

# Information technology — Data centre facilities and infrastructures

## Part 31: Key performance indicators for Resilience-resilience

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ISO/IEC DTS 22237-31

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## Foreword

ISO (the International Organization for Standardization) ~~is a~~ and IEC (the International Electrotechnical Commission) ~~form the specialized system for worldwide federation of national standards~~ standardization. National bodies ~~(that are members of ISO member bodies)~~. The ~~work~~ IEC ~~participate in the development~~ of preparing International Standards ~~is normally carried out through ISO technical committees~~. Each member body interested in a subject for which a technical committee has been established ~~has the right to be represented on that committee~~. International ~~by the respective organization to deal with particular fields of technical activity~~. ISO and IEC technical committees ~~collaborate in fields of mutual interest~~. Other international organizations, governmental and non-governmental, in liaison with ISO ~~and IEC~~, also take part in the work. ~~ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization~~.

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~~ document 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 2~~ (see [www.iso.org/directives](http://www.iso.org/directives) or [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs)).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), ~~see www.iso.org/iso/foreword.html~~ see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html). In the IEC, see [www.iec.ch/understanding-standards](http://www.iec.ch/understanding-standards).

This document was prepared by Joint Technical Committee ISO/IEC JTC-1, *Information technology, Subcommittee SC-39, Sustainability, IT and data centres*.

A list of all parts in the ISO/IEC 22237 series can be found on the ISO ~~website~~ and IEC ~~websites~~.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html) ~~www.iso.org/members.html~~ and [www.iec.ch/national-committees](http://www.iec.ch/national-committees).

## Introduction

The ~~data centre standards~~ various parts of the ISO/IEC 22237 series reference four qualitative Availability Classes as well as structural definitions to categorize different designs. The ~~standards documents~~ also refer to ~~Resilience~~ resilience criteria in order to improve structural requirements ~~on for~~ a qualitative approach.

In order to meet the requirements necessary ~~to evaluate/compare~~ for evaluating or comparing different designs or to validate ~~Service Level Agreements~~ service level agreements (SLAs) for data centres, ~~this document introduces~~ quantitative metrics as key performance indicators (KPIs) ~~are introduced in this document.~~ The proposed KPIs cover ~~Resilience~~ resilience attributes, including ~~Dependability~~ dependability and ~~Fault Tolerance~~ fault tolerance metrics. ~~Furthermore, the~~ The characteristics of aging of infrastructures are covered by ~~the Reliability~~ reliability criteria.

Through the use of KPIs, ~~the~~ comparison of designs, functional elements, and components of infrastructure designs ~~become~~ becomes possible. In addition, it is possible to ~~optimise Data Centre Infrastructures~~ optimize data centre infrastructures (DCI) with holistic targets. It is recommended to use the KPIs of this document in combination with the efficiency and sustainability KPIs of ~~the~~ ISO/IEC 30134 series.

~~Annex A of~~ ISO/IEC 22237-1 ~~proves~~ 2021, Annex A, demonstrates that a single KPI, such as Availability, is not sufficient to describe the complexity of a DCI. In recognition, this document has been developed in order to compare and value different designs with different Availability Classes of DCIs based on a set of selected KPIs.

Furthermore, the document has been created to establish KPIs for ~~Resilience~~ resilience of ~~data centre infrastructures~~ DCIs with defined ~~Resilience Levels~~ resilience levels. ~~The resilience objectives can vary depending~~ on the outcome of the risk analysis of ~~ISO/IEC 22237-1~~ risk analysis, the end user ~~Information Technology Equipment~~ information technology equipment (ITE) process criticality, and the data centre type of business, ~~the resilience objectives can vary.~~

Using the different stages of a data centre design process, this document describes in which phases the application of KPIs for ~~Resilience~~ resilience is appropriate. With its assistance, data centre designers, planners, and operators will be supported ~~to define Resilience~~ in defining resilience Levels, ~~to perform~~ performing theoretical assessments and ~~to design~~ designing and ~~operate~~ operating DCIs which are able to meet SLAs.



# Information technology — Data centre facilities and infrastructures

## Part 31: Key performance indicators for Resilience

### 1 Scope

This document:

- defines metrics as key performance indicators (KPIs) for Resilience, as well as of Dependability, Fault Tolerance, resilience, dependability, fault tolerance and Availability Tolerance availability tolerance for data centres;
- covers the Data Centre Infrastructure data centre infrastructure (DCI) of power distribution and supply, and environmental control;
- can be referred to for covering further infrastructures, ~~as~~ e.g. telecommunications cabling;
- defines the measurement and calculation of the KPIs and Resilience Levels (RL) resilience levels (RLs);
- targets maintainability, recoverability, and vulnerability;
- provides examples ~~on~~ for calculating these KPIs for the purpose of analytical comparison of different DCIs.

This document does not ~~cover~~ apply to IT-equipment, cloud services, software or business applications.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC-22237-1, *Information technology — Data centre facilities and infrastructures — Part 1: General concepts*

ISO/IEC-22237-3, *Information technology — Data centre facilities and infrastructures — Part 3: Power distribution*

ISO/IEC-22237-4, *Information technology — Data centre facilities and infrastructures — Part 4: Environmental control*

~~ISO/IEC-22237-5, Information technology — Data centre facilities and infrastructures — Part 5: Telecommunications cabling infrastructure~~

~~ISO/IEC-30134-1, Information technology — Data centres — Key performance indicators — Part 1: Overview and general requirements~~

IEC-61078, *Reliability block diagrams*

### 3 Terms and definitions

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 22237-1, ISO/IEC 22237-3, ISO/IEC 22237-4 and the following apply.

ISO and IEC maintain ~~terminological~~**terminology** databases for use in standardization at the following addresses:

— IEC Electropedia: available at <https://www.electropedia.org/>

— ISO Online browsing platform: available at <https://www.iso.org/obp>~~https://www.iso.org/obp~~

— IEC Electropedia: available at <https://www.electropedia.org/>

##### 3.1.1

###### **availability**

ability to be in a state to perform as required

[SOURCE: IEC 60050-192:2015, 192-01-23~~—~~, modified: ~~—~~ Notes 1 and 2 to entry have been deleted].]

##### 3.1.2

###### **availability tolerance**

ability to be in a state to perform as required with certain *failures* ~~(3.1.7)~~**(3.1.8)** present

##### 3.1.3

###### **dependability**

ability to perform as and when required

Note ~~1~~ to entry: In this document, the term is used for the determination of data centre *reliability*, ~~(3.1.28)~~, *availability*, ~~(3.1.1)~~ and *failure rate* ~~(3.1.9)~~.

[SOURCE: IEC 60050-192~~—~~:2015, 192-01-22~~—~~, modified: ~~—~~ Notes 1 and 2 to entry have been replaced by a new Note 1 to entry].]

##### 3.1.4

###### **double point of failure**

###### **DPoF**

combination of two functional elements whose simultaneous *failures* ~~(3.1.8)~~ causes**(3.1.8)** cause overall system *fault* ~~(3.1.9)~~

~~[(3.1.10)]~~[SOURCE: IET, Journal of Engineering, Vol. 2019 Iss. 12, 99. 8419-8427 ~~[1]]~~ <sup>[1]</sup>

##### 3.1.5

###### **double point of reduced availability**

###### **DPoRA**

combination of two functional elements whose simultaneous *failures* ~~(3.1.8)~~ results**(3.1.8)** result in the violation of the *service level agreement*

~~[(SLA) (3.1.30)]~~[SOURCE: IET, Journal of Engineering, Vol. 2019 Iss. 12, 99. 8419-8427 ~~[1]]~~ <sup>[1]</sup>

##### 3.1.6

###### **down state**

state of being unable to perform as required, due to *failures* ~~(3.1.8)~~**(3.1.8)** or *faults* ~~(3.9.10)~~**(3.1.10)**

Note-1-to-entry:-The state can be related to failures of items or faults at a specified ~~Operation Point~~operation point (OP) (3.1.21).

[SOURCE: IEC 60050-192-:2015, 192-02-20]

### 3.1.7 event

something that happens and leads to one or more ~~failures~~ (3.1.8) or ~~faults~~ (3.1.10).

### 3.1.8 failure, <of an item>

loss of ability to perform as required

Note-1-to-entry:-In this context it is irrelevant if ~~is the~~ cause was planned or unplanned.

[SOURCE: IEC 60050-192:2015, 192-03-01-~~2~~, modified: ~~—~~ Notes 1 to 3 to entry have been replaced by Note 1 to entry].]

### 3.1.9 failure rate

limit of the ratio of the conditional probability that the instant of time,  $T$ , of a ~~failure~~ (3.1.8) of a product falls within a given ~~time interval~~  $(t, t + \Delta t)$  (3.1.35)  $(t, t + \Delta t)$  and the duration of this interval,  $\Delta t$ , when  $\Delta t$  tends towards zero, given that the item is in an ~~up state~~ (3.1.36) at the start of the time interval

[SOURCE: IEC 60050-192:2015, 821-12-21]

### 3.1.10 fault

inability to perform as required, due to an internal state

Note-1-to-entry:-Opposite of success; ~~in~~, In the context of the expected ~~Resilience Level~~resilience level (RL), (3.1.26), at a specified operation point (OP) (3.1.21).

[SOURCE: IEC 60050-192:2015, 192-04-01]

### 3.1.11 fault tolerance

ability to continue functioning with certain ~~faults~~ (3.1.10) present

[SOURCE: IEC 60050-192:2015, 192-10-09]

### 3.1.12 information technology equipment

#### ITE

equipment providing data storage, processing, and transport services together with equipment dedicated to providing direct connection to core and/or access networks

### 3.1.13 infrastructure

technical systems providing the functional capability of the data centre

Note-1-to-entry:-Examples are power distribution, environmental control, telecommunications cabling, physical security

[SOURCE: ISO/IEC 22237-1:2021, 3.1.21], modified — "telecommunications cabling" has been added to the list in Note 1 to entry.

### **3.1.14**

#### **inherent availability**

*availability* ~~(3.1.1)~~(3.1.1) provided by the design under ideal conditions of operation and maintenance

[SOURCE: IEC 60050-192:2015, 192-08-02]

### **3.1.15**

#### **mean down time**

##### **MDT**

average downtime caused by scheduled and unscheduled maintenance, including any logistics time (expectations including detection time, diagnostic time, spare part delivery time, repair time)

[SOURCE: IEEE Std. 493-2007]

### **3.1.16**

#### **mean operating time between failures**

##### **MTBF**

expectation of the duration of the operating time between *failures* ~~(3.1.8)~~(3.1.8)

Note-1-to entry:- Mean operating time between failures should only be applied to repairable items. For non-repairable items, see *mean operating time to failure*: (3.1.17).

Note-2-to entry:- The term "mean time between failures" (MTBF) is used synonymously in this document.

[SOURCE: IEC 60050-192:2015, 192-05-13]

### **3.1.17**

#### **mean operating time to failure**

expectation of the operating time to *failure* ~~(3.1.8)~~(3.1.8)

Note-1-to entry:- In the case of non-repairable items with an exponential distribution of operating times to failure (i.e. a constant *failure rate*) (3.1.9), the MTTFmean operating time to failure is numerically equal to the reciprocal of the failure rate. This is also true for repairable items if after restoration they can be considered to be "as-good-as-new".

Note-2-to entry:- The term "mean time to failures" (MTTF) is used synonymously in this document.

[SOURCE: IEC 60050-192:2015, 192-05-11]

### **3.1.18**

#### **mean time between maintenance**

##### **MTBM**

average time between all maintenance *events*: (3.1.7), scheduled and unscheduled, and also includes any associated logistics time

[SOURCE: IEEE Std. 493-2007]

### **3.1.19**

#### **mean time to restoration**

mean time to replace or repair a failed component

Note-1-to entry:- Logistics time associated with the repair, such as parts acquisitions, or crew mobilization, are not included.

[SOURCE: IEEE Std. 493-2007]

### 3.1.20

#### normal resilience level

##### NRL

*resilience level* (3.1.26) mandatory during nominal operation

### 3.1.21

#### operation point

##### OP

point of reference for which calculation of *resilience level* (3.1.26) is performed

Note 1 to entry: This can be an individual *socket* (3.1.33) taking into account the entire data centre infrastructure (DCI) or certain defined parts of the *infrastructure*, the (3.1.13). The documentation of the referenced ~~Operation Point~~ *operation point* (OP) is required for any *key performance indicator* (KPI).

### 3.1.22

#### operational availability

*availability* (3.1.1) experienced under actual conditions of operation and maintenance

[SOURCE: IEC 60050-192:2015, 192-08-03→, modified: — Note 1 to entry *has been* deleted].

### 3.1.23

#### past availability

*availability* (3.1.1)(3.1.1) measured during a period of 1-year

Note 1 to entry: For the purposes of this document, 1-year equals 8 760 hours.

### 3.1.24

#### reduced resilience level

##### RRL

*resilience level* (3.1.26) mandatory during reduced operation in case of one or more *failures* (3.1.8)(3.1.8)

### 3.1.25

#### resilience

ability to withstand and reduce the magnitude and ~~+/~~ or duration of disruptive *events*, (3.1.7), including the capability to anticipate, absorb, adapt to, and ~~+/~~ or rapidly recover from such an event

[SOURCE: IEEE Task Force on Definition and Quantification of Resilience, PES-TR65:2018-04, [2]] [2]

### 3.1.26

#### resilience level

enumeration of attributes for the determination of *resilience* (3.1.25) aspects of a defined service at a defined *operation point* (~~OP~~(3.1.21)) (3.1.21)

### 3.1.27

#### redundancy

<in a system> provision of more than one means for performing a function

Note 1 to entry: In a data centre, redundancy can be achieved by duplication of devices, functional elements, and/or supply paths.

[SOURCE: IEC 60050-192:2015, 192-10-02→, modified: — Note 1 to entry *has been* replaced by *a new Note 1 to entry*].