
**Information technology — Automatic
identification and data capture
technique — Identifier resolution protocol
for multimedia information access
triggered by tag-based identification**

*Technologies de l'information — Techniques automatiques
d'identification et de capture des données — Protocole de résolution
d'identification de l'accès à des données multimédia déclenché par une
identification basée sur des labels*

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Published in Switzerland

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ISO/IEC 29177 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*, in collaboration with ITU-T. The identical text is published as ITU-T H.642.3 (06/2012).

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TELECOMMUNICATION
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H.642.3

(06/2012)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Broadband, triple-play and advanced multimedia
services – Ubiquitous sensor network applications and
Internet of Things

**Information technology – Automatic
identification and data capture technique –
Identifier resolution protocol for multimedia
information access triggered by tag-based
identification**

Recommendation ITU-T H.642.3

ITU-T H-SERIES RECOMMENDATIONS
AUDIOVISUAL AND MULTIMEDIA SYSTEMS

CHARACTERISTICS OF VISUAL TELEPHONE SYSTEMS	H.100–H.199
INFRASTRUCTURE OF AUDIOVISUAL SERVICES	
General	H.200–H.219
Transmission multiplexing and synchronization	H.220–H.229
Systems aspects	H.230–H.239
Communication procedures	H.240–H.259
Coding of moving video	H.260–H.279
Related systems aspects	H.280–H.299
Systems and terminal equipment for audiovisual services	H.300–H.349
Directory services architecture for audiovisual and multimedia services	H.350–H.359
Quality of service architecture for audiovisual and multimedia services	H.360–H.369
Supplementary services for multimedia	H.450–H.499
MOBILITY AND COLLABORATION PROCEDURES	
Overview of Mobility and Collaboration, definitions, protocols and procedures	H.500–H.509
Mobility for H-Series multimedia systems and services	H.510–H.519
Mobile multimedia collaboration applications and services	H.520–H.529
Security for mobile multimedia systems and services	H.530–H.539
Security for mobile multimedia collaboration applications and services	H.540–H.549
Mobility interworking procedures	H.550–H.559
Mobile multimedia collaboration inter-working procedures	H.560–H.569
BROADBAND, TRIPLE-PLAY AND ADVANCED MULTIMEDIA SERVICES	
Broadband multimedia services over VDSL	H.610–H.619
Advanced multimedia services and applications	H.620–H.629
Ubiquitous sensor network applications and Internet of Things	H.640–H.649
IPTV MULTIMEDIA SERVICES AND APPLICATIONS FOR IPTV	
General aspects	H.700–H.719
IPTV terminal devices	H.720–H.729
IPTV middleware	H.730–H.739
IPTV application event handling	H.740–H.749
IPTV metadata	H.750–H.759
IPTV multimedia application frameworks	H.760–H.769
IPTV service discovery up to consumption	H.770–H.779
Digital Signage	H.780–H.789

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

**Information technology – Automatic identification and data capture technique –
Identifier resolution protocol for multimedia information access triggered
by tag-based identification**

Summary

Recommendation ITU-T H.642.3 | ISO/IEC 29177 specifies the identifier (ID) resolution protocol for multimedia information access triggered by tag-based identification. This ID resolution protocol is used to retrieve the location and access method of the multimedia information associated with an ID.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.642.3	2012-06-29	16

Keywords

Identifier, IRP, resolution, tag-based identification.

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.

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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.

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CONTENTS

	<i>Page</i>
1 Scope	1
2 Normative references.....	1
2.1 Identical Recommendations International Standards	1
2.2 Additional references	1
3 Definitions.....	1
3.1 Imported definitions	1
3.2 Additional definitions.....	2
4 Abbreviations and acronyms	2
5 Overview of the ID resolution protocol.....	2
6 Application-specific OID resolution process.....	3
6.1 Overview	3
6.2 OID transformation rules	4
6.3 ID structure information.....	4
6.4 Operation of a client.....	4
6.5 Format of NAPTR resource record	5
6.6 Operation of application-specific OID resolution servers	5
7 ID resolution process.....	5
7.1 Overview	5
7.2 Query to ID resolution server	6
7.3 Response from ID resolution server.....	6
7.4 Configuration of NAPTR resource record	6
7.5 Operation of a client.....	6
7.6 Operation of ID resolution servers	7
Annex A – Configuration and operation of application-specific OID resolution process	8
A.1 Assumptions	8
A.2 Configuration of NAPTR resource records.....	8
A.3 Operation example	9
Annex B – Configuration and operation of ID resolution servers	10
Annex C – Bibliography	11

List of Tables

	<i>Page</i>
Table 1 – Example of NAPTR resource record format.....	5
Table 2 – Example of NAPTR resource record configuration.....	6

List of Figures

	<i>Page</i>
Figure 1 – Overall procedure of ID resolution.....	3
Figure 2 – Operation of application-specific OID resolution process.....	4
Figure B.1 – An example of delegation hierarchy of ID resolution servers	10

Introduction

This Recommendation | International Standard specifies the identifier (ID) resolution protocol (IRP). This ID resolution protocol is used to retrieve the location and access method of the multimedia information associated with an ID.

Clause 6 provides an overview of the ID resolution protocol.

Clause 7 specifies the application-specific OID resolution process which will follow the general OID resolution process defined in Rec. ITU-T X.672 | ISO/IEC 29168-1.

Clause 8 specifies the ID resolution process.

There are alternative techniques to meet the use case addressed by this Recommendation | International Standard. One of those techniques is the use of the Electronic Product Code (EPC) and the Object Name Service (ONS). Those interested in this technique are encouraged to consult the documents in the Bibliography for further information.

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

Information technology – Automatic identification and data capture technique – Identifier resolution protocol for multimedia information access triggered by tag-based identification**1 Scope**

This Recommendation | International Standard defines the identifier (ID) resolution protocol for multimedia information access triggered by tag-based identification which is described in Recommendations ITU-T F.771 and ITU-T H.621.

The identifier resolution protocol (IRP) in this Recommendation | International Standard consists of two processes: an application-specific object identifier (OID) resolution process which is specified in Rec. ITU-T X.672 | ISO/IEC 29168-1 and an identifier resolution process.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- Recommendation ITU-T X.668 (2009) | ISO/IEC 9834-9:2009, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: Registration of object identifier arcs for applications and services using tag-based identification.*
- Recommendation ITU-T X.672 | ISO/IEC 29168-1, *Information technology – Open Systems Interconnection – Object Identifier Resolution System (ORS).*

2.2 Additional references

- Recommendation ITU-T F.771 (2008), *Service description and requirements for multimedia information access triggered by tag-based identification.*
- Recommendation ITU-T H.621 (2009), *Architecture of a system for multimedia information access triggered by tag-based identification.*
- IETF RFC 1035:1987, *Domain names – Implementation and specification.*
- IETF RFC 3403:2002, *Dynamic Delegation Discovery System (DDDS) Part Three: The Domain Name System (DNS) Database.*

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Imported definitions

3.1.1 This Recommendation | International Standard uses the following terms defined in Rec. ITU-T X.672 | ISO/IEC 29168-1:

- a) application-specific OID resolution process;
- b) general OID resolution process;

ISO/IEC 29177:2016 (E)

3.1.2 This Recommendation | International Standard uses the following terms defined in Rec. ITU-T F.771:

- a) ID tag;
- b) ID terminal.

3.2 Additional definitions

3.2.1 **ID resolution protocol (IRP):** A protocol used to find uniform resource locator (URL) of multimedia information associated with ID.

3.2.2 **ID resolution server (IRS):** A server that contains location and access method information of multimedia information and resolves an ID into URL of associated information.

3.2.3 **mobile AIDC service:** Use of a mobile AIDC application to provide a value to end users.

4 Abbreviations and acronyms

For the purposes of this Recommendation | International Standard, the following abbreviations and acronyms apply.

AIDC	Automatic Identification and Data Capture
C2U	Code to URL
DNS	Domain Name System
EPC	Electronic Product Code
FQDN	Fully Qualified Domain Name
HLC	High Level Code
ID	Identifier
IRP	ID Resolution Protocol
IRS	ID Resolution Server
MIDS	Multimedia Information Delivery Server
NAPTR	Naming Authority Pointer
NS	(DNS) Name Server
OID	Object Identifier
ONS	Object Name Service
ORS	OID Resolution System
RegExp	Regular Expression
RFID	Radio Frequency ID
TLC	Top Level Code
URL	Uniform Resource Locator

5 Overview of the ID resolution protocol

This clause defines an overall architecture of the ID resolution protocol (IRP) for multimedia information access triggered by tag-based identification based on the architecture described in clause 6 of Rec. ITU-T H.621, requirements described in clause 7.3 of Rec. ITU-T F.771, and the OID resolution system in Rec. ITU-T X.672 | ISO/IEC 29168-1.

Figure 1 shows the overall architecture of the IRP.

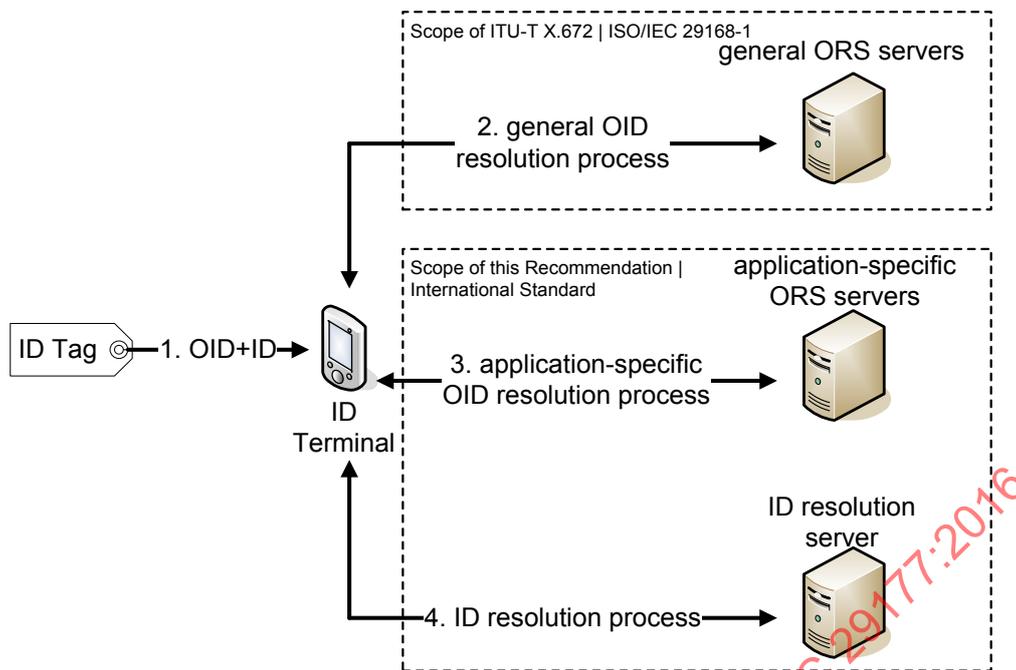


Figure 1 – Overall procedure of ID resolution

The overall ID resolution is composed of two processes: application-specific OID resolution process and ID resolution process. The general OID resolution process is out of the scope of this Recommendation | International Standard.

In the multimedia information access process triggered by tag-based identification, an ID terminal reads the ID from an ID tag such as a barcode and a radio frequency ID (RFID) (Step 1). The OID may be available directly from the tag or may be added by the tag reader and its software before the ID is passed to the ID terminal; or application software on the ID terminal may add an OID based on other context information.

If the ID terminal does not know how to process the ID, it first sends the OID to an OID resolution system (ORS) server. The ORS server sends back to the ID terminal ID processing information which contains a converting rule of ID into a specific format for the ID resolution protocol (Steps 2 and 3). If the ID terminal knows how to process the ID read from the ID tag, it can skip both the general and the application-specific OID resolution process.

The ID terminal then sends the ID in a suitable format for ID resolution to an ID resolution server (Step 4). The ID resolution server gets the ID as an input, and returns a URL of multimedia information contained in the multimedia information delivery server (MIDS).

Lastly, the ID terminal accesses the MIDS to obtain corresponding multimedia information.

This Recommendation | International Standard specifies the application-specific OID resolution process for multimedia information access triggered by tag-based identification and the ID resolution process for Steps 3 and 4 in Figure 1.

The general OID resolution process is defined in Rec. ITU-T X.672 | ISO/IEC 29168-1 and it will return some information which will be used in the application-specific OID resolution process for multimedia information access triggered by tag-based identification. An ID resolution process will follow this application-specific OID resolution process.

6 Application-specific OID resolution process

6.1 Overview

The application-specific OID resolution process works based on the domain name system (DNS) protocol defined in IETF RFC 1035 and the naming authority pointer (NAPTR) resource records defined in IETF RFC 3403.

The application-specific OID resolution process is initiated when the general OID resolution process returns an ORS service type "**ORS+TINF**". The returned NAPTR resource record with this service type contains a location address of application-specific ORS resolution server. An ID terminal should send a DNS query to this server with an OID as an input. The result of this application-specific OID resolution process is ID structure information in **RegExp** field of a responding NAPTR resource record.

6.2 OID transformation rules

The OID should be converted in the fully qualified domain name (FQDN) form to be sent to the application-specific OID resolution server. The transformation rule of OID into FQDN is defined as following three steps:

- Step 1: separate each arc with period (".")
- Step 2: reverse the order of the arcs
- Step 3: add ".oid-res.org." at the end of result from Step 2

For example, OID {2 27 1} will be converted as "1.27.2.oid-res.org."

6.3 ID structure information

The ID structure information is stored in NAPTR resource records at the application-specific ORS server. The ID structure information is expressed in **RegExp** field of NAPTR resource record using POSIX regular expression. This rule is substitution syntax of ID into a certain format for ID resolution process.

For this purpose, following new **Service** field values of NAPTR resource record shall be defined.

- IRP+FFT:** Fixed Form Type identifier scheme. It indicates that **RegExp** field contains a rule for converting an ID into a certain format for ID resolution process and it needs no more query to an application-specific ORS server.
- IRP+VFT:** Variable Form Type identifier scheme. It indicates that **RegExp** field contains a rule for extracting some fields from an ID and it needs more query to an application-specific ORS server.

For example, the following NAPTR resource record is for FFT identifier scheme.

```
0 100 "U" "IRP+FFT" "!^(.{3})(.{5}).{3}$!\2.\1.anydomain.example.com.!".
```

Applying the above **RegExp** to an ID, of which total length is 11 bits, a text string is obtained in the form of "nnnnn.nnn.anydomain.example.com." where **n** is either '0' or '1'.

Here is another example. The following NAPTR resource record is for VFT identifier scheme.

```
0 100 "U" "IRP+VFT" "!^(.{2}).{11}$!\1!".
```

Applying the above **RegExp** to an ID, the first 2 bits of the ID is obtained which total length is 13 bits.

6.4 Operation of a client

Figure 2 shows the operation of a client in an application-specific OID resolution process.

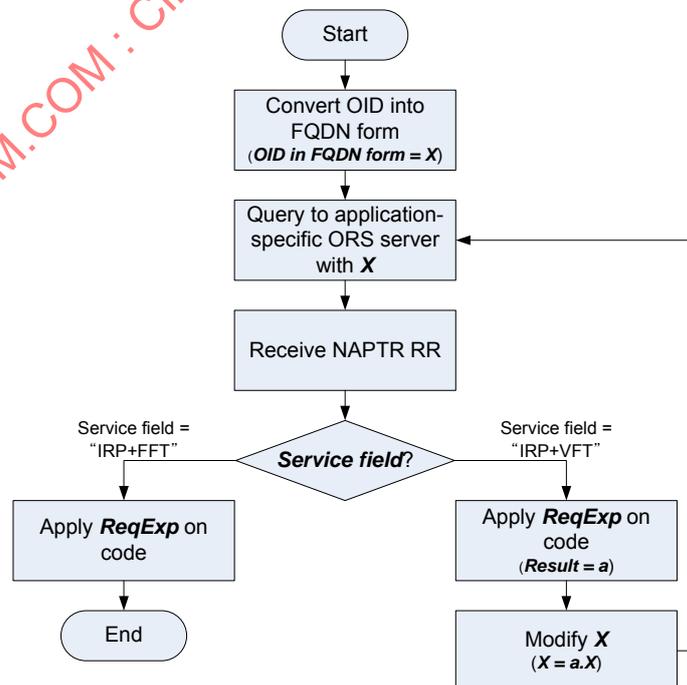


Figure 2 – Operation of application-specific OID resolution process

The client converts an OID into an FQDN form as defined in clause 7.1 and sends it to the application-specific ORS server. When the client receives a NAPTR resource record with the **Service** field value of "**IRP+FFT**", it applies the rule in **RegExp** field on the ID and obtains a new text value suitable for ID resolution process. When the client receives a NAPTR resource record with the **Service** field value "**IRP+VFT**", it applies the rule in **RegExp** field on the ID and obtains a new text value which is added to the front of the OID in FQDN form.

For example, if an OID in FQDN form is "**99.27.2.oid-res.org.**" and the substitution result of applying the **RegExp** field obtained by the query to application-specific ORS server to the ID value is "**5**", then new FQDN form "**5.99.27.2.oid-res.org.**" for the subsequent query will be generated.

6.5 Format of NAPTR resource record

The contents of a NAPTR resource record are formatted as in the example of Table 1.

Table 1 – Example of NAPTR resource record format

Order	Preference	Flags	Service	RegExp	Replacement
0	100	u	IRP+FFT	!^(. {2}) . {11}\$!\\1!	.

The application-specific OID resolution server operators should obey the following rules to configure the NAPTR resource record:

- The order field should be zero.
- The preference field should be non-negative integer.
- The flags field should be set to "u", indicating that the **RegExp** field contains URL.
- The service field should be set to "**IRP+VFT**" or "**IRP+FFT**" (See 7.2).
- The **RegExp** field specifies an ID structure information. The value of this field should be the string **!^ID structure information!**

6.6 Operation of application-specific OID resolution servers

The application-specific OID resolution server should behave as a DNS server which is defined in IETF RFC 1035.

NOTE – An example configuration and operation of the application-specific OID resolution process is given in Annex A.

7 ID resolution process

7.1 Overview

The ID resolution process uses the DNS protocol as defined in IETF RFC 1035 and NAPTR resource records as defined in IETF RFC 3034.

The purpose of this process is to find location and access method information for the multimedia information associated with an ID by using the DNS. In order to use the DNS, the ID should be converted into an FQDN format that the DNS can understand.

DNS servers used for this ID resolution process may contain a delegation pointer to another DNS server in NS records or URL of multimedia information associated with ID in the NAPTR Resource Record.

The ID terminal reads an ID from an ID tag. It then knows how to convert the ID into the FQDN form, and it converts the ID into an FQDN form for sending it as part of a DNS query. If the user terminal does not know how to convert the ID into an FQDN form, it should initiate an OID resolution process as specified in Rec. ITU-T X.672 | ISO/IEC 29168-1.

The NAPTR type is used for the DNS query. This DNS query is sent to the default DNS server (local DNS server). If the default DNS server has a NAPTR resource record for that ID, it returns the NAPTR resource record which includes the URL of the multimedia information content. If the default DNS server does not have any NAPTR resource record for that ID, it sends a query to the ROOT DNS server and the ROOT DNS server returns the IP address of another DNS server which has been delegated from the delegation hierarchy of the ID. The default DNS server then sends another query to this new address. This procedure runs recursively until a NAPTR resource record can be obtained. When the default DNS server successfully receives a NAPTR resource record, it sends the NAPTR resource record back to the ID terminal and the ID resolution process is completed.

In the case of using EPC Tag Data in the EPC Tag Data Standard, the ID resolution process shall follow the Object Name Service (see document Object Name Service (ONS)).

7.2 Query to ID resolution server

This clause specifies the DNS query format. The ID in this query should be presented in an FQDN format and the query type should be set to "NAPTR".

The rule to convert an ID into an FQDN format is defined as follows:

STEP 1: Put dots (".") between each field, producing for example, 101010.101.11

STEP 2: Convert binary digits into hexadecimal, producing for example, 2A.5.3

STEP 3: Reverse the order, producing for example, 3.5.2A

STEP 4: Append the string ".anydomain.example.com.", producing for example, 3.5.2A.anydomain.example.com.

NOTE – The anydomain.example.com here means the domain name for a particular identifier scheme. Each identifier scheme should have a unique domain name to use ID resolution protocol in this Recommendation | International Standard. If OID resolution process is performed, this converting process automatically done by application-specific OID resolution process.

7.3 Response from ID resolution server

This clause specifies the DNS response format.

The URL of multimedia information associated with ID is contained in **RegExp** field. The rule for setting each field of NAPTR resource record is specified in clause 7.4.

7.4 Configuration of NAPTR resource record

The content of a NAPTR resource record is formatted as in the example of Table 2.

Table 2 – Example of NAPTR resource record configuration

Order	Preference	Flags	Service	RegExp	Replacement
0	100	u	C2U	!^.*\$!http://anydomain.example.com/example1.html!	.

ID resolution server operators should obey the following rules to configure the NAPTR resource record:

- a) The order field should be zero.
- b) The preference field should be a non-negative integer.
- c) The flags field should be set to "u", indicating that the **RegExp** field contains a URL.
- d) The service field should be set to "C2U".
- e) The **RegExp** field specifies a URL of multimedia information. The value of this field should be the string **!^.*\$!URL of multimedia content!**

NOTE – NAPTR record with 'C2U' in **Service** field should contain a valid URL in the **RegExp** field.

7.5 Operation of a client

The client should use the following procedure to interpret the results returned by a DNS query:

- STEP 1: From the results of the query, select those NAPTR resource records which have flag field value "u" and service field value "C2U". If there is no such record, stop.
- STEP 2: From the result from STEP 1, select those records having the lowest value in the preference field.
- STEP 3: From the result from STEP 2, select a record randomly.
- STEP 4: Extract the URL from the record from STEP 3, by extracting the substring between the "!^.*\$!" and the "!".
- STEP 5: Get multimedia contents using the URL from STEP 4.
- STEP 6: If STEP 5 is not successful, go back to STEP 3, using a different record from the STEP 2. If all records from STEP 2 have been tried, go back to STEP 2 using record from STEP 1 having the next lowest value in the preference field. If all records from STEP 1 have been tried, stop.

7.6 Operation of ID resolution servers

The ID resolution server should behave as the DNS server which is defined in IETF RFC 1035.

NOTE – An example configuration of ID resolution servers is available in Annex B.

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