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Information technology — Data structure — Unique identification for the Internet of Things

Technologies de l'information — Structure de données — Identification unique pour l'Internet des Objets

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Foreword

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Introduction

In applications of the Internet of Things (IoT), one “thing” can communicate with other “things” via the Internet. For that “thing” to communicate, it should possess an identifier of “which” it is.

The ISO/IEC 15459- series does a good job identifying how groups that have been assigned an issuing agency code can create a character-based system of unique identification.

There is no shortage of claimants to provide that identifier. Each is understandable due to its origins and the perspective from which it comes. The Internet is a network and groups such as the International Telecommunications Union (ITU) and the Internet Engineering Task Force (IETF) view this identifier as a mechanism to facilitate network routing. ITU-T X.668 | ISO/IEC 9834-9 and ITU-T X.660 | ISO/IEC 9834-1 attempt to fill this need from a network perspective. From a network perspective, it is accepted that the identification of an entity must resolve to an IP address for contacting it, whether its domain name “hangs” from an OID root using an OID resolver, or from a more general DNS node (which may end up as the same thing).

However, not everything is viewed from the perspective of the network, nor necessarily should it so be viewed. The network is a transport mechanism and the entities themselves have historic identifiers, which have their genesis from supply chain applications and identification.

Ultimately, the various forms of unique identification identified within this International Standard need to be combined in a single message in an unambiguous form. This International Standard provides a method enabling this combination in an unambiguous form.

Information technology — Data structure — Unique identification for the Internet of Things

1 Scope

This International Standard establishes a unique identification scheme for the Internet of Things (IoT), based on existing and evolving data structures. This International Standard specifies the common rules applicable for unique identification that are required to ensure full compatibility across different identities. The unique identification is a universal construct for any physical object, virtual object, or person. It is used in IoT information systems that need to track or otherwise refer to entities. It is intended for use with any IoT media.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 and the following apply.

3.1
coap
constrained application protocol

[SOURCE: RFC 7252]

3.2
entity
any concrete or abstract thing of interest, including associations among things

[SOURCE: ISO/PAS 16917]

Note 1 to entry: Information also provided in Annex D.

3.3
rest
representational state transfer

4 Abbreviated terms

2D	2 Dimensional
AIDC	Automatic Identification and Data Capture
IC	Integrated Circuit
IoT	Internet of Things

IPv4 Internet Protocol version 4

IPv6 Internet Protocol version 6

MAC Media Access Control

RF Radio Frequency

RFID Radio Frequency Identification

URI Uniform Resource Identifier

URL Uniform Resource Locator

URN Uniform Resource Name

XMPP Extensible Messaging and Presence Protocol

5 Identification of an “entity”

5.1 General

For the purpose of this International Standard, the term “thing” considers the following as synonyms; “item”, “object” and “entity”. A thing may be a person, object, or location; see also Annex D.

When one considers the Internet of Things (IoT), the definition of the “thing” is most often coloured by the perspective of the person undertaking the consideration. If one is coming from the world of sensors, the IoT is simply an expansion of a sensor network. If one is coming from the world of RFID, the IoT is simply an expansion of an RFID infrastructure. If one is coming from the world of geospatial data, the IoT is simply an expansion of a location-based network. If one is coming from the world of telecommunications, the IoT is simply an expansion of a telecommunications network. In truth, all are correct. Figure 2 shows some of the possible iterations of “things” that would be possible to connect through the IoT, using various existing communication interfaces. Of course, there are other possibilities and these iterations of IoT might actually be combined, e.g. a mobile phone reading a 2D symbol, an RF tag, or a wireless IC device.

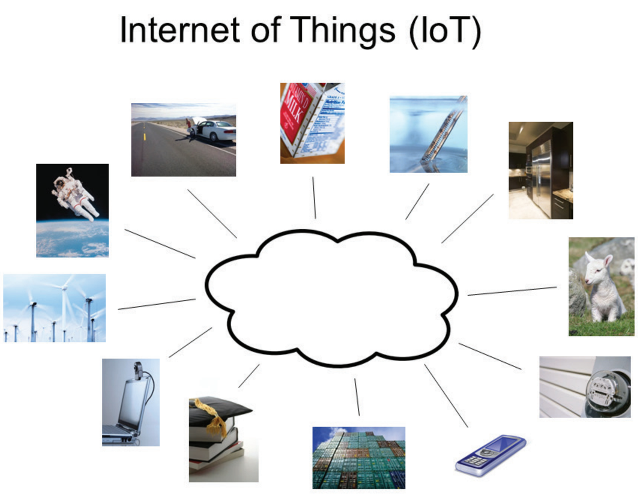

Figure 1 — IoT — everything possible being connected

A single transaction may need to capture several identities as it progresses from origin to destination (and return). For example, there may exist a need to capture, each time a transaction is recorded, the following:

— item identification;

— sensor identification;

— node identification;

— gateway identification;

— target resource identification;

— location of data capture, if mobile;

— time of data capture;

— identification of the individual;

As a virtual thing, software, or software content, ISO/IEC 8824-1:2015, 3.8.52 defines an "object" as *A well-defined piece of information, definition, or specification which requires a name in order to identify its use in an instance of communication. An object is an abstraction or simulation of physical things such as people* ("people" are included in this definition of object only to be true to the quote, whereas this International Standard discriminates between people, objects, and locations) *and machines or intangible things such as events and processes that captures their characteristics and behaviour. Something you can do things to. An object has* ***state***, ***behaviour***, *and* ***identity****; the structure and behaviour of similar objects are defined in their common class.*[64]

The following are properties that may characterize a thing:

a) Identity: the property of an entity that distinguishes it from other entities;

b) Type: describes the type of entity;

c) Data: describes if and how persons, locations and/or other entities can be tied to the entity;

d) Behaviour: describes the methods in the location's interface by which the location can be used.

5.2 Overview of the "IoT Network"

The Internet of Things (IoT) network aims to enable almost everything to communicate with each other, being connected using various communication interfaces and protocols like IPv4, IPv6, MAC addresses, CoAP/REST, XMPP, etc.

Prerequisite for the IoT network is the possibility to tie various information to the right thing for a given purpose using unambiguous identities to which specified information is tied which is then exchanged using application defined protocols.

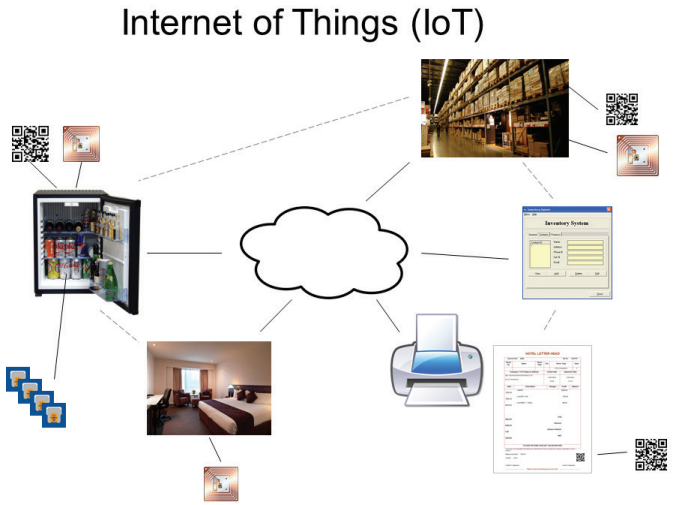

Figure 2 — Possible information exchange using IoT

Figure 2 shows an example where the items positions in a minibar in a hotel room are defined and monitored using sensing techniques. When an item is removed, it is automatically sensed and information is sent so it is registered as being removed. The item will then be added as purchased and the price added to the room bill, to be paid at check out. Received information will also trigger refilling of minibar with the removed item.

The scenario above requires that everything is possible to be uniquely identified, for which this International Standard is to provide a method for adding a wrapper to already existing identification schemes.

6 Unambiguous wrapper for unique identifiers in IoT applications

6.1 Overview

Each form of unique identification stands on its own within the context of applications within that specific identification's domain. When one travels outside of that closed system, an open system form of the identification is required. The nature of the Internet of Things (IoT) is for people and objects to communicate with one and the other. This means that the unique identification scheme will need to accommodate established forms of identification.

For the purposes of this International Standard, the "unambiguous wrapper" for identifiers used in IoT communications shall be a Uniform Resource Identifier (URI) defined by IETF, in RFC 3986. URIs are traditionally classified as either a Uniform Resource Locator (URL, using a string starting with "http://") denoting a web resource, or a Uniform Resource Name (URN, using a string starting with "urn:") as defined in RFC 2141. In both cases, the URI is a text string from a limited subset of US ASCII (for maximum portability across systems). The URI syntax is organized hierarchically, with components listed in order of decreasing significance from left to right. Other structures were considered, but the URI structure is widely accepted and extensively used with today's AIDC data carriers, while providing the flexibility of a broader implementation.

This International Standard is primarily concerned with supporting the interoperable use of Identification schemes from different domains, using existing URNs as needed to provide this interoperability in an efficient manner. Although URLs will also be used extensively in IoT applications, no special treatment of them is required for interoperability, and so this International Standard does not also define headers for URLs.

Various current AIDC data carriers and published ISO/IEC standards already make extensive use of URIs, including the following:

— the encoding of web addresses such as "http://www.iso.org/iso/home.html" in QR Code symbols;

— EPCglobal identifiers such as "urn:epc:id:sgtin:0614141.033254.1" encoded in RFID tags;

— the encoding and transmission protocols for RFID data objects using object identifiers (such as "urn:oid:1.0.15961.9.1" for GS1 Application Identifier "01") in accordance with ISO/IEC 15961-2 and ISO/IEC 15962.

Messages may freely and unambiguously mix identifiers from various AIDC media if published standards already specify a URI format for the identifier. However, no standard URI format is specified for many other identifier schemes that will likely see widespread usage in IoT systems. If an unambiguous wrapper for those identification schemes is needed, it is recommended to use ITU-T X.668 | ISO/IEC 9834-9.

6.2 URN schemes suitable for identification in IoT systems

6.2.1 Instances of URN schemes

Several instances of unique identifiers have already been assigned URN schemes and one of these shall be used if there does not exist an URN representation for an identification scheme to be used. In general, pre-existing URN formats for Identifiers that are recognized by this International Standard include all of those listed in the IANA Registry of URN Namespaces (see http://www.iana.org/assignments/urn-namespaces). Two forms of registered URNs are already in widespread use in AIDC applications and are of particular interest for IoT identification, these URNs are those with a prefix of:

— urn:epc [RFC 5134] in a format defined in the GS1/EPCglobal Tag Data Standards

— urn:oid:1.0.sssss [RFC 3061] where:

  — Per RFC 3061, the first numeric arc of "1" denotes an ISO-assigned OID, then

  — Per ITU-T X.660, the second numeric arc of "0" denotes an International Standard issued by ISO or IEC, and sssss is a specific standard number. Arcs below this are determined as necessary by the corresponding International Standard.

  — Pre-existing urn schemes of this form, of particular relevance to IoT identification, include those with a prefix of:

    — urn:oid:1.0.15961.df, as defined in ISO/IEC 15962 and the ISO/IEC 15961 multi-part series of standards;

  NOTE These OID formats may be utilized both to encode individual data items on RFID tags using a registered Data Format 'df' and to convey the resulting identifier "names" in RFID middleware protocols.

    — urn:oid:1.0.15434.fh, which assigns an OID when the data structure represents an entire ISO/IEC 15434 Format Envelope that utilizes Format Header "fh", as might be encoded in a two-dimensional bar code or RFID tag;

    — urn:oid:1.0.15459.gh, which assigns an OID for the unique identification of products, packages, transport units and groupings. Where "gh" indicates which part of ISO 15459 that is used.

— Other registered urns of interest for identification purposes in IoT applications include (but are not limited to) urn:clei (RFC 4152), urn:isbn (RFC 3187), urn:issn (RFC 3044), urn:iso (RFC 5141), and urn:uuid (RFC 4122).