# ISO/IEC 30181

Edition 1.0 2024-11

# INTERNATIONAL STANDARD

colour inside

## Internet of Things (IoT) – Functional architecture for resource identifier interoperability



ISO/IEC 30181:2024-11(en)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

**About the IEC**
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

**About IEC publications**
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

**IEC publications search - webstore.iec.ch/advsearchform**
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - webstore.iec.ch/justpublished**
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

**IEC Customer Service Centre - webstore.iec.ch/csc**
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

**IEC Products & Services Portal - products.iec.ch**
Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

**Electropedia - www.electropedia.org**
The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

# ISO/IEC 30181

Edition 1.0 2024-11

# INTERNATIONAL STANDARD

colour inside

## Internet of Things (IoT) – Functional architecture for resource identifier interoperability



INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 35.020

ISBN 978-2-8327-0065-5

# CONTENTS

# INTERNET OF THINGS (IoT) – FUNCTIONAL ARCHITECTURE FOR RESOURCE IDENTIFIER INTEROPERABILITY

## FOREWORD

1) 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.
2) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO National bodies.
3) IEC and ISO documents have the form of recommendations for international use and are accepted by IEC and ISO National bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC and ISO documents is accurate, IEC and ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC and ISO National bodies undertake to apply IEC and ISO documents transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC and ISO document and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC and ISO do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC and ISO marks of conformity. IEC and ISO are not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this document.
7) No liability shall attach to IEC and ISO or their directors, employees, servants or agents including individual experts and members of its technical committees and IEC and ISO National bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this ISO/IEC document or any other IEC and ISO documents.
8) Attention is drawn to the Normative references cited in this document. Use of the referenced publications is indispensable for the correct application of this document.
9) IEC and ISO draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC and ISO take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC and ISO had received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch and www.iso.org/patents. IEC and ISO shall not be held responsible for identifying any or all such patent rights.



ISO/IEC 30181 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.

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

| Draft | Report on voting |
|---|---|
| JTC1-SC41/458/FDIS | JTC1-SC41/471/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

Internet of Things (IoT) is defined as an infrastructure of interconnected entities, people, systems and information resources together with services which processes and reacts to information from the physical world and virtual world. IoT has attracted significant social attention globally and is expanding in various fields such as smart homes, healthcare, smart cities, logistics, smart cars, etc. In particular, IoT platforms are essential because they connect various devices (e.g. sensors, access points, and data networks) and provide services to the user. Heterogeneous IoT platforms refer to IoT platforms developed based on different standards such as various data models, policies, vendors, interfaces, and specifications. Therefore, interoperability, such as requesting services and sharing resources among heterogeneous IoT platforms, is important, and it is essential for a real IoT system.

IoT platform has many challenges to interoperability, such as support for diverse protocols, discovery service, well-defined semantic management, and processing of data formats in heterogeneous IoT platforms. However, current diverse IoT platforms and related standards make it difficult to achieve interoperability and collaboration between heterogeneous IoT platforms. Especially regarding resource interoperability issues, each IoT platform has been developed using a specific and unique resource identifier, including a different type of resource-request format, so it is difficult to identify resources among heterogeneous IoT platforms. Furthermore, the existing approaches mainly focus on integrating and managing each IoT platform's ontology and a method of duplicating resources for the target IoT platforms. It makes it a burden for the developer to construct specific ontologies for the diverse IoT platforms.

This document provides a functional architecture for resource identifier (ID) interoperability, which converts the format of a resource identifier among heterogeneous IoT platforms. This document concentrates on converting resource paths (e.g. uniform resource identifier (URI)) used in a specific IoT platform to the target IoT platform. In addition, this document provides an IoT resource name system (RNS) architecture based on the comparative analysis of heterogeneous IoT platforms and a smart city scenario, including resource registration, resource deletion, sharing mapping tables, and resource path conversion. To ensure the user can use heterogeneous IoT resources, IoT RNS analyses and converts identifier into desired resource-request formats, including reconfiguring resource requests between heterogeneous IoT platforms as appropriate for the user-requested resources.



This document has the ISO/IEC 30141 [1][1] IoT reference architecture as a reference to consider interoperability among heterogeneous components and systems. In addition, this document has IEC 61406-2 [2] as a reference to specify minimum requirements for a globally unique identification of resources which constitutes a link to its related digital information. Furthermore, the IoT RNS in this document can be modularized in middleware as edge computing in the IoT system. Therefore, this document has as a reference ISO/IEC TR 30164 [3], which describes the general concepts, terms, characteristics, use cases, and techniques (e.g. data management, coordination, processing, network functionality, heterogeneous computing, security, hardware and software optimization) of edge computing for IoT system applications.

---

1 Numbers in square brackets refer to the Bibliography.

# INTERNET OF THINGS (IoT) – FUNCTIONAL ARCHITECTURE FOR RESOURCE IDENTIFIER INTEROPERABILITY

## 1 Scope

This document specifies functional requirements and architecture about the following items for resource interoperability among heterogeneous IoT platforms through the conversion of resource identifiers (IDs) and paths (e.g. uniform resource identifier (URI)):

– requirements for interoperability of resource IDs in the heterogeneous IoT platforms;
– functional architecture for converting IDs and paths of resources on heterogeneous IoT platforms; and,
– functional architecture for mapping and managing resource IDs among heterogeneous IoT platforms.

## 2 Normative references

There are no normative references in this document.



## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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



- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

**3.1**
**identifier**
information that unambiguously distinguishes one entity from other entities in a given identity context

Note 1 to entry: It refers to a name used to identify and distinguish an object.

Note 2 to entry: In the IoT system, it is used to identify resources such as devices and services and related policies can be different for each platform.

[SOURCE: ISO/IEC 20924:2024, 3.1.19 [4], modified – The Notes to entry have been added.]

**3.2**
**identity context**
environment where an entity can be sufficiently identified by a certain set of its attributes and values

[SOURCE: ISO/IEC 20924:2024, 3.1.20]

**3.3**
**Internet of Things**
**IoT**
infrastructure of interconnected entities, people, systems and information resources together with services which processes and reacts to information from the physical world and virtual world

Note 1 to entry: In this document, IoT is described as a hyper-connection among smart things, services, and humans that provides useful and seamless services with minimum human involvement.

[SOURCE: ISO/IEC 20924:2024, 3.2.8 modified – Note 1 to entry has been added.]

**3.4**
**IoT platform**
software that connects various devices, including sensors, access points, and data networks

Note 1 to entry: An IoT platform is the role of middleware that can connect to networked devices and provide a hosted infrastructure to cost-effectively and securely manage and path data.

Note 2 to entry: It is important that scalable and provide interoperability that handles connectivity to large numbers of devices and easily interacts with them.

Note 3 to entry: It provides user security such as authentication and access control, and a service that collects, visualizes, and analyses data from sensors.

**3.5**
**IoT resource name system**
**IoT RNS**
module that converts resource requests into the respective format of each IoT platform



Note 1 to entry: The IoT RNS can be implemented as local IoT RNS or root IoT RNS.

Note 2 to entry: The local IoT RNS is modularized on each IoT platform to store metadata of registered devices and services. It also converts the resource paths of heterogeneous IoT platforms.

Note 3 to entry: All resource metadata are stored in the root resource table of the root IoT RNS and sent to each local IoT RNS if the root resource table is updated.



**3.6**
**near field communication**
**NFC**
wireless technology that enables communication between devices over a short distance

[SOURCE: ISO 20252:2019, 3.55]

**3.7**
**next generation service interface for linked data**
**NGSI-LD**
information model and API for publishing, querying and subscribing to context-aware information management in IoT systems

**3.8**
**object identifier**
**OID**
ordered list of primary integer values from the root of the international object identifier tree to a node, which unambiguously identifies that node

[SOURCE: ISO/IEC 9834-1:2012, 3.5.11]

**3.9**
**resource**
application service used between devices based on various IoT platforms

**3.10**
**radio frequency identification**
**RFID**
wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects

[SOURCE: ISO/IEC 18038:2020, 3.25]

**3.11**
**discovery service**
service to find resources, entities, or services based on a specification of the desired target

[SOURCE: ISO/IEC 20924:2024, 3.1.14, modified – Note 1 to entry has been deleted.]

**3.12**
**uniform resource identifier**
**URI**
compact sequence of characters that identifies an abstract or physical resource

Note 1 to entry: It is a conceptual term that refers to a unified identifier for Internet application information resources.

Note 2 to entry: It includes a URN indicating an identifier using the name and a URL indicating a resource path.

[SOURCE: ISO/IEC 12785-1:2009, 3.23, modified – Note 1 to entry has been replaced and Note 2 to entry has been added.]



## 4 Abbreviated terms

| | |
|---|---|
| ADN | application dedicated node |
| ASN | application service node |
| CSE | common service entity |
| ID | identifier |
| IN | infrastructure node |
| IoT | Internet of Things |
| MN | middle node |
| OID | object identifier |
| RNS | resource name system |
| URI | uniform resource identifier |
| URL | uniform resource locator |
| URN | uniform resource name |