

**Access, Terminals, Transmission and Multiplexing (ATTM);
Broadband Deployment - Energy Efficiency
and Key Performance Indicators;
Part 5: Customer network infrastructures;
Sub-part 1: Homes (single-tenant)**

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 5-1 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.36].

Introduction

The increasing interaction between the different elements of the Information Communication Technology (ICT) sector (hardware, middleware, software and services) supports the concept of convergence in which:

- multi-service packages can be delivered over a common infrastructure;
- a variety of infrastructures is able to deliver these packages;
- a single multi-service-package may delivered over different infrastructures.

As a result of this convergence, the development of new services, applications and content has resulted in an increased demand for bandwidth, reliability, quality and performance, with a consequent increase in the demand for power which has implications for cost and, in some cases, availability. It is therefore important to maximize the energy efficiency of all the network elements necessary to deliver the required services.

New technologies and infrastructure strategies are expected to enable operators to decrease the energy consumption, for a given level of service, of their existing and future infrastructures thus decreasing their costs. This requires a common understanding among market participants that only standards can produce.

The present document is part 5-1 of a multi-part deliverable which has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM) in close collaboration with CENELEC via the Co-ordination Group on Installations and Cabling (CGIC). It offers a contribution to the required standardization process by establishing an initial basis for work on ICT networks and transmission engineering, with active collaboration from a number of other ETSI and CENELEC Technical Bodies. When complete, the documents will contain information that has been jointly evolved to present developments in installations and transmission implementation, and describing their progress towards energy efficiency in Next Generation Networks (NGN).

1 Scope

The present document details measures which may be taken to improve the energy efficiency within homes (single-tenant) by virtue of broadband deployment. Clauses 2 and 3 contain references, definitions and abbreviations which relate to this part; similar information will be included in the corresponding clauses of the other parts, thus ensuring that each document can be used on a "stand-alone" basis.

Within the present document:

- clause 4 describes the nature of customer premises networks in homes (single tenant), defines the interfaces to those networks and identifies the standardization bodies working on the design and installation of those networks;
- clause 5 describes the strategies that may be employed within homes (single tenant) to both increase the energy efficiency of installed information technology equipment and to use the facilities offered by information technology services to reduce overall energy consumption.

This will enable the proper implementation of services, applications and content on an energy efficient infrastructure, though it is not the goal of this multi-part deliverable to provide detailed standardized solutions for home broadband network architecture.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
 - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
 - for informative references.

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] European Commission: "DG-JRC Code of Conduct on Energy Consumption of Broadband Equipment".

- [i.2] CENELEC EN 50090 series: "Home and Building Electronic Systems (HBES)".
- [i.3] CENELEC EN 50173-1: "Information technology - Generic cabling systems - Part 1: General requirements".
- [i.4] CENELEC EN 50173-4: "Information technology - Generic cabling - Part 4: Homes".
- [i.5] CENELEC EN 50174-1: "Information technology - Cabling installation - Part 1: Installation specification and quality assurance".
- [i.6] CENELEC EN 50174-2: "Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings".
- [i.7] CENELEC EN 50090-2-1: "Home and Building Electronic Systems (HBES) - Part 2-1: System overview - Architecture".
- [i.8] CENELEC EN 50090-2-2: "Home and Building Electronic Systems (HBES) - Part 2-2: System overview - General technical requirements".
- [i.9] CENELEC EN 50090-2-3: "Home and Building Electronic Systems (HBES) - Part 2-2: System overview - General functional safety requirements for products intended to be integrated in HBES".
- [i.10] CENELEC EN 50090-3-1: "Home and Building Electronic Systems (HBES) - Part 3-1: Aspects of application - Introduction to the application structure".
- [i.11] CENELEC EN 50090-3-2: "Home and Building Electronic Systems (HBES) - Part 3-2: Aspects of application - User process for HBES Class 1".
- [i.12] CENELEC EN 50090-3-3: "Home and Building Electronic Systems (HBES) - Part 3-3: Aspects of application - HBES Interworking model and common HBES data types".
- [i.13] CENELEC EN 50090-4-1: "Home and Building Electronic Systems (HBES) - Part 4-1: Media independent layers - Application layer for HBES Class 1".
- [i.14] CENELEC EN 50090-4-2: "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".
- [i.15] CENELEC EN 50090-4-3: "Home and Building Electronic Systems (HBES) - Part 4-3: Media independent layers - Communication over IP".
- [i.16] CENELEC EN 50090-5-1: "Home and Building Electronic Systems (HBES) - Part 5-1: Media and media dependent layers - Power line for HBES Class 1".
- [i.17] CENELEC EN 50090-5-2: "Home and Building Electronic Systems (HBES) - Part 5-2: Media and media dependent layers - Network based on HBES Class 1, Twisted Pair".
- [i.18] CENELEC EN 50090-5-3: "Home and Building Electronic Systems (HBES) - Part 5-3: Media and media dependent layers - Radio frequency".
- [i.19] CENELEC prTS 50090-6-4: "Home and Building Electronic Systems (HBES) - Part 6-4: Interfaces - Residential gateway model for a home and building electronic system".
- [i.20] CENELEC EN 50090-7-1: "Home and Building Electronic Systems (HBES) - Part 7-1: System management - Management procedures".
- [i.21] CENELEC EN 50090-8: "Home and Building Electronic Systems (HBES) - Part 8: Conformity assessment of products".
- [i.22] CENELEC EN 50090-9-1: "Home and Building Electronic Systems (HBES) - Part 9-1: Installation requirements - Generic cabling for HBES Class 1 Twisted Pair".
- [i.23] CENELEC TR 50090-9-2: "Home and Building Electronic Systems (HBES) - Part 9-2: Installation requirements - Inspection and testing of HBES installation".

- [i.24] CENELEC EN 50491-2 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) -- Part 2: Environmental conditions".
- [i.25] CENELEC EN 50491-3 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) -- Part 3: Electrical safety requirements".
- [i.26] CENELEC EN 50491-5-1 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) -- Part 5-1: EMC requirements, conditions and test set-up".
- [i.27] CENELEC EN 50491-5-2 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) -- Part 5-2: EMC requirements for HBES/BACS used in residential, commercial and light industry environment".
- [i.28] CENELEC EN 50491-5-3 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) -- Part 5-3: EMC requirements for HBES/BACS used in industry environment".
- [i.29] CENELEC EN 50491-6 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) -- Part 6: Design, planning and installation".
- [i.30] ETSI TS 102 973: "Access Terminals, Transmission and Multiplexing (ATTM); Network Termination (NT) in Next Generation Network architectures".
- [i.31] IEEE 802.3af: "IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)".
- [i.32] IEEE 802.3at: "Standard for Information Technology Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Amendment: Data Terminal Equipment (DTE) Power Via the Media Dependent Interface (MDI) Enhancements".
- [i.33] IEEE 802.3az: "IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Amendment: Media Access Control Parameters, Physical Layers and Management Parameters for Energy-Efficient Ethernet".
- [i.34] ISO/IEC 15018: "Information technology - Generic cabling for homes".
- [i.35] Commission Regulation (EC) No 1275/2008 of 17 December 2008, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to "ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment".
- [i.36] ETSI TS 105 174-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 1: Overview, common and generic aspects".
- [i.37] CENELEC EN 60603-7 series: "Connectors for electronic equipment -- Part 7: Detail specification for 8-way".
- [i.38] CENELEC EN 50491-4 (in development): "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS); Part 4: Functional safety requirements".

[i.39] ETSI TR 105 174-4: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 4: Access networks".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

application: system, with its associated transmission method that is supported by telecommunications cabling (this corresponds to a Layer One application in the OSI 7-layer model)

Broadcast Communication Technology (BCT) application: system, with its associated transmission method using the HF band (3 MHz to 30 MHz), the VHF band (30 MHz to 300 MHz) and the UHF band (300 MHz to 3 000 MHz) dedicated to the transmission of sound radio, TV and two-way data services, as well as for in-home inter-networking

NOTE: See EN 50173-1 [i.3] modified.

BCT service: transmission of sound radio, TV and two-way data

NOTE: See EN 50173-1 [i.3] modified.

Control, Command and Communications in Building (CCCB) application: system, with its associated transmission method dedicated to providing appliance control and building control

NOTE: See EN 50173-1 [i.3] modified.

CCCB services: appliance control and building control

NOTE: See EN 50173-1 [i.3] modified.

Information Communication Technology (ICT) applications: system, with its associated transmission method for the communication of information

ICT services: creation, communication dissemination, storage and management of information

network convergence: ability of a network, by virtue of the applications it supports, to deliver multiple ICT, BCT and CCCB services

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACP	Area Connection Point
ACS	Adjacent Channel Selectivity
BACS	Building Automation and Control Systems
BCT	Broadcast Communications Technology
BO	Broadcast Outlet
CATV	Cable Television
CCCB	Command Control and Communications in Buildings
CGIC	ETSI CLC Co-ordination Group on Installations and Cabling
CO	Control Outlet
CPE	Customer Premises Equipment
DC	Dedicated Control
DSL	Digital Subscriber Line
DTE	Data Terminal Equipment
ENTI	External Network Termination Interface
FTTH	Fibre To The Home
HBES	Home and Building Electronic Systems
HD	Home Distributor
HDMI	High Definition Media Interface

ICT	Information and Communication Technology
KPI	Key Performance Indicator
MATO	Multi-Application Telecommunications Outlet
MDI	Media-Dependent Interface
NGN	Next Generation Network
OIE	Operator Independent Equipment
OSE	Operator Specific Equipment
PDA	Personal Digital Assistant
PoE	Power over Ethernet
POF	Plastic Optical Fibre
QoE	Quality of Experience
QoS	Quality of Service
SHD	Secondary Home Distributor
SMI	Structure of Management Information
TO	Telecommunications Outlet
VoIP	Voice over Internet Protocol

4 Customer networks in homes (single-tenant)

4.1 Overview of home network infrastructures

4.1.1 General

Homes, both as single-tenant and multi-tenant premises, are unique with respect to cabling infrastructures for the following reasons:

- they represent the largest constituency for broadband services;
- there are limited or non-existent cabling infrastructures within the home for the distribution of external network telecommunications services or internally generated information technology services;
- residents are either willing to physically move within the home, or install service-specific wireless systems to access the primary telecommunications equipment;
- residents tend to situate their living space(s) according to the availability of the BCT service;
- the ongoing development of BCT services and the consequent requirements of the local cabling (HDMI etc.) restrict distribution of those services within the home since a significant percentage of installations have been changed by the user and which restrict the capability of the infrastructure to support upgraded services.

The growth of ICT applications within the home and the advent of broadband services allowing access to BCT services using ICT applications has failed to encourage large scale installation of home cabling infrastructures as a means of distribution since:

- aesthetic considerations have prominence in domestic premises;
- refurbishment of the building structures is uncommon;
- residents expect temporal flexibility in access to services.

Instead there has been a substantial investment in wireless infrastructures within the home. These systems lie outside the scope of this multi-part document.

4.1.2 Network convergence

Within the home, telecommunications services fall into three groups:

- ICT (also referred to as HBES Class 2): for example, telephone, local area network;

- BCT (also referred to as HBES Class 3): for example, broadcast television;
- CCCB (also referred to as HBES Class 1): for example, security alarms, surveillance and door access control, environmental controls.

Annex A includes details of the types of services and the group into which they fall.

Access networks providing ICT services are also supporting BCT and CCCB services using ICT applications. Access networks providing BCT services also support ICT services using embedded ICT applications.

Within customer premises, the range of networks has, in the past, reflected the diversity of the services with:

- ICT services being delivered over a variety of cabling infrastructures ranging from those suitable only for basic telephony through to those used for generic cabling (see clause 4.2.1);
- BCT services being delivered over application-specific coaxial cabling systems;
- CCCB services being delivered over a variety of cabling infrastructures ranging from application-specific solutions described in general terms in clause 4.2.2, often including those combining power with control systems, through to those used for generic cabling (see clause 4.2.1).

However, the network convergence seen in the access network may also extend into the customer premises. Within customer premises, the opportunity for network convergence is further enhanced by the development of ICT networking standards that support delivery of Power over Ethernet (PoE). These can typically provide approximately 13 W via IEEE 802.3af [i.31] and approximately 25 W via IEEE 802.3at [i.32]) when using ICT applications such as 10/100/1000BASE-T.

The emergence and further development of PoE is expected to encourage the use of cabled infrastructure installations since:

- both existing residents and developers of new homes will recognize the benefits of being able to control and provide power to a wide range of equipment (for example, surveillance systems, door access control, environmental control system) that can be managed from a central location and via a common infrastructure;
- residents will see an increase in equipment specified for connection to PoE without the need for external power supplies and with a common connection style (EN 60603-7 series [i.37], also known as the RJ-45).

By these means, ICT applications, such as 10/100/1000BASE-T, are able to support ICT, BCT and CCCB services within the home.

In order to meet the potential need for a common infrastructure to support network convergence within the home, CENELEC TC215 developed EN 50173-4 [i.4], covering the design and specification of generic cabling.

4.2 Infrastructure standardization activities

4.2.1 Generic cabling designs in accordance with EN 50173-4

NOTE: EN 50173-4 [i.4], first published in 2007, has a similar scope to that of ISO/IEC 15018 [i.34] produced by ISO/IEC JTC1 SC25. However, the two documents contain different requirements and are therefore not identical at a technical level.

4.2.1.1 Infrastructure layers

EN 50173-4 [i.4] specifies two layers of infrastructure as shown in figure 1 (*modified from EN 50173-4 [i.4]*). Both layers are fed from a Home Distributor (HD) or, if the dimensions of the home, its configuration or the complexity of the network supports their use, Secondary Home Distributors (SHD) as shown in figure 2 (*modified from EN 50173-4 [i.4]*). Figure 2 (*modified from EN 50173-4 [i.4]*) shows that generic cabling of EN 50173-4 [i.4] not only provides distribution of broadband services delivered over cabled media via the access network but also supports the reception of BCT services using antennae.