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SERIES Q: SWITCHING AND SIGNALLING

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

Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks

ITU-T Recommendation Q.3900

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ITU-T Recommendation Q.3900

Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks

Summary

ITU-T Recommendation Q.3900 describes the main approaches to NGN solutions and technical means testing. This Recommendation gives the basic principles of NGN testing based on model networks and includes the basic methodology of testing and the common architectures of model networks.

Source

ITU-T Recommendation Q.3900 was approved on 29 September 2006 by ITU-T Study Group 11 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

Model networks, next generation networks, NGN, PSTN, technical means, testing.

FOREWORD

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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

Introduction

In the environments of public telecommunication networks conversion from digital circuit-switched to packet switching networks, apart from the aspects regarding networking architecture, quality of service, network management, etc., the issues of NGN equipment testing become of primary importance in respect of both compatibility testing of various vendors' NGN equipment and compatibility testing of new services with the existing ones in the process of NGN equipment operation.

All these is due to:

1) the growth of the manufactured equipment nomenclature and the increase of software product share used in telecommunications technical means realization and a greater openness of the market;

2) the reduction of new services development and implementation period.

The negative aspects, however, which influence faster introduction of developments are:

1) the standardization process delay from the development and implementation processes, increase of the share of corporate standard documentation;

2) the testing costs increase compared to the circuit-switched networks testing as the result of a greater complexity of the equipment used.

Taking into consideration the above, it is reasonable to use model networks for the NGN equipment testing and, in the first place, for testing of new protocols as the most complicated elements of NGN.

At present the process of testing may be divided into the following stages:

– Testing for conformance;

– Testing for interoperability.

A great amount of standards for testing has been developed by ETSI. The most significant achievements (or contributions) include the specifications for testing methods using TTCN, those on the capabilities of SDL, and those on general testing principles for conformance to ETSI standards.

Equipment testing for the conformance of protocols and interfaces to the international standards is performed as a rule in the factory environment; but, for the purposes of compatibility and interworking testing the telecommunications operators' networks are used.

To perform equipment interoperability tests, ETSI has developed a network integral testing approach known as NIT (Network Integration/Interconnection Testing), which is detailed in [ETSI TR 101 667]. NIT comprises two types of basic tests: end-to-end tests and node-to-node tests.

The idea of integral testing in itself is fruitful since the operator should be offered equipment of high quality. However, taking into account rapid growth of new technologies and, as a consequence, the increase in equipment complexity, integral testing performed on operator networks is quite costly and lengthy in view of the arrangement of testing zones. Besides, it would not be reasonable to wait for external events like incidents affecting the operator networks in order to test them.

It seems that the methodology of integral testing may be complemented and updated by the creation of model networks to perform equipment compatibility tests, followed by subsequent resource integration of the model networks to ensure full-fledged integral testing taking into account the interworking testing results.

ITU-T Recommendation Q.3900

Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks

1 Scope

This Recommendation assumes conformance with the functionality and purpose defined in [ITU-T Y.2001] and [ITU-T Y.2011]. While it defines a network structure to which the testing requirements can be related, it also defines general principles which hold independently of details which may change with further work. Further Recommendations extend these principles into a detailed testing methodology.

Administrations may require operators and service providers to take into account national regulatory and national policy requirements in implementing this Recommendation.

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 X.295] ITU-T Recommendation X.295 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Protocol profile test specification*.

[ITU-T Y.1540] ITU-T Recommendation Y.1540 (2002), *Internet protocol data communication service – IP packet transfer and availability performance parameters*.

[ITU-T Y.1541] ITU-T Recommendation Y.1541 (2006), *Network performance objectives for IP-based services*.

[ITU-T Y.2001] ITU-T Recommendation Y.2001 (2004), *General overview of NGN*.

[ITU-T Y.2011] ITU-T Recommendation Y.2011 (2004), *General principles and general reference model for Next Generation Networks*.

[ITU-T Y.2012] ITU-T Recommendation Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.

[ITU-T Y.2111] ITU-T Recommendation Y.2111 (2006), *Resource and admission control functions in Next Generation Networks*.

[ITU-T Y.2201] ITU-T Recommendation Y.2201 (2007), *NGN release 1 requirements*.

[ETSI TR 101 667] ETSI TR 101 667 (1999), *Methods for Testing and Specification (MTS); Network Integration Testing (NIT); Interconnection; Reasons and goals for a global service testing approach*.

[ETSI TS 102 237-1] ETSI TS 102 237-1 (2003), *Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Interoperability test methods and approaches; Part 1: Generic approach to interoperability testing*.

3 Definitions

This Recommendation defines the following terms:

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

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

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3G	Third Generation
ANI	Application Network Interface
AS	Application Server
ASN	Abstract Syntax Notation
ATM	Asynchronous Transfer Mode
ATS	Abstract Test Suite
BICC	Bearer Independent Call Control
BS	Billing System
CMIP	Common Management Information Protocol
CORBA IDL	Common Object Request Broker Architecture Interface Definition Language
DSS 1	Digital Subscriber System No. 1
DTMF	Dual Tone Multifrequency
FE	Functional Entities
FTAM	File Transfer Access Management
FTP	File Transfer Protocol
GDMO	Guidelines for the Definition of Managed Objects
GK	Gatekeeper
GSM	Global System for Mobile communications
GW	Gateway
GW-LTE	Media Gateway for Legacy Terminal Equipment
HSS	Home Subscriber System
IIOP	Internet Inter-Orb protocol
IMS	IP Multimedia Subsystem

IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IUA	ISDN User Adaptation
M3UA	MTP 3 User Adaptation layer
MDS	Media Server
MeS	Messaging Server
MGC	Media Gateway Controller
MGCP	Media Gateway Control Protocol
MGW	Media Gateway
MSC	Mobile Switching Centre
NACF	Network Attachment Control Function
NAPT	Network Address Port Translation
NGN	Next Generation Network
NGN-IAD	NGN Integrated Access Devices
NIT	Network Integration/Interconnection Testing
NMS	NGN Management System
NNI	Network-Network Interface
NUT	Network Under Test
PBX	Private Branch Exchange
PICS	Protocol Implementation Conformance Statement
PLMN	Public land Mobile Network
PS	Proxy Server
PSN	Packet Switched Network
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RTCP	Real-time Transfer Control Protocol
RTP	Real-time Transfer Protocol
SCTP	Session Control Transfer Protocol
SDH	Synchronous Digital Hierarchy
SDL	Specification and Description Language
SG	Signalling Gateway
SIP	Session Initiation Protocol
SIP-I	Session Initiation Protocol for ISDN
SLA	Service Level Agreement

SNMP	Simple Network Management Protocol
SP	Signalling Point
SS7	Signalling System No. 7
SSP	Service Switching Point
STP	Signalling Transfer Point
TE	Terminal Equipment
TM	Technical Means
TNE	Transport Network Environment
TSS&TP	Test Suite Structure and Test Purposes
TTCN	Tree and Tabular Combined Notation
VPN	Virtual Private Network
UNI	User-Network Interface

5 Conventions

None.

6 Compatibility issues

None.

7 Classification of NGN functions, services and technical means to be tested

In accordance with [ITU-T Y.2001] and [ITU-T Y.2011], the NGN architecture is comprised of two stratas – the service stratum and the transport stratum. Each of these layer's functionality is determined by the general functionality of the units which are part of the NGN architecture. The NGN architecture which has to be tested and described in this Recommendation supports the delivery of services identified in the NGN Release 1 requirements [ITU-T Y.2201].

The service layer functionality is determined by control over the NGN services provided to the user, whereas the transport layer is determined by control over access to the NGN resources and transmission of information over it (speech, signalling and management). The services implemented in the NGN are divided into the basic ones, using the SIP protocol, and the additional ones which are not SIP-oriented and are used in the various NGN subsystems. The main elements of each of the NGN layers and their purpose are given in Figure 7-1 in accordance with [ITU-T Y.2012].

Testing of NGN technical means[1] assumes checking of the NGN main (mandatory) and a number of additional functions which are implemented in the network with the aid of tested technical means as well as the implemented basic and additional telecommunication services.

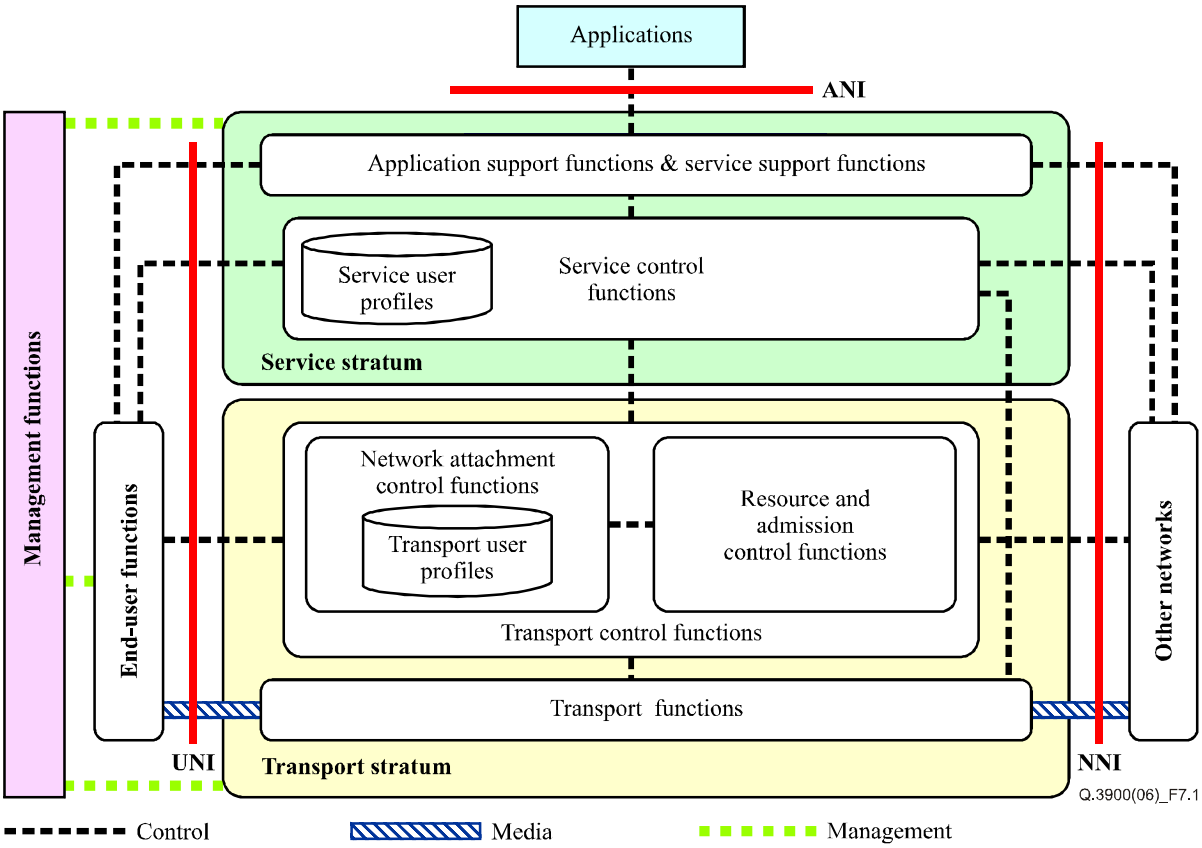

Figure 7-1 – NGN functional architecture [ITU-T Y.2012]

7.1 Classification of NGN technical means to be tested

For the purpose of this Recommendation, the assumed main NGN technical means used in public networks are the following:

– *Call session control system*

- Media gateway controller (MGC);
- Proxy server SIP (PS);
- IP multimedia subsystem (IMS).

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[1] NGN technical means shall be implemented taking into account the mandatory NGN function set corresponding to the supposed sphere of application of these means; at the same time, the composition and number of protocols and interfaces in the specified functionality may be implemented by the manufacturer at his discretion.

For the purposes of this Recommendation, the technical means functionality implemented by the manufacturer, including the requirements for the protocols and interfaces to be implemented in the specified functionality, are assumed to be in complete conformance with the functionality and purpose defined in the NGN requirements (see [ITU-T Y.2012] and [ITU-T Y.2201]).

– *Voice and signalling transmit system*
  - Media gateway (GW);
  - Signalling gateway (SG);
  - Transport network environment (TNE).
– *Application servers*
  - Application server (AS);
  - Media server (MDS);
  - Messaging server (MeS).
– *Management and billing system*
  - NGN management system (NMS);
  - Billing system (BS).
– *Access environment*
  - NGN integrated access devices (NGN-IAD);
  - Media gateway for legacy terminal equipment (GW-LTE).

Each one of the above-enumerated types of NGN technical means shall implement, within its composition, both a mandatory share of the functionality, without which the performance of the system's basic functions is impossible, and a number of additional functions which provide users with various special capabilities. The functionality implemented using the NGN technical means may include the functions of different layers (access layer, transport layer and service layer).

Let us consider in more detail the purpose and functionality of the main NGN technical means used in public networks.

7.1.1 Media gateway controller (MGC)

The major MGC task is the control of one or more media gateways (trunk media gateway).

The MGC controls the calls among the PSTN subscribers. The MGC features a direct interface for interoperation with application servers and is capable of managing the services provided by the AS.

Each MGC should provide for a basic part of functionality while controlling the communication sessions, including: transfer of routing tables, reconfiguring the numbering systems among various numbering plan formats, GW controlling by means of the signalling protocols (MGCP, H.248/Megaco, H.323, SIP), etc.

The MGC is a main component of softswitch and is applied in the NGN networks as a main switching device which controls the various communication sessions. Utilization of various components, found in the NGN, in the softswitch solutions allows to use the softswitch technology as various types of equipment – ranging from distributed office exchanges (PBX) to a central component of the multi-service communication networks.

7.1.2 Application server (AS)

The AS is a software server providing new services to the users.

The AS ensures provisioning of a number of new services, for example, e-commerce and electronic trade (e-market).

The AS occupies a very significant place in the NGN networks. The AS may functionally perform as most of the NGN network components in the field of COMMUNICATION SESSION AND SERVICES CONTROL AREA – that is, it functions as MGC, media server, message server, etc.

The AS utilization will allow a more flexible management of network capabilities and the creation of new and promising network scenarios.

7.1.3 Media server (MDS)

The MDS provides services of interaction between the user and application or other additional communication services by means of voice and DTMF instructions.

The MS architecturally may be divided into:

1) A Media Resource Control Unit which ensures: DTMF recognition, speech synthesis, speech recognition, etc.

2) A Service Control Unit which ensures: forwarding messages into the message line, message recording, transfer of facsimile services, arranging conference communication, etc.

The MDS may be implemented on various software and hardware platforms based on the VoiceXML languages and so on.

7.1.4 Messaging server (MeS)

The MeS is responsible for message saving and message transfer to the users. The MeS will also provide users with additional communication services. The MeS, like the MDS, may be built around diversified software and hardware platforms based on various programming languages.

7.1.5 Media gateway (GW)

The GW provides the functions of transforming the voice information into a digital format and its transfer through the Packet Switched Networks, including the NGN networks.

The GW performs coding of the amplitude-frequency signals by means of its integrated codecs (G.711, G.723, G.726, G.729, etc.), as well as transfer of digitized signals with the aid of transport protocols RTP/RTCP. To establish connection within the GW, it is necessary to have implemented, at least, one of the assortment of protocols (H.323, MGCP, H.248/Megaco, SIP).

The GW is used for the arrangement of interaction on the level of voice circuits between a Circuit Switched Network and a Packet Switched Network. Within an NGN network, this component fulfils the functions of interaction between the PSTN and IP networks.

7.1.6 Signalling Gateway (SG)

The SG allows to convert and send a signalling load of the PSTN network to the Media Gateway Controller.

The SG converts such signalling types as ISDN, SS7, etc. To transfer in MGC the information signals from the PSTN network protocols, a Packet Switched Network uses the SIGTRAN stack signalling protocols – namely, the protocols responsible for data transfer of a certain protocol of the Circuit Switched Network, for example: Q.931 (ISDN) – IUA; MTP (SS7) – M3UA, SIP NNI and/or SIP-I.

Transfer of the SIGTRAN-stack protocols is effected over the SCTP transport protocol.

The SG is used at the boarder of the Packet Switched Network with the PSTN network, including the arrangement of interaction of the NGN and PSTN networks.

In certain events it is possible to apply the equipment providing for the integration of functions of a media gateway and a signalling gateway.

7.1.7 Configuration and management system (MS)

The configuration and management system should provide management and control of all the NGN technical means. Similar systems have to be constructed with the use of distributed and object-oriented structure and should be multi-protocol. The management systems, interfaces should be open. The main features of such interfaces should be: standard protocols (IIOP, CMIP, SNMP, FTP, FTAM, etc.) and the usage of formal languages for description of standard interfaces (CORBA IDL, JAVA, GDMO, ASN.1, etc.), stability which makes it possible to introduce only the changes that will be backwards compatible.

7.2 Classification of NGN functions to be tested

The main functions which require mandatory testing are:

– *Transport stratum functions*
  - Transport functions;
  - Transport control functions;
  - Transport user profile functions.

– *Service stratum functions*
  - Service control functions;
  - Application/Service support functions;
  - Service user profile functions.

– *End-user functions*

– *Management functions*

To test each of the functions listed above, it is necessary to examine in more detail their internal functionality, to determine the purpose and degree of their responsibility.

The presented NGN technical means may implement, within their composition, several functions at a time. The function sets implemented in particular technical means will be defined below.

An NGN functional functionality scheme is given in Figure 7-2.

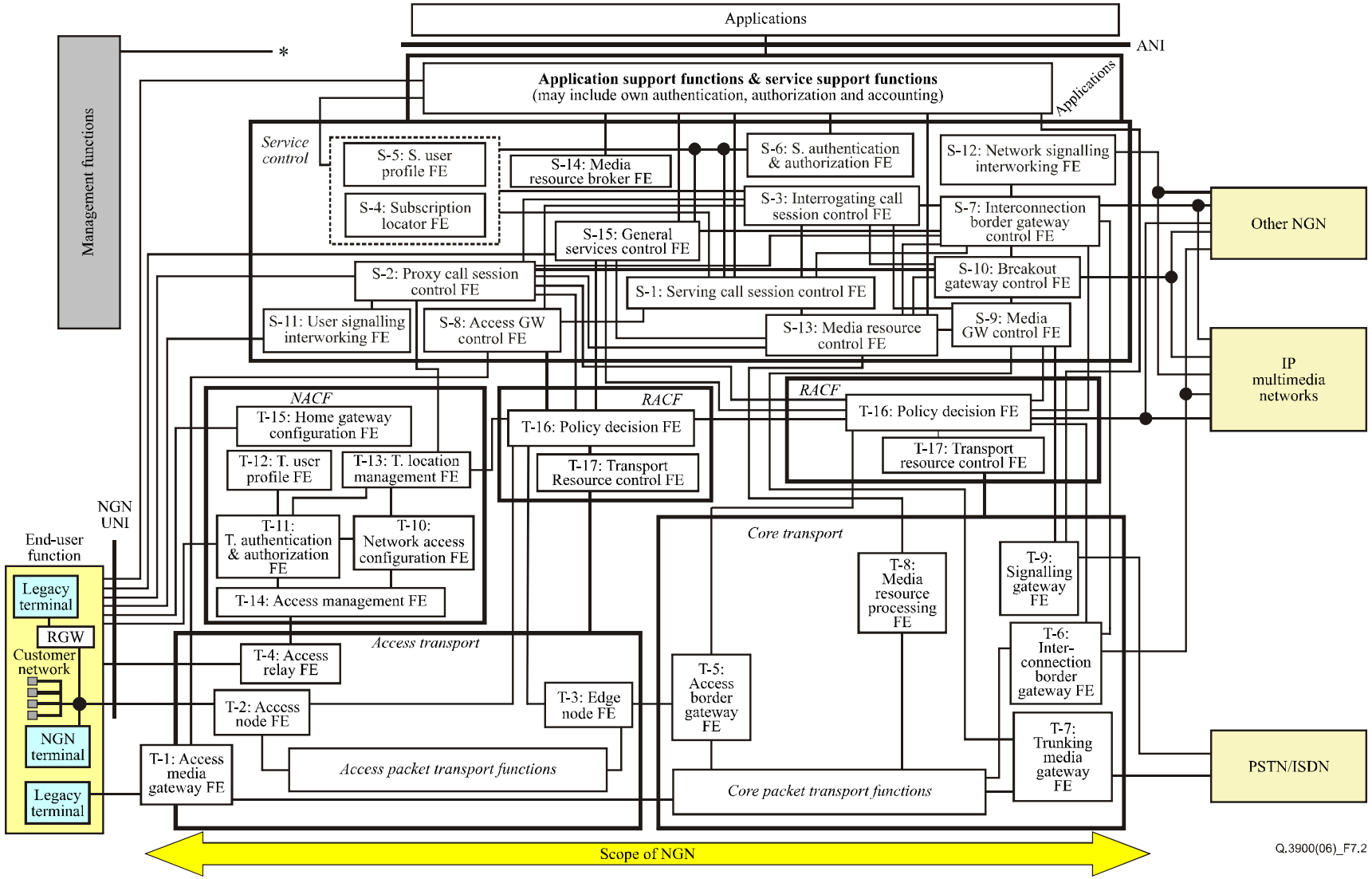

Figure 7-2 – NGN functional architecture [ITU-T Y.2012]

7.2.1 Transport stratum functions

7.2.1.1 Transport functions

Testing of this function assumes checking of the implementation and conformance of the following mandatory capabilities:

– User connection to the NGN. Aggregation from user terminal equipment, including analog and digital terminal equipment of pubic networks, all traffic and its subsequent transfer to the common transport network (Access transport functions: T-1, T-2, T-4).

– Transfer of traffic from the access network to the common transport network with the support of all mechanisms and functions resembling ATF and an additional routing capability (Edge&Access Border Gateway Functions: T-3, T-5).

– Transfer and management of all types of information being transmitted over the transport network (media streams, signalling messages and control system signals) (Core Transport Functions: T-8, T-9, T-6, T-7).

7.2.1.2 Transport control functions

Testing of this function assumes checking of the implementation and conformance of the following mandatory capabilities:

– QoS management with expanded capabilities for resource management (resource reservation), management of NAPT and NAPT Traversal at the access and transport layer. Testing should be divided for each layer, while identifying separate tests both for Access Transport Resource Control (ATRC) and for Core Transport Resource Control (CTRC). Testing of the resource control function should incorporate checking of the following mandatory procedures: packet filtering, traffic classification, service priority policies, passband reservation, network address translation, Firewall (RACF: T-17 for both access and core). Testing procedures have to be realized by [ITU-T Y.2111], Resource and admission control functions in Next Generation Networks.

– Control of user access to the network resources (Admission Control Function). During testing, user authorization based on the profile should be checked (SLA, service priority, access policies determined by the type of the model network used for testing (the description and composition of model networks will be presented below)); the access and/or transport resources available to the user (RACF: T-16 for both access and core). Testing procedures have to be realized by [ITU-T Y.2111], Resource and admission control functions in Next Generation Networks.

– Control of user access to NGN services. During testing, the following mandatory functions shall be checked: dynamic allocation of IP addresses and additional configuration parameters needed for user identification/authentication, user authentication at the network layer (IP-layer); user authorization for access to the network based on the user profile; user localization (NACF: T-10, T-11, T-13, T-14).

– Control of home gateway (HGW) configuration functionality (configuration of a firewall internally in the HGW, QoS marking of IP packets, etc.) in accordance with [ITU-T Y.2012] (NACF: T-15).

7.2.1.3 Transport user profile functions

Testing of this function assumes checking the possibility of configuring and modifying the information contained in the user profile at the transport layer (Transport stratum: T-12).

7.2.2 Service stratum functions

7.2.2.1 Service control functions

Testing of this function assumes checking the implementation and conformance of the following mandatory capabilities:

– User registration and authorization at the service layer (S-6);

– Management media streams, terminal equipment and gateways (S-1, S-11, S-8, S-2, S-3, S-12, S-7, S-10, S-9, S-13).

7.2.2.2 Application/Service support functions

Testing of this function assumes checking the implementation and conformance of the following mandatory capabilities:

– User registration and authorization at the application layer, for user access to the telecommunication services provided by application servers (S-4, S-5, S-6);

– Management of media streams and telecommunication services (S-14, S-15).

7.2.2.3 Service user profile functions

Testing of this function assumes checking the capability of configuring and modifying the information contained in the user profile at the Service Control layer and checking the capability of interaction with the user-profile databases of other NGN architecture layers.

7.2.3 End-user functions

Testing of this function assumes checking the capabilities of the terminal equipment from the gateway, to which conventional telephone sets are connected, to the multipurpose sets designed specifically for NGN networks. Among other things, testing assumes checking codecs, echo-cancellation systems, signalling systems and functions of interaction with the relevant NGN layers.

7.2.4 Management functions

Testing of this function assumes checking management at various layers – both the data and the application layer. The following capabilities should be checked for each of these levels:

– Error processing management;

– Equipment configuration management;

– Billing system management;

– Service management;

– Security management.

7.3 Conformance of NGN functions to NGN technical means to be tested

The technical means used in NGN networks may implement, within their composition, the functionalities in accordance with Table 7-1.

Table 7-1 – Conformance of NGN functions to NGN technical means

NGN technical means	NGN functionality
Call session control system	
Media gateway controller (MGC)	S-3, S-7, S-9, S-10, S-12 T-10, T-11, T-12, T-13
Proxy server SIP (PS)	S-2, S-3, S-7, S-11, S-12 T-10, T-11, T-12, T-13
IP multimedia subsystem (IMS)	S-1, S-3, S-6, S-7, S-8, S-10, S-12, S-13 T-10, T-11, T-12, T-13, T-14, T-15, T-16, T-17
Voice and signalling transmit system	
Media gateway (GW)	T-7, T-8
Signalling gateway (SG)	T-8, T-9
Transport network environment (TNE)	T-5, T-6, T-8
Application servers	
Application server (AS)	S-4, S-5, S-6, S-14, S-15
Media server (MDS)	S-4, S-5, S-6, S-14, S-15
Messaging server (MeS)	S-4, S-5, S-6, S-14, S-15
Management and billing system	
Management system (MS) Billing system (BS)	– Error processing management – Equipment configuration management – Billing system management – Service management – Security management
Access environment	
NGN integrated access devices (NGN-IAD)	T-2, T-4, T-3, T-5, T-15, T-14
Media gateway for legacy terminal equipment (GW-LTE)	T-1, T-2, T-3, T-4, T-5

8 Testing procedure

The testing process shall incorporate two main levels responsible for NGN technical means testing (NGN TM local testing) and testing of comprehensive NGN solutions and the telecommunication services implemented with their aid (network under test – NUT). The testing process architecture is shown in Figure 8-1.[2]

Level 1 NGN TM local testing	
1.1	Functional testing
1.2	Load&stress testing
1.3	Conformance testing

Level 2 NUT testing	
2.1	Functional testing
2.2	Interconnect testing
2.3	Service testing
2.4	End-to-end testing
2.5	QoS testing
2.6	Mobility & roaming testing

Figure 8-1 – Testing process architecture

8.1 Level 1 – NGN TM local testing

At this level the NGN TM assumes TM testing independent from other parts of NGN. This level is divided into three sub-levels, each of them being responsible for a specific test set.

- Level 1.1 – Functional testing;
- Level 1.2 – Load&stress testing;
- Level 1.3 – Conformance testing.

Level 1.1 – Functional testing

The NGN TM local testing method at this level assumes checking the functionality implemented by the equipment, in accordance with the classification given in clause 7.

The tests to be applied at this level should include the following:

1) Checking the list and composition of the TM mandatory and additional functionality;
2) Checking the correctness and completeness of functionality implementation at TM.

ITU-T Recommendations and ETSI standards shall constitute a basis for developing TM checking tests at this level.

Level 1.2 – Load&stress testing

The testing method at this level assumes checking the TM functioning under load and stress. Testing should assume checking the equipment under the maximum possible load and stress. Testing will make it possible to assess the equipment's operational capability at peak loads and stresses.

Testing should include checking the correctness and completeness of functionality implementation at TM under peak loads and stresses.

[2] The sub-levels of tests do not assume step-by-step testing. Each of the tests could be used separately.

Level 1.3 – Conformance testing

The method of TM testing at this level assumes checking the protocols and interfaces used in it and the completeness of their implementation in accordance with international standards.

The tests applied at this level should include the following:

1) Checking the composition of the TM protocols and interfaces for conformance to one of the NGN equipment classes (MGC, GW, SG, etc.) and, accordingly, the functionality built into it.

2) Checking the correctness and completeness of TM protocol implementation for conformance to international recommendations and standards.

ITU-T Recommendations and ETSI standards shall be a basis for TM testing method at this level.

Conformance checking is obliged to include the testing of NGN technical means protocols and interfaces in accordance with their classification (clause 7).

8.2 Level 2 – NUT testing

At this level, testing of solutions built on the basis of NGN TM for public networks and the set of telecommunication services provided with their aid shall be performed. NUT testing includes interoperability testing which proves the end-to-end functionality between (at least) two NGN TM as required by those base systems' standards and some additional testing as QoS testing and others.

This level is comprised of six sub-levels:

- Level 2.1 – Testing of functionality implemented at NUT (NUT functionality testing);
- Level 2.2 – Interconnect testing;
- Level 2.3 – Service testing at NUT;
- Level 2.4 – End-to-end testing;
- Level 2.5 – QoS testing;
- Level 2.6 – Mobility & roaming testing at NUT.

Level 2.1 – NUT functional testing

Classification of the NGN equipment and the services implemented with it will determine not only the applicability but also the application sphere of the equipment as one of the PSTN components. Interworking of various NGN network equipment types with each other is defined through complete solutions which resolve particular tasks.

Level 2.2 – Interconnect testing

This level includes a number of tests for checking the interaction at NUT TMs from different vendors. Testing includes point-to-point checks and interoperability tests, excluding the use of external (third-party) means whose checking should be performed at level 2.4 (end-to-end testing).

The tests applied at this level should include the following:

1) Checking the fulfillment of the TMs specified functionality during their interoperability at NUT;

2) Checking the conformance of the sufficiency and completeness of protocol implementation at tested TMs necessary to fulfil the specified functionality;

3) Checking the conformance of the capabilities of TMs, tested during interoperation, in the sense of the volume and make-up of the implementation of the services built into them.

ITU-T Recommendations and ETSI standards shall constitute a basis for the TM testing method at this level.

Level 2.3 – Service testing

This level includes a number of tests for checking various telecommunication services implemented at NUT.

The NGN basic services tested at NUT include:

1) The telecommunication services for customer (for example speech, data, video and so on);

2) Traffic transit services;

3) Value-added services.

Testing shall not be restricted to that of basic services only, but it shall also assume the possibility to verify the value-added services implemented on the basis of NGN equipment in a public telecommunication network.

Level 2.4 – Testing of solutions based on EUT using end-to-end testing or network integration testing (NIT)

The interoperability testing assumes checking the operational capability of TM NUT throughout the whole communication set-up cycle.

The tests applied at this level should include the following:

– End-to-end: designed for checking the correctness of communication set-up (all scenarios – ranging from connection set-up to its support and breaking) during its passage over NUT at the user level;

– Node-to-node: designed for the testing of individual nodal TMs at NUT.

Level 2.5 – QoS testing

The NGN TM local testing method at this level assumes performing measurement of QoS indicators and checks of the implementation of the possibility to manage quality at TM NUT. Testing and the check method applied at this level should be implemented in accordance with ITU-T and ETSI international standards.

Level 2.6 – Mobility & roaming testing

The NUT testing method at this level assumes performing the check of the possibilities of subscribers' mobility and of their roaming.

The tests applied at this level should include the following:

1) The check of the implementation of mobility possibilities at the tested NUT and, accordingly, of the functionality built into it;

2) The check of the correctness and completeness of protocol implementation at NUT for supporting mobility and roaming functions.

ITU-T Recommendations and ETSI standards shall constitute a basis of the techniques used for NUT testing at this level.

9 Model networks

9.1 Purposes of using model networks

The model network is a prototype of present public telecommunication networks based on NGN equipment. By means of model networks, in order to identify the specific features of the tested equipment's functioning and compatibility, it is possible to perform equipment testing under load and stress, which is of higher quality and objectivity.

Model networks can be used for testing the full list of NGN technical means according to the method described in clause 8. The NGN equipment to be tested should include all the technical means defined in the NGN equipment classificatory used for public networks (clause 7), namely:

– *Call session control system*
  - Media gateway controller (MGC)
  - Proxy server SIP (PS)
  - IP multimedia subsystem (IMS)
– *Voice and signalling transmit system*
  - Media gateway (GW)
  - Signalling gateway (SG)
  - Transport network environment (TNE)
– *Application servers*
  - Application server (AS)
  - Media server (MDS)
  - Messaging server (MeS)
– *Management and billing system*
  - NGN management system (NMS)
  - Billing system (BS)
– *Access environment*
  - NGN integrated access devices (NGN-IAD)
  - Media gateway for legacy terminal equipment (GW-LTE)

Depending upon their configuration and sphere of application, the model networks can also be used for checking:

– Quality of service parameters;
– information security requirements;
– interworking with the technical means employed prior to the NGN period.

9.2 Types of model networks

Model networks designed for testing can be both dedicated and distributed.

A **dedicated model network** is a fragment of the public telecommunication network which is not connected to other model networks. The dedicated model network can be connected to a public telecommunication network and/or corporate network. Dedicated model networks are used to perform testing for compatibility and, if possible, for interaction with the technical means employed prior to the NGN development period, which may be part of the model network.

A **distributed model network** is composed of several model networks, two as a minimum, interconnected via communication channels and through an Intranet network that is set up, as a rule, on their basis. The distributed model networks can also be connected to public telecommunication networks and/or corporate networks. The distributed model networks are used to perform complex tests for compatibility and interworking as well as to check quality of service parameters, information security requirements and interworking with the technical means employed prior to the NGN development period.

9.2.1 Dedicated model network

The basic architecture of a dedicated model network should include, as a minimum, two different-type nodes combined by a single telecommunication network (of the SDH, ATM or IP level) – one node belongs to the model network, the second is the equipment under test. The common parts of a model network should include all technical means described in clause 9.1.

The basic architecture of a dedicated model network is shown in Figure 9-1[3].

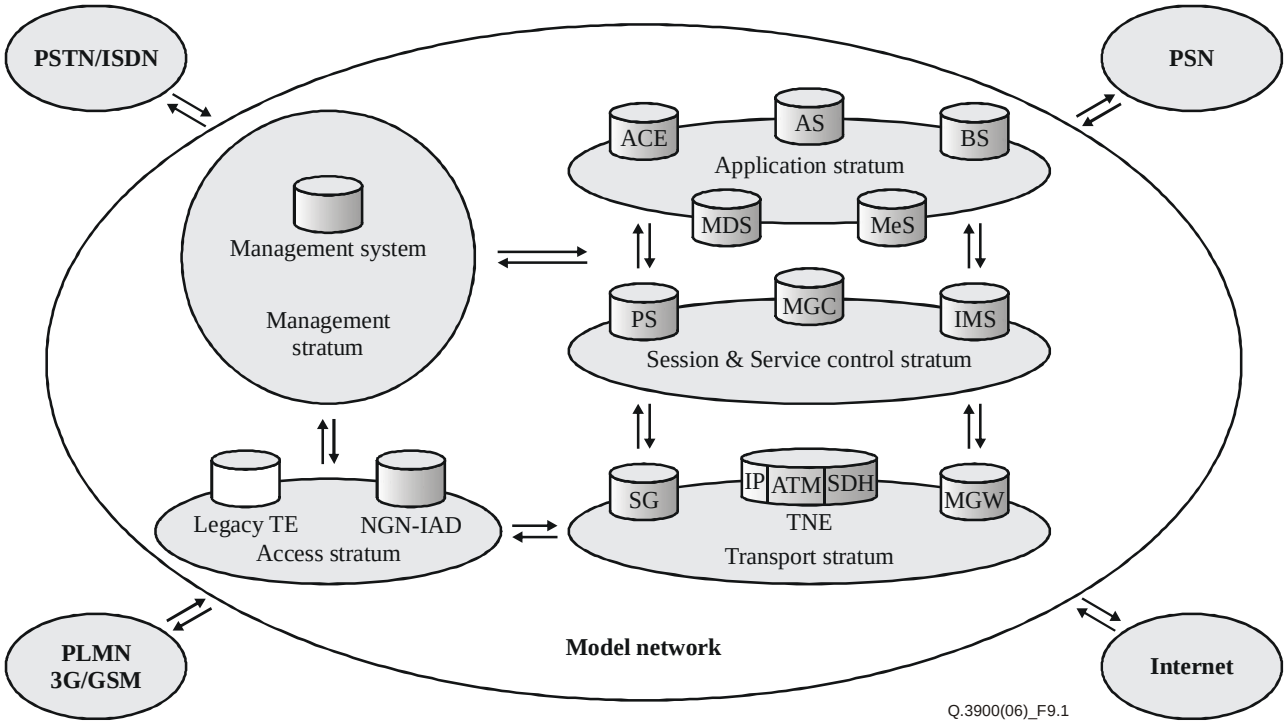

Figure 9-1 – Basic architecture of a model network

At each stratum (Access, Transport, Session & Service control, Application and management), NGN TM local testing or some solutions of NUT for testing may be installed. The detailed testing scheme of each NGN TM local testing is to be determined later.

[3] The PSTN/ISDN, PLMN (3G/GSM) and PSN networks could be stand-alone or part of the model network.

9.2.2 Distributed model network

A distributed model network architecture in its minimum-size configuration should comprise two dedicated model networks, located in different ITU-T member communication administrations' areas; each of the networks, in its turn, should meet the configuration as described in clause 9.2 (Figure 9-1) and should be interconnected by the dedicated (VPN) Intranet network.

The minimum-size configuration of the model network should have:

– four nodes of the public telecommunication network; three of them should be of different types and two, as a minimum, should originate from different vendors;

– the communication networks inside the dedicated model networks provide internal communication (of the SDH, ATM or IP level) without limitation in types and manufacturers;

– four media gateways, the minimum of three of which should be of different types and the minimum of two should come from different manufacturers;

– four signalling gateways meeting the same different-type and manufacture brand requirements;

– four application servers, out of which at least two should be of different types;

– additional NGN technical means.

The basic architecture of a distributed model network is shown in Figure 9-2.

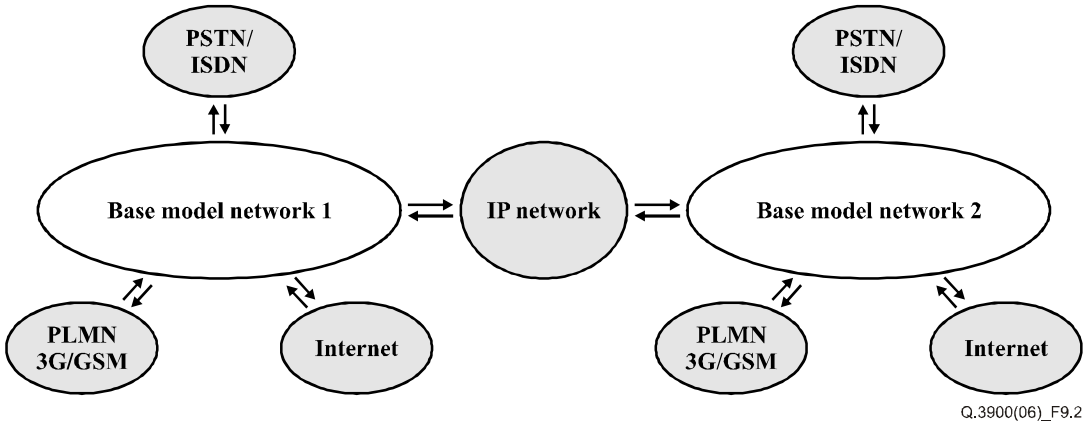

Figure 9-2 – Architecture of a distributed model network in minimum-size configuration[4]

9.2.3 Regional model network

Although creation of model networks appears to be a promising testing method, not all countries are in a position to implement them to the necessary extent desired. Hence, it is reasonable to create regional model networks whose resources could be employed for testing by various countries located in the given region.

4 An Intranet network could be based on the PSTN, the Internet and so on.

10 Testing requirements

10.1 Model network configuration requirements

The protocols scheme of dedicated and distributed model networks must be realized in accordance with the scheme illustrated in Figure 10-1.

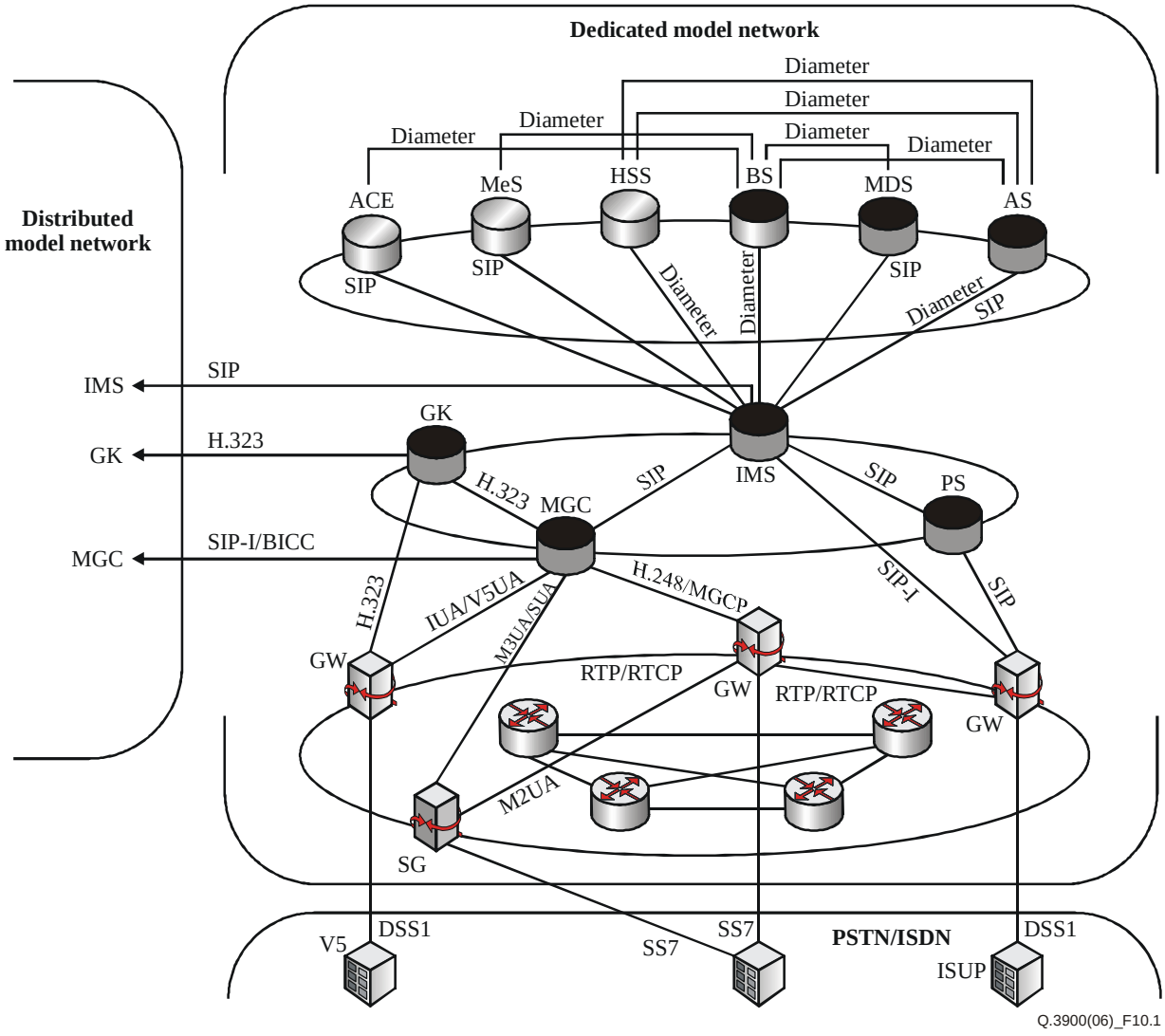

Figure 10-1 – Model network configuration

10.2 Methodology of model networks testing

The methodology of testing on the model networks has to permit realizing of all tests which are described in clause 8 and accordingly has to allow checking TM, NUT and services.

10.2.1 Methodology of NGN TM local testing

The NGN TM local testing procedure includes several testing stages. The TM testing scheme is shown in Figure 10-2. The first stage of TMs testing is based on the methodology in [ITU-T X.295] and in [ETSI TS 102 237-1]. All TM have to be checked on conformance to ITU-T Recommendations and ETSI standards in accordance with the ETSI and ISO/IEC 9646 methodology (TSS&TP, PICS, ATS, PIXIT). The second stage has to define TM functionality testing in accordance with the methodology which will be described further. The following stages have to include TM functionality testing under load and TM compatibility testing.

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

All TM tests have to be based on the existing and developing methodologies (Figure 10-2). The results of each TM testing have to be delivered to the database, the structure and data format of which will be determined later.

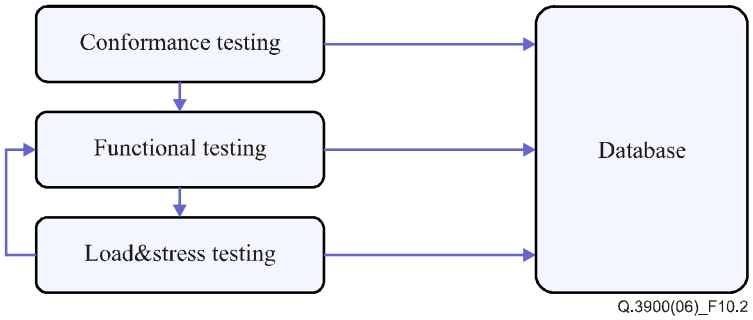

Figure 10-2 – NGN TM local testing methodology

10.2.2 Methodology of NUT testing

The NUT testing scheme is shown in Figure 10-3. The NUT testing have to be based on [ETSI TS 102 237-1].

The first and second NUT testing stages have to be based on the methodology which will be determined later in this series of recommendations; end-to-end testing in accordance with the methodology defined in [ETSI TR 101 667]; QoS testing on conformance with [ITU-T Y.1540] and [ITU-T Y.1541]; mobility management testing on conformance with requirements to be determined later.

All NUT tests have to be based on the existing and developing methodologies (Figure 10-3). The results of each NUT testing have to be delivered to the database, the structure and data format of which will be determined later.

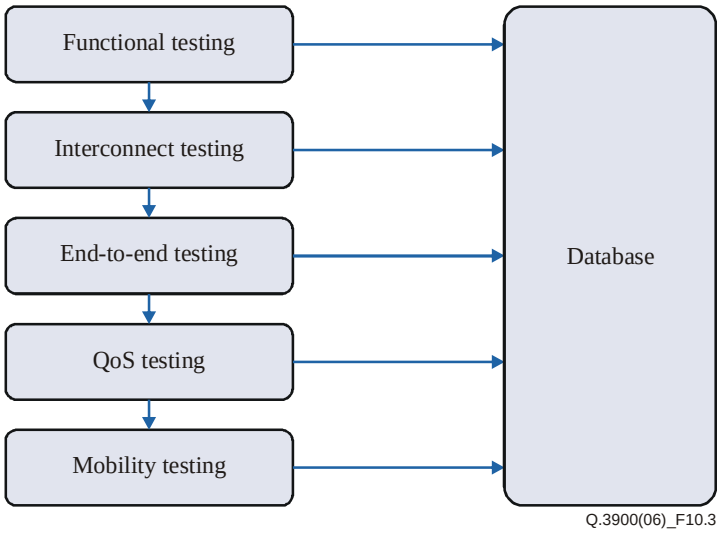

Figure 10-3 – NUT testing methodology

10.2.3 Methodology of services testing

The services testing scheme is shown in Figure 10-4. The testing procedure is based on the methodology which will be determined later.

The results of each service's testing have to be delivered to the database, the structure and data format of which will be determined later.

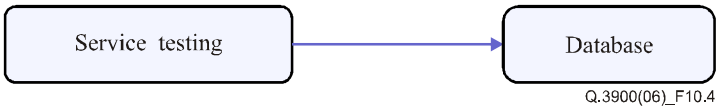

Figure 10-4 – Services testing methodology

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