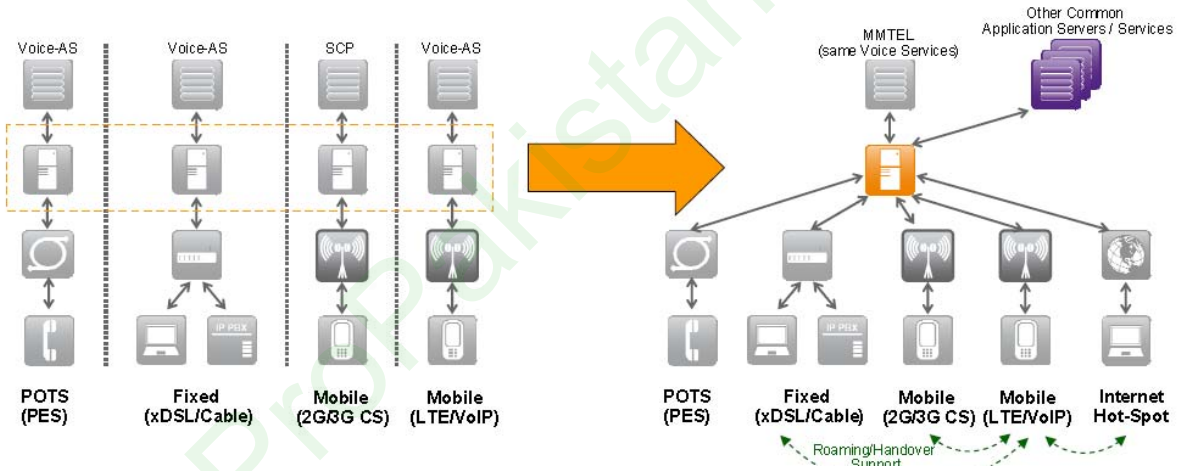
Pakistan Telecommunication Authority

NGN IN PAKISTAN
Challenges During Migration

Report 2010

NGN Architecture



2010

Next Generation Networks can be viewed as a ―communication network that allows unfettered access to all communication products and services, irrespective of the service provider or network connection. Basically the boom in the services of wired as well as wireless technologies, both in narrowband as well as broadband environments has created the demand for seamless connectivity between the networks as well as services. This has given rise to a need for an unwired network to support voice, data and video (triple play) over a common network, which is typically called Next Generation Network. In an NGN environment, it is expected that the consumers will be able to access their voice, data, video and new emerging media applications over a single network.At the same time, the provided service functions are independent from the basic transmission media. All the services are based on the Internet Protocol (IP). The advantage of IP networks is their flexibility and the simple integration of new applications.

1. NGN Worldwide:

iLocus published in its 11th annual VoIP industry report in April, 2010, the industry's first estimates related to the extent to which world's voice network has migrated to NGN/softswitch based technology.

According to the report, on a cumulative basis, vendors have shipped an estimated total of 283 million NGN voice subscriber licenses in the wireline segment. There are an estimated 1.27 billion subscribers lines in wireline networks worldwide, which implies that round about 22% of the total subscriber capacity in wireline networks has migrated to NGN voice. An estimated 116 million of these lines are IMS or Pre-IMS.

Round the globe, about 22% of the total subscriber capacity in wireline networks has migrated to NGN voice &

An estimated 41% of the voice gateway ports in wireless networks are NGN.

NGN/Softswitch has comparatively performed better at the hardware level. An estimated 41% of the voice gateway ports in wireless networks are NGN now, compared to around 58% in the wireline. However, the number of NGN voice ports shipped in wireless is almost double the volume shipped for wireline networks. These findings dispel the notion that softswitch deployments are still in infancy and that there are limitless opportunities for vendors to ship softswitches for the foreseeable future.

Majority of NGN/softswitch action has been witnessed on the trunk/Class 4 side where it has made its biggest impact. What primarily drove the Class 4 softswitch in wireline network was equal access and the growth of wireless networks driving huge requirements for interconnects. In the wireless networks the industry saw

The number of NGN voice ports shipped in wireless is almost double the volume shipped for wireline networks and, Majority of NGN/softswitch action has

migration from 2G to 3G to handle that growth and prepare networks for 3gpp.

been witnessed on the trunk/Class 4 side

In the US majority of wireline TDM lines are now NGN as is the case in Western Europe. Italy has the highest percentage component of NGN voice element, followed by France and the UK. Out of BRIC countries (Brazil, Russia, India and China), China seems to have the most advanced wireline network in terms of the proportion of NGN/Softswitch component in carrier networks there. In November, 2004, China Mobile completed the cut-over of the Softswitch in the long- distance tandem network, the ever largest one in the world. Brazil started around four years ago.

India showed some activities during 2007 and 2008.According to ilocous, India announced in 2008, "Carriers in India have already drawn up plans for deployment of more than 14.9 million Class 4 NGN ports and over 4.1 million Class 5 NGN lines, making it one of the top Nextgen Voice markets over the coming few years. In majority of the cases, vendors have already been finalized"

China Mobile completed the cut-over of the Softswitch in the long- distance tandem network, in November, 2004.

In the US and Western Europe majority of wireline TDM lines are now NGN .

In Pakistan NGN deployments started in 2005 but appreciable activity has been noticed during 2008 & 2009.

1.1 NGNuk:

Next Generation Networks UK ('NGNuk') as an independent NGN industry body, with a view to creating an improved framework for industry engagement was formed by OFCOM in 2006.

NGNuk's mission is to act as a co-ordination forum in which key investors in NGN infrastructure and services will discuss, research, consider and, where possible, agree the direction for NGNs in the UK and communicate such direction to other players in the telecommunications industry and the general public.

OFCOM says: "Although it may not be practicable to replicate every feature of an existing service in NGN services, consumers should be offered services that are not inferior in any key respect.

NGNuk has a two way relationship with other industry bodies , such as Consult 21 and NICC taking input to enable its commercial work to succeed and providing policy output to enable them to undertake their functions.

Operators are keen to ensure that any services offered over NGNs are at least equivalent to a customer's existing services, and that any changes are clearly explained. Ofcom shares this view. The regulator is keen to promote improved service levels stating that

"*although it may not be practicable to replicate every feature of an existing service in NGN services, consumers should be offered services that are not inferior in any key respect such as service quality or access to emergency services".*[2]

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1.1.1 **Regulators & NGN**

In its consultation papers, Ofcom believes, NGN will result in a substantial change in the quality and scope of telecommunications service and hence, a substantial change in regulation, but it is too soon to be clear about the direction that regulators should take. In these circumstances regulatory authorities need to approach NGNs with considerable care, and we suggest that if a NGN is to be built in their country, regulators should:

- Understand NGNs and their implications thoroughly through dialogue with operators and suppliers.
- Exercise forbearance in the regulation of new products, markets and interconnection arrangements, only becoming involved for good reasons or where there is a dispute.
- Create a framework that will promote investment in NGNs by setting out regulatory principles for NGNs;
- Be prepared for a period of uncertainty and change that will require flexibility and willingness to experiment.

A challenging but exciting time ahead for regulators as well as operators!

1.2 IPTV

A survey report published by iLocus in August, 2010 reveals that 44% of IPTV service providers regard the IPTV technology immature. The technology, according to them, is not robust enough to support a scalable IPTV deployment. The report is based on interactions with 100 IPTV service providers worldwide.

The other challenges facing the IPTV service providers include

- Absence of Standards,
- Lack of User Friendly UI (user interface), and
- difficulty they are experiencing in monetizing VOD**.**

44% of IPTV service providers Worldwide regard the IPTV technology Immature.

In another survey report published by iLocus recently it appears that 54% of the IPTV service providers use Commercial Off The Shelf (COTS) hardware as the underlying platform for VOD solutions. Among the remaining 46% that use proprietary hardware, a majority of, i.e. almost 30% will shift over to COTS hardware in the near future.[1]

1.3 IMS

In a report on October 2010, iLocus states that on a cumulative basis, a total of 208 million IMS subscriber lines had been deployed across both wireline and wireless networks as of end 1H10. More than half the deployments have taken place in wireline networks.

An estimated 25 percent of the total subscriber capacity in wireline networks has migrated to VoIP. Of the 25 percent, around 14 percent is comprised of softswitc based subscriber lines and remaining 11 percent is comprised of IMS based subscriber lines.

By the year 2014 the ratio of IMS-to-softswitch based subscriber lines deployed in the wireline networks is forecast to be around 2:1

Obviously most of the IMS action surrounds the wireline market, where the IP-packetization has been pushed to the edge through broadband deployment. For mobile operators, the short term driver to IMS is to launch the enhanced communications services like RCS (Rich Communication Suite). But it is not a sufficiently large motivation to go for IMS deployment. VoLTE is more attractive midterm driver for IMS within mobile networks.

75 percent of the subscriber lines in wireline segment that remain TDM based are likely to be migrated direct to IMS according to the iLocus report. By the year 2014 the ratio of IMS-to-softswitch based subscriber lines deployed in the wireline networks is forecast to be around 2:1. Among the vendors, Ericsson ranks at number one position in the report, followed by ZTE at number two, and Huawei at number three.

2. NGN PAKISTAN

In Pakistan NGN deployments started in 2005 but appreciable activity has been noticed during 2008 & 2009.The probable answer to, "why not an aggressive activity in NGN migration observed, four to five years back is , there has been a substantial growth in GSM-telecom subscribers in Pakistan over the last few years. The operators have been relatively less aggressive about offering new services. And the current networks are still so much revenue generating that operators have shown their hesitation to move from legacy interconnects to IP-interconnects. Probably the launch of 3G will change this approach of the industry here.

2.1 PK NGN Working Group (NGN-WG):

Pakistan Telecom Authority has established an industry working group with all the major operators and stakeholders to help guide the industry momentum to an effective migration and to resolve any problems that may be faced during transition.

In the past seven months, meetings of the Working Group, addressing the following agendas have been held.

1. Hardware standardization.
2. Carrier Interconnects in Pakistan, Present and future roadmaps.
3. Requirements and framework of end-to-end QoS in NGN.
4. Security considerations for NGN networks.

Vendors also participated , addressing the QoS and Security reservations and consideration. All the stakeholders came-up with concerns and also provided their network status to help assist the authority for future policy.

An idea of a 'Pakistan internet-backbone' on Gigabit Ethernet (GigE) interface (IP-MPLS) has been proposed which will converge the multi-protocols on an optical backhaul platform i.e. virtually any type of traffic coming from customers networks or other access networks will be converged to one protocol. That is, one protocol from access to core, simplified management throughout the network with flexible service creation and hence Fast Services Roll-out.

In Pakistan NGN deployments started in 2005 but appreciable activity has been noticed during 2008 & 2009.

This report reflects the current status of NGN networks in Pakistan, the migration status and future plans of the operators, experiences , difficulties and feedback about the migration to these networks.

2.2 Current Network Status:

The NGN Networks are categorized into two, The Core Networks and The Access Networks.

a) Core Networks:

The core network of the NGN is an IP network. This is a standardized transport platform consisting of various IP routers and switches. The connection control of the individual components is carried out by the control level. Standard and value-added services can then be provided via the service management level.

All the main stream operators have started their activity in migrating the core networks from legacy to NGN. The incumbent PTCL, having the largest fixed line network has 10 % of its network operating on C5 NGN architecture. The CMTOs, Ufone, Telenor and Mobilink have 100%,75% and 70%of their networks migrated to R4 architecture respectively, with an approved plan for 100% by December 2011.

PTCL has 10 % of its network operating on C5 NGN architecture. The CMTOs, Ufone, Telenor and Mobilink have 100%,75% and 70%of their networks migrated to R4 architecture respectively.

The major LDI's, Wateen, Worldcall and Telecard have whole of their LDI network on NGN architecture where as LL networks are still on legacy networks**.**

The laying of the fiber at the backhaul level is aggressively in progress here, PTCL has installed 1600 FTTC PoPs in 12 cities. Many other LDIs are also owning Fiber as main carrier of their infrastructure. *

Domestic laid Backhaul Fiber Infrastructure

1	PTCL	5500 Km
2	Wateen	5500 Km
3	Multinet	4500 Km
4	Link Direct	5000 Km

b) Access Network:

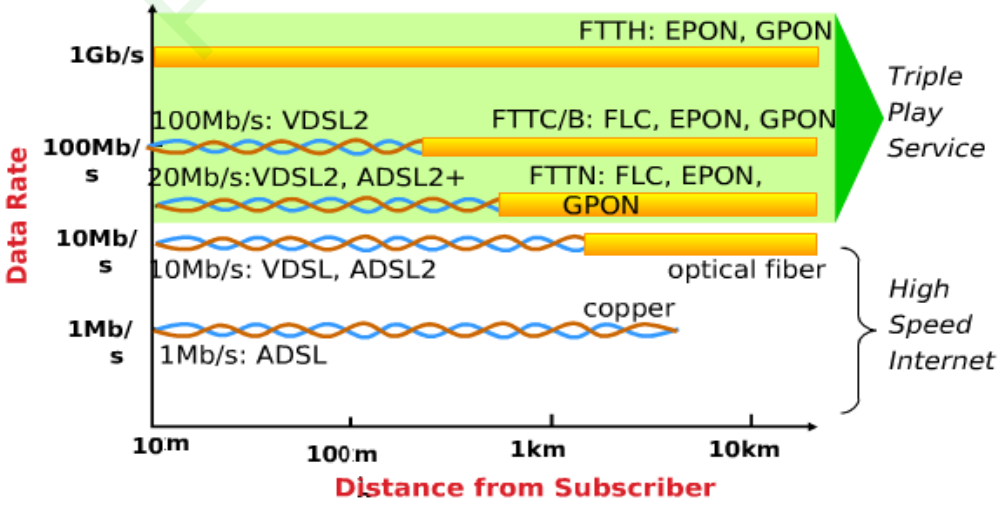
NGN access networks deployment typically refer to network segment which connects an end-user to the nearest location which houses the network access providers' equipment. So as per the definition , NGN access can be delivered by the network of different technologies including fiber, copper, coaxial as well as different wireless options.

Most of the countries mainly consider Access Network as, referring to the introduction of fiber into the local loop in order to enjoy NGN to the full.

The operators and stakeholders here agree to the fact that Fiber at the access level of NGN is matchless in performance, but its high cost and maintenance due to physical breaks, high ROW charges and above all, the user affordability concerns overshadow its performance advantages in our market, especially at the domestic level.

Access Network Technologies,

Data Rate vs. Distance



i) Fiber in the Access Network:

FTTH will make possible NGN's full capability use. As far as Fiber to the customer premises is concerned it is deemed that it should be able to meet customer requirements, as fiber can offer much more than copper is delivering at the subscriber premises. As far as its affordability is concerned, it will be, undoubtedly, an expensive solution as compared to the existing networks. The OSP(Outside Plant) part of laying fiber is very expensive due to very high ROW charges. Moreover FTTH terminals are also expensive at the moment. This concern of RoI on FTTH is prevailing worldwide and it is a hurdle for the deployment of fiber in access networks specially in the low income regions of the world. The industry members of the NGN-WG came up with special request to the authority to look into the issue of ROW.

This concern of RoI on FTTH is prevailing worldwide and it is a hurdle for the deployment of fiber in access network.

Domestic laid Fiber Optical Access Network

1	PTCL	12000 Km
2	Nayatel	2300 Km
3	NTC	637 Km
4	World Call	558

2.3 Drivers Of Migration:

a) Cost Saving:

One of the major drivers of NGN migration is the cost saving, but it is very clear that the NGN-core saves the cost but the deployment of NGN-access needs a lot of investment to be pooled in. According to an operator "NGN still needs to prove their ROI's and the total cost of ownership needs to be considered while evaluating such investments." The market research company Ovum has pointed out that it will take some time before the cost-reduction potential in NGN will becomes noticeable due to more efficient network management**.** The procedure will take several years.

It will take some time before the cost-reduction potential in NGN will becomes noticeable due to more efficient network management.

b) Rid of old Equipment:

The other core driver is that, the legacy TDM network equipment is reaching obsolesces and not fully covered by vendor's support and maintenance contracts.

So the motivation for NGN migration is not necessarily just to advance the services and reduce to OPEX but rater to move the network to next stage and get rid of 20 years old TDM equipment. Almost all the operators would prefer opting for Buy-Back arrangement of the dismantled TDM equipment with respective vendors.

3. CHALLENGES DURING MIGRATION:

3.1 Implementation Challenges During Migration:

Some of the challenging tasks identified in NGN networks have been related to:

a) Planning and network dimensioning, arising because of differences in dimensioning parameters.

b) Similarly in operations, maintaining KPIs to a certain level in rearranged networks.

c) Propagation delays, jitters and packets loss are the common problems effecting quality due to lack of high standard SLAs.

d) During transition from legacy to NGN networks spam and voice quality will need focused attention.

e) Other major migration concerns for fixedline operators have been identified as:

i. OSP (Outside Plant) transfer from legacy to new system**,** and its development,
ii. Migration/transfer of Subscriber profiling and
iii. Routing issues.

3.2 Dismantled Legacy Assets:

With this migration and significant network rearrangements, there will be a good count of dismantled equipment , and the best approach in dealing with dismantled assets is to

a) Cannibalize this equipment and use as a spare hardware for other sites or some may also be given to R&D labs of academia.

b) It may also be used in low revenue, underserved areas,

c) Or otherwise operators may prefers to go with buy back arrangement of dismantled assets with their suppliers.

3.3 Bandwidth:

With the development and delivery of multiple services, the Bandwidth demand will certainly increase. Following are few of the services which have been planned to be offered here, three years down the road:-

i. Tele presence
ii. IMS IPTV VOD
iii. IMS based services
iv. Gaming
ii. Internet Downloading
iii. Video sharing
iv. VoIP

All these services are Bandwidth hungry and, the service offering of bandwidth demanding applications need to be commonly familiarized, very user-friendly and cost-effective enough in the markets, because, the timing for people to start using bandwidth demanding applications does matter. The cost of the devices required for such

applications is also one of the major factor for the spread and use of these services/ applications.

Bandwidth Requirements.

Service	Bandwidth (downstream)	QoS Requirement
Broadcast TV (MPEG-2)	2 to 6Mb/s	Parameterized
HDTV (MPEG-4)	6 to 12Mb/s	Parameterized
PPV or NVoD	2 to 6Mb/s	Prioritized
VoD	2 to 6Mb/s	Prioritized
Picture in Picture (MPEG-2)	up to 12Mb/s	Parameterized
PVR	2 to 6Mb/s	Prioritized
Interactive TV	up to 3Mb/s	Best effort
High-speed Internet	3 to 10Mb/s	Best effort
Video Conferencing	300 to 750Kb/s	Prioritized
Voice/Video Telephony	64 to 750Kb/s	Prioritized

3.4 Convergence across services and markets:

a) This technology change is enabling network and service convergence, and new business models. In few years to come, there will be a blend of services being offered by stakeholders. Market boundaries will be blurred by expanding in to adjacent markets (i.e. mobile network based service providers in to fixed voice and broadband and voice markets, and service providers into telecommunications markets). Network innovations will lead to cost savings.

b) In an NGN environment, service innovation occurs on the basis of a broadband connection and includes a wider set of products, for example, voice and content/media applications. So better content will come with better broadband connection.

3.5 Tariff/Charging Principles in NGN:

a) In NGN Networks the principle of tariffs shall be dependent on the different flavors of services offered to the public and the bundle formats. Principles of charging will change due to flexibilities of applications bundling. The consumers will be able to enjoy both the flat rates or pay-as- you-go tariffs and the combination there-off. Other variants will be customer segmentation, timing of day and area of service etc.

b) Similarly, End to End QoS guarantees may become difficult unless interconnects and SLAs are made between all service providers in chain as well as between

originator and the end users. Standardization of definitions of class of services will be the issue.

c) There will be no new scalable competition with NGN unless significant market power rules are adopted by the PTA.

3.6 Commercial Issues in NGN:

There are few commercial issues highlighted by the industry , to be resolved from regulatory point of view, like:-

a) For SIP telephony, tariffs and numbering plan may be addressed by regulatory authority.
b) Realization of SMP.
c) Coordination with municipal authorities for RoW issues for new laying.
d) Realistic policies for segregation of different type of voice traffic, e.g. national, international etc
e) Internet bandwidth costs are very high as compare to growing markets like UK.
f) Tariff harmonization.

3.7 Technical Issues:

Some of the technical issues highlighted by the industry that are to be resolved from regulatory point of view are:-

a) The biggest challenge with NGN is the QoS which depends on many factors. If some QoS mechanisms are implemented by bandwidth providers (PIE and TW1) then service quality can be improved.
b) Interoperability standardization.
c) The IP based multimedia protocols are still evolving and different variants have been implemented. Standardization on a national level is required and regulatory framework may be helpful, however, the industry may also itself can come up with such standardization mutually.
d) Clear definitions of any interconnect with upper and lower bounds for service, content and application provider interconnects may be given by authority.

3.8 IP-Interconnect Issues:

There are a lot many issues which may arise in NGN interconnect and may require a standard framework to be followed by all the stakeholders in order to establish successful interconnections. The foreseen issues may be:-

a) Interoperability of multiple services.
b) Proprietary signaling or incorrect signaling mappings.
c) Session control.
d) Cost bearing for incorrect calls / sessions etc.
e) Protocol compatibility.
f) Security.

Aside from the issues highlighted by the industry, none of the major operators is ready to migrate to IP-interconnects at this point in time. Reason being, the entire core network is designed on the TDM based inter-connect model & a huge investment is required in order to replace existing infrastructure with IP inter-connect model and the TDM interconnects proves best until some high bandwidth and delay sensitive services are not being offered .For Any such service, other than voice, IP-interconnection may be considered on per service basis.

3.9 Payment for interconnection:

It is likely to be much more varied. At present most interconnection charges are based on a per minute charge for traffic, based on the underlying cost.

In the NGN world the cost of transmission will be significantly lower, and many retail tariffs for voice services will be based on flat rate subscriptions. Moreover retail tariffs for other services provided over the NGN will be based on other criteria, such as

a) quality of service,
b) capacity used,
c) type of content etc.

Interconnection arrangements will have to accommodate these changes, and time based interconnection charges may be superseded by other models, such as sender-keeps-all, capacity charging or a flat rate access charge.

3.10 The location of interconnection points (POI):

a) The location of points of interconnection will change. The NGN points of interconnection are likely to be in geographically different locations, and at different levels in the network than in the legacy. As a result other operators will have to reconfigure and rebuild their own networks in order to continue interconnection with the incumbent operator

b) In Britain, BT plans to replace its network of about 360 local and trunk exchanges (the points of interconnection for the PSTN) and 3000 DSLAMs (the co-location facilities for unbundled local loops) with about 6,000 multi service access nodes, 120 metro nodes and 10 IP nodes. BT has proposed that the points of interconnection should be at the metro nodes.

3.11 QoS issues:

The Quality of service can be guaranteed by

- Resource Reservation,
- Proper Network Dimensioning.
- State Maintenance

a) End to End QoS guarantees cannot be provided unless interconnects and SLAs are made between all service providers in chain as well as between originator and the

end users. Due to inherent design of internet based on best effort, delivery may cause serious QoS issues for multimedia services if not resolved before implementation.

b) Latency can badly affect upcoming boom of streaming contents.

c) Definitions of the Standard class of services may be dictated by the authority and compliance form each player may be mandatory in order to avoid interoperability issues.

d) For real time/ non real time voice, data, vedio and steaming multimedia services, the following be defined for various classes of services separately

- IP Packet Transfer Delay IPTD,
- IP Packet Delay Variation (IPDV),
- IP Packet Error Ratio (IPER),
- IP Packet Loss Ratio (IPLR), This should.

e) In case of VOIP, toll quality and non toll quality parameters needs to be defined. Customers should be made aware of the difference in quality and tariff between two services, by service providers.

f) Interconnection congestion limit needs to be specified.

g) Some percentage level should be defied for bandwidth utilization.

h) Call completion rate within networks and across networks. (inter network) may be defined.

3.12 Signaling

NGN requires a defined list of protocols in the Interface Requirement (IR) for connectivity between two networks.
The following standards based signalling protocols are expected to be used in Next Generations Networks (NGN):

- SIGTRAN-between PSTN/PLMN and IP networks.
- H.248-between media gateway and media gateway controller.
- SIP, SIP-T/SIP-I- between two networks and between PSTN/PLMN and IP networks.
- H.323/SIP-T/SIP-I for international connectivity.
- Free delivery of content (voice/data/video etc), RTP/RTCP protocol is to be used.

PTA needs to prepare national Generic Requirements/Standards for the signalling protocols interface and also examine interoperability issues.

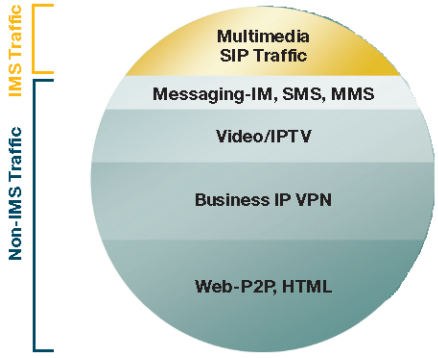
3.13 IP MULTIMEDIA SUBSYSTEM (IMS)

IMS is most effective way to grow network, as the future customers / market needs could be more effectively met. All networks can be integrated on common platform. For example 3 GPP, Cable TV etc. By vertical integration, more focused development on applications would result in optimal time-to market solutions. PTCL plans for IMS network till 2012. All other operators will be adopting with the evolution of their IP-networks.

3.13.1 Non-IMS Applications

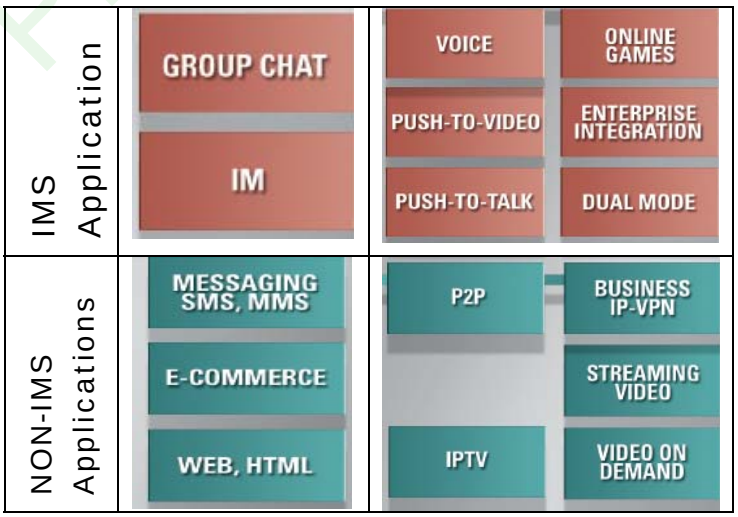
IMS and non-IMS service applications have significant differences, which affect how they are provisioned and how to best design a network for all-encompassing IP service delivery. Designing for IMS alone addresses only part of a service provider's business opportunity—and may create the need for costly network redesign if the needs of non-IMS service delivery are not met.

Making the right decisions now means providers are best equipped to meet short- and long-term business and service delivery challenges. Many service providers worldwide are struggling to find the best way to balance their IMS and non-IMS offerings. What approach has the highest probability for success?



Cisco:

The best solution for dealing with complex IP service delivery must enable network operators to effectively manage any IP application . Non-IMS applications generate significant revenue and will continue to do so in comprehensive service portfolios—but they are not supported by the IMS standard. Can providers afford to ignore them? Certainly not.



Cisco:

4 PLANNED TARGETS

Established network operators are pursuing two basic goals with NGN. On the one hand, the optimization of the networks and technology should open up excellent potential for cost savings.

On the other hand, they intend to exploit new income sources with the future network. The plan is to create an entirely new form of communication for the customers**.**

4.1 Cost Reduction:

These savings will be produced by focusing on:

- A single technology system and
- Related reduction in technology sites and
- Reduction in technical equipment areas.

PTCL has experiences 75% reduction in the power consumption after migrating to softswitche.

A single infrastructure is easier to maintain. PTCL has experiences 75% reduction in the power consumption after migrating to softswitches. Similarly many other parameters cuts the cost due to converged architecture.

4.2 Services:

Established network operators see the possibility of new income as another motivation for promoting NGN. More and more innovations with new sales opportunities are expected in the field of value-added services. The operators are planning to offer the following, three years down the road.

- Tele presence,
- IMS IPTV VOD,
- IMS based services,
- Gaming,
- Internet Downloading,
- Video sharing,
- VPNs,
- WLL voice,
- VoIP .

4.3 ENUM:

It establishes a bridge between the worlds of telephony and the Internet. Just one number is enough to reach someone not only at their home or mobile telephone but also over a fax machine or even at an e-mail address or through a webpage.

ENUM, as a standardized technology, offers solutions for many known problems within an NGN. It provides mechanism for the mapping of E.164 telephone numbers into URIs (Uniform Resource Identifiers) and thereby enables new service features within an IP based network.

The deployment of ENUM will support the smooth migration of service discovery & signaling functions from the existing SS7 databases and protocol mechanisms to an ENUM based NGN.

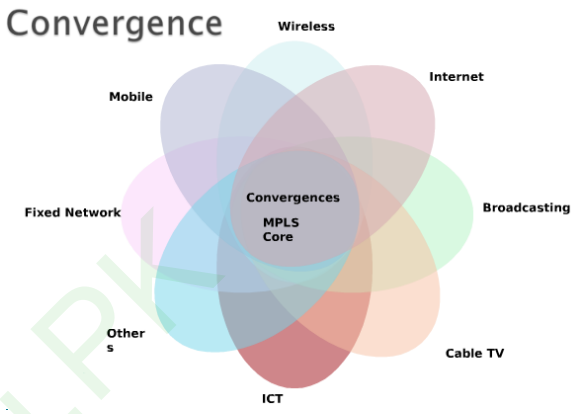
This may be the right time for the regulator to explore the best use of ENUM.

4.4 IP-MPLS:

The backhaul networks are required to support services that are delay and loss sensitive, that are used for revenue generating and mission critical applications and a high level of network availability. These networks must also support the evolution from TDM-based backhaul, ATM based backhaul through to 3G, mobile WiMAX [WiMAX-IEEE] and LTE.

Internet Protocol/Multi-Protocol Label Switching (IP-MPLS) is the flavour that provides transport services for mobile control and user plane traffic in all different topologies used to support various RAN interfaces (e.g., from SONET/SDH, PDH and ATM, to Ethernet) and different technologies (e.g. from GSM, UMTS,LTE, mobile WiMAX, HSPA).

Hence a common MPLS backbone ring may be created that articulates all the operators.



5. Threats from NGN

The advent of NGNs seems to increase the digital divide within the country by enabling some customers to have access to a wide range of broadband services while others have only narrowband, or no, telecommunication services.

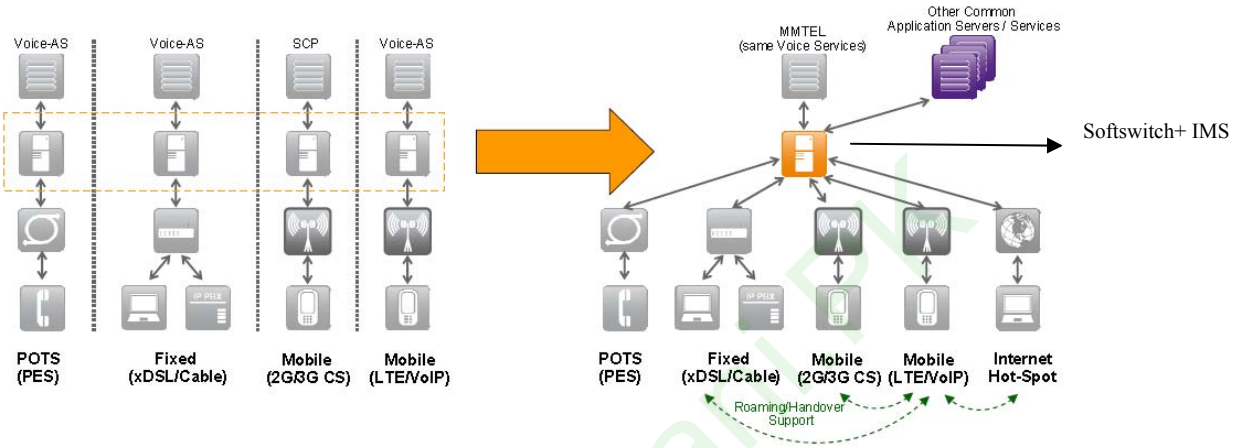
This will raise questions of whether the national priorities for investment should be in allowing the country to compete internationally by allowing businesses and others to have broadband services, or --- in extending narrowband penetration.

Whether the national priorities for investment should be in allowing the country to compete internationally Or extending narrowband penetration?.

6. Recommendations:

a) Deployment of Pakistan internet-backbone, on Gigabit Ethernet (GigE) interface (IP-MPLS) is the most important step in efficient laying/performance of NGN networks.
b) Significant market power rules may be adopted by the PTA in order to have new scalable competition with NGN.
c) Clear definitions of any interconnect with upper and lower bounds for service, content and application provider interconnects may be given by authority.
d) It may be ensured that NGN services providers ensure interconnection to all existing telecom service providers.
e) It is needed to prepare National Generic Requirements/Standards for the signalling protocols interface and also examine interoperability issues.
f) Definition of the Standard classes of services may be dictated by the authority in order to avoid interoperability issues.

g) Tariffs and numbering plan may be addressed for SIP telephony.
h) Bulk selling and virtual network operations in the context of NGN needs to be considered. Services providers should have full flexibility to have mutually agreed SLAs to provide end-to-end QoS for various applications.
i) Emergency number dialling from IP telephony subscribers be mandated.
j) The ROW issues & charges may be given special consideration in order to promote the NGN Access network on Fibber optic cable.



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*Note: CMTOs to update status during industry consultation.