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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for the NGN –
Testing for NGN networks

Testing topology for networks and services based on NGN technical means

Recommendation ITU-T Q.3901

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Recommendation ITU-T Q.3901

Testing topology for networks and services based on NGN technical means

Summary

Recommendation ITU-T Q.3901 describes the methodology and list of mandatory tests of NGN functions. This Recommendation is based on Recommendation ITU-T Q.3900. It gives a list of tests related to NGN technical means, NGN solutions and NGN services which shall be used in model and operator networks.

Source

Recommendation ITU-T Q.3901 was approved on 23 January 2008 by ITU-T Study Group 11 (2005-2008) under Recommendation ITU-T A.8 procedure.

Keywords

Model networks, next generation networks (NGN), PSTN, service testing, technical means, testing.

FOREWORD

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Recommendation ITU-T Q.3901

Testing topology for networks and services based on NGN technical means

1 Scope

This Recommendation defines the list of checks to be performed during the testing of NGN (NGN TM local testing, NUT and services) in model and operator networks.

This Recommendation defines the tasks for NGN TM, NUT and services testing on NGN for model and operator network, a tests list for model network and operator network, and the reasons for using one or the other network for carrying out the specified test groups.

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.1706] | Recommendation ITU-T Q.1706/Y.2801 (2006), <i>Mobility management requirements for NGN.</i> |
| [ITU-T Q.3900] | Recommendation ITU-T Q.3900 (2006), <i>Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks.</i> |
| [ITU-T X.290] | Recommendation ITU-T X.290 (1995), <i>OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts.</i> |
| [ITU-T X.292] | Recommendation ITU-T X.292 (2002), <i>OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – The Tree and Tabular Combined Notation (TTCN).</i> |
| [ITU-T X.295] | Recommendation ITU-T X.295 (1995), <i>OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Protocol profile test specification.</i> |
| [ITU-T Y.1540] | Recommendation ITU-T Y.1540 (2007), <i>Internet protocol data communication service – IP packet transfer and availability performance parameters.</i> |
| [ITU-T Y.1541] | Recommendation ITU-T Y.1541 (2006), <i>Network performance objectives for IP-based services.</i> |
| [ITU-T Y.2011] | Recommendation ITU-T Y.2011 (2004), <i>General principles and general reference model for Next Generation Networks.</i> |
| [ITU-T Y.2012] | Recommendation ITU-T Y.2012 (2006), <i>Functional requirements and architecture of the NGN release 1.</i> |
| [ITU-T Z.140] | Recommendation ITU-T Z.140 (2006), <i>Testing and Test Control Notation version 3 (TTCN-3): Core language.</i> |



- [ETSI TR 101 667] ETSI TR 101 667 V1.1.2 (1999), *Methods for Testing and Specification (MTS); Network Integration Testing (NIT); Interconnection; Reasons and goals for a global service testing approach.*
<http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=3202>
- [ETSI TS 102 237-1] ETSI TS 102 237-1 V4.1.1 (2003), *Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Interoperability test methods and approaches; Part 1: Generic approach to interoperability testing.*
<http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=17051>
- [ETSI TS 102 237-2] ETSI TS 102 237-2 V4.1.1 (2003), *Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Interoperability test methods and approaches; Part 2: H.323-SIP interoperability test scenarios to support multimedia communications in NGN environments.*
<http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=19707>

3 Definitions

This Recommendation defines the following terms:

3.1 model network: A network which simulates the capabilities similar to those available in telecommunication networks; it has a similar architecture and functionality and uses the same telecommunication technical means.

3.2 NGN technical means: The NGN network equipment which serves as a basis for building next generation network solutions, including applications in public telecommunication networks.

4 Abbreviations

This Recommendation uses the following abbreviations:

ABG-FE	Access Border Gateway Functional Entity
AG	Access Gateway
AGC	Access Gateway Controller
AGC-FE	Access Gateway Control Functional Entity
AM-FE	Access Management Functional Entity
AMG-FE	Access Media Gateway Functional Entity
AN-FE	Access Node Functional Entity
AR-FE	Access Relay Functional Entity
AS	Application Server
AS-FE	Application Support Functional Entity
BGC-FE	Breakout Gateway Control Functional Entity
BICC	Bearer Independent Call Control
DNS	Domain Name System
EN-FE	Edge Node Functional Entity
FTP	File Transfer Protocol

RACF	Resource and Admission Control Function
RGW	Residential Gateway
SAA-FE	Service Authentication and Authorization Functional Entity
S-CSC-FE	Serving Call Session Control Functional Entity
SCTP	Stream Control Transmission Protocol
SDL	Specification and Description Language
SG	Signalling Gateway
SG-FE	Signalling Gateway Functional Entity
SIP	Session Initiation Protocol
SL-FE	Subscription Locator Functional Entity
SMTP	Simple Mail Transfer Protocol
SP	Signalling Point
SS7	Signalling System 7
STP	Signalling Transfer Point
SUP-FE	Service User Profile Functional Entity
SUP-PE	Service User Profile Physical Entity
TAA-FE	Transport Authentication and Authorization Functional Entity
TCAP	Transactional Capabilities Application Part
TCP	Transmission Control Protocol
TE	Terminal Equipment
TMG-FE	Trunking Media Gateway Functional Entity
TSSTP	Test Suite Structure and Test Purpose
TTCN	Tree and Tabular Combined Notation
TUP-FE	Transport User Profile Functional Entity
UDP	User Datagram Protocol
UNI	User Network Interface
URI	Uniform Resource Identifier
USIW-FE	User Signalling InterWorking Functional Entity

5 Testing principles

One should begin testing each component on the so-called NGN TM – locally, as described in clause 5.1. Then one may confidently test a network of NGN TM, as described in clause 5.2. After these tests are complete, service testing may be executed, as discussed in clause 5.3.

5.1 NGN TM local testing methodology

The NGN TM local testing procedure includes several testing stages. The NGN TM local testing scheme is as shown in Figure 5-1. The first stage of NGN TM local testing is based on the methodology described in [ITU-T X.295] and [ETSI TS 102 237-1] and [ETSI TS 102 237-2]. All technical means shall be checked for conformance to ITU-T Recommendations and ETSI standards

under the methodology defined in [ITU-T X.290], especially through the use of TSS&TP and PICS. The following stages shall include NGN TM functional testing, NGN TM functional local testing under load and NGN TM conformance local testing.

A ring scheme is used in the methodology of NGN TM testing. All testing stages depend on the previous testing stage results.

All NGN TM local tests shall be based on the existing and developing methodologies (Figure 5-1). The results of each NGN TM local testing shall be delivered to the global database, whose structure and data format are not defined in this Recommendation.

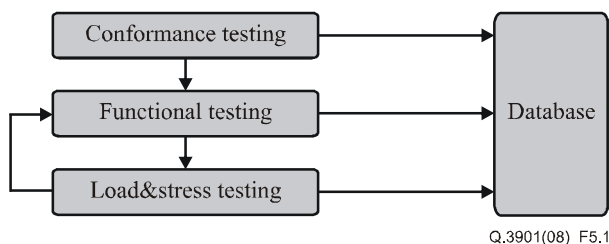


Figure 5-1 – NGN TM local testing methodology

5.1.1 NGN TM functionality testing

Tables 1 and 2 show the NGN TM functional tests list and a short description of each under the list of mandatory functions in the framework of the test described in clause 7.2 of [ITU-T Q.3900]. This Recommendation uses the same designations of the functional entities as shown in Figure 3 of [ITU-T Y.2012].

Table 1 – NGN functions tests list

No.	Tests purpose	Functional entity	Function under test
1.1	The feasibility check to provide interaction between the packet-based transport used in the NGN, and analogue lines or ISDN access.	T-1	Access transport functions
1.2	The feasibility check to support dynamic QoS control and firewall function to access NGN network.	T-2	
1.3	The feasibility check to transmit local pre-set configuration information to the user's equipment when necessary.	T-4	
2.1	The feasibility check to transmit and route traffic from access network to the common transport network, according to QoS mechanisms.	T-3	Edge and access border gateway functions
2.2	The feasibility check to access gateway between access network and core network.	T-5	

Table 1 – NGN functions tests list

No.	Tests purpose	Functional entity	Function under test
3.1	The feasibility check to support firewall functions to interconnect an operator's core network with another operator's core network supporting the packet-based services.	T-6	Core transport functions
3.2	The feasibility check to provide interaction between the packet-based transport used in the NGN and trunk lines from the circuit-switched network.	T-7	
3.3	The feasibility check to provide load processing of packets used in the NGN.	T-8	
3.4	The feasibility check to provide signalling transport interaction between such NGN and existing networks as PSTN, ISDN, IN networks, and signalling system No. 7.	T-9	
4.1	Refer to [ITU-T Y.2011].	T-16	RACF
4.2	Refer to [ITU-T Y.2011].	T-17	
5.1	The feasibility check to provide an access network identifier to a terminal.	T-10	NACF
5.2	The feasibility check to provide authentication and authorization in the transport stratum.	T-11	
5.3	The feasibility check to register the association between the IP address allocated to the user equipment and related network location information provided by the NAC-FE (e.g., access line identifier).	T-13	
5.4	The feasibility check to translate network access requests issued by the user equipment.	T-14	
5.5	The feasibility check to provide the HGW with additional configuration information (e.g., configuration of a firewall internally in the HGW, QoS marking of IP packets, etc.).	T-15	
6.1	The feasibility check to support subscriber-related data.	T-12	Transport user profile functions

Table 1 – NGN functions tests list

No.	Tests purpose	Functional entity	Function under test
7.1	The feasibility check to provide session control, and routing of session messages.	S-1	Service control functions
7.2	The feasibility check to act as the contact point to the user terminal for session services.	S-2	
7.3	The feasibility check to provide a contact point within an operator's network for all connections destined to a user of that network operator.	S-3	
7.4	The feasibility check to provide authentication and authorization in the service stratum.	S-6	
7.5	The feasibility check to interwork with other packet-based networks.	S-7	
7.6	The feasibility check to control one or more AMG-FEs to access PSTN or ISDN users and handle registration, authentication, and security for the user.	S-8	
7.7	The feasibility check to control the TMG-FE for interaction with PSTN/ISDN.	S-9	
7.8	The feasibility check to select defined MGC for interworking with defined PSTN breakout.	S-10	
7.9	The feasibility check to provide an interworking for different types of application signalling at the subscriber side (access-to-core).	S-11	
7.10	The feasibility check to provide an interworking for different types of application signalling at the trunk side (inter-operator).	S-12	
7.11	The feasibility check to control the media resource processing functional entity and allocate/assign MRP-FE resources that are needed for such services as streaming, announcements, and interactive voice response (IVR) support.	S-13	
7.12	The feasibility check to act as a contact point for application support and service support functional entities, as well as user terminals.	S-15	
8.1	The feasibility check to query by the S-CSC-FE, I-CSC-FE, or AS-FE to obtain the address of the SUP-FE for the required subscriber.	S-4	Application/Service support functions
8.2	The feasibility check to store user profiles, subscriber-related location data, and presence status data in the service stratum.	S-5	
8.3	The feasibility check to assign media server resources for real-time calls coming into the network.	S-14	
9.1	The feasibility check to represent the combination of user information and other control data into a single user profile function in the service stratum.		Service user profile functions
10.1	The feasibility check to connect various user terminal equipment to an NGN network.		End user functions

Table 2 – Functional entities' tests list

No.	Test name	Functional entity
1.1	Bidirectional media processing functions.	T-1
1.2	PSTN user call control signalling backhaul.	
1.3	ISDN user call control signalling backhaul.	
1.4	Codecs for user plane traffic.	
1.5	Echo cancellation.	
2.1	Packet filtering.	T-2
3.1	IP routing (L2 and L3).	T-3
4.1	Automatic configuration of end-user terminal equipment.	T-4
5.1	Opening and closing a gate.	T-5
5.2	Packet filtering.	
5.3	Network address and port translation.	
5.4	Media relay for NAT traversal.	
5.5	Collecting and reporting resource usage information.	
6.1	Packet filtering.	T-6
6.2	Network address and port translation.	
7.1	Interworking media trunks circuit-switched network with packet-based transport.	T-7
7.2	Codecs for trunk interworking.	
7.3	Echo cancellers.	
8.1	Allocation of specialized media resources.	T-8
8.2	Collection and generation of DTMF signals.	
8.3	Generation of tone signals.	
8.4	Generation of announcements.	
9.1	Signalling interworking with PSTN/ISDN/IN (2CAS, SS7).	T-9
10.1	IP address allocation to terminals.	T-10
11.1	Users or terminals identification in networks.	T-11
12.1	User profiles, subscriber-related location data, and presence status data.	T-12
12.2	Responses to queries for user profiles.	
13	Testing methods for this functionality will be considered in the context of the other ITU-T Recommendations according to the development of new NGN specifications.	T-13
14.1	Forwarding of network configuration parameters and authentication and authorization requests.	T-14
15	Testing methods for this functionality will be considered in the context of the other ITU-T Recommendations according to the development of new NGN specifications.	T-15
16	Testing methods for this functionality will be considered in the context of the other ITU-T Recommendations according to the development of new NGN specifications.	T-16

Table 2 – Functional entities' tests list

No.	Test name	Functional entity
17	Testing methods for this functionality will be considered in the context of the other ITU-T Recommendations according to the development of new NGN specifications.	T-17
18.1	Interaction with AS.	S-1
18.2	Registration.	
18.3	Routing messages.	
18.4	Interaction with AGC-FE.	
18.5	Support of services.	
19.1	Forward a register request from the terminal.	S-2
19.2	Forward SIP messages from the terminal to the SIP server.	
19.3	Forward a SIP request to the SIP-terminal.	
19.4	Emergency session establishment requests.	
19.5	Security.	
19.6	NAT traversal.	
20.1	Registration.	S-3
20.2	Session-related and session-unrelated flows.	
21.1	Obtaining of the address.	S-4
22.1	User profile management.	S-5
22.2	Providing access to user data.	
23.1	Rights of end-user.	S-6
23.2	Using policy rules.	
23.3	Mobility management.	
24	Testing methods for this functionality will be considered in the context of the other ITU-T Recommendations according to the development of new NGN specifications.	S-7
25.1	Signalling translation and conversion.	S-8
25.2	Providing ISDN supplementary services.	
25.3	Forwarding requests.	
25.4	Forwarding value-added service requests.	
25.5	NAPT proxy function.	
26.1	Forwarding requests.	S-9
27.1	Interworking with different PSTN breakouts.	S-10
28.1	Interworking (access-to-core).	S-11
29.1	Interworking (inter-operator).	S-12
30.1	Media resources allocation.	S-13
31.1	Media server resources control.	S-14
32	Testing methods for this functionality will be considered in the context of the other ITU-T Recommendations according to the development of new NGN specifications.	S-15

5.1.1.1 Methods of checking T-1 functionality

Test No.	T-1_01
Test Name	Bidirectional media processing functions
Status	Mandatory
Test purpose	The feasibility check to provide bidirectional media processing functions for user plane traffic between EU-FE and the NGN.
Configuration	 <pre> graph LR EU-FE[EU-FE] --- AMG-FE[AMG-FE] AMG-FE --- Core[Core Transport functions] </pre>
Initial condition	There is a media session established between the EU-FE and the AMG-FE.
Test procedure	Check whether the EU-FE receives and transmits any media information from/to NGN through AMG-FE simultaneously in the real-time mode.
Expected results	EU-FE receives and transmits media information simultaneously in the real-time mode from/to NGN through the AMG-FE.

Test No.	T-1_02
Test Name	PSTN user call control signalling backhaul
Status	Mandatory
Test purpose	The feasibility check to transfer PSTN user call control signalling to the AGC-FE for processing.
Configuration	 <pre> graph LR EU-FE[EU-FE] --- AMG-FE[AMG-FE] AMG-FE --- AGC-FE[AGC-FE] </pre>
Initial condition	There is a connection between the PSTN EU-FE and the AMG-FE.
Test procedure	1) Initiate a call from PSTN EU-FE to the AMG-FE. 2) Check whether the AMG-FE backhauls PSTN EU-FE call control signalling to the AGC-FE for processing using the appropriate signalling protocol. 3) Check whether a call has been established between PSTN EU-FE and NGN through the AMG-FE. 4) Release a call from the PSTN EU-FE side. 5) Check whether a call has been terminated.
Expected results	1) AMG-FE backhauls PSTN EU-FE call control signalling to the AGC-FE using the appropriate signalling protocol. 2) A call is established between PSTN EU-FE and NGN through the AMG-FE. 3) A call is terminated.

Test No.	T-1_03
Test Name	ISDN user call control signalling backhaul
Status	Mandatory
Test purpose	The feasibility check to transfer ISDN user call control signalling to the AGC-FE for processing.
Configuration	 <pre> graph LR EU-FE --- AMG-FE --- AGC-FE </pre>
Initial condition	There is a connection between the ISDN EU-FE and the AMG-FE.
Test procedure	1) Initiate a "3.1 kHz" call from ISDN EU-FE to the AMG-FE. 2) Check whether the AMG-FE can backhaul ISDN EU-FE call control signalling to the AGC-FE for processing using the appropriate signalling protocol. 3) Check whether a call has been established between ISDN EU-FE and the NGN through the AMG-FE. 4) Release a call from the ISDN EU-FE side. 5) Check whether a call has been terminated. 6) Repeat steps 1 to 5 for "64 kbit/s" and "speech" ISDN calls.
Expected results	1) AMG-FE backhauls ISDN EU-FE call control signalling to the AGC-FE using the appropriate signalling protocol. 2) A call is established between ISDN EU-FE and the NGN through the AMG-FE. 3) A call is terminated.

Test No.	T-1_04
Test Name	Codecs for user plane traffic
Status	Optional
Test purpose	The feasibility check to select different types of codecs for payload processing.
Configuration	 <pre> graph LR EU-FE --- AMG-FE --- Core Transport functions </pre>
Initial condition	There is a connection between the EU-FE and the AMG-FE. ITU-T G.711 (a-law) codec is chosen for payload processing on the AMG-FE.
Test procedure	1) Initiate a call from EU-FE to the AMG-FE. 2) Check whether all EU-FE media information passing through the AMG-FE is encoded via ITU-T G.711 (a-law) codec. 3) Release a call from the EU-FE side. 4) Repeat steps 1 to 3 for ITU-T G.723, ITU-T G.729 and other types of codecs.
Expected results	EU-FE media information is encoded via selected codec.

Test No.	T-1_05
Test Name	Echo cancellation
Status	Optional
Test purpose	The feasibility check to support echo cancellation for payload processing.
Configuration	 <pre> graph LR EU-FE[EU-FE] --- AMG-FE[AMG-FE] AMG-FE --- Core[Core Transport functions] </pre>
Initial condition	There is a connection between the EU-FE and the AMG-FE. The echo cancellation function on the AMG-FE is switched off.
Test procedure	1) Initiate a call from EU-FE to the AMG-FE. 2) Check the quality of the speech for a call. 3) Release a call from the EU-FE side. 4) Switch on the echo cancellation function on the AMG-FE. 5) Initiate a call from EU-FE to the AMG-FE. 6) Check the quality of the speech for a call.
Expected results	1) An echo occurs during the first call. 2) No echo for the second call.

5.1.1.2 Methods of checking T-2 functionality

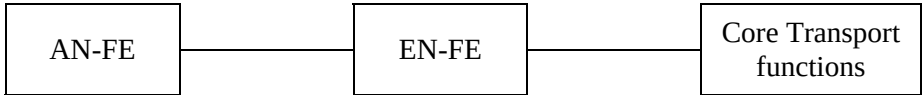
Test No.	T-2_01
Test Name	Packet filtering
Status	Mandatory
Test purpose	The feasibility check to support firewall function for access to the NGN.
Configuration	 <pre> graph LR EU-FE[EU-FE] --- AN-FE[AN-FE] AN-FE --- EN-FE[EN-FE] </pre>
Initial condition	There is an IP route from the EU-FE to the EN-FE provisioned in the AN-FE. There is an IP traffic initiated from the EU-FE to the NGN through the AN-FE. There are no filters applied in the AN-FE.
Test procedure	1) Check whether all IP traffic from the EU-FE to the NGN is passing through the AN-FE and the EN-FE. 2) Set a filter for the particular protocol of the IP traffic in the AN-FE. 3) Check whether any packets of the selected protocol are transported via the common IP traffic from the AN-FE to the EN-FE. 4) Delete a filter from the AN-FE. 5) Check whether all IP traffic from the EU-FE to the NGN is passing through the AN-FE and the EN-FE. 6) Repeat steps 1 to 5 for filters based on the particular port and sender/receiver IP addresses.

Expected results	1) All IP traffic from the EU-FE to the NGN is passing through the AN-FE and the EN-FE. 2) There are no packets of the selected protocol/port/IP address in the common IP traffic. 3) All IP traffic from the EU-FE to the NGN is passing through the AN-FE in the normal way.
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Current functionality also requires testing of QoS parameters and mechanisms such as buffer management, queuing and scheduling, traffic classification, marking, policing, shaping, and forwarding.

Methods of testing of QoS parameters and mechanisms will be considered in the context of the other ITU-T Recommendations according to the development of new NGN testing specifications.

5.1.1.3 Methods of checking T-3 functionality

Test No.	T-3_01
Test Name	IP routing (L2 and L3)
Status	Mandatory
Test purpose	The feasibility check to aggregate user traffic from an access network and route it to the common transport network.
Configuration	 <pre> graph LR AN-FE[AN-FE] --- EN-FE[EN-FE] EN-FE --- Core[Core Transport functions] </pre>
Initial condition	Several routes from the access network to the common transport network are provisioned in the EN-FE.
Test procedure	1) Initiate the users' IP traffic with different destinations, different values and defined lengths from the AN-FE to the NGN through the EN-FE. 2) Check whether EN-FE has received the IP traffic from different users with defined lengths. 3) Check whether EN-FE has sent the users' IP traffic with defined lengths to the requested destinations of the NGN.
Expected results	1) EN-FE has received the IP traffic from different users with predefined lengths. 2) EN-FE has sent the users' IP traffic with predefined lengths to the requested destinations of the NGN according to provisioned routes.

Current functionality also requires testing of QoS parameters and mechanisms such as buffer management, queuing and scheduling, traffic classification, marking, policing, shaping, and forwarding.

Methods of testing of QoS parameters and mechanisms will be considered in the context of the other ITU-T Recommendations according to the development of new NGN testing specifications.

5.1.1.4 Methods of checking T-4 functionality

Test No.	T-4_01
Test Name	Automatic configuration of end-user terminal equipment
Status	Mandatory
Test purpose	The feasibility check to transmit local preconfiguration information to the user equipment when necessary.
Configuration	 <pre> graph LR EU-FE --- AR-FE AR-FE --- NAC-FE </pre>
Initial condition	The end-user terminal equipment (TE) is connected to the access network. The end-user TE has no local preconfiguration or it is switched off. The NAC-FE stores the local configuration in order to give access to end-user TEs to the service stratum functions.
Test procedure	1) Initiate a request for a local preconfiguration (e.g., IP address of the P-CSC-FE, the addresses of DNS servers, etc.) for the end-user TE to the NAC-FE or switch the end-user TE on. 2) Check whether the NAC-FE has received the request for the local preconfiguration and has sent the current local preconfiguration to the end-user TE through the AR-FE. 3) Check whether the end-user TE has received the local preconfiguration and is able to access the service stratum functions.
Expected results	1) The NAC-FE has sent the appropriate pre-set configuration to the end-user TE through initiation of the request. 2) The end-user TE is able to access the service stratum functions (e.g., can register in the NGN).

5.1.1.5 Methods of checking T-5 functionality

Test No.	T-5_01
Test Name	Opening and closing a gate
Status	Mandatory
Test purpose	The feasibility check to realize gateway function between an access network and a core network.
Configuration	 <pre> graph LR EN-FE --- ABG-FE ABG-FE --- CoreTransport[Core Transport functions] </pre>
Initial condition	There is an IP route from the EN-FE to the core transport functions provisioned in the ABG-FE. The IP traffic from the access network to the core network is prohibited by the ABG-FE (the gate is closed).