International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

F.748.1

(10/2014)

SERIES F: NON-TELEPHONE TELECOMMUNICATION SERVICES

Audiovisual services

Requirements and common characteristics of the IoT identifier for the IoT service

Recommendation ITU-T F.748.1

ITU-T F-SERIES RECOMMENDATIONS

NON-TELEPHONE TELECOMMUNICATION SERVICES

TELEGRAPH SERVICE	
Operating methods for the international public telegram service	F.1–F.19
The gentex network	F.20–F.29
Message switching	F.30–F.39
The international telemessage service	F.40–F.58
The international telex service	F.59–F.89
Statistics and publications on international telegraph services	F.90–F.99
Scheduled and leased communication services	F.100–F.104
Phototelegraph service	F.105–F.109
MOBILE SERVICE	
Mobile services and multidestination satellite services	F.110–F.159
TELEMATIC SERVICES	
Public facsimile service	F.160–F.199
Teletex service	F.200–F.299
Videotex service	F.300–F.349
General provisions for telematic services	F.350–F.399
MESSAGE HANDLING SERVICES	F.400–F.499
DIRECTORY SERVICES	F.500–F.549
DOCUMENT COMMUNICATION	
Document communication	F.550–F.579
Programming communication interfaces	F.580–F.599
DATA TRANSMISSION SERVICES	F.600–F.699
AUDIOVISUAL SERVICES	**F.700–F.799**
ISDN SERVICES	F.800–F.849
UNIVERSAL PERSONAL TELECOMMUNICATION	F.850–F.899
HUMAN FACTORS	F.900–F.999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T F.748.1

Requirements and common characteristics of the IoT identifier for the IoT service

Summary

Recommendation ITU-T F.748.1 describes the requirements and common characteristics of the Internet of things (IoT) identifier for the IoT service.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T F.748.1	2014-10-14	16	11.1002/1000/12229

Keywords

Identifier, IoT.

---

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Introduction

ITU perceives the Internet of things (IoT) as a vision with technological and societal implications that can be viewed as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. As a common understanding, the IoT involves various kinds of technologies such as: identification, architectural work, communications, networking, discovery and search engines, power and energy storage and security and privacy. Among these technologies, it is widely agreed that radio frequency identification (RFID), ubiquitous sensor network (USN) or sensor networks and machine-to-machine (M2M) or machine oriented communication (MOC) will be enablers for the IoT.

In RFID environments, tag-based identification [b-ITU-T F.771] enables users to access multimedia information through users' electronic devices equipped with ID tag readers and communication functions. In the IoT environments, it is required to study not only tag-based identification, but also general-purpose identification schemes. Because the IoT involves various enablers such as RFID, USN or sensor networks, and M2M or MOC, the identification scheme of the IoT is required to be applied to these various enablers.

To realize the IoT services, existing information and communication technologies should evolve to support the characteristics of the IoT. Third generation partnership project (3GPP) systems, Internet, wireless local area network (WLAN), wireless personal area network (WPAN), and next generation networks (NGNs) are evolving to provide IoT services based on existing technologies. Due to economic and technical challenges, it is rare to implement completely new technologies. As existing technologies are evolving respectively and independently, the existing identification scheme for each technology will be used continually.

There may be two options for the creation of a future IoT identifier. One is the evolution from existing identifiers, and the other is the creation of a new identifier. Given that information and communication technologies are typically developed with the guarantee of interoperability using existing technologies, a future IoT identifier looks likely to evolve from existing identifiers.

Recommendation ITU-T F.748.1

Requirements and common characteristics of the IoT identifier for the IoT services

1 Scope

The objective of this Recommendation is to analyse identifiers in existing technologies for the Internet of things (IoT) services, and describe the requirements of the IoT identifier, common characteristics of the IoT identifier, and the reference model of the IoT identifier.

This Recommendation describes the requirements and common characteristics of the IoT identifier for the IoT services. The scope of this Recommendation includes:

– analysis of identifiers in existing technologies,

– common characteristics of the IoT identifier,

– requirements of the IoT identifier,

– reference model of the IoT identifier.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.2060] Recommendation ITU-T Y.2060 (2012), *Overview of the Internet of things*.

[ITU-T Y.2063] Recommendation ITU-T Y.2063 (2012), *Framework of the web of things*.

[ITU-T Y.2091] Recommendation ITU-T Y.2091 (2011), *Terms and definitions for next generation networks*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 address [ITU-T Y.2091]: An address is the identifier for a specific termination point and is used for routing to this termination point.

3.1.2 identifier [ITU-T Y.2091]: An identifier is a series of digits, characters and symbols or any other form of data used to identify subscriber(s), user(s), network element(s), function(s), network entity(ies) providing services/applications, or other entities (e.g., physical or logical objects). Identifiers can be used for registration or authorization. They can be either public to all networks, shared between a limited number of networks or private to a specific network (private IDs are normally not disclosed to third parties).

3.1.3 Internet of things [ITU-T Y.2060]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3GPP	Third Generation Partnership Project
CID	Caller ID
DNS	Domain Name System
ETSI	European Telecommunications Standards Institute
FQDN	Fully Qualified Domain Name
HTTP	Hypertext Transfer Protocol
ICTs	Information and Communication Technologies
IEEE	Institute of Electrical and Electronics Engineers
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IoT	Internet of Things
Ipv4	Internet Protocol version 4
Ipv6	Internet Protocol version 6
ITS	Intelligent Transport Systems
M2M	Machine-to-Machine
MAC	Medium Access Control
MOC	Machine Oriented Communication
MSISDN	Mobile Subscriber ISDN Number
MTC	Machine Type Communication
NGN	Next Generation Network
PDA	Personal Digital Assistant
RFID	Radio Frequency Identification
TCP/IP	Transmission Control Protocol/Internet Protocol
URI	Uniform Resource Identifier
USN	Ubiquitous Sensor Network
WLAN	Wireless Local Area Network
WPAN	Wireless Personal Area Network

5 Conventions

None.

6 Introduction of the IoT identifier

Information and communication technologies (ICTs) have been used for and by humans, but this situation is evolving. ICTs are being used not only by humans, but also by machines (e.g., things, devices, objects). Specifically, technological environments composed of fixed computers, laptops and high performance machines are evolving to be composed of smartphones, personal digital assistants (PDAs), portable multimedia devices, lightweight devices and sensors. Moreover, all things will be connected to networks as time goes by. This change will be one of the features of IoT.

ICT services are evolving to support the IoT services; as a result, various services such as intelligent transport systems (ITS), smart home services, u-Health, and smart-metering services will converge into the IoT services. Communication and networking technologies such as third generation partnership project (3GPP) systems, Internet, wireless local area network (WLAN), wireless personal area network (WPAN) and next generation network (NGN) are also evolving to provide IoT services based on existing technologies. However, to provide the IoT services, it is necessary to implement completely new services and technologies.

As the existing ICTs services are evolving respectively and independently, the identifier for the existing technologies will be used continually. In the same manner, the future IoT identifier may evolve from the existing identifiers. In 3GPP system-based networks, the mobile subscriber ISDN number (MSISDN), international mobile equipment identity (IMEI), and international mobile subscriber identity (IMSI) are used to provide the IoT services. In the Institute of Electrical and Electronics Engineers (IEEE) 802.11 WLAN-based networks, the medium access control (MAC) address is used as an identifier. In IEEE 802.16 WiMAX-based networks, caller IDs (CID) or MAC addresses are used as an identifier. Each identifier can be used in the same networking technologies, but it is impossible to interoperate with other identifiers used in different networking technologies. If it is required that different identifiers are interoperable in the same manner as the conventional Internet, upper layer identifiers such as Internet protocol version 4 (IPv4), Internet protocol version 6 (IPv6) and uniform resource identifiers (URI) can be used.

If the use of IoT services increases exponentially and globally, new access technologies and new communication networks can be deployed for the IoT services. In this case, a new IoT identifier should be designed and implemented.

Since ICTs are developed with the guarantee of interoperability using existing technologies, then the future IoT identifier looks likely to evolve from the existing identifiers. For interconnection among things (e.g., machines, devices, objects) that are connected to different networks where different identifiers are used, the existing approach of the conventional Internet (interconnection at upper layer using IPv4, IPv6, and URI) or a new approach considering the characteristics of the IoT can be used. For example, a new identifier can be considered to associate the IoT services with devices and vice versa.

In the IoT environment, various ICTs as well as various services and applications should provide for interworking. The existing ICT services and applications have been developed for their own purpose and there is no requirement for them to interconnect with other services and applications. As many things are interconnected and connected to the networks, various services and applications have become interworked. To interwork different services and applications, web-based services and applications have been acknowledged to support this requirement [ITU-T Y.2063]. Whatever the future features of services and applications are in the IoT, the IoT identifier in services and applications will be developed based on the existing identifiers with interoperability.

This Recommendation analyses identifiers in the existing technologies for the IoT services, and describes the requirements of the IoT identifier, common characteristics of the IoT identifier, and the reference model of the IoT identifier.

7 Analysis of identifiers in the existing technologies

This clause describes the existing identifiers in 3G networks and the Internet that can be used in a network for the IoT services.

Both MSISDN and IMSI are used as identifiers in 3G networks; on the other hand, IPv4 and IPv6 addresses, URIs, and fully qualified domain names (FQDNs) are used as identifiers in the Internet.

Each identifier can be used in the same network, but it is impossible to be interoperable with other identifiers used in different networks. If it is required that different identifiers are interoperable, in the same manner as those in the conventional Internet, upper layer identifier such as IPv4 and IPv6 can be used. Considering the characteristics of the IoT, it is certain that the approach used in the conventional Internet is not suitable for the IoT.

In the 3GPP network, identifiers are categorized as follows [b-3GPP 23.003]:

– MSISDN with existing length,

– MSISDN with max length of 15 digits,

– IMSI

Although the maximum length of the MSISDN is 15 digits, the currently used length is 12 to 13 digits. The MSISDN with existing length is a globally unique identifier in the 3GPP network and it does not impact the current billing system and authentication scheme in the 3G network. In addition, the MSISDN scheme can represent location information and service information of a device. The MSISDN with existing length can work very well as an identifier scheme in the 3G network. However, the length of the MSISDN is limited; therefore, the MSISDN can lead to a lack of identifiers holding numerous numbers of devices connected to the 3G network [b-3GPP 22.988].

The MSISDN with a maximum length of 15 digits can be used as another identifier in the 3G networks and is a globally unique identifier. In addition, this scheme does not require new standards in 3G networks and can provide a large number of additional MSISDNs. However, if this scheme is used as an identifier of a device in the IoT, it may require changes to existing devices in 3G networks and can have an impact on billing systems.

The IMSI is supported widely in 3G networks and serves as an effective identification scheme to uniquely identify each device. However, it is not suitable for session/call routing identifiers, but rather its primary purpose is for authenticating devices. In addition, the IMSI is not generally accessible when a device is connected through the Internet. Even if the IMSI is used as an identifier of a device in the IoT, the domain name systems (DNS) have to translate the IMSI into an IP address. The IMSI cannot be used as an identifier for billing systems. Thus, modifications to existing billing systems may be required. The IMSI is geographically distributed, but used within a dedicated region. Although the available number of IMSIs is much larger than the number of MSISDNs, the number of devices in the IoT may increase dramatically and consequently lead to insufficient numbers for the IMSI to be used as an identifier.

In the Internet, identifiers are categorized as follows:

– uniform resource identifier,

– fully qualified domain names,

– IPv4 address, IPv6 address.

URIs are widely used as generic identifiers. They can be resolved to an IP address by DNS and enable interaction between resources over the Internet using specific protocols (e.g., hypertext transfer

protocol (HTTP)). Thus, if the IoT network infrastructure is realized by existing network technologies, such as conventional transmission control protocol/Internet protocol (TCP/IP) based networks, URIs can be used as a generic identifier of the IoT.

In the conventional Internet environment, the FQDN is a basic domain name scheme and works very well with current IP networks. However, if the FQDN is used as a device identifier in the IoT, the FQDN scheme can be a huge burden on DNS servers. Mapping of every FQDN to an IP address requires an entry in the DNS system. Thus, using the FQDN as an identifier of the IoT devices would increase entries in the DNS system. In addition, this scheme requires additional system updates for authentication and billing in 3G networks. The FQDN scheme has virtually unlimited name space, thus it does not have a limit to the number of identifiers.

IPv4/IPv6 addresses are not suitable as public identifiers because they are used as routing identifiers in the Internet. Although IPv4/IPv6 addresses are generic identifiers, there are not enough of them to accommodate numerous devices in the IoT (i.e., the exhaustion of identifiers can occur).

8 Common characteristics of the IoT identifier

Common characteristics of the existing identifiers can be applied to the IoT identifier. Generally, an identifier can be used to identify subscriber, user, network element, function, network entity, or other entity (e.g., physical or logical objects) [ITU-T Y.2091].

In addition to common characteristics of the existing identifiers, the IoT identifier has the following additional characteristics:

– Identifying things:

  An identifier can identify various kinds of things. The existing identifiers identify *specific* things, but the IoT identifiers identify *various* kinds of things. To identify various kinds of things and interconnect things, it is acknowledged that the Internet and the web-based identifiers are more suitable.

– Communicating with other things:

  After being identified, various types of things can communicate with computers, humans, and other things. With communication between things, things can be interconnected with each other.

– Connecting to networks:

  Although different communication technologies and services/applications are used, things are connected to networks directly/indirectly and always/periodically/on-demand with identifiers.

– Huge accommodation:

  Existing identifiers have a limited range of available allocation. The number of the IoT identifiers should be large enough (may be limitless) to cover an enormous number of things.

– Interconnection:

  Identifiers of things in different networks can be interconnected. Identifiers of physical things in the physical world and identifiers of virtual things in the information world will be interconnected.

– Diversity:

  Identifiers in the physical world and the information world are different. In the physical world, the identifiers of physical things of the IoT devices may be different according to applied technologies.

– Multiplicity:

  Multiple identifiers may be allocated to a physical thing, a device and a virtual thing. For a specific service and a specific operation, a particular identifier will be selected and utilized.

– Permanent or limited lifetime:

  Some identifiers that are assigned to things will be either permanent or temporary (i.e., vanish after their time-to-live).

– Identification of the IoT services:

  Some identifiers can be used to identify the IoT services. When doing this, it is efficient to manage resource and devices in the application layer.

9 Requirements of the IoT identifier

In the IoT environment, a thing is understood as a physical object in the physical world and a virtual object in the information world that is capable of being identified and connected to information and communication networks. The role of an identifier of a thing in the IoT environment is to uniquely identify a physical and a virtual object. An IoT identifier has the requirements listed in the following clauses.

9.1 Identifying anything

REQ-001: It is required that identification schemes be able to identify anything.

According to the fundamental characteristics of interconnectivity in [ITU-T Y.2060], anything (physical or virtual, devices or non-devices (do not need communication capabilities)) will be interconnected with the global information and communication infrastructure.

9.2 Communication between things

REQ-002: It is required to support the connectivity between things and to provide communication based on identifiers of things.

REQ-003: It is recommended to provide a harmonized way to integrate identifiers of devices that need communication capability with identifiers of things that do not need communication capability.

In IoT environments, a thing can be a physical and a virtual object, but some things do not need communication capability.

9.3 Association between physical objects and virtual objects

REQ-004: It is required to provide association between a physical object and a virtual object using an identifier.

An identifier in conventional information and communication networks is mainly used to provide connectivity and communication between physical objects. However, an identifier in an IoT environment can be used to provide connectivity and association between physical objects and/or virtual objects.

9.4 Networking technology independency

REQ-005: As IoT devices may use different network technologies, identifiers for these IoT devices are recommended to be independent of underlying networking technologies.

In IoT environments, numerous devices will be connected to each other, and those devices may belong to different networks that use different networking technologies. Generally, devices in a network using specific networking technologies can be identified by a specific identifier and/or address used in those networking technologies.

9.5 Mapping identifiers to objects

The IoT reference model in [ITU-T Y.2060] is composed of four layers as well as management capabilities and security capabilities associated with the four layers. The four layers are: application layer, service/application support layer, network layer and device layer. From the point of view of an identifier, an identifier in each layer is used to map specific objects (resources) in each layer or one universal identifier can be used to map specific objects (resources) in all layers. Figure 9-1 (a) shows the case where an identifier in each layer is used to map to specific objects in each layer and Figure 9-1 (b) shows the case where one universal identifier is used to map to specific objects in all layers.

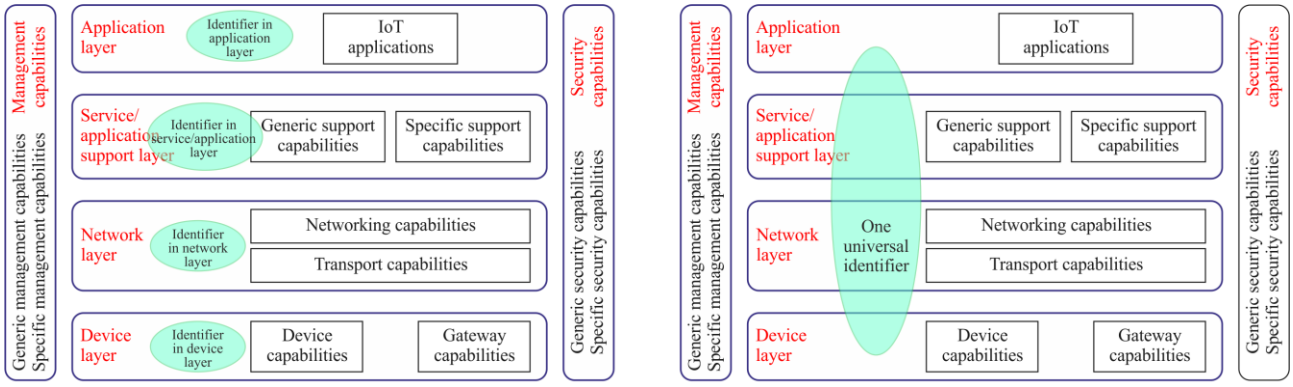

Figure 9-1 – Mapping identifiers to objects

REQ-006: In the case where an identifier in each layer is used to map to specific objects in each layer, it is required that each identifier, in each layer, does not directly impact other identifiers in adjacent layers.

When an identifier in each layer is used to map to specific objects in each layer, it is similar to the usage of identifiers in the conventional Internet. For example, in the application layer URIs and FQDNs are used. In the service/application support layer, port numbers and session numbers are used. In the network layer, IPv4 addresses or IPv6 addresses are used. In the device layer, IEEE 802.11 MAC addresses can be used.

REQ-007: In the case where one universal identifier is used to map to specific objects in all layers, it is recommended that this one universal identifier efficiently maps to specific objects in each layer and is integrated in a harmonized way.

The case where one universal identifier is used to map to specific objects in all layers is somewhat different from the conventional Internet. One universal identifier may cover all four layers, provide interconnection capabilities between physical objects and virtual objects, and provide simplicity. A universal identifier can be a new identifier with or without interoperability with existing identifiers. Alternatively, one identifier in each layer can be chosen and used as the one universal identifier.

9.6 Relation between characteristics and requirements

NOTE – This clause does not define requirements.

In clause 8, common characteristics of IoT identifiers are described. Table 9-1 shows the relation between common characteristics and requirements of the IoT identifiers.

Table 9-1 – Relation between common characteristics and requirements of IoT identifiers

Common characteristics	Requirements
Identifying things	REQ-001
Communicating with other things	REQ-002, REQ-003
Connecting to networks	REQ-002, REQ-003
Huge accommodation	REQ-001
Inter-connection	REQ-002, REQ-003, REQ-004, REQ-005
Diversity	REQ-004, REQ-005
Multiplicity	REQ-006
Permanent or limited life-time	
Identification of the IoT services	

10 New capability for IoT identifiers

As described above, the IoT reference model in [ITU-T Y.2060] is composed of four layers (application, service/application support, network, and device) and two capabilities (management and security). When only considering the IoT identifier in the physical world, the reference model of identification in the IoT is not different from the reference model in [ITU-T Y.2060]. The fact that the IoT identifier should identify devices and physical things in the physical world and virtual things in the information world necessitates a different reference model of identification in the IoT.

In [ITU-T Y.2060] a device, a physical thing and a virtual thing are described as follows:

– A device is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing.

– A physical thing is an object of the physical world that is capable of being identified and integrated into the communication networks.

– A virtual thing is an object of the information world that is capable of being identified and integrated into the communication network.

A physical thing may be represented in the information world via one or more virtual things (mapping), but a virtual thing can exist without an associated physical thing. A device and a physical thing are well identified in the [ITU-T Y.2060] reference model, but it is difficult to identify a virtual thing in that reference model. Therefore, it is required to associate identifiers in the physical world with identifiers in the information world and vice versa.

– Mapping capability: Mapping capability is a particular capability that can be used by two different worlds. Due to the nature of different characteristics of the physical world and the information world, identifiers in each world may be different. This capability associates identifiers in the physical world with identifiers in the information world and vice versa.

11 Reference model of identification in the IoT

Figure 11-1 shows a reference model of identification in the IoT where an identifier in each layer is used to identify specific objects in each layer (see clause 9.5). As shown in Figure 11-1, identifiers in each layer in the physical world may be associated with identifiers in the information world. For some specific cases, only related identifiers in the physical world may be associated with identifiers in the information world. In this scenario, mapping capability associates (all or some specific) identifiers in the physical world with the identifier in the information world and vice versa.

Figure 11-2 shows a reference model of identification where one identifier is used to identify specific objects in all layers (see in clause 9.5). As shown in Figure 11-2, one identifier in the physical world

may be associated with identifiers in the information world. In this scenario, mapping capability associates one identifier in the physical world with identifiers in the information world and vice versa.

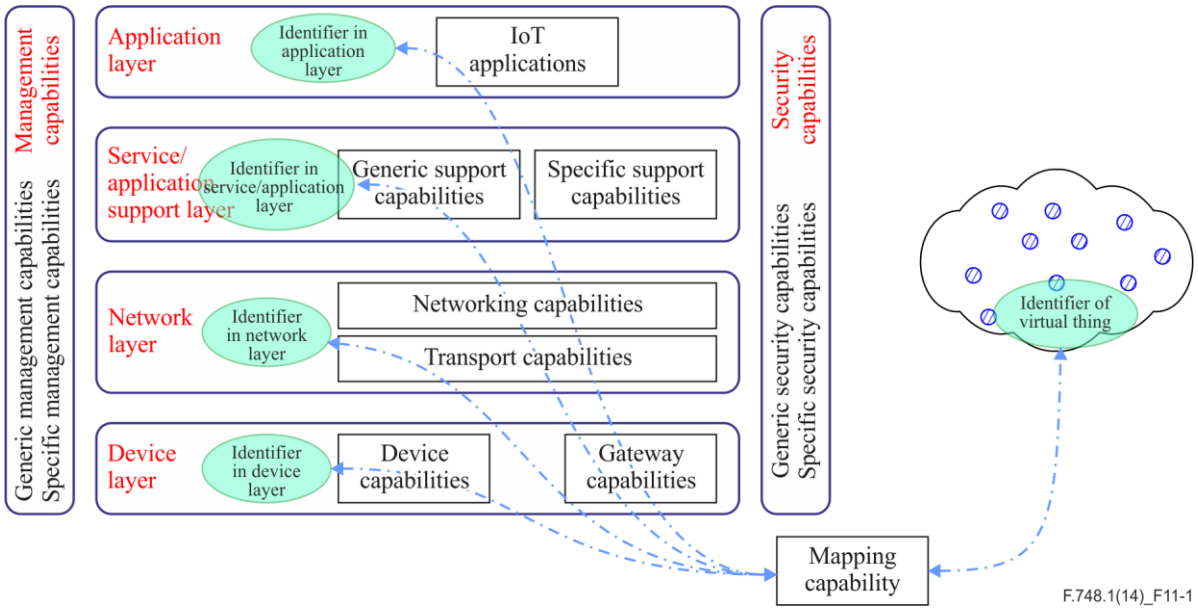

Figure 11-1 – Reference model of identification (case (a) in Figure 9-1)

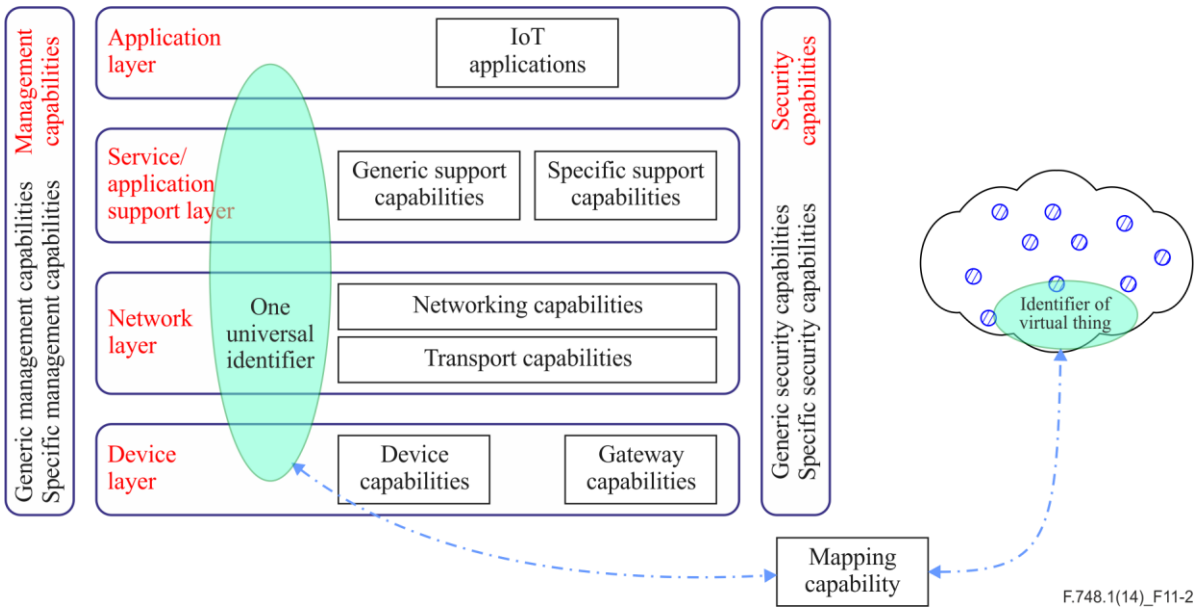

Figure 11-2 – Reference model of identification (case (b) in Figure 9-1)

Bibliography

[b-ITU-T F.771] Recommendation ITU-T F.771 (2008), *Service description and requirements for multimedia information access triggered by tag-based identification*; Amendment 1 (2014).

[b-3GPP 22.988] 3GPP TR 22.988 v12.2.0 (2012-09), *Study on alternatives to E.164 for Machine-Type Communications (MTC).*

[b-3GPP 23.003] 3GPP TS 23.003 v11.0.0 (2011-12), *Numbering, addressing and identification*.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	**Non-telephone telecommunication services**
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2015