Next Generation Network Standards in ITU-T

Chae-Sub Lee[1] and Naotaka Morita[2]
[1]HiSPOT S.A., 64 Chemin-Auguste Vilbert, 1218 Grand-Saconnex, Geneva, Switzerland
[2]NTT Corporation, 3-9-11, Midori-Cho, Musashino-Shi, Tokyo, Japan
genevalee@empal.com, morita.naotaka@lab.ntt.co.jp

Abstract: ITU-T, the global standard organization in telecommunication area, is developing standards for Next Generation Networks. These standard activities already started, but major focus was given to Focus Group on NGN which launched at June 2004 and finished at November 2005. This paper is a kind of key summary report of NGN standard development mainly based on FGNGN deliverables and some updates which taken from the 1st NGN-GSI event at this January 2006. ITU-T NGN standards are covering many of aspects; this paper focuses on requirements, functional architecture, quality of services and resource control issues.

1. Introduction

The concept of a new, integrated broadband network has developed over the last few years and has been labeled "Next Generation Network: NGN". ITU-T as a global standard organization initiated its standard development activity from 2003 with the name of JRG on NGN (Joint Rapporteur Group on NGN) in SG13. And this was continued through NGN Focus Group (formally called FGNGN) from June 2004 until November 2005.

FGNGN developed 18 approved deliverables and on-going drafts which will be developed further through relevant Study Groups under the banner of NGN-GSI (Global Standard Initiative). FGNGN deliverables cover mainly seven working areas as fundamental framework areas of NGN; services and capabilities, functional architecture and requirements, quality of service (QoS), control aspects, security issues, migration of current networks into NGN and future packet based network requirements. FGNGN was made-up of seven working groups according to each study area. Its final output was a total of 30 documents. A few of them were already approved during the meetings and transferred to the relevant Study Groups for their further consideration [1].

After the FGNGN, the NGN standard activity is transferred to NGN-GSI. The 1st NGN-GSI event was held at Geneva from 16th to 27th January of 2006 as joint study group meetings among SG11, SG13, SG19 and part of SG17 (WP2) and SG16 (Q29). This paper is a kind of summary report of current status of NGN standards mainly based on ITU-T FGNGN and the 1st NGN-GSI event. This summary mainly focuses on requirements, functional architecture, QoS, mobility and migration aspects.

2. Key Objectives of ITU-T NGN

IP (Internet Protocol) is the dominant transport protocol in the world. One of the most important features of IP is the independence of protocol layers (upper or lower). This feature has greatly impacted global connectivity networks, which provide connections independently of any kind of sub layer networks such as TDM, ATM and Frame relay etc. But its basic feature so called “Best Effort” is not enough to meet various requirements from users, providers and operators. Especially broadband access, such as ADSL, has enabled global connectivity coupled with various on-line applications, making a huge impact and creating a kind of on-line global village. This leaded many different requirements but similar features as in PSTN/ISDN/mobile; QoS (Quality of Service) guaranteed, support nomadicity and mobility, securing communication sessions and profiles and managing resources to provide services etc.

A Next Generation Network (NGN) aims to combine the best of both worlds from the telecommunication network (e.g. PSTN/ISDN) and the Internet. ITU-T is developing NGN as “Next Generation public telecommunication Network” can be determined with followings [2]:

- Provide both Customer and Provider facilitated provision to support services over wireline and wireless broadband accesses
- Support the desire of customers to be able to access their services from anywhere (inherent mobility)
- Facilitate to merge diverse network services – data (web browsing), voice, telephony, multimedia and emerging “popular” internet services such as Instant Messaging and Presence and broadcast type services
- Support a flexible platform for service delivery

3. Definition and Features of ITU-T NGN [3][4]

ITU-T Study Group 13 defined an NGN in Recommendation Y.2001, as “A packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies, and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.”

Recommendation Y.2001 further defines the NGN by the following fundamental characteristics:

- packet-based transfer;
- separation of control functions among bearer capabilities, call/session, and application/ service;
- decoupling of service provision from transport, and provision of open

interfaces;

- support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming/ non-real time and multimedia services);
- broadband capabilities with end-to-end QoS (Quality of Service);
- inter-working with legacy networks via open interfaces;
- generalized mobility;
- unrestricted access by users to different service providers;
- a variety of identification schemes;
- unified service characteristics for the same service as perceived by the user;
- converged services between fixed/mobile;
- independence of service-related functions from underlying transport technologies;
- support of multiple last mile technologies;
- compliance with all regulatory requirements, for example concerning emergency communications, security, privacy, lawful interception.

4. NGN Release 1 Requirements

ITU-T FGNGN works on a Release basis. A Release is a method of prioritizing by identifying a set of services to be addressed in a specific time frame. The FGNGN was progressed the work to define the service requirements, and the capabilities needed to realize those services as well as defining other associated capabilities to facilitate an NGN in its first Release. This release plan reviewed in NGN-GSI from last January meeting as well as other deliverables. It will get on board as ITU-T release plan soon.

4.1 NGN Release 1 Target Environment [5]

The first phase of NGN (Release 1) standards, especially scope and requirements, is developed to realize advanced environments for both services and networks including users and providers or operators view points. Followings are summary of these Release 1 target environments.

The NGN framework supports advanced architecture objectives; the transport stratum has to support a multiplicity of access networks and a variety of terminal types; Services are separable from the transport stratum to support “home network”, multiple Service Providers and third parties

The QoS objectives are supported End-End QoS; QoS across the transport stratum (access and core segments), in cooperation with application resource requirements for the services offered to end users; NGN Release 1 will provide an initial set of requirements, architectures, mechanisms and guidelines to enable end-to-end QoS, including resource and admission control

The NGN management supports the monitoring and control of the NGN; service/transport components via the communication of management information across interfaces between NGN components and management systems, between

NGN-supportive management systems, and between NGN components and personnel of service providers and network operators (the NGN Management Focus Group has charged on this area). This work includes, for example, provisioning of capabilities for management of NGN service components independently from the underlying NGN transport components, for personalization of end user services and creation of new services from service capabilities, for end user service improvements such as customer self service, for enabling service providers to reduce the time frame for the design, creation and delivery of new services.

Generalized Mobility support NGN communications and services have to be available to all qualified users requesting mobility services; regardless of the access network technology, as long as the services can be tailored for the specific terminal type and are compatible with the QoS of the access network; no major new interfaces for mobility are proposed for Release 1, then existing interfaces will be used, as well as existing signaling capabilities for all types of mobility as currently defined; personal/terminal mobility will continue to be used where users/terminal can register themselves with the services/access network; Nomadism, defined as personal or terminal mobility without maintaining an active service session during mobility, shall be supported between networks and within a network. This does not exclude support for mobility with active service session.

Applications and end user services are designed to be easily created in an open environment for both operators and third parties; A flexible service framework will enable implementation of value added services making usage of core network capabilities in an agnostic fashion; These core capabilities will be accessed via published application interfaces and features providing consistent access methods to the capabilities; NGN Release 1 aims to support interfaces to the following classes of services (where applicable): Intelligent Network-based services, Session Initiation Protocol (SIP)-based services, and Open Service Environment (OSA/Parlay, OMA etc.)-based services.

All NGN access network types are required to offer IP connectivity. NGN will support access agnostic features, that is, independence of diverse access technologies and capabilities. The following provides a non-exhaustive set of candidate technologies for Release 1:

- wireline domain: xDSL (ADSL, SDSL and VDSL transport systems and supporting connection/multiplexing technologies), PDH/SDH dedicated bandwidth access, Optical access (point to point, single star and xPON (Passive Optical Network) transport systems, such as BPON, EPON, GPON, GEPON), Cable networks, LAN (Local Area Network) networks, PLC (Power Line Carrier) networks
- wireless domain: IEEE 802.X Wireless networks [e.g., WLAN, Broadband Wireless Access (BWA)], 3GPP/3GPP2 Packet Switched (PS) domain (Circuit Switched (CS) domain is not supported), Broadcast networks

User equipment uses its Network Termination function to access services. This function being access network technology specific, the Network Termination

function types supported in Release 1 will be determined by the Release 1 Access network types. The simultaneous use of multiple access networks by single equipment shall be allowed, however there is no requirement to co-ordinate the communication in such scenarios.

The interconnection between multiple NGN network administrative domains or between NGN domains and other networks are concerned, the NGN is required to support access to and from other networks that provide communications, services and content. Release 1 will provide support for services across multiple NGN network administrative domains. Direct interconnection with the PSTN/ISDN will be supported by means of interworking functions implemented within the NGN. The followings are lists the Network-to-Network interconnection capabilities supported in Release 1:

- Circuit based legacy networks: PSTN/ISDN, PLMN (Public Land Mobile Network)
- other IP based networks: public Internet, Cable networks, Broadcast networks, other multimedia networks (3GPP/3GPP2 IMS)

4.2 Basic Components [6]

NGN defines four different types of service components according to the service targets. IP Multimedia Service Components and PSTN/ISDN Emulation Components are two key components within Release 1.

IP Multimedia Service Component is a service component within the Service Stratum based on the capabilities of the IP Multimedia Subsystem (IMS) [23.228, TIA-873]. It has been a starting point for the definition of Release 1 to leverage the capabilities of the IMS. To support the heterogeneous access transport environment of Release 1 the capabilities of the IMS need to be extended. The IMS functionality for NGN Release 1 employs SIP based service control. NGN Rel.1 shall maintain full compatibility with 3GPP/3GPP2 IP connectivity access transport functions (e.g. IP-CAN) and terminals.

PSTN/ISDN Emulation component fully supports legacy (PSTN/ISDN) interfaces to customer equipment and provides the user with identical services and experience to that of the existing PSTN/ISDN. Release 1 supports PSTN/ISDN replacement scenarios, with full interoperability with existing (legacy) PSTN/ISDN networks.

Other two components are service components one for streaming services and the other for multimedia services.

4.3 NGN Release 1 Services [6][7]

The following services are examples of the types of services supported by NGN Release 1. It has to be noted that compliance of a given network environment to NGN Release 1 does not mean support of all possible combinations of services (as well as capabilities and network configurations).

- Multimedia services: Release 1 will support both real time conversational communications (beyond voice) and non-real time communications. This includes, but is not limited to, the end to end delivery of communications using more than one media.
  - Messaging services (Instant Messaging (IM), Short Messaging Service (SMS), Multimedia Messaging Service (MMS), etc.)
  - Group Messaging
  - Push to talk over NGN and other Push-based services(e.g., IP multimedia services, MMS, etc.)
  - Point-to-point interactive multimedia services (e.g., video-telephony, white-boarding), collaborative interactive communication services (multimedia conferencing with file sharing and application sharing, e-learning, gaming)
  - Content delivery services (Radio and Video streaming, Music/Video on demand, TV channel distribution, financial information distribution, professional and medical image distribution, electronic publishing)
  - Broadcast/Multicast services
  - Hosted and transit services for enterprises (IP Centrex, etc.)
  - Information services (e.g., cinema ticket information, motorway traffic status)
  - Presence and General Notification services
  - 3GPP/3GPP2 OSA-based services
- PSTN/ISDN Emulation services: enabling legacy terminals to continue to use existing telecommunication services while connected to an NGN network. The user should have the identical experience as provided by the legacy PSTN/ISDN services. Not all service capabilities and interfaces have to be present to provide an emulation of a particular PSTN/ISDN network.
- PSTN/ISDN Simulation services: enabling NGN terminals in an NGN network to use telecommunication services similar to legacy PSTN/ISDN services (legacy terminals with terminal adaptations may also use these simulation services). Simulated services may not necessarily have the full functionality as defined for PSTN/ISDN, and may not necessarily use PSTN/ISDN call models or signaling protocols.
- Public Service aspects: These services may be applicable to NGN networks required to support public services. The NGN network should provide these services in compliance with national and regional regulations and international treaties. Precise network realizations of these services are beyond the scope of FGNGN Release 1.
  - Lawful Interception
  - Malicious Call Trace
  - User Identity Presentation and Privacy
  - Emergency Telecommunication Services and Telecommunication Disaster Relief
  - Users with Disabilities
  - Carrier Selection
  - Number Portability

- Other services: addresses various data services common to packet data networks. Examples include Data Retrieval applications, Data Communication services (ex. data file transfer, electronic mailbox and web browsing), Online applications (online sales for consumers, e-commerce, online procurement for commercials), Sensor Network services, Remote Control/Tele-Action services (ex. home applications control, telemetry, alarms), Over-the-Network Device Management.

4.4 Basic and Service support Capabilities [6][7]

In order to support multiple, innovative and evolving services, allowing flexible service design, creation and development, as well as third-party development and support, the concept of "*capabilities*" as set of basic building blocks for the provisioning of NGN service features is essential. NGN shall provide such a standard set of capabilities. One possible way to characterize these capabilities is to distinguish them in two groups, one constituting of underlying capabilities, called "basic capabilities", and the other one of used by services and user applications, called "service support capabilities".

Examples of basic capabilities include: connectivity support and management, routing, network authentication and authorization, accounting, traffic class and priority management, media resource management, interconnection and interworking etc.

Service support capabilities: generally combined with other capabilities or services to provide enhanced functionality, although some may be also used as stand alone services in specific cases. Within the set of (more or less service or environmen t-specific) service support capabilities, those supporting critical features of NG N Release 1 services include presence, location, group management, message handling, broadcast/multicast, push, session handling, device management.

5. Functional Architecture of NGN

5.1 General Principles of NGN Functional Architecture [8]

The NGN functional architecture shall incorporate several principles to meet its requirements which are defined in ITU-T recommendation Y.2001. It might be summarized these principles as "Open", "Independent" and "Multiplicity".

Open architecture: The NGN control interface should be open to support service creation, service updating, and incorporation of service logic provision by third parties. And the NGN will also support "Distributed control" which enable adaptation to the distributed processing nature of IP networks and support location transparency for distributed computing. Enhanced security and protection are the basic principle of an open architecture. It is imperative to protect the network infrastructure by providing mechanisms for security and survivability in the relevant layers.

Independent provisioning: The service provision process should be separated from

network operation by using the above-mentioned distributed, open control mechanism. This is intended to promote a competitive environment for NGN development in order to speed up the provision of diversified value-added services. Extending of this, NGN also will provide access agnostic architecture which separate access technology with end users and core networks.

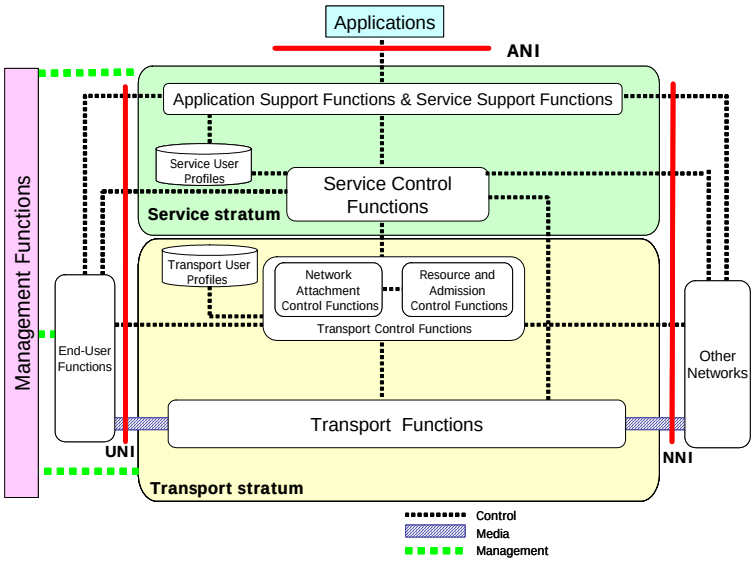
Multiplicity: Support for services in a converged network is needed to generate flexible, easy-to-use multimedia services, by tapping the technical potential of the converged, fixed-mobile functional architecture of the NGN. The NGN functional architecture shall offer the configuration flexibility needed to support multiple access technologies.

In addition to this, functional entities should incorporate the following principles:

- Functional entities may not be distributed over multiple physical units but may have multiple instances.
- Functional entities have no direct relationship with the layered architecture. However, similar entities may be located in different logical layers.

5.2 NGN Functional Architecture

The NGN architectural overview is shown in Fig. 1. NGN functions are divided into service functions and transport functions. According to recommendation Y.2011, it is called functional categories stratum.



Note: UNI/NNI/ANI are not meant to represent any specific interfaces.
(This type of note is written in TR-FRA word file.)

Fig. 1 NGN architecture overview

Customer networks and terminals are connected by UNI. Other networks are interconnected through NNI. Clear identification of UNI and NNI is important to accommodate a wide variety of off-the-shelf customer equipment while maintaining

business boundaries and demarcation points for the NGN environment [9].

It is noted that the UNI/NNI/ANI should be understood as general NGN reference points that can be mapped to specific physical interfaces depending on the particular physical implementations. Some functional groups, such as RACF, NACF, and Service Control functions, may be distributed and instantiated over different NGN provider domains. The functional groups in the Service stratum and the Transport stratum may be distributed between a visited network and a home network.

User profiles in both the service stratum and the transport stratum are shown as separate functional databases. Depending on the business model in place, these two functional databases can be co-located. It is also noted that other functional databases required for the support of NGN release 1 services (such as DNS) are not illustrated in Figure 1.

The delivery of services/applications to the end-user is provided by utilizing the Application Support functions and Service Support functions and related control functions. The NGN supports a reference point to the Applications functional group called Application-to-Network Interface (ANI), enabling application of NGN capabilities to create and provision enhanced services for NGN users.

The Transport stratum provides IP connectivity services to NGN users under the control of Transport control functions, including the Network Attachment Control Functions (NACF) and Resource and Admission Control Functions (RACF)

5.2.1 Transport stratum functions

Transport stratum functions provide connectivity for all components and physically separated functions within the NGN. IP is recognized as the most promising technology for NGN. Thus, the transport stratum will provide IP connectivity for both end-user equipment outside the NGN and controllers and enablers, which usually reside on the servers inside the NGN. The transport stratum is responsible for providing end-to-end QoS, which is a desirable feature of the NGN. The transport stratum is divided into access networks and the core network, with a function linking the two transport network portions.

- Transport functions: The transport functions provide the connectivity for all components and 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 include access network functions, edge functions, core transport functions, and gateway functions.
- Transport control functions: The Transport control functions include Resource and Admission Control Functions and Network Attachment Control Functions.
  - NACF (Network attachment control functions): provide registration at the access level and initialization of end-user functions for accessing NGN services. These functions provide network level identification/authentication, manage the IP address space of the access network, and authenticate access sessions. The functions also announce the contact point of the NGN

Service/Application functions to the end user.

– RACF (Resource and Admission Control Functions): provide QoS control (including resource reservation, admission control and gate control), NAPT and/or Firewall traversal control Functions over access and core transport networks. Admission control involves checking authorization based on user profiles, SLAs, operator specific policy rules, service priority, and resource availability within access and core transport. The functions act as the arbitrator for resource negotiation and allocation between Service Control Functions and Transport Functions.

- Transport user profile functions: take 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 stratum. This functional database may be specified and implemented as a set of cooperating databases with functionalities residing in any part of the NGN.

5.2.2 Service stratum functions

The service stratum functions provide session-based and non session-based services including subscribe/notify for presence information and the message method for instant message exchange.

- Service control functions: The Service control functions include both session and non-session control, registration, and authentication and authorization functions at the service level. They can also include functions for controlling media resources, i.e., specialized resources and gateways at the service-signaling level.

- Service user profile functions: The service user profile functions represent the combination of user information and other control data into a single user profile function in the service stratum, in the form of a functional database. This functional database may be specified and implemented as a set of cooperating databases with functionalities residing in any part of the NGN.

- Application/Service support functions: The Application/Service support functions include functions such as the gateway, registration, authentication and authorization functions at the application level. These functions are available to the "Third-Party Applications" and "End-User" functional groups. The Application/Service support functions work in conjunction with the Service control functions to provide end-users and third party application providers with the value added services they request. Through the UNI, the Application/Service support functions provide a reference point to the end-user functions (e.g., in the case of third-party call control for Click to Call service). The Third-party applications' interactions with the Application/Service support functions are handled through the ANI reference point.

5.2.3 End-user functions

No assumptions are made about the diverse end-user interfaces and end-user networks that may be connected to the NGN access network. Different categories of

end-user equipment are supported in the NGN, from single-line legacy telephones to complex corporate networks. End-user equipment may be either mobile or fixed.

5.2.4 Management Functions

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. 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 Functional Entities. Further details of the management functions, including their division into administrative domains, can be found in ITU-T recommendation M.3060. Management functions apply to the NGN service and transport stratum. For each of these stratums, they cover the FCAPS.

The accounting management functions also include charging and billing functions. 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.

6. Quality of Service and RACF

6.1 QoS, NP and QoE in NGN [10]

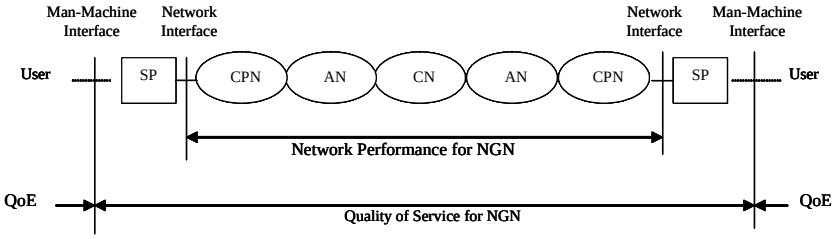
Quality issue is one of the most important subjects in the development of NGN. NGN is a packet based next generation network, but it is and will be based on IP until develop new transport technology. Because of this, supporting quality in NGN could be a key point differentiates NGN with IP based network. Key theme of quality in NGN is providing End-End quality, so ITU-T is developing three view points to identify quality: QoS (Quality of Service), NP (Network Performance) and QoE (Quality of Experience).

QoS is defined in Recommendation E.800 as follows: “Collective effect of service performance which determines the degree of satisfaction of a user of the service”. The definition of QoS in Recommendation E.800 is a wide one encompassing many areas of work, including subjective user satisfaction.

ITU-T Recommendation I.350 defines Network Performance as the “NP is measured in terms of parameters which are meaningful to the network provider and are used for the purpose of system design, configuration, operation and maintenance. NP is defined independently of terminal performance and user actions”.

Quality of Experience (QoE) is defined as the overall acceptability of an application or service, as perceived subjectively by the end-user. QoE includes the complete end-to-end system effects (client, terminal, network, services infrastructure, etc). Overall acceptability may be influenced by user expectations and context.

Fig. 2 illustrates how the concepts of QoS, NP and QoE are applied in the NGN environment.



* CN : Core Network, SP : Service Platform, AN : Access Network, CPN : Customer Premise Network

Fig. 2. General reference configuration for NGN QoS, NP and QoE

QoS provides a valuable framework for network provider, but it is not necessarily usable in specifying performance requirements for particular network technologies (i.e. ATM, IP, MPLS, etc.). Similarly, NP ultimately determines the (user observed) QoS, but it does not necessarily describe that quality in a way that is meaningful to users. QoE is subjective in nature, i.e. depend upon user actions and subjective opinions. The definition of QoS, NP and QoE should make mapping clear in cases where there is not a simple one-to-one relationship among them. Following table shows some of the characteristics which distinguish QoS, NP and QoE.

Table 1. Distinction between QoE, QoS and NP

Quality of Experience	Quality of Service	Network Performance
User oriented		Provider oriented
User behaviour attribute	Service attribute	Connection/Flow element attribute
Focus on user-expected effects	Focus on user-observable effects	Focus on planning, development (design), operations and maintenance
User subject	Between (at) service access points	End-to-end or network elements capabilities

6.2 Resource Admission Control Functions [11]

The RACF provides an abstract view of transport network infrastructure to SCFs (Service Control Functions) and makes Service Providers agnostic to the details of transport facilities such as network topology, connectivity, resource utilization and QoS mechanisms/technology etc. The RACF interacts with Service Control Functions and Transport Functions for a variety of applications (e.g. SIP-based call, Video Streaming etc.) that require the control of NGN transport resource, including QoS control and NAPT/Firewall control and NAT Traversal.

The RACF performs the policy based resource control based on the service information, transforms the service information to the transport resource demand and requests Transport Functions to enforce the policy decision, which builds up the linkage between the application characteristics and the underlying transport capabilities. The RACF interacts with Transport Functions for the purpose of controlling one or more the following functions in the transport layer: packet filtering; traffic classification, marking, policing, and priority handling; bandwidth reservation and allocation; network address and port translation; Firewall.

The RACF takes into account the capabilities of access transport network and associated transport subscription information for specific subscribers in support of the resource control. The RACF interacts with Network Attachment Control Functions (NACF, including network access registration, authentication and authorization, parameters configuration) for checking transport subscription information. For those services across multiple providers or operators, Service Control Functions (SCFs), RACF and Transport Functions may interact with the corresponding functions in other packet networks.

The RACF shall perform the resource control based on the following information:

- Service Information: A collective of data provided by SCFs for resource control request, which is derived from service subscription, service QoS requirement and service policy.
- Network Information: A collective of data collected from the transport networks, which may consist of network resource availability information and operator's network policy information.
- Transport Subscription Information: A collective of data provided by NACF, which includes the transport subscription profile such as the maximum transport capacity per subscriber.

The RACF may use the soft-state or hard-state approach in support of resource control per the network complexity, scalability and performance requirements.

7. Other issues

7.1 Security issues [12]

Security is another important subject in IP based network, especially in NGN. NGN security could be based on ITU-T recommendation X.805 and followings are summary of security requirements of NGN.

NGN security shall support interoperability; in particular among the various NGN security mechanisms. NGN shall provide the possibility to establish trust relationships with other networks and with users. This includes the capability of the network to authenticate and authorize a single subscriber and another network. Authentication and authorization shall be performed at both service and transport stratum (user-to-network, network-to-user, network-to-network). An NGN shall be capable of supporting a service that can ensure source address authentication. This

should be possible also in presence of NAT transversal.

The NGN architecture shall allow for network operators to limit the visibility of the network topology and resources to authorized entities. An NGN shall support multiple security zones. Isolation in security terms may be required between different security zones. An NGN shall allow provision of security measures to block unwanted traffic and shall allow provision of security measures against unauthorized access to network resources, devices, services and subscriber data (profile).

The security of NGN network management resources (OSS, database, etc.) shall be ensured. An NGN shall be capable of supporting a service which can ensure integrity and confidentiality of communications. An NGN shall be capable of supporting a service that can prove the origin of received data as a particular subscriber or address, and a service that can prove the delivery of data to a particular subscriber or address. This should be possible also in presence of NAT transversal.

Security functionality shall be installed on the boundary between the networks and passage of data should be controlled through it. This includes functions such as filtering data packets and signaling information according the rules specified e.g. refusal of communication from particular applications or users

7.2 Evolution issues [13][14]

Next Generation Network (NGN) is believed to provide new opportunities for and capabilities to the network and service providers. Considering that existing networks have different life span and vast amount of capital has been spent on them, complete replacement of their components is not considered to be either advisable or possible. So, a phased approach should be considered for evolution of existing networks to NGN. Public Switched Telephone Network/Integrated Services Digital Network (PSTN/ISDN) being one of the first networks, is considered to be prime candidate for evolution. For PSTN/ISDN evolution to NGN a phased approach is mainly considered in the development of FGNGN deliverables and continues through NGN-GSI.

Evolution to NGN should allow continuation of the existing network capabilities and in addition facilitate implementation of new capabilities. Evolution to NGN should respect the integrity of services provided by the existing networks and should facilitate introduction of new services. Considering that provision of NGN is an evolutionary process it is necessary to define a step-by-step approach leading to the NGN as a target network. This approach should consider the following objectives:

- separation of transport, control, management and service functions.
- reduction of cost for the network infrastructure and its maintenance
- maximum reuse of the existing resources
- achieving comparable QoS level as provided in the existing network
- optimum use of the new technologies
- rapid implementation of new services and technologies enabling introduction of new applications
- provision of mechanisms enabling user’s full utilization of the applications and network resources.

PSTN/ISDN Simulation and Emulation services explained in section 4.3 are developed to support of this evolution to NGN during the FGNGN.

8. Conclusion

Many of people confused of NGN would be next generation Internet. This confusion caused from use of IP in both networks. ITU-T NGN is now developing this for the next generation public telecommunication networks. This means NGN could be incorporated by many of public telecommunications view points. Critical examples of this are supporting public services such as “Emergence Services/Telecommunication Disaster Relief” and “Lawful Intercept Capabilities” etc. And NGN also provide certain capabilities for fare and transparent competition among different players (network providers, service providers and information providers etc.).

NGN standards mainly focused on service requirements, functional architectures, QoS aspects, but this will be expanded to cover rest of areas, especially for implementation and provisioning. Development of signaling and QoS control protocols are being developed now and it will be followed provisioning issues such as addressing and accounting aspects soon. All these activities are now carrying out in ITU-T NGN-GSI.

References

[1] ITU-T FGNGN-MR-0065.
[2] Chae Sub Lee, Dick Knight, “Realization of Next Generation Network”, IEEE Communication Magazine, October 2005.
[3] ITU-T Recommendation Y.2001.
[4] ITU-T Recommendation Y.2011.
[3] ITU-T Recommendation M.3060.
[5] ITU-T FGNGN-OD-253, “NGN Release 1 Scope.”
[6] ITU-T FGNGN-OD-252, “NGN Release 1 requirements.”
[7] Marco Carugi, Brent Hirschman, Atsunobu Narita, “Introduction to the ITU-T NGN Focus Group Release 1: Target Environment, Services and Capabilities,” IEEE Communication Magazine, October 2005.
[8] ITU-T FGNGN-OD-244R2, “Functional Requirements and Architecture of the NGN.”
[9] Keith Knight, Thomas Towle, Naotaka Morita, “NGN architecture: generic principle, functional architecture, and its realization”, IEEE Communication Magazine, October 2005.
[10] ITU-T FGNGN-OD-166, “General Aspects of Quality of Service and Network Performance in the Next Generation Networks.”
[11] ITU-T SG13 TD-81R2 (WP4/13), “Draft Recommendation Y.RACF Version 8.0”, January 2006, Geneva Switzerland.
[12] ITU-T FGNGN-OD-255, “Security Requirements for NGN Release 1.”
[13] ITU-T FGNGN-OD-257, “Evolution of Networks to NGN.”
[14] ITU-T FGNGN-OD-258, “PSTN/ISDN evolution to NGN.”