GUIDELINE ON NEXT GENERATION NETWORK (NGN) REALIZATION

MTSFB 001:2005

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Acknowledgement

Committee Representation

The Next Generation Network (NGN) Working Group which developed this Guideline comprises representatives from the following organisations:

Digi Telecommunications Sdn Bhd
Malaysian Communications and Multimedia Commission
Maxis Communications Bhd
Telekom Malaysia Berhad
Time dotCom Bhd

Foreword

The Next Generation Network (NGN) Working Group in Malaysian Technical Standards Forum Bhd (MTSFB) was set up to address issues and concerns with regards to standards and regulatory policies with the on set of IP services.

Working Group Objectives

- To highlight implications of network convergence including the arrangements to support the migration of telephony services on to future networks and to support current/future regulatory/interconnect requirements.
- To study on the introduction of broadband NGN services, such as triple play, where voice is incorporated.
- To be a single Study Group for core NGN studies covering fixed, mobile and broadband technologies.
- To be a single coordinated forum for all NGN industry players (network providers, content providers, service providers, vendors, etc.) to share NGN knowledge, define standards based on Malaysian needs, and manage proper releases to industry players.
- To ensure all activities above will and must support the current/future Malaysian regulatory requirements as well as to recommend changes to the current regulatory framework to enable NGN.
- To identify problems/issues (on network design implementation, test, commissioning, commercial and etc.) and to provide/recommend common solutions for them.

Working Group Scope

- Service interworking across networks for end-to-end services
- Features and functionality requirements, end-to-end service quality and support for existing/legacy services
- Network/service architecture and protocol options and arrangements
- Interconnection options and arrangements within NGN and with existing networks (PSTN/PLMN/internet)
- Network service management, interception and security, emergency services and privacy implications
- Policy and regulatory options to be supported by NGN
- Special user requirements
- Broadband NGN services and its CPE
- Promote interworking with other bodies such as 3GPP/TISPAN-IMS, ATIS - US carrier requirements, DSL Forum – remote management of CPE, IETF – IPv6, SIP extensions, MPLS, etc., TMF – standardized OSS components, Open Mobile Alliance (OMA) – Mobile Applications, DRM, Metro Ethernet Forum (MEF) – role of Ethernet in transport network, IEEE802.x – WiFi and WiMax hotspots.
- Charging and billing mechanism

1 Executive Summary

Communications as we know, has reached new dimensions beyond traditional voice. In fact the pace of change for the past few years has seen more developments compared to twenty years prior to that. The future networks have resulted in the term NGN (Next Generation Network). NGN encompasses the Access, Core, Transport and the Applications that ride on it.

Next-Generation Network is a generic term used to describe the emerging packet-based networks. The common principle of NGN is to use packet mode data transmission technologies to transport all the various types of telecommunication services. Interfaces are separated from the different layers of the communication network (transmission, control and applications) to allow for a greater evolution of the network. The NGN architecture is based on Internet Protocol (IP) with multimedia rich and bandwidth hungry applications in addition to legacy services such as voice and text. In summary, the objective of NGN is to have a single network for all the services.

MTSFB forms an NGN Working Group to address the many issues (technical and non-technical) and concerns that may arise amongst the industry in Malaysia pertaining to NGN deployment.

This paper as being a pre-standard document addressing NGN needs in Malaysia has got the following objectives and scope.

1.1 Document Objectives

- To explain the concept of NGN and its migratory path.
- To ensure all activities above will and must support the current/future Malaysian regulatory requirements as well as to recommend changes to the current regulatory framework to enable NGN.
- To raise the need for addressing to ensure (i.e. special numbering blocks) differentiation of services and to simplify/enable interconnects settlement.
- To highlight the need for QoS in core networks within and external to ensure carrier grade voice and data services.

1.2 Document Scope

- To recommend the need for a special numbering block for NGN services to simplify interconnect settlements.
- Features and functionality requirements, end-to-end service quality (QoS) and support for existing/legacy services
- Network service management, interception and security, emergency services and privacy implications
- Policy and regulatory options to be supported by NGN

2 Target Audience

- Government bodies: Ministry of Energy, Water and Communications, Ministry of Science, Technology and Innovation, Prime Minister Department, Polis Di Raja Malaysia etc
- Regulator: Malaysian Communications and Multimedia Commission
- SIRIM Berhad
- MSC Development Corporation
- Licensee: NFP, NSP, CASP, ASP
- Vendors
- Forums: Consumer, Content, Access
- Higher Learning Institution

- Non Government Organizations
- General Public

3 Introduction And Overview

NGN has been designated to take into account the new situation in telecommunications, characterized by a lot of factors: open competition between service providers due to the total deregulation of markets, explosion of digital traffic, e.g. due to the increasing presence and relevance of the internet, increasing demand of new multimedia services, general mobility and so on

NGN implementations therefore will always be technologically diverse, but common global driving forces include:

- The need to deliver increasingly larger capacities to end users (both fixed and mobile) for marginal increases in cost
- The need for supporting seamless service
- The need to consolidate network protocols
- The need to support QoS for real-time services.
- To described the users/subscribers benefits in using NGN services
- To demand to improve the existing life style of end user by simplifying the subscribers lives e.g. single account and bill

This paper outlines the views of MTSFB comprising of telecommunications and broadcasting industry in Malaysia. The purpose is to outline the desirable policies and regulations required to deploy complete infrastructure based on IP.

4 NGN Context

The NGN or Next Generation Networks term as we know has been around for more than a decade. It is well understood as the future of all existing communication technologies and perceived as the most efficient, optimized and secures method to deliver basic and advanced voice and data services to the customer. Generic NGN networks can be depicted in Figure 1 as follows:

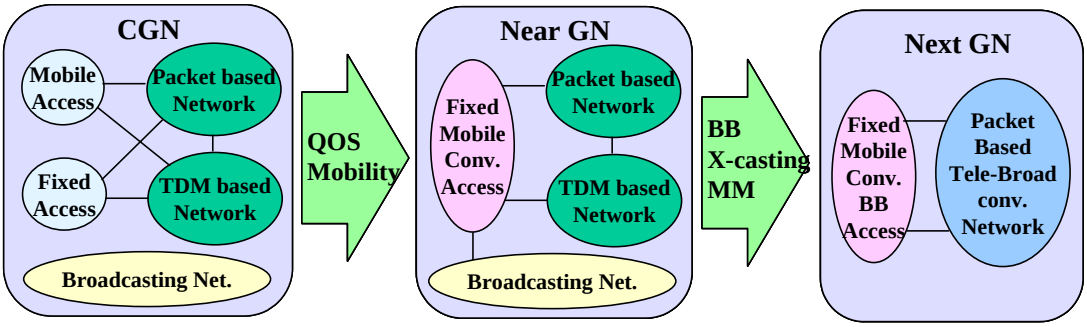

Figure 1: NGN Convergence (Source: ITU-T)

In a generic manner, the convergence towards NGN is leading into two approaches, which are the “telephony” approach and the “multimedia” approach. Telephone operators, who want to develop multimedia services, thus introduce data in their networks and in reversal, the ISPs who want to introduce voice. The “multimedia” approach seems to be preferred by the market and is more of an evolution of the IP networks.

4.1 MTSFB's View of NGN

MTSFB views NGN as the evolution of not only existing telecom but also broadcasting networks delivering carrier grade IP services to the end user. There is a need to list all standards bodies with their different areas of work to produce an overall inventory of standards (approved or under consideration) for each network access technology so as to identify existing gaps and standardization plans for each body.

- NGN as a concept relates to multiple networks eventually converging into one.
- NGN being packet based will be governed by standards from IEEE, IETF, ITU-T, 3GPP-TISPAN-IMS
- NGN architecture is based on a 3GPP-layered structure that clearly defines control and data planes that separate the network into 3 different planes which are the access plane, control plane and application/service plane as illustrated by the generic NGN layered architecture model in Figure 2 as follows:

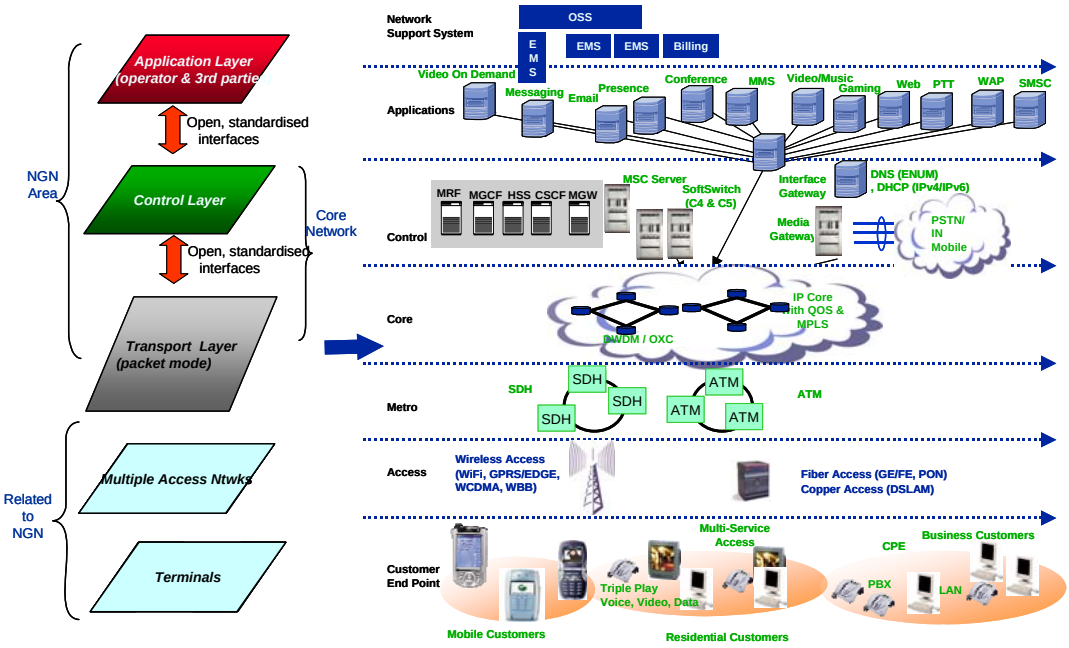

Figure 2: NGN Layered Architecture Model (Source: ITU-T)

- Interworking between NGN and legacy networks need to be supported with clear interconnect requirements.

4.2 ITU-T's definition of NGN

A Next Generation Network (NGN) is a packet-based network able to provide services including 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 offers unrestricted access by users to different service providers. It supports generalized mobility, which will allow consistent and ubiquitous provision of services to users.

The following fundamental aspects characterize the NGN:

- Packet-based transfer
- Separation of control functions among bearer capabilities, call/session, and application/ service

- Decoupling of service provision from network, 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 services and multi-media)
- Broadband capabilities with end-to-end QoS and transparency
- Interworking with legacy networks via open interfaces
- Generalized mobility
- Unrestricted access by users to different service providers
- A variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks
- 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
- Compliant with all Regulatory requirements, for example concerning emergency communications and security/privacy, etc.

5 NGN Architecture

NGN architecture principles:

- A layered approach, including
  - A transport layer, including functional entities that do transport routing
  - A service layer, including functional entities that provide services

- A sub-system oriented approach, enabling
  - The addition of new subsystems over the time to cover new demands and service classes.
  - To import (and adapt) subsystems from other standardization bodies
  - Flexibility to adjust a subsystem architecture with no or limited impact on other subsystems.

- IP connectivity is provided using two subsystems
  - Network Attachment SubSystem (NASS)
  - Resource and Admission Control SubSystem (RACS)

- Initial service-oriented subsystems include
  - The 3GPP/IMS, a PSTN/ISDN Simulation Subsystem
  - A PSTN/ISDN Emulation Subsystem (PES)

- Future service-oriented subsystems may include
  - A streaming subsystem
  - A TV Broadcasting subsystem

5.1 Evolution/migration from Fixed network/PSTN

Phase 1: Introduction of NGN network for Fixed Access

In this phase, the NGN is mainly aimed at offloading the existing trunk traffic and introduction of IP based services to customers.

During the introduction of NGN network, Soft switches and Media Gateways are to be installed at several locations. Its main function is to do the transit and routing of the trunk traffics and accessibility to IP based services. Both PSTN and NGN will operate concurrently in this phase.

The network configuration of Phase 1 is shown in Figure 3.

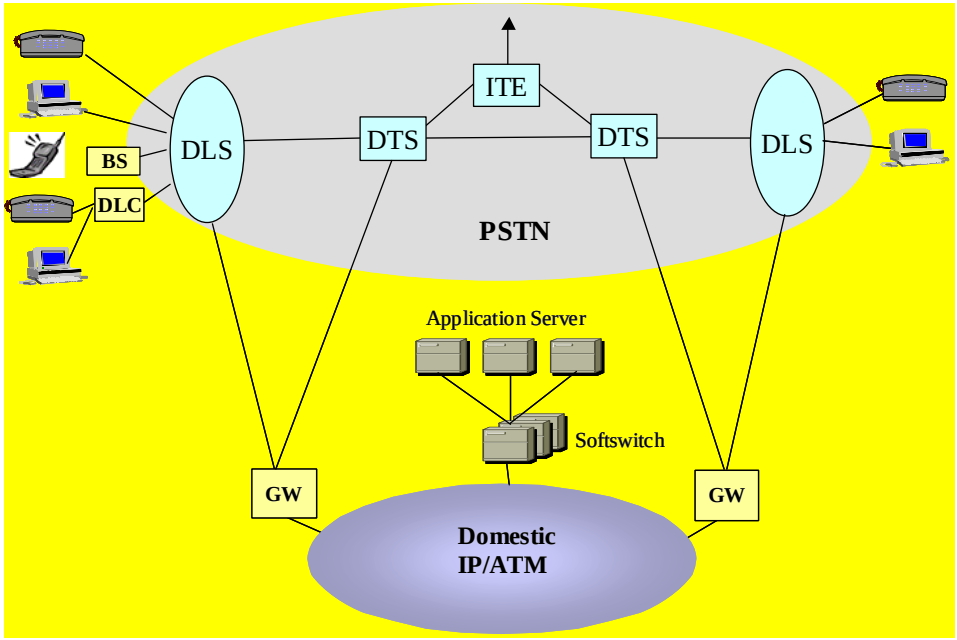

Figure 3: Implementation of NGN network in Phase 1

Phase 2: Migration to Full NGN for Fixed Access

As a final migration step towards the full NGN, the legacy PSTN equipment will be transformed or replaced by NGN compliant network components. In this phase, the IP network is used as a core transport to carry the NGN traffic i.e. voice, data and multimedia or triple play application.

The final network configuration of NGN network is shown in Figure 4.

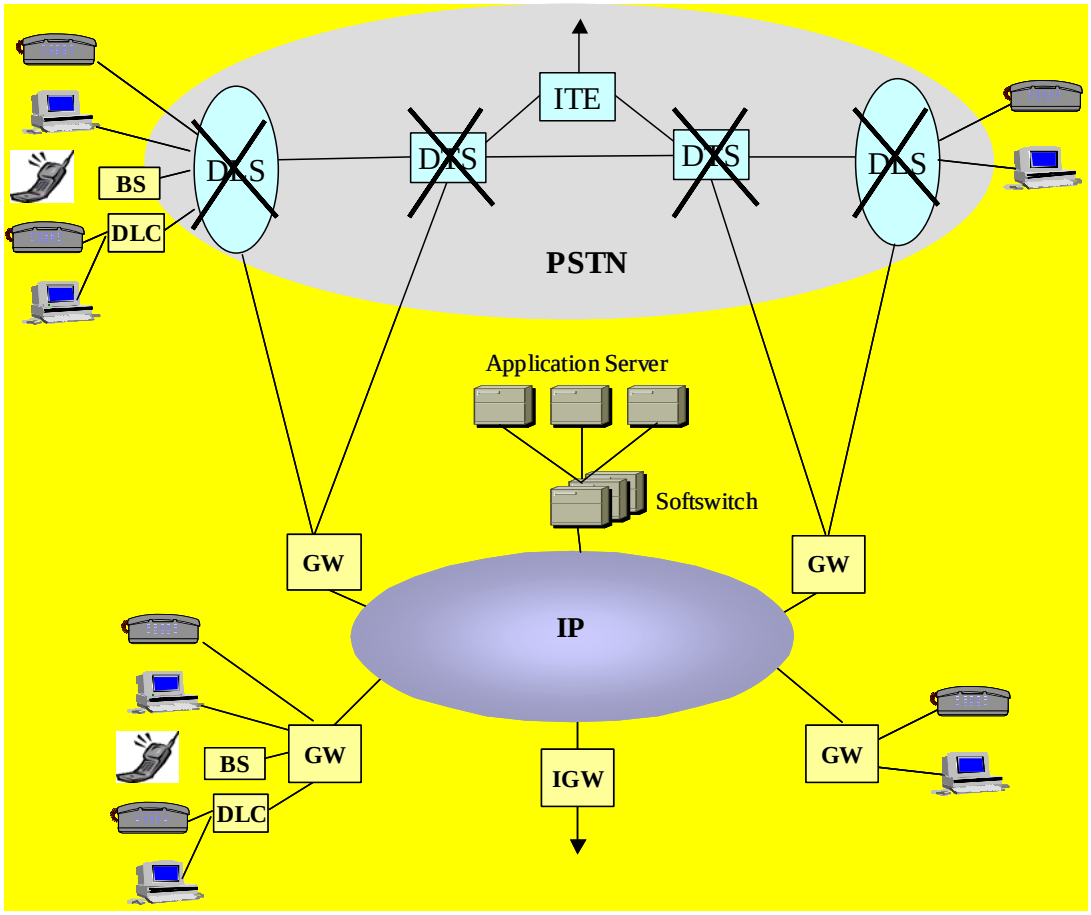

Figure 4: Phasing out of TDM switches and full NGN implementation roll out

The different scenarios of migration for the fixed access will be addressed in other specific documents and will be based on recommendations from ITU-T Y.PSTN-MIG: PSTN migration to NGN.

5.2 Evolution/migration from Mobile Network

5.2.1 Baseline Architecture

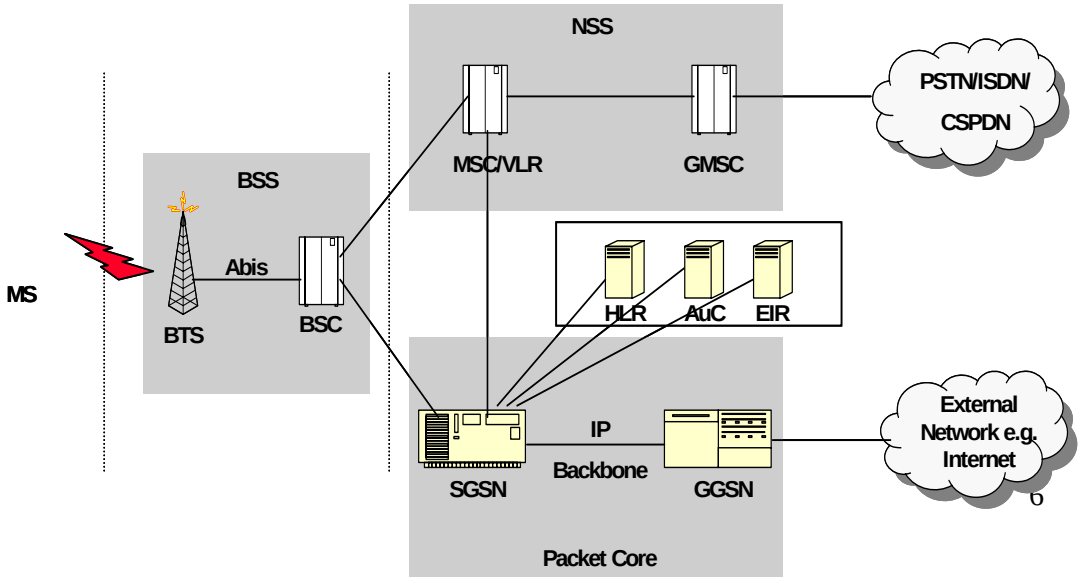

Figure 5: Baseline Architecture

The current baseline architecture based on Rel 97/99 architecture makes use of much of the existing GSM infrastructure. There is no convergence between the GSM telephony and the fixed telephony systems.

5.2.2 R4 Architecture

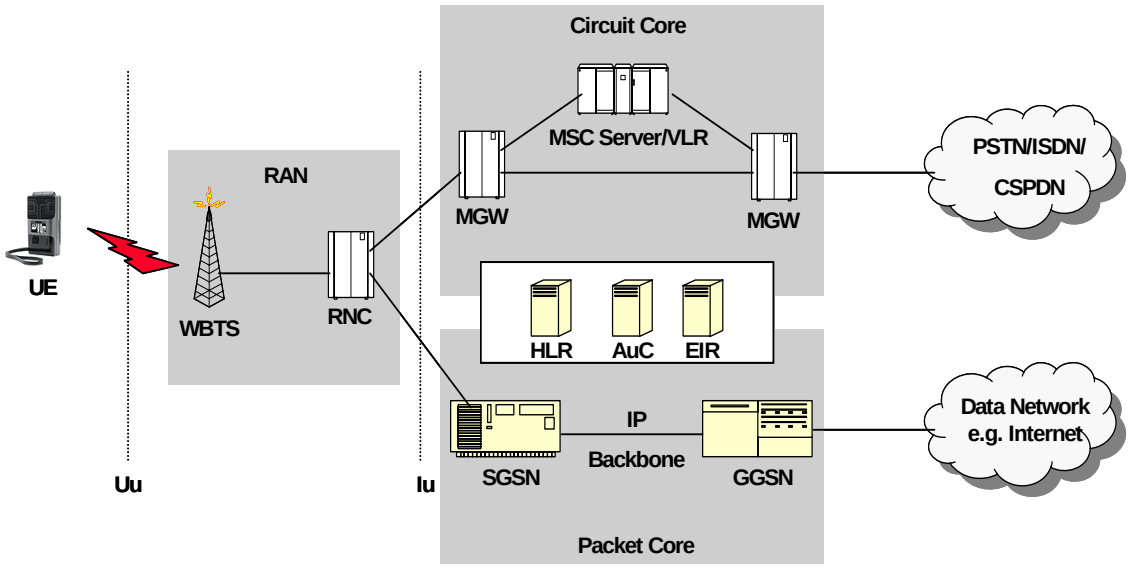

Figure 6: R4 Architecture

With R4 architecture, the core network circuit switched domain is radically revised whereby the circuit traffic is delivered over an internal packet switch Internet protocol (IP) network with connections to external networks handled via media gateways (MGW).

5.2.3 R5 Architecture

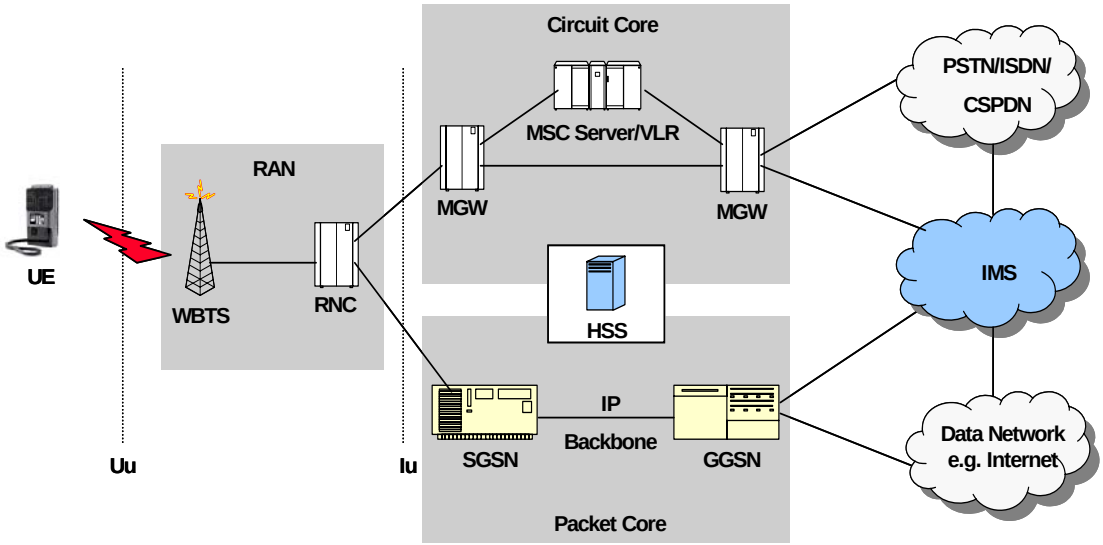

Figure 7: R5 Architecture

Moving from R4 to R5, HSS is being introduced and services are interconnected to both the CS and PS domains. Release 5 architecture builds on the partial implementation of IP packet switching within the core network to move to an all-IP architecture. Packets can be moved from end to end using IP transport connected to an IP multimedia subsystem.

5.3 Fixed Mobile Convergence (FMC)

"FMC includes convergence of the services, convergence of the basic architecture of NGN and Mobile Networks etc." - ITU-T Q6/13 Description.

Different types of FMC:

- Commercial convergence – the marketing and administration personnel of both the fixed and mobile departments are pooled together.
- Service convergence – fixed and mobile services are offered to the customer in one package with or without integration between the two.
- Network convergence – the same physical infrastructure is used for both fixed and mobile services.
- Terminal convergence – single terminal could access to services by different technologies.

6 NGN Security, Fraud & Risk Management

Fraud prevention cooperation between key players becomes inevitable. Licensee, credit card issuers, banks and merchants must cooperate with law enforcement to reduce fraud. Strategies to minimize fraud through law & regulations and tools must be developed. The industry must have a joined approach with other agencies from other countries such as AFTRA (Australasian Telecommunications Fraud and Risk Association), TUFF and FINA.

Within NGN, security issues interrelate with architecture, QoS, network management, mobility, billing and payment. One of the most significant challenges facing the design of NGN security standards is the fact that the networks are no longer conceived as monolithic systems with clear interfaces. Much of the standardization work in NGN security has to be based on guides and principles along with APIs so that a secure network can be built from a given selection of specific NGN components.
NGN work on security should concentrate on:

- Development of compound security architecture for NGNs. In a further step, this NGN security group should devise NGN operational security guidelines.
- Development of NGN specific security protocols and APIs

7 End to End Quality of Service (E2E QoS)

End-to-end QoS explains the commercial understanding on NGN services/products for service operator, customers, and regulator.

Work is required to handle both the way in which different end system can reach agreement on the end-to-end QoS for a call and how the parameters set with this upper layer protocol can be used to control the lower layer, transport and access level QoS mechanisms.
For the issue of upper layer QoS control it is felt that a distinction can be made between telephony, where the work is now almost complete, and the wider topic of QoS for multimedia which needs work on both a "framework" and the definition of each individual media stream (video, white board, etc.).

Likewise the control of lower layer QoS mechanisms is best divided into two topics: a "vertical" protocol linking the upper and lower layer QoS mechanisms (diffserv, etc) and a lower layer "horizontal" mechanism to link the lower layer QoS control between different domains and networks.

NGN work on end-to-end QoS should concentrate on:

- Completion of end-to-end QoS class definition for telephony, including voice over packet networks
- Definition of a new end-to-end multimedia QoS class definition framework and a method of registering QoS classes of individual media components
- Specification of how to use lower layer QoS mechanism to achieve upper layer QoS within the network
- Inter-domain lower layer QoS control
- End user perception of QoS
- Meeting Bandwidth requirements
- Supports multimedia rich applications
- Supports common applications for fixed and mobile
- Path towards IMS and FMC
- Common Subscription and Customer management database

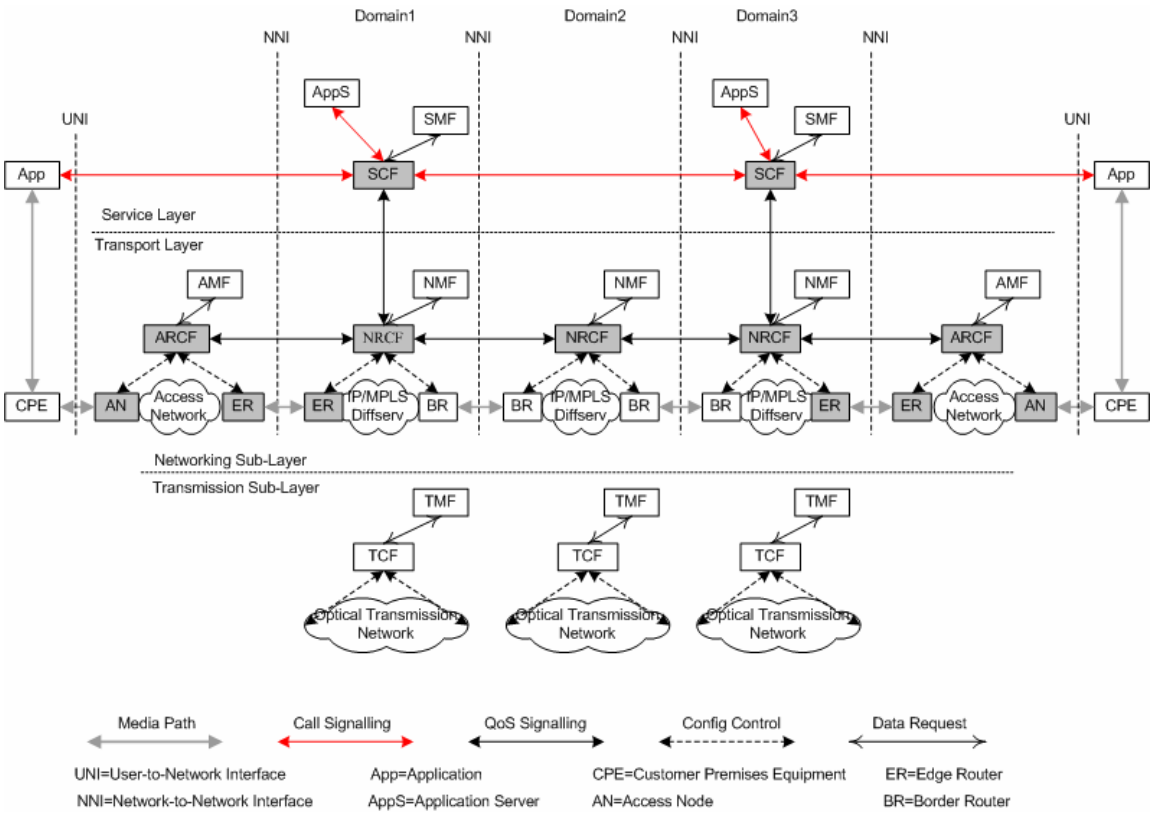

Figure 8: Reference model of End-to-end QoS architecture (Source: ITU-T)

In figure 8, the most important QoS-related functional entities are SCF (Service Control Function), NRCF (Network Resource Control Function), ARCF (Access Resource Control

Function), ER (Edge Router) and AN (Access Node). They work together to achieve end-to-end QoS control through end-to-end QoS signaling. And they interact individually with SMF (Service Management Function), NMF (Network Management Function) and AMF to support QoS-related management and billing.

It is assumed that IP Diffserv and MPLS Diffserv are supported in IP core networks. The services requiring QoS guarantee are categorized into several end-to-end QoS service classes by service types (e.g. voice) or QoS levels (e.g. EF). For each service class, operator makes capacity planning such as existing and predicted traffic patterns, topology, routing design and etc.

8 Numbering, Naming and Addressing

NGN consists of interconnected heterogeneous networks, using heterogeneous user access and heterogeneous user devices (fixed, mobile, nomadic, etc) and it should provide a "seamless user experience" independent of access method and network, therefore Numbering, Naming and Addressing has been added as an element of the NGN-2004 Project.

Individual users may be identified by name/numbers using a name/number resolution system, which will be able to translate a given name/number into a routable and valid address in order to establish a transfer (transport).
Examples of such Naming/Numbering schemes may be:

- E.164 numbering scheme
- unified resource locater (URL) scheme
- unique name system (e.g. 1800Airways etc.)
- or other naming conventions like developed in the Internet community, like H.323, SIP, telephone and mail unified resource identifier (URIs. - Use of International character set for URIs is for further study.) etc.

A user who requires access to another user may directly input one of the above mentioned identifiers and then either the terminal or the network may translate the user input into an end-point address, either using internal data or an external database (for example, accessed via the DNS using *enum* functionality.

Within the NGN, preference should be given to portable numbering and naming schemes to provide full control to the end user as well as service providers over his identity.

9 Network Interconnect

Considering that NGN will involve a large amount of protocols (including various profiles) at the services and network level, there is a need in the framework of the NGN-2004 project to ensure the interoperability among systems and networks.

This study area includes in particular:

- Specifications for interoperable profiles for complex systems
- Specifications for compliance verification of standards
- The development of the relevant procedures and documentation, including the development of tools

The various interconnect/interworking scenarios are as below:

- Legacy – interconnect between NGN and legacy

- Network to network interface – interconnect occurs at the Control part of the Core Layer between either soft switch-legacy switch or media gateway-legacy switch. Legacy network protocols/versions need to be supported and managed to ensure end-to-end service, call control and user mobility is maintained across heterogeneous networks.
- Network to network services – interconnect occurs at the Application Layer to enable legacy/new services within and across NGN networks. This requires standard APIs through a middleware that can deliver these.

- NGN – interconnect between NGN and NGN
  - Network to network interface – interconnect occurs at the Control part of the Core Layer between either soft switch-soft switch or media gateway- media gateway. The preferred interface is SIP (Session Initiation Protocol)

Please refer to Appendix 1 for ITU-T NGN Interconnect description.

10 Regulatory Requirements

10.1 Issues

- License:
  The liberalization of the license regulation supports the implementation and realization of NGN. The license regimes, which are Network Facilities Provider, Network Service Provider, Class Applications Service Provider and Applications Service Provider, are based on layered network.
- Access:
  In the access list, the access for NGN is similar to VoIP where the interconnect is at the gateway. Therefore, access is not an issue.
- Quality Of Service:
  The quality of service for each service is already defined through the existing mandatory standards. However, in the case for end to end for NGN is more complex because of the layered scenarios. Further studies on multiple scenarios needs to be done in order to understand and regulate the requirements.
- Tariff
  Should the tariff be regulated in order to avoid price war and to protect the network facilities providers' interest for the huge investment in order to allow service providers to sell their services?
- Numbering/addressing/coding
  National numbering/addressing/coding must be developed in order to smoothen the implementation and ensure that there are ample numbers are allocated.
- Security and safety of subscriber privacy
  A national council on security must be formed to monitor the security, fraud and risk management closely. This council should consist of Prime Minister Dept, Ministry of Communications, Water and Energy, Malaysian Communications and Multimedia Commission, Telcos, Bank Negara, banks, Police DiRaja Malaysia etc. (reference to NISER)
- Required application services (RAS)-Emergency, directory, help lines
- Database and Other Operational Issue
  Is there a requirement to review the current Record Keeping Rules (RKR) to support NGN?

10.2 Considerations

As it is well known that NGN projects are costly, the following recommendations are for companies who are seriously involved in NGN implementation in supporting the national's aspiration for high growth of broadband penetration by 2008:

- MCMC to provide full or partial fund to NGN projects from industry development funds

- Rebates on license fees
- Tax exemption on procured equipment
- Determinations and mandatory free list. Allow business arrangements to take place as to spur growth for a certain determined timeframe. I.e. from now until 2010.

11 NGN Benefits

11.1 Benefits to Industry (NFP, NSP, CASP, ASP)

One network, multiple access technology where: -

- Fewer network elements:
  - Lower operating cost: space requirement, power consumption, maintenance staff and service issue period are reduced. Training of staff becomes simplified.
  - Increase network reliability
  - Improve economic of scale (supplier independent), Operational efficiency, flexibility and scalability
  - Customer service (subscribers and billing)
  - Operations (routing & translations, engineering & capacity planning
  - Fewer devices
- Market entry and new service deployment are fast and cost effective
- Allow bundling of services and applications which will create customer "stickiness"
- Partnerships which will enable win-win
- Lower churn through high customer satisfaction levels
- Expand consumer share of wallet beyond communications i.e. integrating communications and entertainment

11.2 Benefits to the Nation

- Simplified life style with single bill and account - Flexibility to use services without having to choose fixed line, mobile, BB or ISP suppliers
- Single device in the future – consistent personalization
- Consistent services across all types of access - seamless
- Malaysia to be among the fast-developed countries to implement NGN – good for the country typically for foreign investors, which has, interconnects with local service providers. Roaming – seamless.
- Liberalization of the industry attracts foreign investment

12 Conclusion And Recommendations

As NGN interconnects heterogeneous networks, special numbering/addressing requirements arise to ensure seamless ubiquitous experience. Detailed study needs to be done to highlight these issues and whether special numbering blocks are required. This will also ensure numbering, naming and addressing are evolved to enable efficient interconnects with other operators. Furthermore, this will allow new termination rates to cater for all new charging scenarios "on-net" and "off-net".

The focus on end-to-end QoS should continue to ensure near TDM quality speech with IP pricing. With the introduction of MPLS and Session Border Controllers (SBC), QoS can and must be extended across heterogeneous networks. Both voice and data services in NGN must provide similar expectations as the current legacy networks. In addition, all VoIP offerings must have emergency services, security and privacy policies as mandatory.

Based on published documents of ITU-T, depth is lacking. Consolidation efforts appear to be too slow, however the "IP"nization of networks are fast approaching. MTSFB shall closely monitor the progress and happenings in NGN standards worldwide to ensure the best is adopted for Malaysia. However, the potential threats posed by free VoIP operators i.e. Skype etc. will erode further the voice revenues of local circuit voice and VoIP operators, hence the economy. The regulatory policies devised for NGN need to address these threats for reactionary purposes.

13 References

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- ITU-T NGN seminar URL, dated July 9 to 10, 2004; http://www.itu.int/ITU-T/worksem/ngn/program.html
- ITU-T NGN home page; http://www.itu.int/ITU-T/ngn/
- Information on ITU-IETF seminar on NGN scheduled for May 1 to 2, 2005; http://www.itu.int/ITU-T/worksem/ngn/200505/
- Refer to Appendixes, relevant standard docs from ITU-T, IETF (RFC), etc
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- Convergence Technologies for 3G Networks IP, UMTS, EGPRS and ATM, Jeffrey Bannister, Paul Mather, Sebastian Coope, Wiley, 2004
- ITU-T Study Group 13 NGN Related Recommendations: NGN WD-87 14 – 21 June 2004
  - Draft new Recommendation Y.NGN-Overview
  - Draft new Recommendation Y.GRM-NGN
  - Draft new Recommendation Y.NGN-FRM (ex NGN-FRA)
  - Draft new Recommendation Y.NGN-MIG
  - Draft new Recommendation Y.NGN-SRQ
  - Draft new Recommendation Y.NGN-MOB
  - Draft new Recommendation Y.NGN-MAN
  - Draft new Recommendation Y.NGN.CON (ex NGN-POL)
  - Draft new Recommendation Y.123.qos
  - Draft new Recommendation Y.e2eqos
  - Draft new Recommendation Y.NGN-TERM

14 Glossary

PSTN – Public Switched Telephone Network

PLMN – Public Land Mobile Network

CPE – Customer Premise Equipment

3GPP – 3rd Generation Partnership Project

TISPAN – Telecoms & Internet Converged Services & Protocols for Advanced Networks

IMS – IP Multimedia Subsystem

DSL – Digital Subscriber Line

SIP – Session Initiation Protocol

MPLS – Multiprotocol Label Switching

OSS – Open Source Management

DRM – Digital Right Management

WiFi – Wireless Fidelity

IP – Internet Protocol

NASS – Network Attachment Subsystem

RACS – Resource & Admission Control Subsystem

ISDN – Integrated Services Digital Network

TDM – Time Division Multiplexing

GSM – Global System for Mobile Communications

MGW – Media Gateway

MSC – Mobile Switching Centre

HLR – Home Location Register

VLR – Visitor Location Register

RNC – Radio Network Controller

WBTS – Wideband Base Transceiver Station

SGSN – Serving GPRS Support Node

GGSN – Gateway GPRS Support Node

API – Application Programming Interface

SCF – Service Control Function

NRCF – Network Resource Control Function

ARCF – Access Resource Control Function

ER – Edge Router

AN – Access Node

SMF – Service Management Function

NMF – Network Management Function

VoIP – Voice over Internet Protocol

ATM – Asynchronous Transfer Mode

Appendix 1: Interaction between NGN and Non-NGN environment

1 Introduction

An important aspect to retaining seamless operation is the interworking between NGNs and other networks, such as PSTN, 3G, INTERNET and existing H.323 network etc., just as the Figure 9 shows.

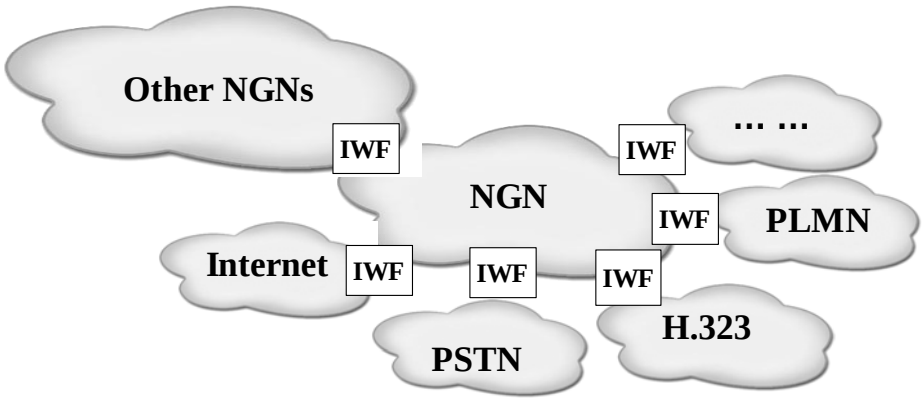

Figure 9: Requirements for Interworking with legacy networks

- Interworking with legacy networks and other NGNs ensure the end-to-end communication capabilities for users, such as 3G, PSTN and H.323 networks etc;
- Interworking with legacy networks enrichments the contents for users, such as INTERNET and TV networks etc.;
- Interworking with legacy networks makes it possible that NGN is deployed step by step;
- Interworking with legacy network makes NGN inherit rich of services and keeps user enjoy the seamless evolvement from legacy network.

2 Principles for IWF between NGNs

From ITU-T Recommendation Y.GRM-NGN, it has already been established that the NGN can be divided into two layers in horizontal and three planes in vertical simply. The functions for IWF between NGNs will be distributed in all planes and layers.

The functions for interworking between NGN1 and NGN2, for either **service interworking** or **transport interworking**, are provided by an interworking function (IWF) considered to notionally existing between the NGN1 and NGN2, as shown in Figure 10. The exact physical location of the interworking unit (IWU) containing the IWF is an implementation issue, but could be contained within NGN1, NGN2, or as an independent unit. IWF should differ from each other in the condition that they are located between different two networks.

Service interworking: In service interworking, the Interworking Function (IWF) of Figure 10 terminates the protocol used in network 1 and translates (i.e., mapping) the Protocol Control Information (PCI) to the PCI of the protocol used in network 2 for User, Control and Management Plane functions to the extent possible. In general, since not all functions may be supported in one or other of the networks, the translation of PCI may be partial or non-existent. However, this should not result in any loss of user data since the payload is not affected by PCI conversion at the service interworking IWF.

Transport interworking: In transport interworking, the PCI of the protocol used in both of NGNs and the payload information are transferred transparently by an IWF of Figure 10.

Typically the IWF encapsulates (known as tunneling in some specifications) the information that is transmitted by means of an adaptation function and transfers it transparently to the other network.

[Notes] The definitions of service interworking and transport interworking are identical to that given in ITU-T Rec. Y.1251, section 3.2 and section 3.3 (name as network interworking).

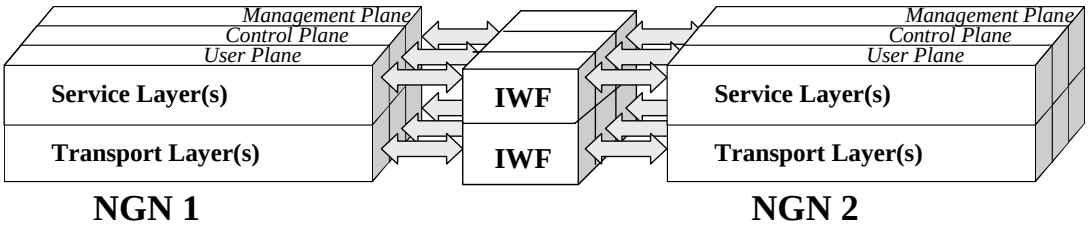

Figure 10: Interworking function

To provide any instance of IWF, the following must be deserved:

a) User plane's interworking has responsibility for media flow processes, such as NAT, firewall, link mapping, QoS-relative processing and codec converting etc.

b) Control plane's interworking has responsibility exchange processing, such as connectivity control, service logical control, user policy negotiations, calling signalling, addressing and routing etc.

c) Management plane's interworking is commonly used for operating when necessary, such as settlement, bandwidth limitation policy and usage measurements etc.

d) IWF can differ from each other when located in different layers.

3 Agent Model for Interworking

Notwithstanding the layer and plane architecture are defined as Sec, IWF can be decomposed with agent-based architecture, which has been established in ITU-T Recommendation Y.130, showed as the Figure 11.

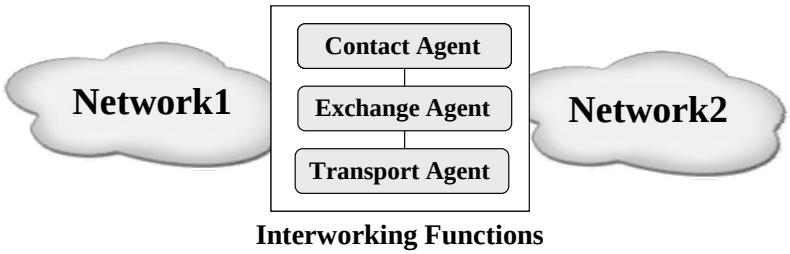

Figure 11: Agent-based Architecture of IWF

[Notes] The concept of agent, party and the definitions of three agents refer to Section 6.3, Chapter 8, 9 and 10 of Y.130, detailed parts can copy from corresponding chapter directly if necessary.

- IWF in each layer can be composed with three logical agents, but no necessary with all of them in different conditions.

- In practice these agents can be combined, replicated, or divided into a number of further sub-entities, to achieve specific geographical distributions of network components that might be encountered in real-word cases.
- Networks interact with these agents according to the context defined by a connection/session instance established between communicating parties.

Contact Agent (Chapter 8 in ITU-T Rec. Y.130)
Exchange Agent (Chapter 9 in ITU-T Rec. Y.130)
Transport Agent (Chapter 10 in ITU-T Rec. Y.130)

[Notes] Because Y.130 aimed at enabling applications to communicate information using infrastructural capabilities that are based on middleware service components, all relative contents from Y.130 should be reviewed again to ensure them suitable to Y.GRM-NGN.

Appendix 2: Standardization activities – International Standards Organizations

1. 3GPP – http://www.3gpp.org
   - 3GPP is not defining the NGN but will work with TISPAN to establish a common approach to establish IMS as an NGN platform
   - 3GPP NGN dependencies and priorities are monitored by TISPAN
   - List of existing work items with potential interest:
     - All-IP feasibility study
     - Architectural enhancements for E2E Quality of Service
     - WLAN – UMTS interworking
     - QoS improvement:
       - Gq interface specification for Dynamic Policy control enhancements
     - Interworking aspects and migration scenarios for IPv4 based IMS implementations
     - Interoperability and commonality between IMS using different "IP-connectivity networks"
     - IP flow based bearer lever charging

2. ETSI TISPAN – http://www.e-europestandards.org/ETSI_activities.htm
   - The core competence centre for fixed networks and for migration from switched circuit networks to packet-based networks with an architecture that can serve in both.
   - TISPAN is responsible for all aspects of standardization for present and future converged networks including the NGN (Next Generation Network) which includes:
     - Service aspects
     - Architectural aspects
     - Protocol aspects
     - QoS studies
     - Security related studies
     - Mobility aspects within fixed networks, using existing and emerging technologies

3. IEEE – http://www.ieee.org
   - Establishing new standards IEEE 802.16 (WiMax), IEEE 802.20 and IEEE 802.21 and their emergence to cater for the future convergence
   - Gather the state-of-the-art NGN research activities
   - Address the evolution of today's internet, the PSTN and third Generation Mobile Networks to a future multi-platform and multi-service ubiquitous network
   - Focus on:
     - Network architecture

- Protocols and service platforms
- Evolution towards 4G mobile networks
- Integration of heterogeneous network technologies like fixed, mobile and satellite access, content distribution and streaming
- QoS
- Multicasting
- Operational aspects of next generation networks:
  - Management
  - Charging
  - Service provisioning

4. APT – http://www.apt.org
   - Transition to NGN
   - Standardizing NGN
   - NGN developments

5. Internet Engineering Task Force (IETF) – http://www.ietf.org
   - Evolution of internet architecture;
   - SIP standards

6. ITU – http://www.itu.int/home/index.html
   - NGN Work in ITU-T SG11
   - ITU-T NGN - Progress and Plans
   - End-to-End Quality of Service in ITU-T

Appendix 3: Links to other Self Regulatory Organizations

1. Australian Communications Industrial Forum (ACIF) – http://www.acif.org.au
2. Alliance for Telecommunications Industry Solutions (ATIS) - http://www.atis.org
3. Telecommunication Industry Association (TIA) - http://www.tiaonline.org
4. Telecommunications Standards Advisory Council of Canada (TSACC) - http://www.tsacc.ic.gc.ca/e
5. Telecommunications Technology Association (TTA) - http://www.tta.or.kr/Home2003/main/index.jsp
6. Telecommunications Technology Committee (TTC) - http://www.ttc.or.jp
7. InfoCommunications Development Authority (IDA) - http://www.ida.gov.sg
8. Office of the Telecommunications Authority (OFTA) - http://www.ofta.gov.hk
9. TeleManagement Forum (TMF) - http://www.tmforum.org

Appendix 4: NGN Implementation Strategies and Considerations

There are 3 strategies to deliver NGN:

- Evolutionary strategies – When growing in a new geographical location or growing in size at the present location, operators must actively evaluate and implement NGN

- Migratory strategy – This involves evaluating the needs and upgrading systems side by side rather than in one single shift
- Revolutionary strategy – At the end of system support for the existing infrastructure, companies must look at revolutionizing the entire system. As the system grows older, the cost involved maintaining these systems increases drastically.

Key Issues for considerations are:

- Future proof – Enhanced capability
- Future proof – A key part of IMS Architecture
- Migration in Access Layer – MSAN
- Future proof – MSAN supporting FTTH and WiMax
- Future proof – Universal Media Gateway
- Dual Homing – High Reliability
- Terminal Management – HCMS (Home CPE Management System)

The strategy of network migration towards NGN is a key issue for all operators. Taking into account the fact that the building of a network takes place on the way of evolution, it is necessary to define some kind of milestones leading to the NGN network as a target network.

Main principles of migration based on Draft Recommendation Y.NGN-MIG

The strategy for migrating to NGN could be the same for all the operators. The most important are:

- If possible, reducing their network infrastructure and maintenance costs
- Optimum use of resources invested in new technologies
- Maximum reuse of the already implemented resources
- Enabling faster service deployment for the provisioning of enhanced services and therefore creating new sources of revenue
- Achieve quality of service at least on the same level as in the current network
- Keeping NGN's capabilities of the service provision and open network architecture

Network operators will potentially choose a different migration path depending on their actual resources. This path will therefore involve different technologies and happen at different speeds.

There is a need to prepare a set of drafts to help evolution of the existing networks towards NGN. Taking into consideration that potentially there are a lot of possible migration ways (at least as many as the existing networks), it seems to be purposeful to create some kind of base networks, from which there should be a limited number of possible ways of approaching target NGN. It is an assumption that target networks don't have to be identical in each variant – different networks have different historical origins. The common feature of these networks is conformity with the general concept and requirements for NGN [ref. to Y.GRM-NGN].

There should be a stepwise approach in which operating companies can migrate based on decomposition of their exiting networks into sub-networks (example of base network can be IN, ATM, etc.) to ease migration. One strategy could be to select certain pieces of a technology from each technology itself as a way of migration towards NGN.

One example of this decomposition can be choosing parts of each of the technologies listed below to make an NGN:

- PSTN network (TDM technology)
- IN network
- Management network
- SS7 signalling network
- Lease line network
- IP network

- ATM/FR network

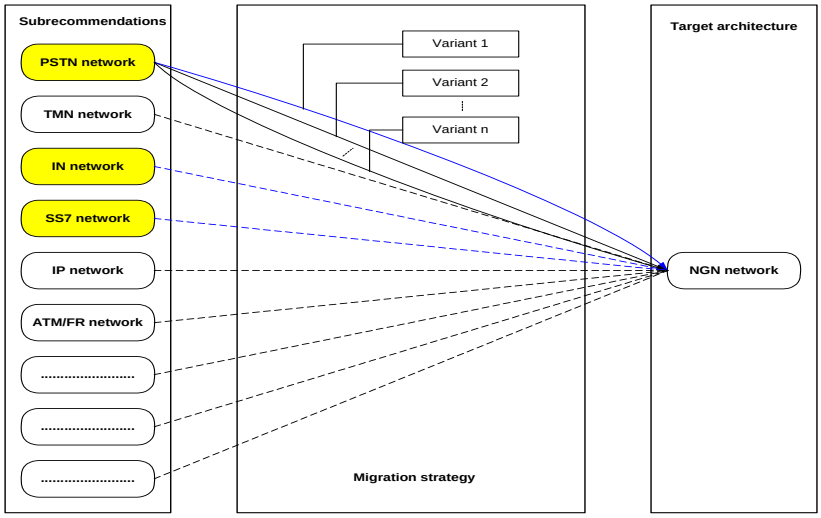

Figure 12: Concatenation of migration ways of particular networks.

The migration should consider transport, control, services and management functions as a whole.

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