INTERNATIONAL STANDARD

ISO/IEC 20547-3

First edition
2020-03

Information technology — Big data reference architecture —

Part 3: Reference architecture

Technologies de l'information — Architecture de référence des mégadonnées —

Partie 3: Architecture de référence

Reference number
ISO/IEC 20547-3:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established 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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 42, *Artificial intelligence*.

A list of all parts in the ISO/IEC 20547 series can be found on the ISO website.

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

The ISO/IEC 20547 series is intended to provide users with a standardized approach to developing and implementing big data architectures and provide references for approaches. ISO/IEC TR 20547-1 provides users with an overview of the reference architecture framework described in this document and a process for applying that framework in developing an architecture. ISO/IEC TR 20547-2 provides a collection of big data use cases and decomposes those use cases into technical considerations that big data architects and system implementers can consider. This document describes the reference architecture in terms of User and Functional views. Those views can be used by the big data architect to describe their specific system. ISO/IEC 20547-4 describes the security and privacy aspects unique to big data. ISO/IEC TR 20547-5 provides a list of standards and their relationship to the reference architecture that architects and implementers can consider as part of the design and implementation of their system.

Each of these parts is built on the common vocabulary and concepts described in ISO/IEC 20546.

In general terms, reference architecture provides an authoritative source of information about a specific subject area that guides and constrains the instantiations of multiple architectures and solutions (see 3.2). Reference architectures generally serve as a reference foundation for solution architectures and can also be used for comparison and alignment purposes.

The key goal of this reference architecture is to facilitate a shared understanding across multiple products, organizations, and disciplines about current architectures and future direction.

The reference architecture presented in this document provides an architecture framework for describing the big data components, processes, and systems to establish a common language for the various stakeholders named as big data reference architecture (BDRA). It does not represent the system architecture of a specific big data system. Instead, it is a tool for describing, discussing, and developing system-specific architectures using an architecture framework of reference. It provides generic high-level architectural views that are an effective tool for discussing the requirements, structures, and operations inherent to big data. The model is not tied to any specific vendor products, services or reference implementation, nor does it define prescriptive solutions that inhibit innovation.

Information technology — Big data reference architecture —

Part 3: Reference architecture

1 Scope

This document specifies the big data reference architecture (BDRA). The reference architecture includes concepts and architectural views.

The reference architecture specified in this document defines two architectural viewpoints:

— a user view defining roles/sub-roles, their relationships, and types of activities within a big data ecosystem;

— a functional view defining the architectural layers and the classes of functional components within those layers that implement the activities of the roles/sub-roles within the user view.

The BDRA is intended to:

— provide a common language for the various stakeholders;

— encourage adherence to common standards, specifications, and patterns;

— provide consistency of implementation of technology to solve similar problem sets;

— facilitate the understanding of the operational intricacies in big data;

— illustrate and understand the various big data components, processes, and systems, in the context of an overall big data conceptual model;

— provide a technical reference for government departments, agencies and other consumers to understand, discuss, categorize and compare big data solutions; and

— facilitate the analysis of candidate standards for interoperability, portability, reusability, and extendibility.

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 8000-2, *Data quality — Part 2: Vocabulary*

ISO/TS 8000-60, *Data quality — Part 60: Data quality management: Overview*

ISO 8000-61, *Data quality — Part 61: Data quality management: Process reference model*

ISO/IEC 38500, *Information technology — Governance of IT for the organization*

ISO/IEC 38505-1, *Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data*

ISO/IEC TR 38505-2, *Information technology — Governance of IT — Governance of data — Part 2: Implications of ISO/IEC 38505-1 for data management*

ISO 55000, *Asset management — Overview, principles and terminology*

ISO 55001, *Asset management — Management systems — Requirements*

ISO 55002, *Asset management — Management systems — Guidelines for the application of ISO 55001*

ISO/IEC/IEEE 42010, *Systems and software engineering — Architecture description*

ISO/IEC 20546, *Information technology — Big data — Overview and vocabulary*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8000-2, ISO/TS 8000-60, ISO 8000-61, ISO/IEC 38500, ISO/IEC 38505-1, ISO/IEC TR 38505-2, ISO 55000, ISO 55001, ISO 55002, ISO/IEC/IEEE 42010, ISO/IEC 20546, ISO/IEC 17789 and the following 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/

3.1
data
reinterpretable representation of *information* (3.3) in a formalized manner suitable for communication, interpretation, or processing

[SOURCE: ISO/IEC 2382:2015, 2121272]

3.2
reference architecture
authoritative source of information about a specific subject area that guides and constrains the instantiations of multiple architectures and solutions

Note 1 to entry: This document utilizes the definition of reference architecture from DoD "reference architecture description"[7].

Note 2 to entry: Reference architectures generally serve as a foundation for solution architectures and can also be used for comparison and alignment of instantiations of architectures and solutions.

3.3
information
data (3.1) that are processed, organized and correlated to produce meaning

Note 1 to entry: Information concerns facts, concepts, objects, events, ideas, processes, etc.

3.4
activity
specified pursuit or set of tasks

[SOURCE: ISO/IEC 17789:2014, 3.2.1]

3.5
knowledge
maintained, processed, and interpreted *information* (3.3)

[SOURCE: ISO 5127:2017, 3.1.1.17]

3.6
functional component
functional building block needed to engage in an *activity* (3.4), backed by an implementation

[SOURCE: ISO/IEC 17789:2014, 3.2.3]

3.7
data governance
property or ability that needs to be coordinated and implemented by a set of *activities* (3.4) aimed to design, implement and monitoring a *strategic plan for data asset management*

Note 1 to entry: Governance of data is described in ISO/IEC 38505-1.

Note 2 to entry: Data asset is understood as a set of data items, or data entities, that have a real or potential benefit for an organization. Data asset is a subset of asset defined in ISO 55000. A benefit is an advantage to the organization of the actionable knowledge derived from an analytic system. It is often ascribed to big data due to the understanding that data has potential benefit that was typically not considered previously.

Note 3 to entry: A strategic plan for data asset management is a document specifying how *data management* (3.15) is to be aligned to the organizational strategy. This term has the same meaning as strategic asset management plan (SAMP) defined in ISO 55000 with data point of view.

3.8
data quality
degree to which the characteristics of data satisfy stated and implied needs when used under specified conditions

[SOURCE: ISO/IEC 25024:2015, 4.11]

3.9
data quality management
coordinated activities to direct and control an organization with regard to data quality

[SOURCE: ISO 8000-2:2018, 3.4.9]

3.10
party
natural person or legal person, whether or not incorporated, or a group of either

[SOURCE: ISO/IEC 17789:2014, 7.2.3]

3.11
policy
intention and direction of an organization as formally expressed by its top management

[SOURCE: ISO 55000:2014, 3.1.18, modified — The term has been changed to the singular form and the final stop has been removed from the definition.]

3.12
role
set of *activities* (3.4) that serves a common purpose

[SOURCE: ISO/IEC 17789:2014, 3.2.7]

3.13
stream
list of flow objects attached to a port of a flow object

[SOURCE: ISO/IEC 10179:1996, 4.33, modified — by deleting leading article and trailing full stop.]

3.14
sub-role
subset of the *activities* (3.4) of a given *role* (3.12)

[SOURCE: ISO/IEC 17789:2014, 3.2.9]

3.15
data management
set of *activities* (3.4) aimed to implement the big data architecture that best meet business goals by following the strategic plan for data management assessment

3.16
data lifecycle
stages in the management of a data

Note 1 to entry: The target of lifecycle (defined in ISO 55000) is data in this document.

3.17
application programming interface
API
boundary across which application software uses facilities of programming languages to invoke services

[SOURCE: ISO/IEC 18012-2:2012, 3.1.4, modified — Note 1 to entry has been removed and the final stop has been deleted from the definition.]

4 Abbreviated terms

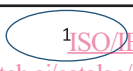
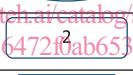
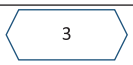
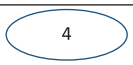
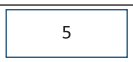
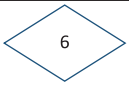
ACID	atomicity, consistency, isolation, and durability
API	application programming interface
CEP	complex event processing
CPU	central processing unit
BDA	big data auditor
BDAP	big data application provider
BDAcP	big data access provider
BDAnP	big data analytics provider
BDC	big data consumer
BDCP	big data collection provider
BDFP	big data framework provider
BDIP	big data infrastructure provider
BDP	big data provider
BDPlaP	big data platform provider
BDPreP	big data preparation provider
BDProP	big data processing provider

BDRA	big data reference architecture
BDSD	big data service developer
BDSO	big data system orchestrator
BDSP	big data service partner
BDVP	big data visualization provider
DG	data governance
DM	data manager
DQM	data quality manager
PII	personally identifiable information
RA	reference architecture

5 Conventions

The diagrams that appear in this document are presented using the conventions that are shown in Table 1. This notation is used as described in ISO/IEC 17789.

Table 1 — Legend to the diagrams used throughout this document

Object	Meaning
	Party
	Role
	Sub-Role
	Activity
	Functional component
	Cross-cutting aspect

6 Big data reference architecture concepts

6.1 General

This document defines a BDRA that serves as a fundamental reference point for big data standardization and which provides an overall architecture framework for the basic concepts and principles of a big data system.

This document describes the logical relationships between the roles/sub-roles, activities, and functional components, and cross-cutting aspects that comprise a big data system architecture.

Standards can be relevant to some of these relationships. Standards associated with a relationship can be used to:

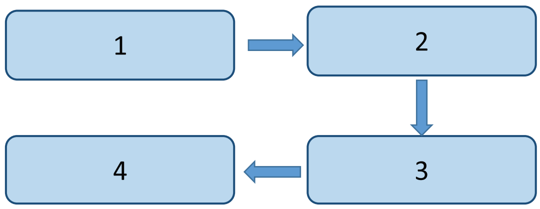
— specify degrees of information flow or other types of interoperability; and/or

— ensure specified degrees of quality (e.g. security or service level).

Logical relationships defined in this architecture are a significant part of specifying the BDRA and its behaviour. The relationship describes matters such as the categories of information flows between the functional components in the BDRA.

6.2 Views

Big data can be described using a viewpoint approach. Four distinct viewpoints are used in the BDRA (see Figure 1 and Table 2):



Key

1 user view

2 functional view

3 implementation view

4 deployment view

Figure 1 — Transformations between architectural views

Table 2 — BDRA views

BDRA view	Description of the BDRA view	Scope
User view	The ecosystem of big data with the stakeholders (used in ISO/IEC/IEEE 42010), the roles, the sub-roles and the big data activities	Within scope
Functional view	The functions necessary for the support of big data activities	Within scope
Implementation view	The functions necessary for the implementation of big data within service parts and/or infrastructure parts	Out of scope
Deployment view	How the functions of big data 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 big data implementations and actual deployments, and are therefore out of the scope of this document.

6.3 Overview of user view

The user view addresses the ecosystem of big data with the following concepts:

— **parties**: a party is a natural person or legal person, whether or not incorporated, or a group of either or both parties in a big data ecosystem are its stakeholders;

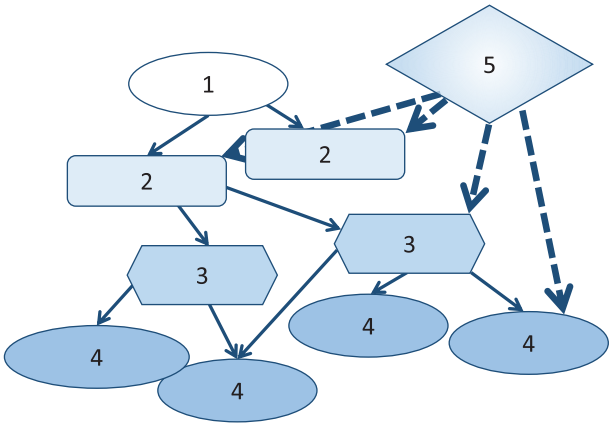
— **roles and sub-roles**: a role is a set of big data activities that serves a common purpose. a sub-role is a subset of the big data activities for a given role, and different sub-roles can share the big data activities associated with a given role;

— **activities**: an activity is defined as a specified pursuit or set of tasks. big data activities need to have a purpose and deliver one or more outcomes and these are conducted using functional components;

— **cross-cutting aspects**: cross-cutting aspects can be shared and can impact multiple roles, and big data activities. Cross-cutting aspects may map to multi-layer functions and their associated functional components which implement the activities within the cross-cutting aspect.

NOTE A party can assume more than one role at any given point in time and can engage in a specific subset of activities of that role. Examples of parties include, but are not limited to, large corporations, small- and medium-sized enterprises, government departments, academic institutions and private citizens.

Figure 2 illustrates the entities that are defined for the user view.



Key

1 party
2 role
3 sub-role
4 activity
5 cross-cutting aspect

Figure 2 — User view entities

6.4 Overview of functional view

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

The functional architecture also defines the dependencies between functions.

The functional view addresses the following big data concepts:

— **functional components**: a functional component is a functional building block needed to engage in an activity, backed by an implementation;

— **functional layers:** a layer is a set of functional components that provide similar capabilities or serve a common purpose;

— **multi-layer functions**: the multi-layer functions include functional components that provide capabilities that are used across multiple functional layers, and they are grouped into subsets.

NOTE Not all layers or functional components are necessarily instantiated in a specific big data system.

Figure 3 illustrates the concepts of functional components, layers and multi-layer functions.