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Internet of things (IoT) – Data exchange platform for IoT services – Part 1: General requirements and architecture

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CONTENTS

INTERNET OF THINGS (IoT) – DATA EXCHANGE PLATFORM FOR IOT SERVICES – Part 1: General requirements and architecture

FOREWORD

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International Standard ISO/IEC 30161 was prepared by subcommittee 41: Internet of Things and related technologies, of ISO/IEC joint technical committee 1: Information technology.

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

FDIS	Report on voting
JTC1-SC41/178/FDIS	JTC1-SC41/187/RVD

Full information on the voting for the approval of this International 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

IoT implements various services in many fields, such as "Remote Management of Large Equipment in a Plant", "Warehouse Goods Monitoring", "IoT Endpoint (Sensors and Actuators) Monitoring Systems", etc. The IoT architecture can be categorized into vertical and horizontal approaches. For small deployments in limited areas, the vertical approach is possible. However, for large scale deployments, the horizontal approach is required, and then introducing the concept of a common platform is helpful for implementing various services. In the horizontal approach, information processing and networking are positioned as the platform. And also, the types of IoT services are increasing in different application fields. To make IoT services more creative and productive, data exchange between various IoT services needs to be supported and a common platform for data exchange is the simplest way. This document has been developed in accordance with a detailed study of a platform that supports various IoT use cases.

INTERNET OF THINGS (IoT) – DATA EXCHANGE PLATFORM FOR IOT SERVICES – Part 1: General requirements and architecture

1 Scope

This document specifies requirements for an Internet of Things (IoT) data exchange platform for various services in the technology areas of:

- the middleware components of communication networks allowing the co-existence of IoT services with legacy services;
- the end-points performance across the communication networks among the IoT and legacy services;
- the IoT specific functions and functionalities allowing the efficient deployment of IoT services;
- the IoT service communication networks' framework and infrastructure; and
- the IoT service implementation guideline for the IoT data exchange platform.

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 30141:2018, *Internet of Things (IoT) – Reference architecture*

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
IoT data exchange platform
IoT DEP
set of functional blocks that provide an abstraction of IoT data blocks and exchange of IoT data with other entities

Note 1 to entry: For example, in a huge number of sensors across various networks, IoT DEP reduces traffic volumes and exchanges IoT data with other entities. Functional blocks of IoT DEP are implemented at endpoints and nodal points in IoT networks. These functional blocks cooperate as a platform.

3.2
nodal point
point that investigates routing information specified in communication protocols and relays data blocks according to such information

4 Abbreviated terms

CAC	communication access control
CCN	content centric network
DNS	domain name service
ICN	information centric network
IoT	Internet of Things
IoT DEP	IoT data exchange platform
IP	internet protocol
MQTT	Message Queuing Telemetry Transport
OSI	open systems interconnection
QoS	quality of service
TCP	transmission control protocol
UDP	user datagram protocol

5 Overview of IoT services

Considering IoT use cases across sectors, it can be assumed that data blocks from/to sensors and actuators, referred to as "IoT data", are transferred across networks. To reduce traffic volume and comply with various user requirements on QoS, it is reasonable that an IoT DEP should be deployed. The IoT DEP is positioned in the application layer of the OSI reference model. However, IoT data is transferred over abstracted lower layers including the current Internet. An IoT DEP shall be implemented in accordance with the networking view of IoT reference architecture defined in ISO/IEC 30141:2018.

The IoT DEP should not impact communications other than IoT data and permit co-existence of communications of IoT data and other data. Therefore, this document promotes an approach that isolates communications of IoT data from other communications. It excludes specifications of cloud computing and edge computing, which deal with distributed operations for every layer in the reference model.

Overviews and analyses of the IoT use cases have motivated this document and are summarized in Annex C. These use cases are collected in ISO/IEC TR 22417 [1][1].

6 Network configurations for IoT services

6.1 Overview of network configurations for IoT

An overview of network configurations for IoT is shown in Figure 1. Networks provide connection among IoT users, IoT gateway, and IoT devices specified in ISO/IEC 30141:2018. Moreover, IoT devices – for example specified in ISO/IEC 30118-1 to ISO/IEC 30118-6 [2],[3],[4],[5],[6],[7] – are included.

Each network can have several nodal points. In ISO/IEC 30141:2018, sub-systems (Operations & Management sub-system, Application & Service sub-system, and Resource Access & Interchange sub-system) in entity-based reference models take on the role of nodal points. These sub-systems correspond to the Operations & Management Domain, Application & Service Domain, and Resource Access & Interchange Domain in a domain-based reference model.

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

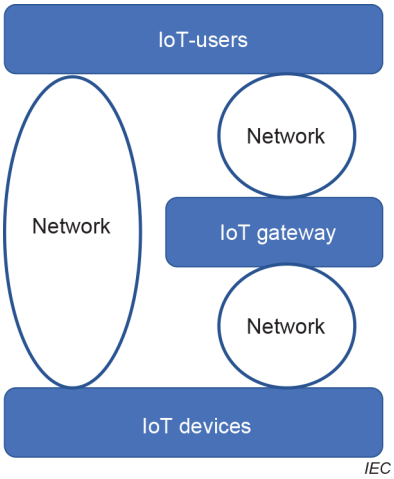

Figure 1 – Overview of network configurations

Detailed network configurations based on Figure 1 are shown in Figure 2. As shown in Figure 2, configurations consist of five service types. Service type 1 provides local services for limited areas. Service types 2 to 5 provide wide area services. In some cases of wide area services, IoT gateway can be deployed for connections between IoT users and IoT devices. However, in other cases, IoT users can be connected to IoT devices without IoT gateway. In network types based on ISO/IEC 30141:2018, a proximity network provides connections for the limited areas. For the wide area services, the user network, service network, and access network are deployed. In these, the user network takes the role of network for IoT specific applications and is operated by IoT user. The service network and access network accommodate generic applications, including IoT-specific applications and legacy applications (e.g. telephony, video distribution, and Internet access). The service network includes switching functions among locations. The access network provides multiplexing functions of traffic flow from every specific area.

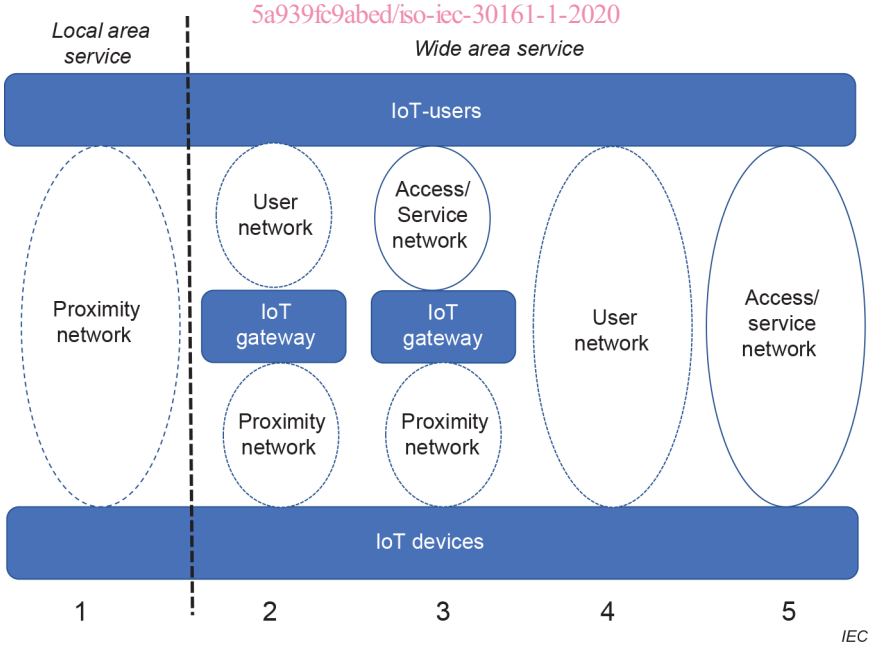

Figure 2 – Service types of the network configurations

6.2 Network models for an IoT DEP

An IoT DEP transfers a huge number of data blocks from/to sensors and actuators effectively. It should be applied to any service including local area services and wide area services for IoT. It should be operated across any network, including proximity networks, access networks, service networks, and user networks specified in ISO/IEC 30141:2018, even if applications other than IoT are deployed in these networks.

Although network configurations are categorized into five types (Figure 2), these five types are aggregated into three types from an IoT DEP point (Figure 3). As shown in Figure 3, configuration type 1, types 2 and 3, and types 4 and 5 are redefined as configuration types X, Y, and Z, respectively.

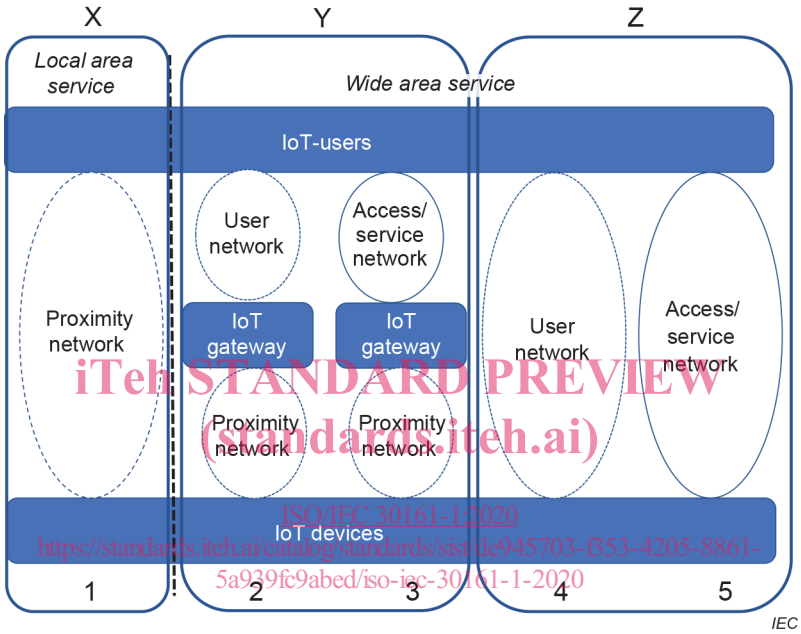

Figure 3 – Redefined configuration types for an IoT DEP

7 Data exchange platform in IoT reference architecture

7.1 General

IoT DEP takes the role of the interworking of information in IoT systems. Cloud computing related technologies, including interfaces of connections to the cloud, are not specified in this document.

An IoT DEP is distributed to entities specified in ISO/IEC 30141:2018. Therefore, it works as a platform by combining distributed parts.

7.2 Position of an IoT DEP in IoT reference architecture

7.2.1 Functions of the IoT DEP

An IoT DEP transfers data to IoT applications effectively as a part of network functions. IoT DEP shall not include data processing and computation in cloud computing.

An IoT DEP shall provide the following functions.

– In order to ensure effective IoT application services, an IoT DEP shall operate independent of communication media and protocols. It shall connect among IoT users and IoT devices via IoT gateway or directly. For example, when a huge volume of data from sensors is transferred across wide area networks using Internet technologies, an IoT DEP provides the communication with small overheads such as small processing delay and/or a small traffic volume by reducing processing on complicated IP related protocols.
– An IoT DEP shall dynamically control the required functions for IoT applications. For example, it controls traffic flows for IoT applications and shall provide a requested QoS.
– An IoT DEP shall manage the validation of communication paths and IoT devices.

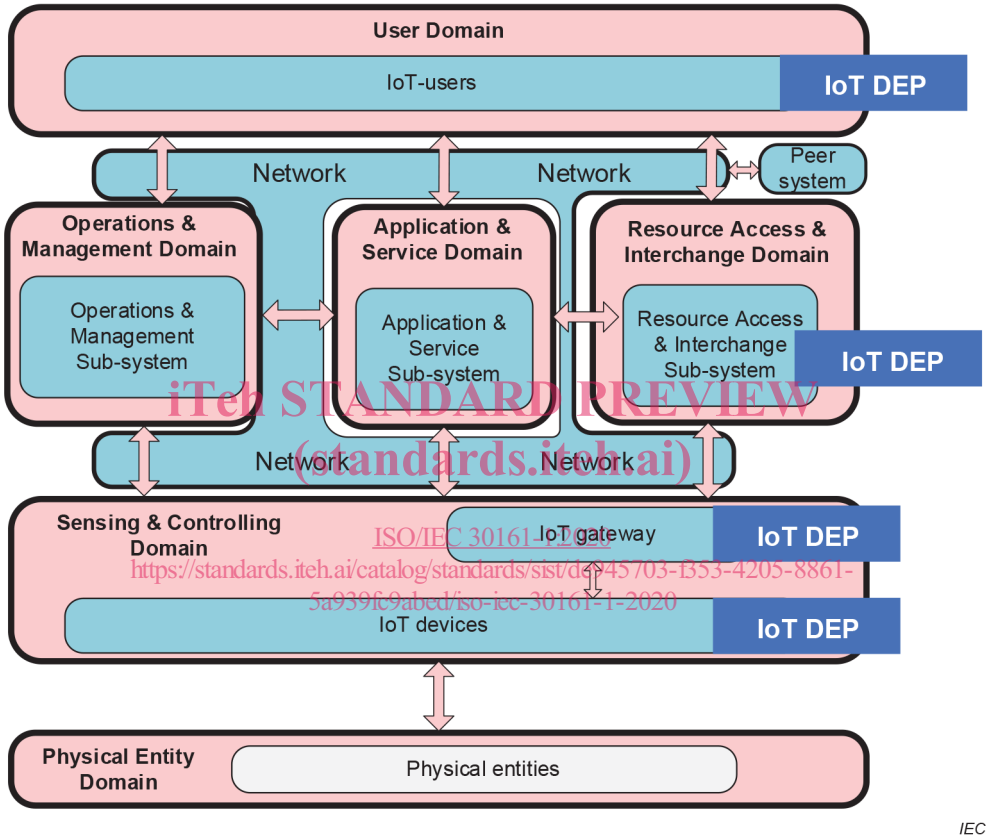

Figure 4 – Locations of IoT DEP functions in the IoT reference models

7.2.2 Positions of the IoT DEP

IoT DEP functions are implemented in IoT user, Resource Access & Interchange sub-system, IoT gateway, and IoT devices that are specified in the entity-based model of ISO/IEC 30141:2018. The relationship between the reference model specified in ISO/IEC 30141:2018 and an IoT DEP is shown in Figure 4. In ISO/IEC 30141:2018, two reference models – entity-based and domain-based – are specified. In Figure 4, locations of the IoT DEP functions are shown, explaining the relationship between both reference models in ISO/IEC 30141:2018.

7.3 Operation of an IoT DEP in an IoT system

Functions of IoT DEP are described in 7.2.1. In Cases C and D, IoT applications provided by an IoT DEP co-exist with legacy applications. Figure 5 shows a logical configuration; however, IoT gateway and Resource Access & Interchange sub-system accommodating IoT DEP functions can be shared with nodal points for legacy applications, from an implementation point of view.