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NGN Migration- Interconnection Challenges Role of CBC and IX

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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

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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.

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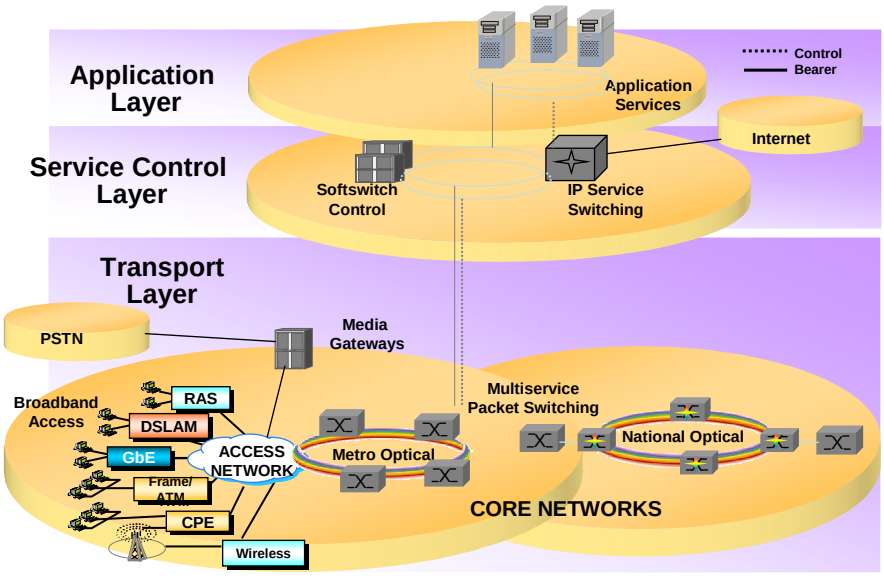
IP based NGN – A Layered Architecture



Implications of NGN-Something for Everyone

- **Different implications for different stakeholders**

  - ✓ **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**

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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**

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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
- *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
  - No need for separate networks for voice, data and video
- *Advantages for subscribers*
  - Reduced call charges
  - New innovative services at a fast speed
  - Single connection and bill for voice, data, video,mobile (Quad play)

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NGN Regulatory Challenges- Emerging Markets

(i) Death of distance and blurring of the traditional boundaries between Access (local) providers and long distance carriers.

(ii) VOIP as a "disruptive technology" putting a challenge for the regulators to perform a balancing act in maintaining level playing field.

(iii) 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.

(iv) Level playing field issue between the licensed telecom operators and value added service providers.

(v) Need for new interconnect products based on capacity and quality (V&V) in place of those based on distance and duration (miles & minutes).

(vi) Access to emergency services like police control room, fire services, medical help etc. (PSAP, E 911 (US), 999 (UK), 100 (India))

(vii) Security monitoring like legal interception & monitoring (LIM), wiretap, CLI etc.

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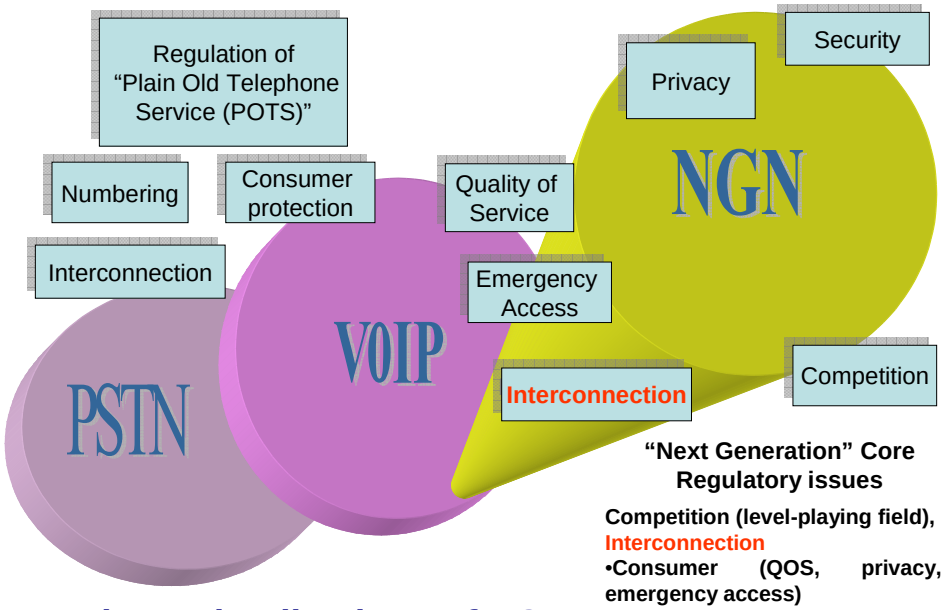


Regulatory implications of NGN

"Next Generation" Core Regulatory issues

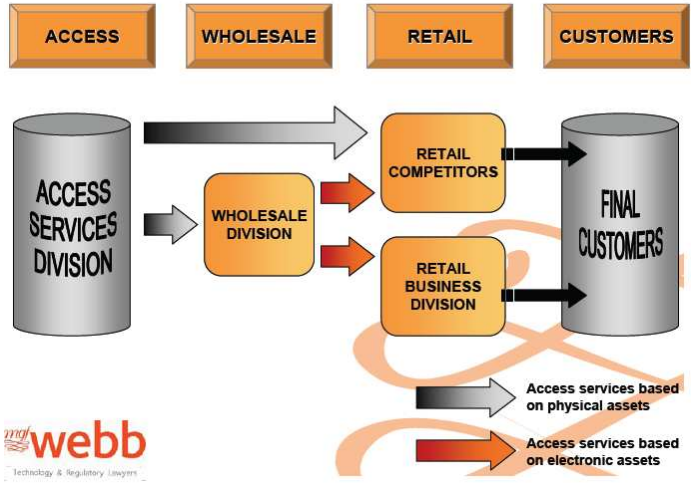
Competition (level-playing field), Interconnection

- **Consumer (QOS, privacy, emergency access)**
- **Security & legal interception**

Scope for light-touch regulation

Source: ASTAP05_WS.IP&NGN-09

Functional Separation – A new Wholesale Concept



NGN Regulatory Ecosystem for Emerging Markets

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 Efficiencies

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

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Interconnection in 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.

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Interconnection – General Requirement

❒ Users of different networks need to Communicate with or Access each other.

❒ Dominant or Incumbent operators should provide Access to new entrants for:

- **Enabling competition and growth**
- **Increased and efficient use of telecom facilities**
- **End- to- end seamless connectivity of networks**
- **Facilitating efficient capacity utilization and enhanced service quality**
- **Avoiding non-discriminatory Access**

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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.

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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)**

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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

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Components of Interconnect Usage Charges (IUC) -OTT

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

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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.

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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

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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

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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 ?

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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)

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Interconnection Charging in IP Domain

Four main basis for Interconnect charges in IP based regime:

A.Calling Party's Network Pays (CPNP)

Network that initiates the call pays for the call, usually based on the duration of the call.

B. Bill and Keep (Senders Keep All)

No charges for termination, a kind of barter system used in Internet, too revolutionary for NGN

C. Based on Capacity and Quality of Service/Experience

Capacity of the Interconnection Links and Commitments (SLA) for Quality of Service

D. Bulk Basis ('Interconnect Hotel' IX)

Charging of applicable Interconnection charges on bulk usage basis rather than per minute basis which is prevalent currently

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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?

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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)

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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.

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NGN Interconnection - Charging options *(Contd..)*

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

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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

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NGN Charging Challenges: traditional cost allocation method?

- **Extrapolation of current model can work but only for a short time:**
  - **Assumes costs of NGNs should not be greater than Circuit Switched networks**
  - **Ignores NGN structural changes in the industry**
- **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 business plans are needed to provide reality-check to any regulator to ensure reward for innovative investment and to provide fair ROI.**

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NGN Interconnect- Charging options: EBC vs. 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).**

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NGN charging options: 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.

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NGN charging options: Bill and keep (Contd..)

- 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).

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NGN costing options: Bill and keep (Contd..)

Bill & Keep Option – 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.**

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NGN costing options: Bill and keep (Contd..)

- **Bill & Keep Option- 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 presentaly .**

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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).

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NGN costing : a combination of options (Contd..)

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.

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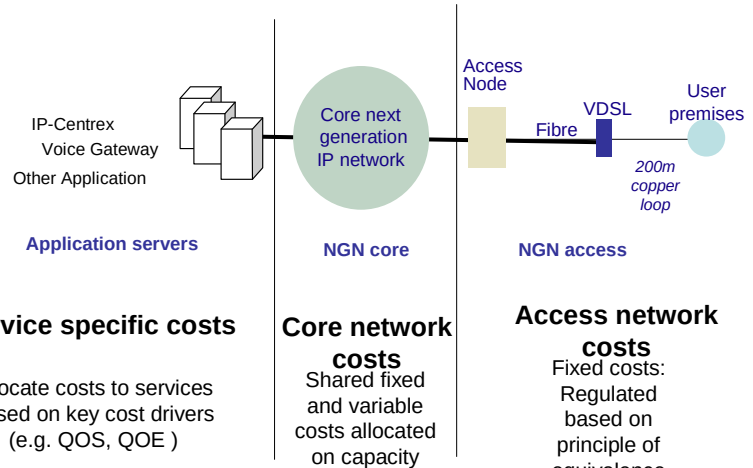
A Hybrid model for NGN cost allocation



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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.

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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.

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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

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Interconnection in NGN- Technical Issues (Contd..)

- Numbering, Charging, Switching & Routing for Interconnection in Multiple-Operator Multi-Service Networking scenario
- Technical/ Network up-gradation or modifications to facilitate Interconnection

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NGN Interconnection-Technical issues

1. **Interconnection between two IP networks**
2. **Interconnection between traditional PSTN/PLMN networks with IP Networks.**

1.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**

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NGN Interconnection-Technical issues

- **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**

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NGN Interconnection- Technical issues (contd..)

- **Application Layer 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)

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2.Interconnection of PSTN/PLMN with IP Networks

a.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

b.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.**

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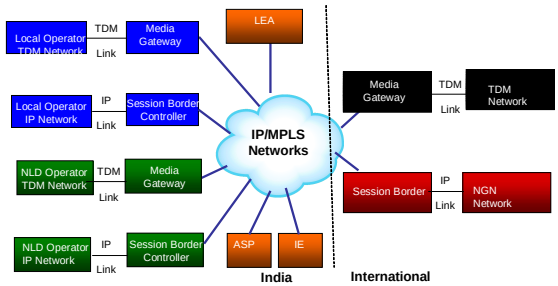
NGN-PSTN Interconnection Architecture

The inter-operator scenario in a NGN environment is shown below:



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NGN PSTN Interconnection-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**

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NGN-PSTN Points of Interconnection

•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?

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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.).

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Interconnection in NGN - Interconnect Exchange (IX)

Role of Interconnect Exchange-Simplification

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

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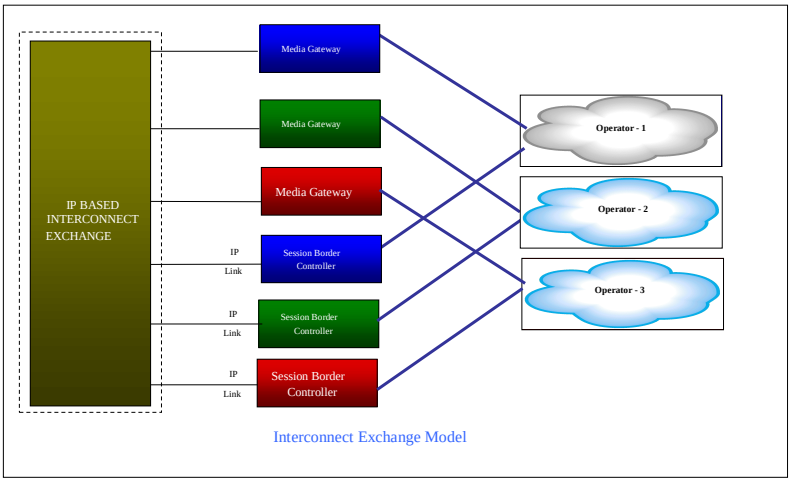
Interconnect Exchange Model



Interconnect Exchange Model

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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.

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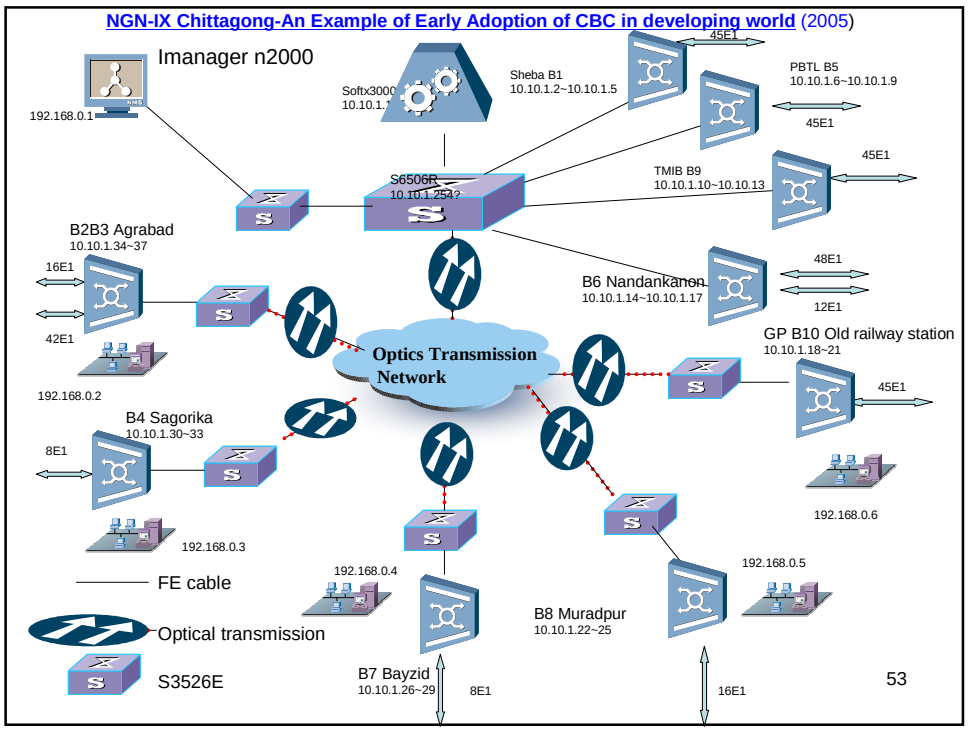

Thank You

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