

# INTERNATIONAL STANDARD



Internet of things (IoT) – Interoperability for iot systems –  
Part 1: Framework

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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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ISO/IEC 21823-1

Edition 1.0 2019-02

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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ICS 33.020

ISBN 978-2-8322-6567-3

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# INTERNET OF THINGS (IoT) – INTEROPERABILITY FOR IoT SYSTEMS –

## Part 1: Framework

### FOREWORD

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International Standard ISO/IEC 21823-1 was prepared by subcommittee 41: Internet of Things and related technologies, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 21823 series, under the general title *Information technology – Internet of Things (IoT) – Interoperability for IoT systems*, can be found on the IEC and ISO websites.

The text of this standard is based on the following documents:

FDIS	Report on voting
JTC1-SC41/75/FDIS	JTC1-SC41/87/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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## INTRODUCTION

Internet of Things (IoT) systems involve communications between different entities. This applies to connections between different IoT systems. It also applies to the many connections that exist within IoT systems. The various entities and their connections are described in ISO/IEC 30141.

The ISO/IEC 21823 series addresses issues that relate to interoperability of the communications between IoT systems entities. ISO/IEC 21823-1 describes a general framework for interoperability of IoT systems. This includes a facet model for interoperability which includes five facets of interoperability (i.e. transport, syntactic, semantic, behavioural and policy). This document addresses the framework to achieve interoperability for IoT; the specific facets are addressed in other parts of ISO/IEC 21823.

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# INTERNET OF THINGS (IoT) – INTEROPERABILITY FOR IoT SYSTEMS –

## Part 1: Framework

### 1 Scope

This document provides an overview of interoperability as it applies to IoT systems and a framework for interoperability for IoT systems. This document enables IoT systems to be built in such a way that the entities of the IoT system are able to exchange information and mutually use the information in an efficient way. This document enables peer-to-peer interoperability between separate IoT systems.

This document ensures that all parties involved in building and using IoT systems have a common understanding of interoperability as it applies to IoT systems and the various entities within them.

### 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 30141, *Internet of Things (IoT) – Reference architecture*

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### 3 Terms and definitions

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

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

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

#### 3.1

##### interface

named set of operations that characterize the behaviour of an entity

[SOURCE: ISO 19142:2010, 4.10]

#### 3.2

##### operation

specification of a transformation or query that an object may be called to execute

[SOURCE: ISO 19142:2010, 4.17]

#### 3.3

##### framework

structure of processes and specifications designed to support the accomplishment of a specific task

[SOURCE: ISO/IEEE 11073-10201:2004, 3.22]



### **3.4 interoperability**

ability for two or more systems or applications to exchange information and to mutually use the information that has been exchanged

[SOURCE: ISO/IEC 17788:2014, 3.1.5]

### **3.5 transport interoperability**

interoperability (3.4) where information exchange uses an established communication infrastructure between the participating systems

Note 1 to entry: System means IoT system.

Note 2 to entry: IoT device, IoT gateway, sensor and actuator are considered as a system.

[SOURCE: ISO/IEC 19941:2017, 3.1.3]

### **3.6 syntactic interoperability**

interoperability (3.4) such that the formats of the exchanged information can be understood by the participating systems

Note 1 to entry: System means IoT system.

Note 2 to entry: IoT device, IoT gateway, sensor and actuator are considered as a system.

[SOURCE: ISO/IEC 19941:2017, 3.1.4]

### **3.7 behavioural interoperability**

interoperability (3.4) so that the actual result achieves the expected outcome

Note 1 to entry: System means IoT system.

Note 2 to entry: IoT device, IoT gateway, sensor and actuator are considered as a system.

[SOURCE: ISO/IEC 19941:2017, 3.1.6, modified – In the definition, "result of the exchange" has been replaced with "result".]

### **3.8 policy interoperability**

interoperability (3.4) while complying with the legal, organizational, and policy frameworks applicable to the participating systems

Note 1 to entry: System means IoT system.

Note 2 to entry: IoT device, IoT gateway, sensor and actuator are considered as a system.

[SOURCE: ISO/IEC 19941:2017, 3.1.7]

### **3.9 semantic interoperability**

interoperability (3.4) so that the meaning of the data model within the context of a subject area is understood by the participating systems

Note 1 to entry: System means IoT system.

Note 2 to entry: IoT device, IoT gateway, sensor and actuator are considered as a system.

[SOURCE: ISO/IEC 19941:2017, 3.1.5, modified – The term "semantic data interoperability" has been replaced with "semantic interoperability".]

## 4 Abbreviated terms

AMQP	Advanced Message Queuing Protocol
API	Application Programming Interface
ASD	Application & Service Domain
IoT	Internet of Things
JSON	JavaScript Object Notation
MQTT	Message Queuing Telemetry Transport
OMD	Operation & Management Domain
PII	Personally Identifiable Information
RAID	Resource Access & Interchange Domain
SCD	Sensing & Controlling Domain
UD	User Domain
PED	Physical Entity Domain

## 5 Overview of Internet of Things interoperability

### 5.1 Descriptions

Clause 5 provides an overview and facet models for Internet of Things interoperability. The goal is to ensure that parties involved in the IoT, particularly as specified in ISO/IEC 30141, have a common understanding of IoT interoperability for their specific needs. This common understanding helps to achieve interoperability in IoT by establishing common terminology and concepts used to describe it, particularly as they relate to IoT entities.

### 5.2 Considerations for Internet of Things interoperability

Interoperability can be defined as a measure of the degree to which various kinds of systems or components interact successfully. For the purposes of this document, interoperability is defined in 3.4. In the context of IoT, interoperability is further described as the successful interaction among the IoT entities specified in ISO/IEC 30141.

Interoperability, in the context of IoT, involves a number of different types of interacting entities and their associated interfaces. While interoperability matters in sectors throughout the economy, this document specifically focuses on the context of IoT and especially relating to the framework for interoperability based on the IoT reference architecture defined in ISO/IEC 30141.

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

- ability for communication between entities in different domains or between different IoT systems;
- ability for the exchange of data between entities in different domains or between different IoT systems;
- ability of an understanding of the meaning of exchanged data between entities in different domains or different IoT systems;
- ability for an IoT service to work with other IoT services;
- roles and activities of functional components as defined in ISO/IEC 30141 for interoperability.

By taking these considerations into account, this document provides a context of framework for a better understanding of existing and future interoperability standards.

### 5.3 Internet of Things interoperability facet model

#### 5.3.1 General

Interoperability involves a number of elements, starting at the simple exchange of data bytes, facilitating an understanding of the semantics of the exchanged information, and also an alignment of the business processes, behaviour and policies on either side of the exchange. Semantic, behavioural and policy interoperability can result in a significantly bigger challenge than the bits and bytes. [1]<sup>1</sup>

In dealing with the various interactions to which interoperability applies in IoT, it is necessary to explore technological, information and human aspects. Moving forward, interoperability related challenges are likely to intensify and get more difficult to manage as IoT systems grow more complex and interconnected. In IoT systems where anything can be connected, the complexities are further extended from technological aspects to global policies, regulation and international law.

To discuss interoperability within the context of IoT, it is necessary to deal with different perspectives of conceptual interoperability and identify with whom, with what, and circumstances in which interoperability plays a vital role. This document describes these various aspects of interoperability in terms of facets. Interoperability of two entities may be described in terms of different facets, where each facet focuses on one aspect of interoperability. To achieve interoperability, it is important that all facets are understood and mutually agreed upon by interacting entities.

The interoperability facet model described in this document defines five facets within the context of IoT interoperability. These five facets, shown in Figure 1, are transport, syntactic, semantic, behavioural and policy. This model is derived by combining and abstracting the European Interoperability Framework [2] and the Levels of Conceptual Interoperability Model (LCIM) [3].

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<sup>1</sup> Numbers in square brackets refer to the Bibliography.