



SLOVENSKI STANDARD

SIST EN 14908-1:2006

01-marec-2006

BUXca Yý U
SIST ENV 13154-2:2005

Odprta izmenjava podatkov v avtomatizaciji stavb in izvršnih elementov ter pri upravljanju stavb – Protokol regulacijske mreže – 1. del: Protokolarni sklad

Open Data Communication in Building Automation, Controls and Building Management - Control Network Protocol - Part 1: Protocol Stack

ITeh STANDARD PREVIEW
(standards.iteh.ai)

Firmenneutrale Datenkommunikation für die Gebäudeautomation und Gebäudemanagement - Gebäudedatennetzprotokoll - Teil 1: Datenprotokollschichtenmodell

[SIST EN 14908-1:2006](#)

<https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-fc37a6b56859/sist-en-14908-1-2006>

Réseau ouvert de communication de données pour l'automatisation, la régulation et la gestion techniques du bâtiment - Protocole de réseau pour le bâtiment - Partie 1 : Niveaux du protocole

Ta slovenski standard je istoveten z: EN 14908-1:2005

ICS:

35.240.99	Wj [!æ} ž \ ^ Á ^ zãç ^ ÁVÁ æ åi ^ * äÄ [åi [ä@	IT applications in other fields
97.120	Avtomatske krmilne naprave za dom	Automatic controls for household use

SIST EN 14908-1:2006

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 14908-1:2006

<https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-fc37a6b56859/sist-en-14908-1-2006>

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 14908-1

November 2005

ICS 97.120

Supersedes ENV 13154-2:1998

English Version

Open Data Communication in Building Automation, Controls and Building Management - Building Network Protocol - Part 1: Protocol Stack

Réseau ouvert de communication de données pour
l'automatisation, la régulation et la gestion techniques du
bâtiment - Protocole de réseau pour le bâtiment - Partie 1 :
Niveaux du protocole

Firmenneutrale Datenkommunikation für die
Gebäudeautomation und Gebäudemanagement -
Gebäudedatennetzprotokoll - Teil 1:
Datenprotokollschichtenmodell

This European Standard was approved by CEN on 11 August 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

page

Foreword.....	7
Introduction	8
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	9
4 Symbols and abbreviations	11
4.1 Symbols and Graphical Representations	11
4.2 Abbreviations.....	13
5 Overview of Protocol Layering	13
6 MAC Sublayer	15
6.1 Service Provided	15
6.2 Interface to the Link Layer	15
6.3 Interface to the Physical Layer	16
6.4 MPDU Format.....	17
6.5 Predictive <i>p</i> -persistent CSMA — Overview Description.....	18
6.6 Idle Channel Detection	19
6.7 Randomising.....	19
6.8 Backlog Estimation	19
6.9 Optional Priority	20
6.10 Optional Collision Detection.....	21
6.11 Beta1, Beta2 and Preamble Timings.....	22
7 Link Layer	24
7.1 Assumptions.....	24
7.2 Service Provided	24
7.3 CRC.....	24
7.4 Transmit Algorithm.....	25
8 Network Layer	25
8.1 Assumptions.....	25
8.2 Service Provided	27
8.3 Service Interface.....	27
8.4 Internal Structuring of the Network Layer	28
8.5 NPDU Format	28
8.6 Address Recognition.....	29
8.7 Routers.....	29
8.8 Routing Algorithm	30
8.9 Learning Algorithm — Subnets	30
9 Transaction Control Sublayer.....	30
9.1 Assumptions.....	30
9.2 Service Provided	31
9.3 Service Interface.....	31
9.4 State Variables.....	32
9.5 Transaction Control Algorithm.....	32
10 Transport Layer	32
10.1 Assumptions.....	32
10.2 Service Provided	33
10.3 Service Interface.....	34
10.4 TPDU Types and Formats	34

10.5	Protocol Diagram	35
10.6	Transport Protocol State Variables	36
10.7	Send Algorithm	36
10.8	Receive Algorithm	37
10.9	Receive Transaction Record Pool Size and Configuration Engineering	37
10.9.1	General	37
10.9.2	Number of Retries	37
10.9.3	Transport Layer Timers	39
11	Session Layer	39
11.1	Assumptions	39
11.2	Service Provided	40
11.3	Service Interface	40
11.4	Internal Structure of the Session Layer	41
11.5	SPDU Types and Formats	41
11.6	Protocol Timing Diagrams	43
11.7	Request-Response State Variables	46
11.8	Request-Response Protocol — Client Part	46
11.9	Request-Response Protocol — Server Part	46
11.10	Request-Response Protocol Timers	47
11.11	Authentication Protocol	47
11.12	Encryption Algorithm	47
11.13	Retries and the Role of the Checksum Function	48
11.14	Random Number Generation	49
11.15	Using Authentication	49
12	Presentation/Application Layer	49
12.1	Assumptions	49
12.2	Service Provided	49
12.3	Service Interface	50
12.4	APDU Types and Formats	51
12.5	Protocol Diagrams	52
12.6	Application Protocol State Variables	54
12.7	Request - Response Messaging in Offline State	55
12.8	Network Variables	55
12.8.1	General	55
12.8.2	Network Variable Processing	55
12.9	Error Notification to the Application Program	56
12.9.1	General	56
12.9.2	Error Notification for Messages	56
12.9.3	Error Notification for Network Variables	56
13	Network Management & Diagnostics	57
13.1	Assumptions	57
13.2	Services Provided	57
13.3	Network Management and Diagnostics Application Structure	57
13.4	Node States	57
13.5	Using the Network Management Services	58
13.5.1	General	58
13.5.2	Addressing Considerations	58
13.5.3	Making Network Configuration Changes	59
13.5.4	Downloading an Application Program	59
13.5.5	Error Handling Conditions (Informative)	60
13.6	Using Router Network Management Commands	62
13.7	NMPDU Formats and Types	63
13.7.1	General	63
13.7.2	Query ID	63
13.7.3	Respond to Query	64
13.7.4	Update Domain	64
13.7.5	Leave Domain	64
13.7.6	Update Key	64

EN 14908-1:2005 (E)

13.7.7	Update Address	64
13.7.8	Query Address	64
13.7.9	Query Network Variable Configuration	65
13.7.10	Update Group Address	65
13.7.11	Query Domain	65
13.7.12	Update Network Variable Configuration	65
13.7.13	Set Node Mode.....	65
13.7.14	Read Memory	66
13.7.15	Write Memory	66
13.7.16	Checksum Recalculate.....	66
13.7.17	Install	66
13.7.18	Memory Refresh	82
13.7.19	Query SI.....	82
13.7.20	Network Variable Value Fetch.....	82
13.7.21	Manual Service Request Message	82
13.7.22	Network Management Escape Code	82
13.7.23	Router Mode.....	83
13.7.24	Router Clear Group or Subnet Table.....	83
13.7.25	Router Group or Subnet Table Download	83
13.7.26	Router Group Forward	83
13.7.27	Router Subnet Forward	84
13.7.28	Router Do Not Forward Group.....	84
13.7.29	Router Do Not Forward Subnet	84
13.7.30	Router Group or Subnet Table Report	84
13.7.31	Router Status	84
13.7.32	Router Half Escape Code.....	84
13.8	DPDU Types and Formats.....	84
13.8.1	General	84
13.8.2	Query Status	84
13.8.3	Proxy Status.....	88
13.8.4	Clear Status.....	88
13.8.5	Query Transceiver Status	88
Annex A	Reference Implementation (Normative).....	89
A.1	General	89
A.2	Predictive CSMA Algorithm	89
A.3	LPDU Transmit Algorithm.....	148
A.4	LPDU Receive Algorithm	150
A.5	Routing Algorithm	153
A.6	Learning Algorithm.....	153
A.7	Transaction Control Algorithm.....	154
A.8	Network Layer Algorithm	161
A.9	TPDU and SPDU Send Algorithm with Authentication	177
A.10	Application Layer	232
A.11	Network Management Commands	287
A.12	Configuration Data Structures.....	324
A.13	Include Files for the Reference Implementation	343
A.14	Application Protocol State Variables and Address Recognition Structures	373
A.15	Query-id Data Structures	375
A.16	Respond to Query Data Structure	376
A.17	Update Domain Data Structures.....	376
A.18	Leave Domain Data Structures.....	376
A.19	Update Key Data Structures	376
A.20	Update Address Data Structures.....	377
A.21	Query Address Data Structures	378
A.22	Query NV Cnfg Data Structures.....	378
A.23	Update Group Address Data Structures	378
A.24	Query Domain Data Structures.....	378
A.25	Update Network Variable Configuration Data Structures	379
A.26	Set Node Mode Data Structures	379

Ifeh STANDARD PREVIEW
(standards.ifeh.ai)

SIST EN 14908-1:2006

<https://standards.ifeh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6->

<fc37a6b56859/sist-en-14908-1-2006>

A.27	Read Memory Data Structures	380
A.28	Write Memory Data Structures	380
A.29	Checksum Recalculate Data Structures	380
A.30	Install Command Data Structures	381
A.31	Memory Refresh Data Structures	389
A.32	Query SI Data Structures	389
A.33	NV Fetch Data Structures	390
A.34	Manual Service Request Message Data Structures	390
A.35	Product Query Data Structures	390
A.36	Router Mode Data Structures	390
A.37	Router Table Clear Group or Subnet Table Data Structures	391
A.38	Router Group or Subnet Download Data Structures	391
A.39	Router Group Forward Data Structures	391
A.40	Router Subnet Forward Data Structures	391
A.41	Router Group No-Forward Data Structures	392
A.42	Router Subnet No-Forward Data Structures	392
A.43	Group / Subnet Table Report Data Structures	392
A.44	Router Status Data Structures	392
A.45	Query Status Data Structures	393
A.46	Proxy Status Data Structures	393
A.47	Clear Status Data Structures	394
A.48	Query Transceiver Status Data Structures	394
Annex B	Additional Data Structures (Normative)	395
B.1	General	395
B.1.1	The System Image	395
B.1.2	The Application Image	395
B.1.3	The Network Image	396
B.2	Read-Only Structures	396
B.2.1	Fixed Read-Only Data Structures	396
B.2.2	Read-only Structure Field Descriptions	398
B.3	Domain Table	401
B.3.1	Domain Table Field Descriptions	402
B.4	Address Table	402
B.4.1	Declaration of Group Address Format	403
B.4.2	Group Address Field Descriptions	403
B.4.3	Declaration of Subnet/Node Address Format	404
B.4.4	Subnet/Node Address Field Descriptions	404
B.4.5	Declaration of Broadcast Address Format	404
B.4.6	Broadcast Address Field Descriptions	404
B.4.7	Declaration of Turnaround Address Format	405
B.4.8	Turnaround Address Field Descriptions	405
B.4.9	Declaration of Protocol Processor's Address Format	405
B.4.10	Protocol Processor Address Field Descriptions	405
B.4.11	Timer Field Descriptions	406
B.5	Network Variable Tables - Informative	407
B.5.1	Network Variable Configuration Table Field Descriptions - Informative	408
B.5.2	Network Variable Alias Table Field Descriptions - Informative	409
B.5.3	Network Variable Fixed Table Field Descriptions - Informative	409
B.6	Self-Identification Structures	409
B.6.1	SI Structure Field Descriptions	410
B.6.2	NV Descriptor Table Field Descriptions	411
B.6.3	SNVT Table Extension Records	411
B.6.4	SNVT Alias Field Descriptions	412
B.6.5	Version 2 SI Data	412
B.7	Configuration Structure	416
B.7.1	General	416
B.7.2	Configuration Structure Field Descriptions	417
B.8	Statistics Relative Structure	418
Annex C	Behavioral Characteristics (Informative)	420

EN 14908-1:2005 (E)

C.1	Channel Capacity and Throughput	420
C.2	Network Metrics	421
C.3	Transaction Metrics	422
C.4	Boundary Conditions — Power-Up	423
C.5	Boundary Conditions — High Load.....	423
	Annex D PDU Summary (Normative)	424
	Annex E Naming and Addressing (Normative)	426
E.1	Address Types and Formats.....	426
E.2	Domains	426
E.3	Subnets and Nodes	427
E.4	Groups.....	427
E.5	Unique_Node_ID and Node Address Assignment	428
E.6	NPDU Addressing.....	429
	Annex F List of patents that pertain to this European Standard (Normative)	431
	Bibliography	434

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN 14908-1:2006

<https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-fc37a6b56859/sist-en-14908-1-2006>

Foreword

This European Standard (EN 14908-1:2005) has been prepared by CEN /TC 247, "Building Automation, Controls and Building Management", the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2006, and conflicting national standards shall be withdrawn at the latest by May 2006.

This European Standard supersedes ENV 13154—2:1998.

This publication is copyright under the Berne Convention and the Universal Copyright Convention. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by means, electronic, mechanical, photocopying, recording, or otherwise, without the permission of the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), their National Standards Bodies and their Licensees to reproduce this European Standard in full and including this copyright notice for the purposes of European standardisation.

CEN draws attention to the fact that it is claimed that compliance with this European Standard may involve the use of patents. The patents that pertain to this European Standard are listed in Annex F.

CEN/TC247 confirms that this European Standard contains patents and like rights claiming by Echelon Corporation. The Echelon Corporation declared to CEN its willingness to negotiate licenses under patents or rights with applicants throughout the world on reasonable terms and conditions without any discrimination.

NOTE For licensing information, contact: Echelon Corporation, 4015 Meridian Avenue, San Jose, CA 94304, USA, phone +1-408-938-5234, fax: +1-408-790-3800 <http://www.echelon.com>.

This European Standard is part of a series of European Standards for open data transmission in building automation, control and in building management systems. The content of this standard covers the data communications used for management, automation/control and field functions. This European Standard is based on the American standards EIA/CEA-709.1-B Control Network Protocol Specification.

The EN 14908-1 is part of a series of European Standards under the general title *Control Network Protocol (CNP)*, which comprises the following parts:

Part 1: *Protocol Stack*

Part 2: *Twisted Pair Communication*

Part 3: *Power Line Channel Specification*

Part 4: *IP-Communication*

Part 5: *Project Implementation Guideline*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EN 14908-1:2005 (E)**Introduction**

This European Standard has been prepared to provide mechanisms through which various vendors of building automation, control, and building management systems may exchange information in a standardised way. It defines communication capabilities.

This European Standard is to be used by all involved in design, manufacture, engineering, installation and commissioning activities.

This European Standard has been made in response to the essential requirements of the Constructive Products Directive.

**iTeh STANDARD PREVIEW
(standards.iteh.ai)**

SIST EN 14908-1:2006

<https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-fc37a6b56859/sist-en-14908-1-2006>

1 Scope

This specification applies to a communication protocol for networked control systems. The protocol provides peer-to-peer communication for networked control and is suitable for implementing both peer-to-peer and master-slave control strategies. This specification describes services in layers 2 - 7. In the layer 2 (data link layer) specification, it also describes the MAC sub-layer interface to the physical layer. The physical layer provides a choice of transmission media. The interface described in this specification supports multiple transmission media at the physical layer. In the layer 7 specification, it includes a description of the types of messages used by applications to exchange application and network management data.

2 Normative references

Not applicable

3 Terms and definitions

For the purposes of this European Standard, the following subclause introduces the basic terminology employed throughout this European Standard. Most of it is commonly used and the terms have the same meaning in both the general and the standard context. However, for some terms, there are subtle differences. For example, in general, bridges do selective forwarding based on the layer 2 destination address. There are no layer 2 addresses in this standard protocol, so bridges forward all packets, as long as the domain address in the packet matches a domain of which the bridge is a member. Routers, in general, perform network address modification so that two protocols with the same transport layer but different network layers can be connected to form a single logical network. Routers of this standard may perform network address modification, but typically they only examine the network address fields and selectively forward packets based on the network layer address fields.

3.1 Channel

<https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-f37a6b56859/sist-en-14908-1-2006>

physical unit of bandwidth linking one or more communication nodes. Refer to Annex E for further explanation of the relationship between a channel and a subnet

3.2 Physical Repeater

device that reconditions the incoming physical layer signal on one channel and retransmits it on to another channel

3.3 Store-and-Forward Repeater

device that stores and then reproduces data packets on to a second channel

3.4 Bridge

device that connects two channels (x and y); forwards all packets from x to y and vice versa, as long as the packets originate on one of the domain(s) that the bridge belongs to

3.5 Configuration

non-volatile information used by the device to customise its operation. There is configuration data for the correct operation of the protocol in each device, and optionally, for application operation. The network configuration data stored in each device has a checksum associated with the data. Examples of network configuration data are node addresses, communication media parameters such as priority settings, etc. Application configuration information is application specific

3.6 Domain

virtual network that is the network unit of management and administration. Group and subnet (see below) addresses are assigned by the administrator responsible for the domain, and they have meaning only in the context of that domain

EN 14908-1:2005 (E)**3.7****Flexible Domain**

used in conjunction with Unique_Node_ID and broadcast addressing. A node responds to a Unique_Node_ID-addressed message if the address matches, regardless of the domain on which the message was sent. To respond so that the sender receives it, the response must be sent on the domain in which it was received. Furthermore, this domain must be remembered for the duration of the transaction so that duplicate detection of any retries is possible. This transitory domain entry at a node is called the flexible domain. How many flexible domain entries a node supports is up to the implementation. However, a minimum of 1 is required

3.8**Subnet**

set of nodes accessible through the same link layer protocol; a routing abstraction for a channel; in this standard subnets are limited to a maximum of 127 nodes

3.9**Node**

abstraction for a physical node that represents the highest degree of address resolvability on a network. A node is identified (addressed) within a subnet by its (logical) node identifier. A physical node may belong to more than one subnet; when it does, it is assigned one (logical) node number for each subnet to which it belongs. A physical node may belong to at most two subnets; these subnets must be in different domains. A node may also be identified (absolutely) within a network by its Unique_Node_ID

3.10**Group**

uniquely identifiable set of nodes within a domain. Within this set, individual members are identified by their member number. Groups facilitate one-to-many communication and are intended to support functional addressing

3.11**Router**

device that routes data packets to their respective destinations by selectively forwarding from subnet to subnet; a router always connects two (sets of) subnets; routers may modify network layer address fields. Routers may be set to one of four modes: repeater mode, bridge mode, learning mode, and configured mode. In repeater mode, packets are forwarded if they are received with no errors. In bridge mode, packets are forwarded if they are received with no errors and match a domain that the router is a member of. Routers in learning mode learn the topology by examining packet traffic, while routers that are set to configured mode have the network topology stored in their memory and make their routing decisions solely upon the contents of their configured tables

3.12**(Application) Gateway**

interconnects networks at their highest protocol layers (often two different protocols). Two domains can also be connected through an application gateway

3.13**Beta1**

period immediately following the end of a packet cycle. A node attempting to transmit monitors the state of the channel, and if it detects no transmission during the Beta1 period, it determines the channel to be idle

3.14**Beta2**

randomising slot. A node wishing to transmit generates a random delay T. This delay is an integer number of randomising slots of duration Beta2

3.15**Network Variable**

variable in an application program whose value is automatically propagated over the network whenever a new value is assigned to it

3.16**Standard Network Variable Types (SNVTs)**

variables with agreed-upon semantics. These variables are interpreted by all applications in the same way, and are the basis for interoperability. Definition of specific SNVTs is beyond the scope of this European Standard

3.17**Manual service request Message**

network management message containing a node's Unique_Node_ID. Used by a network management device that receives this message to install and configure the node. May be generated by application or system code. May be triggered by external hardware event, e.g., driving a "manual service request" input low

3.18**Transaction**

sequence of messages that are correlated together. For example, a request and the responses to the request are all part of a single transaction. A transaction succeeds when all the expected messages from every node involved in the transaction are received at least once. A transaction fails in this European Standard if any of the expected messages within the transaction are not received. Retries of messages within a transaction are used to increase the probability of success of a transaction in the presence of transient errors

4 Symbols and abbreviations**4.1 Symbols and Graphical Representations**

Figure 1 shows the basic topology of networks based on this protocol and the symbolic representations used in this European Standard.

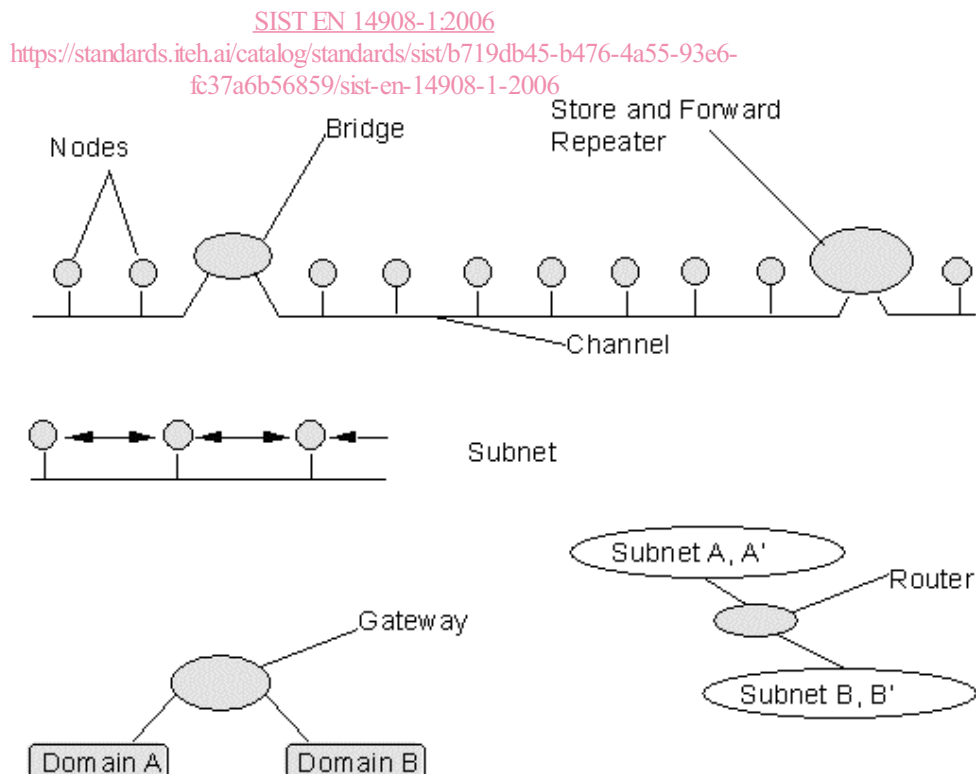


Figure 1 — Network Topology & Symbols

EN 14908-1:2005 (E)

The layering of this protocol is described using standard OSI terminology, as shown in Figure 2.

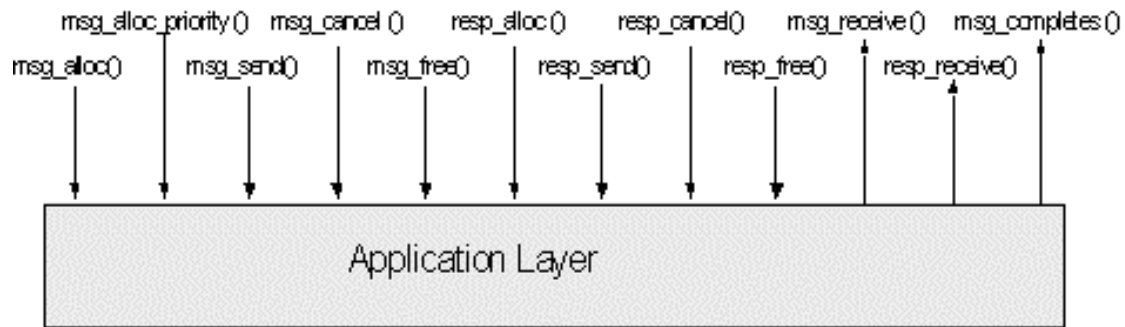


Figure 2 — Protocol Terminology

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 14908-1:2006

<https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-fc37a6b56859/sist-en-14908-1-2006>

4.2 Abbreviations

— CNP Control Network Protocol

The Protocol Data Unit (PDU) abbreviations used throughout this European Standard are:

— PPDU Physical Protocol Data Unit, or frame

— MPDU MAC Protocol Data Unit, or frame

— LPDU Link Protocol Data Unit, or frame

— NPDU Network Protocol Data Unit, or packet

— TPDU Transport Protocol Data Unit, or a message/ack

— SPDU Session Protocol Data Unit, or request/response

— NMPDU Network Management Protocol Data Unit

— DPCDU Diagnostic Protocol Data Unit

— APDU Application Protocol Data Unit

— FSM Finite State Machine (diagram)

Annex D (PDU Summary) contains the details of these PDUs.

[SIST EN 14908-1:2006](https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-63770156859/sist-en-14908-1-2006)

[https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-](https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-63770156859/sist-en-14908-1-2006)

[63770156859/sist-en-14908-1-2006](https://standards.iteh.ai/catalog/standards/sist/b719db45-b476-4a55-93e6-63770156859/sist-en-14908-1-2006)

5 Overview of Protocol Layering

The protocol specified by this European Standard consists of the layers shown in Figure 3. Each layer is described below.

Multiple physical layer protocols and data encoding methods are allowed in systems based on this European Standard. Each encoding scheme is medium-dependent.

The *MAC* (Medium Access Control) sublayer employs a collision avoidance algorithm called Predictive *p*-persistent CSMA (Carrier Sense, Multiple Access). For a number of reasons, including simplicity and compatibility with the multicast protocol, the link *layer* supports a simple connectionless service. Its functions are limited to framing, frame encoding, and error detection, with no error recovery by re-transmission.