Telecommunications Standards Advisory Committee (TSAC)

Reference Specification

Next Generation Networks (NGN) Technical Framework

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NGN Technical Framework

1 Scope

1.1 This Reference Specification outlines the technical framework which is relevant for developing the Next Generation Networks (NGN). It refers to the architecture for NGN given in the ITU-T recommendation for functional requirements and architecture of next generation networks (ITU-T Rec. Y.2012 [1]).

1.2 The architecture for NGN shown in section 2 of this Specification is a functional architecture where a set of functions is used to describe the NGN structure. Each function is defined and specified as a set of functional entities (outlined in sections 3 and 4 of this Specification). Groupings of functional entities are used to describe the physical NGN implementations, and determine the capabilities supported in the NGN. Therefore network operators may choose and combine the functional entities according to their business models, services and capabilities to be supported.

1.3 NGN service-specific components required for the NGN to support services such as the mediated multimedia services and the PSTN/ISDN service capabilities are outlined in section 5 of this Specification. Security considerations are defined in section 6 of this Specification.

1.4 This architecture for NGN allows for the support of services identified in the ITU-T Y series Supplement 7 for the NGN Release 2 scope (ITU-T Rec. Y.Sup7 [2]), which are outlined in section 7 of this Specification. It also allows for the support of capabilities and capability requirements identified in the ITU-T recommendation for the NGN Release 2 (ITU-T Rec. Y.2201 [3]), which are listed in section 8 of this Specification.

1.5 This architecture for NGN does not restrict network operators' freedom to deploy capabilities or use capabilities of their business partners. Specific division of functional entities between the core and access networks is based on operators' business decisions rather than hard points of separation in the architecture. Functional entities may be mixed and matched in different ways. Physical equipment may have both the core and the access network functions.

1.6 Existing network operators may have adopted the overlay approach in which legacy networks like the Public Switched Telephone Network (PSTN) / Integrated Service Digital Network (ISDN) and Public Land Mobile Network (PLMN), will co-exist with the NGN for some time. Therefore inter-working with PSTN/ISDN is an important consideration in the architecture for NGN.

2 Architecture for NGN

2.1 The architecture for NGN described in this Reference Specification conforms to the NGN architecture as shown in Figure 1, which is a 2-layered NGN model, structured according to a service stratum and transport stratum.

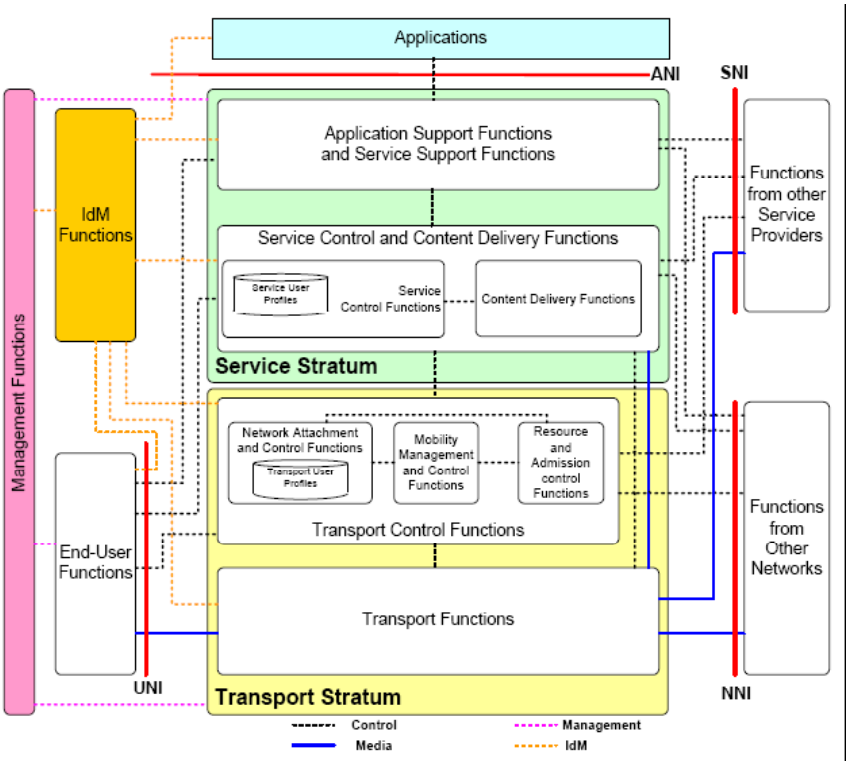

Figure 1: **NGN Architecture Overview (Figure 7-1: ITU-T Y.2012)**

2.2 The set of functions within the transport stratum of the 2-layered NGN model is supported by many protocols which together compose the NGN transport network. The end of the transport stratum protocol stack is denoted by layer 3 of the Open Systems Interconnection (OSI) Basic Reference Model (BRM) and the beginning of the service stratum protocol stack is denoted by layer 4 of the OSI BRM (see Figure 2). Layer 3 is the converging Internet Protocol (IP) layer where the IP-based NGNs converge in providing IP connectivity across the NGN transport network. Layer 4 is the Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) layer. A variety of layer 1 (Physical layer) and layer 2 (Data Link layer) will exist depending on the underlying technologies used to support IP.

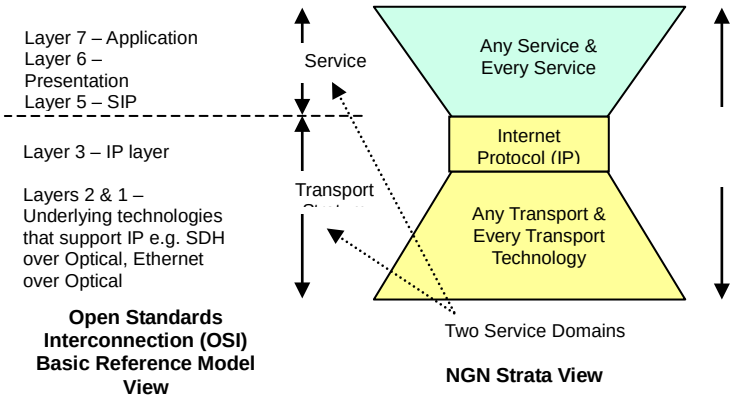

Figure 2: **Generic Layered Protocol Stack Architecture**

2.3 With a flexible architecture for NGN which supports multiple access network technologies, a core network can be set apart from another core network according to administrative needs or ownership. Access networks can be set apart from core networks in that they do not provide end-user services directly other than transport. Access networks can be set apart according to technologies, administrative needs or ownership.

3 NGN Functions

3.1 Transport Layer Functions

The transport layer includes transport functions and transport control functions.

3.1.1 Transport Functions

3.1.1.1 Transport functions provide connectivity for all physically separated functions within the NGN. These functions provide support for the transfer of media information, as well as the transfer of control and management information. Transport functions are defined in the ITU-T Rec. Y.2012 [1], which include access network functions, edge functions, core transport functions, gateway functions and media handling functions.

3.1.1.2 No assumptions are made about either the technologies to be used or the internal structure, for example, the access transport network and the core transport network (§ 4.1.1 of ITU-T Rec. Y.Sup7 [2]).

(a) Access Transport Functions (Network Dependent)

NGN Release 1 supports access transport functions of diverse technologies and capabilities. An access transport function provides IP connectivity at the transport stratum, between the end-user functions and the NGN core transport functions. The following is a list of proposed technologies which implement the access transport functions for the NGN Release 1.

xDSL:	ADSL (ITU-T Recs. G.992.1, G.992.3 and G.992.5), SHDSL (ITU-T Rec. G.991.2), and VDSL (ITU-T Recs. G.993.1 and G.993.2) transport systems and supporting connection/multiplexing technologies
SDH:	SDH dedicated bandwidth access (ITU-T Rec. G.707)
Optical access:	Point-to-point (IEEE 802.3ah 100Base-LX/BX), and xPON transport systems such as BPON (ITU-T Recs. G.983 series), GPON (ITU-T Recs. G.984 series), EPON (Gigabit EPON is sometimes called GEPON), (IEEE 802.3ah 1000Base-PX)
Cable:	Cable networks based on PacketCable multimedia specifications as another type of access transport function (ITU-T Rec. J.179)
LANs:	LANs using either coaxial or twisted pair cable, including 10Base-T Ethernet (IEEE 802.3), Fast Ethernet (IEEE 802.3u), Gigabit Ethernet (IEEE 802.3z), 10 Gigabit Ethernet (IEEE 802.3ae)
PLC:	Power Line Carrier (PLC) networks transmitting and receiving data over the power line
IEEE 802.X:	Wireless networks (various publications for wireless LAN and broadband wireless access)
3GPP IP-CAN:	Mobile networks (IP connectivity access networks)
Broadcast:	Broadcast networks (Internet broadcast/multicast, DVB, ISDB-T, various publications related to broadcasting)

(b) NGN Core Transport Functions (Network Independent)

NGN core transport functions provide IP connectivity at the transport stratum across the core network.

3.1.2 Transport Control Functions

Transport control functions include Resource and Admission Control Functions and Network Attachment Control Functions.

3.1.2.1 Resource and Admission Control Functions (RACF)

(§ 7.1.2.1 of ITU-T Rec. Y.2012 [1])

(a) Within the NGN architecture, the Resource and Admission Control Functions (RACF) act as the arbitrator between Service Control Functions and Transport Functions for QoS (ITU-T Rec. Y.1291) related transport resource control within access and core networks. The decision is based on transport subscription information, Service Level Agreements (SLA), network policy rules, service priority (defined by ITU-T Rec. Y.1571), and transport resource status and utilization information.

(b) The RACF takes into account the capabilities of transport networks and associated transport subscription information for subscribers in support of the transport resource control. The RACF interacts with Network Attachment Control Functions (NACF), including network access registration, authentication and authorization, parameters configuration etc, for checking transport subscription information.

(c) For delivering of those services across multiple providers or operators, SCF, RACF and Transport Functions may interact with the corresponding functions in other NGNs. The details and other aspects of the RACF are specified in ITU-T Rec. Y.2111.

3.1.2.2 Network Attachment Control Functions (NACF)

(§ 7.1.2.2 of ITU-T Rec. Y.2012 [1])

(a) The Network Attachment Control Functions (NACF) provide registration at the access level and initialization of end-user functions for accessing NGN services. These functions provide transport layer level identification/authentication, manage the IP address space of the access network, and authenticate access sessions. These functions include:

- Dynamic provisioning of IP addresses and other user equipment configuration parameters
- With endorsement of user, auto-discovery of user equipment capabilities and other parameters
- Authentication of end user and network at the IP layer (and possibly other layers)
- Authorization of network access based on user profiles
- Access network configuration based on user profiles
- Location management at the IP layer

In NGN release 2, a handover and seamless handover feature that enables service continuity should be supported.

(b) NACF includes Transport user profile which takes the form of a functional database representing the combination of a user’s information and other control data into a single "user profile" function in the transport layer. This functional database may be specified and implemented as a set of cooperating databases with functionalities residing in any part of the NGN.

3.2 Service Layer Functions

Functional groups in the service layer include Service Control Functions and Application Support and Service Support Functions.

3.2.1 Service Control Functions (§ 7.2.1.1 of ITU-T Rec. Y.2012 [1])

3.2.1.1 Service Control Functions (SCF) include resource control, registration, and authentication and authorization functions at the service level for both mediated and non-mediated services. They can also include functions for controlling media resources, i.e., specialized resources and gateways at the service-signalling level.

3.2.1.2 SCF accommodates service user profiles which represent the combination of user information and other control data into a single user profile function in the service layer in the form of functional databases. These functional databases may be specified and implemented as a set of cooperating databases with functionalities residing in any part of the NGN.

3.2.2 Content delivery functions (§ 7.2.1.1 of ITU-T Rec. Y.2012 [1])

The content delivery functions (CDF) receive content from the application support functions and service support functions, store, process, and deliver it to the end-user functions using the capabilities of the transport functions, under control of the service control functions.

3.2.3 Application Support Functions and Service Support Functions
(§ 7.2.2 of ITU-T Rec. Y.2012 [1])

The Application Support functions and Service Support functions include functions such as the gateway, registration, authentication and authorization functions at the application level. These functions are available to the “Applications” and “End-User” functional groups. The Application Support functions and Service Support functions work in conjunction with the Service Control Functions to provide end-users and applications with the NGN services they request.

3.3 End-User Functions (§ 7.3 of ITU-T Rec. Y.2012 [1])

3.3.1 No assumptions are made about the diverse end-user interfaces and end-user networks that may be connected to the NGN access network. End-user equipment may be either mobile or fixed.

3.4 Management Functions (§ 7.4 of ITU-T Rec. Y.2012 [1])

3.4.1 Support for management is fundamental to the operation of the NGN. These functions provide the ability to manage the NGN in order to provide NGN services with the expected quality, security, and reliability.

3.4.2 These functions are allocated in a distributed manner to each functional entity (FE), and they interact with network element (NE) management, network management, and service management FEs. Further details of the management functions, including their division into administrative domains, can be found in ITU-T Rec. M.3060.

3.4.3 Management functions apply to the NGN service and transport layers. For each of these layers, they cover the following areas:

(a) Fault management
(b) Configuration management
(c) Accounting management
(d) Performance management (ITU-T Y.2173)
(e) Security management

3.4.4 The accounting management functions also include charging and accounting functions (CAF). These interact with each other in the NGN to collect accounting information, in order to provide the NGN service provider with appropriate resource utilization data, enabling the service provider to properly bill the users of the system. A detailed description of the CAF functions can be found in §8.5/ITU-T Rec. Y.2012 [1].

4 NGN Functional Entities

The NGN architecture given in Figure 1 is a service and technology independent architecture which can be customised according to services to be offered and technologies to be used. It is a generalised NGN functional architecture where functional entities (NGN FEs) are generic FE, which can become technology-oriented according to context. Most of the NGN transport layer functions (such as the RACF or NACF) will support different types of NGN services in a common way. However, NGN implementations need not implement certain transport layer functions such as gateway FEs with respect to PSTN/ISDN, if they do not require the support of such capabilities.

4.1 Transport processing FEs defined in § 9.3.1/ITU-T Rec. Y.2012 [1]:

T-1 Access Media Gateway Functional Entity (AMG-FE)
T-2 Access Node Functional Entity (AN-FE)
T-3 Edge Node Functional Entity (EN-FE)
T-4 Access Relay Functional Entity (AR-FE)
T-5 Access Border Gateway Functional Entity (ABG-FE)
T-6 Interconnection Border Gateway Functional Entity (IBG-FE)
T-7 Trunking Media Gateway Functional Entity (TMG-FE)
T-8 Media Resource Processing Functional Entity (MRP-FE)
T-9 Signalling Gateway Functional Entity (SG-FE)
Policy enforcement functional entity (PE-FE)
Transport resource enforcement functional entity (TRE-FE)
Elementary forwarding functional entity (EF-FE)
Elementary control functional entity (EC-FE)
T-22: Layer 2 handover execution functional entity (L2HE-FE)

4.2 Transport control FEs defined in § 9.3.2/ITU-T Rec. Y.2012 [1]:

T-10 Network Access Configuration Functional Entity (NAC-FE)
T-11 Transport Authentication and Authorization Functional Entity (TAA-FE)
T-12 Transport User Profile Functional Entity (TUP-FE)
T-13 Transport Location Management Functional Entity (TLM-FE)
T-14 Access Management Functional Entity (AM-FE)
T-15 Home GateWay Configuration Functional Entity (HGWC-FE)
T-16 Policy Decision Functional Entity (PD-FE)
T-17 Transport Resource Control Functional Entity (TRC-FE)
T-18 Mobile location management functional entity (MLM-FE)
T-19 Handover decision and control functional entity (HDC-FE)
T-20 Network information distribution functional entity (NID-FE)
T-21 Network information repository functional entity (NIR-FE)

4.3 Service control FEs defined in § 9.3.3/ITU-T Rec. Y.2012 [1]:

S-1 Serving Call Session Control Functional Entity (S-CSC-FE)
S-2 Proxy Call Session Control Functional Entity (P-CSC-FE)
S-3 Interrogating Call Session Control Functional Entity (I-CSC-FE)
S-4 Subscription Locator Functional Entity (SL-FE)
S-5 Service User Profile Functional Entity (SUP-FE)
S-6 Service Authentication and Authorization Functional Entity (SAA-FE)
S-7 Interconnection Border Gateway Control Functional Entity (IBC-FE)
S-8 Access Gateway Control Functional Entity (AGC-FE)
S-9 Media Gateway Control Functional Entity (MGC-FE)
S-10 Breakout Gateway Control Functional Entity (BGC-FE)
S-11 User Signalling Interworking Functional Entity (USIW-FE)
S-12 Network Signalling Interworking Functional Entity (NSIW-FE)
S-13 Media Resource Control Functional Entity (MRC-FE)
S-14 Media Resource Broker Functional Entity (MRB-FE)
S-15 General Services Control Functional Entity (GSC-FE)

4.4 Content delivery FEs defined in § 9.3.4/ITU-T Rec. Y.2012 [1]:

C-1 Content distribution & location control functional entity (CD&LC-FE)
C-2 Content delivery control functional entity (CDC-FE)
C-3 Content delivery processing functional entity (CDP-FE)

4.5 Application Support and Service Support FEs defined in § 9.3.5/ITU-T Rec. Y.2012 [1]:

A-1 Application Support Functional Entity (AS-FE)
A-2 Application Gateway Functional Entity (APL-GW-FE)
A-3 Application Service Coordination Manager Functional Entity (APL-SCM-FE)
A-4 Service Switching Functional Entity (SS-FE)
A-5 Application support user profile functional entity (ASUP-FE)
A-6 Application provisioning functional entity (APP-FE)
A-7 Content preparation functional entity (CPR-FE)
A-8 Service and content protection functional entity (SCP-FE)

4.6 End-user functions and FEs defined in § 9.3.6/ITU-T Rec. Y.2012 [1]:

U-1 CPN gateway service control functional entity (CGSC-FE)
U-2 CPN gateway network attachment functional entity (CGNA-FE)
U-3 CPN gateway configuration and management functional entity (CGCM-FE)
U-4 CPN gateway policy decision functional entity (CGPD-FE)
U-5 CPN gateway policy enforcement functional entity (CGPE-FE)

4.7 Identity management functions and FEs are defined in § 9.3.7/ITU-T Rec. Y.2012 [1].

5 NGN Service-specific Components

5.1 IP Multimedia Service Component
(§ 10.1.1/ITU-T Rec. Y.2012 [1])

The IP multimedia service (IMS) component provides mediated services including the control and delivery of real-time conversational services based on the re-use of the IMS. The IMS is extended in NGN to support additional access network types such as xDSL and WLAN. PSTN/ISDN simulation service is also provided by this component. PSTN/ISDN simulation service refers to the provision of PSTN/ISDN like services to advanced terminals such as IP phones. The IMS component is specified further in ITU-T Rec. Y.2021.

5.2 PSTN/ISDN Emulation Service Component
(§ 10.1.2/ITU-T Rec. Y.2012 [1])

The PSTN/ISDN emulation (PES) service component enables the support of legacy terminals connected through a gateway to an IP network. All PSTN/ISDN services remain available and identical such that end-users are unaware that they are not connected to a TDM-based PSTN/ISDN. The PES component is specified further in ITU-T Rec. Y.2031.

5.3 IPTV Service Component
(§ 10.1.3/ITU-T Rec. Y.2012 [1])

The IPTV service component is as defined in Annex B of ITU-T Rec. Y.2012 [1]. It is NGN-based which provides an overview of the IPTV service component as shown in Figure 10-1 of ITU-T Rec. Y.2012 [1]), and encompasses both the IMS-based IPTV architecture and the non-IMS-based IPTV architecture.

5.4 Other NGN Service Components
(§ 10.1.4/ITU-T Rec. Y.2012 [1])

Other NGN service components will be defined in the future to address other services such push services, data retrieval applications, data communication services, online applications, sensor network services, remote control services, and over-the-network device management.

6 Security Considerations

Security requirements within the functional requirements and architecture of the NGN are addressed by the Security Requirements for NGN Release 1 (ITU-T Rec. Y.2701). Security requirements are voluntarily implemented by network operators or service providers to protect their customers and the networks. NGN security is based on a four layer conceptual model.

(a) NGN security at the application layer focuses on network-based applications accessed by service providers' customers. Applications include web browsing, email, basic file transfer etc. Security applied is to protect the customers and the networks.

(b) NGN security at the service layer addresses the security concerns of the services provided by service providers to their customers. Services include domain name services, value-added services and quality of service etc. Security applied is to protect the service providers and their customers.

(c) NGN security at the IP layer addresses the packet flow which is supported by the network facilities in transporting information. Security is focused on protecting the IP packets.

(d) NGN security at the data link layer focuses on protecting the data frames within a single link.

7 NGN Release 2 Environment Overview

7.1 The NGN Release 1 provides an extensible platform for services and an architecture which is designed to be extensible, allowing new services to be implemented as and when required. All services are carried over the Internet Protocol (IP), which in turn may be carried over a number of underlying technologies such as Asynchronous Transfer Mode (ATM), Ethernet, etc. The functions supported by the NGN Release 1 specifications are again illustrated in Figure 3, which includes interfaces between NGN and end-user functions, between NGN and other networks, and between NGN and applications.

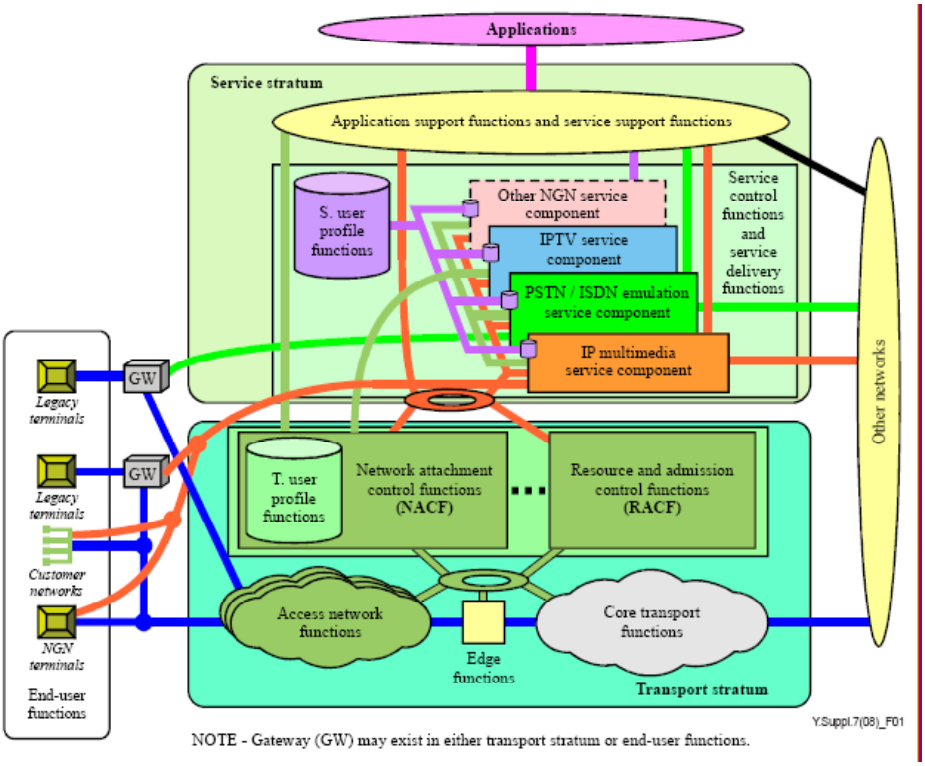

Figure 3: **Transport and Service Configuration of the NGN (ITU-T Y series – Supplement 7)**

7.2 The NGN Release 1 extensible platform and architecture supports the following services:

(a) Multimedia services (including PSTN/ISDN simulation services);
(b) PSTN/ISDN replacement support (emulation services);
(c) Data communication services; and
(d) Public Interest Aspects (for both multimedia services and PSTN/ISDN replacement support)

7.3 In addition, the NGN Release 2 extensible platform and architecture supports the following services:

(a) IPTV services;
(b) Converged web browsing services;
(c) Ubiquitous sensor network (USN) applications and services;
(d) Tag-based identification applications and services; and
(e) Managed delivery services.

7.4 The NGN Release 1 supports the following functions:

a) Control of access and core transport networks (QoS, admission control, authentication, etc.);
b) Co-ordination of multiple control components to a single core transport network for resource control;
c) Inter-working and interoperability with legacy networks;
d) Mutual de-coupling of the application support functions from the service control functions and the transport layer; and
e) Access technology independence of service control functions and application support functions.

7.5 Figure 3 represents the compilation of user and other control data into two functions: "service user profile" and "transport user profile" functions. These functions may be specified and realised as a set of co-operating databases with functionality residing in any part of the NGN.

7.6 End-user interfaces are supported by both physical and functional (control) interfaces. All categories of customer equipment are supported in the NGN, from single-line legacy telephones to complex corporate networks. Customer equipment may be both mobile and fixed.

7.7 NGN release 2 supports the following functions:

a) All the functionalities of NGN release 1;
b) Delivery functions for streaming content including multicasting, such as IPTV services; and
c) Mobility support functions, e.g., fixed-mobile convergence (FMC) and seamless handover.

IPTV service component is added in NGN release 2, which provides the service control and content delivery functionalities associated with providing IPTV services over an NGN environment.

8 Capability Requirements for NGN Release 2

The high level requirements and related capabilities for enabling the NGN Release 2 services (identified in ITU-T Rec. Y.Sup7 [2]) are defined in ITU-T Rec. Y.2201 [3], and are listed below. Selection of services to be included in any specific network is a deployment decision of the operator.

(a) Transport (use of IPv4 and IPv6; real-time and non-real-time communications; one-to-one and one-to-many connectivity; multicast)
(b) Service and application support (open service environment; service enablers; context awareness)
(c) Routing (Routing schemes suitable for NGN providers (static and dynamic routing schemes; within an NGN domain, and between domains; based on ITU-T E.164)
(d) Quality of service
(e) Identification and security
(f) Management
(g) Mobility handling
(h) Profile management
(i) Media handling
(j) Content management
(k) Operations and provisioning
(l) User networks including enterprise networks
(m) Interconnection and interworking
(n) Service-specific requirements
(o) Public interest aspects

9 References

Requirements given in this Specification are based on the following reference documents:

[1]	ITU-T Rec. Y.2012 (04/2010)	Functional requirements and architecture of next generation networks
[2]	ITU-T Rec. Y.sup7 (09/2008)	ITU-T Y.2000-series – Supplement on NGN release 2 scope
[3]	ITU-T Rec. Y.2201 (09/2009)	Requirements and capabilities for ITU-T NGN

Annex A

Addendum/Corrigendum

Changes to IDA RS NGN Technical Framework Issue 1, Feb 2007			
Page	**RS Ref**	**Items Changed**	**Date of Issue**
3 , 15 & 16	§ 1.1, 1.4, 8 and 9	The Specification has been updated with references for supporting the implementation of the NGN Release 2 scope of capabilities and services.	XX Jan 2014
4, 13 & 14	Figure 1 of § 2.1 and 7	The functions of the NGN Release 1 scope remain unchanged while additional functions have been included for the NGN Release 2, such as content delivery functions for streaming content for providing IPTV services, mobility support functions for fixed-mobile convergence and seamless handover.	
		Additional functions and components are:	
8 & 10	§ 3.2.2 and 4.4	Content delivery functions	
11	§ 5.3	IPTV Service Component	