



## Energy Consumption Measurement of Operational Information Technology Storage Units

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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

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## Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Operational energy Efficiency for Users (OEU).

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## 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

Information and communication technology (ICT) sites constitute one of the most important areas of the worldwide growing energy consumption. They are responsible for at least 2 % of the worldwide greenhouse gas emissions, still growing.

Energy management performance of ICT sites is an important matter. It is now essential if not vital to implement commitments in order to reduce the energy consumption by ICT sites.

Further to the 1997 Kyoto protocol [i.1], the European Commission has issued, and will issue, Directives in order to improve energy management of networks, sites included, of whole industry sectors.

Therefore suppliers and users of ICT equipment are obliged to implement "Green" tools (indicators, recognized Green levels) to monitor the efficiency of their greener networks.

Consequently, ISG OEU has developed the present document in order to define this operational measurement method.

The present document defines requirements for operational measurement of energy consumption by ICT equipment as well as requirements for technical KPIs allowing selection of energy efficient equipment for specific uses.

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# 1 Scope

The present document defines the current standpoint of ISG OEU members in relation to the operational measurement of energy performance and selection of ICT physical storage units.

It defines an energy performance operational KPI and its related measurement points, measurement protocols and transmission. The measured KPI is simply and unequivocally linked to the measured ICT physical storage unit.

It defines technical KPIs allowing to predict energy consumption and task efficiency for specific uses.

An ICT physical storage unit is equipment dedicated to storing permanent data with its own dedicated power supplies. The aforementioned KPIs apply to different configurations meeting specific requirements (e.g. resilience (raid mechanisms)), configuration type, I/O rate, I/O throughput, write ratio.

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# 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>.

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

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

- [1] ETSI EN 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations".

## 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.

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

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] Kyoto Protocol to the United Nations Framework Convention on Climate Change.

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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

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

**Kibibyte (KiB):** 1 024<sup>2</sup> bytes

**installed raw capacity:** sum of capacities of installed disks in storage unit

**installed useable capacity:** maximum storage unit capacity that may be seen by a user of that unit

**Gibibyte (GiB):** 1 024<sup>3</sup> Bytes

**physical Storage Unit:** any ICT equipment dedicated to storing data powered by one or more dedicated power supplies

**Tebibyte (TiB):** 1 024<sup>4</sup> Bytes

### 3.2 Symbols

Void.

### 3.3 Abbreviations

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

EE	Environmental Engineering
EN	European Norm
I/O	Input/Output
IOPs	I/O per Second
ICT	Information and Communications Technology
IPMI	Intelligent Platform Management Interface
KPI	Key Performance Indicator
SNMP	Simple Network Management Protocol
SPEC	Standard Performance Evaluation Corporation®

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## 4 Classification of storage units

### 4.1 General

In order to define the most efficient measurement of storage unit consumption, ICT users propose to divide the world of storage units in several functional families.

Performance effectiveness of a storage unit depends on the kind of task it is supposed to fulfil. Performance of each functional family shall be measured with an appropriate KPI that depends on the said family. This KPI shall be then compared to the required power to produce the performance.

## 4.2 Functional use examples

Table 1 contains example functional uses of storage unit. Table 1 is not expected to be exhaustive nor exact after the publication.

**Table 1**

Category	Description
Archive	Data written once, read sometimes
Logs	Extensive write activity, high I/O load
Transactional	High read/write activity with high throughput

## 4.3 Storage unit gauges

Table 2 contains a proposal to classify storage units against gauges.

**Table 2**

Category	Useable capacity
Entry level	Up to 100 GiB
Midrange	100 GiB to 10 TiB
High end	More than 10 TiB

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## 5 KPIs

### 5.1 Operational KPIs

#### 5.1.1 General

Operational KPIs refer to measurement of actual storage units' consumptions while in normal operations.

The operational energy consumption by a physical storage unit shall be measured. The measurement shall be unequivocally linked to the physical storage unit being measured. In addition to that, the installed useable capacity shall be reported.

#### 5.1.2 Measurement points

The energy shall be measured at the hardware level inside the storage unit. The energy consumption data shall be available at the physical storage unit level by a storage unit interface such as IPMI.

All reporting should include a unique physical storage unit identification such as its serial number to ease reconciliation of different measurements and various data collections.

### 5.2 Technical KPIs

#### 5.2.1 General

Technical KPIs shall be measured under specified operational conditions such as temperature and relative hygrometry as well as specified benchmark programs. Their aim is to provide energy performance information under these operational conditions running the specified benchmark. They are not a guarantee that the same performance will be achieved under different operational conditions.

## 5.2.2 Power KPIs

Technical KPIs shall be provided for general use of the storage unit for a given configuration (e.g. raid, supported maximum I/O throughput, rate and ratio) under specific load conditions.

The load conditions shall include all the following cases:

- Idle: physical unit powered on, no disk activity.
- Full load: all components in the physical storage unit are used to their maximum consumption.

In addition, consumption at mid-load should be provided. In such case mid-load definition shall be provided by vendor

The temperature conditions shall include all the following cases:

- Consumption at 23 °C.
- Consumption at maximum temperature supported by the ICT physical storage unit during normal operations.
- Consumption at maximum temperature by ETSI EN 300 019-1-3 [1] (Class 3.1/40 °C) if applicable.

Vendor may add specific temperature conditions to the required above.

**Table 3**

	Idle	Medium (specify)	Full
<b>23 °C</b>	Total consumption	Total consumption	Total consumption
<b>40 °C</b>	Total consumption	Total consumption	Total consumption
<b>MAX (specify)</b>	Total consumption	Total consumption	Total consumption

## 5.2.3 Technical task efficiency KPIs

Technical KPIs shall determine the task efficiency of ICT physical storage units depending on the currently available benchmarks (e.g. privately defined benchmark below) together with their overall power needs at the measured performance at 23 °C.

**Table 4**

% Read /% Write	Block Size	Maximum IOpS	Power needs at 23 °C		
			At 100 % Max IOpS	At 50 % Max IOpS	At 20 % Max IOpS
100 %/0 %	128 KiB	IOpS	Watts	Watts	Watts
90 %/10 %	128 KiB	IOpS	Watts	Watts	Watts
50 %/50 %	128 KiB	IOpS	Watts	Watts	Watts
10 %/90 %	128 KiB	IOpS	Watts	Watts	Watts
90 %/10 %	128 KiB	IOpS	Watts	Watts	Watts
0 %/100 %	128 KiB	IOpS	Watts	Watts	Watts

Where block size may vary or even be randomly specified.

Clause 4.2 lists different profiles to which this KPI may apply at the time of writing.

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# 6 Communication protocols

## 6.1 General

This clause only applies to Operational KPIs.

## 6.2 Protocol description

Industry existing standards such as IPMI or SNMP shall be used. These protocols shall allow identifying unambiguously the physical storage unit they refer to.

## 6.3 Requirements for expected data

Communication protocol shall include following data:

- Unique identification of originating physical storage unit.
- Current overall power use from the outlet(s).

## 6.4 Recommendations for expected data

Communication protocol should include following data:

- Current storage unit energy use from last power-on.
- Duration since last power-on.
- Power use by "noble" parts as defined in clause 5.2.2.
- Energy use since last power-on by "noble" parts as defined in clause 5.2.2.

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# 7 Precision of measure

## 7.1 General

This clause only applies to Operational KPIs.

## 7.2 Recommendations

Precision of measurement should be better than 10 %.

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# 8 Conclusion

According to ISG members, these elements appear necessary to ensure a proper selection and field operational follow-up:

- to take into account the present document;
- to issue a specification describing the implementation of an operational process related to the present document.

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## History

<b>Document history</b>		
V1.1.1	February 2019	Publication