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Technical Report

Environmental Engineering (EE); The reduction of energy consumption in telecommunications equipment and related infrastructure

Reference

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Keywords

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Environmental Engineering (EE).

Introduction

Recent Life Cycle Assessment (LCA) studies have revealed that the energy consumption of telecom equipment during operation is the most significant environmental impact factor of the telecom business.

In future also the energy consumption during the manufacture phase will increase the impact on the LCA

The cost of energy is significant and rising due to the cost of raw materials and government policies, which will impact on the operating cost of telecomm services. It is therefore in the interest of operators to reduce their energy usage, distribution and unit cost.

The present document covers various methods of increasing the efficiency of telecom systems by controlling/reducing the energy consumption in the telecommunication network equipment and related infrastructure.

This first version of the document is in particular dedicated to the Broadband Access technology.

1 Scope

The present document is an accumulation of ideas from operators and manufacturers on the methods to increase the energy efficiency of telecommunication systems in order to reduce its operational energy use; the present document considers telecommunication equipment and infrastructure equipment (power station, air cooling, control of equipment, etc.) in telecommunication centres. The energy efficiency of end-user equipment is not considered.

2 References

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2.1 Normative references

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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] ETSI EN 300 019-1-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".

[i.2] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".

[i.3] ETSI EN 300 132-3: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V".

[i.4] IEC EN 60896-21:2004: "Stationary lead-acid batteries; Part 21: Valve regulated types. Methods of test".

[i.5] IEC EN 60950-22: "Information technology equipment Safety; Part 22: Equipment to be installed outdoors". .

[i.6] BS EN 50272-2: "Safety requirements for secondary batteries and battery installations - Part 2: Stationary batteries".

[i.7] ETSI TS 102 533: "Environmental Engineering (EE) Measurement Methods and limits for Energy Consumption in Broadband Telecommunication Networks Equipment".

[i.8] IEC 60950-1: "Radiation monitoring equipment for accident and post-accident conditions in nuclear power plants. Part 1: General requirements".

[i.9] ETSI TR 102 532: "Environmental Engineering (EE) The use of alternative energy sources in telecommunication installations".

[i.10] ETSI EN 300 132: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment".".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

infrastructure equipment: power, cooling and building environment systems used in telecommunications centres and Access Networks locations

telecommunication centre: location where telecommunications equipment is installed and which is the sole responsibility of the operator

3.2 Symbols

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

Ln	Line
Po	Power output
V	Volts
W	Watt

3.3 Abbreviations

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

3rdpp/	3rd party products
AC	Alternating Current
Aux Eq.	/ Auxiliary Equipment
BB	BroadBand
BBCoC	BroadBand Code of Conduct
CDF	Cumulative Distribution Function
COP	Co-efficient Of Performance
CPA	Central Power Architecture
DC	Direct Current
DPA	Distribution Power Architecture
DS Mbps	Down Stream Mbps
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Module
DSM	Dynamic Spectrum Management

EC	Electrically Commutated
EN	European Norm
HVDC	High Voltage Direct Curren
HW	HardWare
IBA	Inter media Bus Architecture
ICT	Information communication technology
ISDN	Integrated Services Digital Network
ISO	International Standards Organisation
LCA	Life Cycle Assessment
MOD	Mask On Demand
MODEM	MOdulator and DEModulator

NOTE: I.e. receiver and transmitter function.

NPC	Normalized Power Consumption
NPC	Normalized Power Consumption
OEM	Original Equipment Manufacturer
PA	Power Amplifier
POTS	Plain Old Telephony Service
SLA	Service Level Agreement
SW	SoftWare
Transm/	Transmission equipment
UPS	Uninterruptible Power Supply
US Mbps	UpStream Mbps
VDSL	Very high speed Digital Subscriber Line
VDSL2	Very high speed Digital Subscriber Line 2
VRLA	Valve regulated lead acid

4 Company Environmental Procedures

4.1 Guidance on Company Environmental Procedures

A number of international standards and guides related to companies' environmental work have been prepared or are under preparation. Some of these are given in bibliography (see item 1).

5 Telecom System Power and Energy Efficiency

5.1 Introduction

Power consumption figures are comparable, if done on similar equipment, with similar performance and measured at the same interfaces. However, if we want to compare products with different technology, with new features and higher bit rates or improved distance coverage, we need to evolve our view from power consumption towards energy efficiency. If we want to set requirements on new technology, we need to consider the demands for increased performance and corresponding impact on power consumption. A measure of power or energy efficiency is needed.

In the following, a number of terms are proposed in order to properly define power consumption and energy efficiency.

The energy efficiency is understood as the relation between the Useful Output and the Energy or Power Consumption. This efficiency measure could either be defined on power scale, or on energy scale as an integration of power consumption over time.

In the following examples, for Broadband access equipment, Useful Output is defined as the peak performance of bit rate and reach distance. Useful Output is compared with the long term Average Power Consumption.

The power consumption is related to a number of conditions as:

- Configuration and involved equipment.

- Operational conditions.
- Measurement interfaces.

A set of definitions is needed. The following terms are proposed:

- Reference models.
- Operating conditions.
- Power efficiency.
- Useful unit.

NOTE: This covers use phase only, not production phase.

5.2 Power consumption of telecom systems - ICT view

Average power consumption of ICT and telecom systems is indicated in figure 1, for further information see bibliography. The Broadband Access part is used for further analysis.

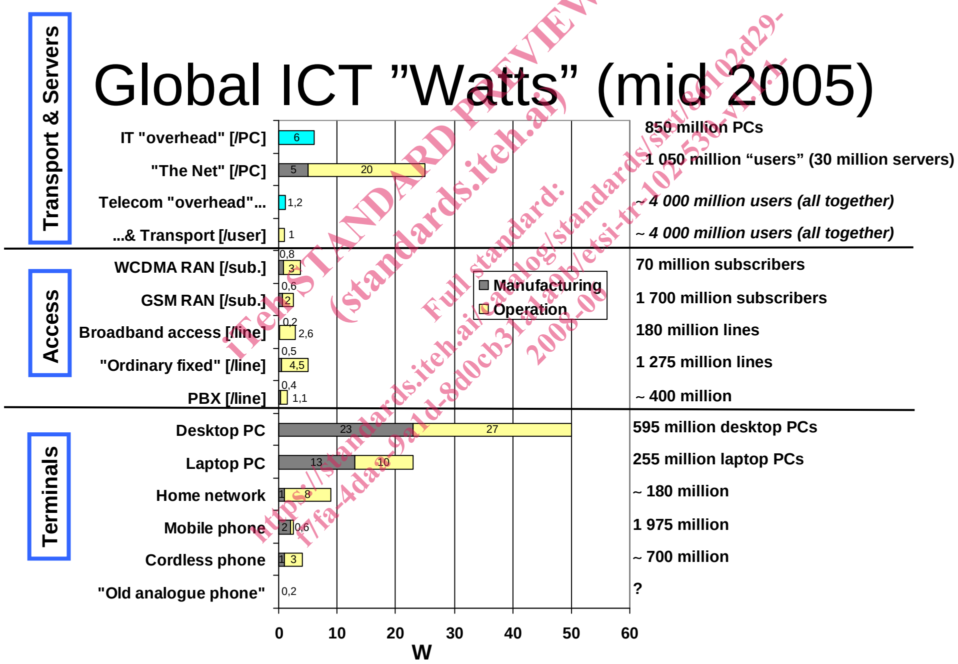
Global ICT "Watts" (mid 2005)
Transport & Servers
Access
Terminals
IT "overhead" [/PC]
"The Net" [/PC]
Telecom "overhead"...
...& Transport [/user]
WCDMA RAN [/sub.]
GSM RAN [/sub.]
Broadband access [/line]
"Ordinary fixed" [/line]
PBX [/line]
Desktop PC
Laptop PC
Home network
Mobile phone
Cordless phone
"Old analogue phone"
Manufacturing
Operation
850 million PCs
1 050 million "users" (30 million servers)
~ 4 000 million users (all together)
~ 4 000 million users (all together)
70 million subscribers
1 700 million subscribers
180 million lines
1 275 million lines
~ 400 million
595 million desktop PCs
255 million laptop PCs
~ 180 million
1 975 million
~ 700 million
?
0
10
20
30
40
50
60
W

Figure 1: Average power consumption of ICT equipment, use phase and production

5.2.1 Manufacturing impact on the power consumption

The CO_2 equivalent of the complete manufacturing chain, from mine through end of life treatment, is estimated. The CO_2 value is recalculated into electrical energy, using the global energy production mix index of 0,6 kg CO_2/kWh. The energy is distributed over the life-time of the device, resulting in average power consumption of manufacturing.

Life time assumptions used in the examples reported in the present document:

- Mobile handset: 2,5 Year.
- DSL modem: 5 Year.
- Server: 4,25 Year.
- DSLAM: 10 Year.

- Radio Base Station: 10 Year, mechanically, 5 Year for the circuit boards.
- Radio Base Station Site: 20 year for Tower, Antenna and Shelter, 3,5 Year for the batteries.

5.2.2 Sources

Three different sources are used (see bibliography for details).

5.3 Reference models

A Reference model is needed to indicate what equipment is involved and what measurement interfaces are used. Example: The reference model will make it clear whether power consumption is measured at DC or AC, what functional units/configurations are included in the power measurement.

A number of reference models may be needed to cover different types of telecom equipment.

Reference model example proposals for DSLAM and Radio Base nodes are provided below.

5.3.1 Reference model content

The reference model is a block diagram that may include:

- Interfaces, internal and external.
- Climate shell(s).
- Hi Level functional parts like nodes - for a model network, or functional units like climate equipment, rectifiers, modems, etc., for a node site model.

5.3.2 Reference Model Network

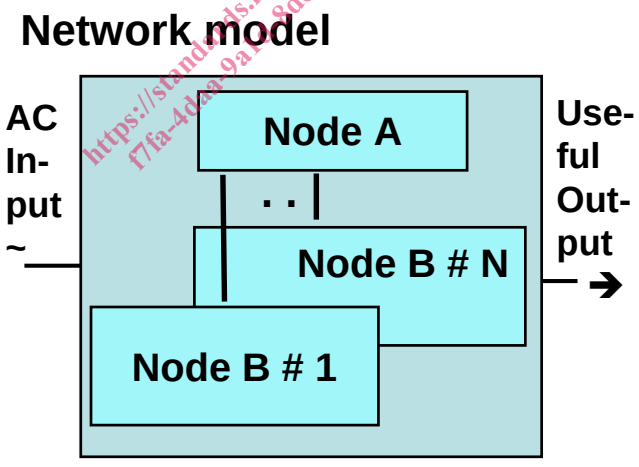

Figure 2: Reference Model Network

Basic reference model network is needed to calculate the overall efficiency of telecom networks and the impact of different nodes in the Network.

It is important to include the nodes typically needed and to capture the typical proportions of the different node types in order to estimate how the different nodes contribute to power consumption of a typical network

5.3.3 Node Site Reference Model

It is important to compare equipment power consumption at similar conditions. Usually the power consumption at site is relevant. A site model should be applied that includes climate equipment, rectifiers and other infrastructure equipment, if typically needed on a site level.

Preferable the site power should be measured at the AC level. See annex A for explanation.

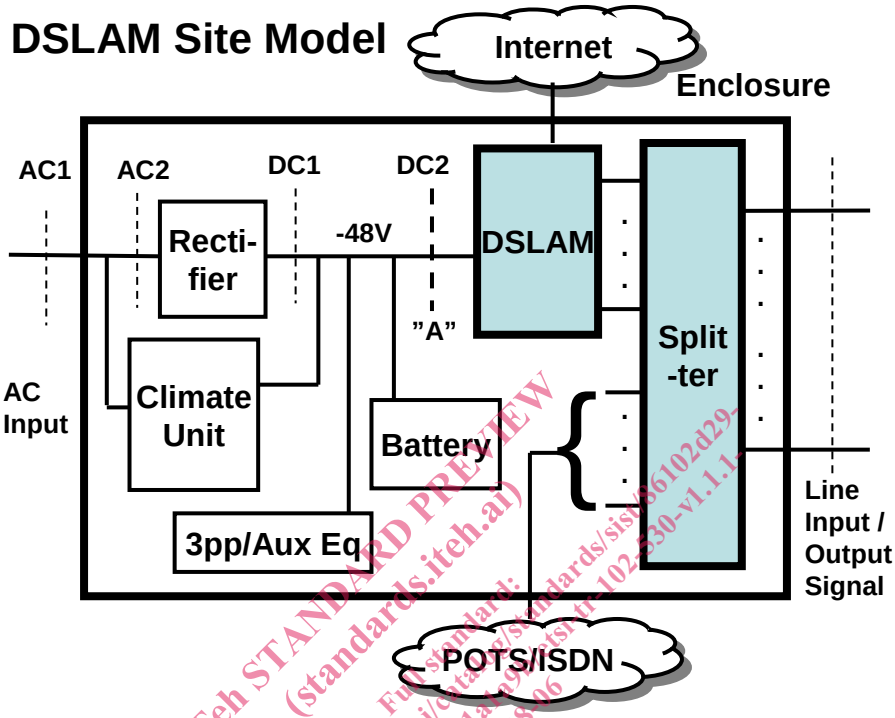

Figure 3: DLSAM Node Site reference model

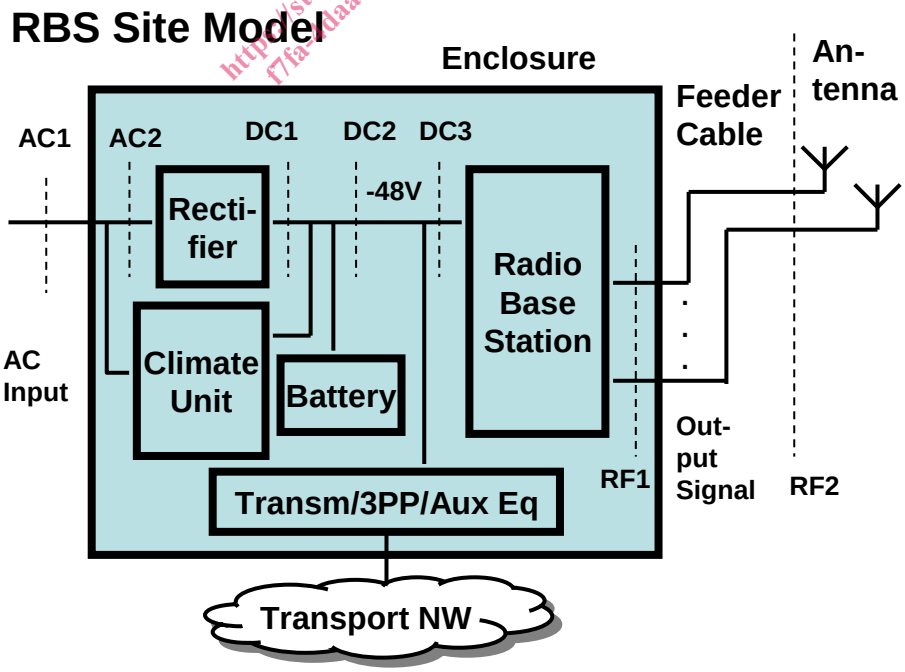

Figure 4: RBS Node site reference model