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Foreword

This final draft ETSI Standard (ES) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM), and is now submitted for the ETSI standards Membership Approval Procedure.

The present document is part 2, sub-part 2 of a multi-part deliverable covering operational energy management and sustainability of broadband deployment, as identified below:

Part 1: "General requirements".

Part 2: "Specific requirements":

Sub-part 1: "Data centres";

Sub-part 2: "Fixed broadband access networks";

Sub-part 3: "Mobile access networks";

Sub-part 4: "Cable Access Networks".

Part 3: "Global KPIs of ICT sites";

Part 4: "Monitoring of sustainability".

NOTE 1: Additional documents are in development by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM) which include:

- ETSI ES 205 200-1-1: "Energy management: Global KPIs: Operational infrastructures: Guidance" (see NWIP DES/ATTM-02025).
- ETSI ES 205 200-3: "Monitoring of other environmental viability aspects of sustainability" (see NWIP DES/ATTM-02027).

NOTE 2: A further document is under consideration in ETSI Technical Committee CABLE to address "cable access networks".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

Energy costs continue to increase, a trend that will continue in the future, while broadband penetration is introducing new active equipment to the network architecture. In this context, and to reflect other environmental aspects of sustainability, it is vital that the main telecommunication actors implement effective general engineering of fixed and mobile broadband networks and sites provisioning, managing or using those networks (i.e. operator sites, operator data centres and customer data centres) in order to respond to critical issues of energy consumption while proposing essential solutions to true broadband deployment. To guide this process, it is essential that metrics are defined, termed Global Key Performance Indicators (KPI_{EM}), that enable energy usage to be managed more effectively.

The ETSI ES 205 200 series of standards comprises:

- ETSI ES 205 200-1 [1]: a generic requirements document addressing Global KPIs for operational infrastructures;

NOTE: Global KPIs do not address design/operation of components or subsystems of broadband deployment networks.

- a sub-series ETSI ES 205 200-2 that defines the Global KPIs, and drives energy management targets, for specific operational networks and sites and which describes how the Global KPIs are to be applied (which may be used to support future regulatory objectives):
  - ETSI ES 205 200-2-1 [i.11]: Data centres;
  - ETSI ES 205 200-2-2 (the present document): Fixed broadband access networks;
  - ETSI ES 205 200-2-3 [i.12]: Mobile access networks;
  - ETSI ES 205 200-2-4 [i.13]: Cable Access Networks.

  These documents do not define KPI limits or targets (which is outside the scope of the ETSI ES 205 200 series of standards).

These documents will accelerate:

- availability of operational infrastructure architectures and network implementations that use energy more efficiently;
- the definition and attainment of sustainability objectives for operational broadband networks.

Within the present document:

- clause 4 explains the definition of a Broadband access network in terms of the systems it comprises and the boundaries that apply;
- clause 5 describes how the Objective KPIs of the present document meet the requirements of ETSI ES 205 200-1 [1];
- clause 6 describes the specific requirements of the Global KPI and the supporting Objective KPIs for fixed access networks;
- Annex A discusses the roles of different types of Key Performance Indicators i.e. Technical, Objective and Global in relation to the overall energy management concepts of the present document.

1 Scope

The present document specifies the requirements for a Global KPI for energy management (KPI_{EM}) and their underpinning Objective KPIs addressing the following objectives for the fixed access networks (FANs) of broadband deployment:

- energy consumption;
- task effectiveness;
- renewable energy.

The requirements are mapped to the general requirements of ETSI ES 205 200-1 [1].

Energy management of fixed access networks comprises a number of independent layers. The present document addresses performance of infrastructures that supports the normal function of hosted ICT equipment within the fixed access network (e.g. power distribution, environmental control, security and safety). The present document does not address other layers such as performance of ICT equipment itself, performance of usage of available processing power, and layers related to final service delivered (e.g. processing power required per itemized outcome) or overlay layers (e.g. energy consumption required per itemized outcome).

The environmental impact and management of different energy sources are outside the scope of the present document.

KPI_{EM} may be tailored for specific needs by changing weighting of renewable energies. Calculations should be based on a significant sample of network elements.

The Global KPI alone is not designed for comparison of fixed networks. It does not define a fixed network as good or bad unless combined with other parameters considered relevant for a comparison, such as local climatic conditions, availability requirements or purpose of fixed networks.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

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The following referenced documents are necessary for the application of the present document.

[1] ETSI ES 205 200-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 1: General requirements".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] EC Mandate M/462: "Standardisation mandate addressed to CEN, CENELEC and ETSI in the field of Information and Communication Technologies".

[i.2] ETSI ES 203 215 (V1.3.1): "Environmental Engineering (EE); Measurement Methods and Limits for Power Consumption in Broadband Telecommunication Networks Equipment".

[i.3] ISO Guide 82: "Guide for addressing sustainability in standards".

[i.4] Recommendation ITU-T G.993.2: "Very high speed digital subscriber line transceivers 2 (VDSL2)".

[i.5] Recommendation ITU-T G.992.5: "Asymmetric digital subscriber line 2 transceivers (ADSL2) - Extended bandwidth ADSL2 (ADSL2plus)".

[i.6] Recommendation ITU-T G.984: "Series describing Gigabit-capable passive optical networks (GPON)".

[i.7] Recommendation ITU-T G.987: "Series describing 10 Gigabit-capable passive optical networks (XG-PON)".

[i.8] Recommendation ITU-T G.989: "Series describing 40 Gigabit-capable passive optical networks (NG-PON2)".

[i.9] Recommendation ITU-T G.991.1: "High bit rate digital subscriber line (HDSL) transceivers".

[i.10] Recommendation ITU-T G.991.2: "Single-pair high-speed digital subscriber line (SHDSL) transceivers".

[i.11] ETSI ES 205 200-2-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements; Sub-part 1: Data centres".

[i.12] ETSI ES 205 200-2-3: "Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements; Sub-part 3: Mobile access networks".

[i.13] ETSI ES 205 200-2-4: "Integrated broadband cable telecommunication networks (CABLE); Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements; Sub-part 4: Cable Access Networks".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

energy consumption: total energy consumption as measured by an operational infrastructure

NOTE: This consumption does not include losses resulting from transportation to the consumption point and transformation of primary energy, if any.

energy management: combination of reduced energy consumption and increased task effectiveness, re-use of energy and use of renewable energy

energy re-use: transfer or conversion of energy (typically in the form of heat) produced by the operational infrastructure to do other work

NOTE: The present document does not take energy re-use into consideration.

fixed access network: functional elements that enable wired (including optical fibre) communications to customer equipment

Information Technology Equipment (ITE): equipment providing data storage, processing and transport services for subsequent distribution by network telecommunications equipment

Network Element (NE): equipment dedicated to providing connectivity to core and/or access networks

objective KPI: KPI assessing one of the objectives of operational energy performance which is subsequently used to define a Global KPI for energy management (KPI_{EM})

operational infrastructure: combination of Information Technology Equipment (ITE) and/or network telecommunications equipment (NE) together with the power supply and environmental control systems necessary to ensure provision of service

operator site: premises accommodating network telecommunications equipment providing direct connection to the core and access networks and which may also accommodate information technology equipment

renewable energy: energy produced from dedicated generation systems using resources that are naturally replenished

task effectiveness: measure of the energy consumed for a given work done (as a result of design and/or operational procedures) [1]

work done: amount of energy directly consumed by NE

3.2 Symbols

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

Δt	The maximum time variation between measurement points of the different Objective Key Performance Indicators within a given Global Key Performance Indicator
KPI_{EM}	Global Key Performance Indicator of energy management
KPI_{EC}	Objective Key Performance Indicator of energy consumption
KPI_{TE}	Objective Key Performance Indicator of task effectiveness
KPI_{REN}	Objective Key Performance Indicator of renewable energy usage
P	Projection factor applied to sample results used in calculation of m to KPI_{EM}
T_{KPI}	Period of time over which Objective KPIs are assessed
T_{REPEAT}	The minimum time between which the Objective KPIs can be assessed to determine relevant trend information
W_{EC}	Weighting factor applied to KPI_{EC}
W_{TE}	Weighting factor applied to KPI_{TE}
W_{REN}	Weighting factor applied to KPI_{REN}

3.3 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
AN	Access Network
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EE	Energy Efficiency
FAN	Fixed Access Node
FTTB	Fibre To The Building
FTTH	Fibre To The Home
GPON	Gigabit Passive Optical Network
HDSL	High-bit-rate Digital Subscriber Line
ICT	Information and Communication(s) Technology
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union-Telecommunication
KPI	Key Performance Indicator
LOC	Last Operator Connection point
LT	Line Terminal

NOTE: Collective ONU used in FTTB architecture.

MSAN Multi Service Access Node
NE Network Element
NDN Network Distribution Node
NT Network Termination
ODC Operator Data Centre
OLT Optical Line Termination
ONT Optical Network Termination

NOTE: Single user type of ONU used in FTTH.

ONU Optical Network Unit

NOTE: Generic name for remote optical termination, to be used for shared ONU and those with a secondary monitored transmission.

OS Operator Site
PON Passive Optical Network

NOTE: Using optical passive splitters sharing an OLT port capacity across a plurality of ONUs.

SHDSL Single-pair High-speed Digital Subscriber Line
TE Terminal Equipment

NOTE: In architecture figures.

VDSL Very high speed Digital Subscriber Line

4 System definition and boundaries

4.1 Fixed access networks

Figure 1 shows the schematic of the operational infrastructures of broadband deployment as contained with the ESO response to the EC Mandate M/462 [i.1].