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"Next Generation Networks (NGN) –Technology, Architecture, Applications"

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Content

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 Wi-Fi and Wi-Max are making broadband access faster and cost effective.

All IP Networks-NGN *(Cont..)*

- **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.**

All IP Networks-NGN (Cont...)

• 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.

(iv) Open standard architecture.

(v) Integrated users interface.

• 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 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 (Broadband) 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

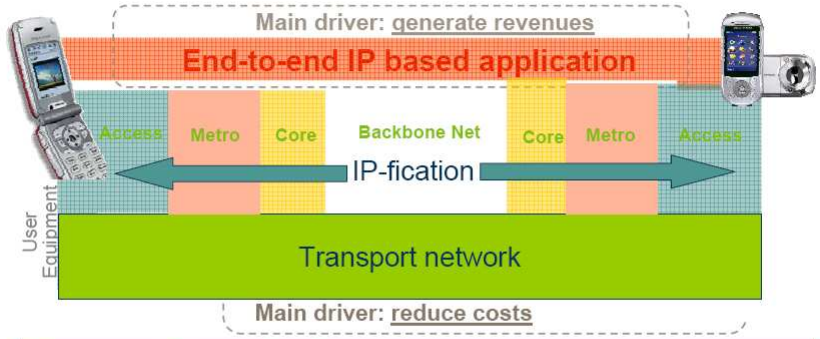
NGN makes use of best of both the worlds (flexibility, efficiency & Innovativeness of IP and QOS, Security, Reliability, Customer-friendly features of proven PSTN

- ***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 Emerging Services-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	**IPTV**	**BW on-demand**
IP Centrex	**Video on demand**	**QOS on demand**
Cloud Computing	**TV on demand**	**Triple play/Quad Play**
Virtualisation	**HDTV**	**Instant Messaging/ presence management**
Multimedia Conferencing	**Long distance bypass**	**MMS on fixed network**
Distance learning		**3G applications**
Tele Presence		**FMC (Fixed Mobile Convergence)**

What "All-IP" means



The term "All-IP network" refers both to:

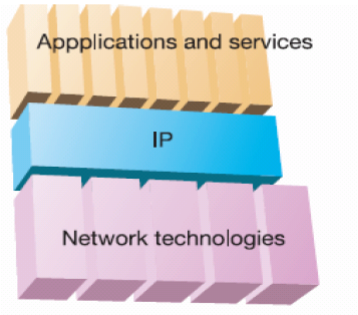
1. an enabler, together with other associated technology, to provide enhanced integrated service set, independent, as far as possible, of the access system used
2. transport technology as enabler to achieve decreasing OPEX

So…why using IP technology?

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

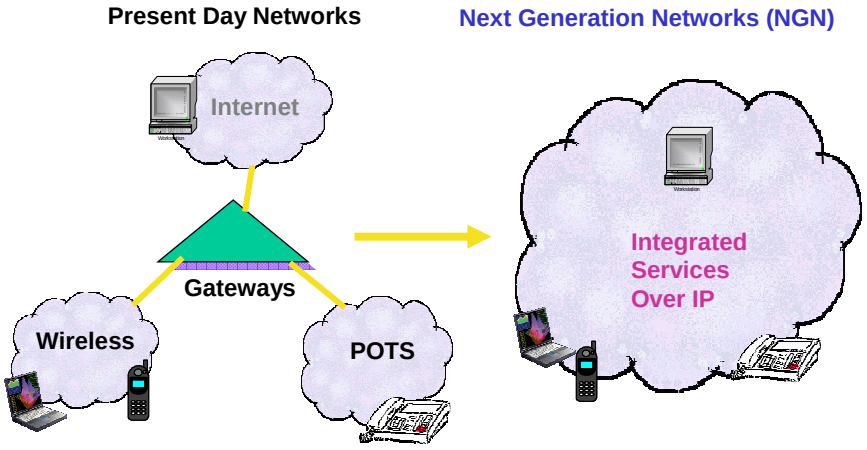
Everything over IP:
Any service & application due to protocol incapsulation on IP
IP independence of stream length

IP over everything:
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

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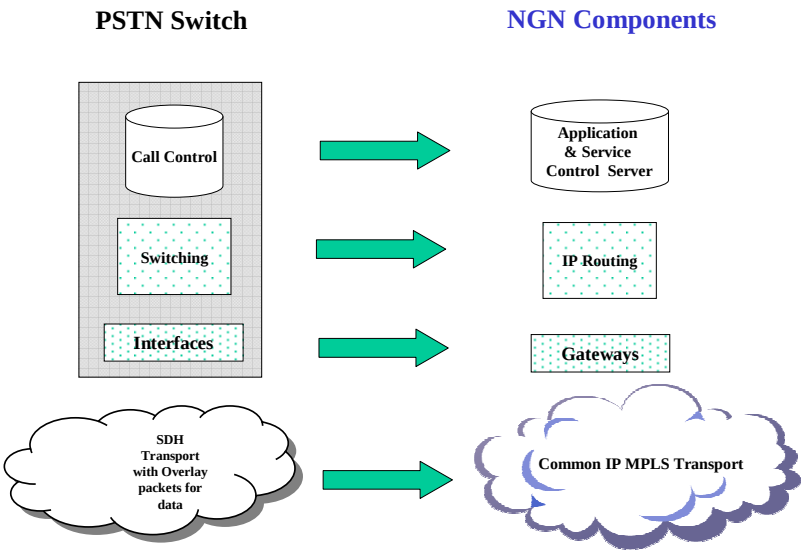
NGN v/s PSTN Elements



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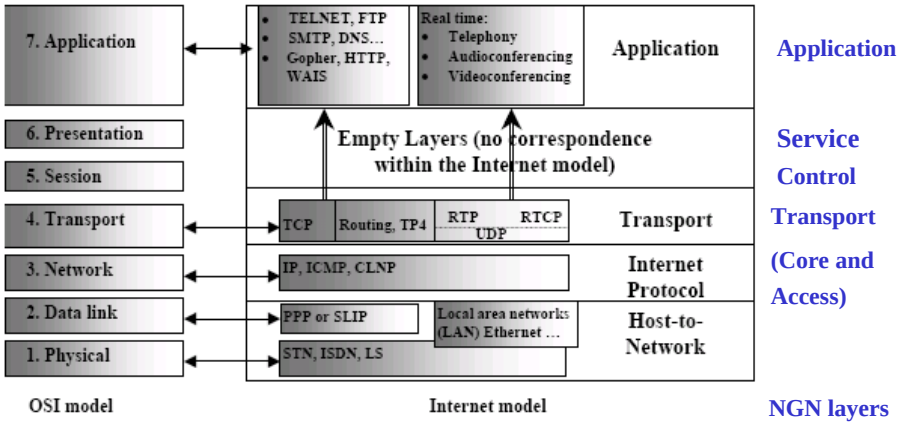
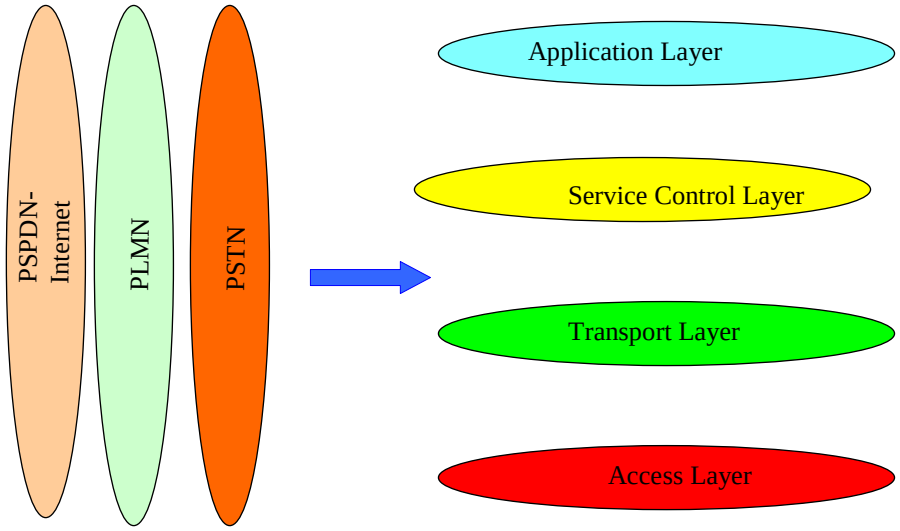
All-IP NGN Architecture – Layered Approach

Correspondence between the OSI, Internet and NGN model



NGN Concept-Layered Approach

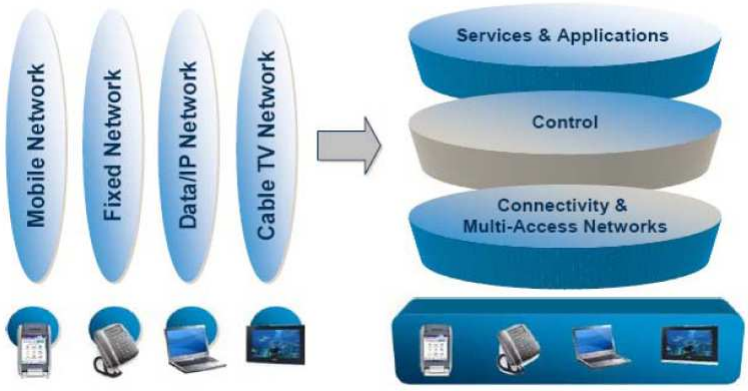


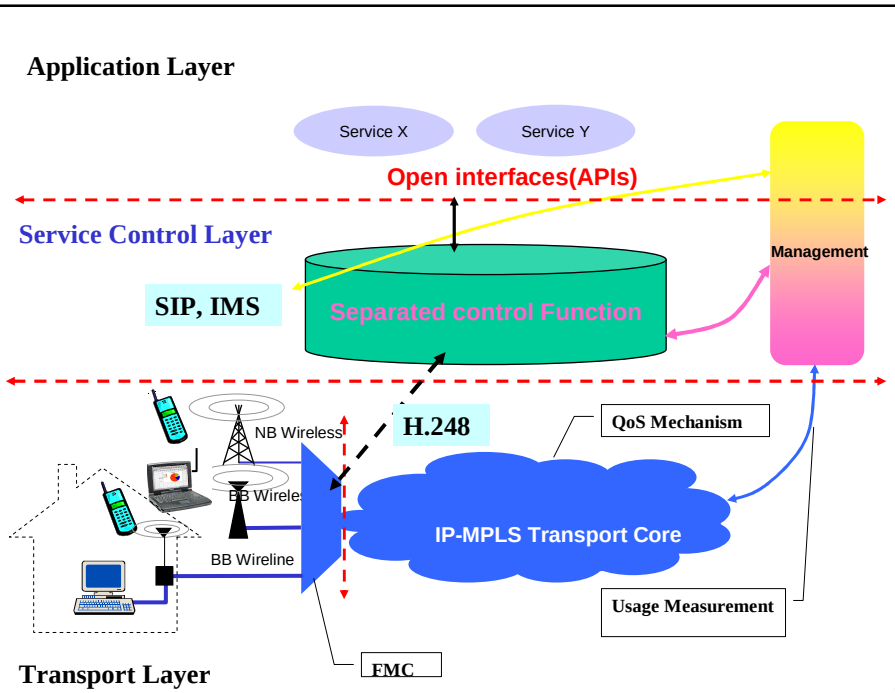
Silo Approach → **Layered Approach**

From Vertical to Layered Architecture

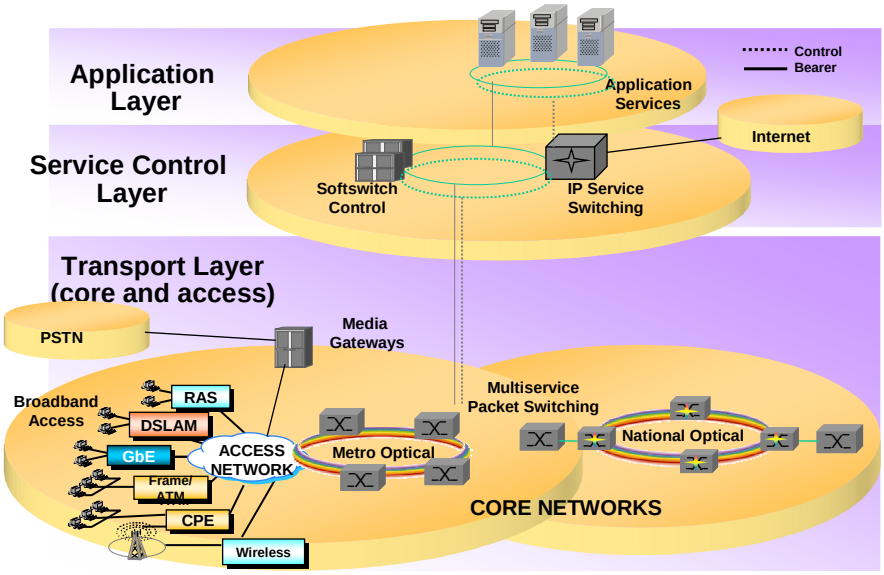
Past: one network for each service/device

Future: common net for all services/devices; services independent of connectivity & control

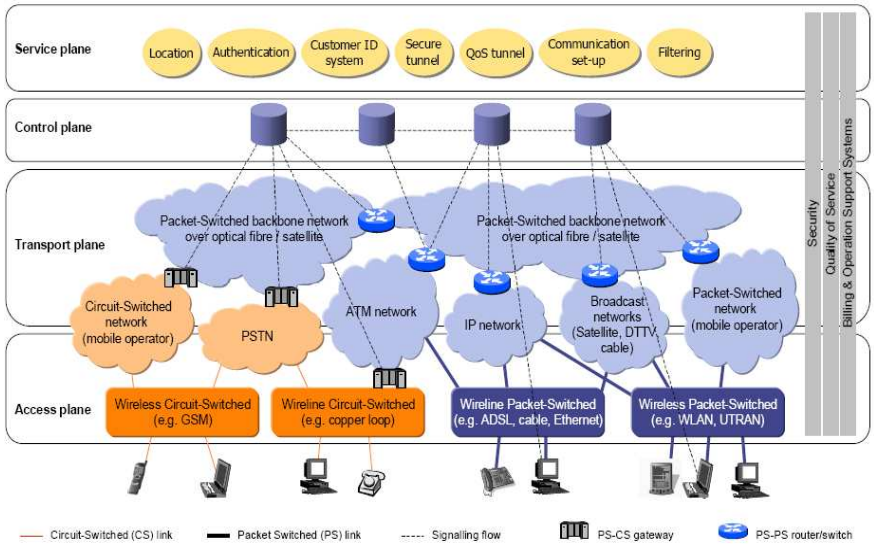




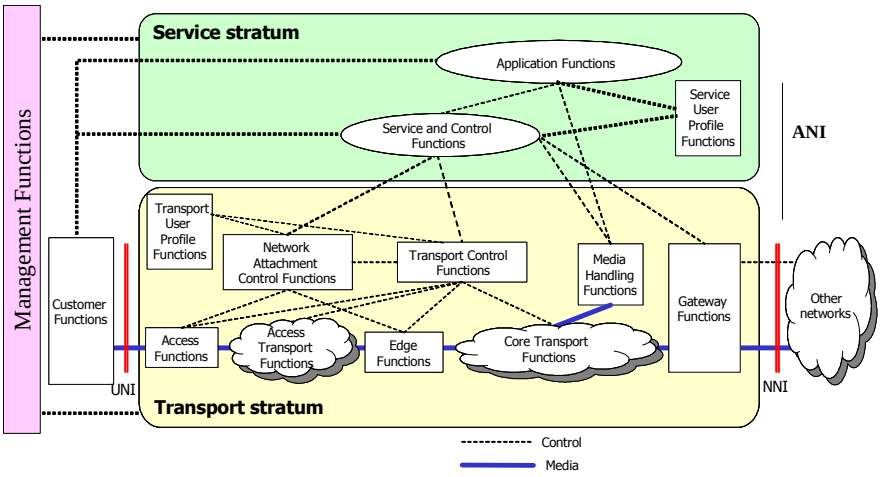
NGN – a layered architecture distributing intelligence



Practical NGN architecture



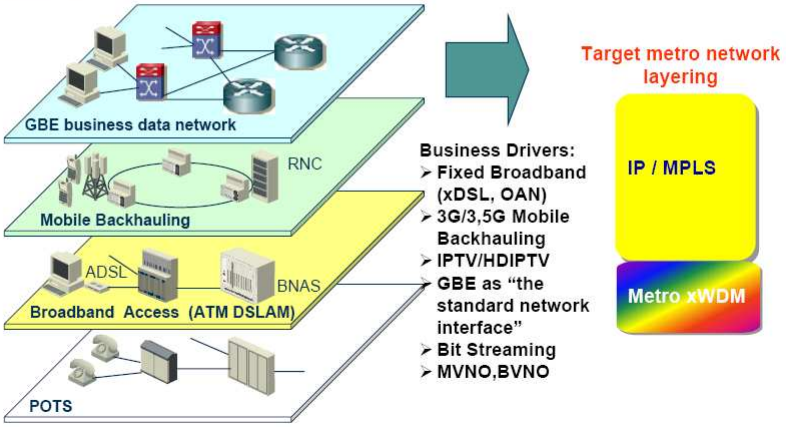
ITU-T Structural model of NGN functional components



Ref: http://ties.itu.int/u/fgngn/fgngn/readonly/200504_Geneva/focus_group_reports/FGNGN-MR-0040r1.doc

Convergence in the Metro Network

Simplify metro network, de-layering, scale-up for optimization



Fundamental characteristics of All-IP NGN

* Packet-based transfer (IP)
•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

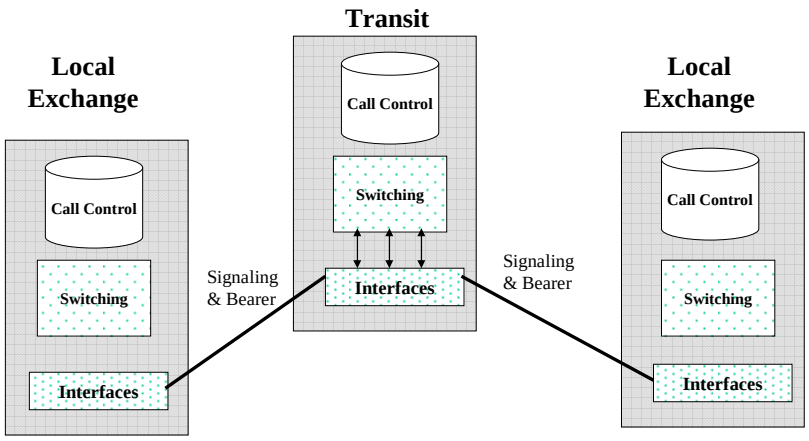
Requirements for NGN Implementation

- 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

Requirements for NGN Implementation

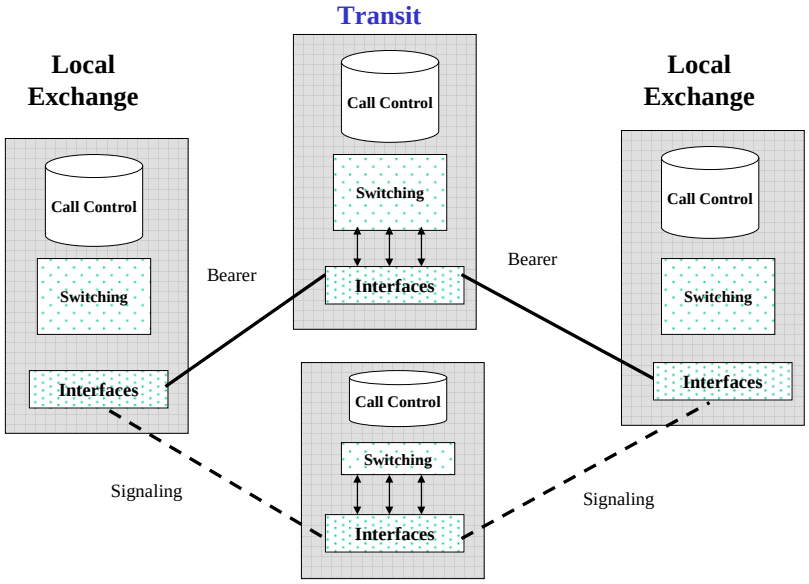
- Need to share management functions like provisioning, metering, billing, QOS monitoring, OSS etc. among Operators
- Provide Generalized Mobility features
  - Mobility features at the fixed access, nomadism (Limited Mobility)
  - Provide service continuity between fixed and mobile access leading to convergence
- Common technology for transport layer
  - IP MPLS has emerged as the most suitable technology for this layer
  - Carrier Ethernet is emerging as future option

Circuit Switching -Channel Associated Signalling (CAS)



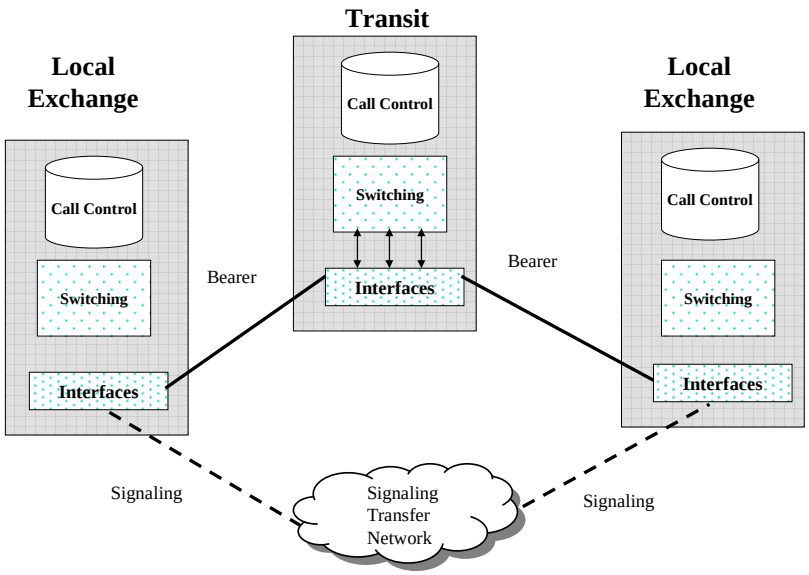
Bearer is a voice channel

Circuit Switching-Common Channel Signalling (CCS)

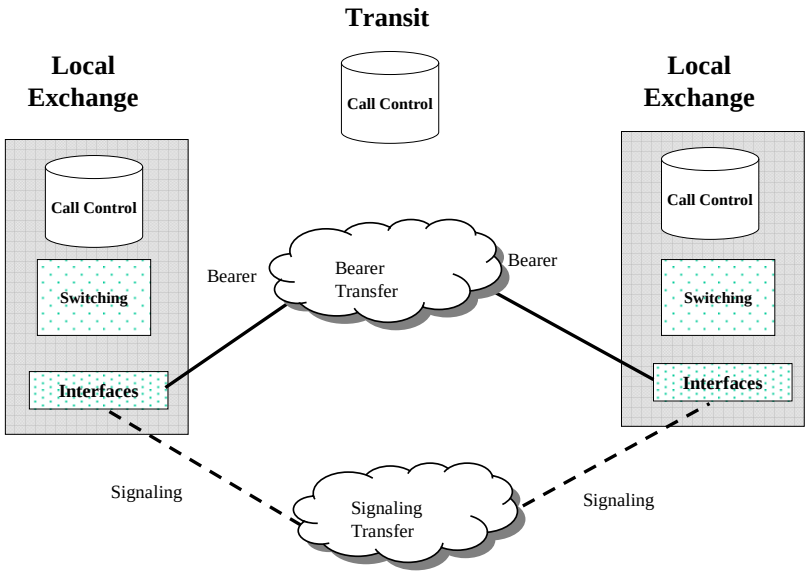


STP- Signalling Transfer Point

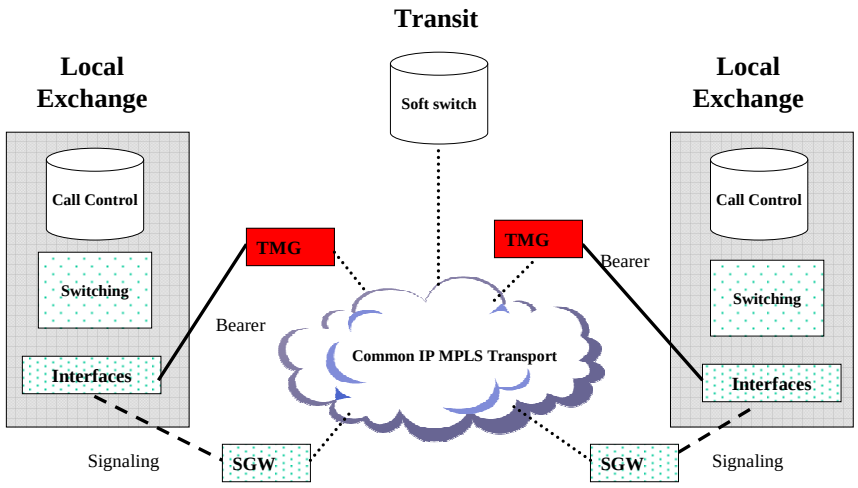
Circuit Switching-(CCS)



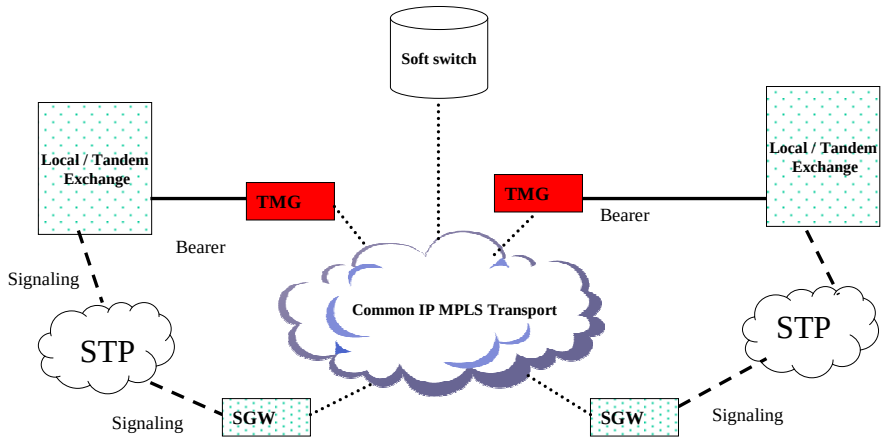
Circuit Switching- (CCS)



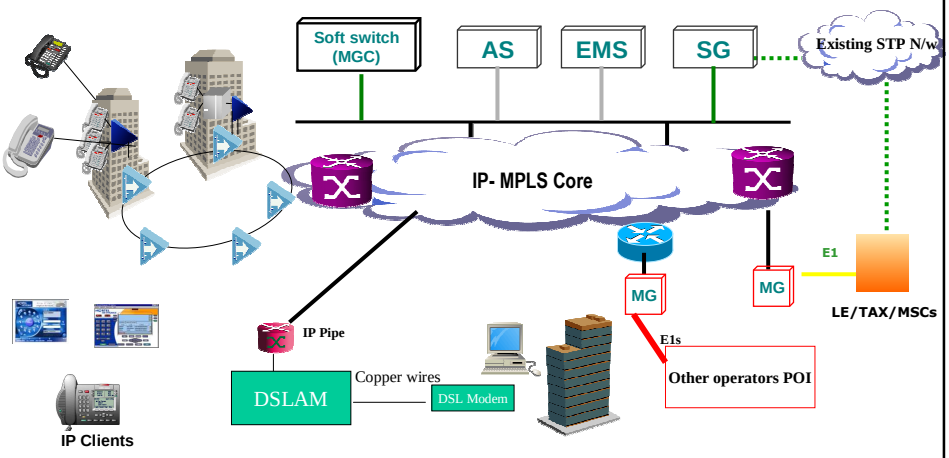
Soft Switching Transit Architecture



Soft Switching Transit Architecture



Access Network-Fixed



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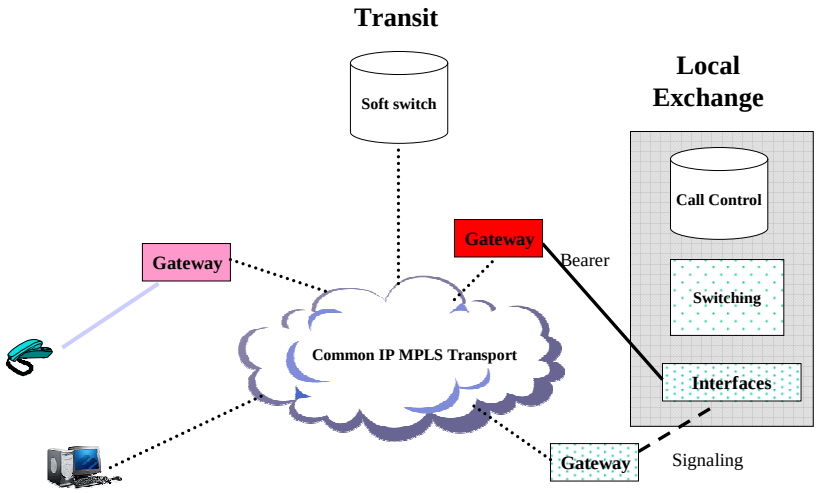
Next Generation Switching



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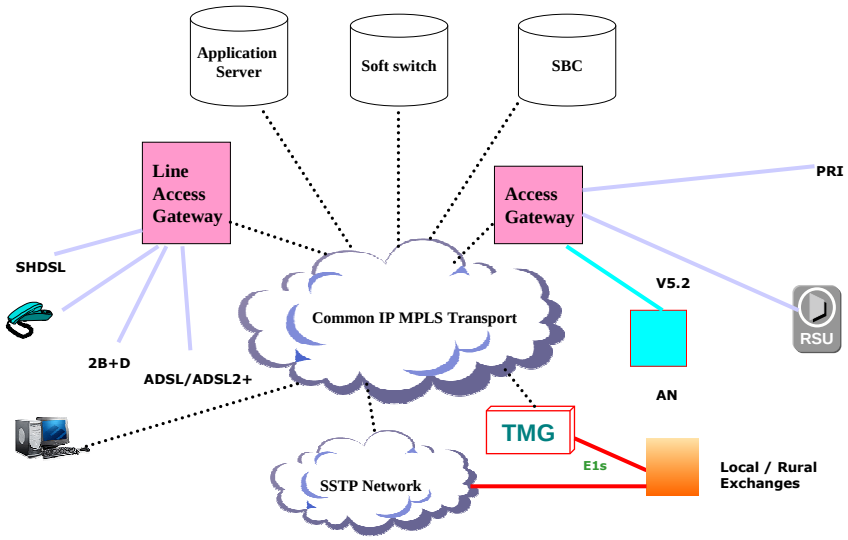
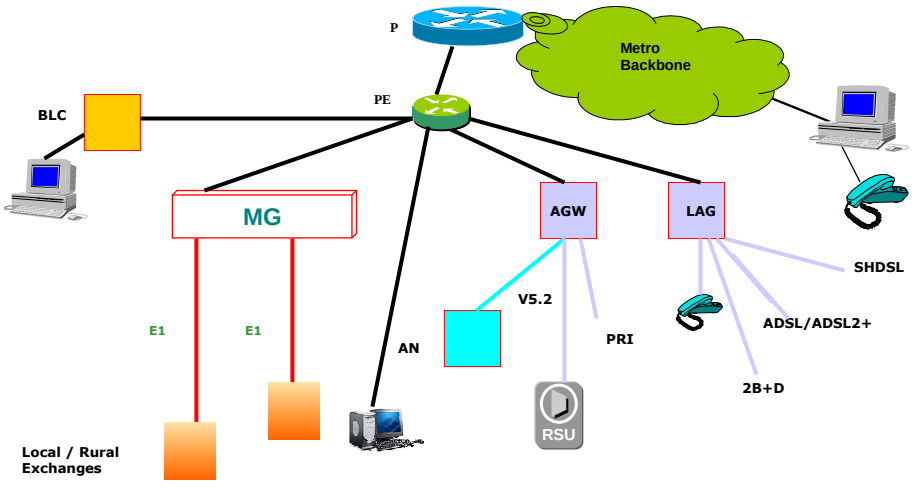
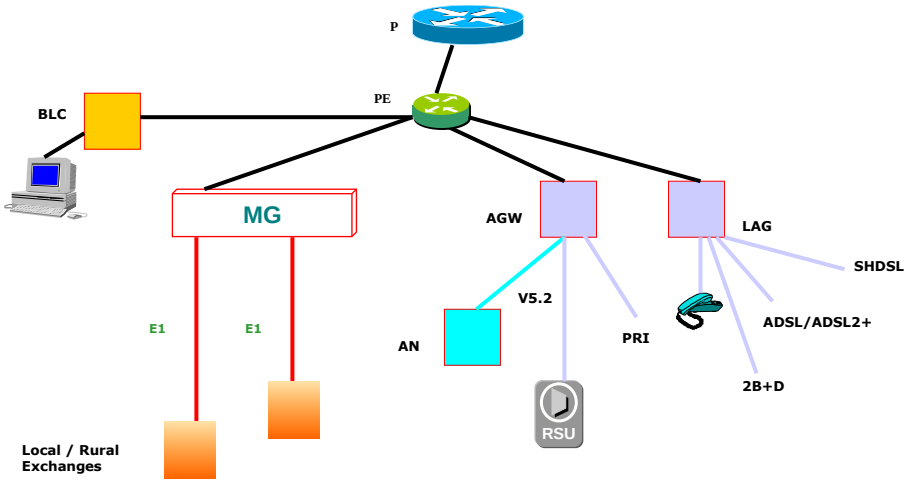
Next Generation Switching Architecture



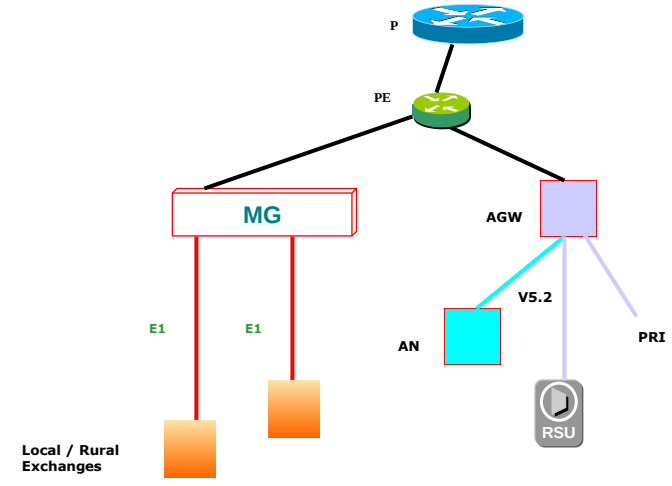
Local Level IP Network- A case of Metro City



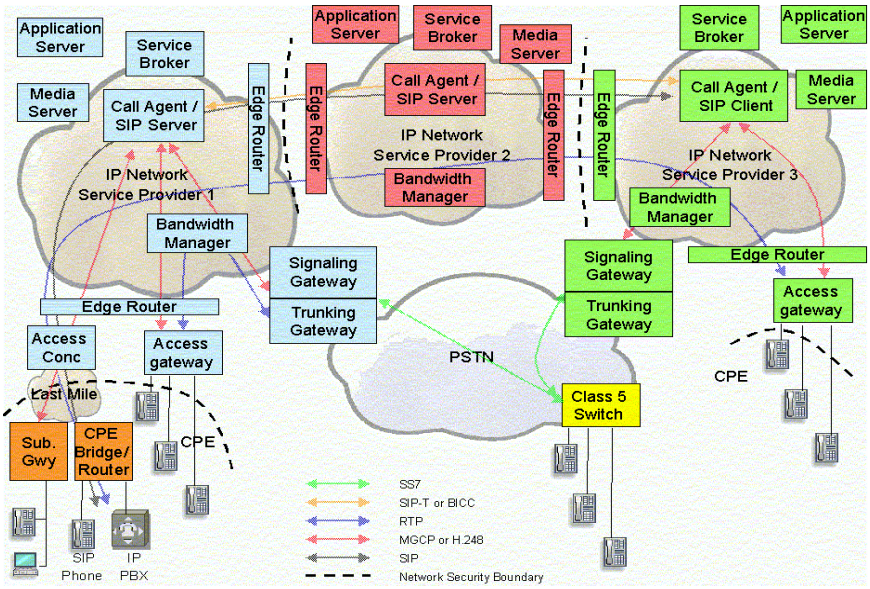
Local Level IP Network-
Case of a Normal City



Local Level IP Network-
Case of a Normal Local Area



Emerging VOIP Architecture



NGN Components

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

1. ***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**

2. ***Service Control Elements***
   - **Policy Control Framework for subscriber policy tracking and enforcement**
   - **Application level policy enforcement**
   - **'AAA' servers for billing and accounting & Authentication**

3. ***End User Devices (CPE)***
   - **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
- **Trunking 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 Network (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)**

Service Control Network Elements (Contd.)

- **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**
- **Signalling Gateway (SG)**
  - **A unit that provides signalling conversion between the NGN and the other networks (e.g. STP in SS7)**
- **E.NUM (Electronic Numbering)**
  - **Protocol that allows to establish a correspondence between the traditional telephone numbering (E.164) and the network addresses related to the packet mode networks (RFC 2916 "E.164 number and DNS" IETF)**

Service Control Network Elements (Contd.)

- **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-Switched 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.**

Service Control Network Elements (Contd.)

- **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**
- **BGP (Border Gateway Protocol)**
  - **Performs inter-domain routing in TCP/IP networks, handling routing between multiple autonomous domains. Routers use BGP to maintain a consistent view of the inter-network topology**

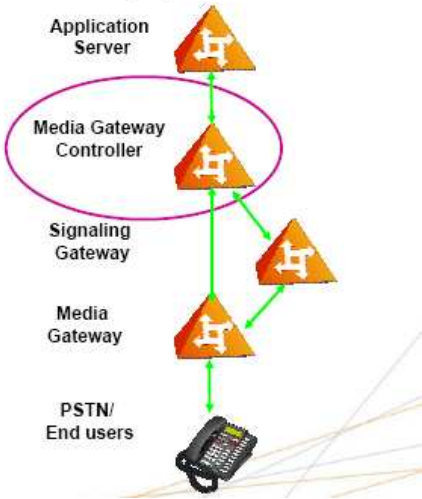
Service Control Network Elements (Contd.)

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

Softswitch – 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



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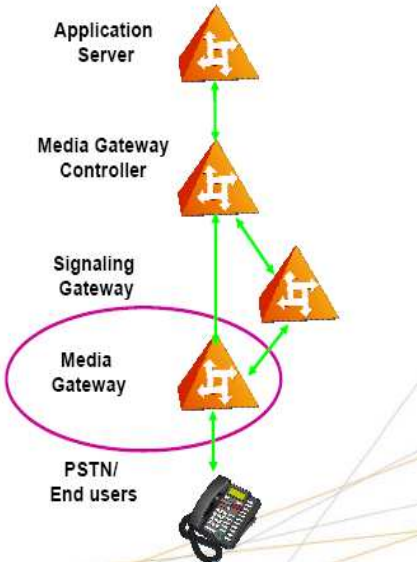
Softswitch – Media Gateway

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



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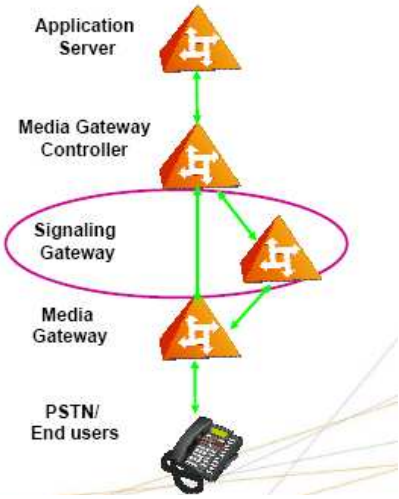
Softswitch – Signalling Gateway

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

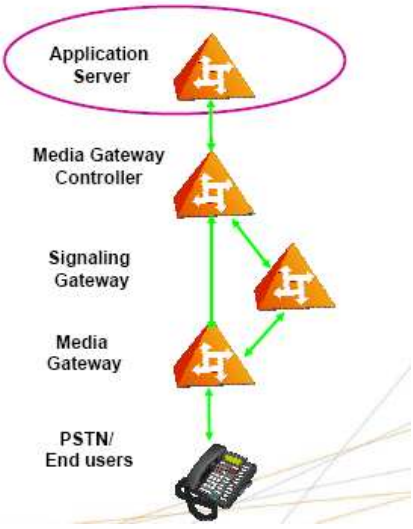
- Convert SS7 to IP packets
- Convert IP to SS7 packets
- Signaling transport (SS7, SIP-T, Sigtran…)
- Extremely secure
- Extremely fault tolerant



Softswitch – Application Server

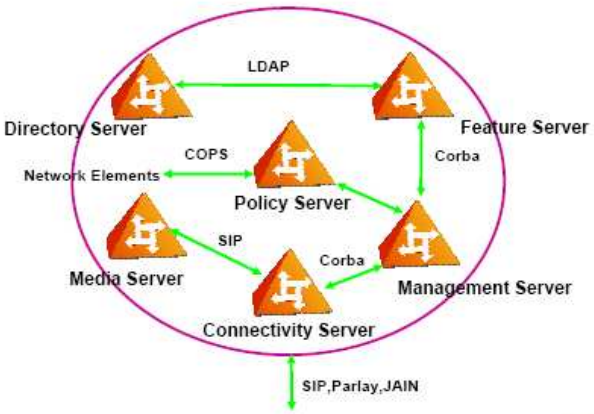
Application Servers(AS) provide the new services that are the real "value-add" for Soft switches

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



Softswitch – Application Server (Cont'd)

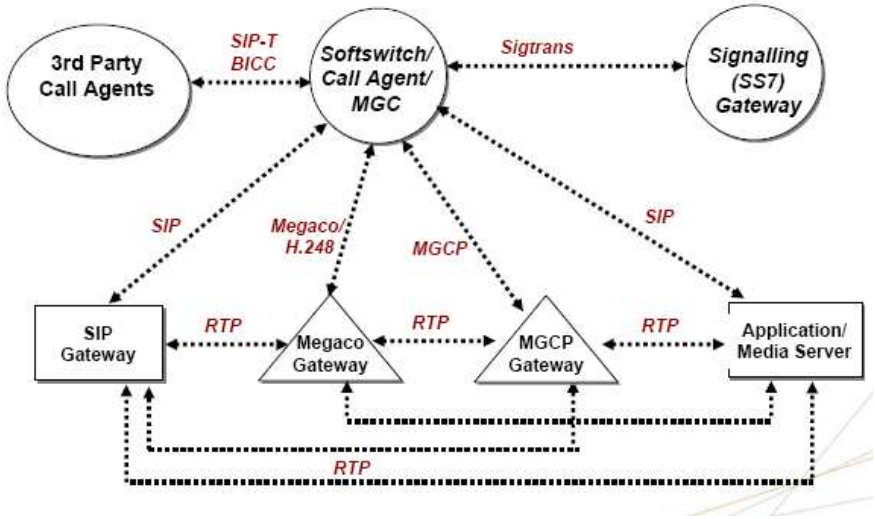
Application Servers(AS) Can be broken apart and distributed in the network



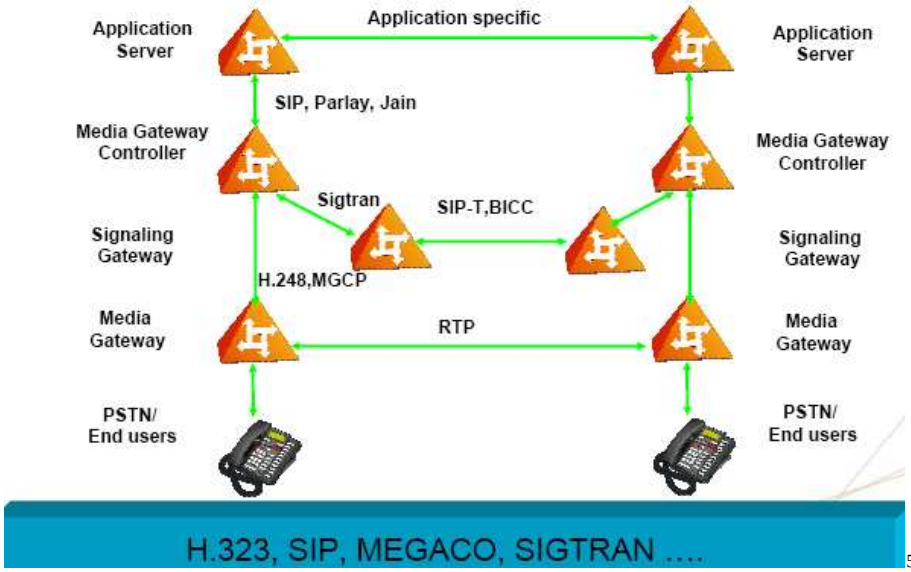
Network Management

- IP
  - SNMP
  - CMIP
  - CORBA
- Legacy
  - TL1
  - Bell core AMA Format (BAF)
- With VoIP far more detail is necessary in the CDRs:
  - Packets transmitted
  - Packets lost
  - Jitter, Delay
  - Call Control / Gateway used
  - Codec used
- New Management applications for VOIP
  - End-to-End Network Management Applications (Fault Management and Provisioning)
  - Policy Management
  - Service Monitoring/Assurance
  - Sophisticated Traffic Engineering Tools
  - Service Portals allowing subscribers to Manage their service profiles

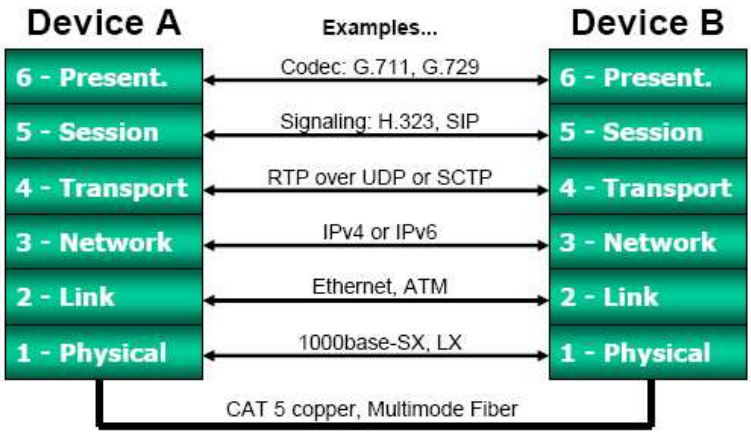
VOIP standards / protocols



Softswitch - Interdomain protocols



Layer-wise Interoperatablity



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

NGN Service Control Network Element-IMS
(IP Multimedia Subsystem)

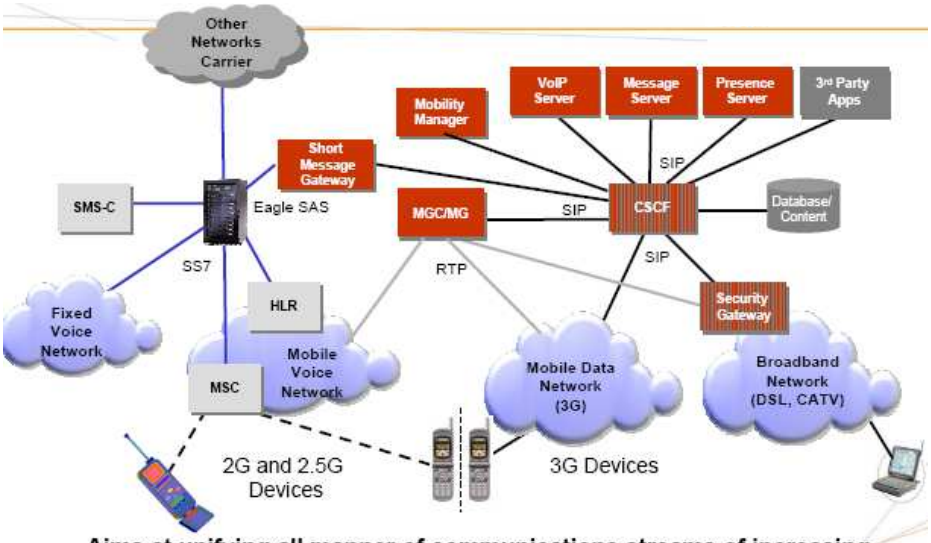
What is IMS?

- **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)**

What does IMS provide?

- **Services 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**
- **Connectivity Network Independence**
  - **Provides access to IP based services independent of the underlying connectivity technology (mobile / fixed)**
- **An open standard with evolutionary scope**
  - **IMS architecture & SIP may be easily extended to provide for new services**

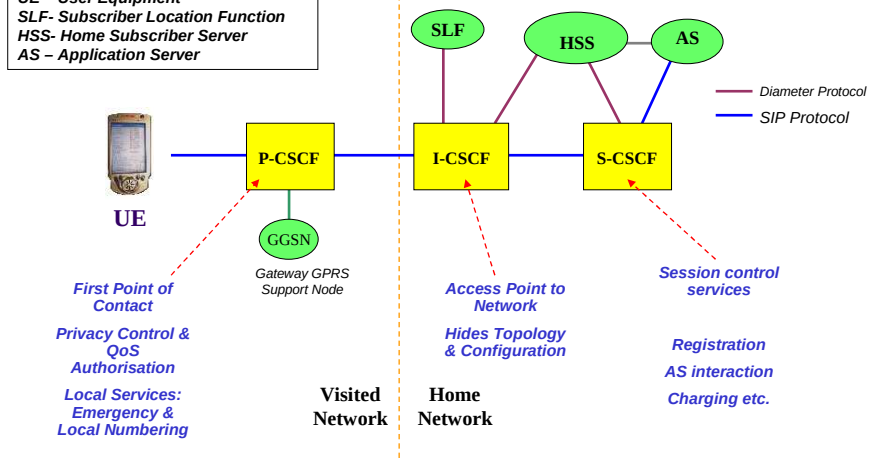
IMS Concept



Aims at unifying all manner of communications streams of increasing complexity with voice, video, data, giving full interoperability between fixed and wireless networks and yielding a common end-user experience

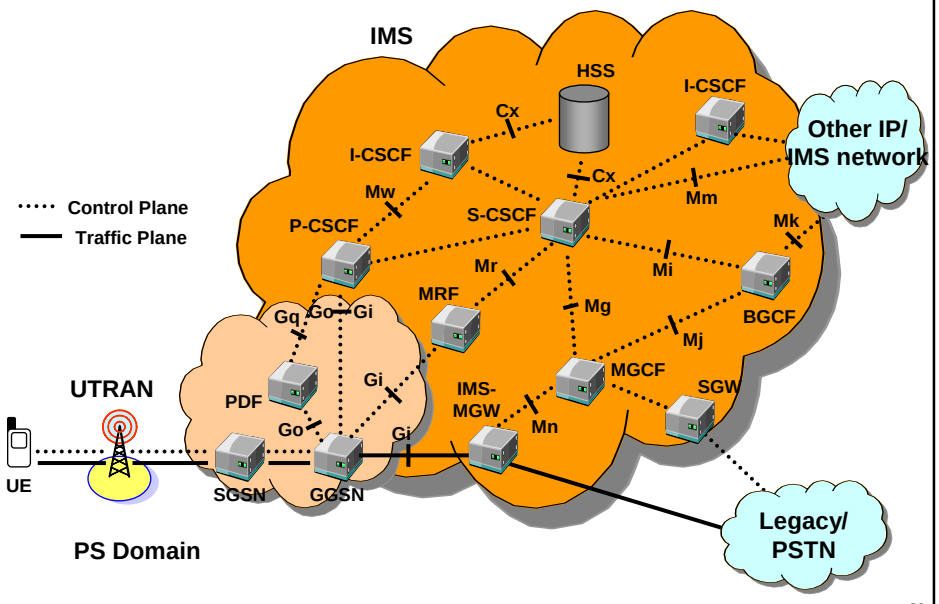
IMS basic components

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



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

IMS Architecture



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

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 encouraging 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)

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

IMS vs. Softswitch

Two approaches to call handling:

- **Soft Switches – 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 vs. 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.

IMS and Softswitch – ETSI's Migration Path to IMS

- **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

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

Fixed Mobile Convergence (FMC)

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 Broadband network on hand-held device (e.g. 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-mode, multi-band, Multi-Purpose hand-held computer**
5. **NGN Technologies enabling FMC (IMS, UMA)**

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).

Advantages of IPv6

- 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'

Key differences between IPv4 & IPv6

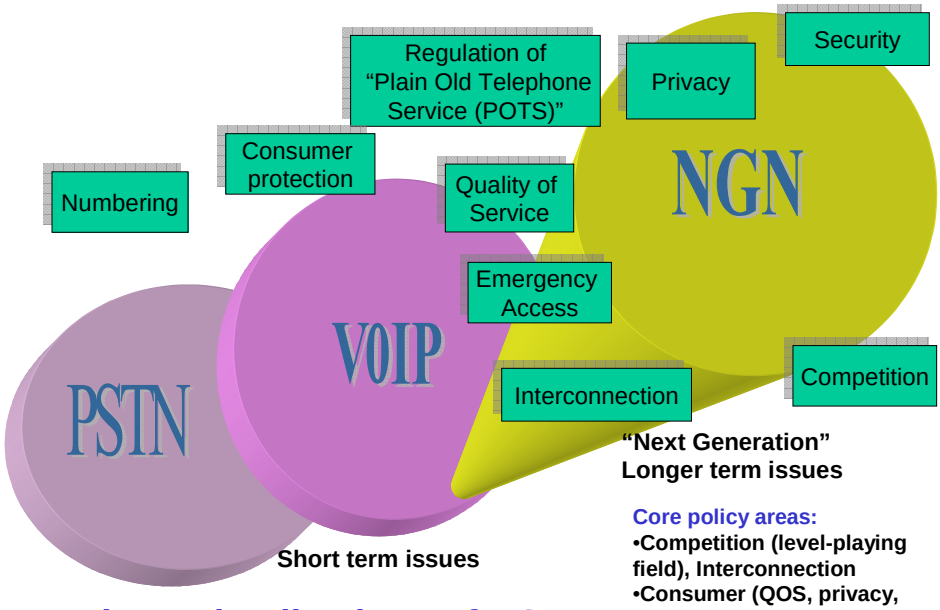
IPv4	IPv6
Source and destination addresses are 32 bits (4 bytes) in length.	Source and destination addresses are 128 bits (16 bytes) in length.
No identification of packet flow for QoS handling by routers is present within the IPv4 header.	Packet flow identification for QoS handling by routers is included 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-Regulatory Challenges

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.

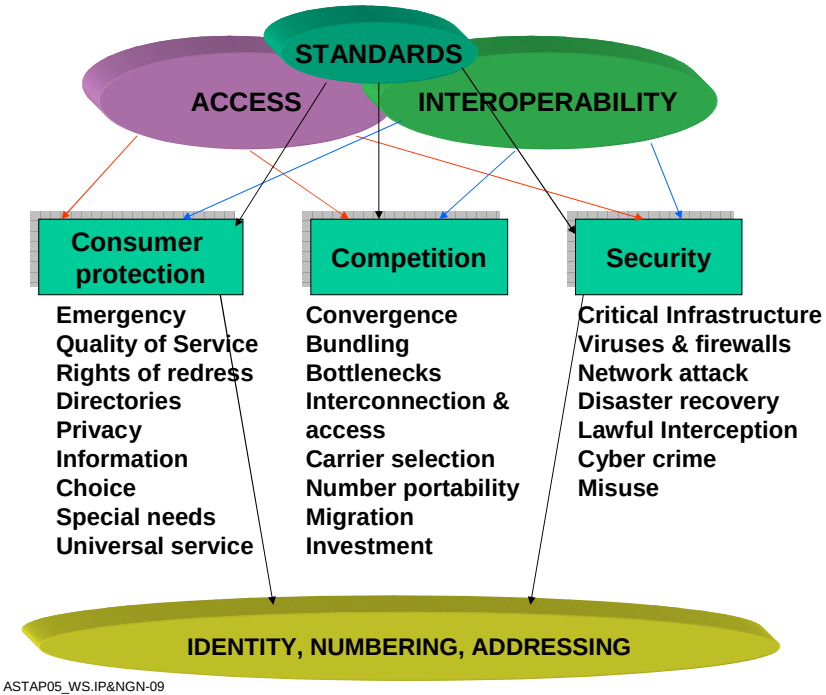


Core policy areas:
- **Competition (level-playing field), Interconnection**
- **Consumer (QOS, privacy, emergency access)**
- **Security & legal interception**

Scope for self-regulation

Regulatory implications of NGN

Source: ASTAP05_WS.IP&NGN-09



Source: ASTAP05_WS.IP&NGN-09

NGN-Regulatory Challenges for Developing Countries

- 'Light-touch' v/s 'Tight' regulation, Regulatory withdrawal, forbearance
- Ex-ante v/s Ex-post regulation
- Level-playing field issues – Service level competition, Network level 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, capacity based charging vs Usage based charging(minutes and miles), CPNP vs. Bill and Keep, FAC vs. FL- LRAIC
- Mandating of emergency access and location details – 100, 101, E911 etc.
- Security aspects of NGN – Amenability for legal intercept and monitoring (LIM), Wiretap, CALEA

NGN QOS Concerns-Already managed

- Four components affect the voice quality:
  - Bitrate
    - The total bitrate depends on the codec used plus the various layer headers
  - Packet Loss
    - Voice is extremely intolerant in regards to packet loss, QoS in the IP infrastructure is essential to carry VoIP
  - Fixed Delay
    - Voice is far more sensitive than data in regards to delay, and special considerations must be taken
  - Jitter
    - Codecs don't deal well with variable delay (a.k.a jitter) and VoIP systems need to compensate for it

MPLS, Diffserv, VAD are some mechanisms to address the above

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

Security Concerns (Cont'd)

- 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)

Implement multiple security solutions for meeting the varying requirements Resulting in a comprehensive layered security solution that will not result in a single point of failure

NGN-Business Survival Opportunity

Evolve towards "all-IP" multi-service infrastructure

- **Exploit**
  - mature IP technology and existing IP infrastructure to transport the fast growing volume of user and signaling traffic
- **Assure**
  - that the IP infrastructure has the telecom grade characteristics

A cost effective way to grow business

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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 minimize it?**
    - **CAPEX : Capital Expenditure**
    - **OPEX : Operational Expenditure**
- **Future convergence with broadband network**
  - **Where to introduce a common part?**
  - **At which pace?**

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Cost Benefits Analysis for Incumbents Considering 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 •Introduction of Wholesale pricing (retail-minus) by regulator

General Consideration for PSTN migration to NGN

- Services are key when defining 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 investments,
- Access modernization (Broadband) 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.

Interaction??

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