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Cloud computing — Interoperability and portability —

Part 1: Overview, terminology and concepts

Informatique en nuage — Interopérabilité et portabilité —

Partie 1: Vue d'ensemble, terminologie et concepts

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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 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 or www.iec.ch/members_experts/refdocs).

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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*.

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This first edition cancels and replaces the first edition (ISO/IEC 19941:2017), which has been technically revised.

The main changes are as follows:

— alignment with the ISO/IEC 22123 series, ISO/IEC 19086-1, ISO/IEC 19944-1, ISO/IEC 5140 and in particular, references to the cross-cutting aspects and components identified in ISO/IEC 22123-1 and ISO/IEC 22123-3 respectively;

— cloud service switching;

— interoperability considerations when using cloud services from multiple CSPs;

— portability considerations when using cloud services from multiple CSPs or between an on-prem data centre and a CSP;

— cloud SLA aspects for interoperability and portability;

— data categories for interoperability and portability.

A list of all parts in the ISO/IEC 19941 series can be found on the ISO 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 and www.iec.ch/national-committees.

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Introduction

This document establishes a common understanding of cloud computing interoperability and portability.

This document is related to other standards, including, ISO/IEC 22123 series, ISO/IEC 19086-1, ISO/IEC 19944-1, ISO/IEC 5140 and in particular, references to the cross-cutting aspects and components identified in ISO/IEC 22123-1 and ISO/IEC 22123-3 respectively.

Cloud computing is defined in ISO/IEC 22123-1 as a paradigm for enabling network access to a scalable and elastic pool of 20 shareable physical or virtual resources with self-service provisioning and administration on demand. ISO/IEC 22123-1, ISO/IEC 22123-2[8] and ISO/IEC 22123-3[9] provide a starting point for the understanding of different types of interoperability and portability, relationships with activities and roles and cloud capabilities types. Interoperability, data portability and application portability are essential to the use of cloud services. Interoperability enables interaction between non-cloud and cloud services and allows composition of services. The goal of portability is to enable cloud service customers (CSCs) to move their data or applications between non-cloud and one or more cloud services and between cloud services. The benefits of interoperability include lower costs of integration and increasing the value of services through enrichment or new functionality provided by composing cloud services. The benefits of portability include greater efficiency by lowering the costs of migration. Both interoperability and portability offer more choices to CSCs by limiting the effects of being locked into any cloud service or cloud service provider (CSP). Interoperability and portability are important aspects of cloud computing, but there is no single way of handling either capability. In new system development, incorporating interoperability and portability as part of business and technical requirements, can be taken as a part of planning process and all design decisions and development environment including application design and development are best implemented in a vendor-neutral way. This approach can simplify portability and interoperability across services. If, on the other hand, switching, porting or interoperability is desired during the operation and maintenance phase, the CSC can require assistance of the incumbent CSP for migration, tools thereof and use of open interfaces and APIs at the interface, immaterial of the internal interfaces used. Additionally, CSCs can use third party tools and services.

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ISO/IEC 22123-1 defines interoperability as the ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged. In the context of cloud computing, interoperability can be viewed as the capability of public cloud services, private cloud services and other CSC systems to understand each other's interfaces, configuration, forms of authentication and authorization, etc. in order to cooperate and work with each other.

Regulators and policy makers are interested in the interoperability of cloud computing. Notably the EU Data Act[18] aims to achieve interoperability between cloud services that cover the same service type and in terms of the ability to exchange data in order to perform their function.

Interoperability is a complex subject in the context of cloud computing because of the number of interactions involved and the potential variations for each interaction. While interoperability and standards add significant value and are advantageous to cloud computing, there are no comprehensive solutions. Many existing IT standards contribute to enabling interoperability between CSC applications and cloud services and between cloud services themselves. Various standards, including widely adopted industry specifications and formally established standards, can contribute to interoperability. Using standards can be one way to build interoperable cloud services. In addition, well-documented API specifications can support the development of interoperable applications.

Cloud services designed with portability mechanisms can help CSCs move data between services using defined policies standards, or documented formats, as this allows CSCs to move to a cloud service of another CSP and also to drive integration of heterogeneous cloud services.

ISO/IEC 22123-1 defines data portability as the ability to easily transfer data from one system to another without being required to re-enter data and application portability as the ability to migrate an application from a source system to a target. Portability is relevant where CSCs aim to reduce the risk of vendor lock-in. Therefore, in the context of cloud computing, portability can have multiple aspects depending on what is being ported and which cloud services are involved. For portability, there are no specific requirements for the source and target systems to be directly connected.

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Portability is not a binary property; applications can vary in the ease with which they can be ported Applications can often be ported between cloud services when necessary resources and capabilities are made available. The critical considerations for portability discussions are the porting cost, the risks associated with the porting and how to control the costs and risks compared to the expected benefits.

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Cloud computing — Interoperability and portability —

Part 1: Overview, terminology and concepts

1 Scope

This document specifies cloud computing interoperability and portability types, the relationship and interactions between these two cross-cutting aspects of cloud computing and distributed platforms, as well as common terminology and concepts used to discuss interoperability and portability, particularly relating to cloud services.

The goal of this document is to ensure that all parties involved in cloud computing, particularly cloud service customers (CSC), cloud service providers (CSP) and cloud service partners (CSN) acting as cloud service developers, have a common understanding of interoperability and portability for their specific needs, including switching service provision from one CSP to another. This common understanding helps to achieve interoperability and portability in cloud computing by establishing common terminology and concepts.

2 Normative references

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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.

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ISO/IEC 22123-1, *Information technology — Cloud computing — Part 1: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 22123-1 and the following apply.

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

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

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

3.1
cloud service switching
process whereby a CSC changes the provisioning of a cloud service from the current cloud service provider to another cloud service provider

Note 1 to entry: To move the provisioning of a cloud service to an on-premises service, the other CSP can be the same party as the CSC.

3.2
CSC-provided code
software code artefacts created by CSDs acting on the CSC's behalf, that are designed to execute within a cloud service to meet the needs of the CSC

Note 1 to entry: Such code artefacts can be supplemented by data or metadata.

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Note 2 to entry: The CSDs creating the code can be employees or contractors of the CSC, or of another organization such as a vendor, partner, or contractor to the CSC.

[SOURCE: ISO/IEC TS 7339:2024, 3.2]

3.3
metadata
data that defines and describes other data

Note 1 to entry: Metadata can include many different kinds of attributes of the data it describes. Some metadata fields are almost universal, such as date of creation and last change, type of file or object, permissions, and ownership. Other metadata can be specific to the type of object, such as the camera settings of a digital image, the author's name for a document, the version of a code artefact, etc.

Note 2 to entry: Some metadata can be directly attached to (or embedded within) the data to which it relates and will always move with it. Other metadata can be stored separately and associated with the data by reference or other means.

[SOURCE: ISO/IEC TS 7339:2024, 3.3]

3.4
CSC digital asset
class of data objects that includes CSC data and a subset of cloud service derived data essential for the effective use of the cloud service

Note 1 to entry: Examples of cloud service derived data that are part of CSC digital asset are configuration settings, security and access and control rights management. Such cloud service derived data is sometimes referred to as CSC *metadata* (3.3).

Note 2 to entry: Examples of cloud service derived data that are not part of CSC digital asset are those covered by the intellectual property rights of others, or that constitute a trade secret of another party, or that can compromise the security and integrity of the cloud service.

Note 3 to entry: CSPs and CSNs also have their own digital assets, (not defined in this document).

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Note 4 to entry: CSC digital assets are in digital form, limited to that for which the CSC has control and is independent from its contractual relationship with the CSP.

3.5
jurisdiction
<cloud computing> geographical or corporate area over which a cloud computing policy extends

Note 1 to entry: In a government policy context this will generally be the geographical area over which the body enacting the policy has legal authority either as government or as authorised regulator. However, in an enterprise or government agency environment, the jurisdiction of a policy can cover a business function, department, agency, or other organisational area of responsibility not tied to geography.

[SOURCE: ISO/IEC TR 22678:2019 3.2]

3.6
observed derived data
subset of cloud service derived data consisting of records of interactions that the CSC has had with a cloud service

Note 1 to entry: Examples of observed derived data are service configurations, access logs, call logs, change records and audit records.

3.7
inferred derived data
subset of cloud service derived data created by the CSP through analysis of the cloud service and its usage

Note 1 to entry: Inferred derived data is often a subjective and approximate estimate rather than an objectively calculated derivative.

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Note 2 to entry: Inferred derived data is often (though not exclusively) used to estimate CSC attributes, interests and potential behaviours.

Note 3 to entry: Examples of using inferred derived data include product recommendations.

3.8
idempotency
idempotence
operation feature which means there is no additional effect if the operation is called more than once

Note 1 to entry: Idempotent operations are often used to design a Web-based system since it is hard to restrict redundancy access.

[SOURCE: ISO/IEC TS 23029:2020, 3.2]

4 Abbreviated terms

ACL	Access Control List
AI	Artificial Intelligence
AMQP	Advanced Message Queuing Protocol
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
ASN.1	Abstract Syntax Notation 1
BPEL	Business Process Execution Language
BPML	Business Process Management Language
CD	Continuous Deployment
CI	Continuous Integration
CPU	Central Processing Unit
CRM	Customer Relationship Management
CSA	Cloud Service Agreement
CSC	Cloud Service Customer
CSD	Cloud Service Developer
CSN	Cloud Service Partner
CSP	Cloud Service Provider
CSU	Cloud Service User
CSV	Comma-separated Values
DSP	Data Space Protocol
EC	European Commission
ERP	Enterprise Resource Planning

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ESB	Enterprise Service Bus
EU	European Union
FIPS	Federal Information Processing Standard
GDPR	General Data Protection Regulation (EU)
GPU	Graphics Processing Unit
HCM	Human Capital Management
HTTP	Hyper Text Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IaaS	Infrastructure as a Service
IaC	Infrastructure as Code
IAM	Identity and Access Management
ICT	Information & Communication Technology
IDAM	Identity and Access Management
IDaaS	Identity as a Service
IoT	Internet of Things
IP	Internet Protocol
IT	Information Technology
JPEG	Joint Photographic Experts Group
JSON	JavaScript Object Notation
LCIM	Levels of Conceptual Interoperability Model
MIME	Multipurpose Internet Mail Extensions
MQTT	Message Queuing Telemetry Transport
OVF	Open Virtualization Format
OWL	Web Ontology Language
PaaS	Platform as a Service
PCI-DSS	Payment Card Industry – Data Security Standard
PII	Personally identifiable information
RDF	Resource Description Framework
REST	Representational State Transfer
SaaS	Software as a Service
SAML	Security Assertion Markup Language

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SDK	Software Development Kit
SLA	Service Level Agreement
SLO	Service Level Objective
SOAP	Simple Object Access Protocol
SPARQL	SPARQL Protocol and RDF Query Language
SQO	Service Qualitative Objective
SSO	Single Sign-On
TAR	Tape Archive
TCK	Technology Compatibility Kit
TCP	Transmission Control Protocol
TLS	Transport Layer Security
UML	Unified Modeling Language
VM	Virtual Machine
VPN	Virtual Private Network
XML	eXtensible Markup Language
YAML	Yet Another Mark-Up Language

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5 Overview of cloud computing interoperability and portability

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5.1 Description of cloud computing interoperability and portability

5.1.1 General

This clause provides an overview and models (known as “facet models”; refer to 5.2.1, 5.2.2 and 5.2.3 for details) for cloud interoperability, cloud data portability and cloud application portability. There are various perspectives of interoperability and portability that need to be considered. These perspectives are called “facets”.

Interoperability and portability in cloud computing involve interactions affected by technological, information and human aspects. Portability in this document includes both data portability and application portability. Interoperability and portability related challenges can increase in complexity as systems grow more interconnected. In cloud computing environments with internationally interconnected systems, the complexities also include matters of corporate policy, regulation and laws of applicable jurisdictions.

For information on cloud service switching, see Clause 10.

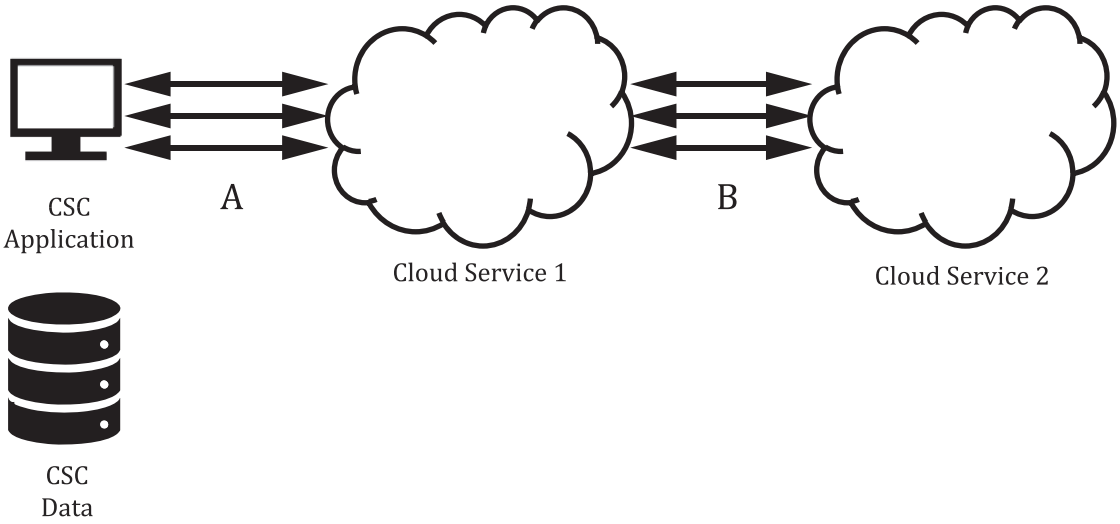
5.1.2 Considerations for cloud interoperability

ISO/IEC 22123-1 defines interoperability as “the ability for two or more systems or applications to exchange information and mutually use the information that has been exchanged”. In the context of cloud computing, interoperability is further described as a cross-cutting aspect providing the ability for a CSC’s on-premises system to interact with a cloud service and exchange information according to a prescribed method and obtain predictable results (see ISO/IEC 22123-2:2023, 7.5[8]). Interoperability also includes the ability for one cloud service to interact with other cloud services (see ISO/IEC 22123-3:2023, 8.3.4[9]). Figure 1 illustrates that cloud interoperability takes place both between a CSC's application and cloud services (A)

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and also between cloud services (B). There are typically multiple interactions involved in both of these cases, as indicated by the multiple arrows. The interactions can be for different services or for multiple instances of the same cloud service. In Figure 1 the arrows indicate that the information to be exchanged is bi-directional, with either end able to initiate the interaction



Key

A application to/from cloud service

B cloud service to/from cloud service

Figure 1 — High-level view of cloud interoperability

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NOTE 1 Figure 1 illustrates basic interaction styles only. Other configurations, such as using Cloud 1 as a relay or intermediary for indirect interactions between the CSC application and Cloud 2, are possible.

NOTE 2 Interoperability in cloud computing has multi-faceted requirements that demand consideration, such as clearly defined IT capabilities and interoperability requirements, realistic expectations, flexibility in approach, commitment of necessary resources, informed decision making, a long-term perspective and active participation to determine and implement effective solutions.

In its simplest form, cloud interoperability means the useful exchange of information between a system and a cloud service so that the systems work together to provide the targeted IT capability.

However, as described further in this document, the degree and usefulness of interoperability between the systems will be determined by many factors including what information needs to be sent to the other system, how that information is interpreted and used by the other system – and ultimately – whether the other system's actions reflect the needs and expectations of the CSC. These are more than simple syntax or even technology factors - since interoperability also requires validation that all facets, including behavioural and policy facets, are respectively interoperable.

Therefore, the CSC should understand the degree of interoperability between systems that is required to meet their needs – and the costs of all facets of achieving such interoperability. The degree of interoperability with existing and future systems is likely to be an important consideration when choosing cloud services. CSPs should align to appropriate standards for interoperability and provide the relevant information about their offered cloud services to assist in these choices.

There are many considerations when addressing cloud interoperability. These include:

— the ability of a CSC to interact with a cloud service by exchanging information according to a prescribed method obtaining predictable results;

— the ability for a cloud service to work with other cloud services, within the same CSP, or other CSPs, or on-premises systems (e.g. through the use of industry standards);

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— properties needed to facilitate successful interactions between an organization's ICT facilities and a cloud service;

— roles and activities as defined in ISO/IEC 22123-3[9];

— cloud capabilities types as defined in ISO/IEC 22123-1 and described in ISO/IEC 22123-2[8];

— interfaces between different functional components as defined in ISO/IEC 22123-3:2023, 9.2[9].

By taking these considerations into account, this document promotes better understanding of interoperable cloud services.

5.1.3 Considerations for cloud service portability

5.1.3.1 General

This document distinguishes between cloud application portability and cloud data portability. In the context of cloud computing, portability refers to the ability of a CSC to move and suitably adapt their applications and data between the CSC's on-premises systems and cloud services, between different cloud deployment models, and between cloud services of different CSPs.

When the CSC has moved the applications or data, they can be deleted from the source CSP's cloud system.

Portability is multifaceted. It involves a nuanced evaluation of potential costs and benefits associated with migration. While initial considerations such as switching costs are pertinent, it is important to approach these deliberations pragmatically. Assessing the alignment between CSC and CSP extends beyond mere cost reduction; it aims for operational optimization. Transitions can necessitate effort and can entail some level of risk. However, by adopting a strategic outlook and recognizing opportunities for growth, organizations can effectively navigate these transitions. Ultimately, informed decision-making that prioritizes long-term viability and success is key.

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There are many considerations when addressing portability in cloud computing. These include:

— allowing CSCs to migrate applications and data in response to business needs such as faster service, lower cost, greater reliability, more performance, better protection and security or disaster recovery needs;

— wider availability of application and data allowing access to a broader market;

— time and effort required for porting both applications and data, however, such overhead can be reduced using common programming languages, standards, tools, frameworks, models, run times and APIs;

— limiting of lock-in situations where the CSC is tied to the cloud services of one CSP.

Portability is an aspect of the more general topic of migration. Other issues related to migration are not considered further in this document.

5.1.3.2 Cloud data portability

Cloud data portability is the ability to transfer data from one cloud service to another cloud service or between a CSC's on-premises system and a cloud service. Data can include every kind of digital information and is not limited to text, numbers, and documents. Digital images, video and audio media files are all examples of data. Also, software code that is not intended to execute in the cloud service (e.g. software code designed for cell phones, cars or factory robots) can be treated as data for portability purposes. A CSC's on-premises system can be hosted by another organization (e.g. hosted physical machines, dedicated private cloud service). Figure 2 illustrates the porting of data between a CSC's on-premises system and a cloud service and porting of data from one cloud service to another. The arrows in both directions indicate the potential to port data to and from any of those places.

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