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Home and building electronic systems (HBES) - Technical Report 7: Aspects of application - Application layer

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REPORT

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English version

Home and Building Electronic Systems (HBES)
Technical Report 7:
Aspects of application - Application Layer

This CENELEC Report has been prepared by Technical Committee CENELEC TC 205, Home and Building Electronic Systems (HBES). It was approved by CENELEC on 1995-11-28.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung
Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. R205-007:1996 E

Foreword

This Technical Report has been prepared by the Technical Committee CENELEC TC 205 (former TC 105), Home and Building Electronic Systems (HBES). It was decided to ask BT for publication during a voting plenary meeting on September 12 and October 18 and 19, 1995.

It was approved for publication as R205-007 by the CENELEC Technical Board on 1995-11-28.

The final intent of TC 205 is to develop a unique standard, with possible use of different media. The following structure of the series of standards *EN 50090 Home and Building Electronic Systems (HBES)* has been decided:

Part 1: Standardization structure
Part 2: System overview
Part 3: Aspects of application
Part 4: Transport Layer and Network Layer
Part 5: Media and media dependent layers
Part 6: Interfaces
Part 7: Management

Nevertheless, due to historical and market reasons, a first step was taken that allows three different implementations for some parts of the standard, the other parts being common. It is expected that a future version of the HBES standard will only propose one unique implementation, including the existing common parts. For the time being, TC 205 had agreed that the existing different implementations are described in European Prestandards (ENVs).

The three implementations are:

- implementation 1: BatiBUS;
- implementation 2: EIB;
- implementation 3: EHS.

The use of one implementation in a specific ENV requires the use of the same implementation throughout the whole series.

As decided during the meeting of TC 205 held on March 28 and 29th 1995, in accordance with the TC 205 standardization structure as approved by the Technical Board, and in line with TC 205's approach initiated and exposed three years ago as laid down in the CENELEC IT Strategy Plan, the following documents - which were expected to become parts of the EN(V) 50090 series and which describe the protocols of the three proposed HBES implementations BatiBUS, EIB and EHS - had been submitted to vote at plenary meetings of TC 205, in accordance with subclause 7.2 of the CEN/CENELEC Internal Regulations Part 2:

prENV 50090-3-3	Aspects of application - Application Layer
prENV 50090-4	Transport Layer and Network Layer
prENV 50090-5-2	Media and media dependent layers - Network based on Twisted Pair, Class 1
prENV 50090-6-3	Interfaces - Media interfaces
prENV 50090-7	Management

The comments expressed by some National Committees during these meetings reflected the reluctance to the principle of endorsing three existing systems as a step to coming to a unique solution.

Despite the public commitment of the consortia supporting these systems to converge on a unique system, a commitment proven already by the acceptance of:

EN 50090-2-1	System overview - Architecture
EN 50090-2-2	System overview - General Technical requirements
EN 50090-3-1	Aspects of application - Introduction to the application structure
EN 50090-3-2	Aspects of application - User process
R205-001	Applications and requirements - Class 1
R205-002	Guidelines for the professional installation of Twisted Pair cables Class 1
R205-004	Applications and requirements - Class 2 and 3

as well as by the ongoing work in TC 205, none of the arguments put forward could change the opinion of these National Committee delegations.

A formal vote at the meetings showed that there was not sufficient consensus to have the prENVs approved. Therefore the Technical Board decided to publish these documents as CENELEC Reports:

R205-007	Aspects of application - Application Layer
R205-008	Transport Layer and Network Layer, Class 1
R205-009	Media and media dependent layers - Network based on Twisted Pair, Class 1
R205-010	Interfaces - Medium Interface, Twisted Pair, Class 1
R205-011	Management

This Technical Report contains clauses which may be subject to Intellectual Property Rights (IPR)[1].

In accordance with CEN/CENELEC Memorandum 8, the Central Secretariat received a declaration from the three consortia whose protocols are described in this Technical Report, i.e. BCi, EHSA and EIBA, the details of which have been made available to the CENELEC membership.

For full details or IPR conditions the three consortia can be contacted at the following addresses:

BatiBus club international (BCi)
11, rue Hamelin
F-75783 PARIS CEDEX 16

European Home System Association (EHSA)
Excelsiorlaan 11 - Bus 1
B-1930 ZAVENTEM

European Installation Bus Association (EIBA)
Avenue de la Tanche 5
B-1160 BRUSSELS

1) As defined in CEN/CENELEC Memorandum No 8.

Contents

Introduction

The three implementations have a similar structure with the following advantages:

- easy comparison of implementations;
- facilitate convergence work towards the future unique implementation;
- facilitate interfacing any implementation, from an upper Layer.

The use of one implementation for this part requires the use of the same implementation for all other parts.

1 Scope

This Technical Report specifies the application layer of BatiBUS (implementation 1), EIBus (implementation 2) and EHS (implementation 3).

2 Normative references

This Technical Report incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Technical Report only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50090-3-1	Home and Building Electronic Systems (HBES) - Part 3-1: Aspects of Application - Introduction to the application structure
EN 50090-3-2	Home and Building Electronic Systems (HBES) - Part 3-2: Aspects of Application - User Process
ISO/IEC 7498-1	Information Technology - Open Systems Interconnection - Basic Reference Model: The basic model
ISO 8859-1	Information processing - 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1

3 Definitions

For the purposes of this Technical Report the following definitions apply. They are arranged according to the different implementations.

3.1 Definitions for implementation 1

3.1.1 Terms from other sources

The following terms defined in the ISO/IEC 7498-1 Service Conventions are used in this Technical Report:

- Confirm
- Request
- Indication
- Primitive

3.1.2 Additional definitions

None

3.2 Definitions for implementation 2

3.2.1 Terms from other sources

The following definitions from ISO/IEC 7498-1 apply:

ACK	Acknowledge
ADC	Analog Digital Converter
APCI	Application Layer Protocol Control Information
APDU	Application Layer Protocol Data Unit

ASDU	Application Layer Service Data Unit
L-Layer	Link Layer
LPDU	Link Layer Protocol Data Unit
LSDU	Link Layer Service Data Unit
N-Layer	Network Layer
NAK	Negative Acknowledge
NPDU	Network Layer Protocol Data Unit
NSDU	Network Layer Service Data Unit
PH-Layer	Physical Layer
TPDU	Transport Layer Protocol Data Unit
TSDU	Transport Layer Service Data Unit.

The following definition from EN 50090-3-2 applies: User process.

3.2.2 Additional definitions

3.2.2.1 communication object: A data structure, through which user processes can communicate.

3.3 Definitions for implementation 3

3.3.1 Terms from other sources

None.

3.3.2 Additional definitions

3.3.2.1 Application Title Directory (ATD): A symbolic store for addresses and related information in the application layer. The main functions of the application layer are performed using the ATD to map addresses and attributes. The address directory function maps application addresses onto network and subunit addresses. The application name directory function maps an application name onto a network and subunit address. The attribute directory function is used to derive information about specific attributes of subunits.

3.3.2.2 category [ii] unit: A unit which re-initialises its address on power-up by means of category [ii] address management mechanism. Other categories for address management are described in R205-.

3.3.2.3 client: The client of a service is the unit which is using functionality provided by a server. The client controls the exchange of information.

3.3.2.4 contention: A management process taking place when two or more units intend to use the same address for the same functions. Only one unit is able to win the address to be used.

3.3.2.5 contracting: A management process which takes place between a device co-ordinator and a simple device. It occurs when either of these is being initialised on the network and it enables the device co-ordinator to perform enrolment, token passing and event management on behalf of the simple device, making it appear as a complex device to the system. In cases where simple devices have been operating as a simple system, this mechanism will enable upgrading to an intelligent system.

3.3.2.6 device: A subunit that can be controlled by a feature controller. It offers an application resource. A device can be either a complex device, or a feature controller that can be controlled by or provide information to another feature controller.

3.3.2.7 enrolling: A management process through which an association is established between an application process in a server, normally a device, and an application process in a client, normally a feature controller.

3.3.2.8 feature controller: A subunit able to interpret and control the application functions offered by devices. It regards devices as application resources, and invokes token passing to gain control over them, if necessary.

3.3.2.9 Invoke_ID: A parameter representing an identifier to be associated with the command issued by the originating application process.

3.3.2.10 open medium: Transmission medium of which signal propagation is not contained to within a single house: powerline and radio frequency.

3.3.2.11 server: A unit where the object is located and which provides services to a client.

3.3.2.12 subunit: The basic building entity for applications. It is individually addressable within a unit and is able to perform operations independently of other subunits within the same unit. A single subunit is associated with a single application process.

3.3.2.13 token passing: An application management mechanism which mediates multiple service requests and resolves any conflicts.

3.3.2.14 unit: Part of a station, corresponding with particular Network Layer, Application Layer and application functions, that has one individual link address for each medium it is connected to.

3.3.2.15 unique code: A globally unique identifier, programmed at manufacture, which can be used during initialisation to assign network addresses to multiple instances of identical units.

4 Abbrevations

HBES	Home and Building Electronic System
LME	Layer Management Entity

4.1 Additional abbreviations for implementation 1

BIN	(Binary INput) i.e. On/Off input
BOUT	Binary OUTput) i.e. On/off output
COUNT	(COUNTer input)
DIN	(Digital INput)
DOUT	(Digital OUTput)
Ind	Indication
ltd_DOUT	(limited Digital OUTput)
PDU	Protocol Data Unit
QOS	Quality Of Service (LLC parameter)
PRI	Priority parameter (MAC parameter)
th_DIN	(threshold Digital INput)

4.2 Additional abbreviations for implementation 2

None.

4.3 Additional abbreviations for implementation 3

ATD	Application Title Directory
CL-PDU	CLSE Protocol Data Unit
CLSE	Command Language Service Element
CoD	Complex Device
DSUA	Destination Subunit Address
DvC	Device Co-ordinator
EC	Error Control byte
FC	Feature Controller
HD	HeaDer byte
LMSE	Local Management Service Element
MdC	Medium Controller
MTSE	Message Transfer Service Element
MT-PDU	MTSE Protocol Data Unit
Rtr	Router
SiD	Simple Device
SSUA	Source Subunit Address
TC	Termination Code byte.

5 Application Layer

5.1 Implementation 1

5.1.1 Introduction

The representation of the Application Layer services makes use of a modelling method allowing the static resources of the Application Layer to be described by abstract objects. This method is described in annex A.

Implementation 1 of the Application Layer is based on a service-oriented approach.

These services apply on user objects as described in EN 50090-3-1. The modelling of these objects is described in this clause.

The services are generally of the following type:

xx-read	Reading of the value of one or more attributes of one or more objects of a HBES device
xx-write	Writing of the value of one or more attributes of one or more objects of a HBES device
xx-report	reporting of the value or change of value of one or more attributes of one or more objects of a HBES device.

These Application Layer services are used by means of request primitives and indication primitives.

The request primitives of the Application Layer are projected onto the Data Link primitive L_MESSAGE_REQ; the Data Link primitive L_MESSAGE_IND is projected onto the indication primitives of the Application Layer.

The spontaneous transmissions and order transmission use the request-indication mechanism directly.

The question-answer type mechanisms are handled by automatic controls and use the request-indication mechanism twice.

The data involved are exchanged by the various services through Protocol Data Unit (PDUs).

A PDU is the part of the frame which corresponds to the Application Layer. Several different services can use a given PDU.

The Application Layer protocol defines the way to use the PDUs for the various services and how to use the parameters and services of the Data Link Layer.

A HBES device does not necessarily use all the services. This clause defines a number of conformity classes. A conformity class corresponds to the definition, for each part of the model, of a sub-set of services. The definition of a conformity class makes for a consistent application on the basis of the services located in each HBES device.

The Network Management or administration services are described in R205-007, implementation 1.

NOTE: This clause may be supplemented, as necessary, by Companion Standards.

These documents have a four-fold purpose:

- to specify the use of the basic services defined in the standard,
- to indicate the use of the data associated with the PDUs when these data are not fully defined in the standard,
- to present the services and the PDUs considered complementary to the standard for a particular field.
- to specify the encoding for PDUs associated with the services presented in the standard for a particular field.

A Companion Standard deals with a set of applications belonging to a given field of application, such as technical management of domestic or service building, management of distributed electrical power, electrical heating, air-conditioning, lighting, detection of intrusions, fire detection, resource management, authorization management.

NOTE: The list of fields in the frame can be found in annex B, the general frame structure is described in annex C.

5.1.2 Services used by implementation 1

These are Layers 1 and 2, described in their corresponding documents. Their main services are reminded here.

5.1.2.1 Addressing

The Physical Layer offers the MAC sublayer a single service access point corresponding to the physical access of a device to the bus. The MAC sublayer offers the LLC sublayer a single service access point corresponding to the address of the station encoded as a single byte. The LLC sublayer offers the Application Layer one or more service access points, each service access point being identified by the station type.

The mechanisms for addressing the MAC and LLC sublayers are used by the Application Layer:

a) direct addressing;

b) addressing by family (MAC sublayer multipoint mode);

c) general addressing (LLC sublayer multipoint mode);

d) distribution addressing (MAC sublayer multipoint mode associatedwith the LLC sublayer multipoint mode).

These mechanisms are supplemented by defining other addressing mechanisms, specific to the Application Layer, and defined in this subclause:

a) source addressing;

b) group addressing;

c) addressing by list of addresses;

d) addressing by list of zones.

5.1.2.2 Confirmation

The LLC Layer offers the Application Layer a confirmed service. It is either a confirmation of good sending (low QOS) or of good arrival to its remote destinary (high QOS). The application choose one of them as wanted.

5.1.2.3 Priority mechanism

The LLC sublayer offers the Application Layer two priority qualities for the transmission of messages:

a) normal messages;

b) urgent messages.

An urgent message differs from a normal message in that it can be sent following a shorter interframe time than for a normal message.

The decision to use, or not to use the urgent messages is taken by the Application Layer, depending on the services used and the control/monitoring system implemented.

The urgent frame traffic in a system should be less than five percent of total traffic (integration time = 1 min).

5.1.3 The services

Services are not the same for every object. They depend on their modelling. So, this clause begins by a description of the modelling and then defines the different classes.

Then, as each generic class has its own services, the services are described after the description of the model of each class.

One service uses only one PDU. One PDU can be used by more than one service. Each PDU is called "frame XX" where XX is a number without any particular meaning.

PDUs are described in 5.1.4.

5.1.3.1 Modelling of HBES devices

This technical report defines and models the classes of generic objects making up HBES devices. These generic classes are :

a) sensors;

b) actuators;

c) controllers.

A device can be modelled as being built using zero, one or several elementary objects, each instanced using a class of generic objects. The device also includes an user process which is responsible for handling the various elementary objects.

To model HBES devices, additional definitions are required : these definitions may call for complex modelling of a controller; it is, however, preferable to model a simple controller, and define the following groups of services, handled by the user process :

a) generic services;

b) network administration services.

Cases of complex operation of HBES devices are handled at the level of user process or defined within the framework of Companion Standards.

The description of the user process, based on EN 50090-3-2, is not the purpose of this clause.

An example of the modelling of a HBES device consisting of two sensor objects and one actuator object is schematically illustrated in figure 1.

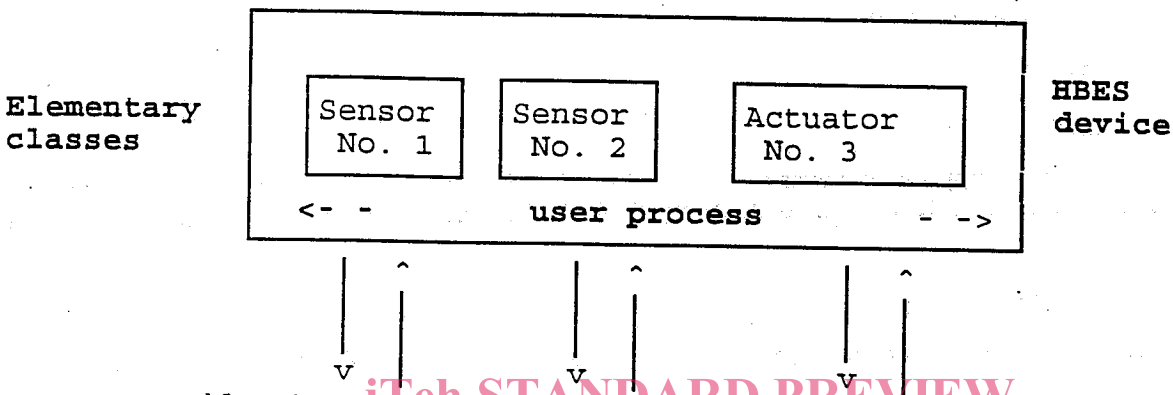

Figure 1: Example of HBES device modelling

5.1.3.2 **Modelling the sensor class**

5.1.3.2.1 **Definition**

A sensor object is used to measure a physical magnitude. This value can be converted by the physical part of the sensor into boolean form or into numerical value form (which is then encoded as n bits, where n is strictly greater than 1).

When the physical magnitude is converted into boolean form, the sensor corresponds to an on/off input (BIN for Binary INput), which takes one of two states: Open or Closed. This input may have a COUNTer operation. The counter increments a counter value at each change of state of the on/off input, or at each transition to high or low state, according to applications.

This counter can be reset by one or more appropriate functions. The transition from counter mode to on/off input mode, and vice versa, is also performed by an appropriate functions.

When the physical magnitude is converted into the numerical value form, the sensor corresponds to a DIN (Digital INput). The numerical value obtained is known as a measurement.

In this second case, the numerical value corresponding to the physical magnitude can be compared against a threshold numerical value (th_DIN for threshold_DIN). The threshold can be set locally on the physical part (by digital or analogue means) or down-loaded via the network.

The result of this comparison is a boolean, known as status relative to threshold, which can be considered as a on/off input.

NOTE: The threshold is noted in the same way as the numerical measurement value.

Modelling the sensor object class leads to the following definition:

Generic Class: sensor

Class Attributes:

attribute:	type of sensor [BIN, DIN, th_DIN, COUNT]
constraint:	type of sensor = BIN, DIN, th_DIN or COUNT
attribute :	size representation [2,...,2^n]

Instance Attributes :

constraint:	type of sensor = BIN
attribute:	state [open, closed]
constraint:	type of sensor = COUNT
attribute:	value_counter [0, (representation size -1)]
constraint:	type of sensor = DIN
attribute:	measurement [0, (representation size -1)]
constraint:	type of sensor = th_DIN
attribute:	measurement [0, (representation size -1)]
attribute:	threshold [0, (representation size -1)]
attribute:	state relative to the threshold [higher, lower]

5.1.3.2.2 Primitives for access to sensor class objects

On/off input (BIN)

The on/off input model selects the essential attribute of the corresponding objects, that is, the state attribute.

The definition of the services regarding an on/off input object may, however, take into account automatic control requirements as well as the characteristics linked to general implementations.

The items of information concerning an on/off input, usable by automatic controls, are as follows:

a) correct operation of the on/off input;

b) change of state of the on/off input (since an item of information was last sent);

c) on/off input state.

Implementations, in the form of equipment, often use several on/off inputs, identically handled by the automatic control program, or not.

The selected services thus allow information to be transferred for a variable number of on/off inputs.

On/off input read service

Function: using this service, a remote user can request information concerning all the on/off inputs of a HBES device.

Primitives : BIN_read_req
BIN_read_ind

Service procedure:

remote device		Application		on/off input
BIN_read_req	->	->		
			->	-> BIN_read_ind

(empty pdu ; see frame 07-3 in annex D)

On/off input information transmit service

Function : using this service, a device with one or more on/off inputs can send information concerning these inputs.

This service can be sent spontaneously by the application handling the on/off input(s).

It can also be sent following the reception of a request for information concerning the on/off inputs.

Primitives : BIN_report_req
BIN_report_ind

Service procedure:

remote device		Application		on/off input
BIN_report_ind	<-	<-	<-	<- BIN_report_req

(BIN_pdu ; see frame 23 in annex D)

Counter input (COUNT)

The counter input model selects the essential attribute of the corresponding objects, that is, the counter value attribute.

The definition of the services regarding a counter input object may, however, take into account automatic control requirements as well as the characteristics linked to general implementations.

The items of information concerning a counter input, usable by automatic controls, are as follows:

a) correct operation of the counter input;

b) counter value (since an item of information was last sent);

c) on/off input state.

Implementations, in the form of equipment, often use several counter inputs, identically handled by the automatic control program, or not. The size of counters can also vary according to the systems considered.

The selected services thus allow information to be transferred for a variable number of counters of variable size.

Counter input read service

Function : using this service, a remote user can request the reading all or part of the counters of a HBES device.

Primitives : COUNT_read_req
COUNT_read_ind

Service procedure :

remote device		Application		Counter input
COUNT_read_req	->	->		
			->	-> COUNT_read_ind

(empty pdu ; see frame 07-1 in annex D)

Counter input information transmit service

Function: using this service, a device with one or more on/off inputs can send information concerning the counters.

This service can be sent spontaneously by the application handling the counter on/off input(s). It can also be sent on the reception of a counter reading indication.

Primitives: COUNT_report_req
COUNT_report_ind

Service procedure:

remote device		Application		Counter input
			<-	<- COUNT_report_req
COUNT_report_ind <-	<-			

NOTE: all the counters shall be encoded in the same way.

(COUNT_pdu ; see frame 20 in annex D)

Digital input (DIN and th_DIN)

The digital input model selects two essential attributes: the "measurement" attribute and the "threshold" attribute.

These two attributes correspond to digital values.

These two attributes depend on a class attribute, which is the "representation size" attribute and which determines the measurement scale, in the form of a power of two.

This technical report defines several services concerned with digital values and their status relative to the threshold. These services are as follows:

a) request the digital value(s) of a device comprising one or more Digital Input objects.

This request may correspond either to a measurement request or a current threshold request;

b) transmission by a device comprising one or more Digital Input objects of one or more digital values. These values correspond either to measurements or to current thresholds;

c) transmission to a device comprising one or more Digital Input objects of digital values. These values then correspond to thresholds;

d) request to a device of the status relative to their threshold of one or more Digital Input objects;

e) transmission of the status relative to the threshold of one or more Digital Input of the device.

The use of these services for transmitting measurements and/or thresholds is defined in the Companion Standards.

The format of measurements is defined in the PDU; several formats are possible and cover the formats most used in the industry (see end of annex D).

These services can be used to transmit:

- a value in a byte,
- several values in one of the existing formats.

Service reading the digital values on a DIN

Function : using this service, a remote user can read the digital values of all or some of the digital inputs of a HBES device.

Primitives : DIN_read_req
DIN_read_ind

Service procedure :

remote device		Application		digital input
DIN_read_req	->	->		
			->	-> DIN_read_ind

(empty pdu ; see frame 7-1 in annex D)

Service transmitting the digital values of a DIN

Function : using this service, a device with one or more digital inputs can transmit the corresponding digital values.

The type of encoding of this information is determined in the message.