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Information technology — Data centres — Key performance indicators —

Part 1: Overview and general requirements

Technologies de l'information — Centres de données — Indicateurs de performance clés —

Partie 1: Aperçu et exigences générales

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 39, *Sustainability for and by Information Technology*.

ISO/IEC 30134 consists of the following parts, under the general title *Information technology — Data centres — Key performance indicators*:

— *Part 1: Overview and general requirements*

— *Part 2: Power usage effectiveness (PUE)*[1)]

— *Part 3: Renewable energy factor (REF)*

The following parts are under preparation:

— *Part 4: IT equipment energy efficiency for servers (ITEE)*

— *Part 5: IT equipment utilization for servers (ITEU_SV)*

Additional parts will be developed, each describing a specific KPI for resource usage effectiveness or efficiency.

1) It is recognized that the term "efficiency" should be employed but "effectiveness" provides continuity with earlier market recognition of the term.

Introduction

The global economy is now reliant on information and communication technologies and the associated generation, transmission, dissemination, computation and storage of digital data. All markets have experienced exponential growth in that data, for social, educational and business sectors and, while the internet backbone carries the traffic, there are a wide variety of data centres at nodes and hubs within both private enterprise and shared/collocation facilities.

The historical data generation growth rate exceeds the capacity growth rate of the information and communications technology hardware and, with less than half (in 2014) of the world's population having access to an internet connection, that growth in data can only accelerate. In addition, with many governments having "digital agendas" to provide both citizens and businesses with ever-faster broadband access, the very increase in network speed and capacity will, by itself, generate ever more usage (Jevons Paradox). Data generation and the consequential increase in data manipulation and storage are directly linked to increasing power consumption.

With this background, it is clear that data centre growth, and power consumption in particular, is an inevitable consequence and that growth will demand increasing power consumption despite the most stringent energy efficiency strategies. This makes the need for key performance indicators (KPIs) that cover the effective use of resources (including but not limited to energy) and the reduction of CO_2 emissions essential.

Within the ISO/IEC 30134 series, the term "resource usage effectiveness" is more generally used for KPIs in preference to "resource usage efficiency", which is restricted to situations where the input and output parameters used to define the KPI have the same units.

In order to enable the optimum resource effectiveness of data centres, a suite of effective KPIs is needed to measure and report on resources consumed in order to develop an improvement roadmap.

The ISO/IEC 30134 series is intended to accelerate the provision of operational infrastructures with improved resource usage effectiveness.

The common objective of the KPIs is the effective or efficient use of resources. Examples are as follows:

a) the minimization of energy and other resource (e.g. water) consumption;

b) the task effectiveness of the IT load (data processing, storage and transport) within the data centre, maximizing the IT output with the minimum energy consumption;

c) the energy reuse in the form of waste heat, if possible;

d) the use of renewable energy, both generated on site and off site.

The ISO/IEC 30134 series do not specify limits or targets for any KPI and do not describe or imply, unless specifically stated, any form of aggregation of individual KPIs into a combined nor an overall KPI for data centre resource usage effectiveness or efficiency.

Information technology — Data centres — Key performance indicators —

Part 1: Overview and general requirements

1 Scope

This part of ISO/IEC 30134 specifies the following for the other parts of ISO/IEC 30134:

a) a common structure;

b) definitions, terminology and boundary conditions for KPIs of data centre resource usage effectiveness and efficiency;

c) common requirements for KPIs of data centre resource usage effectiveness and efficiency;

d) common objectives for KPIs of the data centre resource effectiveness and efficiency;

e) general information regarding the use of KPIs of data centre resource usage effectiveness and efficiency.

2 Normative references

There are no normative references cited in this document.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
building entrance facility
facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and which may allow for transition from external to internal cable

3.1.2
computer room space
area within the data centre that accommodates the data processing, data storage and telecommunication equipment that provides the primary function of the data centre

3.1.3
control room space
area within the data centre used to control the operation of the data centre and to act as a central point for all control and monitoring functions

3.1.4
data centre
structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services together with all the facilities and infrastructures for power distribution and environmental control together with the necessary levels of resilience and security required to provide the desired service availability

Note 1 to entry: A structure can consist of multiple buildings and/or spaces with specific functions to support the primary function.

Note 2 to entry: The boundaries of the structure or space considered the data centre, which includes the information and communication technology equipment and supporting environmental controls, can be defined within a larger structure or building.

3.1.5
electrical distribution space
area used for housing facilities to distribute electrical power between the transformer space and electrical spaces within the data centre or elsewhere within the premises or individual buildings within the premises

3.1.6
electrical space
area within the data centre used for housing facilities to deliver and control electrical power to the data centre spaces (including switchboards, batteries, uninterruptible power supplies (UPS), etc.)

3.1.7
generator space
area used for housing the installation of electrical power supply generation equipment together with associated storage of fuels or energy conversion equipment

3.1.8
holding space
area within the data centre used for the holding of equipment prior to being brought into service or having been taken out of service

3.1.9
information technology equipment
equipment providing data storage, processing and transport services including telecommunications network equipment dedicated to providing direct connection to core and/or access networks

3.1.10
key performance indicator
number representing the resource usage effectiveness or efficiency of a given system

3.1.11
mechanical space
area that is used for housing mechanical equipment and infrastructure that provides environmental control for the data centre spaces (including chillers and water treatment, air handling and fire suppression systems)

3.1.12
resource usage effectiveness
ratio of resulting output to a resource consumed to produce that output when the input and output units are not the same

Note 1 to entry: The term is used generically to describe the conversion of a resource to an output or outcome, such as litres of water per kWh.

3.1.13
resource usage efficiency
ratio of output to the resource used by the device or system when the input and output units are the same

Note 1 to entry: Resources in this context include, but are not limited to, electricity and water, and each will be defined within the same boundary conditions.

3.1.14
storage space
secured area where general goods and/or data centre goods can be stored

3.1.15
telecommunications space
area which may house demarcation points and information technology equipment associated with the building entrance facility and which may allow service providers restricted access to the data centre

3.1.16
testing space
area within the data centre used for the testing and configuring of equipment prior to being brought into service

3.1.17
transformer space
area used for housing equipment necessary to convert primary electrical circuits to levels appropriate for connection to the equipment within the premises or individual buildings within the premises

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply:

AC	Alternating Current
DC	Direct Current
IT	Information Technology
KPI	Key Performance Indicator
SLA	Service Level Agreement
UPS	Uninterruptible Power Supply

4 Conformance

In order for a KPI of data centre resource usage effectiveness or efficiency to be included in the ISO/IEC 30134 series, it should

a) meet the common objectives outlined in 5.2,

b) meet the requirements of 5.3,

c) meet the structure requirements of 5.4, and

d) meet the use requirements of 5.5.

5 Key performance indicators (KPIs)

5.1 General

The ISO/IEC 30134 series defines requirements for the KPIs that are used to address aspects of data centre resource usage effectiveness or efficiency.

Due to the variable nature of type, size, purpose and geographical location of data centres and in order to meet the common objectives defined in 5.2, it is not possible to define a single, universally relevant KPI for resource usage effectiveness or efficiency. As a result, the ISO/IEC 30134 series specifies a suite of KPIs, each of which may be used to measure and report different and relevant aspects of resource usage effectiveness or efficiency.

This Clause defines the following:

a) the common objectives for KPIs (see 5.2);

b) the general requirements for a KPI to be included within the ISO/IEC 30134 series (see 5.3);

c) a common structure within the ISO/IEC 30134 series (see 5.4);

d) the rules for the use of KPIs (see 5.5).

5.2 Common objectives for KPIs

The common objective of the KPIs of the ISO/IEC 30134 series is the efficient or effective use or utilization of resources. Examples are as follows:

a) minimization of energy and other resource consumption;

b) effectiveness of the IT load (processing, storage and transport) within the data centre, maximizing the IT output with the minimum energy consumption;

c) reuse of unconsumed resources (e.g. energy reuse in the form of waste heat);

d) utilization of renewable energy, both generated on site and off site.

The KPIs of the ISO/IEC 30134 series are designed and intended to allow an individual facility to measure and monitor progress in each individual area so as to justify investment in resource usage effectiveness or efficiency measures and plan further improvements.

The KPIs of the ISO/IEC 30134 series shall be

a) applicable to all types of data centres,

b) technology neutral, and

c) geographically neutral.

5.3 Requirements for KPIs

5.3.1 General

In order for a KPI to be included in the ISO/IEC 30134 series, the KPI shall meet the requirements of 5.3.2 to 5.3.10.

5.3.2 Scale

Data centres vary widely in terms of scale (i.e. the maximum design service implementation). KPIs shall be valid for all scales of data centres.

5.3.3 Evolution

Data centres

a) generally do not go from “zero” to full utilization on day one, and

b) tend to feature power demands that grow from day one moving towards the maximum design load and at any point strategic changes may take place (such as the procurement of more efficient IT equipment) which can reduce the load before once again beginning to grow towards the maximum design load.

KPIs shall be valid for all "states of evolution" of an operational infrastructure.

5.3.4 Formulae

Each KPI shall be defined in clear and unambiguous mathematical terms.

5.3.5 Definition of boundaries

Each KPI shall define the boundaries of the elements of the data centre infrastructure to be included in any measurements or calculations (see Clause 6).

5.3.6 Reporting

Each KPI shall define the reporting requirements for resources relevant to the determination of the KPI.

5.3.7 Definition of terms

Each KPI shall clearly define all terms relevant to its application.

5.3.8 Measurement points and procedures

Each KPI shall be based upon parameters that are measureable in an unambiguous manner. The measurement points shall be included for each KPI.

The following procedures shall be followed.

a) Each KPI shall be assessed over a defined period of time.

b) All parameters relevant to the assessment of the KPI shall be measured over a period not exceeding a specified time.

c) The maximum time between measurements defines the time interval between which KPIs shall be re-assessed.

Continuous measurements of KPI parameters are recommended, where applicable.

5.3.9 Requirements

Each KPI shall clearly define strict requirements for inclusions/exemptions/exclusions within the formulae.

5.3.10 Classifications

Each KPI shall clearly define any classification systems that apply to its application.

5.4 Elements addressed within ISO/IEC 30134

ISO/IEC 30134 shall address the following aspects:

a) identification and definition of the consumption of the resource(s);

b) justification and description of its importance to the data centre operator;

c) definition of the indicator;

d) description of the formulae and calculation method;

e) description of the measurement points and procedures.

ISO/IEC 30134 shall also include the following components:

a) interpretation and actions;

b) scale (how the KPI meets the requirement of applicability to all scales of facilities);

c) reporting requirements (including classifications or context indicators);

d) exemptions and/or exceptions and each KPI shall clearly define all terms relevant to its application;

e) reference of use/application in a stand-alone data centre or mixed-use building;

f) each KPI shall include an Annex where application examples and case studies shall be found.

5.5 Use of KPIs

KPIs shall be presented as numeric values, and units where applicable, and can be trended against time in graphical form if required. Due to the diverse nature of the numerical value of individual KPIs, comparisons with other data centres and combinations of KPIs should be approached with caution.

Visualization of a combination of KPIs shall only be undertaken if the combination is both informative and actionable.

KPIs in the ISO/IEC 30134 series are not intended to be

a) used in sub-combination unless specifically stated,

b) aggregated into a single overall KPI, nor is it advised to do so, and

c) used to compare the resource usage effectiveness or efficiency of one data centre with another.

It is recognized that data centres which feature high levels of infrastructural resilience (e.g. power distribution and environmental control) can have a negative impact on any KPIs measured and reported. The KPIs specified in the ISO/IEC 30134 series do not take into account, or make judgement upon, the needs for such resilience. As a result, the impact of targets for data centre reliability and availability should be taken into consideration when reviewing KPI results (for further information, see Annex A).

6 Data centre boundaries

6.1 General

Data centre boundaries define the contents and scope of the structure being considered by the KPI. Boundaries are described by the perimeter, spaces and equipment contained therein.

Boundary conditions may be based on spatial and logical considerations (see 6.2) or include other parameters.

6.2 Spatial and logical boundaries

The boundary descriptions may be in terms of aggregate space and electrical load, but shall include key elements of space and equipment considered as the “data centre” under evaluation. Changes to the boundaries require updates to the KPI in order to evaluate the efficiency and/or effectiveness changes in the “data centre” under consideration. These boundaries shall be described and accompany the disclosure or report of the KPI.

Typical boundaries shall include the perimeter of the data centre property, for example for power or water. Other sub-section boundaries may be established for a KPI, such as that for the cooling system where the boundary is the energy interface enclosing the cooling system itself.

7 Data centre spaces and equipment

7.1 Data centre spaces

The area within the premises designated as containing the data centre may contain the following spaces (examples):

a) electrical space;

b) transformer space;

c) generator space;

d) electrical distribution space;

e) mechanical space;

f) telecommunications space;

g) control room space;

h) holding space;

i) storage space;

j) computer room space;

k) testing space;

l) common access spaces (e.g. halls, corridors, elevators);

m) office spaces, cafeteria (if applicable);

n) loading dock and/or shipping/receiving areas.

7.2 Data centre equipment (logical boundaries)

7.2.1 IT and network telecommunications/infrastructure

The infrastructure used to process, store and transport data includes, but is not limited to, the following:

a) servers and computing systems: e.g. servers, hardware accelerators, digital and physical security devices, workload schedulers, workstations;

b) networking and communication equipment: e.g. switches, routers, firewall, network analyzers, networking appliances;

c) data storage equipment: e.g. storage arrays, data archive appliances;

d) supporting electronic equipment: IT/data services control equipment and displays, control terminals, printers.

7.2.2 Power generation and distribution infrastructure

The power generation and distribution infrastructure includes, but is not limited to, the following:

a) power generation: e.g. co-generation, back-up generation (diesel generators, fuel tanks), renewable energy sources (e.g. biomass, solar, wind farm, ground water/geothermal);

b) grid/utility: e.g. connectivity, in-coming electrical sub-stations;

c) electrical distribution: e.g. medium and low voltage distribution and protections, transformers, transfer switches;

d) critical power: e.g. uninterruptible power supplies, electrical conversion (AC/DC and DC/DC converters), energy storage (e.g. battery);

e) protection, meters and control: e.g. automation system, surge protection, protection coordination, energy measurement and quality, load balancing.

7.2.3 Environmental control/infrastructure

The environment control (heating ventilation and air conditioning) infrastructure and controls (external to the IT equipment) includes, but is not limited to, the following:

a) water utility: e.g. connection, waste water, water treatment and storage;

b) liquid conditioners and controls: e.g. chillers, cooling tower, pumps, buffer tank and expansion, flow control, ice-storage;

c) air conditioners: e.g. heat-exchangers, humidifiers/de-humidifiers (if required), filtration systems, ventilation, automation and control;

d) sensors: e.g. temperature, humidity, air flow;

e) air quality and safety: e.g. refreshed air and control, smoke exhaust, louvers.

7.2.4 Security and safety infrastructure

The data centre security and safety infrastructure includes, but is not limited to, the following:

a) lighting: e.g. external (if applicable) and internal of the building;

b) fire detection and suppression systems: e.g. lighting, sensors, gas, tanks and water piping, sprinklers;

c) access control: zoning/physical gates, passes, physical security and control systems, alarms, vocal systems;

d) electronic security and monitoring: e.g. video surveillance system cameras and networks, etc.