply.

3.1.1
individual address
IA
unique identifier for every device in a network

NOTE The individual address is a 2-octet value that consists of an 8-bit subnetwork address and an 8-bit device address.

3.1.2
subnetwork 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.

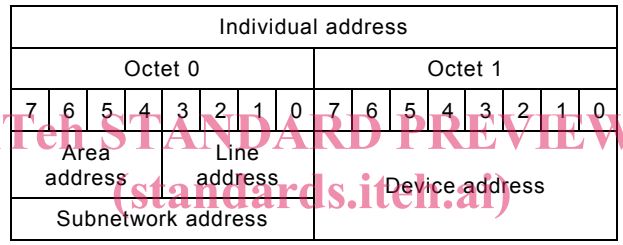

Figure 1 – Individual address

3.1.6
group address
GA
2-octet value

NOTE Figure 2 shows the group address, consisting of main group and sub-group address.

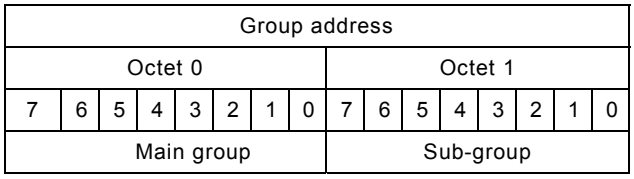

Figure 2 – Group address

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
HES Class 1	refers to simple control and command.
HES Class 2	refers to Class 1 plus simple voice and stable picture transmission
HES 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 Conformance

An entity of operational exchange conforming to this International Standard shall contain a physical layer and data link layer in accordance with the requirements of clause 5, a network layer in accordance with the requirements of clause 6 and a transport layer in accordance with the requirements of clause 7.

5 Requirements for the physical layer and independent data link layer

5.1 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/IEC 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).

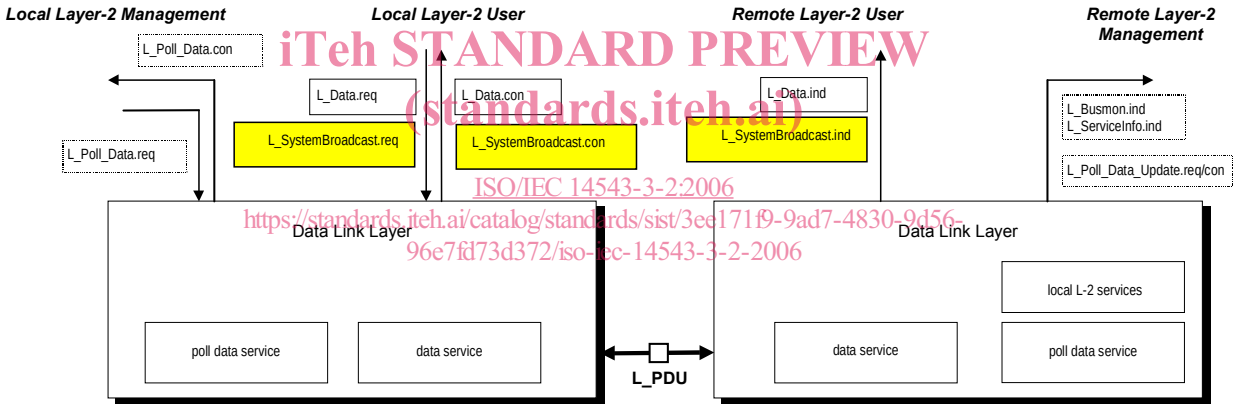

Figure 3 – Interaction of the data link layer

5.2 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, for example on the provided service interface to network layer.

The physical layer dependent requirements are specified in ISO/IEC 14543-3-5, ISO/IEC 14543-5-6 and ISO/IEC 14543-3-7 (EN 50090-5 series).

5.3 Data link layer services

5.3.1 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:

1) the normal mode;
2) 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 ISO/IEC 14543-3-5, ISO/IEC 14543-5-6 and ISO/IEC 14543-3-7 (EN 50090-5 series), respectively.

5.3.2 L_Data service

5.3.2.1 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, as shown in Figure 4.

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.

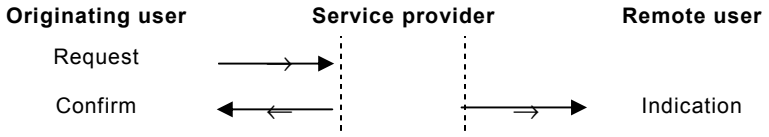

Figure 4 – Exchange of primitives for the L_Data-Service

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 on whether 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 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: the value of this parameter shall be used to indicate that the transmission of the frame has been successful

not_ok: the 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

5.3.2.2 Usage of priority

Table 1 – Usage of priority

Priority value	Priority	Usage
11	low	shall be used for long frames, burst traffic, etc.
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, see Table 1, are specified in ISO/IEC 14543–3-1.

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

5.3.2.3 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.

5.3.2.4 Ack_request

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

5.3.2.5 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, see Figure 5.

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.