International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.3909

(11/2011)

SERIES Q: SWITCHING AND SIGNALLING

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

The framework and overview of NGN conformance and interoperability testing

Recommendation ITU-T Q.3909

International Telecommunication Union

ITU-T Q-SERIES RECOMMENDATIONS

SWITCHING AND SIGNALLING

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE	Q.1–Q.3
INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING	Q.4–Q.59
FUNCTIONS AND INFORMATION FLOWS FOR SERVICES IN THE ISDN	Q.60–Q.99
CLAUSES APPLICABLE TO ITU-T STANDARD SYSTEMS	Q.100–Q.119
SPECIFICATIONS OF SIGNALLING SYSTEMS No. 4, 5, 6, R1 AND R2	Q.120–Q.499
DIGITAL EXCHANGES	Q.500–Q.599
INTERWORKING OF SIGNALLING SYSTEMS	Q.600–Q.699
SPECIFICATIONS OF SIGNALLING SYSTEM No. 7	Q.700–Q.799
Q3 INTERFACE	Q.800–Q.849
DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1	Q.850–Q.999
PUBLIC LAND MOBILE NETWORK	Q.1000–Q.1099
INTERWORKING WITH SATELLITE MOBILE SYSTEMS	Q.1100–Q.1199
INTELLIGENT NETWORK	Q.1200–Q.1699
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR IMT-2000	Q.1700–Q.1799
SPECIFICATIONS OF SIGNALLING RELATED TO BEARER INDEPENDENT CALL CONTROL (BICC)	Q.1900–Q.1999
BROADBAND ISDN	Q.2000–Q.2999
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR THE NGN	Q.3000–Q.3999
General	Q.3000–Q.3029
Network signalling and control functional architecture	Q.3030–Q.3099
Network data organization within the NGN	Q.3100–Q.3129
Bearer control signalling	Q.3130–Q.3179
Signalling and control requirements and protocols to support attachment in NGN environments	Q.3200–Q.3249
Resource control protocols	Q.3300–Q.3369
Service and session control protocols	Q.3400–Q.3499
Service and session control protocols – supplementary services	Q.3600–Q.3649
NGN applications	Q.3700–Q.3849
Testing for next generation networks	Q.3900–Q.3999

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

Recommendation ITU-T Q.3909

The framework and overview of NGN conformance and interoperability testing

Summary

Recommendation ITU-T Q.3909 describes the framework and overview of NGN conformance and interoperability testing. Recommendations for conformance and interoperability testing will be constructed with a single framework Recommendation and a series of Recommendations that include detailed specifications for functions, protocols, services, quality of service (QoS), and security and mobility testing.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T Q.3909	2011-11-29	11

FOREWORD

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

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

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

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

NOTE

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

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

INTELLECTUAL PROPERTY RIGHTS

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

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

© ITU 2012

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

		Page
1	Scope	1
2	References	1
3	Definitions	2
4	Abbreviations and acronyms	2
5	Overview of NGN conformance testing and interoperability testing	4
6	Conformance testing	5
	6.1 General	5
	6.2 Requirements	7
	6.3 Physical configuration	11
	6.4 Conformance testing for the NGN procedure	11
7	Interoperability testing	13
	7.1 General	13
	7.2 Requirements	15
	7.3 Physical configuration	17
	7.4 Interoperability testing for NGN procedure	19
Appendix I – Positioning map of NGN testing specification documents		22

Recommendation ITU-T Q.3909

The framework and overview of NGN conformance and interoperability testing

1 Scope

This Recommendation describes the framework and overview of next generation network (NGN) conformance testing and interoperability testing. The Recommendations for conformance testing and interoperability testing will be drafted under a single framework Recommendation and a series of Recommendations which include detailed specifications for each function, protocol, service, QoS, and security and mobility testing.

The framework Recommendation defines a four-step approach, as follows:

Step 1: Define the target (service, application, protocol, function)

Step 2: Define specifications (protocol, service, QoS)

Step 3: Define test specifications to examine tests

Step 4: Build up test bed and examine tests

The framework Recommendation includes procedures, requirements, architecture, and base recommendations, as well as scope, references and definitions. It will be general, providing overview descriptions for NGN conformance testing and interoperability testing.

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.

[ITU-T Q.3900] Recommendation ITU-T Q.3900 (2006), *Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks*.

[ITU-T X.290] Recommendation ITU-T X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts*.

[ITU-T X.291] Recommendation ITU-T X.291 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Abstract test suite specification*.

[ITU-T X.292] Recommendation ITU-T X.292 (2002), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – The Tree and Tabular Combined Notation (TTCN)*.

[ITU-T X.293] Recommendation ITU-T X.293 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Test realization*.

[ITU-T X.294] Recommendation ITU-T X.294 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Requirements on test laboratories and clients for the conformance assessment process*.

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

[ITU-T X.296] Recommendation ITU-T X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Implementation conformance statements*.

[ITU-T X-Sup.4] ITU-T X-series Recommendations – Supplement 4 (2008), *ITU-T X.290 series – Supplement on generic approach to interoperability testing*.

[ITU-T X-Sup.5] ITU-T X-series Recommendations – Supplement 5 (2008), *ITU-T X.290 series – Supplement on interoperability testing framework and methodology*.

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

[ITU-T Y.2014] Recommendation ITU-T Y.2014 (2008), *Network attachment control functions in next generation networks*.

[ITU-T Y.2021] Recommendation ITU-T Y.2021 (2006), *IMS for Next Generation Networks*.

[ITU-T Y.2111] Recommendation ITU-T Y.2111 (2011), *Resource and admission control functions in next generation networks*.

[ITU-T Y.2211] Recommendation ITU-T Y.2211 (2007), *IMS-based real-time conversational multimedia services over NGN*.

[ITU-T Y-Sup.7] ITU-T Y-series Recommendations – Supplement 7 (2008), *ITU-T Y.2000-series Recommendations – Supplement on NGN release 2 scope*.

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACR Anonymous Communication Rejection

ANI Application Network Interface

AOC Advice Of Charge

ATS Abstract Test Suite

CB Communication Barring

CCBS Completion of Communication to Busy Subscriber

CDIV Communication DIVersion

CLIP Calling Line Identification Presentation

CLIR Calling Line Identification Restriction

COLP COnnected Line identification Presentation

COLR	COnnected Line identification Restriction
CONF	CONFerence
CRBT	Customized Ring-Back Tone
CRT	Customized Ringing Tone
CW	Communication Waiting
CWBS	Converged Web Browsing Services
ECT	Explicit Communication Transfer
FE	Functional Elements
GW	GateWay
HOLD	Communication HOLD
ICS	Implementation Conformance Statement
IMS	IP Multimedia Subsystem
IOPT	InterOPerability Testing
IPTV	Internet Protocol TeleVision
ISDN	Integrated Services Digital Network
IUT	Implementation Under Test
IXIT	Implementation eXtra Information for Testing
MCID	Malicious Communication IDentification
MDS	Managed Delivery System
MWI	Message Waiting Indication
NACF	Network Attachment Control Function
NNI	Network Network Interface
NUT	Network Unit Test
OIP	Originating Identification Presentation
OIR	Originating Identification Restriction
P/S/I-CSCF	Proxy/Serving/Interrogating-Call Session Control Function
PCTR	Protocol Conformance Test Report
PETS	Parameterized Executable Test Suite
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation Extra Information for Testing
PSTN	Public Switched Telephone Network
PTS	Profile Test Specification
RACF	Resource and Admission Control Function
RC	Reverse Charging
RGW	Residential GateWay
RL	Requirements List
SCS	System Conformance Statement

SCTR System Conformance Test Report

SDP Service Delivery Platform

SNI Service Network Interface

SoA Service oriented Architecture

TIP Terminating Identification Presentation

TIR Terminating Identification Restriction

UE User Equipment

UNI User Network Interface

UPT Universal Personal Telecommunication

VoIP Voice over IP

5 Overview of NGN conformance testing and interoperability testing

Two kinds of test methodologies exist to confirm the function of NGN standards. One methodology is for conformance testing and the other is for interoperability testing.

Conformance and interoperability testing are both effective and useful approaches to the testing of standardized protocol implementations, although it is unlikely that one will ever fully replace the other.

NGN conformance testing is able to show that a particular implementation complies with the protocol requirements specified in the associated base standard.

However, it is difficult for such testing to be able to prove that the implementation will interoperate with similar implementations in other products.

On the other hand, NGN interoperability testing can clearly demonstrate that two or more implementations will cooperate to provide the specified end-to-end functions, but cannot easily prove that either of them conforms to the detailed requirements of the protocol specification.

The purpose of interoperability testing is not only to show that target products from different manufacturers can work together, but also to show that these products can interoperate using a specific protocol.

Figure 1 shows the fundamental elements for defining the specification process for NGN conformance testing and interoperability testing. These tests are actual solutions to achieve NGN interoperability. A four-step approach is described in this Recommendation.

Step 1: Define the target (service, application, protocol, function)

Step 2: Define specifications (Protocol, Service, QoS)

Step 3: Define test specifications to examine tests

Step 4: Build up test bed and examine tests

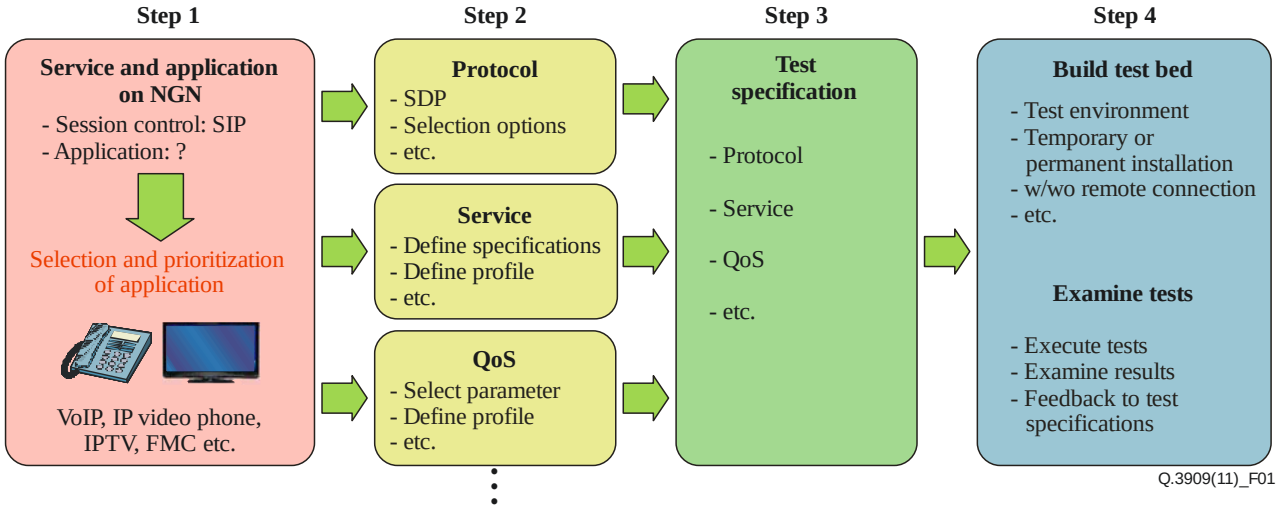

Figure 1 – Typical NGN conformance and interoperability test specification process

NGN conformance testing and interoperability testing are a part of the testing activity included in the existing ITU-T Q.39xx-series Recommendations.

This Recommendation describes the procedure, requirements, architecture, and standard document sets as the fundamental elements for NGN conformance testing and interoperability testing.

6 Conformance testing

6.1 General

NGN conformance testing is performed on a product or a system to confirm that the protocol implemented in the target product (or system) is in accordance with the protocol specification described in specific Recommendations.

Reference can be made to ITU-T X.29x-series Recommendations that define conformance testing for OSI as a procedure for defining NGN conformance testing.

It is possible to refer to part of a procedure of the ITU-T X.29x-series as a procedure for NGN conformance testing. Figure 2 illustrates the overview of conformance testing of the execution procedure in [ITU-T X.290].

The conformance testing methodology is described in ITU-T X.29x-series Recommendations. The conformance-testing system with the target product or system must be able to monitor all communications between the target product and the reference machine, and to operate the management and execution of the target system for the test system.

When conformance testing is executed, the reference machine and the monitor system should be used to confirm the sequence control and the protocol sending and receiving message, etc., of the protocol.

The reference machine and the monitor system should be used to make results correspond within various ranges, such as the expected normal behaviour and the unexpected abnormal behaviour.

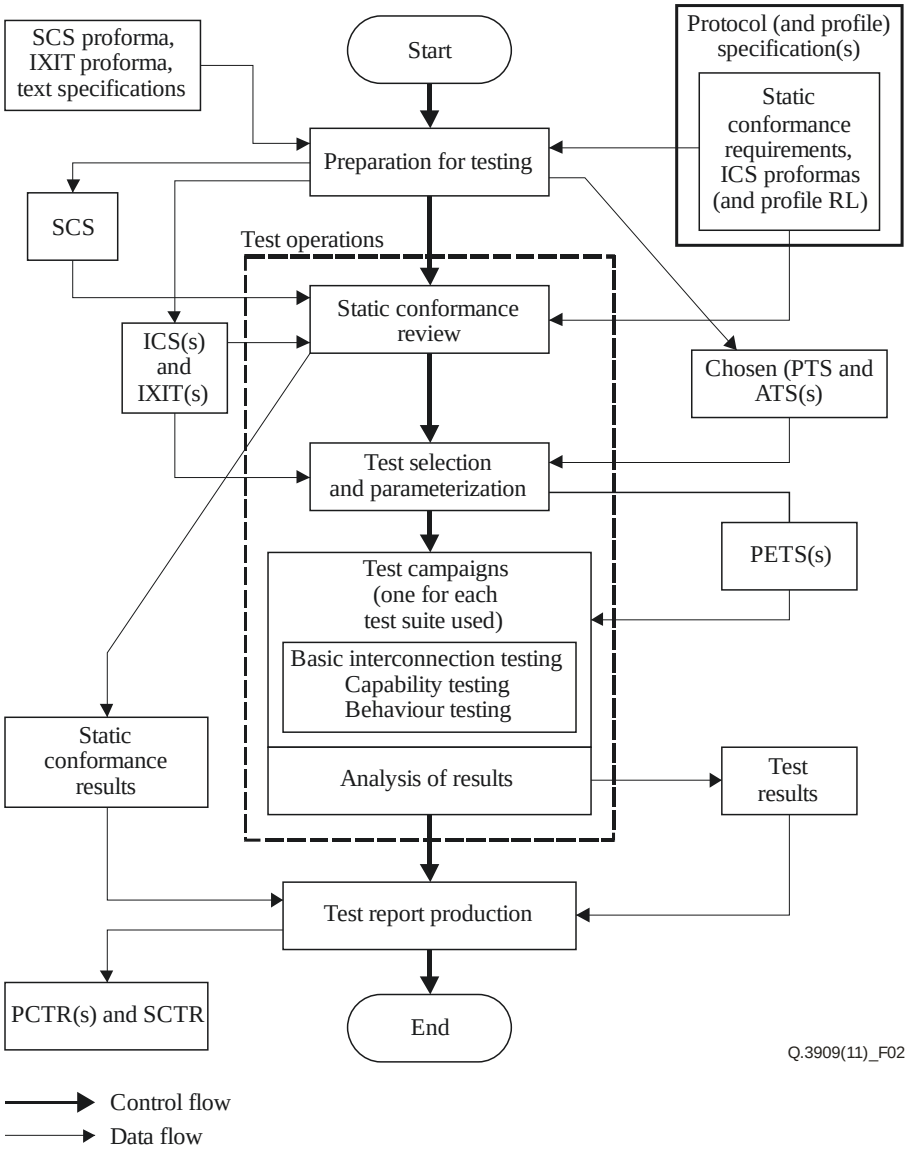

Figure 2 – ITU-T X.290 conformance assessment process overview

It is assumed that the examination is executed according to the following procedures related to the conformance-testing methodology in the ITU-T X.29x-series.

NGN conformance testing should consider specifications on:

- the test subject which is connected to the tester or reference machine and examines conformity with reference Recommendations.
- certifications or the type of approval which may be given to the products passed by the testing authority. This is not a mandatory function of conformance testing.
- test specifications for the conformance testing which are specified in the test specification language (e.g., PICS, PIXIT).

The conformance assessment process involves three phases:

1) Preparation for testing:
   - 1-1) Set the test object, target interface and target Recommendations
   - 1-2) Set the physical configuration and target products
   - 1-3) Define the test scenarios.

2) Test operations:
   2-1) Static conformance review
   2-2) Test selection and parameterization
   2-3) Test campaigns (examine the conformance testing according to the scenarios)
   2-4) Analysis of results.
3) Test report production.

6.2 Requirements

NGN conformance testing verifies the conformity of the products with the ITU-T Recommendations for NGN services, functions, QoS, security, mobility management and transport, etc. NGN conformance testing is required to consider the following steps.

6.2.1 Test object

Set the object for NGN conformance testing. Service, function, QoS, RACF, security, and NACF, can be the object of NGN conformance testing. The candidate test objects and the related Recommendations are shown as follows. (Other test objects, which are not described below, are assumed to be possible objects for NGN conformance testing.)

1) Services specified in [ITU-T Y-Sup.7]:
   - Multimedia services (NGN R1 services)
   - PSTN/ISDN emulation services (NGN R1 services)
   - PSTN/ISDN simulation services (NGN R1 services)
   - Data communication services (NGN R1 services)
   - Public interest aspects (NGN R1 services)
   - IPTV services (NGN R2 services)
   - Enterprise network services
   - Converged web browsing services (CWBS) (NGN R2 service)
   - USN applications and services (NGN R2 service)
   - Tag-based identification applications and services (NGN R2 service)
   - Managed delivery services (MDS) (NGN R2 service).
2) Functions such as IMS specified in [ITU-T Y.2021].
3) QoS (RACF) specified in [ITU-T Y.2111].
4) Security (NACF) specified in [ITU-T Y.2014].

6.2.2 Target interface

Set the target interfaces and/or test target reference points for NGN conformance testing. NGN internal interfaces (Mx, Rx, Nx, etc.) as well as NGN external interfaces (UNI, NNI, ANI, SNI) can be the target interfaces and/or test target reference points. The candidate target interfaces and/or target reference points and related Recommendations are shown as follows. (Other interfaces and reference points, which are not described below, are assumed to be the possible target interfaces or target reference points for NGN conformance testing.)

1) Function reference points specified in [ITU-T Y.2012].

- Reference points of transport processing FEs (T-U1, T-U2, T-U3, TC-T1, TC-T2, TC-T3, TC-T4, TC-T5, S-T1, S-T2, S-T3, S-T4, S-T5, A-T1, T-ON1, T-ON2, T-ON3)
- Reference points of transport-control-related FEs (S-TC1, TC-Ux, TC-U1, TC-T1, TC-TC1, S-TC2, S-TC3, S-TC4, S-TC5, TC-ON1, TC-T3, TC-T2, TC-T5, TC-T4,TC-T6,TC-T9)
- Reference points of service stratum FEs (A-S1, A-S2, A-S3, A-S4, A-S5, A-S6, S-U1, S-U2, S-TC1, S-TC2, S-T1, S-TC3, S-T2, S-TC4, S-T3, S-T4, S-TC5, S-T5, S-ON1, S-ON2, S-ON3)
- Reference points of application/service support FEs (A-U1, A-S1, A-S2, A-S3, A-S4, A-S5, A-S6, A-T1)

2) Mx interfaces specified in [ITU-T Y.2021].

- Reference points ISC/Ma, Cx, Dx, C2, Gm, Rs, Mp, Mn, Ie, Mx, Rf/Ro

3) Rx interfaces specified in [ITU-T Y.2111].

- Reference points Rs, Rw, Ru, Rt, Rp, Ri, Rd, Rn, Rh

4) Nx interfaces specified in [ITU-T Y.2014].

- Reference points Nx, Ng, Ne, Nc, Nd, Ni, Na, Nk, Nb

6.2.3 Target Recommendations

Identify Recommendations for the signalling requirements and protocols for NGN conformance testing from the test object and target interfaces. Numerous Recommendations may be identified for some of the target interfaces.

6.2.4 Target products

Set the target products for NGN conformance testing. NGN conformance testing is generally composed of the target product connecting to the tester at the target interface. NGN conformance testing may be composed of the target product connecting to the reference product which has already confirmed conformity with the target Recommendations.

6.2.5 Specific requirements for each test object

Specific requirements for each test object are described in the following.

1) NGN conformance testing for the service aspect:

- Set the target service. The target service may include basic service, supplementary service and optional service. In the case of conformance testing for the VoIP service, the end-to-end basic call and some supplementary services such as CLIP, CLIR, COLP, and COLR, etc., can be the target service for NGN conformance testing.
- Set the test target interface.
- Verify conformity to the target service at the target interface.
- Identify the Recommendation for service-conformance testing in Table 1.

Table 1 – Target Recommendations for service-conformance testing

		External interface				Internal interface				
		UNI	**NNI**	**ANI**	**SNI**	**Mx**	**Rx**	**Nx**	**Ex**	**…**
VoIP	Basic call	ITU-T Q.3402	ITU-T Q.3401	N/A	N/A					
	PSTN/ISDN simulation services defined in [ITU-T Y.2211] OIP OIR TIP TIR MCID ACR CDIV HOLD CB CCBS CW MWI CONF AOC ECT RC UPT CRBT CRT	ITU-T Q.3610 ITU-T Q.3611	ITU-T Q.3610 ITU-T Q.3611	N/A	N/A					
IPTV	Broadcast services (linear TV)								ITU-T H.701 ITU-T H.721 ITU-T H.740 ITU-T H.750 ITU-T H.761 ITU-T H.762 ITU-T H.770	
	On-demand service (VoD)									
	Advertising services									
Multi media	Audio and video communication									

2) NGN conformance testing for the QoS aspect:

- Set the target elements for QoS aspect. Resource and admission control protocol and conformity of quality of service can be the target elements for QoS conformance testing.
- Set the target interface.
- Verify the conformity of the target QoS element.
- Identify the Recommendation for QoS conformance testing in Table 2.

Table 2 – Target Recommendations for QoS conformance testing

		External Interface				Internal Interface						
		UNI	**NNI**	**ANI**	**SNI**	**Rs**	**Rp**	**Rw**	**Rc**	**Rt**	**Rd**	**Ri**
QoS	Basic	N/A	N/A	N/A	N/A	ITU-T Q.3301	ITU-T Q.3302	ITU-T Q.3303	ITU-T Q.3304	ITU-T Q.3305	ITU-T Q.3306	ITU-T Q.3307

3) NGN conformance testing for the security and mobility management aspect:

- Set the target security and mobility management element. User authentication protocol and the assignment of IP address protocol can be the target element of the security conformance testing.
- Set the target interface.
- Verify the conformity of the target security and mobility management elements.
- Identify the Recommendation for security and mobility management conformance testing in Table 3.

Table 3 – Target Recommendations for security and mobility management conformance testing

		External interface				Internal interface						
		UNI	**NNI**	**ANI**	**SNI**				**Ng**			
	Security	N/A	N/A	N/A	N/A	ITU-T Q.3201	ITU-T Q.3202					
	Mobility management							ITU-T Q.3221	ITU-T Q.3222	ITU-T Q.3223		

4) NGN conformance testing for the transport aspect:

- Set the target transport element. Routing protocols can be the target element of transport conformance testing.
- Set the target interface.
- Verify the conformity of the selected transport element.

Identify the Recommendation for transport conformance testing in Table 4.

Table 4 – Target Recommendations for transport conformance testing

		External Interface				Internal Interface						
		UNI	**NNI**	**ANI**	**SNI**							
	Multicast	N/A	N/A	N/A	N/A							

6.3 Physical configuration

Physical configuration for conformance testing should consider the following steps:

- Set the target product which implements the target interfaces for conformance testing.
- Set the tester and the test reference product (or both) connecting to the target product at the target interfaces.
- Construct the physical configuration for conformance testing, generally so that the tester or the reference product is connected with the target product at the target interface.
- Tools may be connected to the target product to simulate an interface. This is out of the scope of conformance testing.
- Figure 3 shows the general configurations for NGN conformance testing.

Figure 3 – General configurations for conformance testing

- The external interface of NGNs, such as UNI, NNI, ANI and SNI, can be the target interfaces for conformance testing.

6.4 Conformance testing for the NGN procedure

6.4.1 Preparation for testing

Before the test is conducted, both the client and the testing operator must recognize the tested contents and each other's conformance testing method.

The following items form contents of the preparation for testing that are recognized by both the client and the testing operator.

6.4.1.1 Set the test object, target interface and target Recommendations

Set the interface that becomes the confirmation point of NGN conformance testing in the examination target product.

The interface point should be connected with the reference machine for NGNs and should be the point that can confirm the functional operations that the target product implements.

Set the Recommendations that provide the described specifications for NGN conformance testing. Define the functions in Recommendations (defining communication protocol, parameters, message formats, sequence procedure, etc.) that are to be confirmed.

6.4.1.2 Set the physical configuration and target product

To define the test environment, set the physical configuration and the target product for conformance testing. The product must be connected in the specific interface that becomes a confirmation point decided in clause 6.2.2. These decisions become the basic test composition.

6.4.1.3 Define the test scenarios

The test scenarios should be defined for consideration in the interface to be examined.

Define the outlines of the confirmation items of the confirmed service, the function, the communication protocol, the parameters, the message formats, and the sequence procedure, etc.

The testing procedure to operate the conformance testing is defined as a test scenario.

The test scenario should be defined respectively by the test environment and the confirmation item.

6.4.2 Test operations

6.4.2.1 Static conformance review

The static conformance review is to confirm whether the target product has implementation of the NGN functions by comparing the requirement of agreement for the support functions described in the test scenario and the confirmation function with the specification in related Recommendations.

The confirmation items that the target product should be implemented the NGN functions are checked, and the review confirms whether to implement the behaviour expected as a result without doing an actual testing in the test scenario and the test item.

6.4.2.2 Test selection and parameterization

Based on the test scenario and the confirmation item, parameters and statements, etc., are defined for NGN conformance testing to execute a concrete test methodology and the examination.

The parameters are reflected in the test scenario and the confirmation items, and the test specification that concretely describes an actual test environment and the conducting of the test procedure is defined.

6.4.2.3 Test campaigns (examine conformance testing according to the scenarios)

Conformance testing is executed along the test procedure described in the test specification. This conformance testing is executed by connecting the reference machine with the test target device, and exchanging information mutually.

The test event, the test log, and the statement observed in conducting of the conformance testing are recorded as a test outcome.

A basic service test is executed as the order of executing the conformance testing to conform to normal performance. It may confirm the supplementary service and the function after confirming that a basic function operates normally.

6.4.2.4 Analyze test output

The output test event, test logs, and statements of the tested product, etc., as conformance testing results in test campaigns, should be compared with the specifications given in the Recommendations.

6.4.3 Test report production

For each text scenario in a test campaign, the conformance testing result is matched with the result of the static conformance review previously executed by test operations and the examination result report is created.

Based on the generated report, it is possible to confirm the result of the specified function of the target product.

7 Interoperability testing

7.1 General

Interoperability testing for NGNs is performed on two or more products. Its objective is to check the ability and performance of the products implemented by mutually exchanging information.

When undertaking NGN interoperability testing, the interoperability testing procedures of [ITU-T X-Sup.4] and [ITU-T X-Sup.5] may be referenced.

Figure 4 shows the overview of interoperability testing of the execution procedure in [ITU-T X-Sup.4] and [ITU-T X-Sup.5]. The execution procedure of interoperability testing in [ITU-T X-Sup.4] and [ITU-T X-Sup.5] is described as follows:

- The test operator should receive the information conformance statement (ICS) and implementation extra information for testing (IXIT), described in the applicable reference Recommendations.
- A static interoperability review is executed according to the content described in the ICSs and IXITs.
- If after review of the static IOPT results it is judged that interoperability testing does not need to be executed, the test operation will be ended.
- When it is necessary to execute the tests, the settings of the test method, the test environment architecture and the test specification will be explained in detail during the process of test selection and parameterization.
- Dynamic interoperability testing is executed according to the procedure of the prepared test specification that is built in two or more implementations under test (IUTs) which, as target products, connected mutually.
- The test output in dynamic interoperability testing would be analyzed and the test result report would be generated.

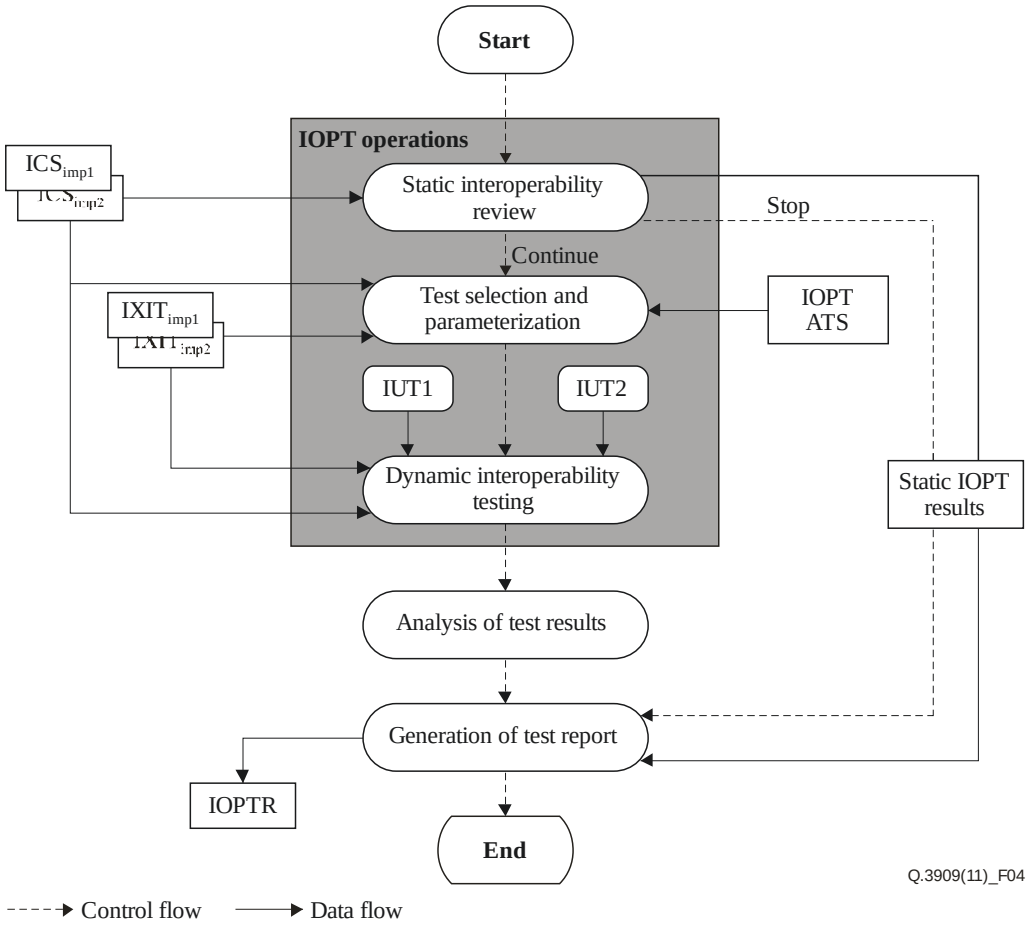

Figure 4 – Interoperability testing procedure referred to in Supplement 5 to the ITU-T X.290-series Recommendations

The NGN interoperability testing methodology should follow the procedures in [ITU-T X-Sup.4] and [ITU-T X-Sup.5].

Interoperability testing for NGNs should consider specifications on:

- Multiple products from multiple vendors that are connected and tested for interoperability at the service and transport level, or both.
- NGN interoperability testing should be conducted in the following steps:
  1) Preparation for testing
     1-1) Set the test object, target interface and target Recommendations
     1-2) Set the physical configuration and target products
     1-3) Define the test scenarios.
  2) IOPT operations
     1-1) Static interoperability review
     1-2) Test selection and parameterization
     1-3) Dynamic interoperability testing (examine the interoperability testing according to the test scenarios).
  3) Analysis of test results.
  4) Generation of test report.

7.2 Requirements

NGN interoperability testing verifies the functional capabilities of the connected products and their capability to interoperate.

NGN interoperability testing is required to consider the following:

7.2.1 Test object

Set the object for NGN interoperability testing. Service, function, QoS, resource and admission control function (RACF, security, and network attachment control function (NACF) can be the object of NGN interoperability testing. The test object of NGN interoperability testing may be a complex set of multiple test objects. Interoperability testing for services often contains combined multiple test objects. The candidates of the test objects and the related Recommendations are shown in clause 5.2.1.

7.2.2 Target interface

Set the target interfaces and reference points, or both, for NGN interoperability testing. NGN internal interfaces (Mx, Rx, Nx, etc.) as well as NGN external interfaces (UNI, NNI, ANI, and SNI) can be the target interface and target reference points, or both. The target interface may be combined with multiple interfaces. In the case of interoperability testing with multiple products (two or more), the target interfaces would be multiplied. The candidate target interfaces and reference points, or both, and the related Recommendations are shown in clause 6.2.2.

7.2.3 Target Recommendation

Set the target Recommendation providing signalling requirements and protocols for NGN interoperability testing from the test object and target interfaces. Some supplementary technical documents, which specify the detailed protocols at the target interface based on Recommendations, may be needed to improve interoperability of products.

7.2.4 Target product

Set the target product of NGN interoperability testing. The physical configuration of NGN interoperability testing is composed of products which realize the function of FEs defined in [ITU-T Y.2012]. The accommodation of FEs to the products is out of the scope of ITU-T Recommendations. See clause 6.3 for detailed specifications for the physical configuration of NGN interoperability testing.

7.2.5 Specific requirements for each test object

Specific requirements for each test object are described as follows:

1) NGN interoperability testing for service aspect

- Set the target service. The target service may include basic service, supplementary service and optional service. In the case of interoperability testing for VoIP service, end-to-end basic call and supplementary services such as CLIP, CLIR, COLP and COLR, etc., can be the target service for VoIP interoperability testing.
- Set the test target interface.
- Verify the interoperability of the target products.
- Identify the Recommendation for service interoperability testing in Table 1 in clause 6.2.5.

2) NGN interoperability testing from the QoS aspect

- Set the target elements for QoS aspect. Resource and admission control protocol and the interoperability of quality of service can be the target elements for QoS interoperability testing.
- Set the target interface.
- Verify the interoperability of the target products.
- Identify the Recommendation for QoS interoperability testing on Table 2 in clause 6.2.5.

3) NGN interoperability testing from the security and mobility management aspect

- Set the target security and mobility management element. The user authentication protocol and the assignment of IP address protocol can be the target elements of the security interoperability testing.
- Set the target interface.
- Verify the interoperability of the target products.
- Identify the Recommendation for security and mobility management interoperability testing in Table 3 in clause 6.2.5.

4) NGN interoperability testing from the transport aspect

- Set the target transport element. Routing protocols can be the target element of transport interoperability testing.
- Set the target interface.
- Verify the interoperability of the target products.
- Identify the Recommendation for transport interoperability testing in Table 4 in clause 6.2.5.

7.2.6 Test methodology

The target products would be combined with two or more interconnected products.

It is not necessary that the connected target products be of the same equipment or have the same functions, but they may be combined with the end-to-end terminal equipment, the terminal equipment and NGN network, the terminal equipment and server, etc.

The two or more target products may not be implemented by the same manufacturer; two or more products may be implemented by two or more manufacturers.

Therefore, to confirm interconnectivity of each of the target products, the test method (for example, round robin method) may be used as a method of interoperability testing.

An important point in interoperability testing is to confirm by a response that is mutually expected whether the mutually connected product operates normally. It may not be confirmed that the products have accurately implemented the function and the protocol, as it is a specification of a Recommendation.

When basic services can be performed to execute interoperability testing for which the service of an NGN is required, and the interconnectivity of the basic service can be confirmed, it is necessary to confirm the interconnectivity of the supplementary service. For instance, after confirmation of a basic call is executed, it is necessary to execute the examination of the supplementary services such as OIP and TIP for VoIP.

7.3 Physical configuration

Physical configuration for interoperability testing should consider the following steps.

- To set the target area of NGN interoperability testing such as service, QoS, security, mobility management and transport.
- To refer to the ITU-T Y.2012 functional requirements and architecture of the NGN as the base of the functional architecture of NGN interoperability testing.
- Some services should refer to the relevant ITU-T Recommendation which defines the functional architecture for each service such as ITU-T Y.1910 IPTV functional architecture in the case of interoperability testing for IPTV service.
- To identify the mandatory and optional functional entity based on the functional architecture.
- In the case of VoIP interoperability testing, the following FEs are needed (see Figure 5).
  1) Mandatory functional elements for basic calls are shown with red colour
     - P/S/I-CSCF, NACF, Switch/Router, NGN terminal
  2) Optional elements
     - Necessary elements for QoS control testing are shown with blue colour in Figure 5: RACF.
     - Necessary elements for terminal variation are shown with green colour in Figure 5: Access Media GW, Access GW control, RGW, Legacy terminal.
     - Necessary elements for SoA/SDP（Click to dial, etc.）are shown with yellow colour in Figure 5: Application support function and service support function.

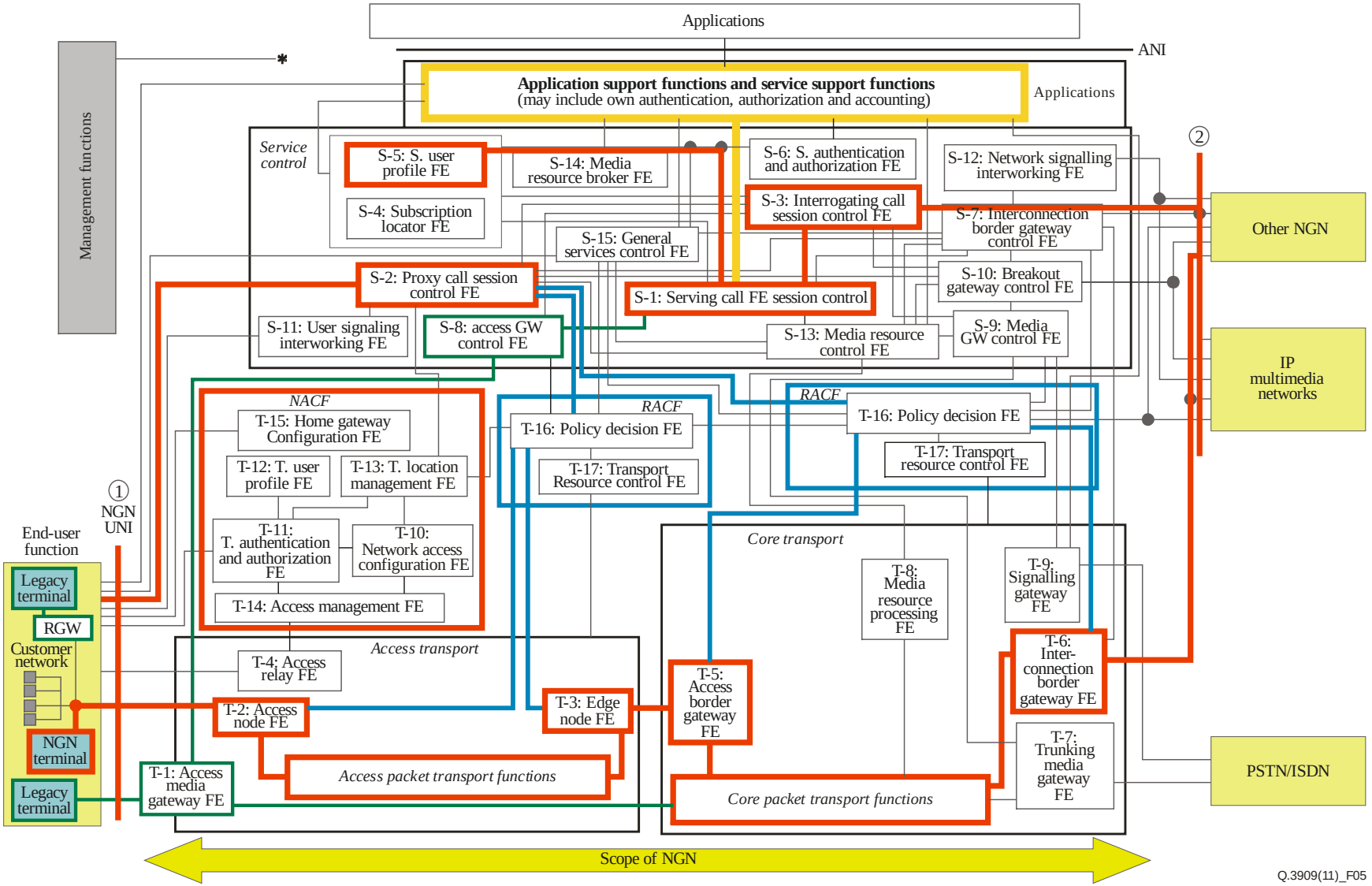

Figure 5 – ITU-T Y.2012 NGN generalized functional architecture

- To set the target product which implements the test objective FEs and defines the physical configuration for interoperability testing.
- The accommodation of the FEs to the products is out of the scope of ITU-T Recommendations because it is an implementation matter of the product. Therefore the physical configuration for interoperability testing depends on the target product.
- To set the target interface from the physical configuration. The interface between FEs which are accommodated in the same product should be the internal interface of the product. These internal interfaces are out of the scope of NGN interoperability testing. The external interface of the target product can be the target interface of NGN interoperability testing.
- Figure 6 shows the general configuration for VoIP interoperability testing between the UE of vendor A and the SIP server of vendor B.

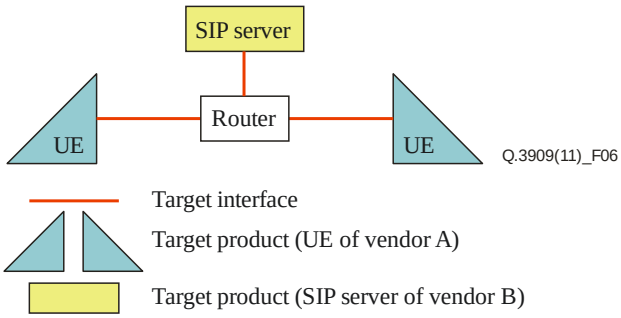

Figure 6 – General configurations for VoIP interoperability testing

- Figure 7 shows the general configuration for IMS-based IPTV interoperability testing between the IMS of vendor B and UE/IPTV-VS/IPTV-AS/QoS/Router of vendor A.
- NGN external interface of NGN such as UNI, NNI, ANI, and SNI, can be the target interfaces for conformance testing.

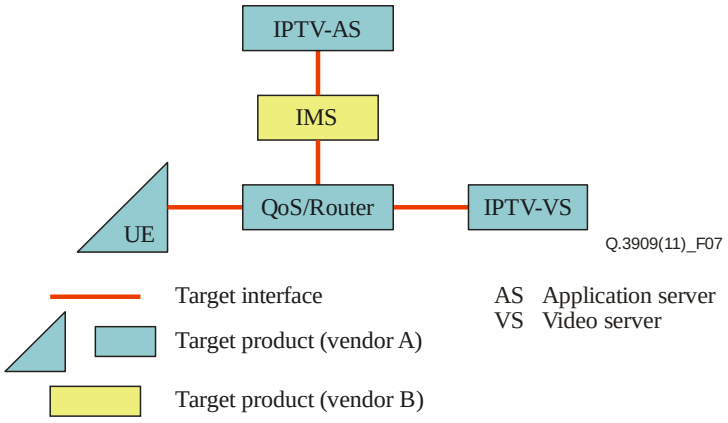

Figure 7 – General configuration for IMS-based IPTV interoperability testing

7.4 Interoperability testing for NGN procedure

7.4.1 Preparation for testing

Both the client and the testing operator must recognize examination contents and each other's interoperability testing method before the examination is executed.

The following items constitute the contents of the recognition match of both the client and the testing operator.

7.4.1.1 Set the test object, target interface and target Recommendations

Set the target products that execute interoperability testing for NGNs. It consists of two or more products that become the testing target products. It is necessary to set up the two or more products respectively in an appropriate point where its function that of each implement can be executed.

The composition may be become complex, because two or more terminals, servers, etc., are included in one interoperability testing.

Set the interfaces that become the connected point of interoperability testing for NGNs in the examination target products.

Because two or more target products exist, all interfaces which each target product is connected become target interfaces, and the target interfaces are points of contact of the target products and the NGN system.

Define the function in Recommendations that is confirmed for the NGN service. It is necessary to execute the examination referring to two or more Recommendations that the protocol specification corresponding to each interface are described so that two or more products may be executed the examination at the same time in NGN interoperability testing.

7.4.1.2 Set the physical configuration and target products

To define the test environment, set the physical configuration of the system that achieves the service of the NGN, and set the target product for interoperability testing.

The target products must be connected in specific interface that becomes a confirmation point decided by clause 7.2. It is necessary to set the two or more target products. These decisions become the basic examination composition.

7.4.1.3 Define the test scenarios

The test scenarios should be defined to be considered into the interface to be examined.

Define the outlines of the confirmation items of the confirmed service, the function, the communication protocol, the parameters, the message formats, and the sequence procedures, etc.

The testing procedure to operate the interoperability testing is defined as the test scenarios.

The test scenario should be defined respectively by the test environment and the confirmation item.

The functions of two or more target products should be understood, and the entire testing system should be into the test scenario.

7.4.2 IOPT Operations

It defined as interoperability specification of the products in the advance preparation, and interoperability testing is operated to the target products by using the agreement requirement for the support object described in the test scenario and the confirmation item.

7.4.2.1 Static interoperability review

A static interoperability review is to confirm whether the target products have implemented a specification for the NGN service or the NGN function, etc., by comparing the requirement for agreement of the support functions described in the test scenario and the confirmation function to the specification in related Recommendations.

The items confirming that the target products should be implemented in the NGN service and the function are checked, and the review confirms whether to implement the expected behaviour as a result without performing an actual testing of the test scenario and the test item.

7.4.2.2 Test selection and parameterization

On the basis of the test scenario and the confirmation item, the parameters and statements, etc., of interoperability testing for NGNs to execute a concrete test methodology and examination, are defined.

The decided parameters are reflected in the test scenario and the confirmation item, and the test specification that concretely describes an actual test environment and the conducting of the test procedure is defined.

7.4.2.3 Dynamic interoperability testing (examine the interoperability testing according to the test scenarios)

The interoperability testing is executed along the test procedure described in the test specification. This interoperability testing is executed by connecting the NGN system or other test target product with the test target product, and exchanging information mutually.

The test event, the test log, and the statement observed in the conducting of the conformance testing are recorded as a test outcome.

A basic service testing is executed on the order to execute interoperability testing to confirm the normal performance.

It may confirm the supplementary service and the function after it is confirmed that a basic function operates normally.

7.4.3 Analysis of test results

The test outcomes assumed to be a test event, an examination log, and a state, etc., output as a test outcome in interoperability testing (IOPT) operations, are compared. When the interoperability testing of one service is executed, the target products that have the same function may become two or more products.

In that case, a couple of target products would be executed in one service. The test should be sequentially executed, with the verification test for interoperability testing by round robin.

It is preferable to show a test table as a test output written in the format of a matrix, for example.

7.4.4 Generation of test report

A comparison is made between the examination scenario and the output of IOPT operations that carries out the examination according to the result of the static interoperability review executed through dynamic interoperability testing. The examination result report is then created.

It is possible to confirm whether each connected target product has the ability to achieve the NGN service function and the QoS function, etc., as specified by the report.

Appendix I

Positioning map of NGN testing specification documents

(This appendix does not form an integral part of this Recommendation.)

A number of ITU-T Recommendations contain NGN testing specifications. To aid in understanding the many NGN testing specifications, Table I.1 shows the relationship between the ITU-T Handbook on testing of next generation networks and ITU-T Recommendations specifying NGN testing.

Table I.1 – Positioning map of NGN testing specifications

	NGN TM local testing			**NUT testing**					
Level	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6
	Functional testing	Load and stress testing	Conformance testing	NUT functional testing	Interconnect testing	Service testing	end-to-end testing	QoS testing	Mobility and roaming testing
Specification process	Conformance			ITU-T Q.3909				Interoperability	
General Procedure	ITU-T Handbook on testing of next generation networks								
Methodology	ITU-T Q.3900								
Model network configuration	ITU-T Q.3901			ITU-T Q.3904					
Test scenarios	ITU-T Q.3948								
Formalized results	ITU-T Q.3903								

The connected devices used are the main difference between NGN TM local testing and the network unit test (NUT). The tester of the reference machine is applied to NGN TM local testing in the local environment and connected to the testing device. On the other hand, the NGN network that belongs to a telecom operator, together with the testing device, are applied to NUT testing in the public environment. Additionally, the reference documents used to confirm the results of NGN TM local testing and NUT testing are different.

SERIES OF ITU-T RECOMMENDATIONS

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

Printed in Switzerland
Geneva, 2012