



# SLOVENSKI STANDARD

## SIST ES 201 554 V1.2.1:2016

01-oktober-2016

---

**Okoljski inženiring (EE) - Metode merjenja energijske učinkovitosti jedrnega mobilnega omrežja in opreme za radiofrekvenčno kontrolo dostopa**

Environmental Engineering (EE) - Measurement method for Energy efficiency of Mobile Core network and Radio Access Control equipment

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

Ta slovenski standard je istoveten z: **ETSI ES 201 554 V1.2.1 (2014-07)**

SIST ES 201 554 V1.2.1:2016  
<https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4838-911b-28b9340d067b/sist-es-201-554-v1-2-1-2016>

---

**ICS:**

19.040	Preskušanje v zvezi z okoljem	Environmental testing
27.015	Energijska učinkovitost. Ohranjanje energije na splošno	Energy efficiency. Energy conservation in general
33.070.01	Mobilni servisi na splošno	Mobile services in general

**SIST ES 201 554 V1.2.1:2016**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST ES 201 554 V1.2.1:2016

<https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858-911b-28b9340d067b/sist-es-201-554-v1-2-1-2016>

# ETSI ES 201 554 V1.2.1 (2014-07)



ETSI STANDARD

**Environmental Engineering (EE);  
Measurement method for  
Energy efficiency of Mobile Core network and Radio Access  
Control equipment**

<https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858-911b-28b9340d067b/sist-es-201-554-v1-2-1-2016>

## Reference

---

RES/EE-EEPS007

## Keywords

---

Core Network, Energy Efficiency**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  
Sous-Préfecture de Grasse (06) N° 7803/88

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST ES 201 554 V1.2.1:2016

<https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858-911b-28b934411111/sist-201-554-v1-2-1-2016>  
**Important notice**

The present document can be downloaded from:

<http://www.etsi.org>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at

<http://portal.etsi.org/tb/status/status.asp>

If you find errors in the present document, please send your comment to one of the following services:

[http://portal.etsi.org/chaircor/ETSI\\_support.asp](http://portal.etsi.org/chaircor/ETSI_support.asp)

---

**Copyright Notification**

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2014.

All rights reserved.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are Trade Marks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

**GSM®** and the GSM logo are Trade Marks registered and owned by the GSM Association.

# Contents

Intellectual Property Rights .....	4
Foreword.....	4
Modal verbs terminology.....	4
Introduction .....	4
1 Scope .....	5
2 References .....	6
2.1 Normative references .....	6
2.2 Informative references.....	6
3 Definitions, symbols and abbreviations .....	6
3.1 Definitions .....	6
3.2 Symbols.....	7
3.3 Abbreviations .....	7
4 Definition of Power consumption and metrics for Core networks.....	9
4.1 Black box.....	9
4.2 Site energy consumption .....	9
4.3 Power consumption .....	9
4.4 Shaping of weight coefficients .....	10
4.5 Energy efficiency .....	11
5 Measurement methods.....	11
5.1 Measurement basics .....	11
5.1.1 General.....	11
5.1.2 Measurement and test equipment requirements .....	11
5.2 Measurement conditions.....	12
5.2.1 Configuration.....	12
5.2.2 Environmental conditions .....	12
5.2.3 Power supply .....	12
5.3 Measurement procedure .....	13
5.3.1 Tests to be performed .....	13
5.3.2 Measurement report.....	13
<b>Annex A (normative): Reference parameters for MGW.....</b>	<b>15</b>
<b>Annex B (normative): Reference parameters for HLR, AUC and EIR.....</b>	<b>16</b>
B.1 Reference parameters for HLR and AUC .....	16
B.2 Reference parameters for EIR .....	17
<b>Annex C (normative): Reference parameters for MSC.....</b>	<b>19</b>
<b>Annex D (normative): Reference parameters for GGSN .....</b>	<b>21</b>
<b>Annex E (normative): Reference parameters for SGSN .....</b>	<b>22</b>
<b>Annex F (normative): Reference parameters for MME.....</b>	<b>23</b>
<b>Annex G (normative): Reference parameters for SGW and PGW .....</b>	<b>24</b>
<b>Annex H (normative): Reference parameters for RNC .....</b>	<b>25</b>
<b>Annex I (informative): Bibliography.....</b>	<b>26</b>
History .....	27

---

## Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<http://ipr.etsi.org>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

---

## Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE).

---

## Modal verbs terminology

In the present document "shall", "shall not", "should", "should not", "may", "may not", "need", "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).

"must" and "must not" are **NOT** allowed in ETSI deliverables except when used in direct citation.

**ITeH STANDARD PREVIEW**  
(standards.iteh.ai)

---

## Introduction

SIST ES 201 554 V1.2.1:2016

<https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858->

Energy efficiency is an increasingly important requirement for all modern systems. Governments, communication service providers, vendors, etc. do all agree that energy efficiency is a critical "piece" in the joint strive for a more sustainable society.

With the present document, the industry gets a jointly agreed definition of metrics and measurement methods that - over time - can serve as a platform to excel, measure, and report energy efficiency of the core networks of telecommunication systems. The present document provides robust and reproducible measurements for products used in core telecom networks.

The present document defines energy efficiency metrics and measurement methods for mobile core equipment. In later revisions Base Station Controller (BSC) and IMS core will be added. Energy efficiency is defined as useful output normalized to energy consumption, and the assumption is that an energy efficient system handles more calls, subscribers, etc., with less energy. The present document promotes energy saving features as the traffic profile is a representation of the expected behaviour of the equipment in operation, i.e. the power consumption is measured at different load levels when processing traffic mimicking a typical usage of the equipment. The defined metrics can be used for comparing energy efficiency of different implementations (HW and SW) of the same function only. Energy efficiency of co-located functions can however not be compared using the methodology defined in the present document.

# 1 Scope

The present document defines metrics and measurement methods applicable for the following systems and nodes defined in TS 123 002 [i.3]:

- Mobile core functions (GGSN, HLR, MGW, MME, MSC, SGSN and PGW/SGW).
- Radio Access Controller (RNC).

Later revisions of the present document will include Base Station Controller (BSC) and IMS core functions (BGCF, CSCF, HSS, IBCF, MRFC, MRFP, SLF and LRF).

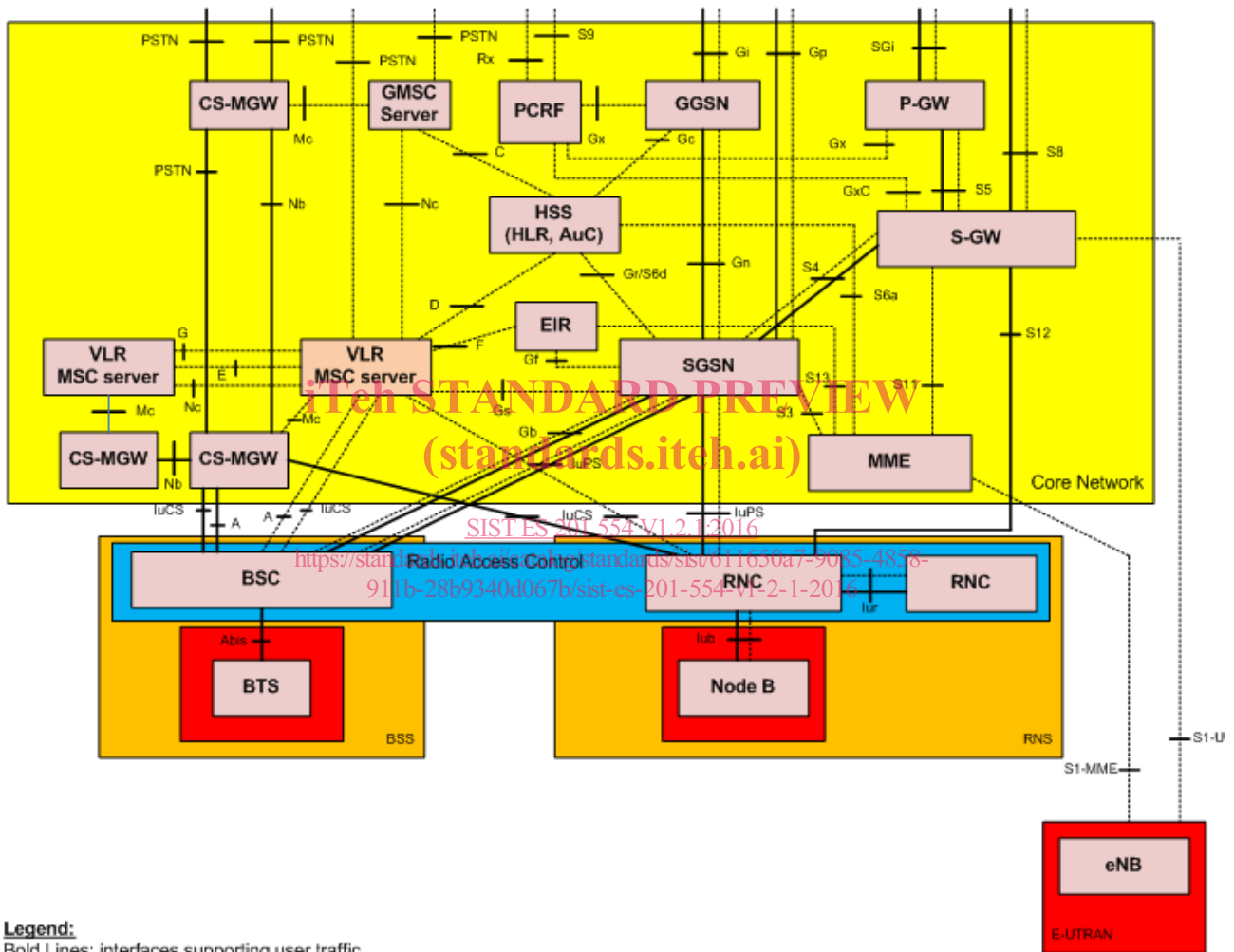


Figure 1: Illustrative view of the scope

## 2 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 reference document (including any amendments) applies.

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 necessary for the application of the present document.

- [1] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 2: Operated by -48 V direct current (dc)".

### 2.2 Informative references

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] IEEE (05 June 2009): "Traffic Analysis for GSM Networks", Boulmalf, M. Abrache, J. Aouam, T. Harroud, H. Al Akhawayn Univ. in Ifrane, Ifrane.
- [i.2] ISO/IEC 17025:2005: "General requirements for the competence of testing and calibration laboratories".
- [i.3] ETSI TS 123 002 (V9.2.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Network architecture (3GPP TS 23.002 version 9.2.0 Release 9)".
- [i.4] ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Vocabulary for 3GPP Specifications (3GPP TR 21.905)".
- [i.5] Sandvine: "Fall 2010 Global Internet Phenomena Report".

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

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

**energy consumption:** amount of consumed energy

NOTE: It is measured in Joule or kWh (where 1 kWh =  $3,6 \times 10^6$  J) and corresponds to energy use.

**energy efficiency:** relation between the useful output and energy consumption

**erlang:** average number of concurrent calls carried by the circuits

**function:** logical representation of a network element defined by 3GPP

**node:** physical representation of one or more functions



**power consumption:** amount of consumed power

NOTE: It is measured in W and corresponds to the rate which energy is converted.

**power saving feature:** feature which contributes to decreasing power consumption compared to the case when the feature is not implemented

**system under test:** node being measured

**test suite:** complete sequence of measurements including low, medium, and high load levels as individual test steps

**useful output:** maximum capacity of the system under test which is depending on the different functions

NOTE 1: It is expressed as the number of Erlang (Erl), Packets/s (PPS), Subscribers (Sub), or Simultaneously Attached Users (SAU).

NOTE 2: It is expressed as maximum instantaneous traffic Erling (CS) and bits/s (PS).

## 3.2 Symbols

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

A Ampere

NOTE: SI unit of electric current.

h Hour

NOTE: SI unit of measurement of time.

J Joule

NOTE: SI unit of energy or work,  $J = W \times s$ .

s Second <https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858-911b-28b9340d067b/sist-es-201-554-v1-2-1-2016>

NOTE: SI unit of measurement of time.

V Volt

NOTE: SI unit for electric potential difference (voltage).

W Watt

NOTE:  $W = V \times A$ .

## 3.3 Abbreviations

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

NOTE: Additional abbreviations may be found in TR 121 905 [i.4].

2G Second-Generation wireless telephone technology

EXAMPLE: GSM.

3G Third-Generation mobile telecommunications

EXAMPLE: WDCMA.

AC Alternating Current

NOTE: Bidirectional flow of electric charge.

AS Application Server

AUC Authentication Centre

BGCF	Breakout Gateway Control Function
BICC	Bearer Independent Call Control
BSC	Base Station Controller
BTS	Base Transceiver Station
CS	Circuit Switched
CSCF	Call Session Control Function
DC	Direct Current

NOTE: Unidirectional flow of electric charge.

EIR	Equipment Identity Register
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
GUTI	Globally Unique Temporary Identity
HLR	Home Location Register
HO	HandOver
HSS	Home Subscriber Service
HW	HardWare
IBCF	Interconnect Border Control Function
IMEI	International Mobile Equipment Identity
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
ISUP	Integrated Services digital network User Part
LRF	Location Retrieval Function
LU	Location Update
MGW	Media GateWay
MHT	Mean Holding Time
MME	Mobility Management Entity
MO	Mobile Originated
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor
MSC	Mobile Switching Centre
MSS	Mobile Switching centre Server
MT	Mobile Terminated
Node B	eq Base Transceiver Station
PDN	Public Data Network
PDP	Packet Data Protocol
PGW	PDN Gateway
PLMN	Public Land Mobile Network
POI	Point Of Interface
PPS	Packets Per Second
PSTN	Public Switched Telephone Network
RNC	Radio Network Controller
SAU	Simultaneously Attached Users
SGSN	Serving GPRS Support Node
SGW	Serving Gateway
SI	International System of units
SIP	Session Initiation Protocol
SLF	Subscriber Location Function
SMS	Short Message Service
SW	SoftWare
TDM	Time Division Multiplexing
USSD	Unstructured Supplementary Service Data
VLR	Visitor Location Register
WCDMA	Wideband Code Division Multiple Access

## 4 Definition of Power consumption and metrics for Core networks

### 4.1 Black box

The system under test is seen as a "black box", i.e. only the total power consumed by the device or shelf/shelves is/are measured and not different parts of the device or shelf/shelves. A "black box" can be viewed solely in terms of its input, output and transfer characteristics without any knowledge of its internal workings.

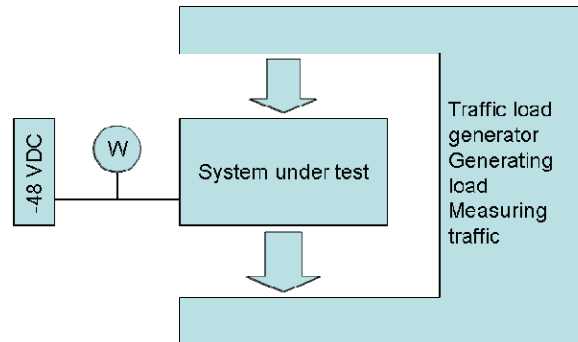


Figure 2: Measurement set-up of system under test

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

### 4.2 Site energy consumption

Energy consumption at site includes also climate units, losses, auxiliary equipment, etc. These aspects are not observed in the present document.

[SIST ES 201 554 V1.2.1:2016](https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858-911b-28b9340d067b/sist-es-201-554-v1-2-1-2016)

<https://standards.iteh.ai/catalog/standards/sist/611650a7-9085-4858-911b-28b9340d067b/sist-es-201-554-v1-2-1-2016>

### 4.3 Power consumption

The defined traffic profile mimics the behaviour of a function in operation (i.e. with load level variations) and the resulting performance indicators constitutes of a weighted average of multiple measurements.

The load levels are defined as:

- Specification:  $T_S$  - the maximum capacity according to the vendor's specification of the specific implementation of the function
- High:  $T_H = 1,0 \times T_S$
- Mid:  $T_M = 0,7 \times T_S$
- Low:  $T_L = 0,1 \times T_S$

As the present document defines metrics and measurements for a wide variety of implementations of functions - operating in control and/or user planes as well as circuit switched and/or packet switched domains - further details on the traffic models are specified per function in annexes A to G.

The power consumption levels associated with the above load levels are defined as:

- High:  $P_H$  = average power consumption [W] measured at  $T_H$
- Mid:  $P_M$  = average power consumption [W] measured at  $T_M$
- Low:  $P_L$  = average power consumption [W] measured at  $T_L$