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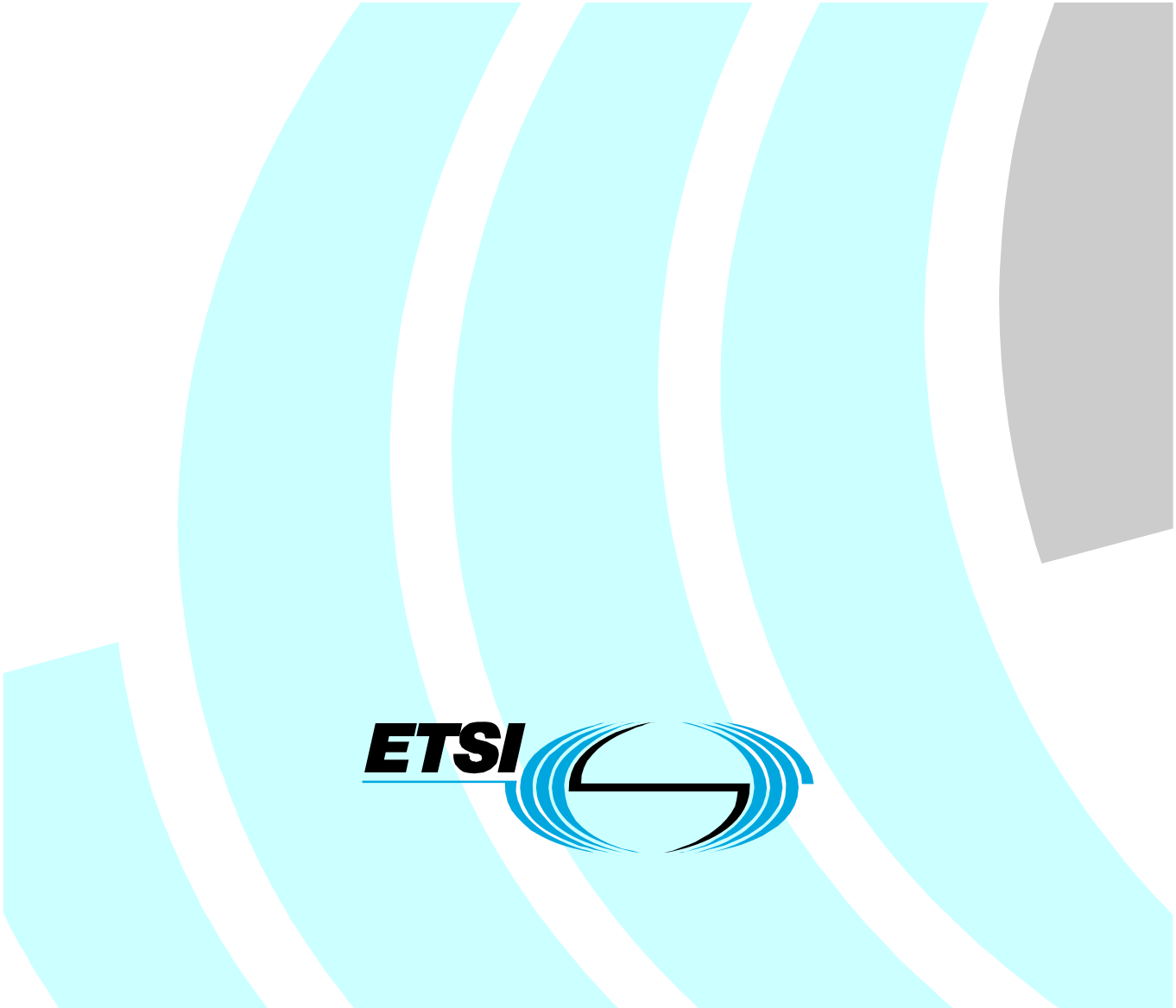
Technical Report

**Access, Terminals, Transmission and Multiplexing (ATTM);
Broadband Deployment - Energy efficiency
and broadband deployment;
Part 5: Customer network infrastructures;
Sub-part 2: Office premises (single-tenant)**



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Contents

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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 5-2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.13].

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 be 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 5-2 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 office premises (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 office premises (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.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

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 50173-1: "Information technology - Generic cabling systems - Part 1: General requirements".

[i.3] CENELEC EN 50173-2: "Information technology - Generic cabling systems -- Part 2: Office premises".

[i.4] CENELEC EN 50174-1: "Information technology - Cabling installation - Part 1: Installation specification and quality assurance".

[i.5] CENELEC EN 50174-2: "Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings".

[i.6] CENELEC EN 50174-3: "Information technology - Cabling installation - Part 3: Installation planning and practices outside buildings".

[i.7] ETSI TS 102 973: "Access Terminals, Transmission and Multiplexing (ATTM); Network Termination (NT) in Next Generation Network architectures".

[i.8] IEEE 802.3af: "IEEEE 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.9] 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.10] 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.11] ISO/IEC 11801: "Information technology- Generic cabling for customer premises".

[i.12] 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.13] 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.14] ETSI TS 105 174-5-4: "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment - Energy Efficiency and Key Performance Indicators; Part 5: Customer network infrastructures; Sub-part 4: Data centres (customer)".

[i.15] 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.2] modified.

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

NOTE: See EN 50173-1 [i.2] 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.2] modified.

CCCB services: appliance control and building control

NOTE: See EN 50173-1 [i.2] 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:

BCT	Broadcast Communication Technology
BD	Building Distributor
CATV	Cable Television
CCCB	Command Control and Communications in Buildings
CD	Campus Distributor
CGIC	ETSI CLC Co-ordination Group on Installations and Cabling
CP	Consolidation Point
DC	Direct Current
DSL	Digital Subscriber Line
DTE	Data Terminal Equipment
ENTI	External Network Termination Interface
FD	Floor Distributor
FTTB	Fibre To The Building
HBES	Home and Building Electronic Systems
HF	High Frequency
ICT	Information and Communication Technology
KPI	Key Performance Indicator
MDI	Media-Dependent Interface
NGN	Next Generation Network
OIE	Operator Independent Equipment
OSE	Operator Specific Equipment

PoE	Power over Ethernet
TO	Telecommunications Outlet
UHF	Ultra High Frequency
USB	Universal Serial Bus
VHF	Very High Frequency

4 Customer networks in office premises (single-tenant)

4.1 Overview of office network infrastructures

4.1.1 General

Office premises typically accommodate personnel that require a variety of ICT services (and BCT services, to a lesser degree) in order to perform relevant commercial activities on behalf of their employers.

In order to provide these services to the desired locations, office premises feature a range of cabling infrastructures for the distribution of external network telecommunications services or internally generated information technology services. In the past separate cabling infrastructures were installed for each service but over the last twenty years there has been a move toward the use of generic cabling infrastructures capable of supporting a wide range of ICT services and the supporting applications. More recently, these cabling infrastructures have been augmented to provide wireless networks within the premises. These systems lie outside the scope of the present document.

Office premises typically also accommodate private data centres housing information technology equipment which both provide generate and process information within the customer network and also have interfaces to the access network. These data centres vary in size and complexity to reflect the operations of the office they support (see TS 105 174-5-4 [i.14]).

In addition to ICT services, office premises have requirements for building management systems including access control, surveillance and environmental control. In the past separate cabling infrastructures have been installed for each service. The trend towards network convergence had led to the installation of multiple "parallel" cabling infrastructures of equivalent performance differentiated only by their function.

As the size and population of offices increases, of energy consumption of information technology equipment as a proportion of the overall energy consumption of the office premises rises significantly. The opportunities for improvements in energy efficiency within the information technology infrastructure, and reduction in overall energy consumption are correspondingly greater for large office premises.

4.1.2 Network convergence

Within the office premises, 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.

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 specified computer-computer or computer-peripheral connections. The concept of generic cabling (see clause 4.2.1), which provides specified levels of transmission performance in support of a wide range of ICT applications, was founded in office premises and has become a de-facto infrastructure solution for the delivery of ICT services.

While some connections to external BCT services are delivered over application-specific coaxial cabling systems, the wide range of transmission distances encountered in office premises support the delivery of such services using ICT applications which are supported by generic cabling.

CCCB services continue to be delivered over a variety of cabling infrastructures ranging from application-specific solutions, often including those combining power with control systems, through to those used for generic cabling (see clause 4.2.1). The use of ICT applications to deliver CCCB services is further enhanced by the development of ICT networking standards that support delivery of Power over Ethernet (PoE). These can typically provide approximately 13W via IEEE 802.3af [i.8] and approximately 25 W via IEEE 802.3at [i.9]) when using ICT applications such as 10/100/1000BASE-T.

By these means, ICT applications, such as 10/100/1000BASE-T, are able to support ICT, BCT and CCCB services within the office premises installed with a generic cabling infrastructure in accordance with EN 50173-2 [i.3] developed by CENELEC TC215.

4.2 Infrastructure standardization activities

4.2.1 Generic cabling designs in accordance with EN 50173-2

NOTE: EN 50173-2 [i.3], published in 2007, has a similar scope, and is intended to be technically equivalent, to ISO/IEC 11801 [i.11] produced by ISO/IEC JTC1 SC25. EN 50173-2 [i.3] is a development of earlier standards EN 50173 (1995) and EN 50173-1 [i.2].

4.2.1.1 Infrastructure design

EN 50173-2 [i.3] specifies a single layer infrastructure as shown in figure 1 (*modified from EN 50173-2 [i.3]*) which supports campus premises containing multiple buildings.

On multi-building campus premises each building is fed from a Campus Distributor (CD).

Within each building the infrastructure is fed from a Building Distributor (BD). Floors or equivalent areas are fed from Floor Distributors (FD) connected to the BD. Information technology equipment may be housed at any distributor as required by the networked application. The final distribution to the "work areas" is from the FD to the Telecommunications Outlets (TO). A Consolidation Point may be installed between a TO and an FD to provide a point of administration but does not house active information technology equipment.

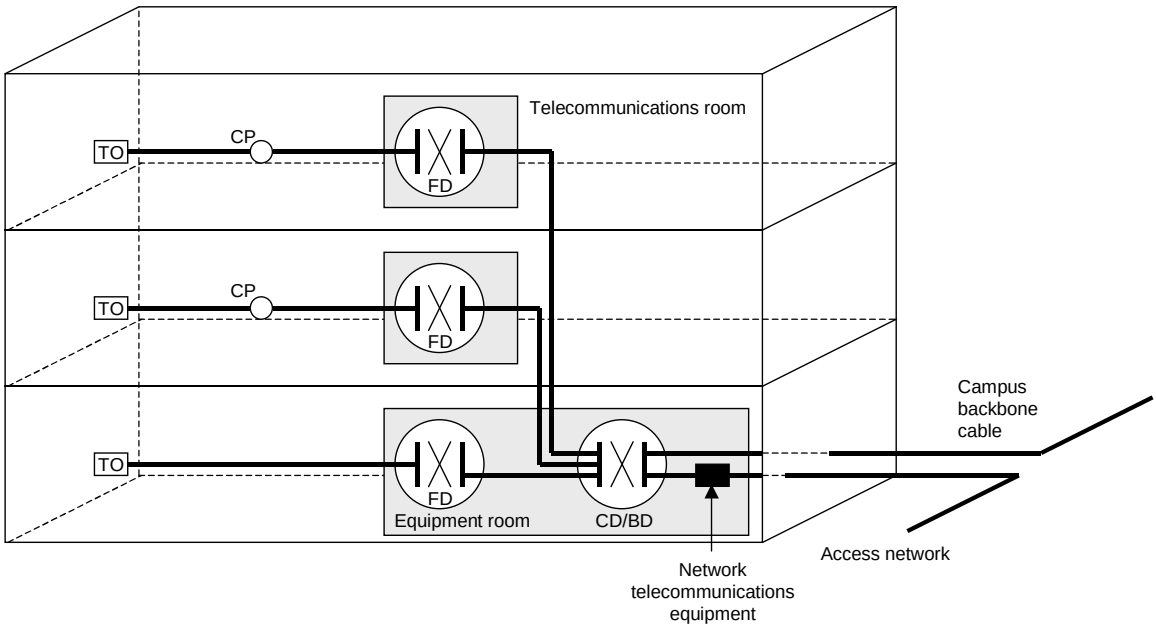

Figure 1: Building cabling infrastructure of EN 50173-2 [i.3]

The provision of ICT services is achieved by the connection of:

- terminal equipment (e.g. telephones, computers and television receivers) at the TO - both of which adopt a point-to-point star topology to the relevant distributor;
- the relevant system equipment at the FD, BD or CD as shown in figure 2 (as in EN 50173-2 [i.3]).

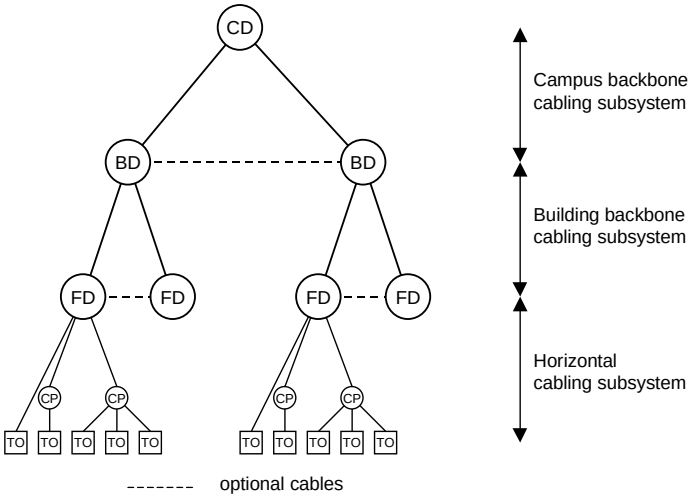

Figure 2: Cabling topology of EN 50173-2 [i.3]

4.2.1.2 Cabling media

The horizontal cabling subsystem of figure 2 presents a minimum of two TO per identified work area within the office premises. EN 50173-2 [i.3] requires that one of the TOs is required to be provided by balanced cabling capable of providing a minimum transmission performance (defined as Class D of EN 50173-1 [i.2]).

Class D cabling of EN 50173-1 [i.2] is capable of supporting applications up to and including 1000BASE-T and incorporating power distribution to the TO in accordance with IEEE 802.3at [i.9].

The second TO serving the work area is required to provide the same minimum performance using balanced cabling or, alternatively, may be implemented with optical fibre cabling. The maximum channel length between the FD and the TO is limited to 100 metres ensuring that the worst case cabled optical fibre allowed (defined as Category OM1 in EN 50173-2 [i.3]) will support 1000BASE-SX or 1000BASE-LX applications using equipment installed at the FD.

The campus backbone cabling and building backbone cabling subsystems of infrastructures of figure 2 are implemented using either balanced cabling or optical fibre cabling. The choice of cabling media and the need for equipment at the distributors reflects the dimensions of the campus/building and the planned evolution of applications. For example, the longer distances of building and campus backbone systems may require the use of cabled single mode optical fibres of Categories OS1 or OS2 as defined in EN 50173-2 [i.3].

4.2.2 Generic cabling for other services in office premises

EN 50173-2 [i.3] specifies cabling infrastructures to work areas, that is fixed areas within which personnel are accommodated to perform their allocated tasks. However, the same cabling infrastructure can be installed to:

- TOs that are dedicated to wireless access points;
- TOs that are dedicated to security systems such as sensors or surveillance cameras;
- TOs that are dedicated to access control systems;
- TOs that are dedicated to sensors and/or actuators to provide CCCB services.

4.2.3 Cabling installation in accordance with EN 50174 standards

EN 50174-1 [i.4], EN 50174-2 [i.5] and EN 50174-3 [i.6] contain requirements and recommendations for the specification, quality assurance, planning and installation practices that apply to all information technology cabling media in all premises. Clause 8 of EN 50174-2 [i.5] specifies the additional/amended requirements and recommendations that apply within the buildings containing office premises.

4.3 Network access infrastructure

The connection between the operators access network may be made to the campus or building distributor as shown in figure 1 (or the equivalent in non-generic cabling) and is provided by cabling and some type of network telecommunication equipment as shown in figure 3.

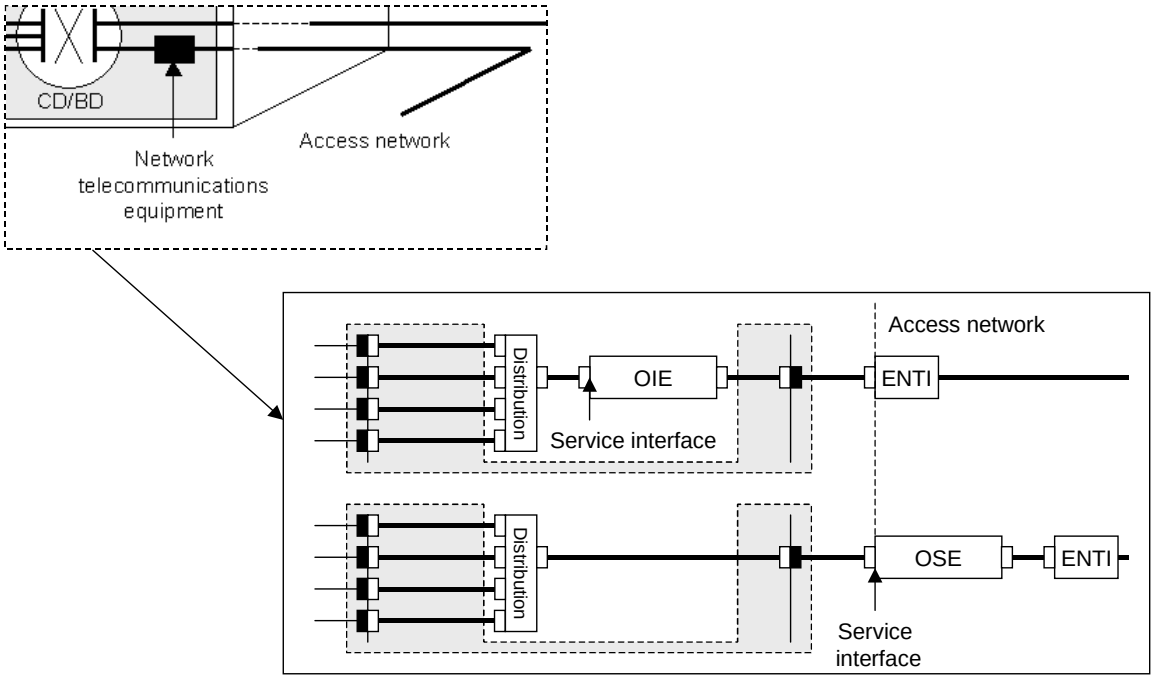

Figure 3: Access network interface and equipment

The network telecommunications equipment typically comprises a passive interface (ENTI) and an optional item of apparatus. The apparatus may be specific to the network operator (OSE) or may be operator independent (OIE) as described in the following examples:

- OIE: DSL modem, FTTB modem (where interoperability standard exists).

NOTE: See TS 102 973 [i.7].

- OSE: CATV modem, FTTB modem (where no interoperability standard exists).

The OSE is part of the access network whereas the OIE is part of the customer premises infrastructure.

In most cases the OIE, or some part of it, may be powered from the access network. In some cases the OSE may be powered from the customer premises.

For this reason, the energy efficiency of the access network takes into account any power required to maintain the functionality at the service interface, whether or not it is part of the access network (and is covered in TR 105 174-4 [i.15]).

The EU Code of Conduct on Energy Consumption of Broadband Equipment [i.1] provides a framework for ensuring operational energy efficiency consumption of network telecommunication equipment.

5 Energy efficiency

5.1 General

It is not possible to determine Key Performance Indicators (KPIs) for the energy efficiency of information technology networks within office premises (single-tenant). However, it is relevant to identify strategies for the improvement of energy efficiency of information technology infrastructures in offices (see clause 5.2) and also to introduce short term and medium term actions, based on the use of information technology networks, to reduce the overall energy consumption within offices (see clause 5.3).

5.2 Energy efficiency of information technology infrastructures

The principal strategy to be adopted in both new and legacy offices involves:

- the use of devices in accordance with the Energy Efficient Ethernet project (IEEE 802.3az [i.10]);
- the use of low consumption visual interfaces;
- the reduction of the number of visual interfaces;
- not just using standby modes for attached devices (opting to turn them off instead).

NOTE: The future provision of equipment meeting the requirements of European Commission Regulation (EC) No 1275/2008 [i.12] will assist in observing this strategy.

Additional strategies that may be considered in both new and legacy offices include:

- the implementation of "thin client computing" to reduce the processing load of information technology equipment, which reduces the energy consumption both within the work areas and the areas designated as data centres within the offices premises;
- a reduction in the number of fixed computing stations within the work area and their replacements with mobile computing solutions;
- the simplification of computing equipment within the work area - removing unnecessary disk drives and USB ports which not only reduces power consumption but increases network security.

The implementation of these additional strategies may allow substantial modifications to the fixed cabling infrastructure within new offices to include:

- the increased application of wireless networking for the majority of users - reversing the trend towards global "flood cabling" of premises (for provision of both information technology and equipment power) irrespective of usage;
- the installation of localized areas of fixed cabling concentrations intended to support the user with identified needs for highest bandwidth that only fixed cabling can currently provide.

5.3 The use of information technology to reduce total energy consumption

5.3.1 Infrastructure

The creation of appropriate network infrastructures can assist in reducing energy consumption by minimizing the energy wasted due to poor control of attached equipment.

Examples include:

- the use of PoE and PoE Plus, representing power on demand:
  - encouraging the use of equipment options with lower power consumption;
  - replacing permanently connected, "on" all the time, equipment (including DC converters in mains sockets).

NOTE: It is recognized that PoE may not be as energy efficient as a means of powering an individual device but it is considered that the benefit of PoE will lie in the control of usage that its fixed infrastructure provides.

5.3.2 Applications

Where CCCB services are already used to monitor and actively control energy consumption, their delivery using ICT applications over a common, but typically parallel, infrastructure to that for the ICT services offers little additional benefit in energy management.

However, where no such systems exist, the ability to monitor, in real time, the energy usage in the office premises, either as a total or more specifically as related to individual circuits (lighting, heating) or components (such as ICT equipment) and to display this information using a common visual interface using an ICT application both within the office premises or remotely may contribute significantly to the reduction of energy consumption within the office premises.

5.3.3 Green issues

The use of high bandwidth broadband deployment to support true "home working" (enabling effective "telepresence") allows the "carbon footprint" of employees to be reduced.

A variety of studies, including those undertaken in the United Kingdom by The Carbon Trust, shows that home working provides substantial beneficial impact.

An increased focus by employers on "mobility", requiring equivalent access to corporate networks, applications and tasks independent of the location from which they are accessed, recognizes home working as offering reductions in both capital and operational expenditure in terms of office space, corporate infrastructure and energy consumption. However, true mobility requires provision of high speed broadband delivery which can replicate, effectively, the office-based environment in the remote location.

History

Document history		
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