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Next Generation Networks – Frameworks and functional
architecture models

General principles and general reference model for Next Generation Networks

ITU-T Recommendation Y.2011

ITU-T Y-SERIES RECOMMENDATIONS

**GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT
GENERATION NETWORKS**

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Numbering, naming and addressing	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899

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

ITU-T Recommendation Y.2011

General principles and general reference model for Next Generation Networks

Summary

This Recommendation specifies general principles and a general reference model for Next Generation Networks.

Source

ITU-T Recommendation Y.2011 was approved on 7 October 2004 by ITU-T Study Group 13 (2001-2004) under the ITU-T Recommendation A.8 procedure.

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Architecture, basic reference model, general functional model, Global Information Infrastructure (GII), layers, Next Generation Network (NGN), protocol models, stratum.

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CONTENTS

Page

1	Scope	1
2	References.....	1
3	Terms and Definitions	2
4	Abbreviations and Acronyms	3
5	Relationship to Global Information Infrastructure	4
6	Relationship to ITU-T Rec. X.200 – OSI Basic Reference Model	4
7	Basic functionality divisions in NGN.....	5
7.1	Separation between services and transport.....	5
7.2	Relationships between NGN basic reference model and ITU-T Recs G.805, G.809 and Y.110.....	8
8	General functional model	8
8.1	Functions	10
8.2	Resources.....	11
9	Multi-layer aspects	11
9.1	Inter-layer and intra-layer interaction.....	12
9.2	Co-ordination activities	13
9.3	Multi-layer network scenario in NGN.....	13
10	Service convergence by NGN	14
11	Multimedia services.....	15
11.1	The support of multimedia services	15
11.2	The access to the services and the support (of the services) requests	15
12	Identification and location	16
13	Emergency communications.....	17
14	Interactions between NGNs and non-NGN environments	18
15	Security.....	18
16	Quality of Service (QoS)	18
16.1	QoS classes.....	18
16.2	QoS control mechanisms.....	18
16.3	QoS control functional architecture.....	19
16.4	QoS control/signalling.....	19
Annex A	– Relationship of NGN to OSI BRM	20
A.1	Distribution of layer functionality	20
A.2	Ordering of protocol layers	20
A.3	Peer semantics of layers	20
A.4	Mode of transmission	20

	Page
Annex B – Principles retained/not retained from X.200 for NGN	21
B.1 X.200 parts applicable to NGN	21
B.2 X.200 parts not applicable to NGN	22
Appendix I – Example of convergence of services.....	22
I.1 Service scenario.....	22
I.2 System configuration.....	22
Appendix II – Interactions between NGNs and non-NGN environments	24
II.1 Introduction	24
II.2 Principle for IWF between NGNs	24
II.3 Agent model for interworking	25
BIBLIOGRAPHY	26

ITU-T Recommendation Y.2011

General principles and general reference model for Next Generation Networks

1 Scope

The seven layered Open Systems Interconnection Basic Reference Model (OSI BRM) as described in ITU-T Rec. X.200 [1] has long provided a basis for a model of communication, and the general principles still apply. However, the layering and protocol hierarchy defined in the OSI BRM cannot be directly applied in the Next Generation Network (NGN) environment and have to be interpreted in specific ways to accommodate the NGN environment.

This Recommendation describes general principles applicable to Next Generation Networks (NGNs) as well as a Basic Reference Model for NGNs, based on the generic foundations first laid down under the Global Information Infrastructure (GII) in ITU-T Recs Y.100 [2] and Y.110 [3], and basic communication architecture principles specified in ITU-T Rec. X.200 [1].

The general reference architecture model described in this Recommendation should enable the support of the overall NGN characteristics as given in ITU-T Rec. Y.2001 [4].

In particular, it is neutral with respect to specific protocols and/or technologies. It is more flexible than ITU-T Rec. X.200 [1] with respect to the positioning of functionality, and is not constrained to a specific hierarchical ordering of protocol layers.

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.

- [1] ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The basic model*.
- [2] ITU-T Recommendation Y.100 (1998), *General overview of the Global Information Infrastructure standards development*.
- [3] ITU-T Recommendation Y.110 (1998), *Global Information Infrastructure principles and framework architecture*.
- [4] ITU-T Recommendation Y.2001 (2004), *General overview of NGN*.
- [5] IETF RFC 791 (1981), *Internet Protocol – DARPA Internet Program – Protocol Specification*.
- [6] ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.
- [7] ITU-T Recommendation G.809 (2003), *Functional architecture of connectionless layer networks*.
- [8] ITU-T Recommendation I.322 (1999), *Generic protocol reference model for telecommunication networks*.

- [9] ITU-T Recommendation G.993.1 (2004), *Very high speed digital subscriber line transceivers*.
- [10] ITU-T Recommendation G.807/Y.1302 (2001), *Requirements for automatic switched transport networks (ASTN)*.
- [11] ITU-T Recommendation G.8080/Y.1304 (2001), *Architecture for the automatically switched optical network (ASON), plus Amendment 1 (2003)*.
- [12] ITU-T Recommendation Y.1241 (2001), *Support of IP-based services using IP transfer capabilities*.
- [13] ITU-T Recommendation Y.1711 (2004), *Operation and maintenance mechanism for MPLS networks*.
- [14] IETF RFC 3471 (2003), *Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description*.
- [15] ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network*.
- [16] ITU-T Recommendation M.3010 Amendment 1 (2003), *TMN conformance and TMN compliance*.
- [17] ITU-T Recommendation M.3400 (2000), *TMN management functions*.
- [18] ITU-T Recommendations M.3050.x series (2004), *Enhanced Telecom Operations Map (eTOM)*.
- [19] ITU-T Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications*.
- [20] ITU-T Recommendation X.701 (1997) | ISO/IEC 10040:1998, *Information technology – Open Systems Interconnection – Systems management overview*.
- [21] ITU-T Recommendation H.323 (2003), *Packet-based multimedia communications systems*.
- [22] IETF RFC 3261 (2002), *SIP: Session Initiation Protocol*.
- [23] IETF RFC 2616 (1999), *Hypertext Transfer Protocol – HTTP/1.1*.
- [24] ITU-T Recommendation Y.130 (2000), *Information communication architecture*.
- [25] ITU-T Recommendation Y.1541 (2002), *Network performance objectives for IP-based services*.
- [26] IETF RFC 2205 (1997), *Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification*.
- [27] IETF RFC 2748 (2000), *The COPS (Common Open Policy Service) Protocol*.
- [28] IETF RFC 793 (1981), *Transmission Control Protocol – DARPA Internet Protocol – Protocol Specification*.
- [29] ITU-T Recommendation Y.1251 (2002), *General architectural model for interworking*.

3 Terms and Definitions

This Recommendation defines or uses the following terms:

3.1 application services: See ITU-T Rec. Y.110 [3].

3.2 baseware services: See ITU-T Rec. Y.110.

3.3 control plane: The set of functions that controls the operation of entities in the stratum or layer under consideration, plus the functions required to support this control (see 8.1.1 for some details).

3.4 data plane: The set of functions used to transfer data in the stratum or layer under consideration.

3.5 horizontal relationship: See ITU-T Rec. Y.110.

3.6 infrastructural services: See ITU-T Rec. Y.110.

3.7 management plane: The set of functions used to manage entities in the stratum or layer under consideration, plus the functions required to support this management (see 8.1.2 for some details).

3.8 middleware services: See ITU-T Rec. Y.110.

3.9 NGN service stratum: That part of the NGN which provides the user functions that transfer service-related data and the functions that control and manage service resources and network services to enable user services and applications (see also 7.1).

3.10 NGN transport stratum: That part of the NGN which provides the user functions that transfer data and the functions that control and manage transport resources to carry such data between terminating entities (see also 7.1).

3.11 player: See ITU-T Rec. Y.110.

3.12 role: See ITU-T Rec. Y.110.

3.13 user plane: A synonym for data plane.

3.14 vertical relationship: See ITU-T Rec. Y.110.

4 Abbreviations and Acronyms

This Recommendation uses the following abbreviations:

3GPP	3rd Generation Partnership Project
ADSL	Asymmetric Digital Subscriber Line
ASON	Automatic Switched Optical Network
ATM	Asynchronous Transfer Mode
BRM	Basic Reference Model
COPS	Common Open Policy Service
FCAPS	Fault, Configuration, Accounting, Performance and Security
FTTH	Fibre to the Home
GII	Global Information Infrastructure
GMPLS	Generalized Multi-Protocol Label Switching
HDTV	High Definition Television
HTTP	Hypertext Transfer Protocol
IETF	Internet Engineering Task Force
IP	Internet Protocol
IWF	Interworking Function
IWU	Interworking Unit

MFA	Management Functional Area
MPLS	Multiprotocol Label Switching
NAT	Network Address Translation
NGN	Next Generation Network
NGN BRM	Next Generation Network Basic Reference Model
NNI	Network to Network Interface
OSI	Open Systems Interconnection
OSI BRM	Open Systems Interconnection Basic Reference Model
PLMN	Public Land Mobile Network
POA	Point of Attachment
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RSVP	Resource Reservation Protocol
SIP	Session Initiation Protocol
TCP	Transmission Control Protocol
TE	Terminal Equipment
TMN	Telecommunications Management Network
UMTS	Universal Mobile Telecommunications System
UNI	User to Network Interface
VDSL	Very high speed Digital Subscriber Line

5 Relationship to Global Information Infrastructure

The Global Information Infrastructure (GII) environment creates a more heterogeneous mix of technological and operational domains. Choices of core technologies can vary and a full set of services is being provided, by, say, a multi-service network. Consequently an end-to-end path may traverse many varied technologies encompassing a variety of protocol arrangements.

This Recommendation builds upon the GII environment described in ITU-T Rec. Y.100 [2], the GII Overview, and, in particular, the concept of "federation of networks" of diverse technologies with diverse services and (end-)user applications.

This Recommendation also adopts the principles specified in ITU-T Rec. Y.110 [3], the GII Principles and Framework Architecture, in respect of the "Enterprise Model", the distinction between "roles" and "players", and the separation between various "infrastructural roles".

An NGN is regarded as the realization of the GII, or at least some component thereof, and this Recommendation develops the architectural model to reflect such realizations.

6 Relationship to ITU-T Rec. X.200 – OSI Basic Reference Model

The OSI Basic Reference Model (OSI BRM) [1] specifies a model for specific 7-layer architecture. Whilst the stated scope of OSI BRM could be construed to be totally generic for all open systems standards development, in practice the OSI BRM has become synonymous with the rigidity associated with the seven layers defined therein, specific characteristics of each layer so defined, and the specific OSI layer protocols that were developed to match these characteristics.

However, the "concepts of a layered architecture" described in clause 5/X.200 [1] apply to all layered architectures. Clause 5/X.200 provides all the necessary definitions, characteristics and properties required to describe any kind of layered structure, not just the specific OSI structure.

The primary difficulties arise when the number and specific characteristics of the 7 layers of the OSI BRM are considered. As far as NGN systems (non-OSI systems) are concerned, all or some of the following situations may be encountered:

- the number of layers may not equal seven;
- the functions of individual layers may not correspond to those of the OSI BRM;
- certain prescribed or proscribed conditions/definitions of the OSI BRM may not be applicable;
- the protocols involved may not be OSI protocols;¹
- the compliance requirements of the OSI BRM may not be applicable.

This is not to say that the functionality resembling that described in the OSI BRM is not present in most systems, but rather that the functionality may be distributed quite differently, say across a fewer or greater number of layers, or just simply differently distributed, and not layered in the same rigid hierarchical fashion as that specified in the OSI BRM.

NGN architectures require a greater amount of flexibility than was envisaged when ITU-T Rec. X.200 was developed. Annex A identifies some areas of ITU-T Rec. X.200 which are either too restrictive and/or insufficient to accommodate recent, emerging or expected future technology. Additionally, a detailed list of items retained from ITU-T Rec. X.200 since applicable to NGN is given in Annex B. A list of items not retained (not applicable to NGN) from ITU-T Rec. X.200 is also given in Annex B.

7 Basic functionality divisions in NGN

The separation of services from transport, allowing them to be offered separately and to evolve independently, is the key cornerstone of NGN characteristics (see ITU-T Rec. Y.2001 [4]).

A second cornerstone are the relationships of the NGN to the principles of ITU-T Recs G.805 [6], G.809 [7] and Y.110 [3].

7.1 Separation between services and transport

The separation is represented by two distinct blocks or strata of functionality. The transport functions reside in the **transport stratum** and the service functions related to applications reside in the **service stratum**.

The horizontal relationship [3] aspects are shown in Figure 1 and the vertical relationship [3] aspects of this decoupling are shown in Figure 2. There are several points of note to be made.

Firstly, there is a set of **transport functions** that are solely concerned with conveyance of digital information, of any kind, between any two geographically separate points. A complex set of layer networks may be involved in the transport stratum, constituting layers 1 through 3 of the OSI 7-layer Basic Reference Model. The transport functions provide connectivity.

¹ One notable example being the Internet Protocol [5].