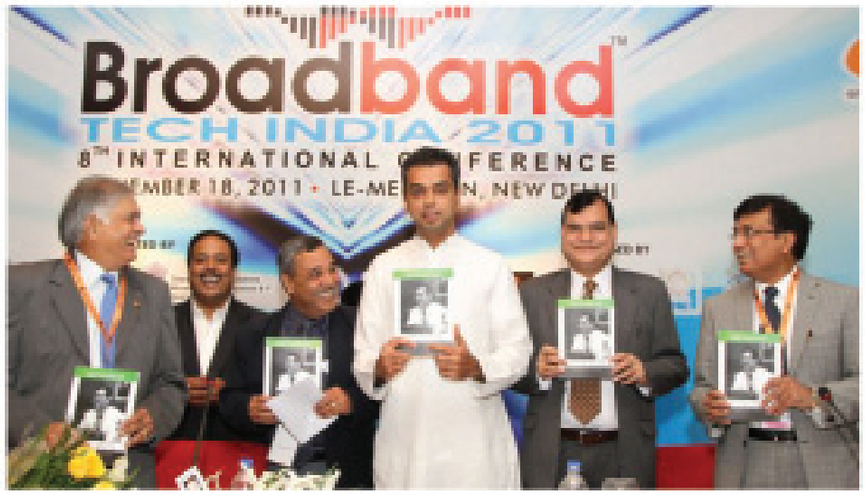
SATYASPEAK

EVERYTHING OVER IP (EOIP)

ALL YOU WANTED TO KNOW ABOUT **NGN**

SATYA N. GUPTA



Minister of State for Communication & IT, Government of India, Mr. Milind Deora releasing the 1st edition of Satyaspeak on 18th November, 2011 at New Delhi

Second Edition- December 2011

All the opinions expressed in this compilation are that in the author's personal capacity as a telecom professional and not necessarily mean the official views of his present and past employer as well as various industry bodies with whom he is associated with.

With Best Compliments & Heartiest Season's Greetings

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ITU-APT Foundation of India

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National Broadband and Telecom Committee of CII
European Business Group, EU Delegation India (EBGI)
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Founder Advisor
Other Service Providers Association of India (OSPAI)

Author with Betterhalf, Mrs.Madhu and son Anind - Success Behind.

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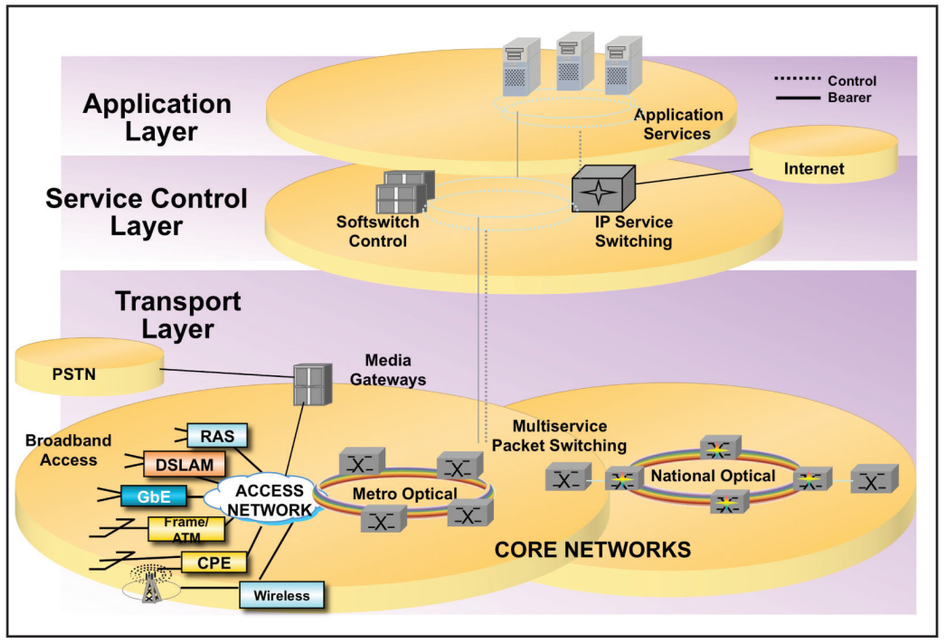

SATYA N. GUPTA

In Lieu of Foreword- "Introducing Mr. NGN"

..... always forthcoming, and candid, he has aired his views on the industry aimed at its progressiveness. And when I saw the title of the booklet – "SATYASPEAK', I felt it was very apt ... SATYA speaks both individually and literally. Being an ardent Tennis player, he has been terming the failure of country to achieve broadband targets as "Double Fault" wherein both the Market as well as Policy failed at the same time and therefore has been advocating for the mid-flight correction in the Broadband policy.

Mr. Satyen Gupta, fondly and very rightly known as Mr. NGN in the International Circles, is the Chief Harbinger of NGN era in India. He started bringing awareness about NGN way back in 2005 wherein he authored a comprehensive consultation paper on NGN which was called "Magna Carta'" in some corners. He followed this by working as the Member of the ITU Expert Group on their International publication on NGN in 2007.

He describes NGN through its layered approach wherein the applications and service control has been separated from the underlying network infrastructure. Then he discusses the advantages of NGN through his famous quote of "Best of both the Worlds" bringing out the synergy between IP (Packetisation) and TDM (circuit switching). One of the compelling applications of NGN is stated to be Fixed-Mobile Convergence (FMC) which has potential to solve the problem of scarcity of licensed spectrum by making more efficient use of unlicensed spectrum. A pleasing simplification of the complex aspects of NGN though various presentations is his main forte. And like the NGN technology, he provides a single solution and a rich content communication. Some one has aptly named him "Walking Encyclopaedia of Telecom" on his Linked-in profile

His presentations are very educative and grasping, captivating and engrossing with his unique, own style of delivery. (Of his many talents, he's also been Grade 1 radio amateur ...) His presentations on "6 Degrees of Infrastructure Sharing" where in he brings the concept of Functional Separation (What he calls "Nirvana") leaves the audience spell bound (Mantra- Mugadh). A great concept which could become all the greater were it to translate into implementation and execution, and has the potential to turnaround the ailing incumbent operator.

He is a strong supporter of need- based "Differential Regulation" in lieu of the policy of "One Size Fits All" and laments that policy makers should be utilising their scarce resources to fix the gaps in the specific areas of market failures and not on the segments which are performing, believing in " Don't try to fix it, if it aint' broken"

He has been advising for the Co-opetition amongst the competing operators on a "Win-Win" platform and a strong believer in exploitation of Managed Services at all layers, when he says "Whatever you cant' do best –Outsource to those who can".

As an executive member of many industry forums in India and abroad he has been appealing for a balancing act on policy front to maximise the Societal welfare as a whole and not just the gains of a single stakeholder. Taking the cognigence of emergence of Packet-based networks and "Death of Distance" he believes that interconnect charges which are based on "Minutes and Miles" should give way to "Capacity Based Charging" (CBC). Also he maintains that costing principles should migrate from the Historical and Current costing towards the Forward looking LRIC.

Of late he has started advocating for Overhauling of Regulatory regime in the country in the era of convergence and NGN through his presentations on "Next Generation Regulatory Reforms-V.2." which could become a compelling motivation for Next Generation Telecom Policy, 2011 for the country. Another of his suggestions has been avoidance of "regulatory capture" to make the regulator independent and empowered.

His presentation on NGN applications towards "better city and better lifestyle" demonstrates the human touch at his heart in everything he does. Therein, he brings out how the new technologies can be used to improve productivity as well as bring flexibility in working leading to better work-life balance which he is known for successfully practicing as well while preaching.

This is a compilation of his many presentations and views expressed in India and abroad and will definitely, like the NGN Technology itself, be satisfying to most of the users/learners, their demands/questions and will expand their knowledge, capability, exposure and approach. As he believes in "A picture is worth thousand words" he has retained the presentations in PPT mode.

It's a Simplification of a complex technology. A practical handbook, for anyone who aspires to be 'THIS GENERATION TECHNOLOGIST', from Mr. NGN, preparing you for the emerging telecommunication environment and challenging ecosystem ahead.

It's a personal honour and privilege to pen down these few words and communicates my congratulations to him and his family and best wishes in all his future endeavours.

To know more about Mr. NGN turn to the last page or visit his linked- in profile.

Vimmy Choudhry
TV Anchor & ICT Event Compere
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SATYASPEAK

INTRODUCTION TO NEXT GENERATION NETWORKS (NGN) - THE FUTURE OF TELECOM

In the current scenario of economic meltdown and cut- throat competition Telecom Operators are in need of ways of providing multiple services over their networks to demanding customers to address the problem of falling average revenues (ARPU) as the voice services penetrates to lower and lower income levels. To establish multiple networks to serve the same customer base for multiple services does not make a business case as it is very inefficient. Could there be a single network that could serve ever widening range of services? The answer is the Next Generation Networks which is a converged network, all based on Internet Protocol (IP). In this introduction it is discussed what these networks are and how these could be established to provide both Mobile and Fixed voice as well as Broadband and Video Services and how this could be done without dumping investments in the existing legacy networks which are still delivering goods, though inefficiently.

What is Next Generation Networks (NGN)

Next Generation Networks (NGN) are the systems based on emerging Packetization technology of IP which is leading to convergence of networks, services and markets and enhancing efficiency and flexibility by following the layered approach for separation of Infrastructure, Service Control and Service Provision functions. NGNs offer service providers and operators a converged, efficient and flexible IP-based platform which can evolve in a modular and flexible manner to create, deploy and manage innovative unified and application services.

As TDM technology, which is Circuit Switched (Connection-Oriented) and hence inefficient and inflexible is being phased out, the IP-based NGN is taking charge. In NGN domain various network elements will be: Softswitch, IMS (IP Multimedia Subsystem), Media Gateways, Service Control servers, Application servers, Routers and Transmission links and Broadband Access.These network elements largely based on IP are grouped in a layered architecture as shown in figure 1.

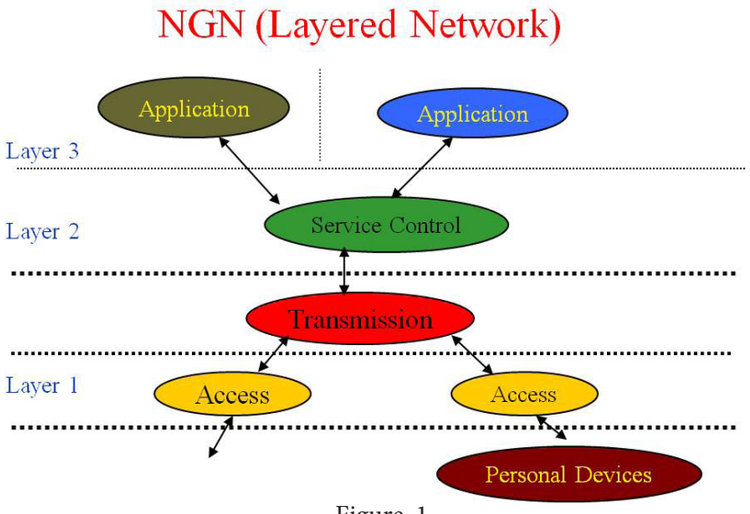
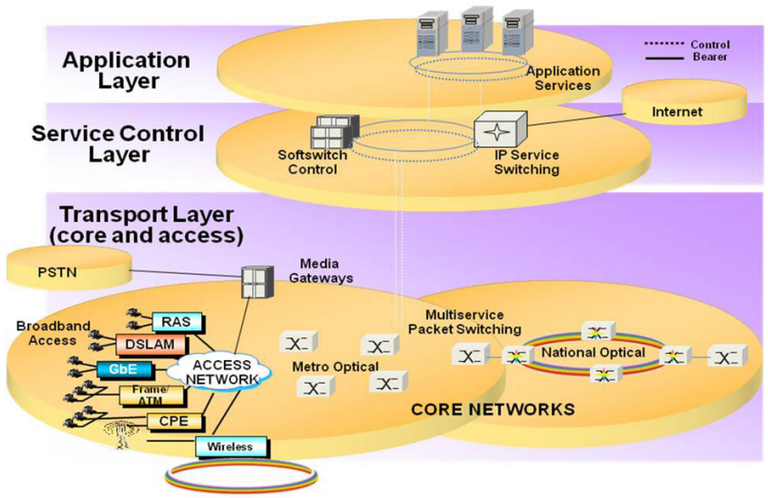


Figure. 1



NGN is a layered architecture consisting of Transport, Service Control and Application layers distributing intelligence at every layer. The underlying packet transport and media infrastructure is grouped under Transport layer which also inter-works with circuit- switched (PSTN) network through Media Gateways so that existing networks need not be scrapped. The Service Control layer consisting of Softswitches, Media Gateway Controllers and IMS performs the functions of control, authentication,accounting, maintaining QOS, security and network management. The Application layer makes use of capabilities provided by other functional layers to provide multi-media services and applications based on Open Architecture of APIs.

The definition of NGN as per ITU is as following:

"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 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."

What are these networks designed to do? From co-existing with PSTN, to be agnostic to access technology, they support quad-play, namely voice, data, video and mobile services including quality of service requirements. The architecture is based on open standard for the networks to be versatile with separation between service provision and underlying infrastructure so that operational license holders have flexibility and could accommodate different content/application providers and niche service providers to serve the customers with innovative and multi-media services.

The emerging communication scenario is such that there is convergence of services and of access and transport supporting for all types of end user devices.NGN has not only to take care of every existing and new multi-media service but also cater to different end user devices. These devices could be computer, laptop, fixed line telephone or mobile handset or TV or may be some other device that is at present in the womb of the future. Such networks are obviously going to be the networks of the future as the handset delivers not only voice and data but also video, mobile TV, mobile

e-mail and all other unified services .In effect NGNs are capable of providing any service from any infrastructure, irrespective of whether the service is in telecom, Internet or broadcasting, anywhere to anywhere from any device to any device. This has become the big story in communication now, a change from VOIP to EOIP or Everything over- Internet Protocol;

PSTN migration to NGN

The evolution of PSTN to NGN would be determined by customers and services. Instead of merely providing broadband, it promises new services to end-users. NGN must build on the strength of both the telephony and the Internet service models. Access modernization is key in this evolution but state of the art PSTN solutions of today can evolve and stay part of the future NGN systems to preserve investments. Access for instance could be through high speed broadband provided through ADSL, VDSL, and Wi-Max, FTTH or PLC or all of them. Carrier Ethernet and IP-MPLS have become preferred transport modes. NGN demands service oriented, layered architecture where transport, control and application are separate and interconnected designed to take in new developments without massive additional investments. In the mobile area the operators have to provide now for a 3G plus Access and and Internet Service Providers migrate to Next Generation Internet (IPv6). This calls for the new eco-system to facilitate the Next Generation Networks and services.

Advantages of NGN

NGN makes use of best of both the worlds (flexibility, efficiency & Innovativeness of IP and QOS, Security, Reliability, Customer-friendly features of proven PSTN)

For service providers these provide many advantages. The integrated and efficient packet based technology reduces capex. Transmission costs are lower, greater power saving, less space requirement and less O&M costs while there is also ability to offer wider range of services at faster speed. Yet another advantage is personal service customization and management. Instead of maintaining different networks for different services, the single

network alone need be managed.

Subscribers also benefit as call charges are reduced, they could choose multiple service providers to get maximum advantage of competitive offers and take advantage of single billing for all services of voice, data, video and mobile.

Fixed Mobile Convergence (FMC) - A Compelling NGN Application

A major development due to the versatility of NGNs is that it is now possible to have a fixed-mobile convergence for the benefit of the users and also to conserve the precious licensed spectrum. That is, as per the convenience of the user, a mobile call can be delivered on fixed phone or can be terminated through a fixed broadband network on mobile phone. In a situation where many networks face spectrum shortage that affects quality of service, the need for spectrum for the mobile user could be reduced. Studies show that 70 per cent of the time a mobile call user is on a fixed location or near a Hot Spot. In the context of decline in fixed line usage and saturation in mobile, there could be more harmonious division of time between the two benefiting the entire system. As broadband becomes ubiquitous and cost effective and mobile handset is turned into a multi-purpose, multi-band palm-held computer, the advantages of increased use of FMC could be easily seen.

NGN Deployment Scenario

Several operators are now realizing NGN as the future and are evolving towards it. Obviously existing PSTN cannot be scrapped overnight but migration has to be initiated the sooner the better. BT in UK is one such operator. Key milestones towards NGN migration in what is termed as 21CN began with the initiation of transition in 2005, completing the transformation into NGN by 2011.

Many countries like UK, Japan, Korea, Malaysia, Italy, Singapore, Australia, New Zealand, Vietnam and China have decided to migrate to NGN. The incumbent operators there are going for NGN and replacing their existing networks to IP -based in a time bound manner. This is being done to beat to competitors and new entrants on the technology front and being able to provide new value added services, cut down on Opex as well as to make the network future-proof.

Regulatory challenges for migration to NGN

NGN capabilities are blurring the differences between multiple services and traditional boundaries between local access and long distance operators are vanishing. Regulators are now faced with ongoing technological developments causing drastic impact on the telecom scenario forcing a re-look at the service based licensing and geographical area based regulatory regime including numbering systems. They have to determine who exclusively telecom operator is and who value added service provider is when operators are also becoming value added service providers and niche operators are connecting to larger networks. Such a scenario compels a unified licensing of operations and services and also the Class licencing for Value Added Services. Another challenging development is the need for new interconnect products based on capacity and quality where so far these products have been designed to deal with distance and duration (Minutes and Miles). In a situation where telecom technologies are causing what one author has termed “death of distance” pricing based on distance becomes out date. For instance, a rupee-a minute charge now prevails across the country for long distance calls whether the call is from Delhi to Lucknow or from Jorhat to Rajkot. Additionally operators and regulators have to deal with providing access to emergency services and security monitoring under all circumstances in IP domain.

Way Forward

All the above challenges and also the technical as well as business oriented hurdles are to be faced and sorted out through consultations among all stakeholders, as there is no option then to migrate to NGN for survival as well as for customers welfare, as they say **“ Packetize or Perish”**.

Author with Hon.Sh. Kapil Sibal, Minister of Communications and IT, Govt. of India

Author as a part of ACTO Board.

Author presenting a copy of Satyaspeak to H. E. Sir Richard, British High Commissioner in India

Author explaining the content of Satyaspeak to H.H. Rani Prernita Kaur, MOS, External affairs, Govt. of India

Author presenting Satyaspeak to H.E. Neelie, Commissioner and Vice-Chairman EU

Author presenting Satyaspeak to Prof. K.K.Aggarwal, Chancellor, Lingaya University

Author with Mr. Sachin Pilot, MOS, CIT, Govt. of India

Author with Mr. Salman Khurshid, Minister of Law, Govt.of India.

CHAPTER ONE

Next Generation Networks (NGN)- Technology, Architecture, Applications

AGENDA

Emerging developments in ICT Technologies

All-IP NGN — Introduction

Advantages of NGN

EOIP— NGN Emerging Services and Applications

Fundamental characteristics of NGN

Next Generation Network Architecture

NGN Network Elements and Building Blocks

IP Multimedia Subsystem (IMS)

Next Generation Internet (IPv6)

Regulatory Challenges for NGN

PSTN Evolution to NGN

EMERGING DEVELOPMENTS IN ICT TECHNOLOGIES

- Increased speed and density of Integrated Circuits (Moore's Law-CPU processing power doubles every 18 months).
- Enhanced Transmission capacities on Optic Fiber Networks and Networking Flexibility (Gilders Law-OFC carrying capacity doubles every 6 months).
- Distributed and Open Platform-based Communication Software (APIs).
- Capacity Growth and new Application Services on Wireless (Coopers Law-wireless capacity doubles every 30 months).
- Emergence of all-IP based networks (Next-Generation Networks) .
- Carriage of real time QOS- requiring multimedia traffic by data networks (VOIP, IPTV, VOD, IM)

ALL IP NETWORKS - NGN

INTRODUCTION

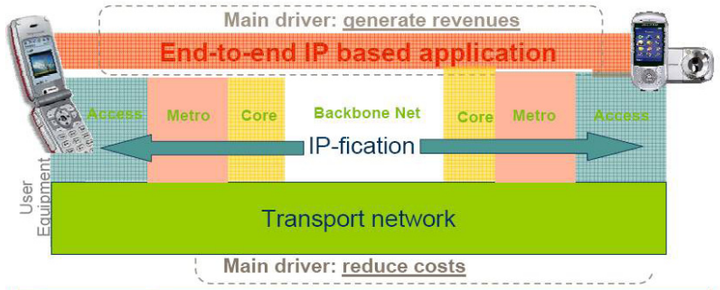
- Next Generation Networks are the systems based on emerging Packetization technology of IP which is leading to convergence of networks, services and markets and enhancing efficiency and flexibility.
- Rapid technological developments are taking place in transmission networks (optic fiber), access networks (wireless), switching (IP) and customer premises equipment (Integrated and Intelligent).
- Wireless based access technologies specially EVDO, Wi-Fi, Wi-Max, LTE are making broadband access faster and cost effective.

- These developments are enabling the operators to increase their depleting ARPU (Average Revenue Per User) by providing advanced value added services in addition to plain Vanilla voice.
- Emergence of EOIP which means Everything over IP. That means you can provide any service through Next generation platform based on All- IP.
- NGN with the help of soft-switch can co-exist with the legacy PSTN networks and hence the existing investments of operators do not go waste.
- Many countries like UK, Japan, Korea, Malaysia, Italy, Singapore, Vietnam and China have decided to migrate to NGN. The incumbent operators there are going for NGN and replacing their existing networks to IP based in a time bound manner. This is being done to beat to competitors and new entrants on the technology front and being able to provide new value added services, cut down on Opex as well as to make the network future-proof
- Broadly, NGN should meet the following basic requirements:

  i. Co-existence with PSTN.
  ii. Access technology agnostic.
  iii. Support quad-play (voice, data, video, mobile) services.

- NGN should be capable of providing seamless converged services from telecom, internet and broadcasting infrastructure at any time, anywhere to anywhere from any device to any device.

WHAT 'ALL-IP' MEANS

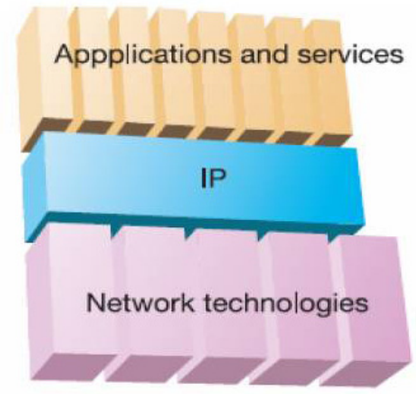


The term '**ALL-IP Network**' refers both to :

1. An enabler, together with other associated technology, to provide enhanced integrated service set, independent , as far as possible of the access system used.
2. Transport technology as enabler to achieve decreasing OPEX.

SO, WHY USING IP TECHNOLOGY?

- Low-Cost (w.r.t technology)
- Flexible (plug & play, adding a node means updating routing table.
- Suitable for packet services.



Everything over IP

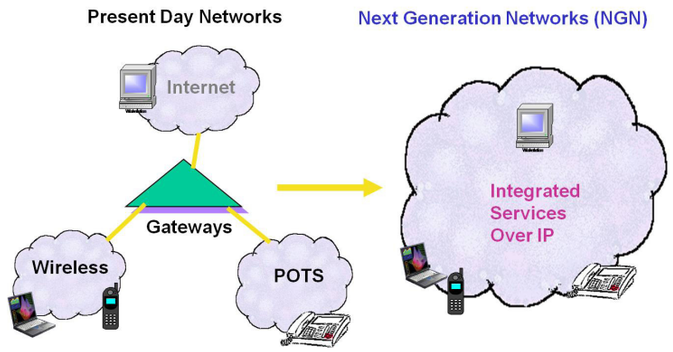
Any service & application due to protocol incapsulation on IP independence of stream length

IP over Anything

Provide connectivity for any transport technology (independent of link layer).

IP Anywhere = ALL - IP Paradigm!

NEXT GENERATION NETWORKS - EVOLUTION



Evolving Towards ALL-IP Flat Network

WHAT IS ALL IP-NGN ECOSYSTEM?
(FROM LAYMAN'S POINT OF VIEW)

- Next Generation Services — Converged (quad-play, voice, data, video, mobile)
- Next Generation Access — High speed (Broad-band) IP based connectivity (ADSL, VDSL, Wi-Max, Cable TV, FTTH, PLC)
- Next Generation Transport — Carrier Ethernet, IP-MPLS
- Next Generation Architecture — Service oriented, Layered (transport, control, application)
- Next Generation Mobile — 3G+
- Next Generation Internet — IPv6
- Next Generation Interconnect — Capacity and Quality based
- Next Generation Licensing — Unified and Class Licensing
- Next Generation Regulation — Converged (Single Regulator for ICE)

DEFINITION OF NEXT GENERATION NETWORK (ITU)

"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 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."

ADVANTAGES OF ALL IP-NGN

NGN makes use of best of both the worlds (flexibility, efficiency & Innovativeness of IP and QOS, Security, Reliability, Customer-friendly features of proven PSTN.

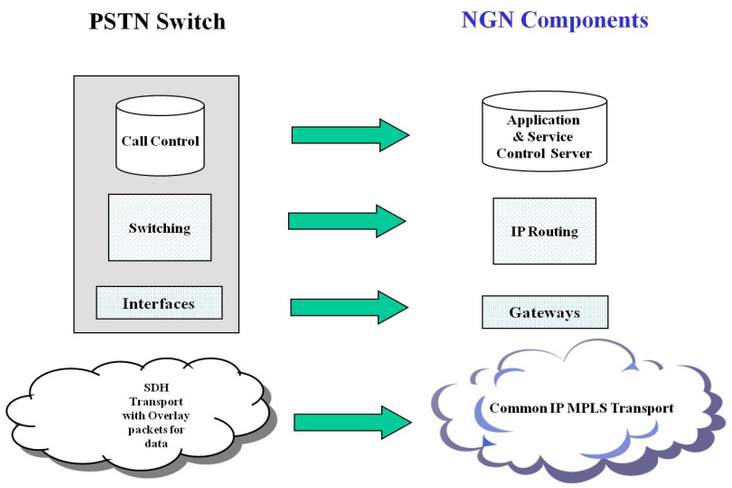
- ***Advantages for Service Providers***

- Reduced CAPEX due to integrated and efficient IP-based technology *(Packetize or Perish)*
- Reduced OPEX due to transmission cost saving, less power consumption, less space requirement, less O&M costs
- Ability to offer increased range of services
- More flexibility increasing market penetration by offering personal service, customization and management
- Single network layer for management
- Avoidance of separate voice, broadcast and data networks

- ***Advantages for Customers***

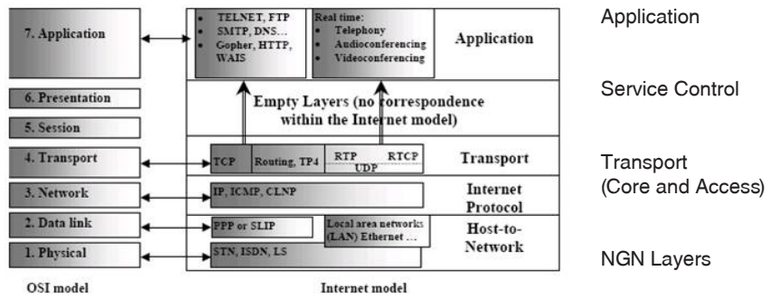
- Reduced call charges due to efficient operation and competition
- New innovative services at a fast speed
- Single connection and bill for voice, data, video, mobile (Quad play)
- Control of application service for flexibility
- NGN should be capable of providing seamless converged services from telecom, internet and broadcasting infrastructure at any time, anywhere to anywhere from any device to any device.

NGN V/S PSTN ELEMENTS



ALL-IP NGN ARCHITECTURE - LAYERED APPROACH

Correspondence between OSI, Internet and NGN models



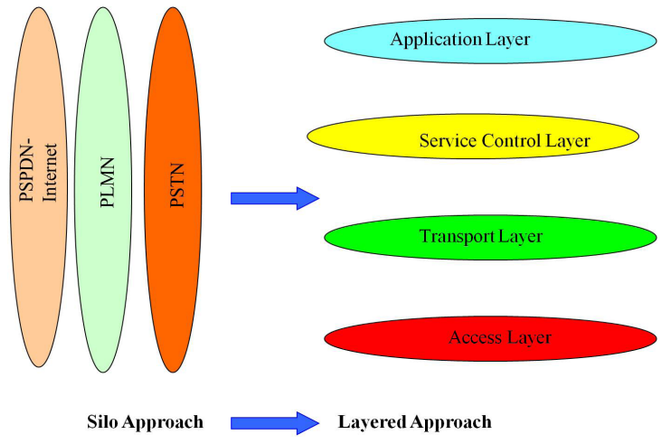
Application

Service Control

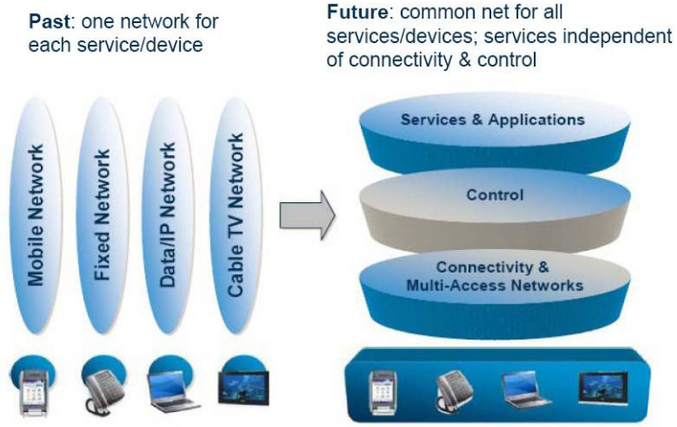
Transport
(Core and Access)

NGN Layers

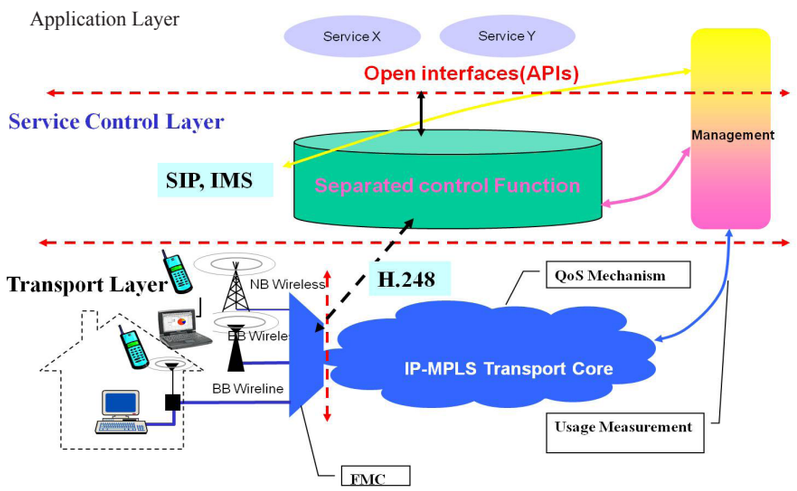
NGN - CONCEPT- LAYERED APPROACH



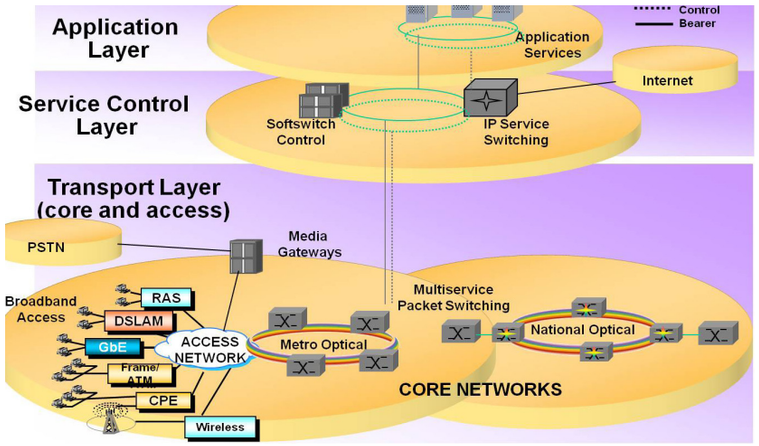
This slide shows NGN Concept briefly. The traditional networks can be represented as stand alone verticals or islands. In this approach PSTN is a separate vertical, PLMN is a separate vertical and so on. NGN is a layered concept in which separate functions are assigned to separate layers. There are four basic layers or horizontals as shown above. Network Elements in each layer talk on same set of protocols. Each layer can be scaled independently. NEs of each layer are based upon open standards and can be sourced from any vendor. Migration means Mapping of verticals on to horizontals. These layers are the essence of converged network.



FROM VERTICAL TO LAYERED ARCHITECTURE

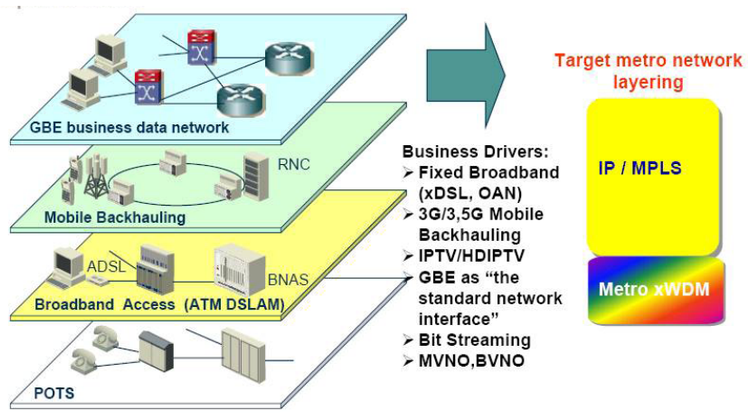


NGN - A LAYERED ARCHITECTURE DISTRIBUTING INTELLIGENCE



CONVERGENCE IN THE METRO NETWORK

SIMPLIFY METRO NETWORK, DE-LAYERING, SCALE-UP FOR OPTIMISATION



FUNDAMENTAL CHARACTERISTICS OF ALL-IP 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. Separation of service-related functions from underlying transport technologies.
- 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, Triple- play).
- Broadband capabilities with end-to-end QoS and transparency.

- Inter working with legacy networks via Media Gateways.
- Generalized mobility support.
- 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.
- Compliant with all Regulatory requirements, for example concerning access to Emergency services and Security monitoring (LIM)/Privacy, etc.

NGN ARCHITECTURE

NGN Concept

- An all IP based Layered Network
- A unified packet transport for all types of services (Transport Layer)
- A session based control architecture (Service Control Layer)
- For user to user voice , video and data services over the IP infrastructure
- A common Open Service Delivery Platform (Application Layer)

Expectations from NGN

- Generate new revenue streams by enabling faster roll out of new multimedia services
- Secure voice revenue stream by integrating PSTN infrastructure with NGN

- Provide solution to cater to PSTN obsolescence and bring in efficiencies and cost reduction

REQUIREMENTS FOR NGN IMPLEMENTATION

Equipment and Network Interoperability between various Operators

- A standards based functional architecture
- Standard interfaces and protocols (ANI,UNI,NNI)

Ability to serve Fixed (Copper and fibre), Wireless and Mobile Networks

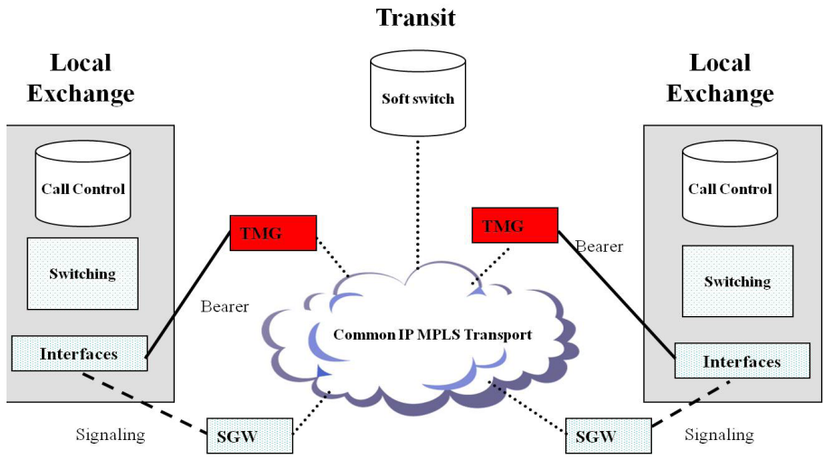
Open Services Architecture (OSA)

- Standard interfaces open to third party application service providers

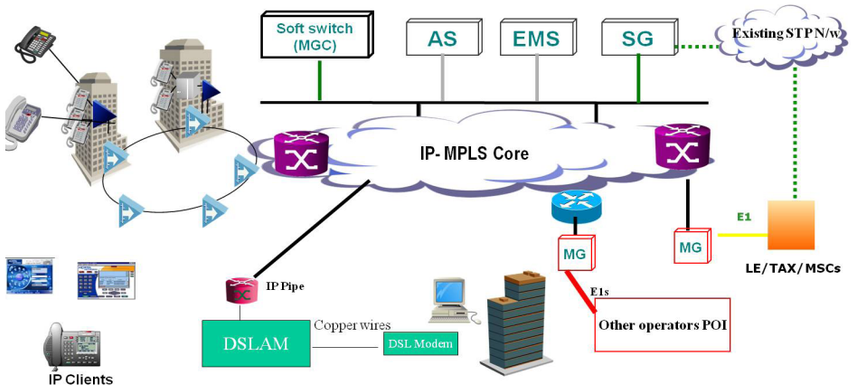
QOS Control Mechanism

- Important for voice and video services (Real-Time)
- Requires bandwidth allocation mechanism at access level as it is shared between various services
- Security Requirements

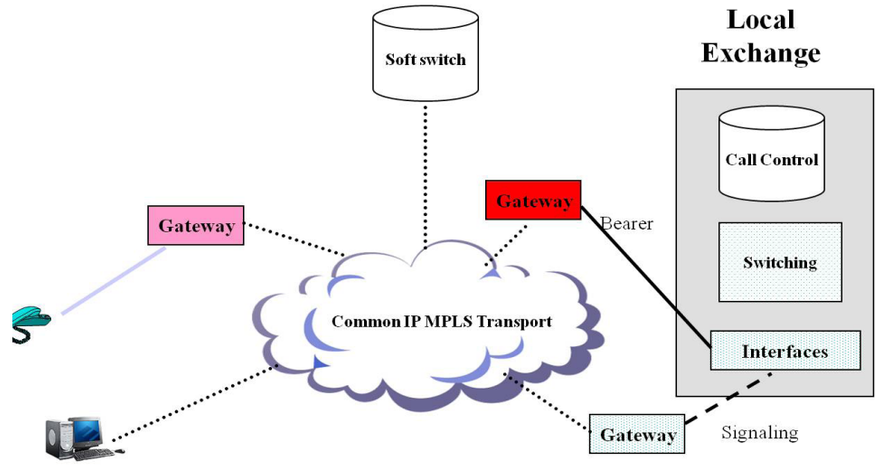
SOFTSWITCHING-TRANSIT ARCHITECTURE



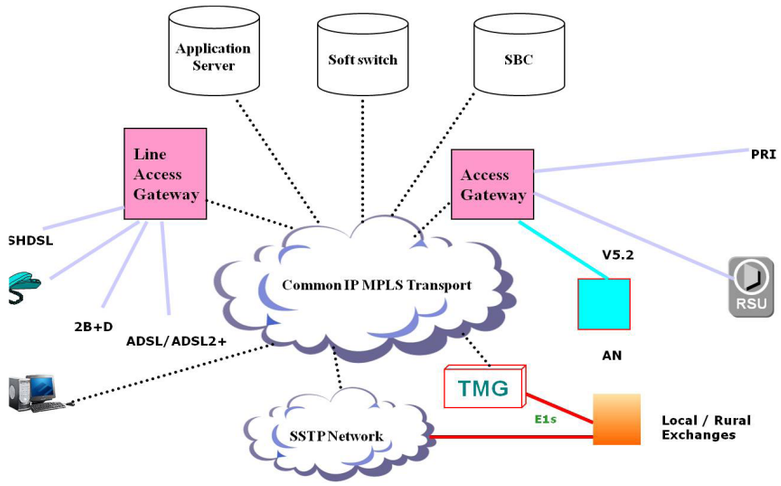
NGN - ACCESS NETWORK (FIXED)



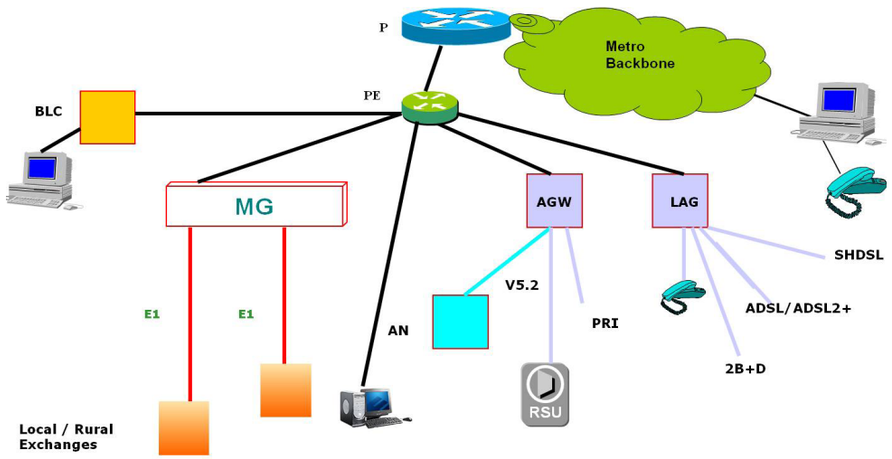
NEXT GENERATION-SWITCHING - LOCAL SWITCHING



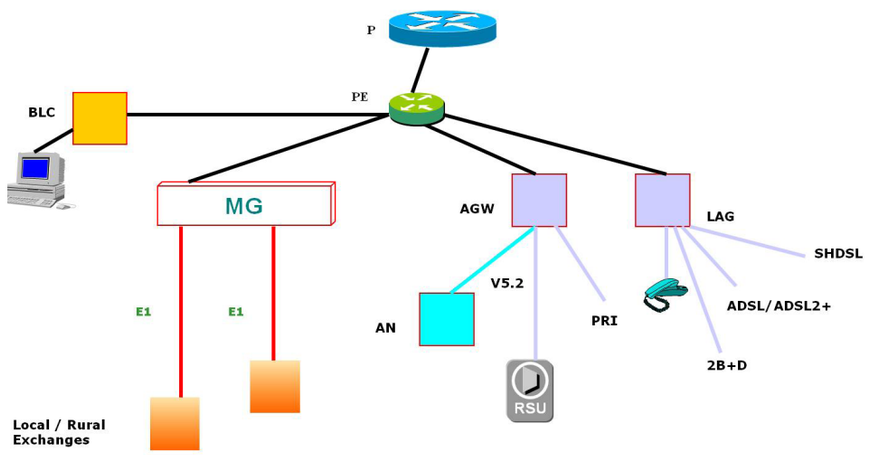
NEXT GENERATION SWITCHING ARCHITECTURE

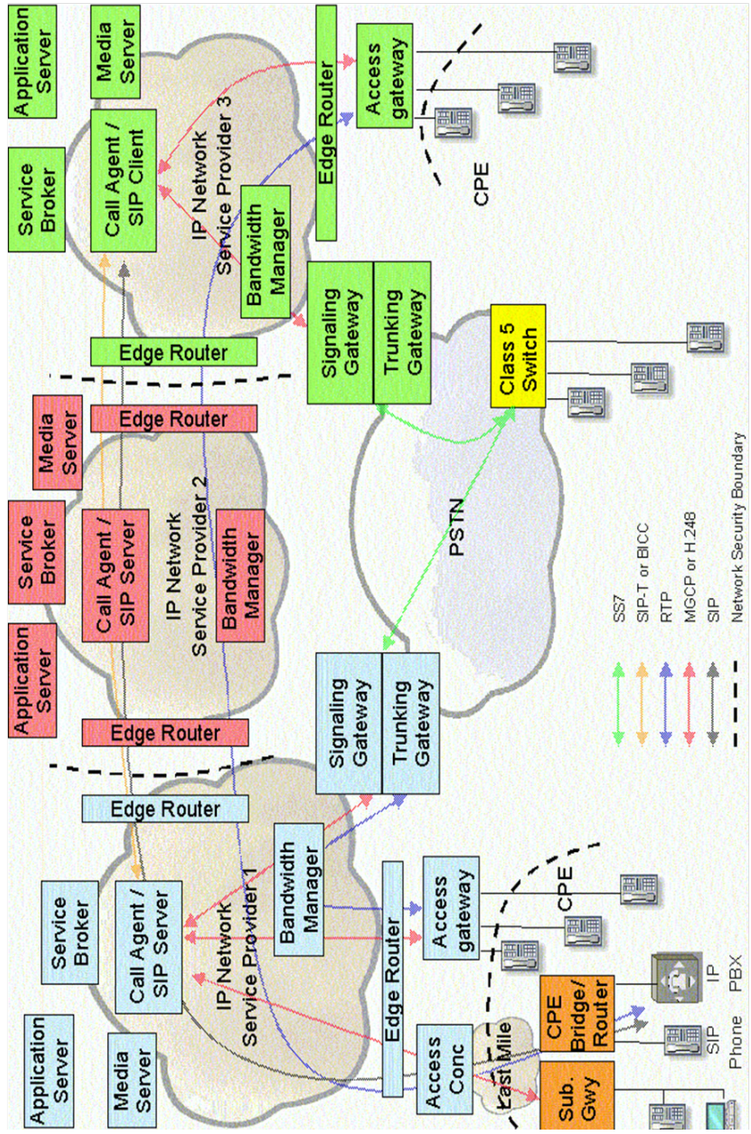


LOCAL LEVEL IP-NETWORK
A CASE OF METRO CITY



LOCAL LEVEL IP-NETWORK
A CASE OF NORMAL CITY





NGN - EMERGING VOIP ARCHITECTURE

NGN ARCHITECTURE - ELEMENTS

NGN architecture breaks the hierarchy-based architecture of the Traditional Networks and follows flat hierarchy for the IP-based Networks with a layered approach.

Transport-Network Elements (Core & Access)

- Converged IP- MPLS Core (Softswitch/ Media Gateway Controllers)
- Intelligent Provider Edge (PE) devices for service enablement (Media,Sig Gateway)
- Ethernet based Access infrastructure to aggregate business and residential users (LAG)
- Diverse set of access architectures in the last mile (Broadband Access Technologies)
- Home gateway, UNI

Service Control Elements

- Policy Control Framework for subscriber policy tracking and enforcement
- Application level policy enforcement
- 'AAA' servers for billing and accounting & Authentication

End User Devices

- Converged devices can be intelligent TVs, combined Mobile/ PDA/ Pocket PC/IAD

TRANSPORT NETWORK ELEMENTS

Access Gateways (LAG)

- Allows the connection of subscriber lines to the packet network
- Converts the traffic flows of analogue access (POTS) or 2 Mb/s access devices into packets
- Provides subscriber access to NGN network and
- services

Trunkling Gateways (TMG, SG)

- Allows inter-working between classical TDM telephony network and packet-based NGN networks
- Converts TDM circuits/ trunks (64 Kbps) flows into data packets and vice versa

Core Networks (MPLS Core)

- Trend is to use IP networks over various transport possibilities (ATM, SDH, WDH)
- IP networks must offer guarantees of Quality of Service (QOS) regarding the real time characteristics of voice.

SERVICE CONTROL NETWORK ELEMENTS

Softswitch

- Referred to as the Call Agent or Media Gateway Controller (MGC)
- Provides the 'service delivery control' within the network
- Incharge of Call Control and handling of Media gateways control (Access and /or Trunking) via H.248 protocol
- Performs signalling gateway functionality or uses a signalling gateway for inter-working with PSTN- C7 signalling network
- Provides connection to Intelligent network/ applications servers to offer the same services as those available to TDM subscriber

Application Server (AS)

- A unit that supports service execution, e.g. to control Call Servers and NGN special resources (e.g. media server, message server)

H.248 Protocol

- Known also as MEGACO: standard protocol, defined by ITU-T, for signalling and session management needed during a communication between a media gateway (MG), and the media gateway controller (MGC) managing it.

- H.248/ MEGACO allows to set up, keep, and terminate calls between multiple endpoints as between telephone subscribers using the TDM.

SIP (Session Initiation Protocol)

Handle communication signalling and negotiation like call establishment, maintenance and termination from packet mode terminals. Has a distributed peer- to- peer implementation.

ENUM (Electronic Numbering)

A unit that provides signalling conversion between the NGN and the other networks (e.g. STP in SS7).

BGP (Border Gateway Protocol)

Performs inter-domain routing in TCP/IP net works, handling routing between multiple autonomous domains. Routers use BGP to maintain a consistent view of the inter-network topology.

MPLS (Multi-Protocol Label-Switching Protocol)

- Assigns labels to information packets in order to allow the node routers to treat and route flows in the network paths according to established priority for each category. Establishes a tunnel for an end-to-end forwarding.

- A label is a short, fixed length, locally significant identifier which is used to identify a 'Forwarding Equivalence Class (FEC)' to which that packet is assigned.

LSP (Label-Switching Paths)

- An LSP is a specific path traffic path through an MPLS network that using convenient protocols will establish a path through an MPLS network and will reserve necessary resources to meet pre-defined service requirements for the data path. It enables the provision of QOS and guaranteed services like circuit- switched over IP network.

COS (Class of Service)

A feature that provides scalable, differentiated types of service across a label switched network. MPLS COS offers packet classification, congestion avoidance, and congestion management

TEM (Traffic Engineering Module)

- Traffic Engineering refers to the process of selecting the paths (LSPs) in order to balance the traffic load on the various links, routers, and switches in the network. A major goal of Traffic Engineering is to facilitate efficient and reliable network operations with guarantee of QOS while simultaneously optimizing network resource utilization and traffic performance.

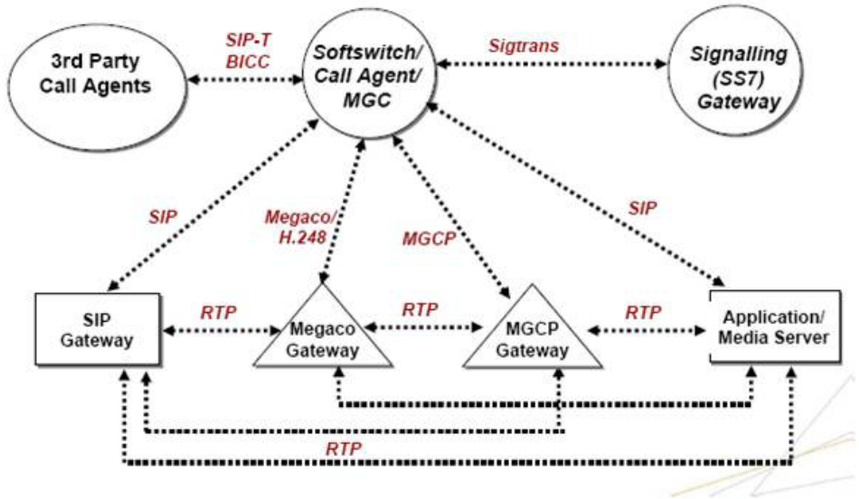
CAC (Call Acceptance Conrol)

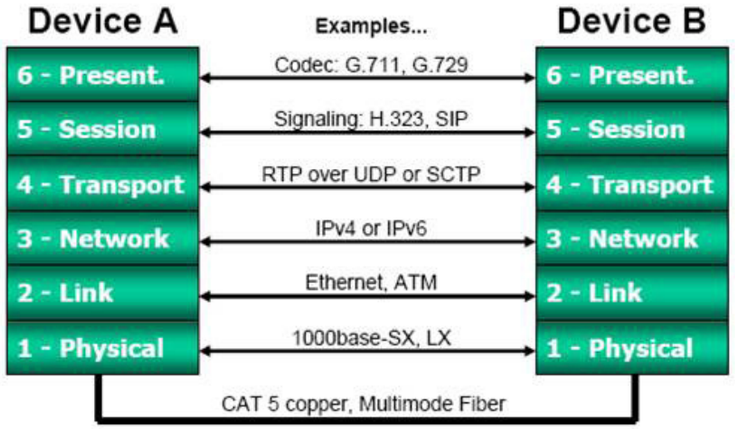
- To accept/ reject traffic in the network that allows guarantee of QOS for services with a given Service Level Agreement.

OSPF (Open Shortest Path First)

- A routing protocol that determines the best path for routing IP traffic over a TCP/IP network based on distance between nodes and several quality parameters. OSPF is an Interior Gateway Protocol (IGP), which is designed to work within an autonomous system.

NGN - SERVICE CONTROL PROTOCOLS



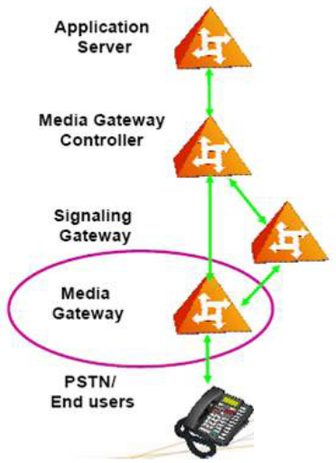


- Devices must interoperate at each layer of the stack, not just use the same H.323 signaling, for example

NGN - SOFT-SWITCH MEDIA GATEWAY

Media Gateways provide interaction between audio in the network and software controlled applications

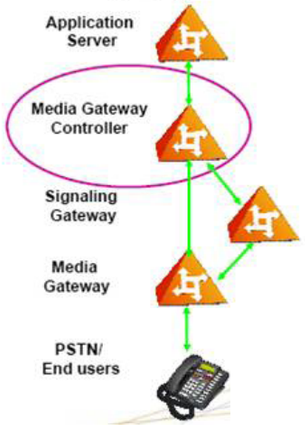
- **Convert PSTN to IP packets**
- **Convert IP packets to PSTN**
- **In-band event detection and generation**
- **Compression (G.7xx,…)**
- **May be distributed across the globe**



NGN-SOFT-SWITCH MEDIA GATEWAY CONTROLLER

An SS7 Enabled Media Gateway Controller integrates the functionality of new applications with the large installed based of legacy systems.

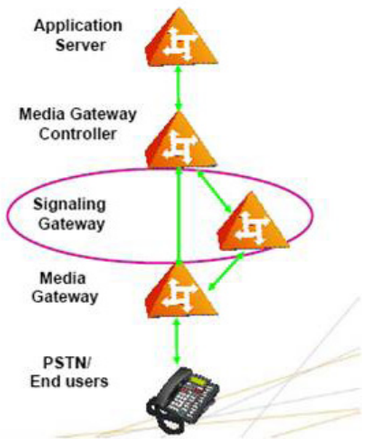
- **Multiple controllers can collaborate on a single call**
- **May be distributed across the globe**
- **May or may not be collocated with SS7 Signaling Gateway**
- **Connections (call setup and teardown)**
- **Events (detection and processing)**
- **Device management (gateway startup, shutdown, alerts**



NGN - SOFTSWITCH AND SIGNALLING GATEWAY

Signaling Gateways provide interaction between the SS7 network and Media Gateway Controllers.

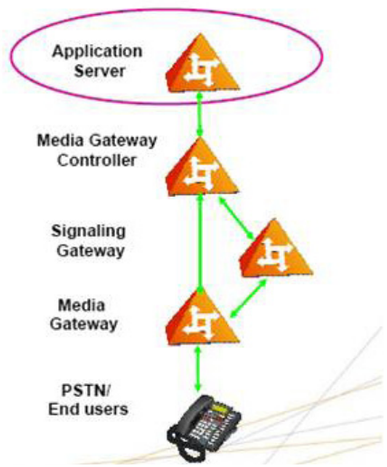
- Convert SS7 to IP packets
- Convert IP to SS7 packets
- Signaling transport (SS7, SIP-T, Sigtran…)
- Extremely secure
- Extremely fault tolerant



NGN - SOFTSWITCH AND APPLICATION SERVER

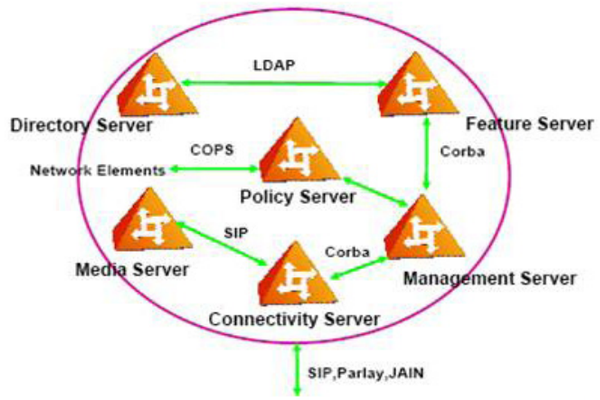
Application Servers(AS) provide the new services that are the real "value-add" for Soft switches

- Many core features are part of the MGC
- Allows new features to be developed by third parties



NGN - SOFTSWITCH AND APPLICATION SERVER

Application Servers(AS) Can be broken apart and distributed in the network



NGN - SERVICE CONTROL NETWORK ELEMENT - IMS
(IP MULTIMEDIA SUBSYSTEM)

What is IMS?

IP Multimedia Subsystem as defined by 3GPP

- 3GPP IMS standards define a network domain dedicated to the control and integration of multimedia services.
- IMS is defined by 3GPP from Release 5 onwards (2002)
- 3GPP2 equivalent of IMS is the MMD (Multimedia Domain), fully interoperable with 3GPP IMS

IMS builds on IETF Protocols

- Based upon SIP, SDP, RTP etc. protocols
- 3GPP have enhanced these IETF protocols for mobility.

IMS Definition

- Open-systems architecture that supports a range of IP-based services over the packet switched domain, employing both wireless and fixed access technologies and enables FMC (Fixed Mobile Convergence)

NGN - WHAT DOES IMS PROVIDE?

Service and Control

- Adds call session control to the packet network (GPRS)
- enables peer-to-peer real-time services - such as voice, video — over a packet-switched domain .
- scalable common service control (based on SIP) gives the ability to manage parallel user services.

Media Mixing

- Ability to pick and mix various multimedia flows in single or multiple sessions.
- Can handle real-time voice, video, data.

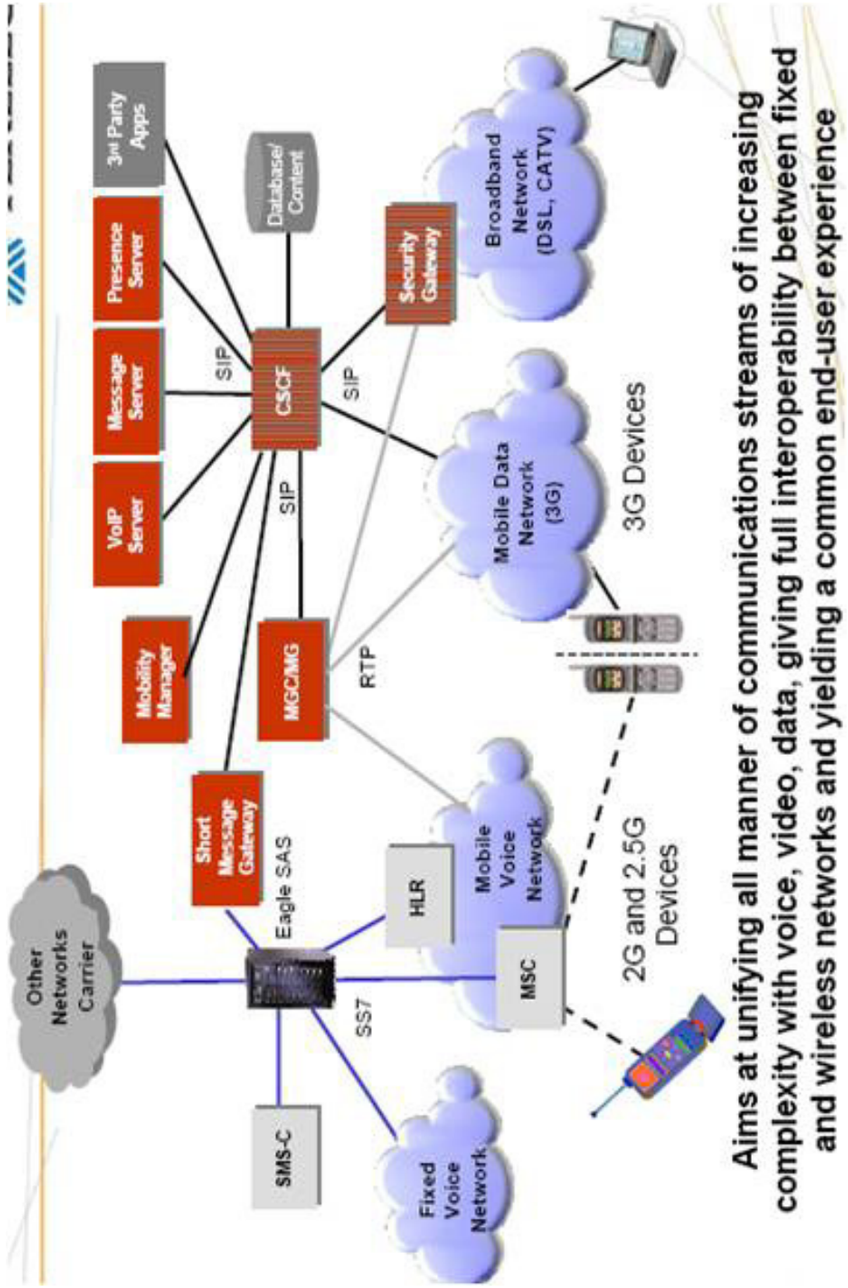
Network Independent Connectivity

- Provides access to IP based services independent of the underlying connectivity technology (mobile / fixed).

An open standard with evolutionary scope

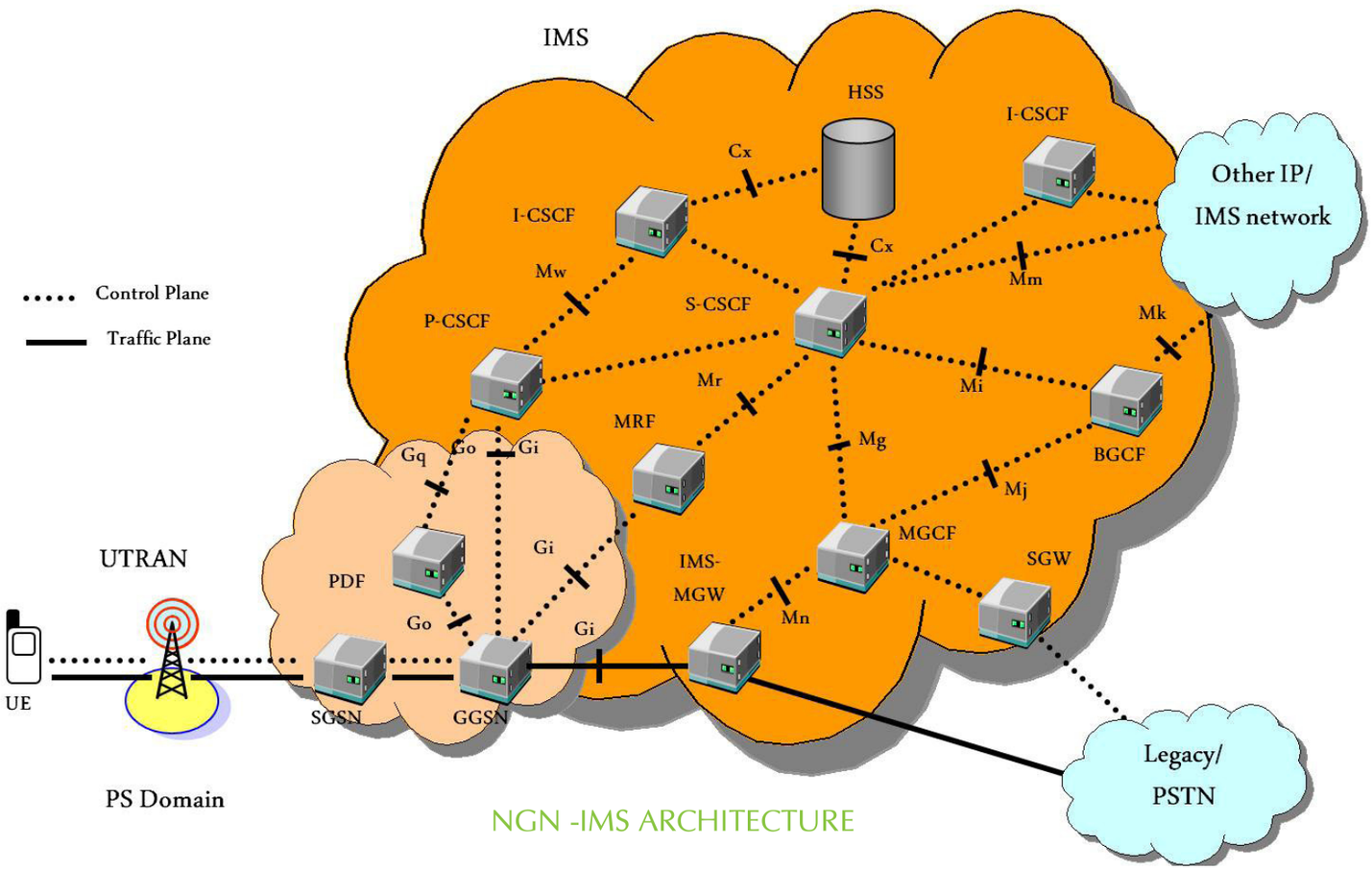
- IMS architecture & SIP are capable of being extended to provide for new emerging services.

SATYASPEAK



NGN -IMS ARCHITECTURE

NEXT GENERATION NETWORKS
TECHNOLOGY, ARCHITECTURE, APPLICATIONS

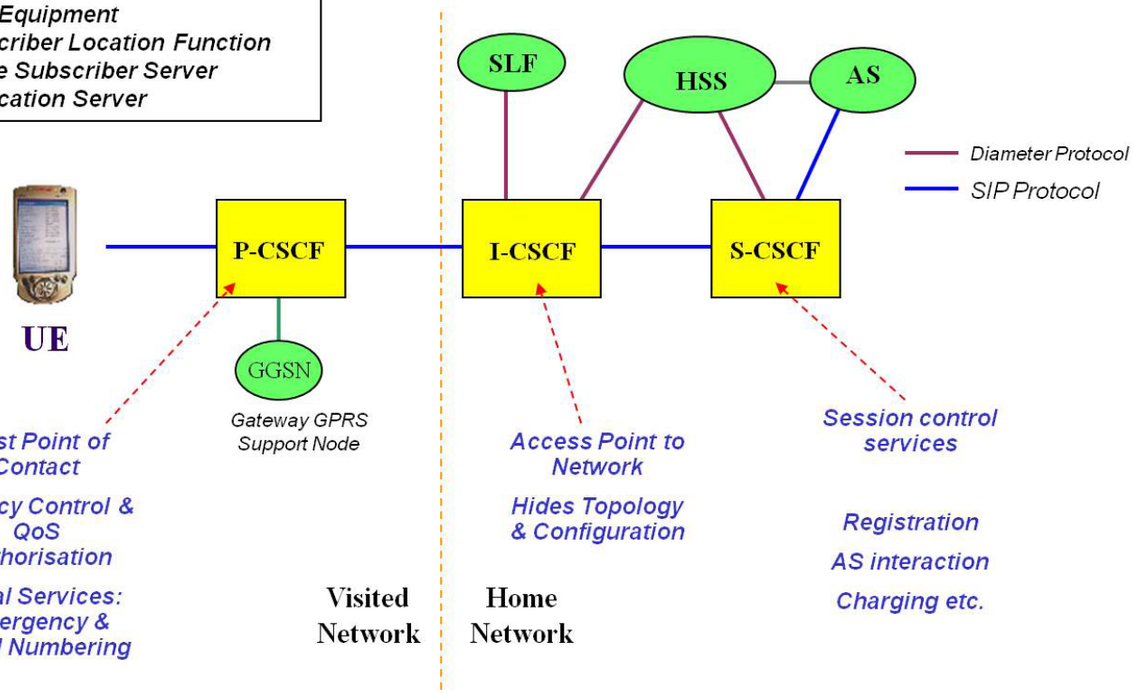


NGN -IMS ARCHITECTURE

SATYASPEAK

CSCF – Call State Control Functions
P – Proxy
I – Interrogating
S – Serving
UE – User Equipment
SLF- Subscriber Location Function
HSS- Home Subscriber Server
AS – Application Server

IMS ARCHITECTURE - BASIC COMPONENTS



Source: ASTAP05-WP.IP&NGN-08_ETSI

SATYASPEAK

WHY IMS IN NGN?

The IP Multimedia Subsystem generally fulfills the NGN requirements for conversational (interactive, real-time) services

- For managed, Carrier operated telecom networks
- With Release 6, IMS becomes applicable to a range of access network types (3G RAN, WLAN)

For the benefit of the overall telecommunications industry

- IMS is being proclaimed as the architecture of choice for converging networks (mobile — fixed), as well as voice and multimedia
- It is predicted that IMS will enable IP to gradually replace circuit switched voice
- Operators who own both fixed and mobile networks want to consolidate their networks
- Growing IMS market, will encourage greater usage and creation of new IP based services
- Open interfaces allow for a wider choice of IMS suppliers
- Market stimulation, decreasing costs (thanks to shared development/deployment costs).

IMS V/S SOFTSWITCH

Two approaches in call-handling

- ***Soft Switch*** **-** A split of today's classic telephone exchange into separate Call Server and Media Gateway functions,
- ***IMS*** **-** A server platform developed by the 3GPPs, where call servers are just one of many types of servers eventually .

Softswitch IMS Comparison

Soft Switch

- Small step
- Yields IP cost advantages
- Easily supports current PSTN services
- Makes use of Intelligent Network (IN) services

IMS

- Big step
- Yields IP cost advantages
- Does not as easily support all PSTN services
- Does not use IN
- Achieves fixed & mobile core network convergence.

- **Step 1 – Telephony Softswitch solution**
  - **Introduction Telephony Softswitches**
    - Cost reduction through the modernization of the ageing circuit switched network.
    - Separates call control from connectivity
    - Lowers CAPEX and OPEX
- **Step 2 – Softswitch / IMS solution**
  - **Roll out of IMS**
    - Introduces IMS alongside Softswitch
    - Allows introduction of new SIP based services
    - Increases services revenues and customer base
- **Step 3 – Full IMS telephony solution**
  - **Introduction of IMS Access Gateways**
    - Softswitches upgraded to telephony servers to enable full-IMS
    - Introduction of IMS telephony gradually to replace legacy

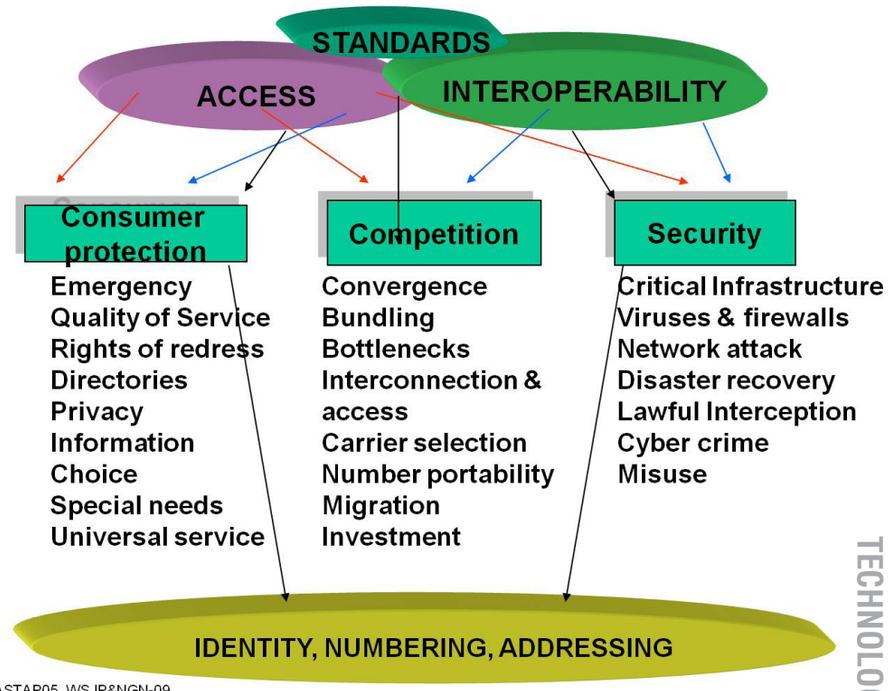
NEXT GENERATION INTERNET (IPV6)

- IPv6 is the Next Generation Internet protocol with improvements over the age old initial version IPv4 (since 1981) to cater for the current & emerging applications and demands on the internet cloud.
- It has capacity to expand the available address space on the Internet enormously, using 128 bits vis-à-vis 32 bits of IPv4.
- Address limit of IPv4 is of the order of 4 Billions, while that for IPv6 is $3X10^{39}$ *(3000 Billion Billion Billion Billion).*
- A larger address space and flexible addressing scheme
- Efficient and Hierarchical Addressing and Routing with Streamlined header format
- Inherent support for secure communications
- The ability to facilitate differentiated services
- Better support for mobility
- Auto-Configuration capability supporting 'plug and play'

DIFFERENCES BETWEEN IPv4 AND IPv6

IPv4	IPv6
Source and destination addresses are 32 bits (4 bytes) in length.	Source and destination addresses are 128 bits (16 bytes) in length.
No identification of packet flow for QoS handling by routers is present within the IPv4 header.	Packet flow identification for QoS handling by routers is included in the IPv6 header using the Flow Label field.
Address Resolution Protocol (ARP) uses broadcast ARP Request frames to resolve an IPv4 address to a link layer address.	ARP Request frames are replaced with multicast Neighbour Solicitation messages.
Internet Group Management Protocol (IGMP) is used to manage local subnet group membership.	IGMP is replaced with Multicast Listener Discovery (MLD) messages.
ICMP (Internet Control Message Protocol) Router Discovery is used to determine the IPv4 address of the best default gateway and is optional.	ICMP Router Discovery is replaced with ICMPv6 Router Solicitation and Router Advertisement messages and is required.
Must be configured either manually or through DHCP.	Does not require manual configuration or DHCP for auto configuration.

NGN - TECHNOLOGY CHALLENGES



Source: ASTAP05_WS.IP&NGN-09

NGN - QOS CONCERNS FOR VOICE SERVICES

Four components affect the voice quality-:

- ***Bitrate -*** The bitrate depends on the codec used and also on the layer headings.
- ***Packet Loss -*** Voice is extremely intolerant in terms of packet loss, QoS in the IP infrastructure is essential to carry VoIP.
- ***Fixed Delay -*** Voice is far more sensitive than data in regards to relay, and special considerations must be taken.
- ***Jitter -*** Codecs don't deal too well with variable delay (i.e. jitter) and VoIP systems need to compensate for that.

NGN - SECURITY CONCERNS

- Anybody can become a hacker in seconds (thank WWW)
- 3 main categories of threats:
  - Service Availability attacks
  - Service Integrity attacks
  - Eavesdropping

Watch out for SPIT and VOMIT

- Service Availability Attacks
  - Denial Of Service (DOS), SPIT (Spam over Internet Telephony), worms, trojans
  - Flooding of network and the VoIP infrastructure
  - Abruptly terminated calls
  - Unsuccessful attempts of any call origination
  - Flooded voice mail servers
  - Loss in revenue, negative customer experience, productivity loss

NGN - SECURITY CONCERNS II

- Service Integrity Attacks
  - Toll Fraud, Identity theft, Phishing
  - Billing inaccuracies, legal exposure, loss in revenue
- Eavesdropping
  - Free tools available on Internet today where any users can sniff a packet and then convert it to a wav file for distribution
  - VOMIT (Voice Over Misconfigured Internet Telephones) and tcpdump
- Legal implications, loss of confidentiality & privacy violation
- Complex security issues potential threat to rapid VoIP adoption

NGN - SECURITY SOLUTIONS

- Firewalls provide basic network perimeter protections.
- Network Scanning tools and services enable an organization to conduct a basic assessment of the security measures and its effectiveness in protecting the network.
- Intrusion Detection & Prevention empowers organizations to continuously monitor their network for security breaches
- Antivirus scanning tools enable organizations to investigate incoming /outgoing traffic for malicious data and to eliminate such data before it can do damage to the network
- Content Control software and services puts companies in the driver seat in determining what content may access the business environment – and which content needs to stay outside
- Additional ways to provide security
  - Encryption and Authentication
  - Separate voice from data traffic on LAN – separate VLANs
  - Voice aware firewall and IPS (Intrusion Protection System)

PSTN EVOLUTION TO NGN - CHALLENGES

PSTN (Basic circuit switched Voice) remains the main revenue source for incumbent.

Its competitiveness must be maintained

- How to keep it the state-of-the art?
- Which technology (NGN, ATM, FR) to use?
  - *For growth (volume)*
  - *For replacing out-phased equipment*
  - *For migrating/consolidating the whole network*

Main concern is the cost of ownership (TCO)

- how to minimise it?
  - *CAPEX : Capital Expenditure*
  - *OPEX : Operational Expenditure*

Future Convergence with Broadband

- ***Where to introduce a common part?***
- ***At which pace?***

COST BENEFIT ANALYSIS FOR NGN MIGRATION

	Access NGN	Core NGN
Benefits	•Improved competitiveness against triple play, cable TV operators / new mobile/value-added service providers	•Significant cost reductions in transmission costs and OPEX due to rationalization of legacy network •Better technology for replacement of old age legacy network
Costs & Risks	•Significant CAPEX •Increased costs due to triple play without matching ARPU initially •Regulatory mandate for whole-selling and unbundling at access layer	•Project risk due to huge scope and complexity •Reduction in the interconnect usage charges by regulator.

CONCLUSION-

GENERAL CONSIDERATION FOR PSTN MIGRATION TO NGN

- Services are key when considering any future evolution of legacy networks,
- NGN is more about bringing new services to end-users than just broadband access or Voice Over Packet (VOIP) though both are very important technological milestones,
- NGN must build on the strengths of both the Telephony and the Internet respective service models,
- NGN emergence will happen but will take time, PSTN networks will likely continue to offer the voice telephony service for a while,
- State-of-the-art PSTN solutions of today can evolve and stay part of the future NGN Ecosystem through MGs to preserve legacy investments,
- Access modernization (Next Generation Access) is key to prepare the introduction of advance converged services and new quad-play services and applications (data, voice, video and mobile) over the same network.

CHAPTER TWO

NGN Ecosystem for Emerging Markets- Regulatory Reforms V.2

AGENDA

NGN Ecosystem — Introduction

Regulatory Challenges for NGN

Existing licensing regime — India

NGN in India — SWOT analysis of present framework

Regulator's consultation process

Way forward
Unified Licensing
Phased Migration

Functional Separation — A Regulated Wholesale concept

NGN Regulatory ecosystem for emerging markets

NGN Vision for Country

NGN INTRODUCTION

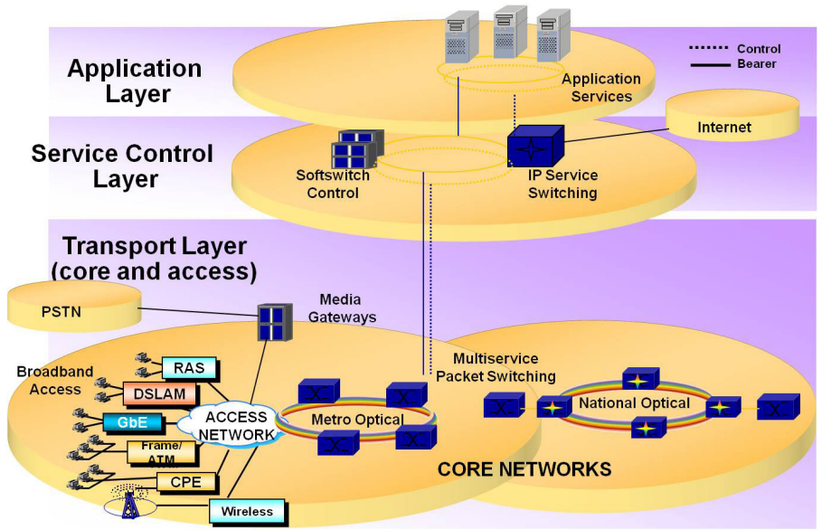
Next Generation Networks as the name suggests are the networks of future based on emerging technology of IP which is leading to convergence of networks, services and markets and providing efficiency and flexibility.

NGN are based on the layered approach wherein services provision is separated from the network infrastructure.

These are enabling the operators to increase their depleting ARPU by providing advanced value added services in addition to plain (vanilla) voice.

The incumbent operators are going for NGN by replacing their existing networks to compete on the technology front and being able to provide innovative value added services, cutdown on Opex as well as to make their network future- proof.

NGN - A LAYERED ARCHITECTURE
DISTRIBUTING INTELLIGENCE AT EVERY LAYER



WHAT IS NGN ECOSYSTEM?

- Next Generation Services — Converged (quad-play-VOIP, data, video, mobile)
- Next Generation Access — High speed (Broadband) IP based connectivity (ADSL, VDSL, WiMax, Digital Cable TV, FTTH, PLC)
- Next Generation Transport — Carrier Ethernet, IP-MPLS
- Next Generation Architecture — Service oriented (SOA), Layered (transport, control, application)
- Next Generation Mobile — 3G+(B3G)
- Next Generation Internet — IPv6
- Next Generation Interconnect — Cost of Capacity and Quality based
- Next Generation Licensing — Unified & Class, technology-neutral and service agnostic
- Next Generation Regulation — Converged, differentiated/ asymmetric, facilitating, Light-handed

DRIVING FORCES FOR NGN

Emerging Markets Motivation

- Operational cost savings, new services for increased ARPU
- Predominantly mobile users, less investment in legacy infrastructure, Greenfield Environment
- Low tele-density and Broadband penetration
- Address space limitations,
- Government's / Regulator's NGN initiatives
- Roll-out of networks by more new entrants

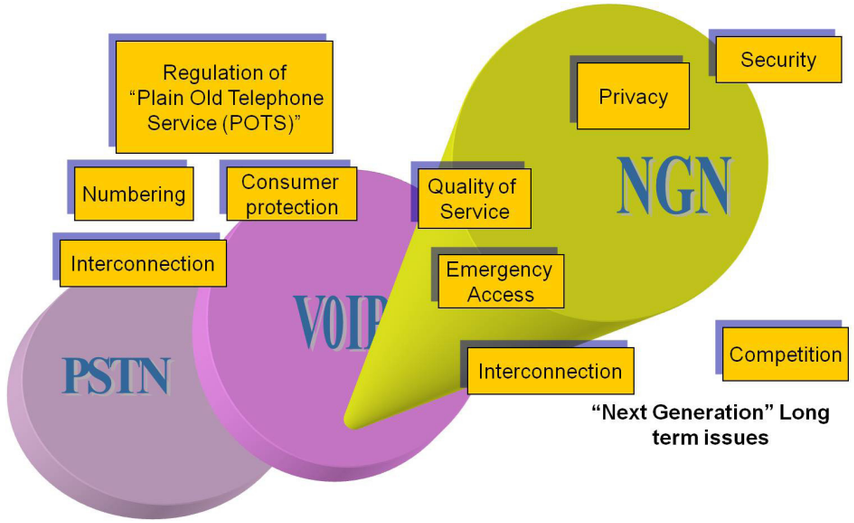
NGN - A REGULATORY OPPORTUNITY

As per ITU:-

"The move to NGNs represents an opportunity to establish in advance ground rules for ensuring the continued passage to effective competition and minimise damage during transition".

It is in contrast to the regulation of the legacy network, which came after the networks were actually in place. That is why, NGN is different.

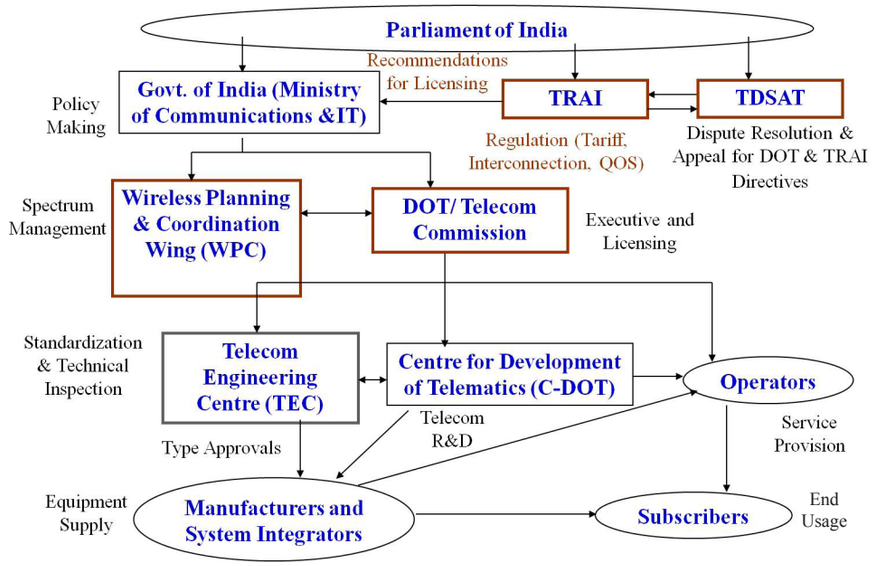
REGULATORY IMPLICATIONS OF NGN



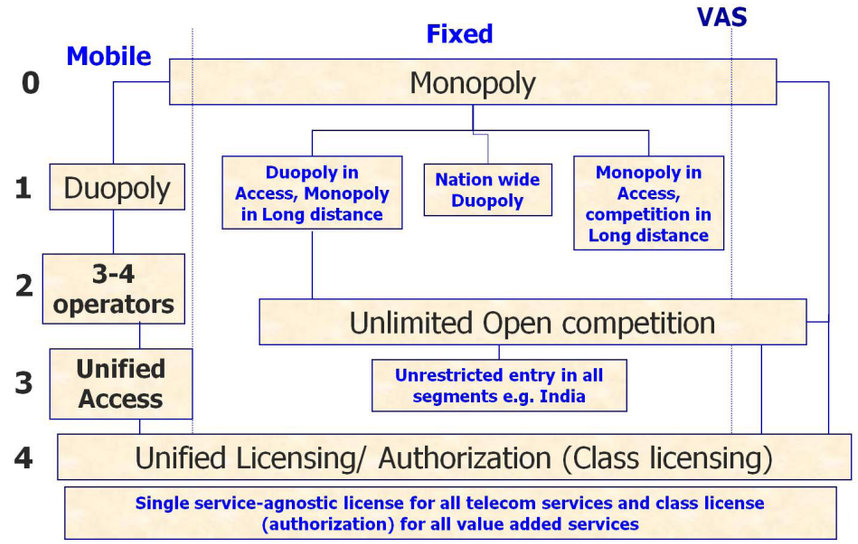
Core policy areas

- Competition (level-playing field), Interconnection
- Consumer (QOS, privacy, emergency access)
- Security & legal interception
- Scope for light-touch regulation

INSTITUTIONAL FRAMEWORK FOR INDIAN TELECOMMUNICATION



PROMOTING COMPETITION IN PHASES



Type of Service	Service Area	Connectivity with PSTN	Entry Fee	Annual License Fee (% revenue share)
ILD	International	Full PSTN/PLMN Interconnection	Rs.25 million	6%
NLD	National	-do-	Rs. 25 million	6%
Unified Access (Fixed and Mobile) (UASP)	Circle	-do-	Different for each Circle (Rs. 16 billion for all India)	Type A - 10% Type B - 8% Type C - 6%
VSAT	National	No Interconnection	Rs. 3 million	6%
Internet Service Providers	National, Circle wise	-do-	Rs. 2 Million (All India)	Nil (6% for Internet Telephony)
Public Mobile Radio Trunked Service	City wise and Circle wise	Limited One way	Nil	5%
Infrastructure Providers Cat I	National	NA	Nil	Nil
OSP (Other Service Providers)	Site Specific	Application services	Nil	Nil

SALIENT FEATURES OF EXISTING REGIME

- Unified Access (technology-neutral) — Coexistence of Mobile (GSM/ CDMA), Fixed, Voice, Data
- Very low termination rates (< 0.5 cent/min) (same for fixed and mobile)
- Very low carriage charges (0.5-2 cent/min)
- Very low mobile tariff (1 cent/min)
- Very low long distance tariff (2 cent/min)
- Very low voice ARPU (4 US$/month)
- Very low Broadband charges (5 US$/month)
- Low rural tele-density (< 35%)
- Highest Mobile additions per month- (> 15 million)
- Overcapacity for international bandwidth (17 Tbps/ 500 Gbps)
- Wide spread national backbone (12 lakhs Km)
- Dominance of wireless access (950 million mobiles vis-à-vis 37 million wirelines)
- Large cable TV homes population- (105 million).

NGN - A SWOT ANALYSIS

Strengths of present licensing framework

- Open unrestricted competition in all segments (including mobile)
- Access service provision unified (broadband, triple play, internet telephony permitted in addition to voice, fixed/ mobile/ WLL)
- General technology-neutrality (technology option left to operators)
- General tariff forbearance (Except leased lines where competition is not enough)
- National Broadband Plan (NBP) in place for creation of NOFN.

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- Access service provision unified (broadband, triple play, internet telephony permitted in addition to voice, fixed/ mobile/ WLL)
- General technology-neutrality (technology option left to operators)
- General tariff forbearance (Except leased lines where competition is not enough).

Weaknesses and Challenges

- Multiple regulatory agencies - licensor (DOT), spectrum management (WPC), technical regulation (TEC), interconnection, tariff & QOS regulation (TRAI), dispute settlement (TDSAT), Security Agencies, Competition Commission.
- Non-unbundling of local loop (no competition for DSL based broadband)
- Unidirectional ,Analog Cable TV infrastructure
- Legacy interconnection regime (Minutes of Usage, MOU based), CPNP (Calling Party Network Pays)
- General Resellers (non-facility based operators) not permitted
- Value-added service providers (ISPs) not treated as interconnection entity
- Unrestricted VoIP not permitted yet for ISPs
- No Functional Separation Regime.

Opportunities/Benefits

- Large unmet demand for telecom services (Rural tele-density< 25%, Broadband penetration - 1%)
- Mobile coverage still 65% (semi-greenfield environment to expand)
- Rationalization of network resulting into simplicity and reduced OPEX
- Network expansion by using future- proof technology (NGN)
- EX-ANTE regulation for NGN to remove uncertainties
- Involvement of industry in various issues fully in a pro-active manner
- Bring Quad play services to rural area (bridge digital divide)

Threats/ Risks

- Standards and interoperability issues yet to be settled
- Technical challenges in Emergency access/ Security monitoring
- High CAPEX without guaranteed corresponding increase in ARPU
- Project oriented risks due to huge scope and costs in migration.

NGN - CONSULTATION PROCESS - INDIA
ISSUES FOR CONSULTATION

- ‘Light-touch’ v/s ‘Tight’ regulation or regulatory withdrawal (hands-off, forbearance)
- Ex-ante v/s Ex-post regulation
- Level-playing field issues — Service-based competition, Network-based competition, Access competition
- Regulatory incentives — standardization, transition time-table, special rate of return, alternate access paths, special concession for deployment in rural areas
- QOS regulation for NGN
- Interconnection regime in NGN context — interconnecting parties, interconnection products, types of interconnection, basis for charging, interconnect exchange
- Mandating for emergency access — 100, 101 etc
- Security aspects of NGN — Adherence to requirements for Legal Interception and Monitoring (LIM), Encryption.

NGN - CONSULTATION PROCESS - INDIA
FINDINGS FROM PUBLIC CONSULTATION

- Lack of awareness about NGN and need for training/ educational programmes
- Lack of enough infrastructure for considering any service based competition
- Need for a single licence to provide all services (data, voice, broadcast through same network)
- Need for detailed consultation on interconnection issues and

QOS regulation in NGN environment

- Need for accelerating the Broadband penetration for access migration
- Need for deliberations on technical and standardization issues with special reference to interoperability, emergency access and legal interception and security monitoring
- Need for cross-industry collaboration under the aegis of regulator to deliberate upon time table for NGN migration as well as interconnection issues(NGN-eCO).

NGN - REGULATORY CHALLENGES IN EMERGING MARKETS

- Death of distance and blurring of the traditional boundaries between Access (local) providers and long distance carriers.
- VOIP as a “disruptive technology” putting a challenge for the regulators to perform a balancing act in maintaining level playing field.
- On-going technological developments causing drastic impact on the telecom scenario forcing a re-look at the service based licensing and geographical area based regulatory regime including Numbering systems.
- Level playing field issue between the licensed telecom operators and value added service providers.
- Need for new interconnect products based on capacity and quality (V&V) in place of those based on distance and duration (miles & minutes).
- Access to emergency services like police control room, fire services, medical help etc. (PSAP, E 911 (US), 999 (UK), 100 (India))
- Security monitoring like legal interception & monitoring (LIM), wiretap, CLI etc.

UNIFIED LICENSING REGIME - RECOMMENDED

Three categories of licenses:

- *Unified License* - All Public networks including switched networks, irrespective of media and technology, capable of offering voice and/or non-voice (data services) including internet telephony. Examples: Unified Access Service, NLDO, ILDO, Broadcast (eg. DTH, FM Radio, TV Broadcast).

- *Class License*- All services including satellite services which do not have both way connectivity with Public network. (The concept of niche operators is being included to promote growth of telecom services in rural/remote/backward areas from tele-density point of view).

- *Licensing through Authorisation* - Services for provision of passive infrastructure and bandwidth services to service providers, Radio Paging, PMRTS and Internet Services.

MAJOR OPERATOR’S APPROACH TOWARDS NGN

Five-Fold Migration Approach

- Create nationwide IP-MPLS backbone network (Fiber-based, Packetisation)
- Create access agnostic Metro Area Networks (MAN) (subscriber access capable of convergent voice, video and data services over DSL, Optical Ethernet and Wireless technologies)
- Implementation of VOIP based Class 4 services (Packetize Trunk Switches)
- Implementation of Class 5 services over packet network (Packetise Access Switches)
- Offer Multimedia/ Triple play services including VOIP and IPTV to Broadband subscribers .

CONCLUSION-

NGN REGULATORY ECOSYSTEM FOR EMERGING MARKETS - REGULATORY REFORMS V.2

A converged regulator for ICE (single regulator for Telecom, IT & Broadcasting)

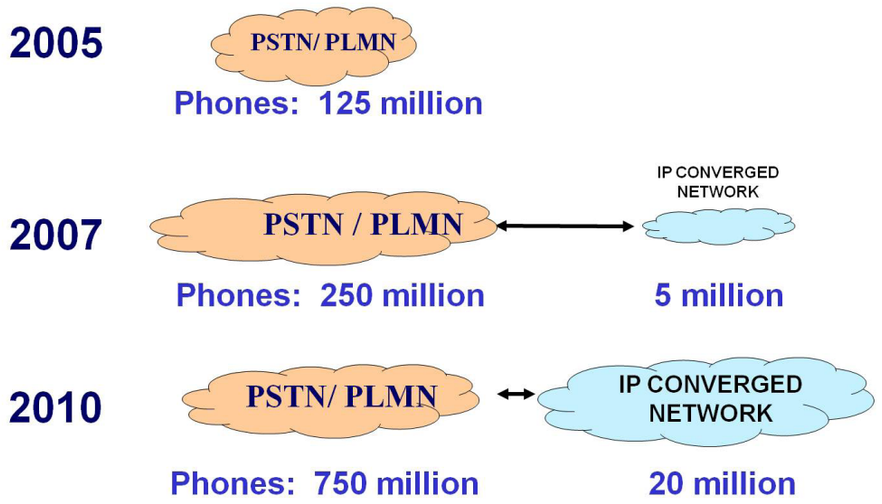
A single technology-neutral, service-agnostic license (one license - one network — all services) to facilitate Convergence and Efficiencies of scale

A Class Licensing Regime (Authorisation/Registration) for Value Added Services to facilitate Innovation

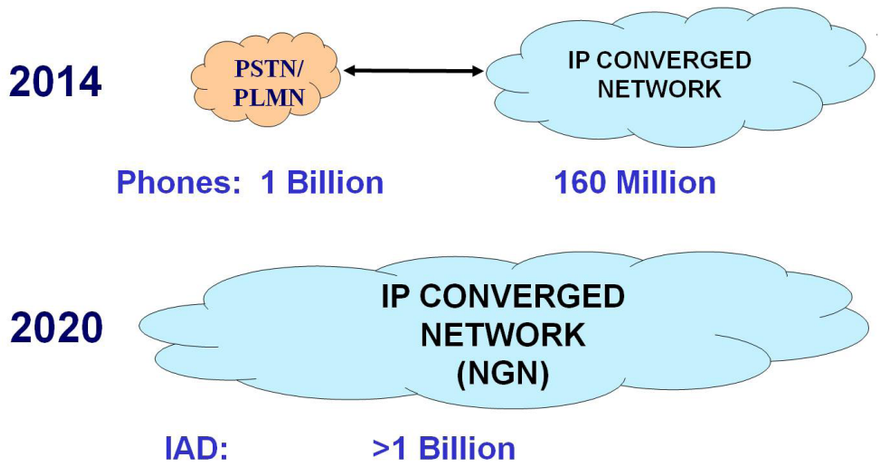
A cost of capacity based, open access, interconnect regime and light handed regulation to promote Competition and Investments

Functional Separation to encourage full infrastructure sharing in open manner and to unlock the potential of existing assets to promote Co-Opetition.

NEXT GENERATION NETWORK - VISION INDIA



TELECOM NETWORK VISION - INDIA



CHAPTER THREE

NGN Interconnection- Challenges and Way Forward

AGENDA

Basic NGN Architecture

Core Regulatory Issues in NGN

Interconnection Challenges

Legacy Interconnection Regime

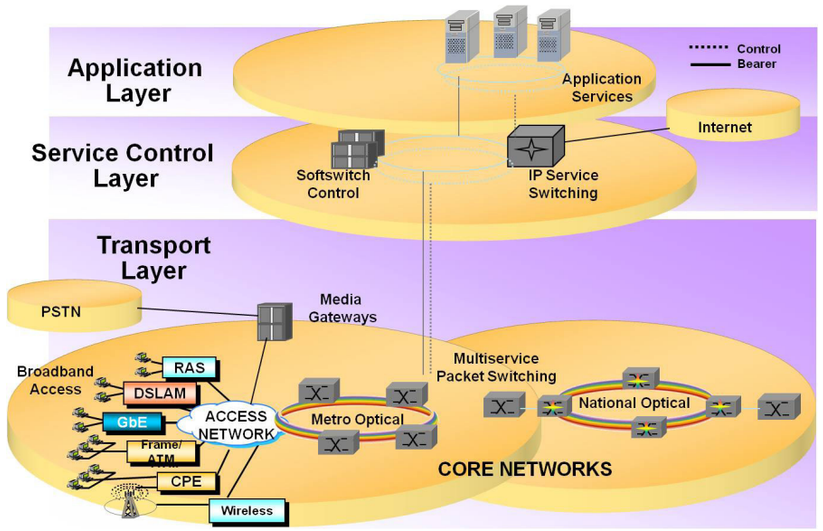
Interconnection in NGN

Interconnect charging in NGN- CBC

Technical Issues for NGN Migration- IX

Conclusion- Way Forward

IP-BASED NGN - A LAYERED ARCHITECTURE



IMPLICATIONS OF NGN - SOMETHING FOR EVERYONE

Different implications for different shareholders

- *Incumbent* —new revenue streams, opportunity of maintaining market share, better margins resulted from efficiency and cost reduction, competition.
- *New players* — new business models, opportunity resulting from converged environment, easy and timely interconnection.
- *Consumers* — more choices, “one stop service provider”, lower tariff, faster provisioning, application control, single bill.
- *Policy makers and Regulators* — converged paradigm, innovative approach to regulation— balancing between innovation, investment and competition, security issues, Interconnection charging issues

INTERCONNECTION - GENERAL DEFINITION

The physical (technical), logical & commercial linking of networks established by the same or a different operator in order to facilitate the users of one operator to communicate with the users of the same or another operator to access services provided by the operators involved or other parties who have Access to the telecom network.

INTERCONNECTION REGIME IN LEGACY SYSTEM

- Concept of “Seeker and Provider”
- Revenue Share based on “Work Done” principle
- Inter-operator charging based on “minutes and miles”
- Causal Principle-Calling Party Network Pays
- Determination of Interconnect Usage Charges (IUC), Setup Costs, Port Charges based on costs of “Unbundled Network Elements” (UNE)
- Need for complex bilateral Interconnect Billing and Settlement system (IBS).

LEGACY INTERCONNECTION - SEEKER AND PROVIDER

- *Interconnection Provider* means the service provider whose network an interconnection is sought for providing Access.

- *Interconnection Seeker* means the service provider who seeks Interconnection to the network of the interconnection provider.

COMPONENTS OF INTERCONNECT USAGE CHARGE (IUC)

There are three main elements of the cost based IUC per minute:

- *Origination Charge*: The amount that is to be retained by the originating network of the call
- *Termination Charge:* To be paid to the network termination of the call.

- *Carriage Charge* The charge for long distance carriage or transiting the call through the network of the Long Distance Carrier.

INTERCONNECT USAGE CHARGES (IUC)
LEGACY METHODOLOGY

- Cost of Upgradation/modifying interconnecting networks to be met by Interconnection seeker .

- General Principle followed shall be that each party bears the INCREMENTAL COST incurred for the additional facilities required for meeting QOS Standards relating to its outgoing traffic to the other party.

TRADITIONAL COST ALLOCATION METHODOLOGY
UNE (UNBUNDLED NETWORK ELEMENTS)

Separation of access and core networks
- volume-based traffic costs and fixed access charges

Core network cost allocation via service routing tables;
- routing tables define network element usage by service
- cost volume relationships determined for each network element

Separation of Fixed Common and Joint Costs
- recovered via a relatively small mark-up

EVOLUTION IN IUC COSTING METHODOLOGY
LONG RUN INCREMENTAL COSTS (LRIC)

- Estimates the incremental cost of providing the service under interconnection defined as the total cost when the service is provided less the cost when the service is not provided (Incremental)
- By measuring over the long run, infrastructure investment is variable rather than fixed and can be matched to capacity
- If common costs are to be recovered, then a mark-up is required

- LRIC can be used with top down or bottom up models and typically uses current or forward looking costs
-

INTERCONNECTION ISSUES IN NGN DOMAIN

- Interconnection Parties-Who pays whom?
- Types of Interconnection- At what layer?
- Interconnection Products- For what?
- Basis for Interconnect Charging- Usage or capacity?
- Costing Methodology- Current or Forward looking costs?
- Interconnect Exchange- Common point of interconnect ?

INTERCONNECTION CHARGING IN INTERNET (IP) DOMAIN

- Bilateral Peering basis
- No concept of “Seeker and Provider”
- Death of Distance (No minutes and Miles)
- Bill and Keep or Sender Keep All (SKA)- Barter approach
- Capacity Based Interconnection Charging (CBC)

INTERCONNECTION CHARGING IN IP DOMAIN

Four main basis for Interconnect charges in IP based regime:

- ***Calling Party’s Network Pays (CPNP)***
  Network that initiates the call pays for the call, usually based on the duration of the call.

- ***Bill and Keep (Senders Keep All)***
  No charges for termination, a kind of barter system used in Internet, too revolutionary for NGN

- ***Based on Capacity and Quality of Service/Experience***
  Capacity of the Interconnection Links and Commitments (SLA) for Quality of Service

- ***Bulk Basis (‘Interconnect Hotel’ IX)***
  Charging of applicable Interconnection charges on bulk usage basis rather than per minute basis which is prevalent currently

INTERCONNECTION IN NGN - MAIN QUESTIONS

- How the inter-operator IP Networks and circuit switched networks with IP networks will Interconnect?
- How the Inter-working of Signalling between IP based networks and circuit based networks will happen?
- How the Settlement for IUC (Interconnect Usage Charge) will take place?

NGN INTERCONNECTION - CHARGING OPTIONS

- Technology neutral interconnection charging system based on capacity instead of traditional method of time and distance but still being CPNP (Calling Party Network Pays)
- Capacity based interconnection is one where operator may request a specific capacity for interconnection and pays flat rate charge that reflects the fixed cost (Capex) nature of interconnection capacity and also O&M Charges which are not Usage dependant.
- Bill and Keep (SKA, Sender Keeps All)

NGN INTERCONNECTION - CHARGING OPTIONS

- Present concept of charging in PSTN/PLMN is based on work done, cost basis, distance and time-duration of call.

- IP Networks may require many more feature for charging:

1. Charging based on call duration, bearer capability, time etc.
2. Charging based on QoS, bandwidth, application etc.
3. Chargeable party (calling, called or third party).
4. Charging of supplementary and value added services.

INTERCONNECTION ISSUES IN NGN DOMAIN

Volume Based

- User pays per kbit/s or Mbit/s of data sent or received
- No charge if link not in use — not time related
- Pay in additional for content e.g. video, music
- Charging methods Only per kbit/s Bundles of X- MB per month

Event Based

- User pays per event, current examples are per SMS, MMS, Song, Ringtone
- Off peak voice move to per event charge, e.g. retail on-net local, national calls
- Users have direct charging relationship with content providers
- Per event charging related to premium content, e.g. premiership football matches

Content/Value Based

- Targeting specific customers
- Based on demand, quality, customer loyalty
- Not necessarily linked to data volume or time on network
- Could be applied to event based model

NGN INTERCONNECTION - DURING TRANSITION

- If all the service providers migrate simultaneously to NGN then there will be least implications.
- But in reality, This will be continuous process, one operator will migrate to NGN early other will follow…
- Therefore TDM-NGN-TDM have to coexist for quite some period.
- Need for a Pragmatic Hybrid approach during migration.

NGN CHARGING CHALLENGES

NON- APPLICABILITY OF TRADITIONAL COST ALLOCATION METHOD?

- ***Extrapolation of a current model can work but only for a short while.***
  - Assumes costs of NGNs should not be greater than Circuit
  - Switched networks
  - Ignores NGN structural changes in the industry

- ***New Costing Models Required***
  No charges for termination, a kind of barter system used in

- ***New Costing Models Required***
  - But what sort of model for what sort of network?
  - How can regulators determine efficient network design when the operators themselves are not sure?
  - Top-down models based on operator accounts and busi ness plans are needed to provide reality-check to any regu lator to ensure reward for innovative investment and to pro vide fair ROI.

NGN INTERCONNECT - CHARGING OPTIONS

EBC V/S CBC

- In the developing world, the CPNP model is commonly used for Interconnection charges. It can either take the form of Element Based Charging (EBC, UNE) or Capacity Based Charging (CBC).
- The main distinction between EBC and CBC is that, under the latter, system bandwidth is being bought in advance by competitors. Therefore in CBC Investment Risk of "Provider" can be covered.
- Usually, the efficient costing is EBC based and consist of LRAIC plus a mark-up for common costs including an appropriate rate of return on capital employed (WACC).

NGN CHARGING OPPTIONS - BILL AND KEEP

- The Bill & Keep principle also known as Sender Keeps All (SKA) is mainly applied for Internet traffic and to some extent to voice traffic interconnection (mobile sector in the USA and previously in France, local interconnection in New Zealand).
- In this interconnection, services costs are confined to capacity costs used by each carrier to carry the traffic to be terminated in the competitor network.
- This method is suitable under the assumption that the traffic between carriers is symmetric, which is not always the case.
- Moreover, in the case of NGNs, the symmetry requirement should be met for each QoS class.

- Another option can be if investment costs in QoS can be recovered through retail tariffs (Internet).

Bill and Keep - Advantages

- Reduced need for regulatory intervention and consultation efforts.
- Regulatory costs can be reduced, for example those of determining the "right" IUC specially, the termination charges.
- No termination monopoly problem under Bill & Keep and positive network externalities are internalized.

Bill and Keep - Shortcomings

- "Hot potato" problem: Operators attempt to hand over their traffic to another network for termination as close to the point of origination as possible.
- The "hot potato" problem entails underinvestment, but could be solved by requiring a minimal number of POIs under rollout obligations.
- The assumption of symmetry of traffic between interconnecting operators is not true for real life voice communications.
- Therefore the use of "B & K" option is considered too revolutionary at this stage and can not be adopted for NGN interconnection presently .

NGN CHARGING : A COMBINATION OF OPTIONS

- In the case of a multi-service IP-network like NGN, there is a certain rationale in combining options either as a function of :

  a) Service or QoS classes (Application layer) or
  b) Network layer (Access vs. Core network).

Option a) implies that it is required to unambiguously distinguish between different services and that usage of services can be measured and even transport them separately. It is also possible to apply different regimes to different QoS classes (example: Best effort vs. Defined QoS).

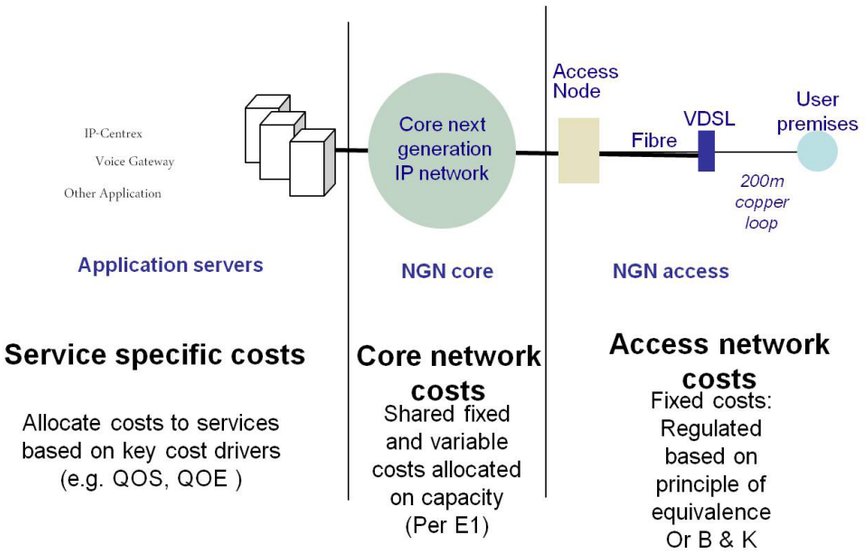
Option b) implies that Different Interconnection regimes are used for different network levels.

A "two-level" hybrid regime could be implemented :

Bill & Keep on the access/backhaul level (between customer and point of interconnection), and Capacity based Charging for transit in the core network.

However, in this approach, the minimum number of POIs should be mandated for Rollout, at the access/backhaul level.

A HYBRID MODEL FOR NGN COST ALLOCATION



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NGN INTERCONNECTION - REGULATORY INTERVENTION

- What works will depend upon the various factors in play at the time and the manner in which the regulator wants the network to develop
- In India after public consultations in Jan 2006 the stakeholders in general expressed an urgent need for the creation of a high-level cross-industry coordination committee for smooth migration to NGN domain.
- A committee (NGN-eCO) was formed consisting of representatives from Licensor, Regulator, Service Providers, Vendors & Academia to examine all the relevant issues for smooth transition to NGN.
- The committee identified three important areas for possible regulatory intervention. Interconnection, Licencing and Quality of Service.

CONCLUSION - WAY FORWARD

- The regulation on interconnection charges should play a facilitating role in removing barriers to the effective migration to NGN.
- Conventional system of Usage (minutes and miles) based interconnect charging will not work for NGN.
- Need for capacity based charging to recover Capex with reasonable ROI to cover Investment risk.
- Choice between CBC and SKA (Bill and Keep which assumes symmetric traffic).
- A hybrid approach of combination of methods can be applied to avoid the "Hot- potato" problem of Bill and Keep.
- Need for "Interconnect Exchange" for green field.

INTERCONNECTION IN NGN - TECHNICAL ISSUES

- Interconnection Architecture and location of Points of Interconnection (POIs).
- Technical Interface Functional Requirements.
- Signalling used for interconnection,
- Traffic measurement and Routing Procedures.
- Numbering, Charging, Switching & Routing for Interconnection in Multiple-Operator Multi-Service Networking scenario.
- Technical/ Network up-gradation or modifications to facilitate Interconnection.

Interconnection between two IP Networks

- SIP based NGN/IMS networks
- ToIP network (Telephony over IP) inter-working on SIP-I/ Q1912.5
- H.323/SIP VoIP international networks

Control Plane Interconnection

- The Call Control Server may not be located in the same Service Area
- If interconnection not in the same Service Area then who will bear the cost of carriage
- BICC/SIP-T/SIP-I inter-working yet to be proven as manufacturer's are implementing partially
- No National H.248 Standard
- Will there be NGN Interconnect service Providers to take care of NGN Federations?

Data Plane Interconnection

- No uniform implementation of RTP among manufacturers
- How to provide end to end protection from eavesdropping
- Interconnection interface E1s/T1s vs Ethernets(1Gbps, 10Gbps)
- Lawful Intercept shall be an issue as Media Path may not be fixed for each session

Application Plane Interconnection

- Few preferred Application Service Providers.
- Cartelization by the Access Service Providers.
- Creating access Bottlenecks - QoS differentiation by Access Service Providers.
- Access of Common Capabilities(services used by customers/applications e.g. Authentication) v/s Network Hooks (how common capability access network)

Interconnection of PSTN/ PLMN with IP Networks

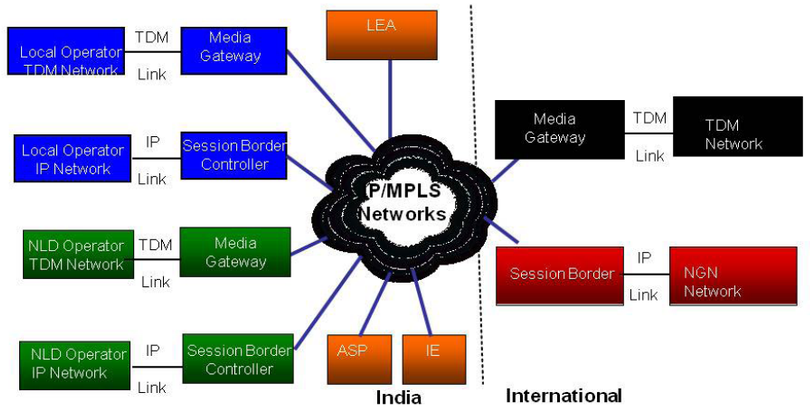
The PSTN/PLMN Uses;

- E.164 Numbers.
- Signaling is based on CCS-7
- The Media is transported using TDM
- The interconnect interfaces are E1/T1 or its multiples
- Intercept is based on 64Kbps/2Mbps Cross connect

Interconnection between traditional PSTN/PLMN networks with IP Networks

- Through Media Gateway- for IP to TDM or TDM to IP conversion and
- Signalling Gateway- for SS7 transport over IP using SIGTRAN protocol.
- The Signaling Gateway can be integrated with the Media Gateway or else can work in stand-alone mode.

NGN - PSTN INTERCONNECTION ARCHITECTURE



NGN - PSTN INTERCONNECTION ARCHITECTURE
SESSION BORDER CONTROLLER (SBC)

SBCs are located at the edge of a network for enforcing policy on multimedia sessions

SBC can perform a number of functions such as:

- Support for redundant physical interfaces
- Protocol Translation
- Inter-working and protocol interoperability between networks
- Network Security management
- Denial of Service attacks and overload control
- Network device resources and bandwidth control
- Network Address Translation and Firewall Traversal
- Lawful Interception
- Quality of Service (QoS) and SLA management
- Call accounting

NGN - PSTN POINTS OF INTERACTION

- It is common for both the peering partners to have TDM based switches at the POI locations.
- NGN with separation of control and transport/ distributed architecture/use of convergent core this restriction is irrelevant
- Should the NGN access operator be allowed to have the option of either centralized control point in its network controlling the distributed media gateways or SBCs within the service area?

NGN INTERCONNECTION - SIGNALING PROTOCOLS

The following standards based signaling protocols are expected to be supported by converged IP Network:

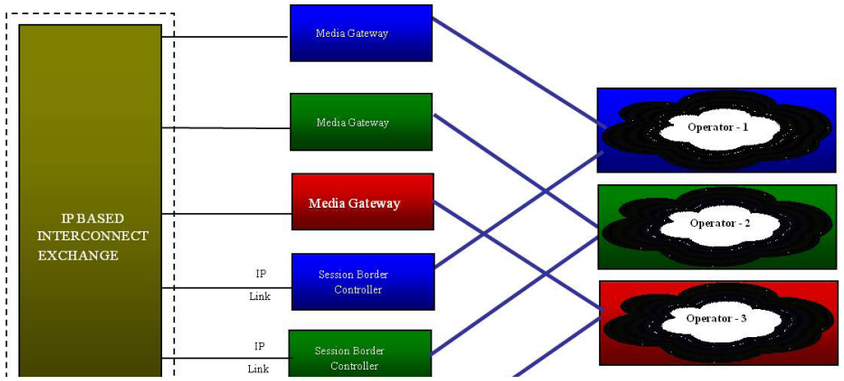
SIGTRAN	between PSTN/PLMN and IP networks
H.248	between Media Gateway and Media Gateway Controller
SIP,SIP-T/SIP-I	between two IP networks & between PSTN/PLMN & IP
H.323/SIP-T/SIP-I	For international connectivity
RTP/RTCP	For delivery of content (voice/data/video etc.).

NGN INTERCONNECTION -
NEED FOR INTERCONNECT EXCHANGE (IX)

Role of Interconnect Exchange- Simplification

- Simplification of interconnect process
- Inter-Carrier Billing clearing house
- Intelligent Network Services
- Number Portability
- Carrier Selection
- Rationalization of interconnect architecture

INTERCONNECT EXCHANGE MODEL



INTERCONNECT EXCHANGE - IMPLICATIONS

Concerns

- The current TDM based PSTN/PLMN follows a hierarchical topology and requires significant modifications/upgradation to comply with the required approach for IP based IX.
- Who will own it ? Who will pay for it ? Where it has to be located ?

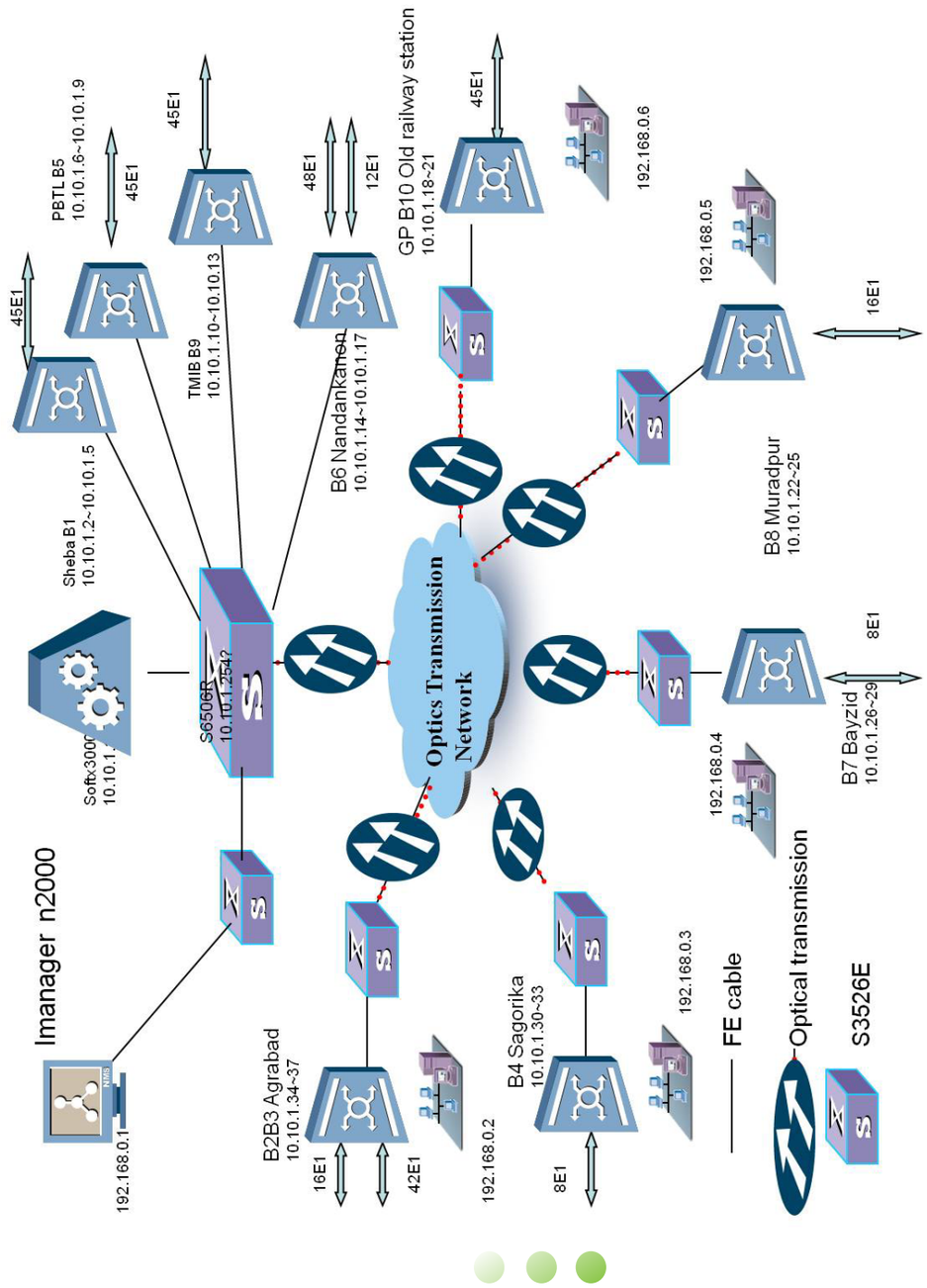
Way Forward

- For few years the existing interconnects regime should continue in parallel with IX.
- Use of IX must be promoted over the conventional regime.
- After some specified period, interconnection at IX may be mandated by licensor / regulator.
- Other issues may be country specific and decided through consultation.

SATYASPEAK

NGN IX - CHITTAGONG, BANGLADESH

AN EXAMPLE OF EARLY ADOPTION OF CBC IN DEVELOPING WORLD



CHAPTER FOUR

Emerging Trends in Next Generation Access (NGA)- Regulation and Innovative Financing Models

AGENDA

Next Generation Network Architecture — Layered approach

Next Generation Access (NGA)

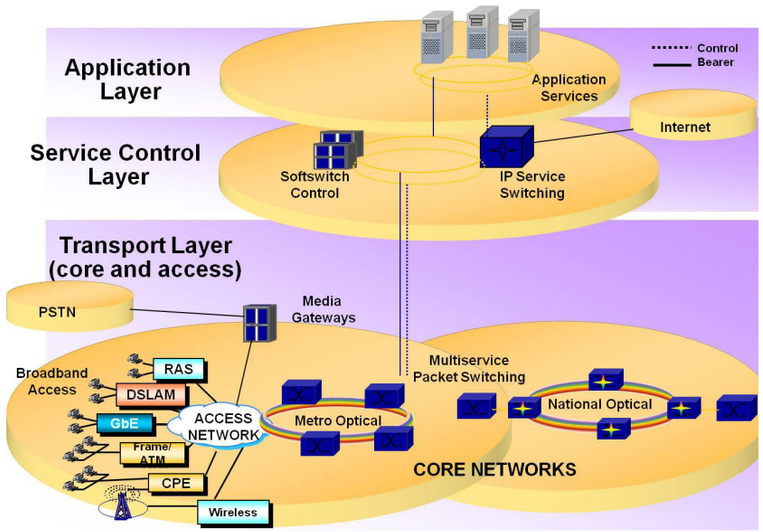
NGtA — Superfast Broadband

NGN Regulation — UK Approach

Enabling Policy for NGA

Innovative Financing Models for NGA

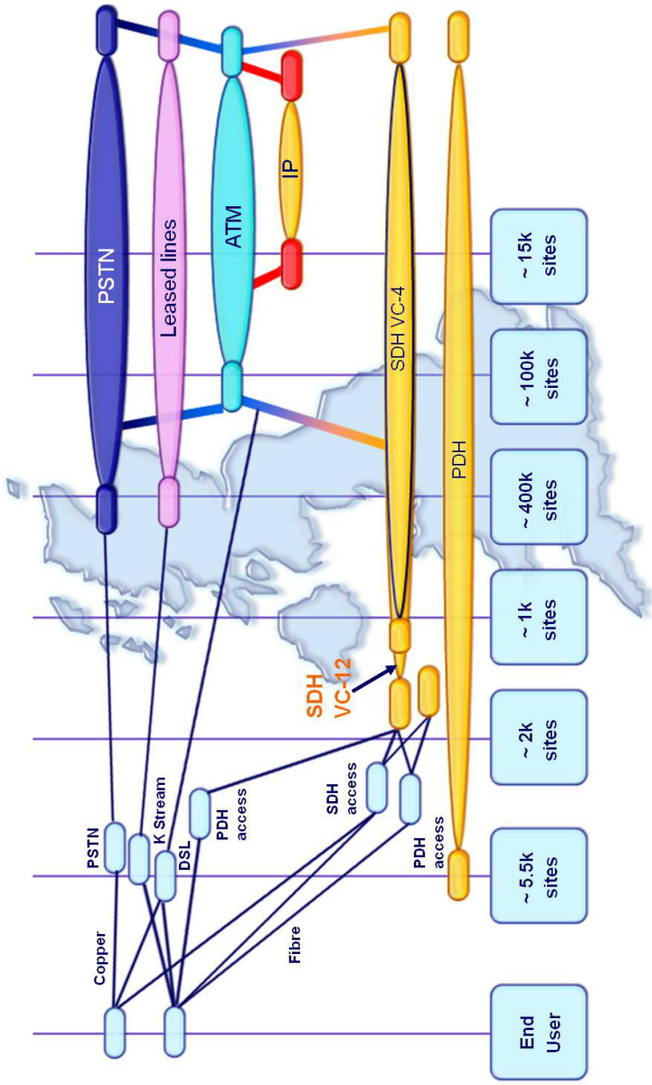
NGN - A LAYERED ARCHITECTURE
DISTRIBUTING INTELLIGENCE

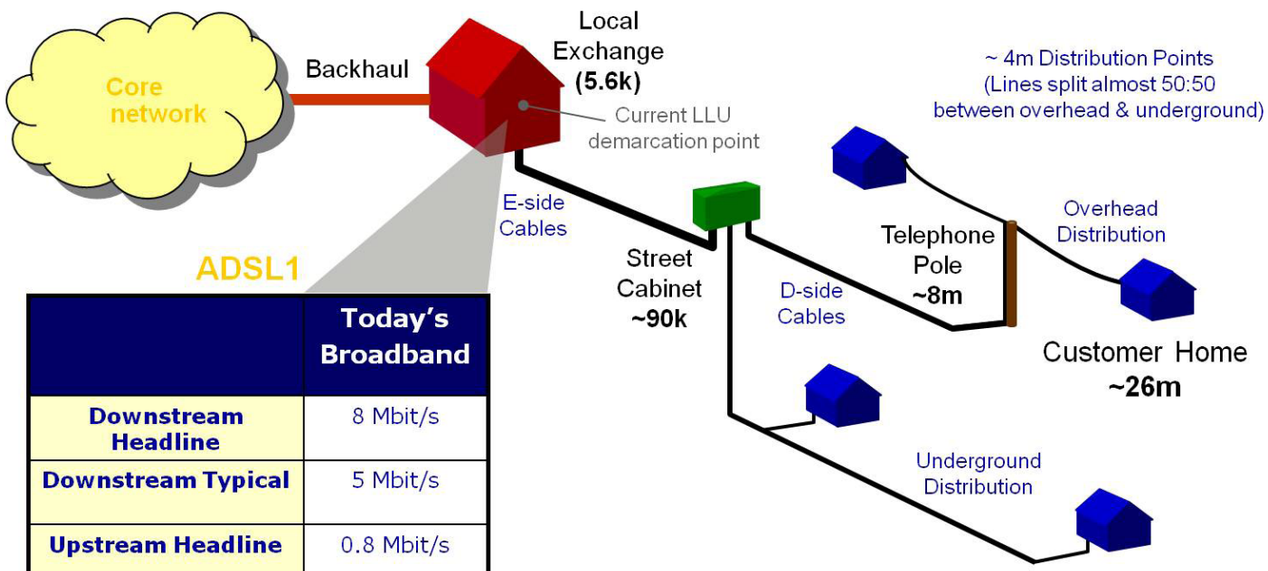


TECHNOLOGIES FOR NEXT GENERATION ACCESS (NGA)

	ADSL	ADSL2+	FTTC (+VDSL)	FTTP (All homes)
Downstream Headline	8 Mbit/s	24 Mbit/s	40 Mbit/s	100 Mbit/s
Downstream Typical	5 Mbit/s	10 Mbit/s	20 Mbit/s	50 Mbit/s
Upstream Headline	0.8 Mbit/s	0.8 Mbit/s	10 Mbit/s	30 Mbit/s
Upstream Typical	0.4 Mbit/s	0.4 Mbit/s	5 Mbit/s	15 Mbit/s
Cost of Deployment			£200 → £400/line	~£600/line
Regulatory Impact				Regulatory issues to be resolved

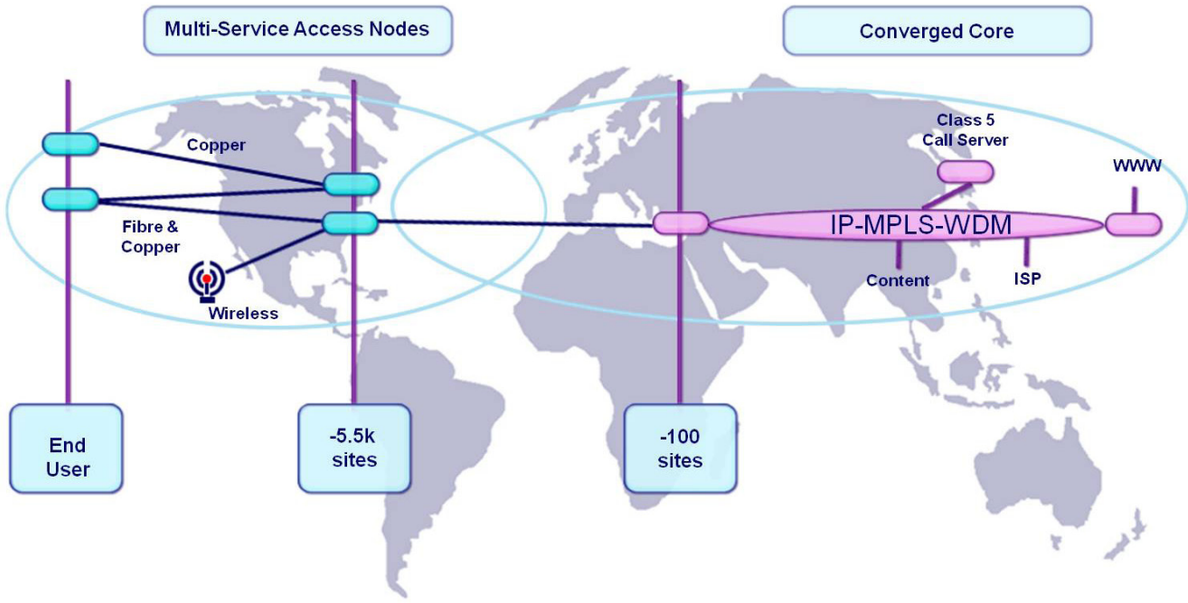
UK - BT'S LEGACY NETWORK





ADSL1

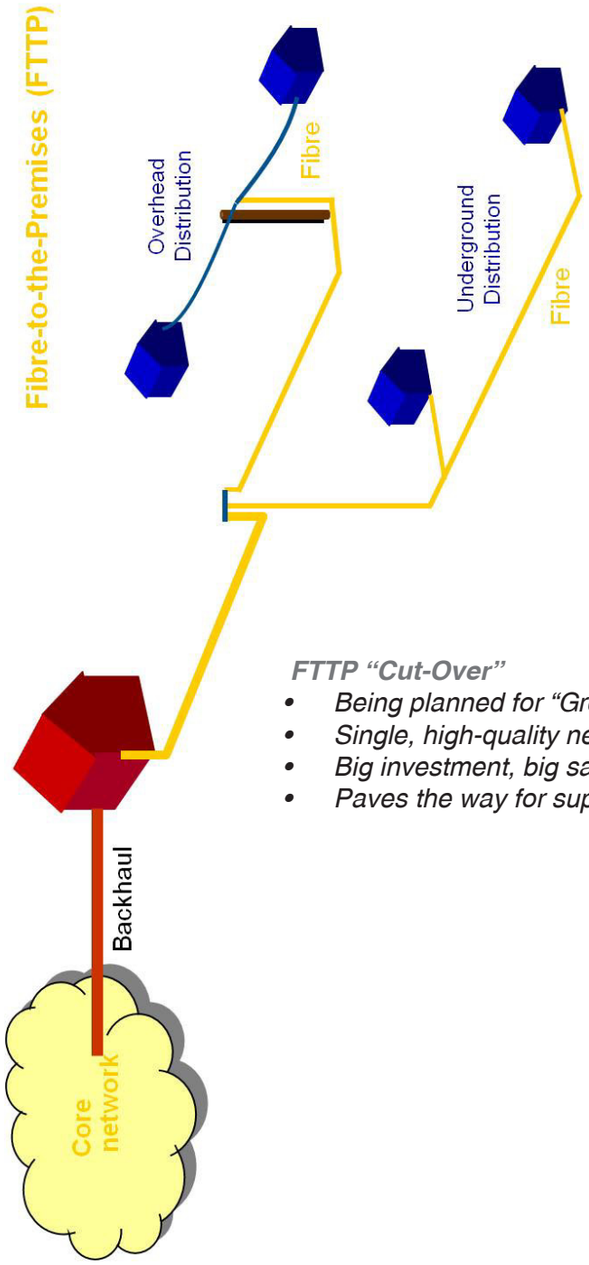
	Today's Broadband
Downstream Headline	8 Mbit/s
Downstream Typical	5 Mbit/s
Upstream Headline	0.8 Mbit/s
Upstream Typical	0.4 Mbit/s



SATYASPEAK

EMERGING TRENDS IN NGA REGULATION AND
INNOVATIVE FINANCING MODELS

UK - ACCESS TOMORROW



FTTP "Cut-Over"

- *Being planned for "Greenfield"*
- *Single, high-quality network*
- *Big investment, big savings*
- *Paves the way for super fast future…*

NEW ERA OF NGN REGULATION
PROMOTING INVESTMENT AND INNOVATION

- BT's Undertakings offered in lieu of reference to Competition Commission in September 2005
- Regulation focused on bottlenecks-Access and Backhaul for SMP
- Incentive to invest in NGA and Innovate
- Expectation of reduced regulation downstream
- Promote infrastructure-based competition
- Benefits the consumers, operators and economy- Maximising the Societal Welfare
- Incumbent to compete fairly on a level playing field with new entrants.

REGULATION AND NGN - KEY ISSUES

INVESTMENT - 'REGULATORY CERTAINTY"

NGNs are driven (in part) by cost savings

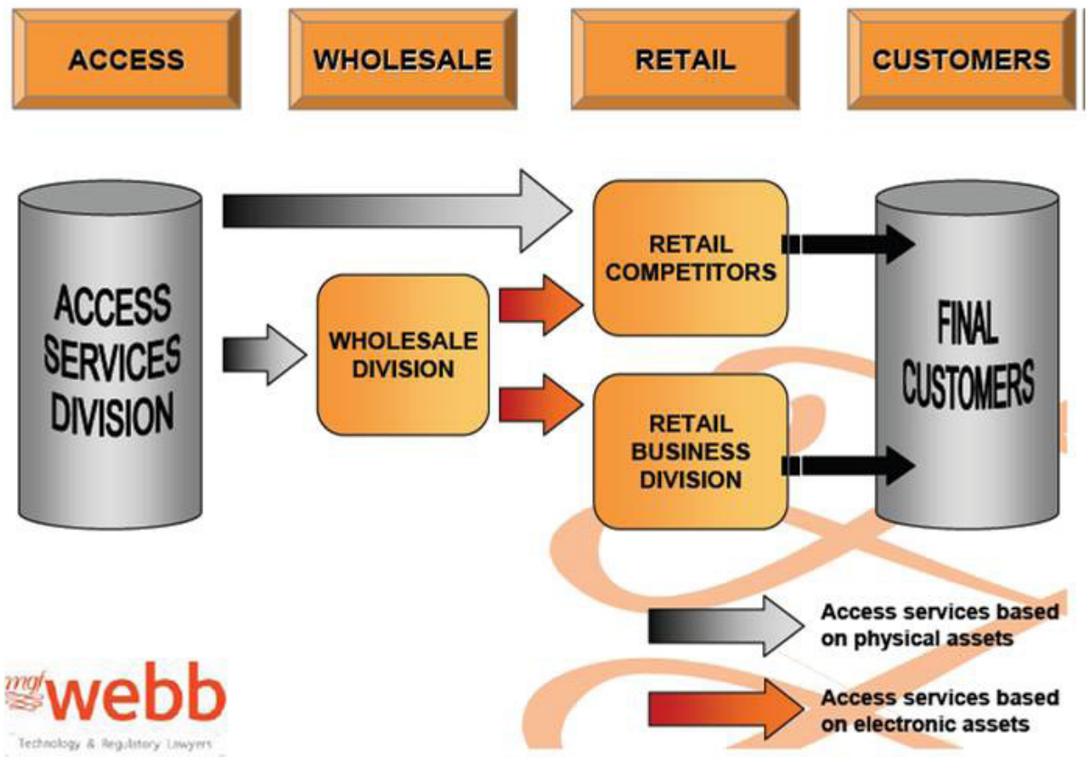
- Investment requires demonstrable shareholder value.

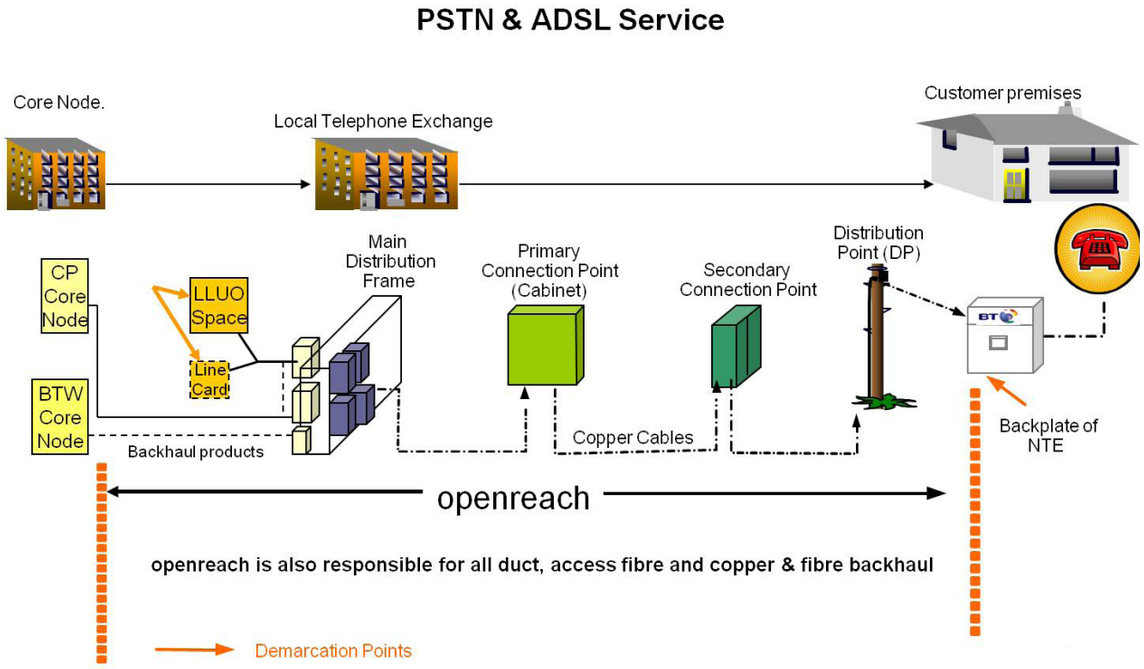
Regulators face a difficult challenge

- No one can "build it and they will come" on revenue bet
- NGNs/NGAs are disruptive to traditional boundaries
- They challenge past regulatory assumptions(e.g. thin & dispersed vs. fat & fewer interconnect, minutes & miles vs. capacity & QOE).

Regulation needs to become simpler

- Requires collaboration amongst incumbents, regulators and Competitive communications providers.
- Over regulation could restrict converged service innovation.





EMERGING TRENDS IN NGA REGULATION AND
INNOVATIVE FINANCING MODELS

NEXT GENERATION BROADBAND
A BOLD VISION FOR THE UK

- UK's biggest super fast broadband investment (£1.5 bn by Govt.)
- Accessible by up to 10 million homes by 2012.
- Range of speeds up to 100mbps: with >1,000mbps potential .
- Basis for nationwide demand led roll out.
- World's most open super-fast network.

UK - NGA BUILDING ON SUCCESS

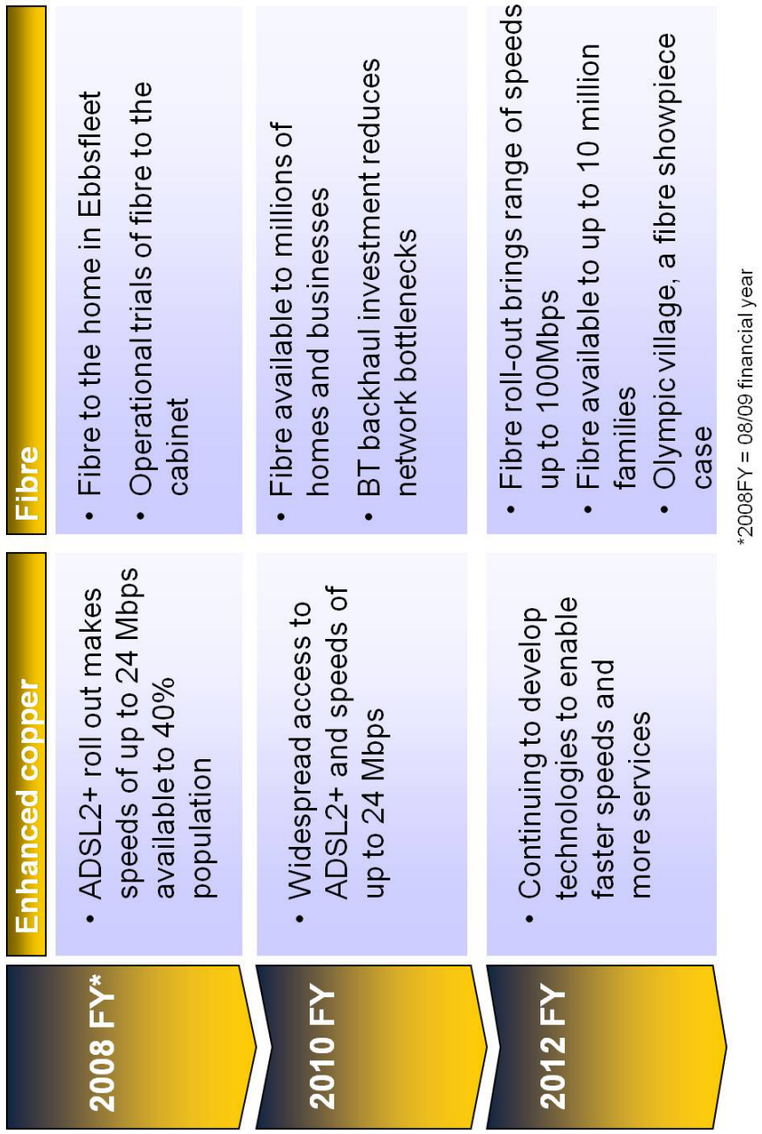
UK has world leading availability and take up

- BT's multi-billion pound investment has ensured everyone can be part of the broadband revolution
- 10 million kilometers of fibre already in the network.
- 120,000 businesses have fibre to the premises.
- 10 million people work from home using broadband.
- Higher take up in rural areas than in cities.

…and provides massive choice to consumer

- Massive customer choice from 200 ISPs.
- Among the lowest prices in the world.
- Opportunity to learn from the experience of others.
- All fibre based services from BT will be wholesaled to other ISPs.

THE NEXT CHAPTER
A MIXED ECONOMY MODEL



*2008FY = 08/09 financial year

TODAY…

Fast internet…

Instant messaging…

VoIP…

IPTV…

iPlayer…

…But growth of simultaneous usage raises potential peak bandwidth issues for the future

TOMORROW…

Multi viewing High Definition TV...

Advanced High Definition gaming experience…

High Definition video conferencing, Cloud computing,Telepresence

'A world of new possibilities from super-fast broadband (up to 100Mbps)…

…Assured high quality experience even with simultaneous usage of all new high speed applications and services

- Bringing big business fibre services to smaller businesses: speeds > 1 Gigabit

- Improved choice in access speeds providing UK businesses with a competitive edge

- Two way speed allowing collaboration across locations between customers and suppliers

- Improved flexibility in remote and home working, cloud computing

REMOVING THE BARRIERS TO INVESTMENT
NEED TO HAVE

- chance to earn a fair return through cost plus tarrifs
- principle based regulation that avoids red tape
- removal of outdated rules, such as having to deploy copper cables in parallel to fibre
- assurance that other Operators will also wholesale their fibre services
- freedom from responsibility for other operators' past investment.

ENABLING POLICY INITIATIVES FOR NGA

- Allowing wholesale pricing flexibility- Enabling ROI appropriate to risks
- Minimizing inefficiencies in Network Design- Forbearing Technical Regulation, Technology- Neutrality
- Supporting use of new and more flexible wholesale services
- Safeguarding the opportunity for further infrastructure based competition
- Symmetric Regulation for all new infrastructure
- Setting up of National Internet Exchange (IXP)
- Utilization of USO/Public fund for National Broadband Network/Alternate Telecom Network (ATN)
- Functional separation of Bottleneck Infrastructure from service provision
- Capping the cost of international connectivity
- Removing any restriction on VOIP.

CONCLUSION - INNOVATIVE FINANCING MODELS

- Fast speed Public funding of NBN/ATN through USO (Universal Service Obligation fund) - USA, UK, Australia, Singapore, Korea, Srilanka, India and New Zealand.
- Public Private Partnerships — collaboration between government and private agencies
- Active infrastructure sharing-Shared LLU, Bit Stream Access, Active Loop Access, BSC, Backhaul Sharing, Franchising
- Bundling of CPE with Service offering
- Functional Separation of SMP-Unlocking the Potential and Turbo-charging the Utilisation
- Managed services (Outsourcing), Capex-Opex conversion/ Vendor financing, BOLT,BOO,EaaS (Everything as a Service).

CHAPTER FIVE

Creation of National Broadband Plan (NBP) for Emerging Market- NOFN India

AGENDA

Introduction— Broadband Definition

Facilitating Regulation for Broadband

—Roadblocks for Broadband

—Govt's Role in promoting Broadband

—Enabling Regulation for Broadband

National Broadband Policy India— Technology —Neutrality

National Broadband Plans— Developed and Emerging Markets

Recommendations for NBP, India Dec 2010

Creation of NBN India — NOFN Implementation Strategy

Conclusions

INTRODUCTION

Broadband - Broad Definition

- Generally, Broadband describes high speed, high capacity data communication making use of DSL, Cable Modem, Ethernet, Fixed Wireless Access, Optical Fiber, W-LAN, V-SAT etc.
- There is no specific international definition for the Broadband though there is a common understanding among developing countries that it should be better than ISDN.
- As per Broadband Policy 2004, Broadband in India was defined as:

> *"'Always-On' data connection that is able to support various interactive services including Internet access having the capacity of a minimum download speed of 256 Kbps to an individual subscriber form the Point of Presence of the service provider. "*

(This definition has already started showing up its limitations and has been recommended for upward revision to 512 KBPS immediately and upto 2 MBPS in the near future)

TARGETS FOR INTERNET AND BROADBAND PENETRATION IN INDIA

(BROADBAND POLICY 2004)

Year Ending	Internet Subscribers (in million)	Broadband Subscribers (in million)
2005	6.0	3.0
2007	18.0	9.0
2010	40.0	20.0
Dec. 2011 (Actual)	50.0	13.0

ROADBLOCKS FOR BROADBAND

Price

- Price for broadband access @ Rs. 300 (USD 6) per month — still unaffordable to masses

Access to the customer

- Lack of access to the incumbent's copper loop for DSL by competitors.
- Low quality of cable TV infrastructure and lack of industry organization.
- High costs for DTH and VSAT access.
- High spectrum costs making wireless based access unaffordable to masses.
- Cumbersome and expensive processes for Right Of Way (ROW).

Cost of Connectivity

- Lack of effective competition in the "within city"/ last mile access networks
- High costs of international bandwidth
- Ineffective implementation of National Internet Exchange of India (NIXI)
- Absence of National Broadband Backbone

FIscal Policies

- High taxes and duties, and lack of fiscal incentives for faster Broadband growth

Content and applications

- Lack of locally relevant content and absence of "change agent" to drive growth

GOVT'S ROLE IN PROMOTING BROADBAND

- Creating the right policy environment by removing entry barriers.
- Creating National Broadband Backbone infrastructure with Open Access.
- Establishing Internet Exchange in the country.
- Permitting Unlimited Service Based Competition for Broadband.
- Encouraging International players to setup Gateways in the country.
- Funding community investment in Broadband in uneconomic remote rural areas.
- Leveraging Govt's own demand and setting example by being on-line leader.
- Extending special tax concessions for equipments, access devices & services used for Broadband.

ENABLING REGULATION FOR BROADBAND

- Promoting service-based competition by lowering market entry barriers.
- Permitting infrastructure sharing among different service providers for optimum utilization and cost reduction.
- Allowing captive infrastructure of utility companies to be used for public Broadband service.
- Reducing the bottleneck in last-mile access by facilitating deployment of alternative technologies like Cable TV network, Wireless, Power Line, unbundling of local loop, etc.
- Reducing the cost of bandwidth for domestic and international Internet connectivity.
- Allocation of suitable Radio Spectrum for Broadband services at reasonable price and making more spectrum delicensed.
- Permitting broadcast infrastructure like DTH to be used for Broadband access.

BROADBAND POLICY, 2004
TECHNOLOGICAL NEUTRALITY

Service Providers can choose any technology

Over-Existing Infrastructure

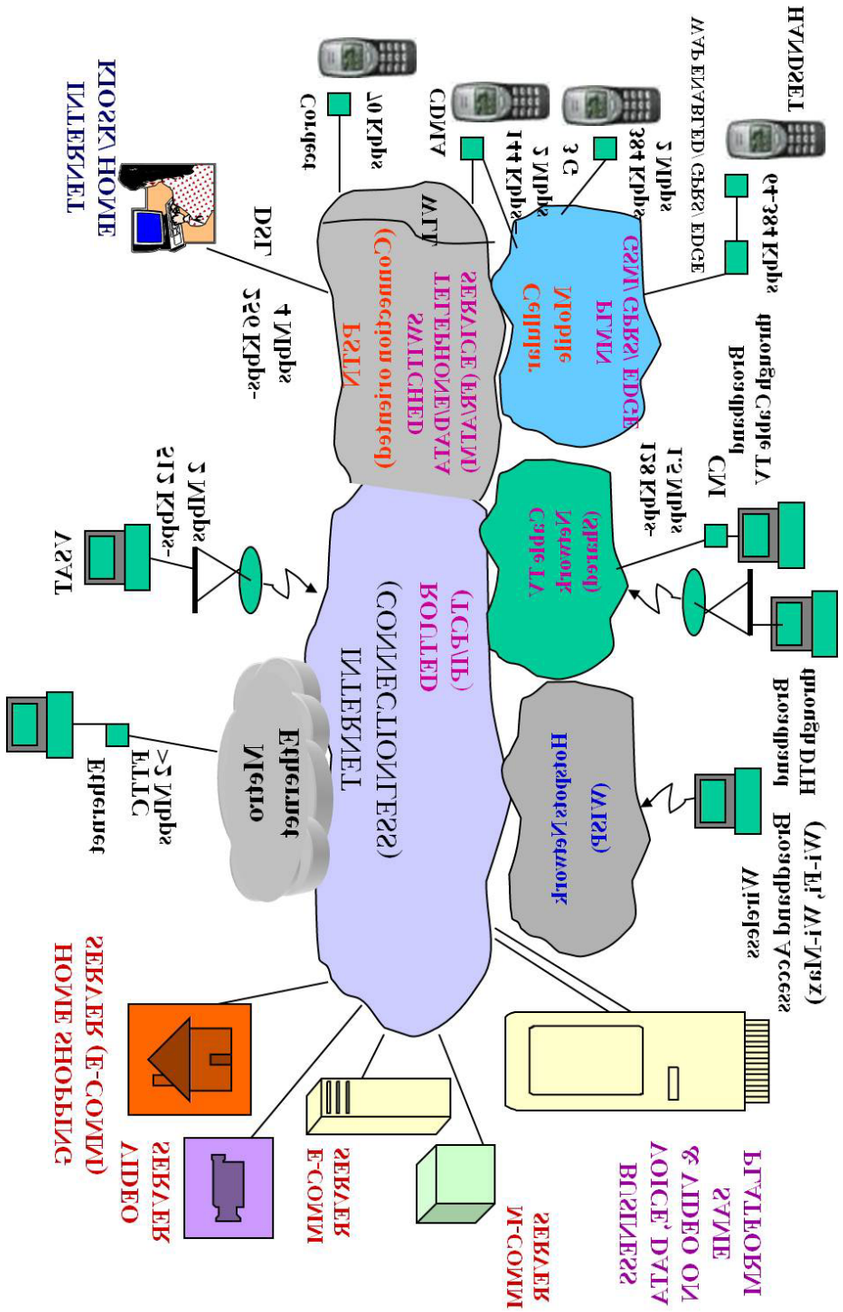
- DSL/ ADSL over Copper loop
- Cable Modem over Cable TV network
- Power Line Broadband Access

Over new cable infrastructure

- Fiber To The Curb (FTTC)
- Fiber To The Home (FTTH)
- Hybrid Fiber Coaxial (HFC)
- Metro Ethernet over Fiber

Over wireless infrastructure

- Fixed Wireless Broadband Access (FWBA) (WiMax 802.16d)
- Wireless LAN (Wi-Fi) (802.11a/ b/ g)
- Satellite (V-SAT, DTH)
- High speed WLL (GPRS, EDGE, CDMA, CorDect)
- 3G Cellular Mobile System (WCDMA, EVDO, IMT2000)
- IMT-advanced Technologies (Wimax,802.16e)



BROADBAND ACCESS IN INDIA - TECHNOLOGICAL NEUTRALITY
MAKING USE OF EXISTING INFRASTRUCTURE AND WIRELESS

SATELLITE BASED DTH SERVICES OFFER ALTERNATE FOR THE BROADBAND VIA RECEIVE ONLY INTERNET SERVICES (ROIS)

- Deployment of DTH for TV has begun, but internet access through this was not permitted
- While internet data is downloaded from the satellite, the uplink connection to the ISP is through another channel
- Since DTH (or receive-only VSAT) dish is only receiving, should not require SACFA clearance or NOCC fee for uplink monitoring
- New technology permits DTH to be used for bi-directional internet access, though costs are high because of required hardware

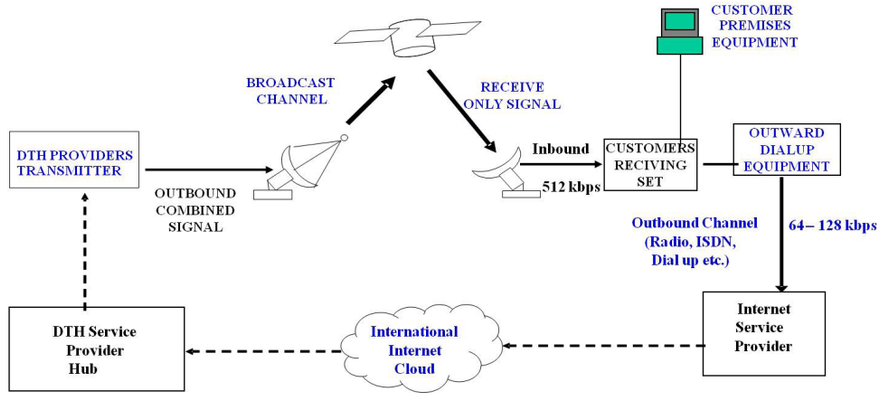
• Broadband Policy 2004

a. DTH provider with ISP license allowed to offer internet services

b. ISP licenses permitted to allow customers for downloading data through DTH

c. DTH providers permitted to provide both way Internet service after obtaining VSAT and ISP license

BROADBAND USING DTH FOR RECEIVE ONLY INTERNET



Speed of outbound channel is generally between 10 to 20% of inbound channel

VSAT HAS THE POTENTIAL FOR SIGNIFICANT IMPACT ON BROADBAND PENETRATION IF ARTIFICIAL COST DRIVERS ARE REMOVED

- Advantages of VSAT for remote geographies, high reliability, multi-casting and disaster recovery applications are well-known
- VSAT operators face increased costs due to special regulations & restrictions because of its CUG category
- Policy makers have some concerns that can be addressed in changing current rules
- To bridge last mile, VSAT license could be permitted to be used as access media for Broadband.

• Broadband Policy 2004

a. Open Sky policy for VSAT to be pursued by DOT

b. Minimum dish size of 1 m for KU-band permitted

c. Throughput restricted upto 2 Mbps

d. VSAT service providers permitted to provide Internet services by obtaining ISP license

FIXED WIRELESS ACCESS

GREAT POTENTIAL TO BE A DOMINANT ACCESS TECHNOLOGY

Unlicensed Bands

- 802.11x (Wi-Fi) technologies are widely used international standards. Wi-Max has substantial future potential
- 5.1 and 5.7 GHz bands (802.11a, Wi-Max) equally important as 2.4 GHz (802.11b/g, Wi-Max)

Licensed Bands

- IMT 2000 bands have been keenly contested world over for 3G
- Need to encourage alternative technologies in less congested bands
- Spectrum allocation for fixed use should be unlinked from mobile
- Certain fixed technologies, e.g., CorDECT, considered WLL and spectrum allocation counted against allocation for mobile services

• Broadband Policy 2004

a. 2.40 – 2.48 GHz spectrum De-licensed for outdoor usage with power restrictions (4W).

b. 5.15–5.35 & 5.7–5.8 GHz spectrum De-licensed for indoor usage for low power (200 mW) systems.

c. 5.25 – 5.35 GHz will be De-licensed for outdoor usage in consultation with DOS.

d. 1880 – 1900 MHz spectrum delinked from access providers allocation and available to ISPs.

e. Alternate spectrum for broadband services to be identified (2.3-2.4, 2.5.-2.7, 3.3-3.8 Ghz)

FACILITATING RADIO SPECTRUM FOR BROADBAND ACCESS

- ISM Spectrum (2.4 to 2.48 GHz, Wi-Fi) de-licensed for in-campus as well as outdoor using any technology.

- De-licensing of 5,75 to 5.825 GHz for outdoor usage has also been notified.
- De-licensing of 5.1 to 5.3 and 5.7 to 5.75 GHz spectrum for indoor & in-campus usage has been notified.
- Earmarking of 20 MHz (1880 to 1900 MHz) for wireless TDD access systems by ISPs (delinking from WLL).
- Time-bound frequency allocation, site clearance & frequency licenses through automation of Spectrum Management System and by setting predetermined standards for WPC.(E-application for SACFA clearance).
- E-Auction of 3G spectrum in 2.1 GHz and BWA spectrum in 2.3 to 2.4 Ghz band has been completed and spectrum allocated.

Fiscal measures to reduce the cost of access devices, infrastructure and broadband service

Recommendations

a. **Allow 100% depreciation of PC's and broadband CPE's in first year**
b. **Give tax benefit for donated PC's**
c. **Remove anti-dumping duty on import of recycled PC's**
d. **Reduce and rationalize import duties**
e. **Put local manufacturing on equal footing with imported finished goods**
f. **Exempt web hosting from income tax**
g. **Exempt ISP's from service tax**
h. **Personal broadband allowance**

→

Broadband Policy 2004

a. **High priority to indigenous manufacture of Broadband related equipments**
b. **Package to bring down the cost of broadband services at affordable level to be worked out in consultation with Ministry of Finance and other related departments.**

REDUCTION IN THE COST OF CONNECTIVITY

- Cost of connectivity (international & domestic) forms a significant part of Opex for Broadband services.
- Tariff for international bandwidth was forborne and left to the market forces. It was considered to be on the higher side in comparison to international benchmarks.
- Govt. has reduced the license fees for ILDOs, NLDOs and Infrastructure Provider category II (IP-II) from 15% to 6% of AGR and bank guarantee for IP-IIs from Rs. 100 crore (USD 20M) to Rs. 5 crore (USD 1M).
- Revised tariff orders reducing the ceiling price for international bandwidth (IPLC) by 35% for E1 and by 70% for DS3 and STM1 capacity has already become effective from 29.11.2005.
- The revised tariff orders reducing the ceiling tariff for domestic leased circuits (DLC) by an extent of 30% for E1 market price and 70% for DS3/ STM1 market price, has become effective from 1.5.2005.

NATIONAL INTERNET EXCHANGE OF INDIA (NIXI)

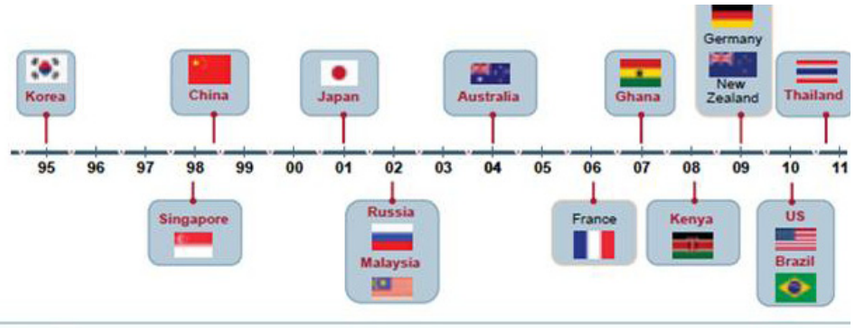
- National Internet Exchange of India (NIXI) has been set up on recommendation of TRAI by DIT, Government of India to ensure that Internet traffic, originating and destined for India, should be routed within India.
- Four nodes of NIXI have been setup in four metros and about 45 ISPs have already connected to these.
- All the ISPs are not still connected to NIXI and also all routes are not announced on NIXI leading to under utilization of the infrastructure.
- NIXI is taking appropriate steps for increasing the utilization of its facilities.

EMERGING BROADBAND SERVICES

- High speed Internet access (death of World-Wide-Wait) — Still the killer application for Broadband in India.
- Video-On Demand, Interactive TV, IPTV, PPV, Time Shifted TV, Videoconferencing (Multimedia over Broadband).
- Triple Play (data, voice, video) — By UASPs

- IP-VPN (low cost connectivity) — By UASP/NLDO
- VOIP (permitted only for UASPs)
- Interactive Gaming (future killer application)
- 4 e's (e-Governance, e-Learning, e-Health, e-Commerce)

INTRODUCTION OF NATIONAL BROADBAND PLAN
BY DEVELOPED AND DEVELOPING COUNTRIES

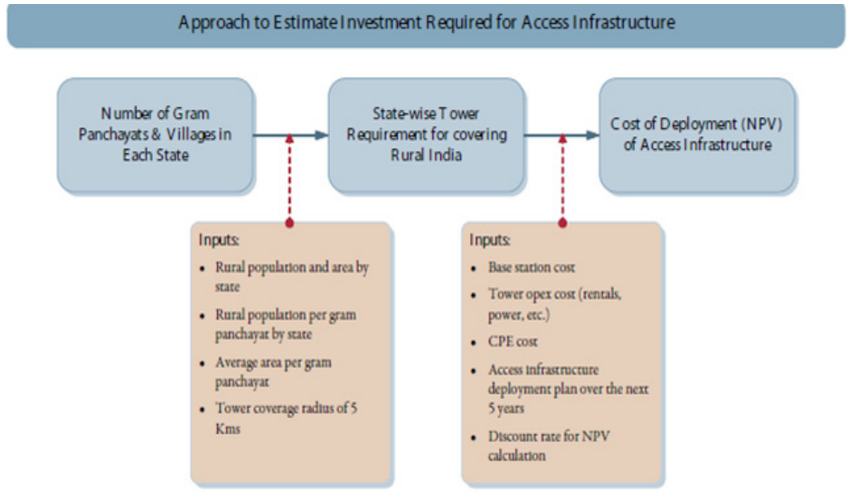


INTERNATIONAL INITIATIVES FOR NBP

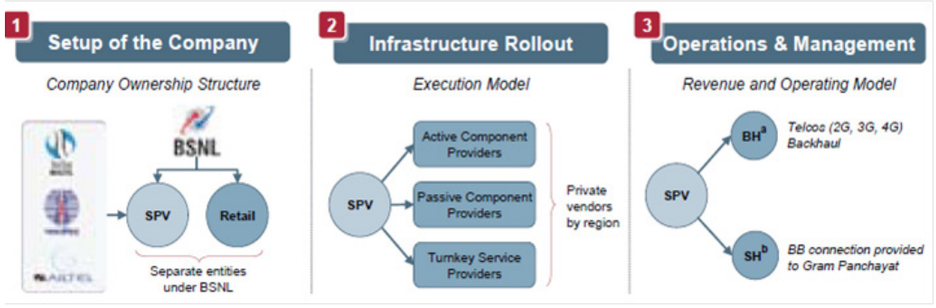
Name of Country	Brief of National Broadband Plan (NBP)
Australia	• Government investment of USD 38 billion in National Broadband Network (NBN). • 90% of population shall be provided broadband access at 100 Mbps speed with fiber based network. • Telstra to be structurally separated under ASD 11B deal.
Singapore	• Next Generation Broadband Plan (NGBP) started in 2006 with Government subsidy. • Open Access Wholesale to 95% population by 2012 with initial speed 100 Mbps rising to 1 Gbps using FTTH network.
Malaysia	• High speed broadband network to connect 1.3 million homes in major cities on FTTH/FTTC network by 2012. • Government to invest USD 0.7 billion out of total cost 3.2 billion USD. • Government to invest additional USD 250 million in rural areas.

Name of Country	Brief of National Broadband Plan (NBP)
EU	EC proposes USD 12B for Broadband Investment to achieve Digital Agenda for Europe to get Broadband for All by 2020
Sweden	• Local municipals to invest more than 180 million USD to deploy 1.2 million km of fiber in and around Stockholm.
United Kingdom	• Government invested 1.6 billion USD for development of NGA (FTTP) in rural areas (1/3rd of UK). • Aim is to bring the superfast broadband (100Mbps) to 90% of population by 2014 and to "All" by 2015. • Private investment is expected to cover 70% (3.5B USD) of optical fiber cost by 2017. • Part funded by proposed broadband levy of USD 0.8 per month on all fixed line in the country .
United States	• There is a National Broadband Plan to provide the nationwide broadband including rural areas. • Government to provide USD 11.6 billion under various broadband programs. • Further USD 2.5 billion is made available for grants loan and loan guarantees.

INDIA-APPROACH TO ESTIMATE INVESTMENT FOR BROADBAND ACCESS INFRASTRUCTURE IN EACH STATE



NBN-OPERATIONAL PLAN FOR INCUMBENT OWNED, GOVERNMENT SUPPORTED SPV MODEL



NOFN INDIA-EXISTING FIBER INFRASTRUCTURE AND COVERAGE BY VARIOUS SERVICE PROVIDERS

Service Provider	Total Fibre Laid	Total Cities Covered	Metros / Tier I Cities[a]	Other Cities	Gram Panchayats	Mid Sized Villages	Small Villages
BSNL	614,755 RKm[b]	All cities & 28 K gram panchayats	●	●	◔	○	○
Reliance	190,000 RKm[b]	44	●	◔	○	○	○
Airtel	126,357 RKm[b]	130	●	◔	○	○	○
Tata	40,000 RKm[b]	60	●	◔	○	○	○
RailTel	37,720 RKm	600	●	◑	◔	○	○
PowerGrid	21,652 RKm	110	●	◔	○	○	○
GAILTEL	13,000 RKm	200	◑	◔	○	○	○

NOFN INDIA-INVESTMENT REQUIRED TO ROLLOUT BACKBONE NETWORK TO CONNECT 250,000 GRAM PANCHAYATS

Backhaul Deployment Options and Required Investments for Covering 250K GPs

	Cost Elements	Investment Required (INR / RKm)	Total Investment (INR Crores)
Backbone Deployment in 250K Gram Panchayats → Underground Fibre (301,000 RKm) — *Deployment of additional fibre along the rural roads*	• Ducting and Trenching	150,000	INR 17,500 crores
	• Cable Cost and Active Equipment	130,000	
	• Right of Way[a]	300,000	
Backbone Deployment in 250K Gram Panchayats → Aerial Fibre[b] (301,000 RKm) — *Deployment of additional fibre through aerial route*	• Cable Cost and Active Equipment	130,000	INR 8,500 crores
	• Right of Way	150,000	
Backbone Deployment in 250K Gram Panchayats → Microwave Link (222K Hops) — *Deployment of 50 Mbps microwave link for BH[d]*	• Equipment and Installation	243,800	INR 25,392 crores[c]
	• Tower Rental per Month	15,000	

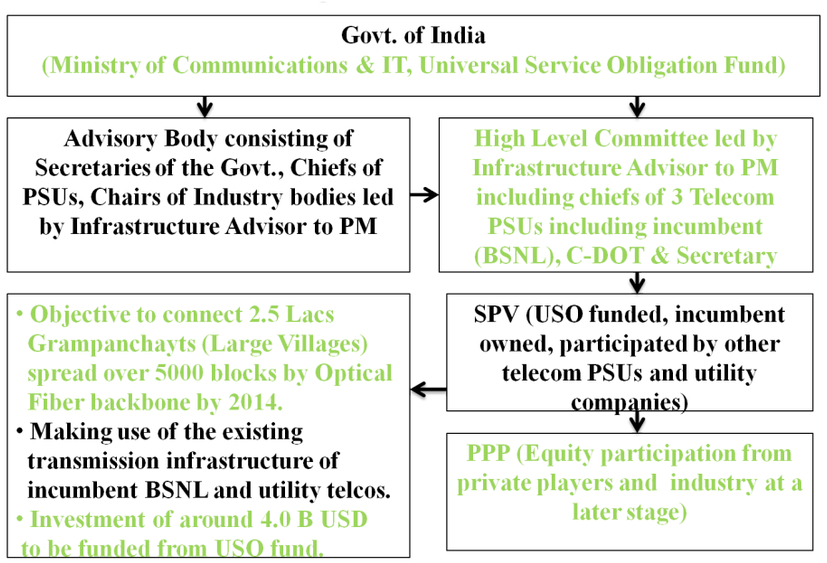
NOFN INDIA-POTENTIAL INVESTMENT MODELS FOR ADDITIONAL FIBER DEPLOYMENT

			Ownership	Deployment	Funding
Investment Models	1 Ownership	1.1 Central Government Owned Model	Central Govt (Core); BSNL (Access)	BSNL (Core and access)	Central Government
		1.2 State Government or Municipality Owned	State Govt or Municipality (Core)	Telcos (Core and access)	Central / State Govt / USOF / Municipality
		1.3 Incumbent Owned Govt Supported SPV	Central Govt & BSNL (Core)	SPV (Core)	Central Government / USOF & BSNL
	2 Public Private Partnership (PPP)	2.1 Jointly Funded & Owned SPV – Telco Led	Telcos and Central Govt (Core and access)	SPV (Core and access)	Central Govt & Public / Private Operators
		2.2 Jointly Funded & Owned SPV – Government Led	Central Govt & Telcos (Core and access)	SPV (Core and access)	Central Govt & Public / Private Telcos
	3 Financial Incentives	3.1 Government Loans & Subsidies, Private Owned	Public / Private Telcos (Core and access)	Public / Private Telcos (Core and access)	Central Govt & Public / Private Telcos
		3.2 Reverse Auctions	Public / Private Telcos (Core and access)	Public / Private Telcos (Core and access)	Central Government

REGULATOR'S RECOMMENDATIONS FOR NBP - DEC 2010

- Price for broadband access @ Rs. 300 (USD 6) per month — still unaffordable to masses.
- Broadband Definition- 512 kbps
- Targets- 75M (17 MDSL, 30M cable and 28M wireless) by 2012 and 160M (20M DSL, 78M Cable and 60M wireless) broadband connections by 2014.
- Connecting all Gram Panchayat (250,000 villages) by 2012.
- Connecting all the villages (6,00,000) by 2013.
- Setting up of Govt. funded National Optic Fiber Agency (S
- Setting up of State Optical Fiber Agency (SOFA) jointly with state governments and NOFA.
- Estimated investment of USD 12.5B financed by USO fund and Govt.
- Bringing out of Right Of Way (ROW) policy in consultation with states.
- Enabling Cable TV infrastructure to be fully digitized.
- Consideration for 100% depreciation for the tax purpose for CPEs and reduction in duties and levies on equipments used for broadband services.

CREATING NBN-NOFN INDIA



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· ESTABLISHMENT AND MAINTENANCE OF NOFN-I: NOFN IMPLEMENTATION STRATEGY

- In its plan for the NOFN, for extension of the existing optical fiber network to all Panchayats, DoT (Govt.) proposed an Executing Agency (EA) to undertake the work of establishment, management and operation of the Dear Cinema; NOFN through a transparent bidding process.
- Phased institutional mechanism for implementation of NOFN
- Stage I: A High Level Committee (HLC) to steer and coordinate all activities related to the NOFN Project.
- An Advisory Body to advise on implementation issues and upstream and downstream integration as well as issues relating to non-discriminatory access.
- A Project Implementation Team (PIT) shall look in to preparatory activities such as GIS Mapping, finalisation of network design, formulation of bid package as well as on issues related to establishment of SPV.
- Stage II: After approval by the Union Cabinet (End Oct. 2011), action to be taken to establish and operationalised a Special Purpose Vehicle (SPV).
- The management of NOFN would be transferred to the Special Purpose Vehicle (SPV), which will take over the functions and responsibilities of the EA.
- Stage III: Private sector companies will also be inducted into the SPV by equity expansion under PPP mode.

FUNDING SOURCE OF NOFN-USO FUND

- Establishment and maintenance of the NOFN will be solely through the USO (Universal Service Obligation) Fund based upon bids received by the Executing Agency (EA). (USD 4.0B for first phase)
- Necessary funds will be allocated by the Ministry of Finance (MoF) to USOF within the amounts accrued/accruing to the USOF. No additional liability on the state exchequer outside of USOF is envisaged.
- Given the size and scope of USOF Projects, budgetary allocation by MoF towards USOF expenditure to be restored under Non Plan budget to avoid procedural delays and ensure timely allocation of funds.
- As on date the funds available are with USOF are approximately INR 18,000 crores (USD 3.5B) and on an average the annual accruals to the fund would be approximately USD 1.2B. it is expected that the approximate funds available including cumulative accrual of funds over the next three years (upto 2014) would be about USD 7.0 B.
- At Intermediate stage Private sector will also be encouraged to make matching investments under PPP mode.

CONCLUSIONS

- BCDD, a UN Initiative has laid down ambitious targets for all the nations to have National Broadband Plan(NBP) and strategy by 2015.
- For ubiquitous broadband the underlying Backbone infrastructure is required to be created by Govt. through State/USOF/Public funding with Access infrastructure to be funded through PPP (Public-Private-Partnership).
- In India, national regulator (TRAI) has provided landmark recommendations to the Govt. for NBP entailing an investment of USD 12B for next 5 years
- Govt. of India has announced draft NTP-2011 providing requisite emphasis on “Broadband for All” and also the NBP. Creation of NOFN with USO Funding (4.0B USD) and utilizing the existing Infrastructure of Govt. telcos has been approved by Cabinet.
- Time and hence the Execution is Essence for such project of national importance which needs to be professionally managed in Mission mode through Special Purpose Vehicle(SPV), involving best talent of the country.

CHAPTER SIX

Emerging Trends in Infrastructure Sharing for Next Generation Telecom

AGENDA

Infrastructure Sharing- What, Why, How

Passive and Active Sharing- Elements

Six Degrees of Sharing — What and What Not

Functional Separation— Unlocking the Infrastructure Potential and Utilisation

India case Study— Mobile revolution through Sharing

Innovative Outsourcing— Managed Services

Interconnect Exchange— Sharing common Interconnect resources

WHAT IS TELECOM INFRASTRUCTURE?

- Passive: Non- Electronic (Civil and Electrical) Elements
- Towers, Masts, Posts, Power System, Land , Building, Duct, Dark Fiber, Trenches, Air-conditioning, Co-location space etc.
- Active: Electronic Elements
- Switches/Routers : TDM and IP based
- Transport network
  - -OFC- Long Distance Carrier
  - -Wireless: M/W, Satellite, Antenae
- Access network
  - -Copper: Local loop(Full, Partial, Bit-stream/ALA)
  - -Fiber: Back Haul and FTTX
  - -Wireless: BTS,BSC,MSC
- Applications, Software, NMS
- IN Platform, BSS, OSS, International Gateways, LIM
- Radio Spectrum

WHAT TO SHARE?

- Any Element which has spare Capacity
- Any Element which can be Pooled
- Any Element which is a Bottleneck
- Passive & Active elements
- Passive Infrastructure
- Access Network
- Carrier/Transport/Backhaul
- Billing System, NMS,OSS, IN
- Applications/Software
- Common interconnect points, Gateways, Radio Spectrum, LIM

WHY SHARE?

- Cost cutting- Single biggest reason to share.
- Developing countries seek to leverage mobile infrastructure boom into Broadband deployment.
- Developing countries seek to build IP-based backbone and backhaul networks (NGN), which has enormous extra capacity due to Packetisation.

- Developed countries seek to leverage fixed line investments and upgrade to Fibre to Home (FTTH), Building or Curb.
- Both share the same goal- To accelerate network deployment and growth by cutting costs and enhancing efficiency through network modernization.

SHARING- TIME IS RIGHT, NOW

- For many developing countries, end of exclusivity periods
- A second wave of regulatory reforms could be unleashed 5(RegulationV2.0)
- Sharing strategies could be central to the new wave of regulatory reform
- Phenomenal help in the Downturn times to become Recession-proof.
- Enabling technologies available (NGN)

SIX DEGREES OF SHARING - WHAT IT IS?

- Using infrastructure sharing together with Universal Access strategies within a competitive framework
- Reducing costs through efficient usage
- Allowing new players to provide services faster
- Relying on time-tested Competition and Regulatory principles
- Allowing markets to function freely
- Enabling Consumers to get services faster and affordable

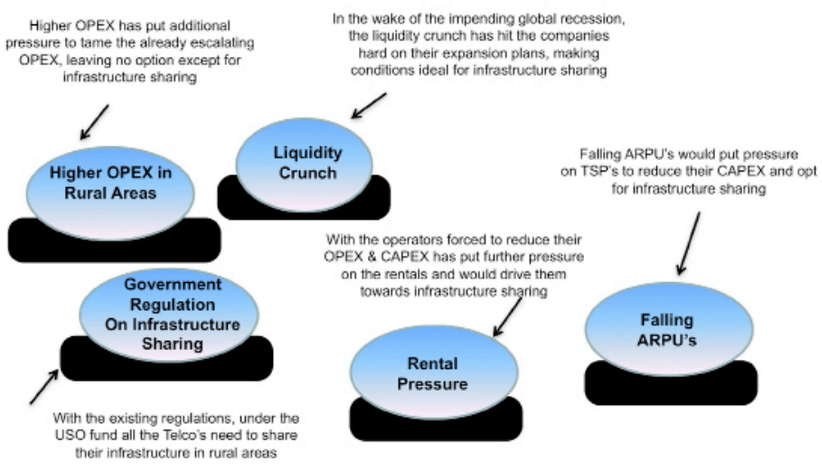
SIX DEGREES OF SHARING - WHAT IT IS NOT?

- An attempt to put infrastructure back in the hands of monopoly providers or to stifle competition (Sharing not possible if there is only one player!)
- A strategy to lessen competition or to deploy less equipment
- About sharing for Free (Cost plus charging)
- Limiting consumer choices
- A limit on facilities-based competition
- Limiting Innovations

HOW TO FACILITATE SHARING

- Share some infrastructure but still compete on end-user Services (Co-opetition)
- Requires political will and clear regulatory framework
- Many of the regulatory tools already exist in Interconnection regulations and Competition frameworks
- Can apply principles like Duct, Tower/Site sharing, Collocation, LLU, Bit-stream/Active Loop Access, Connection services to Mobile Infra, Fibre
- Equal-Ease of Access to International Gateway facilities and permitting Sharing of LIM
- And finally Functional Separation (The Nirvana)

Current economic scenario creates further challenges… and better case for infrastructure sharing



Growth Drivers

Factors driving Infrastructure Sharing

- Compelling economic value proposition
- Reduced time to market
- Plug and play offerings – connected network with backhaul
- Large geographical coverage requirements
- Heavy usage of voice services
- Allow the service provider to focus on their core competencies
- Pressure on strategic site's availability
- ***Infrastructure sharing likely to gain momentum with increasing competition and new entrants in market***
- Government support - Government's aim of narrowing the ***"digital divide"*** between rural and urban areas

Expected CAPEX savings between US$7 Bn to US$12 Bn and additional OPEX savings of US$1 Bn, over four years for telecom operators on account of Infrastructure Sharing

Industry Forecast

By 2012, approx no of towers-350,000 with tenancy ratio of 1.8-2.0 operators per tower

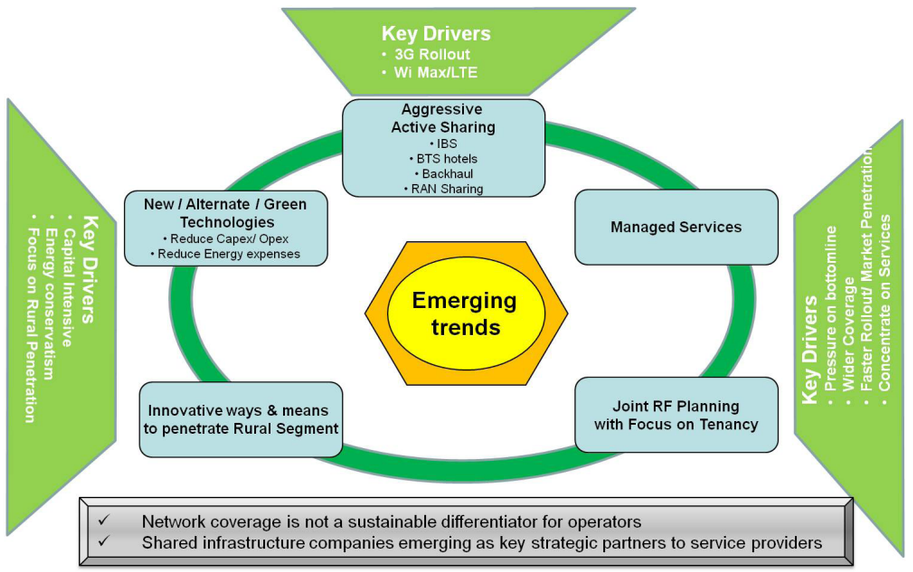
Demand for infrastructure sharing will rise due to:

- Worsening credit conditions and recent surge in cost of capital
- Demand on account of new technologies such as 3G, Wi Max and Broadband Wireless
- Operators need to prioritize capital allocation

A huge Industry in making- Minutes factories

Source: Broker research estimates; Ernst & Young analysis

EMERGING TRENDS IN SHARING



EVOLUTION OF INFRASTRUCTURE SHARING IN INDIA

Lately the Passive sharing has made significant progress and moving towards Active sharing

July 2005	Quippo Telecom, a Tower company pioneered the passive infrastructure model. Signs up with main mobile operators Bharati, Vodafone, Idea and Spice as its customers.
July 2007	Reliance Communication another operators hived off its tower unit and sold a 5% stake to investors in US, Europe and Asia valuing the business at about USD 6.75 bn
December 2007	Quippo Telecom acquired 988 towers from Spice in both its operating circles of Punjab and Karnataka
December 2007	Airtel, Vodafone & Idea cellular merged their tower assets in 16 telecom circles to form Indus.
January 2008	A group of overseas investors acquired a 9% stake for USD 1 bn in Bharti Infratel Limited (Airtel tower unit)
February 2008	US based private equity company Kohlberg Kravis Roberts (KKR) invested USD 250 mn for a 2% stake in BIL
January 2009	Quippo Telecom acquired 49% stake along with management control in Tata Teleservices tower arm - WTTIL
March 2009	American Tower Corporation(ATC) acquired Mumbai based Xcel Telecom established in 2006 with USD 500 mn funding commitment from Q investments
October 2011	Govt. new telecom Policy draft (NTP-11) Purposes to separately categorize Network Operators and Service Providers in a new Unified licencing framework and permits active infrastructure sharing including spectrum sharing.

13

SERVICE PROVIDERS' IMPERATIVE

Investment	Operating Margins	Go-To-Market
• Cater to low ROIC but high rural population • Spectrum scarcity vs. coverage; 3G rollout will require more towers • Huge capacity in high MoU areas • Increased share of passive in total capital expenditure	• Maintain operating margins despite falling tariffs • Keep rentals low despite high demand • Service rural population with high cost per subscriber	• Speed of deployment and time-to-market • Enhance market share by access to larger base of towers and investment in network and product innovations
Capex savings : US$7-12 b in 4 years	Opex savings: US1b per annum	Focus on core areas to enhance market share

Source : E & Y analysis

AGGRESSIVE ACTION SHARING

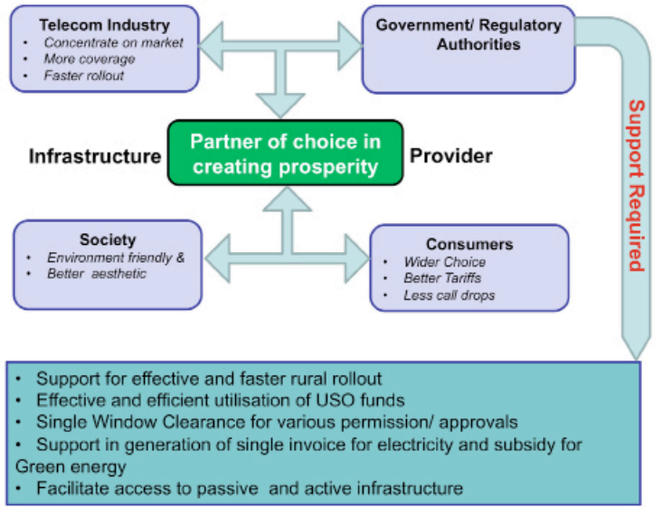
- ✓ Next generation networks (3G+) likely to facilitate greater sharing
- ✓ New Usage by Subscribers - email, text messaging, web access, & media applications such as picture sharing, video viewing
- ✓ 3G antennas need to be installed on each tower and data equipment needs to be added in the common shelter beneath the tower
- ✓ Greater cell-site density is required for data-centric networks.

→

- Intra-circle roaming
- In Building Solution (IBS)
- BTS Hotels
- Backhaul Sharing

Operators	▪ Opex savings on both infrastructure and active equipment O&M – Opex savings per site (~30-35%)
Infra Provider	▪ Capex savings (25% ~40% per site) through leaner remote sites compared to full fledged tower sites ▪ Opportunity to attract incumbents and de-risk the tower business
Target customers	▪ Anchor customers on new sites ▪ Incumbents on existing and new sites

SUPPORT REQUIRED FROM GOVERNMENT/REGULATORS

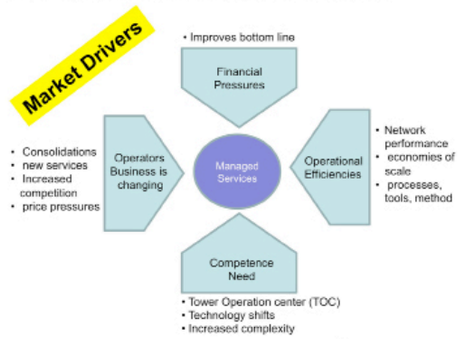


MANAGED SERVICES - SELECTIVE OUTSOURCING

A Managed Service is provided by a service provider that takes on management responsibility for a function that has traditionally been carried out internally by a telecom operator

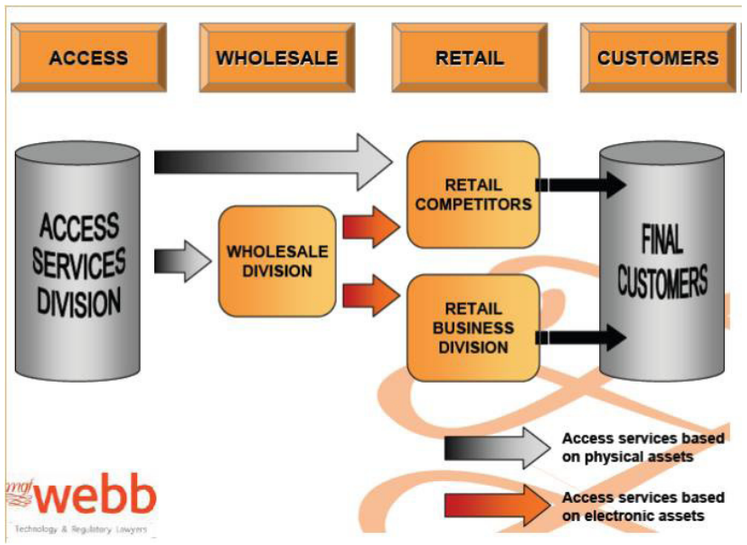
Managed Services **functions** typically include:

- **Plan and design** – planning, optimization and development.
- **Build** – technology integration and implementation of networks, services and business support systems.
- **Operate** – day-to-day operations such as operation and maintenance of networks, services and business support systems, field services, customer problem management including helpdesk, and service and resource fulfillment



Massive deployment of high-speed wireless networks throughout has opened up a new market for telecom outsourcing and managed services

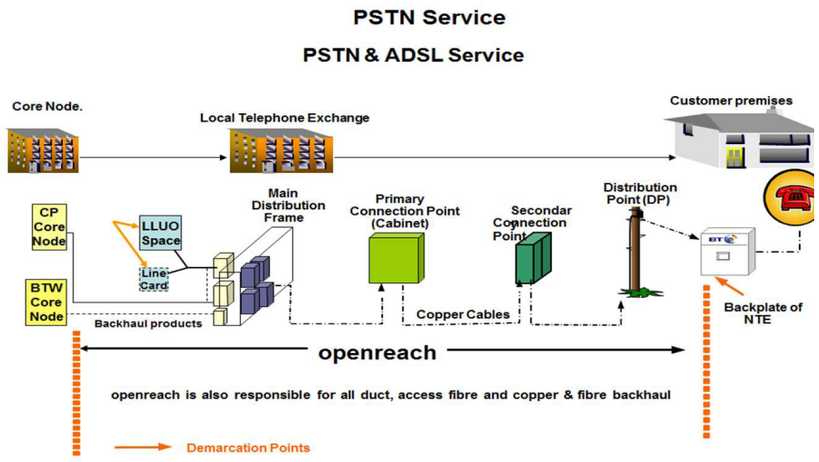
FUNCTIONAL SHARING - A WIN-WIN SHARING CONCEPT



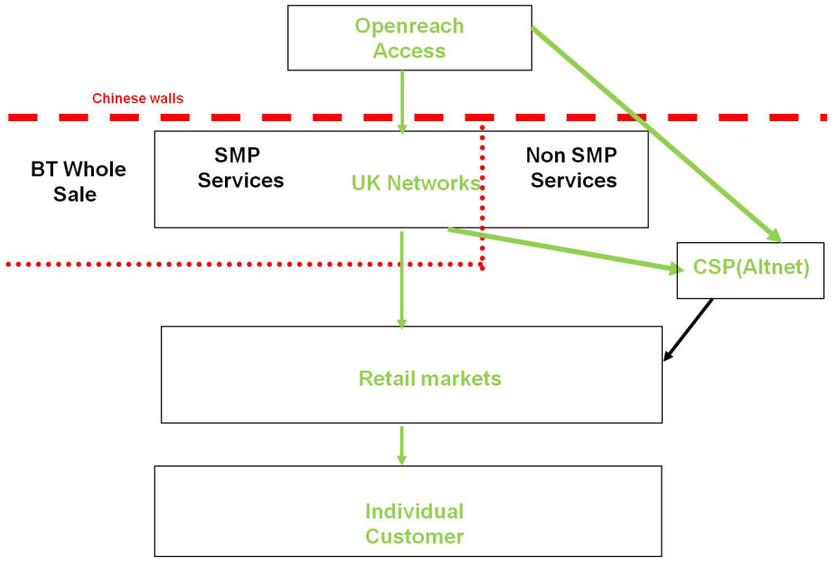
FUNCTIONAL SEPARATION - WHAT IT IS, WHAT IT IS NOT

- It is carving out a separate logical entity (Virtual SPV) out of the sharable under-utilized Infrastructure to unlock its full potential without any Structural change. (eg. ARC in banking). It can offer Infrastructure-as-an-Interconnect-Service (I-a-a-s) on IRU (Indeafisible Right of Use) basis to various service providers.
- It is not any form of Divestment and involves no Ownership/Structural change .
- It does not force any Retrenchment/VRS, but converts the staff Liability into Asset through sense of belongingness, empowerment and accountability.
- It converts NPA(Non-Performing Assets) into Revenue Generating Assets (RGA) by unleashing the capacity through Modernization, upgradation through Managed Services & Efficient Utilization.
- It leverages the Professional Management through empowerment & accountability along with staff participation in decision-making (Best of both the Worlds)
- It does not force a Free/ below cost leasing but enables cost++ returns
- It converts the Competitors into the Wholesale dealers (Co-Opetition)
- It is a Win-Win and maximizes the National (Societal) Welfare.
- It is an implementable Idea whose time has come for India (Nirvana)
- It is not a Rocket Science- It is all about timely Execution through Managed Services, Silly.

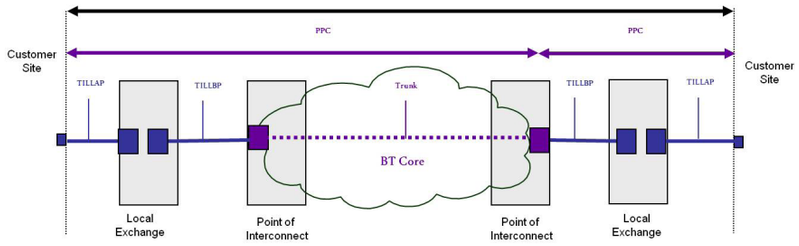
UK - FUNCTIONAL SEPARATION (BT - OPENREACH)



UPSTREAM/DOWNSTREAM FLOWS



PARTIAL PRIVATE CIRCUIT (BUILT-UP LEASED LINE)



- Retail PC Product
- Wholesale Provide
- PPC Partial Private Circuit
- Openreach Provide
- TILLAP and TILLBP

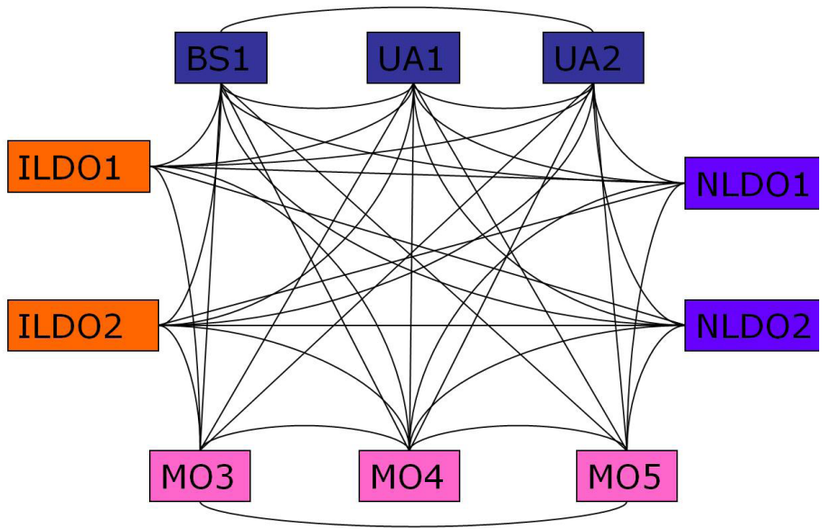
UK - EQUALITY OF ACCESS

- All services falling within the scope of Openreach will be offered to all on equal terms — Equality of Input (EoI).
- EoI is the key concept of Openreach
- EoI is more than non discrimination
    - EoI means: same ordering system, same ability to influence, same prices, terms & conditions, same services and same access to commercial information.
    - It will guarantee equal access to the ‘economic bottleneck’ and drive further downstream competition.
    - It will focus on the regulation where it is needed

SHARING OF INTERCONNECT RESOURCES

- Separate Network for Basic/Mobile (Voice) and for Data
- Huge growth in Mobiles
- Increasing numbers of Application developers, Operators and Traffic
- Every Basic/Mobile operator to have interconnection with each other and with many NLD and ILD operators

PRESENT SCENARIO



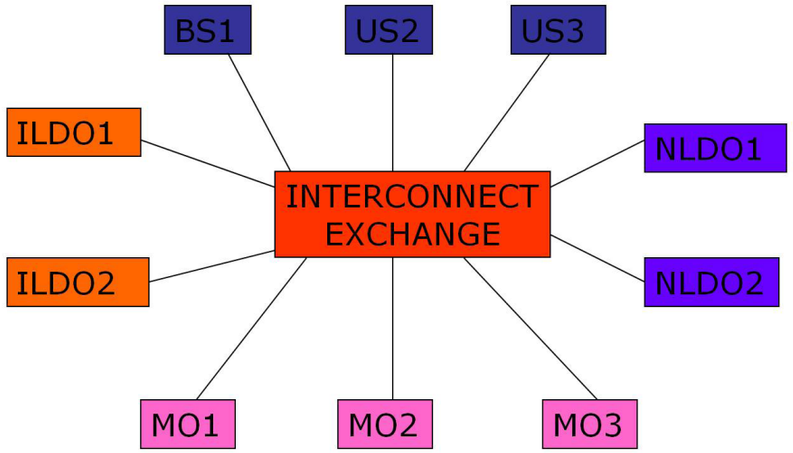
RESULTS

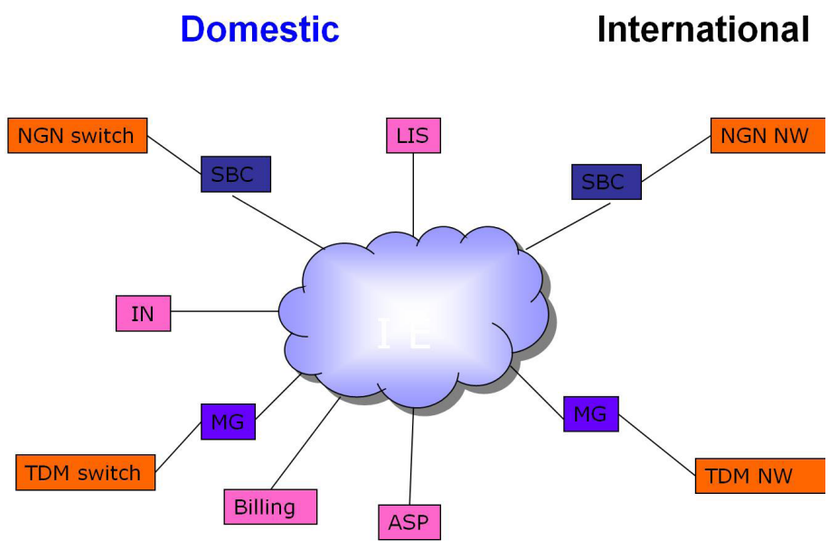
- Sub-optimal utilization of resources
- Inefficient handling of calls
- High operational cost for managing inter operator connections
- Inter carrier billing problems
- Complexity in settlement in Interconnect usage charges
- Increase in CAPEX and OPEX

SHORTCOMINGS

- High interconnection cost
- Connection at different levels and at many places Complex routing at every point
- Huge requirement of ports and their cost
- Physical provisions at different places causes delay and need more capacity

INTERCONNECT EXCHANGE - THE CONCEPT





ADVANTAGES

- Network simplicity leads to reduction in interconnection cost and port charges
  - Simple network interconnection using GE or OFC as per ITU-T G.653
  - Reduction in number of links
  - Simplifies digit analysis for all inter operator and long distance calls from the switches connected to it
- Help in quadruple (Voice, Video, Mobile TV and data) play
- Less time consumption in provision/augmentation of PoIs
- Help in convergence of services, application and provisioning
- Simplification in carrier selection function and Number Portability
- Integration of different service providers at one point
- FMC and Femto cell concept in multi operator environment in case of intra roaming, thus saving in spectrum
- Low latency
- Reduction in Capex and Opex

- Integrated and Inter carrier billing
  - Less connection: less disputes
  - Clearing house function
  - Inter operator charging, based on GOS, Content and network elements used in interconnection
- Intelligent network services
  - Easy provision in a multi operator and multi-service scenario
  - Content can be integrated at ICE and can be pooled to all the operators connected to it

WHO WILL DO IT?

- Regulator and Licensor: Terms to be redefined with light touch approach
- All stake holders to come to-gather
- By incumbent operator or by other or separate independent operator
- Management : To be decided by all stake holders

FUTURE - BACK TO CORE - COMPETENCY TOWARDS MINUTES/BANDWIDTH FACTORY

- Separate access infrastructure providers: DSL, Wi-Fi, FTTX, wireless, cable modems, power line modems etc
- Separate network services providers
- Separate long/short distance connectivity providers
- Separate Infra: Tower, Power, BTS providers
- Separate Operation/ Billing system providers
- MVNO/ Virtual Operator concept
- 3rd party VAS providers

Specialized entities will handle different segments, efficiently and in a cost effective expert manner

CHAPTER SEVEN

Emerging NGN Technology Trends- Better City, Better Lifestyle

AGENDA

Emerging Technological Developments

Evolution of Last mile Technologies

Next Generation Access — FTTH

Next Generation Broadband Converged Network —NGBCN)

Innovative Broadband Applications— EOIP

21st Century City— Digital Ecosystem

Better Lifestyle— Productive Stress-Free Work-Life Balance

TECHNOLOGY DEVELOPMENT TRENDS

- Increased speed and density of Integrated Circuits (Moores Law).
- Enhanced Transmission capacities on Optic Fibre Networks and Networking Flexibility(Gilders Law).
- Distributed and Open Platform-based Communication Software.
- Capacity Growth and new Application Services on Wireless (Coopers Law).
- Emergence of Next-Generation Networks (IP-based)- Delivering QOS for Real time services.
- Ubiquity of networks through RFID & IPv6 (Next Generation Internet).

EVOLUTION OF ALTERNATE LAST MILE TECHNOLOGIES

- Use of Coaxial Cable for Telecom Services (Cable TV Network for Broadband and telephony local loop).
- Use of DSL technology on traditional Copper Loops.
- Wireless Access Service for Fixed and Mobile communication.
- VSAT-based Access in remote areas.
- Broadband over Power-line.
- Free Space Optics (FSO).

SATYASPEAK

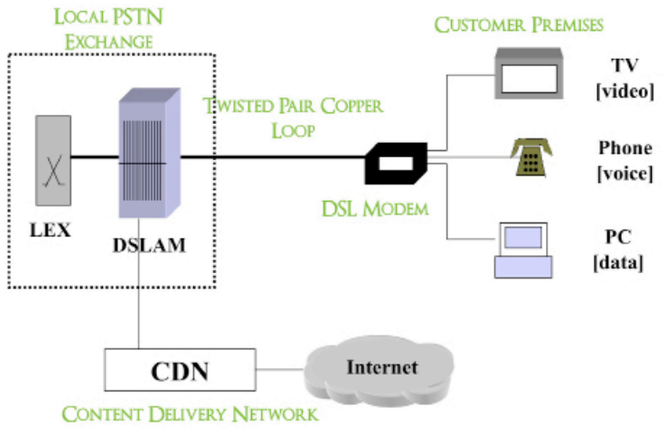
TECHNOLOGY ALTERNATIVES TO WIRELINE BROADBAND

1.Evolution of Wireline Technologies

i). Use of Digital Subscriber Loop (DSL) technology on traditional Copper Loops (DIY, Franchising, Shared unbundling, Bit stream access)

•Asymmetric DSL (ADSL) — 1 Mbps upstream/ 8 Mbps downstream, 3 Km
•ADSL (G.Lite) — Splitter free, 512 Kbps upstream/ 1.5 Mbps downstream, 5.4 km
•Symmetrical DSL — 1.5 Mbps, 3 Km
•Single pair High-speed DSL (SHDSL) — 2.3 Mbps symmetric, 3 Km
•ADSL 2, ADSL 2 plus — 8/24 Mbps, 1.5 Km
•Very high Data Rate DSL (VDSL) — 52 Mbps, 1.5 Km

BROADBAND OVER COPPER LOOP (DSL)



EMERGING NGN TECHNOLOGIES
BETTER CITY, BETTER LIFESTYLE

ii. Cable TV Networks for Broadband acces

- Broadband over cable TV accounts for 74% of total connections in US, and 55% in Canada
- 55 million cable homes in India, but infrastructure can not support bi-directional communication and requires upgrade
- Regulatory environment, via an ISP license, allows this with some MSO's and operators already doing so
- For advances to occur, better organization of the industry needed to be executed
- Cable operators will need to adopt innovative business models to compete in converged environment
- Possible to provide upgraded entertainment services such as interactive digital TV, pay-per-view, video on demand and time-shifted TV
- Benefits operators with significantly higher ARPU and better customer retention
- To start with Cable TV network which is uni-directional can be used for downloading, the uplink to be conventional narrow band like dialup/ ISDN/ RADIO
- Operators need training to create awareness about utility of their networks and understanding of the investments required, returns possible, and technical aspects

iii. Fibre Optic Cable Technologies

- Fiber To The Curb (FTTC) — by existing operators
- Fiber To The Home (FTTH) — Fibre in last mile to deliver converged services
- Hybrid Fiber Coaxial (HFC) — by Cable TV operators
- Metro Ethernet (Fibre based) — extending the range of LAN
- GPON (Gigabit - Passive Optical Network) — triple play over TDM
- (No limitation of distance or throughput speeds)

iv. Broadband over Powerline (BPL) Technologies

- Use of existing domestic power connections for sending data
- Throughput in the range of 1 MHz (4 — 6 Mbps)
- Ideal for rural areas where telecom / cable TV infrastructure may not be there

v. Metro Ethernet Networks

- Use of Ethernet beyond LAN
- Use of high-speed access using hybrid fiber/ copper based

Ethernet technology

- Power over Ethernet (POE)

MOBILE TECHNOLOGY TRENDS

Time sit in such a waythrough crucial sotware wherever we are.

- GSM, GPRS, CDMA, CorDect, 802.11 (WLAN,Wi-Fi) 802.16d(Fix BCDD, a UN Initiative has laid down ambitious targets for all the nations to have National Broadband Plan(NBP) and strategy by 2015.
- For ubiquitous broadband the underlying Backbone infrastructure is required to be created by Govt. through State/USOF/Public funding with Access infrastructure to be funded through PPP (Public-Private-Partnership).
- In India, national regulator (TRAI) has provided landmark recommendations to the Govt. for NBP entailing an investment of USD

Technology Comparison – BWA (IMT and Advanced)

	UMTS (3G)	HSPA	EVDO (3G)	802.16 a/d	802.16e	IMT Advanced (4G)
Bandwidth	5 MHz	5 MHz	1.25 MHz	1.25-20 MHz	1.25-20	5-20 MHz
Typical Spectrum	1.9-2.1 GHz	1.9-2.1 GHz	450-1900 MHz	2.3-5.8 GHz	2.3-5.8 GHz	Various
Downlink Peak Rate	0.4 bps/Hz	2.9 bps/Hz	2.5 bps/Hz	3.2 bps/Hz	3.2 bps/Hz	2.4-3.6 bps/Hz
Uplink Peak Rate	0.4 bps/Hz	0.4 bps/Hz	1.4 bps/Hz	2.4 bps/Hz	2.4 bps/Hz	2.4 bps/Hz
Typical Data rate	2Mbps	20 Mbps	4 Mbps	52 Mbps	52 Mbps	>100 Mbps
Typical Latency	300 ms	300 ms	250 ms	<150 ms	<150 ms	<50 ms
Flat IP Support	No	No	No	Yes	Yes	Yes
Mobility	Full	Full	Full	Fixed	Limited	Full

TREND TOWARDS CONVERGENCE

- Evolving Networks leading to Convergence of Voice, Data & Video services on a common infrastructure resulting into cost saving and performance improvements as well as leading to new avenues for revenue generation.
- Convergence of Telecom, Broadcast and Internet leading to Multi-media services.
- Evolving NGNs and 21CNs capable of guaranteed QOS and high level of Security, Reliability and Flexibility.
- Emergence of single “Information Plug” (Triple- Play).
- Customers aspiration — Better, Faster, Cheaper, One Stop Shop, Single Bill.

SPECTRUM UTILIZATION TRENDS

- Radio Spectrum availability is key to the success of exploitation of new technology trends.
- Being a limited resource, new technological evolution and management techniques required for optimum utilization.
- Usage of Multi-Layer, Hierarchical structures based on Micro , Pico and Femto cells, Cell splitting, Synchronous Frequency Hopping, Narrowbanding ,etc.
- Use of Adaptive, Intelligent Antenna Array , OFDM and Scattering.
- Enhancing the information carrying capacity of radio spectrum by Multi-level Modulation, MIMO, Compression, AMR Coding, DTX, DSI ,OFDM, etc. to move towards Shannon’s limit.

Technologies for Next Generation Access (NGA)

	Now	ADSL2+	FTTC (+VDSL)	FTTP (All homes)
Downstream Headline	8 Mbit/s	24 Mbit/s	40 Mbit/s	100 Mbit/s
Downstream Typical	5 Mbit/s	10 Mbit/s	20 Mbit/s	50 Mbit/s
Upstream Headline	0.8 Mbit/s	0.8 Mbit/s	10 Mbit/s	30 Mbit/s
Upstream Typical	0.4 Mbit/s	0.4 Mbit/s	5 Mbit/s	15 Mbit/s
Cost of Deployment			£200 → £400/line	~£600/line
Regulatory Impact				Regulatory issues to be resolved

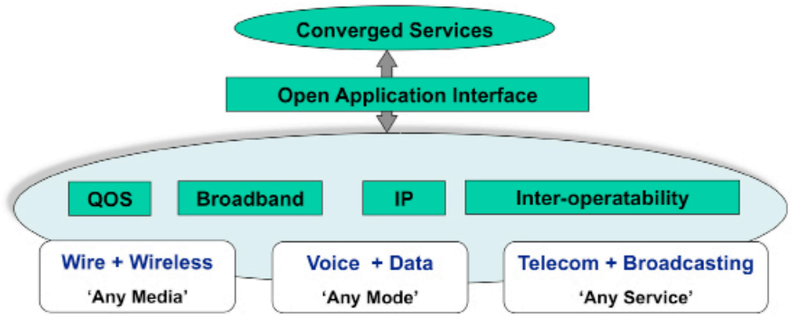
FUTURE OF NEXT GENERATION ACCESS (NGA)

FIBER TO THE HOME (FTTH)

1. Enables Super fast broadband applications to customers (>100MPBS)
2. Green technology
3. Future proof
4. Enables real-time High Definition Multimedia, Convergence, Collaboration and Innovations

NEXT GENERATION BROADBAND CONVERGED NETWORK (NGBCN)

"Next generation network(NGN) which provides seamless converged services from Telecom, Internet & Broadcasting infrastructure at any time, anywhere to anywhere, from any device to any device as per the wish of Customer."



EMERGING NGN APPLICATIONS- EOIP

Voice over IP	Unified Messaging	BB - High Speed Internet
Primary line	**Content Delivery**	**PC to Phone**
Second line	Games	Phone to PC
IP Centrex usage	**Downloads (MP3)**	**IP VPN (data)**
Voice VPN	Gambling	BW on-demand
IP Centrex	**Video on demand**	**QOS on demand**
Basic	TV on demand	Quad play
Advanced	**Cinema of the future**	**Instant messaging presence management**
Multimedia Conferencing	Long distance bypass	MMS on fixed network
IPTV	**Tele Presence (TP)**	Location Based Services (LBS)
		FMC (Fixed Mobile Con.)
Distance learning	**Internal**	**3G & beyond applications**
Distant arraignment	External	
Remote lab	**IP offload**	

FIXED MOBILE CONVERGENCE (FMC)

A Compelling NGN Application

FMC is convergence of access for telephony wherein as per the convenience of the users an mobile call can be delivered on fixed phone or can be terminated through Fixed/ Wi.fi broadband network on mobile phone.

Main motivation for this is :-

1. Spectrum shortage leading to congestion and reduced QoS. (It is believed that 70% of the time a mobile call recipient is on a fixed location/Hot Spot)
2. Mobile subscribers saturation, Fixed lines decline (Battle for in-building minutes)
3. Broadband becoming ubiquitous and cost effective
4. The "Mobile Handset" is becoming a multi-purpose, multi-band, multi-mode palm-held computer
5. NGN Technologies enabling FMC (IMS, UMA ,Femtocells)

NEW DELHI - 21st CENTURY CITY

- 70s- Delhi , a City of Villages
- 80s- Became City of Cities- Urbanisation, NCR, Asiad 82, Color TV Broadcast, FM,Digitisation of telecom network, Computarisation of Railways reservation.
- 90s- CHOGM, Optical Fiber, Internet, Mobile, ATMs
- 2000s- CNG, Broadband, IPTV, CAS, Flyovers, Metro, Teledensity> 100, Mushrooming of Hot-spots, 3G, Corporatisation of Power Distribution
- 10-12- Leapfroging in Infrastructure, CWG-2010, Modern Metro, Green Public Transport, NGN, Tetra, Green Energy, FTTH, Warm Zone, IPV6, Femtocells
- Broadband Backbone, e- Citizen Services, Smart Grid.

BETTER LIFESTYLE THROUGH NGN

- Internet Style- Efficient, Flexible, Innovative, Open
- Work-Life Balance- Prioritise, Flexible Working, Work from Home, Time Management
- Commute Less Communicate More- Trade- off Transport with Telecom
- Use Tele Presence, Web Confrencing, Net meeting,, Audio Con-frencing, IM, Texting, Blogging
- Form focus discussion groups on Professional Networking site (Linked-in), E-learning.
- Exploit the capabilities of Smartphones
- Avail e-citizen services and m-banking from home.
- Take your office with you on move - Office 365.

2012

January

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February

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2012

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The Author

Satya N. Gupta

S. N. Gupta, Born 1957, graduated with Hons, in EC Engineering in 1979 from NIT, Kurukshetra University, INDIA. From 1979 to 1980 he completed his post graduation in Electronics Design Technology at CEDT, Indian Institute of Science, Bangalore and was appointed as Project Manager of ETDC complex of HARTRON. In 1981 he joined Wireless Planning and Coordination Wing of Ministry of Communication and was posted as Officer-in-charge of Wireless Monitoring Station, Srinagar and Secretary, Regional Advisory Committee of SACFA for J&K and HP.

In 1983 he joined IRSSE Cadre of Western Railway. Since 1985 to 1989 he held various positions on that Railway including one-year tenure as Senior Project Manager for Passenger Reservation Computerisation System at Bombay. From 1989 to 1994 he worked with Indian Railways Institute for Signal Engineering & Telecom as a faculty for signalling, Telecom and Computers. At this centre he was involved in developing and conducting courses in advanced Telecommunication technologies for senior Railway officers from India and Abroad.

Since August 94 he worked with IRCON INTERNATIONAL LIMITED as Additional GM and was involved in the execution of optical fibre and other projects dealing with modern telecommunication systems at National and International level.

Up to August, 2000, he was Heading IRCON's first "BUILD-OWN-OPERATE" based Optical Fiber Project between Mumbai and Delhi and also the ISP Project.

Till Nov.2006, he worked as Principal Advisor with Telecom Regulatory Authority of India at the level of Additional Secretary to the Govt. of India and headed the Fixed Network Division incl. Interconnection, IN, IPLC, ILDO, NLDO. Earlier he headed Converged Network Division dealing with Regulatory, Technical and Economic aspects of Data Networks and Services including VOIP, Internet Services, IPv6, Broadband, e-Governance, Internet Governance, QOS and NGN. He was also a member of various task forces of Govt. dealing with implementation of broadband, e-Governance, Internet Governance, Broadband over Power Lines and IPv6.

Mr. Gupta was awarded the Minister of Railways award for the outstanding performance during 1995-96.

He retired as a Major from Railways Engineers Territorial Army and is also a Grade I Radio Amateur.

He is widely traveled abroad to Europe and Asia being Chairman of various Experts' Groups of Asia Pacific and South East Asia in the field of VOIP, Internet Telephony, ICT and Domain Names. He was also deputed as an ITU expert on an UNDP assignment on Internet Exchange and International VOIP Gateway and IP based Interconnect Exchange for Bangladesh. He was also a member of NGN Regulation review group of ITU. Recently he completed his Masters in Telecom Policy and Regulation as an ITU Scholar from University of West Indies through e-learning.

He is the founder President of ACTO, an Industry body of dedicated Carriers and member of National ICT Committees of ASSOCHAM, CII and FICCI. He is a Fellow and Chartered Engineer of Institution of Electronics and Telecom Engineers, India. He is also a Life Member of Institution of Railway Signal and Telecom Engineers & Vice-President and Trustee of PTC India Foundation. He is elected as Vice President of ISP association of India and Advisor to OSP Association of India. He is also elected as the Jt. Secretary of APT-ITU Foundation of India. He has founded the National NGN Forum of India as its Director General.

He is member of India IPV6 Task Force Oversight Committee an Apex body of the Govt. for IPV6 implementation and Industry nominee in the NOFN Advisory body of Government of India. He is the Chairman of ASSOCHAM Broadband Working Group of Convergence Committee. He is also a Director at IT-ITES SSC of National Skill Development Council. He is also included in "Asia-Africa – Men & Women of Achievement" by Reguerdon, Malaysia and in the International Dictionary of Professionals by ABI. He has been awarded Bharat Excellence Award and Jewel of India Medal by Friendship Forum of India during 2009-10.

For the last 5 years, he worked with BT Global Services as Chief Regulatory Advisor and Director Govt. Affairs for India & SAARC, dealing with Regulatory, Licensing, Public Policy, Security, Competition and Government Affairs.

Presently, he is working as Chief of Corporate Affairs with Sterlite Technologies Ltd., and handling their ambitious project of FTTH, creating "Bandwidth Factory" in the country.

Buzz About The Author

"Satya is a walking Encyclopaedia of Telecom Industry in India."
-Anshul G., *Executive Director, RailTel Corporation of India*

"Thanks for coining the term 'Copyleft', it should be used to make the internet content freely available without any cost."
-Mr. Milind Deora, *Minister of State for Telecom & IT, Govt. of India*

"SN is 'Sachin' of Indian Telecom. He keeps it Simple and Straight."
-Mr. R.R.N. Prasad, *Ex-member TRAI*

"No global forum of ITU on NGN can be completed without contribution by Satyen."
-Mr. Riccardo, *Counsellor ITU, Geneva*

"Dont claim to be Google of Indian Telecom, unless your name is Satyen."
-Anonymous, *Someone-Somewhere*

"In my organisation Technology discussion ends at SNG level."
-Mr. Arun Prasada, *Ex-MD, IRCON International*

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