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Information technology — Cloud computing — Guidance for using the cloud SLA metric model

Technologies de l'information — Informatique en nuage — Recommandations pour l'utilisation du modèle métrique d'accord de niveau de service (SLA) dans le Cloud

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 38, *Cloud Computing and Distributed Platforms*.

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.

Introduction

In most cases, cloud service providers (CSPs) and cloud service customers (CSCs) negotiate service level agreements (SLAs) which include service level objectives (SLOs) and service qualitative objectives (SQOs) for which CSPs make commitments. The commitments described in SLAs are expected to be measured against actual performance of the service to ensure compliance with the SLA. How actual performance compares against commitments in SLAs is explained in ISO/IEC 19086-2. Cloud SLAs are covered in ISO/IEC 19086-1 and in ISO/IEC 19086-4.

The metric model in ISO/IEC 19086-2 establishes common terminology, defines a model for specifying metrics for cloud SLAs, and includes applications of the model with examples. This document provides guidance and examples on using the metric model to compose the calculation of a cloud service performance measure in order to compare against an SLA commitment. A few examples from the SLOs listed in ISO/IEC 19086-1:2016, Clause 10 are given in the document, such as Cloud Service Mean Response Time and Simple Cloud Service Availability. As specific, measurable characteristics of a cloud service, SLOs are the basis for defining the metrics used to evaluate and compare agreements between parties.

In Clauses 8, 9 and 10 of this document, a basic explanation of these examples is provided using a practical method based on a tabular format that is a refinement of the informative tables provided in ISO/IEC 19086-2:2018, Annex B. The tabular representation described in this document serves as templates for designing metrics. Guidance in using the metric model with these templates is provided while developing metric examples.

Information technology — Cloud computing — Guidance for using the cloud SLA metric model

1 Scope

The scope of this document is to describe guidance for using the ISO/IEC 19086-2 metric model, illustrated with examples.

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 17788, *Information technology — Cloud computing — Overview and vocabulary*

ISO/IEC 17789, *Information technology — Cloud computing — Reference architecture*

ISO/IEC 19086-1, *Information technology — Cloud computing — Service level agreement (SLA) framework — Part 1: Overview and concepts*

ISO/IEC 19086-2, *Cloud computing — Service level agreement (SLA) framework — Part 2: Metric model*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 17788, ISO/IEC 17789, ISO/IEC 19086-1 and ISO/IEC 19086-2 apply.

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

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

— IEC Electropedia: available at http://www.electropedia.org/

4 Symbols and abbreviated terms

CCRA	cloud computing reference architecture
CSC	cloud service customer
CSN	cloud service partner
CSP	cloud service provider
SLA	service level agreement
SLO	service level objective
SQO	service quality objective

5 Structure of this document

In supporting the scope presented in Clause 1, this document develops the rationale for a practical metric representation to complement the metric model in ISO/IEC 19086-2 in the following clauses:

— Clause 6 states the rationale for complementing the metric model as defined in ISO/IEC 19086-2 with a practical representation and for providing related usage guidance as introduced by this document. It identifies some usage patterns and highlights some usage scenarios where metric definitions are shared across various parties. The users who benefit from this document include parties with roles defined in ISO/IEC 17789 (Cloud computing — Reference architecture).

— Clause 7 introduces the tabular metric representation supportive of the metric model and derived from the informative tables listed in ISO/IEC 19086-2:2018, Annex B. This representation is based on tables intended to serve as templates for metric definitions. This clause represents initial guidance in using the metric model, which is then illustrated and discussed throughout the examples developed later in the document.

— Clause 8 introduces a simple case of metric definition that illustrates the use of the table templates introduced in Clause 7. This example starts with the description of a metric as it would appear in the narrative of an existing SLA and illustrates the extraction of this description toward a more structured and distinct representation using the proposed tabular representation. The example shows practical aspects when designing and developing metrics, such as how metric rules relate to expressions, and how to parameterize rules and expressions.

— Clause 9 is a set of guidelines on how to use the metric model with the tabular templates (Clause 7). This guidance is motivated and illustrated by the examples throughout the document. These guidelines are best understood after developing a preliminary example (Clause 8). They explain how to use the metric model with the tabular templates for metric use cases posing similar challenges or using similar features.

— Clause 10 develops a more elaborate metric example for cloud service availability. It describes two variants of the same metric that illustrate two different approaches in using the metric model elements. Since it comes after the guideline items listed in Clause 9, it is easier to relate the development of this second example to these guidelines.

6 Motivation

6.1 Preamble

This clause first identifies the audience of this document and for the tabular metric representation described in this document. This clause then describes some metric usage patterns and then identifies scenarios and roles for these metric usage patterns. Sharing common guidelines and conventions in using the metric model improves the ability to reuse and compare metrics. These common guidelines extend to the aspects of a metric that are part of the metric model but the details of which are out of scope of the metric model in ISO/IEC 19086-2, such as the use of rule and expression languages and how these constructs relate to each other. Supportive of the goal of harmonizing the usage of the metric model across users, this document proposes a tabular representation for metric definitions that is derived from and augments the tables provided in Annex B of the metric model in ISO/IEC 19086-2:2018, as explained in 7.2.2.

6.2 Audience and some user categories

6.2.1 General

The audience for this document is expected to be diverse, as the metric representation proposed in this document is intended for different parties involved in providing or using cloud services. However not every clause is of interest to all. Those who read, negotiate or create SLA content, such as business users and administrators, are expected to be interested in Clauses 1 to 7 and in the initial approach

to the first metric example (see 8.1). In addition to these clauses, metric designers and developers are expected to be interested in the remaining clauses including more elaborate examples of metrics (starting from 8.2 and beyond).

The parties interested in this document include representatives of the following roles defined in ISO/IEC 17788.

6.2.2 Cloud service customer (CSC)

This document helps the CSC to understand the metrics used for service quality and other assurances described in SLAs. When blended into the narrative of the SLA, metrics are often ambiguous or incomplete. A structured definition as described in the metric model and made practical with a tabular representation helps to avoid or at least detect such issues.

Specific types of customers are interested in understanding how a service is measured without having to read the entire SLA or prior to establishing an SLA. These customers are defined in the CCRA as a cloud service users (who uses a cloud service to fulfil her/his role), a service administrator (who oversees all the operational processes relating to the use of cloud services, serving as intermediary between the user and the provider) and a business manager (who has overall responsibility for the business aspects of using cloud services, including the purchase of the service under appropriate terms and possibly the request of audit reports**)**.

The tabular representation in this document is also an analysis tool for the CSC to identify and extract the metric material found in an SLA in order to get a clearer understanding of how the service is measured, as illustrated in 8.1.

6.2.3 Cloud service provider (CSP)

This document helps the CSP to describe the service metrics that support his or her SLAs, potentially avoiding contentious claims afterward that result from CSCs misunderstanding the terms and conditions of these SLAs. It also helps providers to harmonize their metrics across data-centre operators or world regions. Among activities expected from CSPs as defined in ISO/IEC 17789, the following are facilitated by metric definitions and evaluations: monitoring service, administering service security, providing audit data on request, defining and gathering metrics, managing security and risks, and, finally, handling support requests, reports and incidents from cloud service customers. For these activities, this document helps to establish a common and unambiguous representation of metrics used between parties involved in these activities and distinct from other SLA material.

6.2.4 Cloud service partner (CSN)

The following CSN sub-roles are expected to find value in a metric definition template and guidelines:

— **Cloud service developer**: this user is responsible for designing, developing, integrating, testing, and maintaining cloud services. Developers need to understand the measurements used to evaluate a cloud service. This role includes composing a new cloud service from existing separate cloud services. By having access to precise metric definitions and their rules, such as those illustrated in Clauses 8 and 10, developers understand what features are to be monitored, what is the expected quality of the developed cloud service and its priorities, as well as how to evaluate the quality and risks when integrating third party cloud services.

— **Cloud auditor**: the auditor has the responsibility of conducting an audit of the provision and the use of cloud services. A cloud audit typically covers operations, performance and security and examines whether a specified set of audit criteria are met. By using metrics, the auditor understands or communicates clearly the details of the measurements to perform. Such precision and clarity are provided by a distinct and detailed metric representation, as illustrated in the two examples developed in Clauses 8 and 10.

6.2.5 Regulators and policy makers

Several aspects of policy definition and enforcement concern measurable properties both about the cloud service usage (including cloud service usage duration and times, volume and type of data involved), and the cloud service performance (such as cloud service quality, elasticity and scalability, availability and reliability). Other policies (such as those about trust and transparency, security procedures, privacy) concern the relationship, governance and risk management between parties, especially CSCs and CSPs. Whether these policies involve automated monitoring or some human assessment instead, they rely on some form of measurement for tracking their implementation. See ISO/IEC TR 22678 for more information regarding the development of policies that govern or regulate cloud service providers (CSPs) and cloud services, and those policies and practices that govern the use of cloud services in organizations.

The expression of policies and rules sometimes translates into predefined metric elements that are expected to be used even when defining a customized metric. An example is of a policy that determines the formula (metric expression) to be used when assessing cloud service uptime percentage, while leaving other details unconstrained. As another example, if there is agreement for sharing across CSPs the common definitions of “natural disaster” or “service misuse”, the reuse of such definitions helps to establish a common understanding of what a valid cloud service downtime means. Creating and sharing predefined metric material is a usage pattern described in 6.3.5 as sharing a metric foundation.

6.3 Usage patterns

6.3.1 General

A summary of various usage patterns for the tabular metric representation given in 7.2 and a rationale for doing so are provided in the next subclauses. Some of these usage patterns match usage categories identified in ISO/IEC 19086-2:2018, 6.4.2.

6.3.2 Extract and clarify an existing metric description from an SLA

Often, the metric(s) information in a cloud service SLA is scattered over the SLA narrative. Parts of metric material (such as measurement rules, exceptions, underlying quantities and metrics) is mixed with related information that is not part of the metric definition (such as performance objectives, remediation measures and penalties).

Distinguishing a metric definition apart from its context of usage in an SLA and using for this the metric model and its concrete representation helps detect ambiguities and missing elements. This also promotes the reuse of a metric across SLAs and providers. (See 8.1 for an example of the extraction of a metric definition from an SLA narrative). This pattern of using the tabular metric representation supports the usage categories listed in ISO/IEC 19086-2:2018, 6.4.2.1 (cloud services) and 6.4.2.3 (cloud service agreements).

6.3.3 Create and share a metric description

A metric definition is sometimes intended to be used by various parties including CSP, different CSCs and CSNs including sub-roles such as cloud service developer and cloud auditor. Using a common metric representation and its usage conventions helps these parties to describe and understand metrics that they use and share.

A metric representation separate from an SLA helps different parties to share metrics while leaving aside any other SLA content. Beyond an informal plain text description understandable by all, the tabular representation introduced in 7.2 supports more formal descriptions such as specific languages for the calculation logic (expressions) and its rules, thus serving different users. See 8.1 for using different expression languages of interest to various parties. This pattern of using the tabular metric representation supports usage categories listed in ISO/IEC 19086-2:2018, 6.4.2.1 (cloud services) and 6.4.2.4 (developing performance monitoring tools).

6.3.4 Compare metric descriptions

There are many variants of a seemingly common metric across CSPs. CSCs often want to compare these. Such a comparison is made easier by using the same metric model and elements but also common representation and guidelines. For example, significant variations have been observed between CSPs in a metric as common as "service availability as uptime percentage" due to different definitions of cloud service downtime.

A well-structured metric representation makes it easier to assess comparable metric elements. This pattern of using the tabular metric representation supports usage categories listed in ISO/IEC 19086-2:2018, 6.4.2.2 (comparing cloud services).

6.3.5 Share a common foundation for a set of metrics

In many cases, it is desirable to share the same metric conventions and elements, if not the same metric. These conventions and elements are expressed as a partially developed metric definition, called a metric foundation in this document for convenience. For example, a metric foundation can be defined for cloud service availability that imposes the same general calculation of "availability" as cloud service uptime percentage, leaving the details for each CSP to define (see 6.2.5 about policies requiring to use predefined metric elements).

6.3.6 Build a metrics catalogue

A metrics catalogue collects metrics and their variants in specific areas, along with their association to useful resources such as available implementations. This is of interest to CSPs or communities of CSNs interested in sharing and reusing metric material.

A common metric representation and a set of conventions based on a shared metric model are a step toward building a metrics catalogue. This also helps to create a catalogue of metric implementations of interest to cloud service developers. Such catalogues in turn serve as resources for various parties to search, select and reuse metrics or metric elements.

6.4 Examples of scenarios and roles involved in sharing metric definitions

Metrics may be used in various ways and for different purposes, and therefore may have different measurement definitions. Consider that calculating car rental "availability" is different from calculating "airline seat availability". CSPs may even have different definitions for the same metric. For example, some CSPs may exclude "planned maintenance outages" when calculating "availability", while others include "planned maintenance outages".

Consider an enterprise or government agency that purchases an IaaS service for compute. The role it plays for the IaaS provider is the CSC who consumes a compute service. The enterprise (or government agency) develops customized (PaaS) services to be reused by others in the enterprise or agency. After the PaaS services are deployed, its role is also of a PaaS CSP.

Application developers in the enterprise (or government agency) can use the PaaS to help develop the business applications (SaaS) for the benefit of their own end-users or business customers. After the SaaS services are deployed, the department that provides these services acts in the role of SaaS CSP.

Availability metrics are of interest to several roles and sub-roles with different perspectives and concerns, as illustrated in Table 1.

Table 1 — The use of cloud service availability metrics across roles

Metric: Cloud Service availability		
Role description	**Use case scenario for the metric**	**Potential availability metrics of interest**
CSP – IaaS cloud compute service provider	What level of "cloud infrastructure compute service availability" can the CSP commit to for its customers?	Cloud infrastructure compute availability
CSN – cloud PaaS service developer	The PaaS developer needs to determine what availability "targets" are reasonable when developing and deploying their PaaS services (such as APIs). Does the cloud infrastructure compute service availability commitment from the CSP enable PaaS availability intended targets to be met?	PaaS availability, Cloud infrastructure compute availability
CSC – cloud PaaS service customer, as a SaaS developer	The user needs to understand what availability "targets" they should require to satisfy their customer needs. Does the PaaS availability enable SaaS availability targets to be met? Does the "Cloud infrastructure compute service availability" CSP commitment enable SaaS and/or PaaS availability targets to be met?	SaaS availability, PaaS availability, Cloud infrastructure compute availability
SaaS customer	What application service availability can be expected by the application user?	SaaS availability

Table 1 illustrates the rationale for a metric definition that takes into account a variety of usages and accommodates a range of users. A way to ease the understanding of a metric definition across various parties is to describe it using more than one language, as illustrated in Clause 8.

Table 1 also suggests requirements for metrics to build on each other or to extend each other. An example is of an IaaS CSP who does not include connectivity as part of the availability calculation, while other roles/sub-roles are affected by outages related to network connectivity (such as between the CSNs, CSCs and the CSP) and want it to be part of their notion of availability. A more complete cloud service availability metric could compose a metric already developed for measuring the quality of network connectivity with an availability metric for the service itself.

Designing a metric for reusability makes it more versatile and supports a variety of usages and intents. This concern is briefly discussed in design options for the examples (see 8.2.4.2 and 10.2.3.2) as well as in guideline 6 about parameterization in 9.7.

7 The metric model in practice: templates

7.1 A brief reminder of the metric model

An overview of the metric model is provided in Figure 1 as it appears in ISO/IEC 19086-2 in the form of an UML diagram.

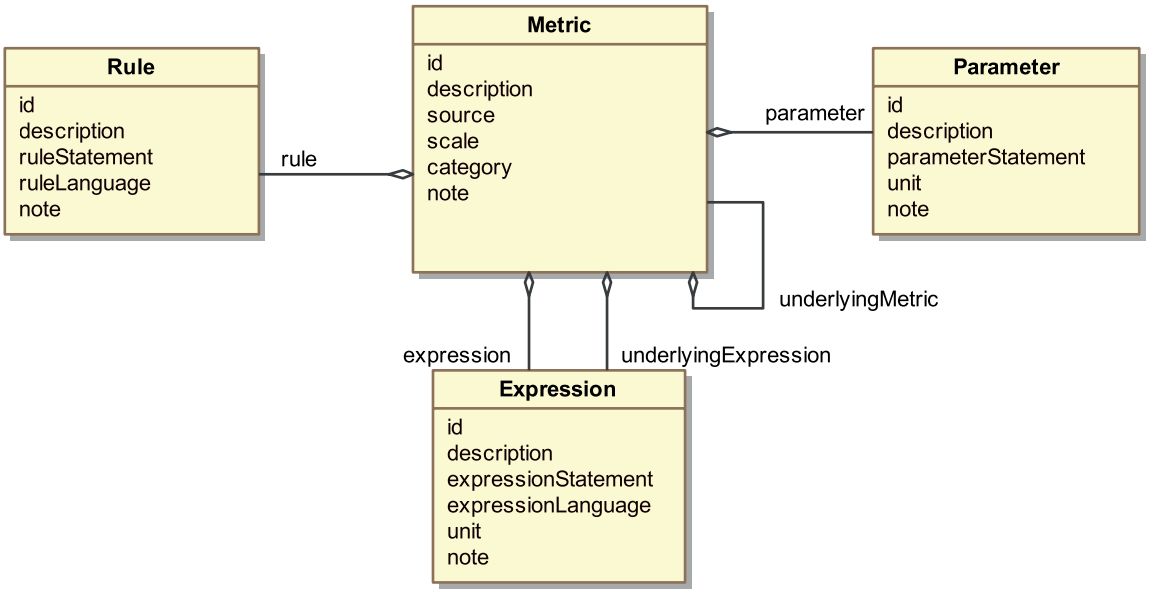

Figure 1 — The metric model in ISO/IEC 19086-2

Each one of the four blocks in Figure 1 (Metric, Rule, Expression, Parameter) is also called a metric element. A more detailed description of the metric elements and their attributes is provided in ISO/IEC 19086-2.

The term Metric element (capitalized) is used to refer specifically to the element named Metric in the UML diagram and the tabular representation of this element.

The term "metric element" is used generically to denote any element that is part of a metric, without necessary reference to a particular element type (i.e., Metric, Expression, Rule, Parameter).

7.2 A tabular representation

7.2.1 General

A tabular rendering of the metric model usable as a set of templates for capturing the definition of a particular metric is provided in Table 2, Table 3, Table 4 and Table 5. There is one table for each type of metric element (Metric, Rule, Expression, Parameter). For example, the Metric table, once filled with values, represents the definition of a Metric element. These templates are described in the next subclauses.

In the Metric table, the associations between the Metric element and its constituents (Rule, Expression and Parameter elements) are represented as references to these constituent elements using the id attribute (see associated element fields in Table 2). Such associations are illustrated as solid lines in the diagram of Figure 1.

There are other relationships between metric elements that are accounted for in the metric model in ISO/IEC 19086-2 although not represented in the diagram of Figure 1. These relationships are instead represented in ways that depend on the metric languages (ruleLanguage, expressionLanguage), the description of which is out of scope of the metric model. These relationships are between metric elements that depend on other metric elements. Examples of such dependencies are:

— An Expression element using another underlying Expression element to support its calculation.

— An Expression element referencing Rule elements that govern its calculation.

— An Expression element referencing another (underlying) Metric element of which it uses the output.