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Information technology — Cloud computing

Part 3: Reference architecture

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National foreword

This British Standard is the UK implementation of ISO/IEC 22123-3:2023. It supersedes BS ISO/IEC 17789:2014, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/38, Cloud Computing and Distributed Platforms.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Part 3: Reference architecture

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Contents

Page

Foreword ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**
3.1 Terms related to security and privacy ... 1
3.2 Terms relating to architecture ... 1

4 Symbols and abbreviated terms ... **2**

5 Conventions ... **2**

6 Cloud computing reference architecture goals and objectives ... **2**

7 CCRA viewpoints ... **3**
7.1 General ... 3
7.2 CCRA architectural views ... 3
7.3 User view of cloud computing ... 5
7.3.1 General ... 5
7.3.2 Cloud computing activities ... 6
7.3.3 Parties ... 6
7.3.4 Roles and sub-roles ... 6
7.3.5 Cloud services ... 7
7.3.6 Cloud deployment models ... 7
7.3.7 Cloud computing cross-cutting aspects ... 8
7.4 Functional view of cloud computing ... 8
7.4.1 General ... 8
7.4.2 Functional components ... 9
7.4.3 Functional layers ... 9
7.4.4 Multi-layer functions ... 9
7.5 Relationship between the user view and the functional view ... 10
7.6 Relationship of the user view and functional view to cross-cutting aspects ... 10
7.7 Implementation view of cloud computing ... 10
7.8 Deployment view of cloud computing ... 11

8 User view ... **11**
8.1 Cloud computing roles and sub-roles ... 11
8.1.1 General ... 11
8.1.2 Cloud service customer role ... 12
8.1.3 Cloud service provider role ... 14
8.1.4 Cloud service partner role ... 17
8.2 Cloud computing activities ... 19
8.2.1 General ... 19
8.2.2 Activities associated with the CSC role ... 19
8.2.3 Activities associated with the CSP role ... 22
8.2.4 Activities associated with the CSN role ... 28
8.3 Cross-cutting aspects ... 29
8.3.1 General ... 29
8.3.2 Auditability ... 30
8.3.3 Governance ... 30
8.3.4 Interoperability ... 30
8.3.5 Maintenance and versioning ... 30
8.3.6 Performance ... 31
8.3.7 Portability ... 31
8.3.8 Protection of Personally Identifiable Information ... 32
8.3.9 Reversibility ... 32
8.3.10 Security ... 32
8.3.11 Service levels and service level agreements ... 34

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Documents
Document Sharing Hub
Full document details: BS ISO/IEC 22123-3:2023

9 Functional view ... **35**
9.1 Functional architecture ... 35
9.1.1 General ... 35
9.1.2 Layering framework ... 35
9.2 Functional components ... 37
9.2.1 General ... 37
9.2.2 User layer functional components ... 38
9.2.3 Access layer functional components ... 38
9.2.4 Service layer functional components ... 39
9.2.5 Resource layer functional components ... 40
9.2.6 Multi-layer functions ... 41

10 Relationship between the user view and the functional view ... **47**
10.1 General ... 47
10.2 Overview ... 48
10.2.1 Service capabilities functional component ... 48
10.2.2 Common roles, activities and functional components ... 48
10.2.3 Multi-tenancy and isolation ... 49

Annex A (informative) **Further details regarding the user view and functional view** ... **50**

Bibliography ... **59**

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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 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 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*.

This first edition of ISO/IEC 22123-3 cancels and replaces ISO/IEC 17789:2014, which has been technically revised.

The main changes are as follows:

— added differentiation between cloud computing parties and role;

— Figures 13, 14, and 15 were removed.

A list of all parts in the ISO/IEC 22123 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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Information technology — Cloud computing —

Part 3:
Reference architecture

1 Scope

This document specifies the cloud computing reference architecture (CCRA).

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

ISO/IEC 22123-2, *Information technology — Cloud computing — Concepts*

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 Terms related to security and privacy

3.1.1
personally identifiable information
PII
any information that (a) can be used to establish a link between the information and the natural person to whom such information relates, or (b) is or can be directly or indirectly linked to a natural person

Note 1 to entry: The "natural person" in the definition is the PII principal. To determine whether a PII principal is identifiable, account should be taken of all the means which can reasonably be used by the privacy stakeholder holding the data, or by any other party, to establish the link between the set of PII and the natural person.

[SOURCE: ISO/IEC 29100:2011/Amd.1:2018, 2.9]

3.2 Terms relating to architecture

3.2.1
architecture
fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.2]

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4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO/IEC 22123-2 and the following apply.

CCRA cloud computing reference architecture

KPI key performance indicator

MSA master service agreement

OSS operational support systems

QoS quality of service

ToS terms of service

VLAN virtual local area network

5 Conventions

The following conventions apply:

1) Diagrams are used throughout this document to help illustrate the cloud computing reference architecture (CCRA). Figure 1 provides the conventions in the diagrams.

NOTE In Figure 1, "Aspect" is to be understood as referring to "Cross-cutting aspect".

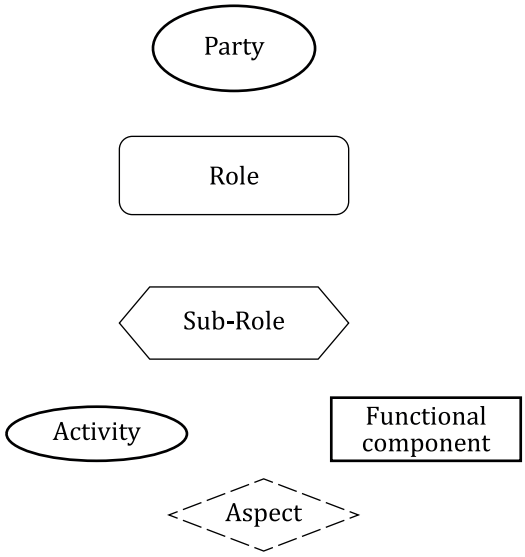

Figure 1 — Conventions for CCRA diagrams

2) This CCRA uses the term ICT (information and communication technology as defined in ISO/IEC/IEEE 24765:2017, 3.1853) and ICT systems. ICT is used to make it clear that the CCRA covers not only the compute and storage technologies associated with computer systems, but also the communications networks that link systems together.

6 Cloud computing reference architecture goals and objectives

Cloud computing is a paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand (see ISO/IEC 22123-1).

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The CCRA presented in this document provides an architectural framework that is effective for describing the cloud computing roles, sub-roles, cloud computing activities, cross-cutting aspects, as well as the functional architecture and functional components of cloud computing.

The CCRA serves the following goals:

— to describe the community of stakeholders for cloud computing;

— to describe the fundamental characteristics of cloud computing systems;

— to specify basic cloud computing activities and functional components, and describe their relationships to each other and to the environment;

— to identify principles guiding the design and evolution of the CCRA.

The CCRA supports the following important standardization objectives:

— to enable the production of a coherent set of international standards for cloud computing;

— to provide a technology-neutral reference point for defining standards for cloud computing;

— to encourage openness and transparency in the identification of cloud computing benefits and risks.

The CCRA focuses on the requirements of "what" cloud services provide and not on "how to" design cloud-based solutions and implementations. The CCRA does not represent the system architecture of a specific cloud computing system, although it can put constraints on a specific system. The CCRA does not define prescriptive solutions and is not tied to any specific vendor products, services or reference implementation.

The CCRA is also intended to:

— facilitate the understanding of the operational intricacies of cloud computing;

— illustrate and provide understanding of various cloud services and their provisioning and use;

— provide a technical reference to enable the international community to understand, discuss, categorize and compare cloud services;

— be a tool for describing, discussing, and developing a system-specific architecture using a common framework of reference;

— facilitate the analysis of candidate standards in areas including security, interoperability, portability, reversibility, reliability and service management, and support analysis of reference implementations.

7 CCRA viewpoints

7.1 General

This document defines a CCRA that can serve as a fundamental reference point for cloud computing standardization and which provides an overall framework for the basic concepts and principles of a cloud computing system.

This clause provides an overview of the architectural approaches that are used in this document. The cloud computing paradigm is composed of key characteristics, cloud computing roles and activities, cloud capabilities types and cloud service categories, cloud deployment models, and cloud computing cross cutting aspects.

7.2 CCRA architectural views

Cloud computing systems can be described using a viewpoint approach.

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Four distinct viewpoints are used in the CCRA (see Figure 2):

— user view;

— functional view;

— implementation view;

— deployment view.

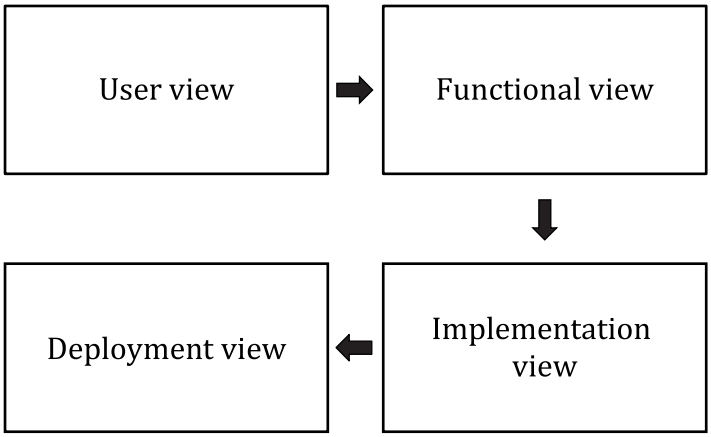

Figure 2 — Cloud computing architectural viewpoints

Table 1 provides a description of each of these views.

Table 1 — CCRA views

CCRA view	Description of the CCRA view	Scope
User view	The system context, the parties, the roles, the sub-roles and the cloud computing activities	Within scope
Functional view	The functions necessary for the support of cloud computing activities	Within scope
Implementation view	The functions necessary for the implementation of a cloud service within service parts and/or infrastructure parts	Out of scope
Deployment view	How the functions of a cloud service are technically implemented within already-existing infrastructure elements or within new elements to be introduced in this infrastructure	Out of scope
NOTE While details of the user view and functional view are addressed within this document, the implementation and deployment views are related to technology and vendor specific cloud computing implementations and actual deployments and are therefore out of scope of this document.		

Figure 3 shows the transition from the user view to the functional view. Details are presented in 7.5.

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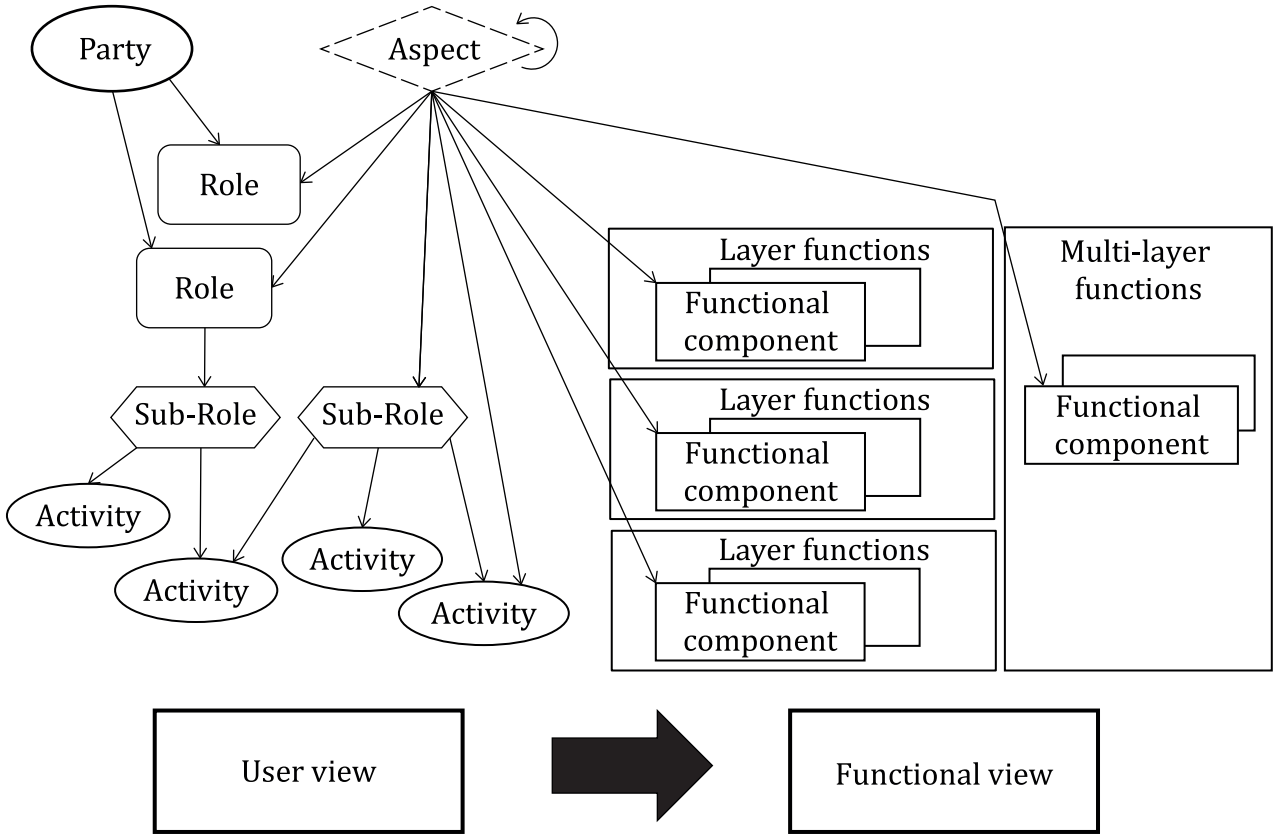

Figure 3 — Transition from user view to functional view

7.3 User view of cloud computing

7.3.1 General

The user view addresses the following cloud computing concepts:

— parties;

— roles and sub-roles;

— cloud computing activities;

— cloud services;

— cloud deployment models;

— cross-cutting aspects.

Figure 4 illustrates the relationships among parties, roles and sub-roles and their relationship to activities and cross-cutting aspects.

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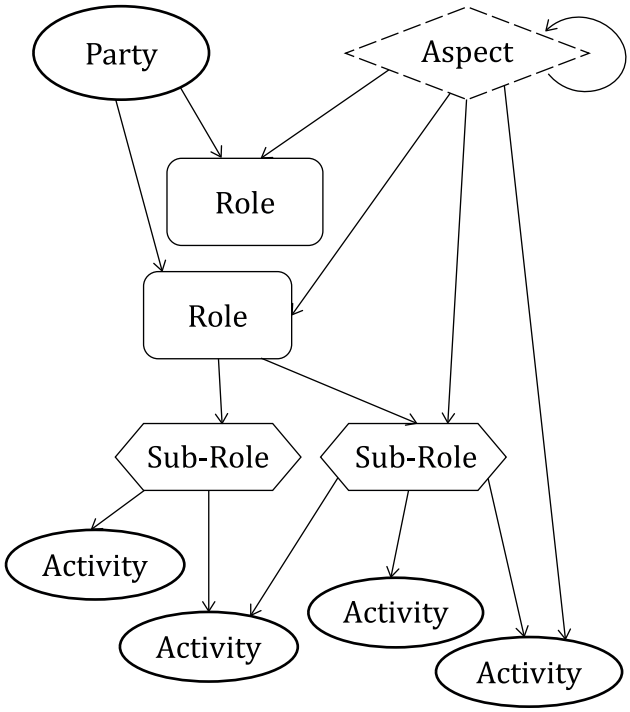

Figure 4 — User view entities

7.3.2 Cloud computing activities

ISO/IEC 22123-1 defines a cloud computing activity as a specified pursuit or set of tasks.

Cloud computing activities have a purpose and deliver one or more outcomes.

Activities in a cloud computing system are conducted using functional components (see 7.4.2).

Cloud computing activities are identified and described in more detail in 8.3.

7.3.3 Parties

ISO/IEC 22123-1 defines a party as a natural person or legal person, whether or not incorporated, or a group of either. Parties in a cloud computing system are its stakeholders. ISO/IEC 22123-2 identifies the following major parties of cloud computing:

— Cloud service customer (CSC)

— Cloud service partner (CSN)

— Cloud service provider (CSP)

ISO/IEC 22123-2 further describes that these parties are entities that play roles (and sub-roles). A party can play more than one role at any given point in time and can only engage in a specific subset of activities of that role.

7.3.4 Roles and sub-roles

ISO/IEC 22123-1 defines a role as a set of cloud computing activities that serves a common purpose.

ISO/IEC 22123-2 identifies the following as the major cloud computing roles:

— cloud service customer role (CSC role);

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— cloud service provider role (CSP role);

— cloud service partner role (CSN role).

A sub-role is a sub-set of the cloud computing activities for a given role.

Different sub-roles can share the cloud computing activities associated with a given role.

Descriptions of the cloud computing roles are provided in 8.1.

7.3.5 Cloud services

Cloud services are the essential elements of a cloud computing system. Cloud services are covered in ISO/IEC 22123-2.

Cloud services can be described in terms of the cloud capabilities types which they offer, based on the resources provided by the cloud service. The CCRA focuses on the following cloud capabilities types:

— application capabilities type;

— platform capabilities type;

— infrastructure capabilities type.

Cloud capabilities types are described in ISO/IEC 22123-2:2023, 5.3.

Cloud services are also grouped into categories, where each category is a group of cloud services that possess some common set of qualities. Representative cloud service categories include:

— infrastructure as a services (IaaS);

— platform as a service (PaaS);

— software as a service (SaaS);

— network as a service (NaaS).

The services in these categories can include capabilities from one or more of the cloud capabilities types above.

Other cloud service categories are described in ISO/IEC 22123-2:2023, 5.4 and Annex A.

7.3.6 Cloud deployment models

Cloud deployment models are defined in ISO/IEC 22123-1 and described in ISO/IEC 22123-2:2023, 5.5.

Cloud deployment models are a way in which cloud computing systems can be organized based on the control and sharing of physical or virtual resources.

The CCRA focuses on the following cloud deployment models:

— public cloud;

— private cloud;

— community cloud;

— hybrid cloud.

NOTE Additional cloud deployment models include multi-cloud and federated cloud. See ISO/IEC 5140 for additional details.

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7.3.7 Cloud computing cross-cutting aspects

Cross-cutting aspects are behaviours or capabilities which need to be coordinated across roles and implemented consistently in a cloud computing system.

Cross-cutting aspects can be shared and can impact multiple roles, cloud computing activities and functional components.

Cross-cutting aspects apply to multiple individual roles or functional components.

Cross-cutting aspects of cloud computing described in ISO/IEC 22123-2:2023, Clause 7 include:

— auditability;

— availability;

— governance;

— interoperability;

— maintenance and versioning;

— performance;

— portability;

— protection of personally identifiable information;

— regulatory;

— resiliency;

— reversibility;

— security;

— service levels and service level agreements.

7.4 Functional view of cloud computing

7.4.1 General

The functional view is a technology neutral view of the functions necessary to form a cloud computing system. The functional view describes the distribution of functions necessary for the support of cloud computing activities.

The functional architecture also defines the dependencies among the functional components.

The functional view addresses the following cloud computing items:

— functional layers;

— functions;

— functional components;

— multi-layer functional components.

For the purposes of this document, the term “functional component” is used to represent a set of one or more functions.

Figure 5 illustrates the concepts of functions, layers and functional components.

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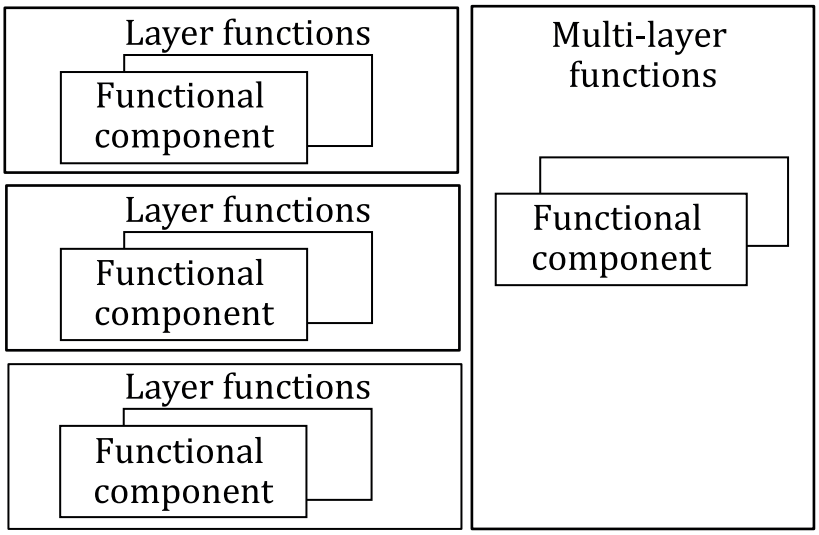

Figure 5 — Functional layering

The cloud computing functional architecture is described in subclause 9.1.

7.4.2 Functional components

ISO/IEC 22123-1 defines a functional component as a functional building block needed to engage in an activity, backed by an implementation.

The capabilities of a cloud computing system are fully defined by the set of implemented functional components.

Functional components are further described in subclause 9.2.

7.4.3 Functional layers

A layer is a set of functional components that provide similar capabilities or serve a common purpose.

The functional architecture is partially layered (i.e. has layers and a set of multi-layer functions).

There are four distinct layers defined in the CCRA:

— user layer, which includes functional components that support the cloud computing activities of CSCs and CSNs;

— access layer, which includes functional components that facilitate function distribution and interconnection;

— service layer, which includes functional components that provide the cloud services themselves plus related administration and business capabilities, and the orchestration capabilities necessary to realize them;

— resource layer, which includes the functional components that represent the resources needed to implement the cloud computing system.

Not all layers or functional components are necessarily instantiated in a specific cloud computing system.

7.4.4 Multi-layer functions

The multi-layer functions include functional components that provide capabilities that are used across multiple functional layers

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Multi-layer functional components can be classified on the basis of their purpose:

— development support;

— integration;

— security systems;

— operational support systems;

— business support systems.

Functional components of the multi-layer functions are described in clause 9.2.6.

7.5 Relationship between the user view and the functional view

Figure 6 illustrates how the user view provides the set of cloud computing activities that are represented within the functional view (and realized using the technologies of the implementation view).

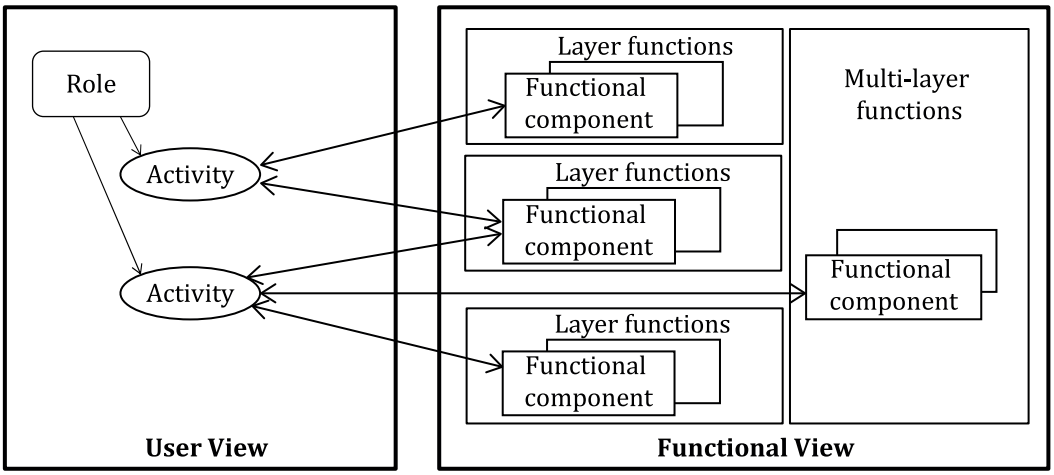

Figure 6 — From user view to functional view

Further details on the relationship between the user view and functional view can be found in clause 10.

7.6 Relationship of the user view and functional view to cross-cutting aspects

Cross-cutting aspects, as their name implies, apply across both the user view and across the functional view of cloud computing.

Cross-cutting aspects apply to roles and sub-roles in the user view and directly or indirectly affect the activities which those roles perform.

Cross-cutting aspects also apply to the functional components within the functional view, which are used when performing the activities described in the user view.

Clause 8.2 provides additional information on cross-cutting aspects.

7.7 Implementation view of cloud computing

While details of the user view and functional view are addressed within this document, the implementation view is out of the scope of this document.

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7.8 Deployment view of cloud computing

While details of the user view and functional view are addressed within this document, the deployment view is out of the scope of this document.

8 User view

8.1 Cloud computing roles and sub-roles

8.1.1 General

It is often necessary to differentiate requirements and issues for the following major cloud computing parties: CSC, CSP, and CSN.

When playing a role, the party can restrict itself to playing one or more sub-roles. Sub-roles are a subset of the cloud computing activities of a given role.

In addition to the CSC role, CSP role, and CSN role (see 7.3.4), ISO/IEC 22123-2 identifies a set of sub-roles for each and uses a naming convention in which the name of a sub-role has the prefix of "CSC:" for CSC sub-roles, "CSN:" for CSN sub-roles, or "CSP:" for CSP sub-roles and then the sub-role name. Table 2 shows the prefix for each of the three cloud computing roles.

Table 2 — Cloud computing sub-roles

Role	Sub-role prefix	Example
CSC role	"CSC:"	CSC:cloud service administrator
CSP role	"CSP:"	CSP:network provider
CSN role	"CSN:"	CSN:cloud auditor

Roles and sub-roles are sets of activities (see 8.2).

Figure 7 shows the roles of cloud computing, with their associated sub-roles.

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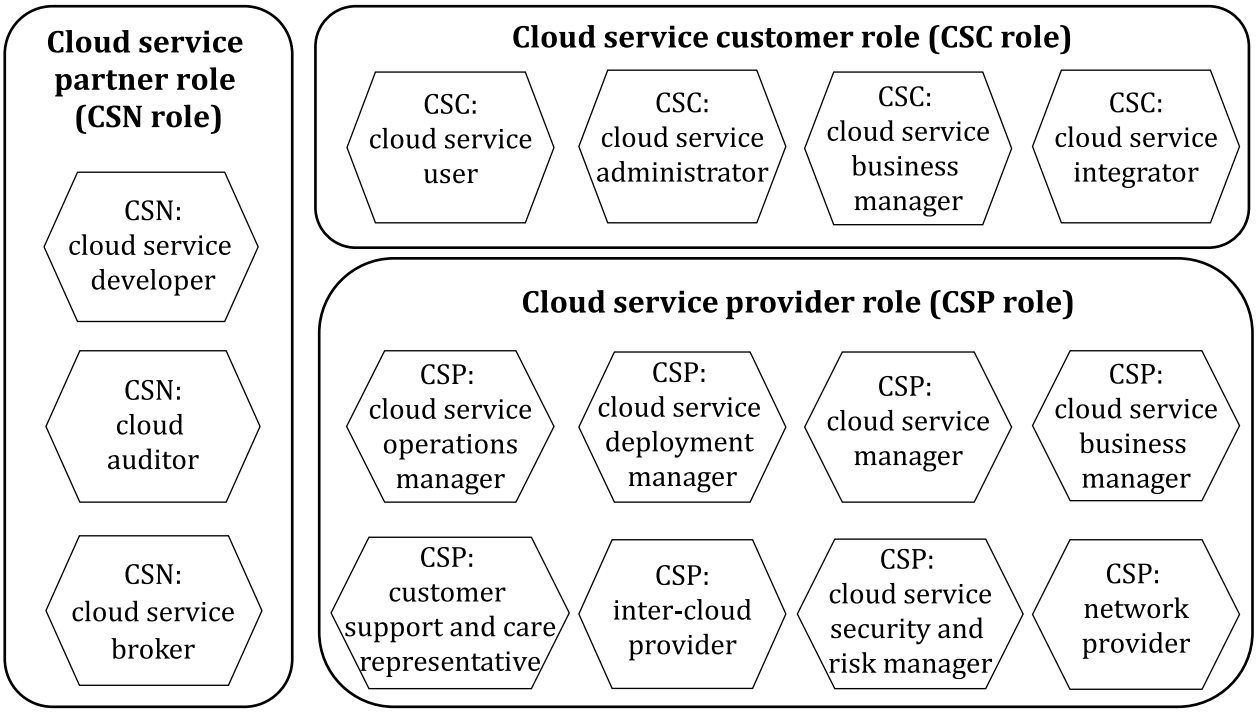

Figure 7 — Roles and sub-roles

Additional information is provided on the CSC role in 8.1.2, the CSP role in 8.1.3, and the CSN role in 8.1.4.

8.1.2 Cloud service customer role

8.1.2.1 General

ISO/IEC 22123-1 defines a CSC as a party that is acting in the cloud service customer role (CSC role). The CSC is in a business relationship with a CSP or a CSN for the purpose of using cloud services. The CSC role can include ensuring the smooth operation of the cloud services, acquisition and use of cloud services, and integration of cloud services with a CSC's existing ICT systems.

Figure 8 shows the common sub-roles for the CSC role as well as the associated activities; the activities listed are not exhaustive.

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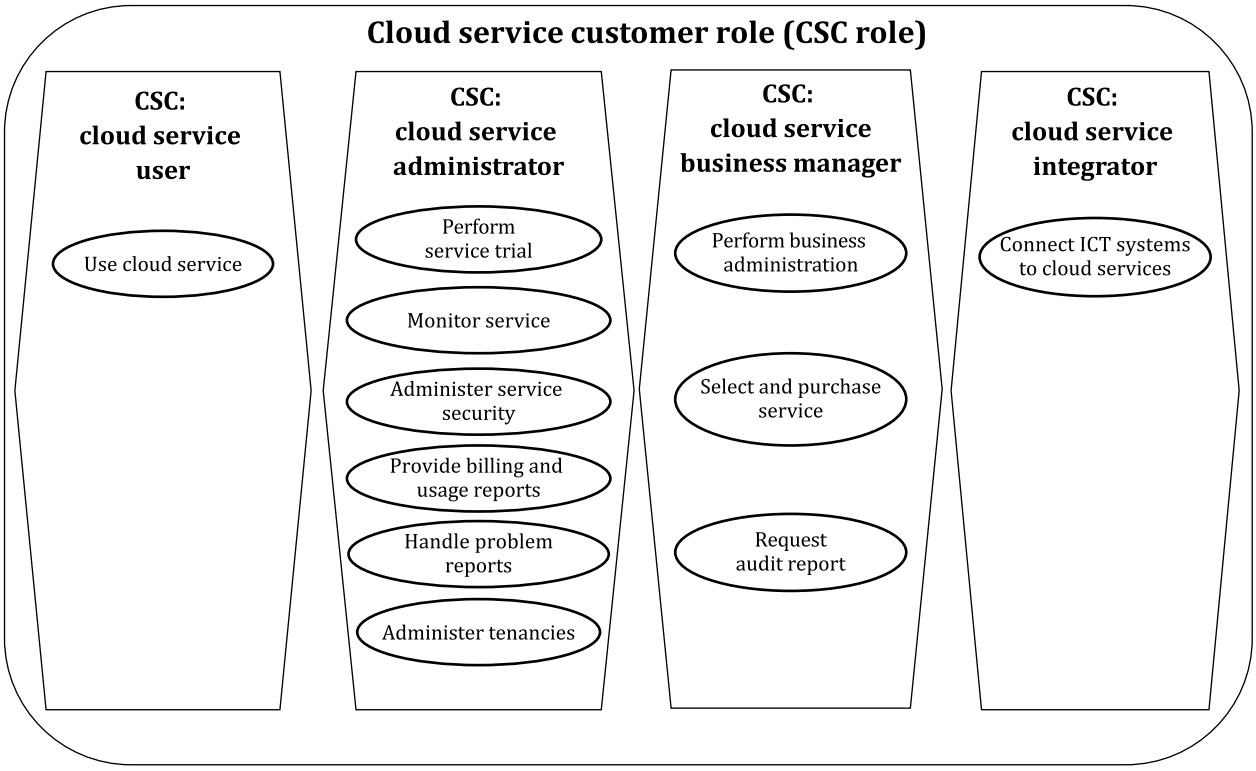

Figure 8 — Sub-roles and activities for the CSC role

8.1.2.2 CSC:cloud service user

The CSC:cloud service user is a sub-role of the CSC role which is associated with a CSC that uses cloud services.

The CSC:cloud service user's cloud computing activities include: use cloud service (8.2.2.1).

8.1.2.3 CSC:cloud service administrator

The CSC:cloud service administrator is a sub-role of the CSC role which has a main goal of ensuring the effective use of cloud services and that those cloud services are running well with the customer's existing ICT systems and applications. The CSC:cloud service administrator oversees all the operational processes relating to the use of cloud services and acts as the focal point for technical communications between the CSC and one or more CSPs.

The CSC:cloud service administrator's cloud computing activities include:

— perform service trial (8.2.2.2);

— monitor service (8.2.2.3);

— administer service security (8.2.2.4);

— handle problem reports (8.2.2.5);

— provide billing and usage reports (8.2.2.6);

— administer tenancies (8.2.2.7).

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