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Home and building electronic systems (HBES) - Technical Report 4: Applications and requirements - Class 2 and 3

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REPORT

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English version

Home and Building Electronic Systems (HBES)
Technical Report 4:
Applications and requirements - Class 2 and 3

This CENELEC Report has been prepared by the Technical Committee CENELEC TC 205, Home and Building electronic Systems (HBES). It was approved by the Technical Committee on 1995-09-12 and endorsed by the CENELEC Technical Board on 1996-03-05.

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CENELEC

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

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Foreword

This Technical Report has been prepared by Working Group 10 of CENELEC Technical Committee TC 205, Home and Building electronic Systems, in accordance with the relevant decisions taken by TC 205 during its meeting in Brussels in September 1993.

During the TC 205 plenary meeting on 12 September 1995 it was decided to ask the CENELEC Technical Board to approve the document for publication as a CENELEC Report. The Technical Board decided to invite CLC/TC 209 and CLC/TC 215 to comment on the document prior to its formal acceptance.

After incorporation of the comments received from CLC/TC 215 (no comments were made by CLC/TC 209), the CENELEC Technical Board approved the document for publication as a CENELEC Report on 1996-03-05.

The need for regulatory approvals of telecommunications terminal equipment to be connected to public telecommunications networks is not described in the present report, but has to be complied with, according to national and international regulations.

Introduction

A bandwidth oriented classification of home control systems is defined in the HBES standard EN 50090-1. It is based on the transport capabilities of the communication system.

In this Technical Report, a supplementary classification is proposed to deal with the increasing level of complexity of systems from Class 1 to Class 3 regarding the management of their information channels.

It is based on the number of channels vis a vis the number of applications.

Classes	Categories		
	A	B	C
1			
2		Applications	
3			

A classification into categories is derived from these considerations.
- category A concerns the case of a home network providing only one control channel
- category B concerns the case of time sharing one information channel
- category C concerns the case of a complete home network providing a number of information channels which may be used by a number of applications, communicating concurrently.

The Class 1 requirements considered by TC 205 are concerning only electrotechnical functions and applications. Thus, this Technical Report deals with Telecommunication and Broadcast Signal Applications with special considerations to Class 1 requirements for non electrotechnical applications and functions. It gives detailed information on these classifications and concepts.

It is structured to present a list of applications in accordance with the proposed classification. The relevant users and systems requirements are listed and recommendations for the selection of media and cabling systems are proposed.

1 Transport capabilities for HBES applications

1.1 Classes and parameters for the transport capabilities

The differentiation into class 1, 2 and 3 transport capabilities for applications has been made to reflect the different bandwidth requirements. There are many definitions circulating, most of them having in common that:

Class 1 is the transport capability for brief commands for remote or distributed control of applications, provided by a shared packet-mode low bitrate channel.

Class 2 is the transport capability, in addition to Class 1, for applications requiring up to 144 kbit/sec (ISDN like services) or a bandwidth below 200 kHz.

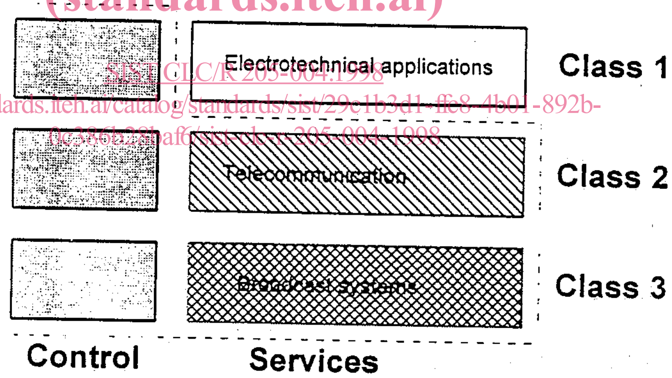
Class 3 is the transport capability, in addition to Class 2, for applications involving the distribution of multiple information channels for audio, video and data.

The distinction into classes is bandwidth related; evaluation of the requirements reveals that more parameters are to be considered to categorise the transport capabilities of the network. Therefore four additional parameters are identified: nature of information, signal type, single/multiple channels and one/two-way transport. The different parameters, used for the distinction in Categories, have a direct relation to the requirements for the network technology.

The "nature of the information" will give a bandwidth requirement of the transport medium. The "signal type", analogue or digital, will require a different network technology (e.g. for the transceivers and for the repeaters). The requirement for a "single or for multiple information channels" means that the channels within the available bandwidth has to be allocated (requiring modulators and tuners, or other channel allocation means). The last parameter is related to the transport requirement of "one-way transmission" or "two-way transmission". The latter may be subdivided in two-way transmission of signals with same bandwidth requirements or that the return channel is a small(er) bandwidth channel.

The definition of the class 1 transport capability has been maintained in the definition of the categories. The classes 2 and 3 are expanded and completed in the categorisation.

Not considered are the application control signals requiring medium or high data rate channels, for non-connected services, like the Class 1 applications.



1.2 Information signals

The different information signals representing speech, music or sounds, images or data processing have each their own characteristics and requirements. Many applications require the transport of one or more information signals in addition to one control channel that is provided for Class 1 type of applications. The information signal transport requirements differ from the control channel requirements in the sense of nature of the signal, in the sense of number - one or many - of signals and the electrical representation (analogue or digital) of the signal and the bandwidth.

Nature of information:

speech — human voice signal, mono, analogue signal. (BW < 4 kHz, real time)

audio — any sound signal within the hearing bandwidth of human ears, mono or stereo, analogue signal. (BW < 20 kHz per signal, real time)

video — live pictures, continuous analogue signal representing a scene scanned at (e.g.) 25 pictures per second and 625 lines per picture, inclusive an audio signal. (BW 6 - 8 MHz, real time). Current developments are aiming at quality improvements requiring larger bandwidths.

data — digitally encoded information representing numeric information, texts, graphics or images. The required bandwidth increases with technological developments (actual figures are ranging from 10 kbit/s to 10 Mbit/s)

Signal type:

analogue — speech, audio and video are initially (at the source) analogue signals. The signals can take any value between the (typical) minimum and maximum values.

digital — data and digitised analogue signals converted or represented by discrete signal values. Depending on the nature of the signal, digitisation will expand the required bandwidth by a factor 16 to 30. (digital speech < 64 kbit/s, digital audio < 150 kbit/s, digital video < 120 Mbit/s, real time). Compression and encoding techniques may reduce the bandwidth requirements. The digital technology allows to package the data and allow for easy multiplexing.

One/two-way transport:

One-way — transmission requires the transport of the information channel from one point to another or multiple other points.

Two way — transmission requires that the transport channel is capable to transport the information to a point or multiple points and that this point or these points can return information.

The downward information may have different characteristics from the upward information.

Single/multiple channels:

Single — channel communication requires that the physical medium is capable to support only one transport channel for digital or analog informations.

Multiple — channel communication requires that the physical medium is capable to support several transport channels. The number of transmitted informations at a time is at most equal to the number of channels. The number of channels depends on the operating bandwidth value. The technologies generally used for multiple channel communications are TDN or FDM. A communication system that uses a PCM (Pulse Code Modulation) system with information signals at 4 MHz, is capable to support 32 channels with a bandwidth of about 2 Mbit/s. When using FDM, the channel bandwidth is divided into a number of non overlapping frequency slots. Each slot carries only one information. When this technology is used to transmit speech informations, it is possible to get a wide number of channels for a given bandwidth. CCITT defined as "Standard Group" the frequency band between 60 and 108 KHz to contain 12 voice channels. In modern FDM carrier equipments, a redundant master frequency generator is used as the prime frequency source from which all carriers are derived or to which they are phase locked.

The transport capabilities required for the information channels depend on the application. The data rate or bandwidth will vary according to the application, but also other parameters may vary.

Some information streams, typically audio or video, require a real-time transport capability. For interactive transmission the delay must be kept below prescribed (low) limits, and for both interactive and non-interactive applications the variation in the delay (jitter) must be controlled. Where a video channel has an associated sound channel, then the relative delay of the two streams must be controlled. Typically, error correction by retransmission is not possible, and so the uncorrected error rate must be sufficiently low. However, audio and video systems may tolerate some residual error (resulting in momentary noise bursts on the decoded audio or video).

Information streams for data have very much less demanding delay and jitter requirements, but the residual error rate (after any retransmission) must usually be very low.

The specific requirements for individual applications is specified in appropriate standards, and the HBES must meet these requirements.

The following types of information signals are indicative of the bandwidth or data rate requirements:

Information signal and required signal bandwidth

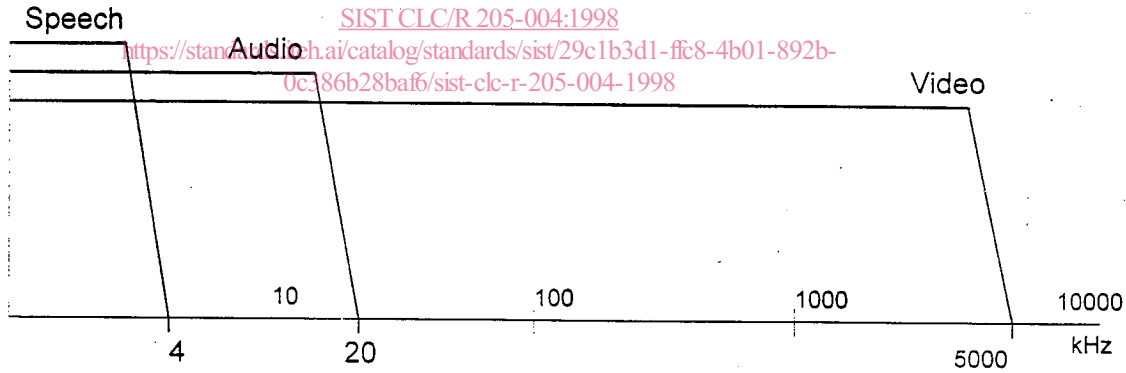
Information	Required bandwidth (example values)
Speech, analogue	4 kHz
Speech, digital	64 kbit/s
Speech, compressed digital	8 - 32 kbit/s
Audio, analogue	20 kHz
Audio, digital	1 500 kbit/s
Audio, compressed digital	100 - 750 kbit/s
Video, analogue	5 000 kHz
Video, digital	over 100 Mbit/s
Video, compressed digital	1 - 40 Mbit/s
Data, low volume	up to 20 kbit/s
Data, medium volume	up to 200 kbit/s
Data, high volume	over 200 kbit/s

Many applications have needs for transport of multiple information channels. Some of these are listed below:

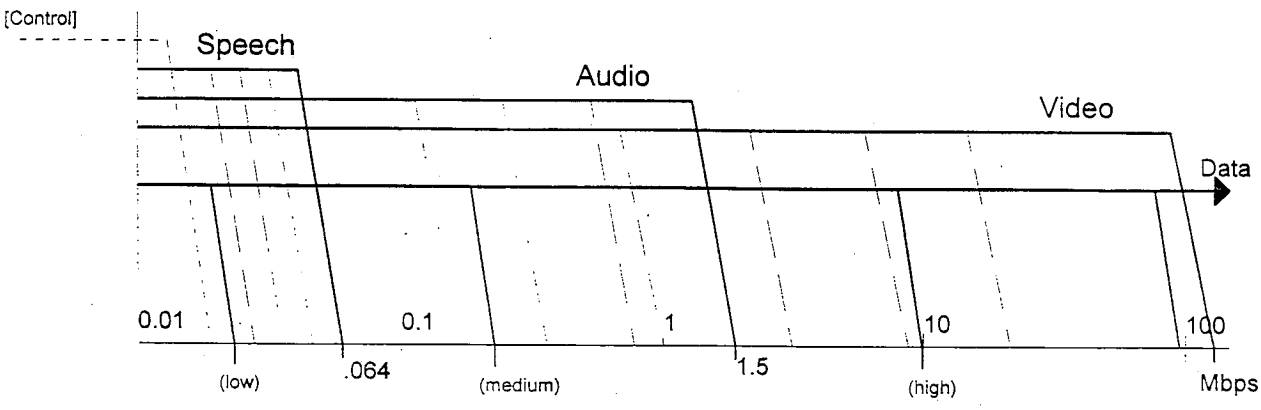
Information Channels and required channel bandwidth

Information (Mode of distribution)	Channels, Bandwidth
Radio (broadcast audio) - 1	Many channels in LW, MW and SW bands, each of analogue speech or medium quality analogue audio (~ 8 kHz)
Radio (broadcast audio) - 2	Many channels in FM bands, each of high quality analogue audio (~150 kHz)
Radio (broadcast audio) - 3	Many channels in 'Satellite' bands, each of high quality digital audio
Television (broadcast video) - 1	Many channels in VHF UHF bands, each of standard quality analogue video (~7 MHz)
Television (broadcast video) - 2	Many channels in 'Satellite' bands, each of standard quality analogue video (< 36 MHz)
Multimedia: any combination of speech, audio, video, data	Application dependent requirements; for sufficient 'interaction' is needed a bandwidth of over 1 000 kbit/s.

Figures 1 and 2 give a representation of the bandwidth requirements of the information signals given above.



Analogue Signal Bandwidth



Digital Signal Data Rates

uncompressed
compressed

Figure 1 - Bandwidth/data rate requirements of information signals

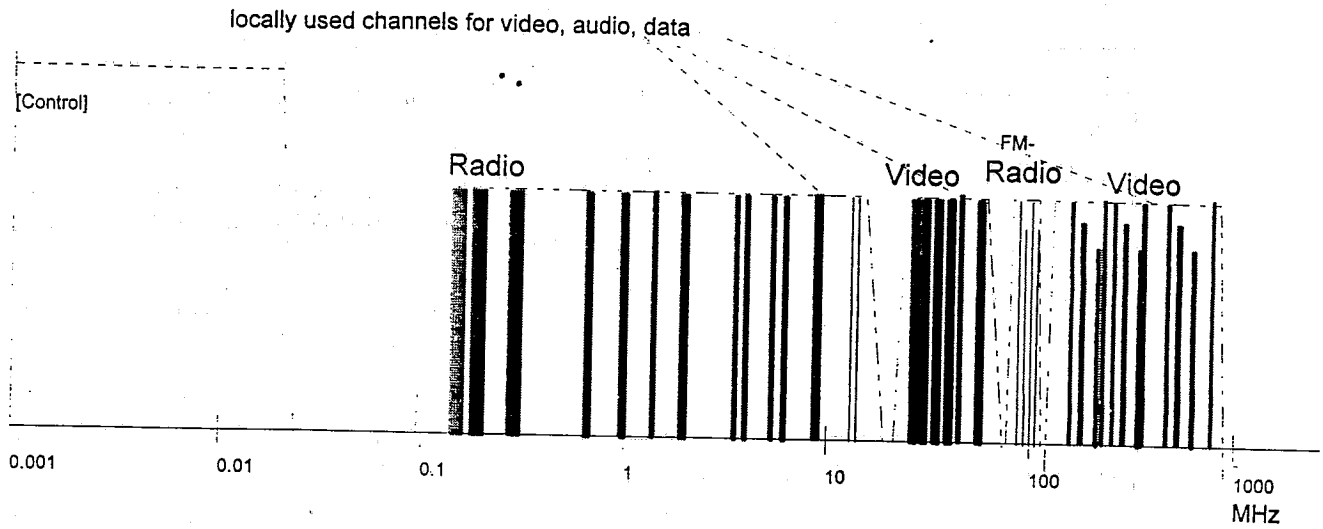


Figure 2 - Example of multi-channel requirements including transport of public broadcast channels. The 'free' channels can be allocated for 'local' use

1.3 Transmission technologies

Information channels, shown as lines in the diagrams, may actually be any kind of virtual or real circuit provided by any one of a number of transmission technologies, i.e.

TDM (time division multiplex)

Time sharing of a digital medium, implying digital transmission. E.g. in fixed time slots, by token passing, or by ATM. One channel can provide either a fixed information carrying capability as in a time slotted medium, or provide a capacity which can be dynamically allocated such as in the ATM technique.

SDM (space division multiplex)

Physical circuits as in a multi-wire cable. Each channel (i.e. wire) can be used with either analog baseband or modulated transmission or with digital transmission.

FDM (frequency division multiplex)

Frequency channels on a wide band medium, such as coaxial cable or RF free air. Each channel or frequency band can be coded or modulated with analog (AM, VSB, FM, ...) signals or digital (OFDM, QPSK, QAM, ...) signals, dependent on the channel characteristics.

2 Categories of management complexity

Classes of HBES are defined in EN 50090-1 and classify networks in terms of quantity / amount of information (bandwidth / bit rate). The Class concept is therefore bandwidth oriented. It is felt that for a classification of home networks other dimensions are to be considered as well. As such, two other distinctions are introduced:

(i) the extent / area (home, building, campus): cable length and number of devices
(ii) number of channels vis a vis number of applications.

While the requirements for different cable lengths and number of devices are easily understood and do not require further explanation, this is not so for the management complexity associated to the number of channels and applications. This section therefore is particularly concerned with the latter and the following categories are defined:

Category A:

The case of a home network providing one control channel, eventually with one or more unmanaged information channels, serving the needs of one or more applications. Obviously, there is no management required of the information channel, since there is a fixed assignment of this channel to a single application. The case that there are more than one channels fixed and permanently assigned to an equal number of applications, this is considered as multiple instances of category A. (For example: CATV is a Category A Class 3 Application)

Category B:

The case of a home network providing, in addition to category A, one single managed information channel, time shared by a number of applications, allowing one application to communicate at any moment in time. A information channel access manager is required which mediates which application may use the one channel.

Category C:

This is the case of a home network providing, in addition to the provision of category B, a number of managed information channels, which may be used by a number of applications, communicating concurrently. A information channel assignment manager is needed, which is capable of detecting or keeping track of free information channels and assigns channels responding to requests from the applications.

Categories of complexity thus relate to the complexity of the management task and particularly to the channel management task. Therefore, there is an increasing functionality required from the control channel (which is in itself class I) to serve the requirements of the management entity. The categories A, B and C are illustrated in the table and the diagrams below.