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SERIES Q: SWITCHING AND SIGNALLING, AND ASSOCIATED MEASUREMENTS AND TESTS

Signalling requirements and protocols for the NGN – VoLTE/ViLTE network signalling

Protocol at the interface between two distributed ENUM servers for IMS

Recommendation ITU-T Q.3645

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Recommendation ITU-T Q.3645

Protocol at the interface between two distributed ENUM servers for IMS

Summary

Recommendation ITU-T Q.3645 defines the protocol at the interface between two distributed ITU-T E.164 number mapping (ENUM) servers (DES) of a distributed ENUM system in support of IP multimedia core network subsystem (IMS) interconnection. Based on the functions and signalling requirements defined in Recommendation ITU-T Q.3643, this Recommendation provides the reference model, procedures, protocol and message specification for the interface between two DES.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Q.3645	2020-09-29	11	11.1002/1000/14414

Keywords

Distributed, ENUM, IMS, protocol.

* 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.

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

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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/.

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Protocol at the interface between two distributed ENUM servers for IMS

1 Scope

This Recommendation specifies the protocol at the interface between two distributed ENUM servers (DES) of distributed ENUM networking in support of IP Multimedia core network subsystem (IMS) interconnection. The functions and signalling requirements for this interface are contained in [ITU-T Q.3643].

Using the protocol specified in this Recommendation, the DES can:

– initiate and provide a response to a DES node management request, including the requests for adding a DES node to and remove a DES node from a distributed ENUM system;

– initiate and provide a response to a DES ENUM data management request, including requests for ENUM data records adding, ENUM data records modification, ENUM data records cancellation, etc.

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 Q.3643] Recommendation ITU-T Q.3643 (2020), *Signalling architecture of distributed infrastructure ENUM networking for IMS.*

[IETF RFC 7230] IETF RFC 7230 (2014), *Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing.*

[IETF RFC 7231] IETF RFC 7231 (2014), *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content.*

[IETF RFC 7232] IETF RFC 7232 (2014), *Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests.*

[IETF RFC 7235] IETF RFC 7235 (2014), *Hypertext Transfer Protocol (HTTP/1.1): Authentication.*

[W3C SOAP] W3C Recommendation (2007), *SOAP Version 1.2 Part 1: Messaging Framework (Second Edition).*

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DES Distributed ENUM server

ENUM ITU-T E.164 Number Mapping

HTTP Hypertext Transfer Protocol

IMS IP Multimedia Core Network Subsystem

NAPTR Naming Authority Pointer

SIP Session Initiation Protocol

SOAP Simple Object Access Protocol

URI Uniform Resource Identifier

5 Conventions

In this Recommendation:

The phrase "is recommended" indicates a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be satisfied to claim conformance.

In the body of this document, the word "should" sometimes appear, in which case it is to be interpreted, respectively, as the phrase "is recommended".

6 Interface between two distributed ENUM servers

6.1 Overview

The Idd interface (defined in clause 6.2) is used for information exchange to synchronize the status and the ENUM data profile of the distributed ENUM servers. The information is used by the IMS SIP proxy for ENUM resolution.

The Idd interface is an inter-operator interface. One distributed ENUM server shall be able to interact with a number of distributed ENUM servers via Idd interfaces in support of interconnection with ENUM servers in different IMS domains.

6.2 Idd reference model

The Idd interface, as shown in Figure 6-1, is defined between two distributed ENUM servers for IMS inter-domain connection. The Idd interface is used for node management and ENUM data management in the distributed ENUM networking environment.

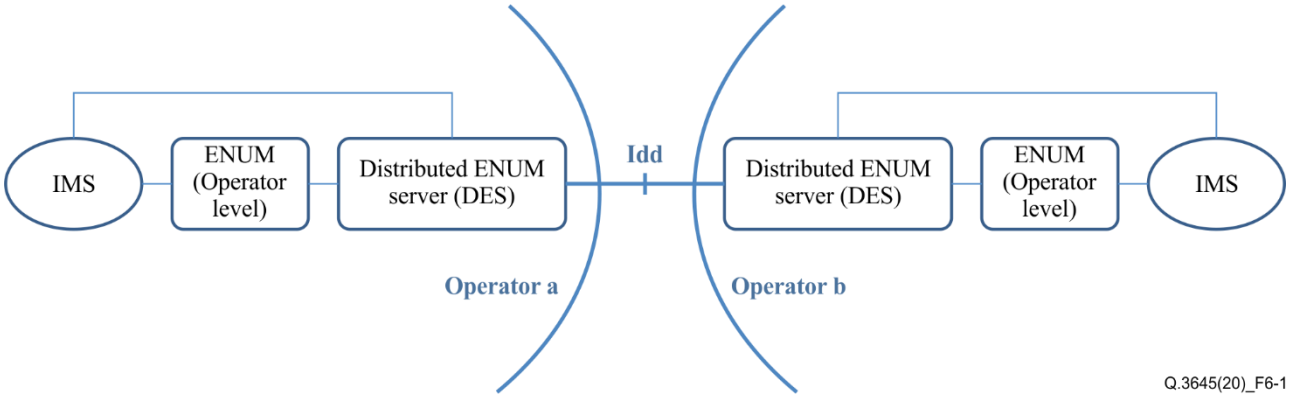

Figure 6-1 – Idd reference model

6.3 Functional elements and capabilities

The DES is a functional element that serves for inter-operator IMS session establishment and provides mapping of ITU-T E.164 numbers to uniform resource identifiers (URIs). The DES stores the ENUM mapping data profile of the host operator and the connecting operators. It performs the ENUM data management procedures to synchronize the ENUM data profile of the connecting DES via Idd interface.

7 DES procedures

7.1 DES node management procedures

7.1.1 DES node added to a distributed ENUM system

Figure 7-1 shows the DES node adding procedure when a DES of a newly involved operator wants to broadcast its ENUM profile to and get ENUM profile from relevant DESs.

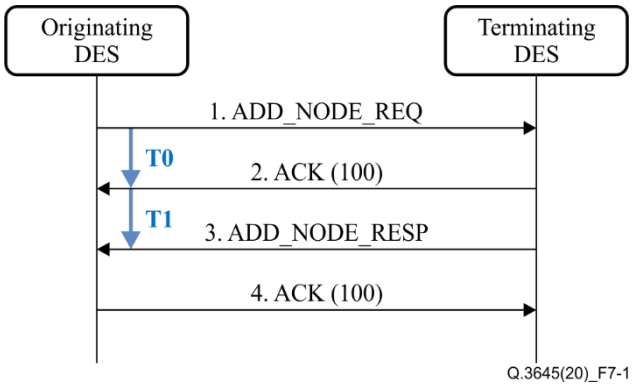

Figure 7-1 – DES node added to a distributed ENUM system

The following steps are performed:

1. The originating DES sends an ADD_NODE_REQ message to the terminating DES for transferring the ENUM mapping data profile of the originating DES and requesting for the ENUM mapping data profile of terminating DES. T0 timer is started.

NOTE 1 – T0 is the maximum duration between sending a request/response message and receiving the message acknowledgement.

The ADD_NODE_REQ message should include:

1) Message identifier
2) The originating operator identifier
3) The terminating operator identifier
4) The IP address of the originating DES
5) The IP address of the terminating DES
6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication
7) ENUM mapping data list which includes the ENUM mapping naming authority pointer (NAPTR) records
8) Timestamp of activation which presents the date and time of involving the ENUM mapping data of originating DES.

2. The originating DES starts timer T1 when receives an ACK (100) from the terminating DES.

NOTE 2 – The timer T1 is the maximum duration between the originating DES receiving an ACK (100) for request message and receiving response message.

3. The terminating DES stores and activates the receiving ENUM mapping data profile of the originating DES. It sends a response to the originating DES with an ADD_NODE_RESP message that contains the requested ENUM mapping data profile of the terminating DES. The originating DES stores and activates the receiving ENUM mapping data profile of the terminating DES.

The ADD_NODE_RESP message should include:

1) Message identifier
2) The originating operator identifier
3) The terminating operator identifier
4) The IP address of the originating DES
5) The IP address of the terminating DES
6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication
7) The result code and result description of the activation of the originating DES.

4. The originating DES sends ACK (100) to the terminating DES with successful acknowledgement.

7.1.2 DES node removed from a distributed ENUM system

Figure 7-2 shows the DES node removed procedure when the operator of the originating DES decides to end the interconnection agreement with the operator of the terminating DES.

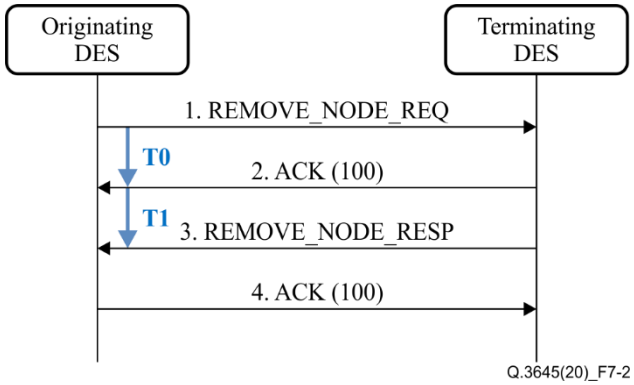

Figure 7-2 – DES node removed from a distributed ENUM system

The following steps are performed:

1. The originating DES sends a REMOVE_NODE_REQ message to the terminating DES to leave the distributed ENUM system.

The REMOVE_NODE_REQ message should include:

1) Message identifier
2) The originating operator identifier
3) The terminating operator identifier
4) The IP address of the originating DES
5) The IP address of the terminating DES
6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) ENUM mapping data list which includes the ENUM mapping NAPTR records

2. The originating DES starts timer T1 when it receives an ACK (100) from the terminating DES.

3. The terminating DES removes the ENUM mapping data profile related to the originating DES and sends a REMOVE_NODE_RESP message to confirm the deactivation of the originating DES. The originating DES removes the ENUM mapping data profile related to the terminating DES. The REMOVE_NODE_RESP message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The result code and result description of the deactivation of the originating DES.

4. The originating DES sends ACK (100) to the terminating DES with successful acknowledgement.

7.2 ENUM data profile management

7.2.1 NAPTR records added to DES

Figure 7-3 shows the ENUM data management procedure when the originating DES adds ENUM NAPTR records and broadcasts the request of adding NAPTR record to the relevant terminating DESs.

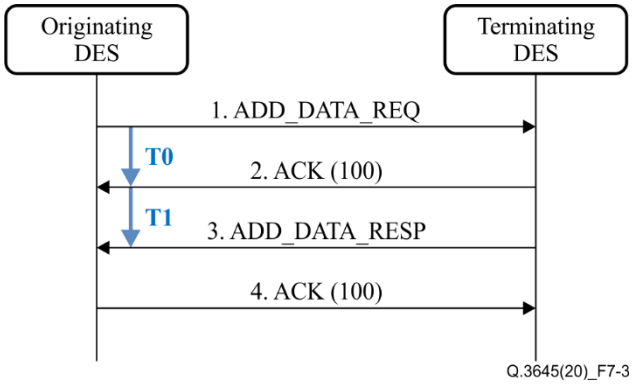

Figure 7-3 – NAPTR records added to DES

The following steps are performed:

1. The originating DES initiates an ADD_DATA_REQ message to indicate to the terminating DES to add new NAPTR records into the ENUM mapping data profile of the originating DES.

The ADD_DATA_REQ message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The ENUM mapping NAPTR records to be added.

2. The originating DES initiates T1 timer when it receives an ACK (100) from the terminating DES.

3. The terminating DES adds the new NAPTR records accordingly and sends the ADD_DATA_RESP message to inform the originating DES whether the result of adding existing ENUM NAPTR records is successful or not.

The ADD_DATA_RESP message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The result code and result description of the adding ENUM mapping NAPTR records.

4. The originating DES sends ACK (100) to the terminating DES with successful acknowledgement.

7.2.2 NAPTR records modified in DES

Figure 7-4 shows the self-management procedure when the key features of existing ENUM NAPTR records were modified in originating DES and the originating DES broadcasts the request of the modification of NAPTR record to relevant terminating DESs.

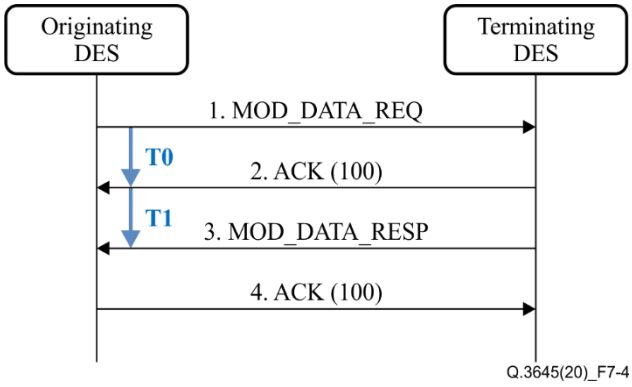

Figure 7-4 – NAPTR records modified in DES

The following steps are performed:

1. The originating DES initiates a MOD_DATA_REQ message to indicate to the terminating DES to modify the existing NAPTR records of ENUM mapping data profile of the originating DES.

The MOD_DATA_REQ message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The ENUM mapping NAPTR records to be modified.

2. The originating DES initiates T1 timer when it receives an ACK (100) from the terminating DES.

3. The terminating DES modifies the requested ENUM NAPTR records accordingly and sends the MOD_DATA_RESP message to inform the originating DES whether the result of modification of existing ENUM NAPTR records is successful or not.

The MOD_DATA_RESP message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The result code and result description of the modification of requested ENUM mapping NAPTR records.

4. The originating DES sends ACK (100) to the terminating DES with successful acknowledgement.

7.2.3 NAPTR records removed from DES

Figure 7-5 shows the self-management procedure when the existing ENUM NAPTR record was removed in the originating DES and the originating DES broadcasts the request of removal of NAPTR record to relevant terminating DESs.

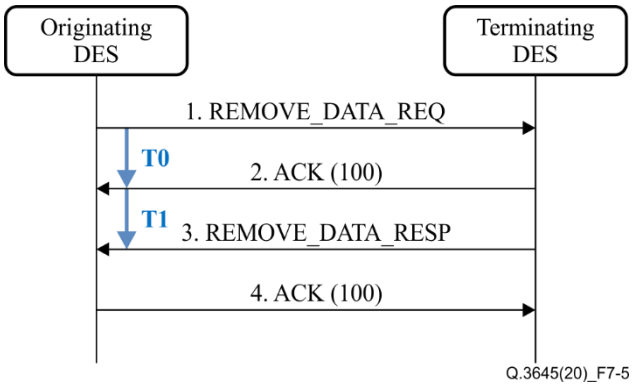

Figure 7-5 – NAPTR records removed from DES

The following steps are performed:

1. The originating DES initiates a request to remove existing NAPTR records of ENUM mapping data profile of the originating DES.

The REMOVE_DATA_REQ message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The ENUM mapping NAPTR records to be cancelled.

2. The originating DES initiates T1 timer when receives an ACK (100) from the terminating DES.

3. The terminating DES cancels the requested ENUM NAPTR records accordingly and sends a REMOVE_DATA_RESP message to indicate to the originating DES whether the result of cancellation of existing ENUM NAPTR records is successful or not.

The REMOVE_DATA_RESP message should include:

1) Message identifier

2) The originating operator identifier

3) The terminating operator identifier

4) The IP address of the originating DES

5) The IP address of the terminating DES

6) The broadcast identifier which can associate the broadcast confirmation with the broadcast indication

7) The result code and result description of the cancellation of requested ENUM mapping NAPTR records.

4. The originating DES sends ACK (100) to the terminating DES with successful acknowledgement.

7.3 Error handling procedures

7.3.1 Message acknowledgement and response timeout

When a DES sends a request/response message which does not receive an ACK message after a T0 timeout, it should retransmit the request/response message and wait for the acknowledgement accordingly. The DES should alarm when it does not receive any ACK message after five retransmits of the request/response message.

When a DES sends a request message which does not receive the response after a T1 timeout, it should retransmit the request message and trigger a system alarm at the meanwhile.

7.3.2 Message acknowledgement errors handling

Table 2 in clause 9 lists the values of message acknowledgement errors in the sender system and receiver system. When the receiver recognizes an error of the sender system, an ACK with value 4XX should be sent to the sender. When a receiver error occurs, an ACK with value 5XX should be sent to the sender.

7.3.3 Service errors handling

Table 3 in clause 9 lists the values of service errors for dealing with the service request. When an error occurs in dealing with a service request, a response with a result code 6XX should be sent to the sender.

8 Protocol specification

The Simple Object Access Protocol (SOAP) defined by [W3C SOAP] is used to support information transfer on the Idd interface. [W3C SOAP] shall apply except as modified by the additional

commands, results and event codes specified in this Recommendation. Unless otherwise indicated, the procedures of [W3C SOAP] (including error handling and unrecognized information handling) are unmodified. HTTP POST over TCP is required to apply in the Idd interface in this Recommendation, as per [IETF RFC 7230], [IETF RFC 7231], [IETF RFC 7232], [IETF RFC 7235].

A heartbeat mechanism is required over the network layer of Idd interface to detect the status of the peer DES. During heartbeat interruption, the sending of messages shall be suspended, and all messages that have not been processed shall be automatically resent after heartbeat recovery.

9 Message specification

9.1 Messages

The messages that use the Idd interface are listed in Table 1.

Table1 – Messages that use the Idd interface

Procedures	Message name	Command code	Results
all	Acknowledgement	ACK	Success: 1XX Failure:4XX, 5XX
DES node added to a distributed ENUM system	Add DES node request	ADD_NODE_REQ	–
	Add DES node response	ADD_NODE_RESP	Success: 200 Failure:6XX
DES node removed from a distributed ENUM system	Remove DES node request	REMOVE_NODE_REQ	–
	Remove DES node response	REMOVE_NODE_RESP	Success: 200 Failure:6XX
NAPTR records added to DES	Add new NAPTR records request	ADD_DATA_REQ	–
	Add new NAPTR records response	ADD_DATA_RESP	Success: 200 Failure:6XX
NAPTR records modified in DES	Modify NAPTR records request	MOD_DATA_REQ	–
	Modify NAPTR records response	MOD_DATA_RESP	Success: 200 Failure:6XX
NAPTR records removed from DES	Remove NAPTR records request	REMOVE_DATA_REQ	–
	Remove NAPTR records response	REMOVE_DATA_RESP	Success: 200 Failure:6XX

9.2 Message acknowledgement

The return codes of the ACK message are listed in Table 2.

Table 2 – Return codes of the ACK message

Return code	Description
1XX	Acknowledges the message was successfully received
100	Message and system are normal
101	Repeated message ID
4XX	Sender system error

Table 2 – Return codes of the ACK message

Return code	Description
400	Message parameter length error
401	Message format error, e.g. absence of a mandatory parameter, or mandatory parameter format error
402	Undefined command code
403	Protocol version error
404	Encoding format error
405	Unrecognized or incorrect identity of the sender
406	Invalid message received when timer was expired
407	Unexpected message, e.g. receive a MOD_DATA_RESP instead of an expected ADD_DATA_RESP
408	Received a response message does not have corresponding request message
409	Received a response message with unexpected result code
410	Mismatched parameters, e.g. mismatched originating operator identifier and IP address of the originating DES
5XX	Other errors
500	Abnormal receiver
501	Receiver is too busy to reply to the request

9.3 Result code of the SOAP response message

The result codes of the SOAP response message are listed in Table 3:

Table 3 – Result codes of the SOAP response message

Result code	Description
2XX	Successful response
200	The request was accepted or operation was completed successfully
6XX	Service error
601	Add DES node request is rejected
602	Remove DES node request is rejected
603	Add NAPTR record request is rejected
604	Modify NAPTR record request is rejected
605	Remove NAPTR record request is rejected
699	Other undefined service errors

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[b-ITU-T E.212] Recommendation ITU-T E.212 (2016), *The international identification plan for public networks and subscriptions.*

[b-GSMA PRD IR.67] GSMA PRD IR.67 (2020), *DNS and ENUM Guidelines for Service Providers and GRX and IPX Providers.*

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