ISO/IEC 30141

Edition 2.0 2024-08

INTERNATIONAL STANDARD

colour inside

Internet of things (IoT) – Reference architecture



ISO/IEC 30141:2024-08(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 35.020

ISBN 978-2-8322-9193-1

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INTERNET OF THINGS (IoT) – REFERENCE ARCHITECTURE

FOREWORD

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ISO/IEC 30141 has been prepared by subcommittee 41: Internet of Things and Digital Twin, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) conformance with ISO/IEC/IEEE 42010:2022;
b) improved usability;
c) implementation pattern support.

The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1-SC41/417/FDIS	JTC1-SC41/431/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, and the ISO/IEC Directives, JTC 1 Supplement available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

0.1 General

This document is the second edition of the Internet of Things reference architecture (IoT RA). This document is in conformance with ISO/IEC/IEEE 42010:2022 requirements on architecture descriptions that are described in Annex B except for aspects, perspectives, decisions and rationale.

The IoT RA addresses systems that:

- use technology for sensing and operating on physical world entities;
- have components that interact through a digital network.

The IoT RA deals with related issues, like trustworthiness functions regarding both the physical and digital worlds.

This document can be used as a generic normative part of IoT domain-specific reference architectures (DSRAs). IoT DSRAs are in conformance with ISO/IEC/IEEE 42010:2022 requirements on architecture descriptions and enable consistency and alignment with other reference architectures within ISO/IEC JTC 1.

0.2 About Internet of Things (IoT)

IoT has broad implications in industry and society today and is likely to continue to have an impact on many aspects of our lives for many years to come. Various IoT applications and services have adopted IoT techniques to provide capabilities that were not possible earlier. IoT is one of the most dynamic areas of information and communication technologies.

Fundamental to IoT are devices that interact with the physical world. Sensors collect the information about the physical world, while actuators can act upon the physical world. These field devices are connected to the digital world through network connections. Both sensors and actuators can be in many forms such as thermometers, accelerometers, video cameras, microphones, relays, heaters or industrial equipment for manufacturing or process control.

IoT is the base for new business models or offerings and new working methods in industry and in the public sector. IoT is an essential enabler for other computing areas such as digital twins, artificial intelligence, cloud computing, big data, data analysis and more. Many application areas called "smart xxx" such as smart grid, smart cities, and even smart cars use IoT as an important technology capability.

IoT can be combined with other technologies to address complex requirements. For example, IoT can leverage cloud computing, including private cloud, public cloud, hybrid cloud, and multi-cloud, for resource provisioning and management. IoT can benefit from machine learning and big data for the analysis of sensor data to enable rapid decisions for improved control and efficiency. IoT with distributed ledger technology can ensure traceability in applications. IoT can take advantage of edge computing to distribute computing resources near the convergence of information technology and operational technology, where they are needed most. The IoT area continues to grow rapidly, and new IoT application areas continue to be found and invented. This document can serve these new technology and application areas.

0.3 IoT sources of information

For a given application field and purpose, the many IoT standards, guidelines, and initiatives in existence today work well on their own and are used by various IoT stakeholders. As a result, heterogeneity is a prominent aspect of IoT. However, support for the combination and interaction of these heterogeneous resources to enable interoperability and convergence between IoT standards and guidelines is necessary.

Stakeholder decisions about both a foundation for long-term investments and durable protection of current cornerstones is more difficult because of uncertainty about resource compatibility.

This document serves as a foundation for creating interoperability and alignment between IoT initiatives. The aim of this document is to bring different views together.

0.4 General principles of a reference architecture

This document is positioned as a reference architecture for IoT systems. It utilizes the terms, definitions, and relationships for best practices in architecture descriptions as outlined in ISO/IEC/IEEE 42010:2022 to:

- establish vocabulary, principles, guidance; and
- provide a description of IoT principles, capabilities, and interactions with the physical and digital worlds.

One of the primary purposes of the IoT RA is to support architects that want to design architectures or reference architectures for IoT systems. Normative parts of the IoT RA can then be included in an architecture closer to the realization of IoT systems.

Figure 1 shows how this document has been specified and how it will be used.

– This document conforms to ISO/IEC/IEEE 42010:2022 requirements for architecture descriptions [1][1] and uses guidelines from the "Best practices and guidelines for RA standards" standing document [2].

– Users of this document apply it to specify an IoT architecture that guides the implementation of an IoT system.

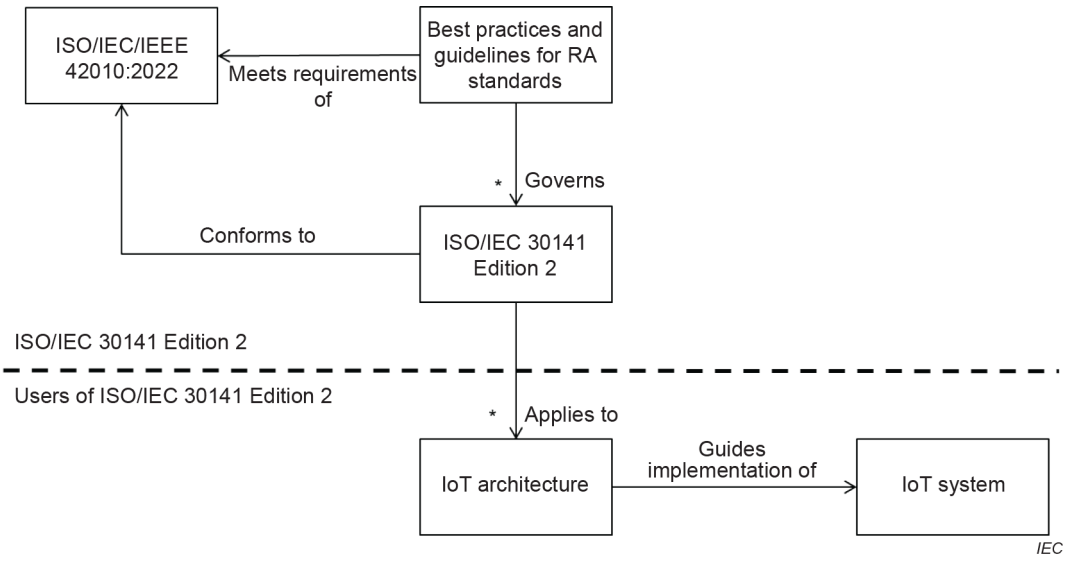


Figure 1 – Using the IoT RA standard

[1] Numbers in square brackets refer to the Bibliography.

INTERNET OF THINGS (IoT) – REFERENCE ARCHITECTURE

1 Scope

This document specifies an Internet of Things (IoT) reference architecture (IoT RA). The IoT RA is a generalization of existing practice including the distinguishing characteristics of IoT systems and other fundamental characteristics exhibited by IoT systems. The IoT RA addresses stakeholder concerns related to the business value of IoT systems. The IoT RA also addresses the interactions between the IoT system, the users, and the physical environment. Implementation of IoT systems is also addressed in this document. Among the characteristics specified in the IoT RA are abstract functions within IoT systems and a variety of structures that are used to construct IoT systems.

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 20924, *Internet of Things (IoT) and digital twin – Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 20924 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

4 Abbreviated terms

AI	artificial intelligence
API	application programming interface
ASD	application and service domain
BSS	business support systems
CM	conceptual model
CPS	cyber physical system
CPO	chief privacy officer
DPO	data protection officer
DSC	dynamic service composition
DSRA	domain specific reference architecture
ETL	extract, transform, load
HMI	human machine interface
HTTP	Hypertext Transfer Protocol
ICT	information and communication technologies