NGN interconnection: technology challenges

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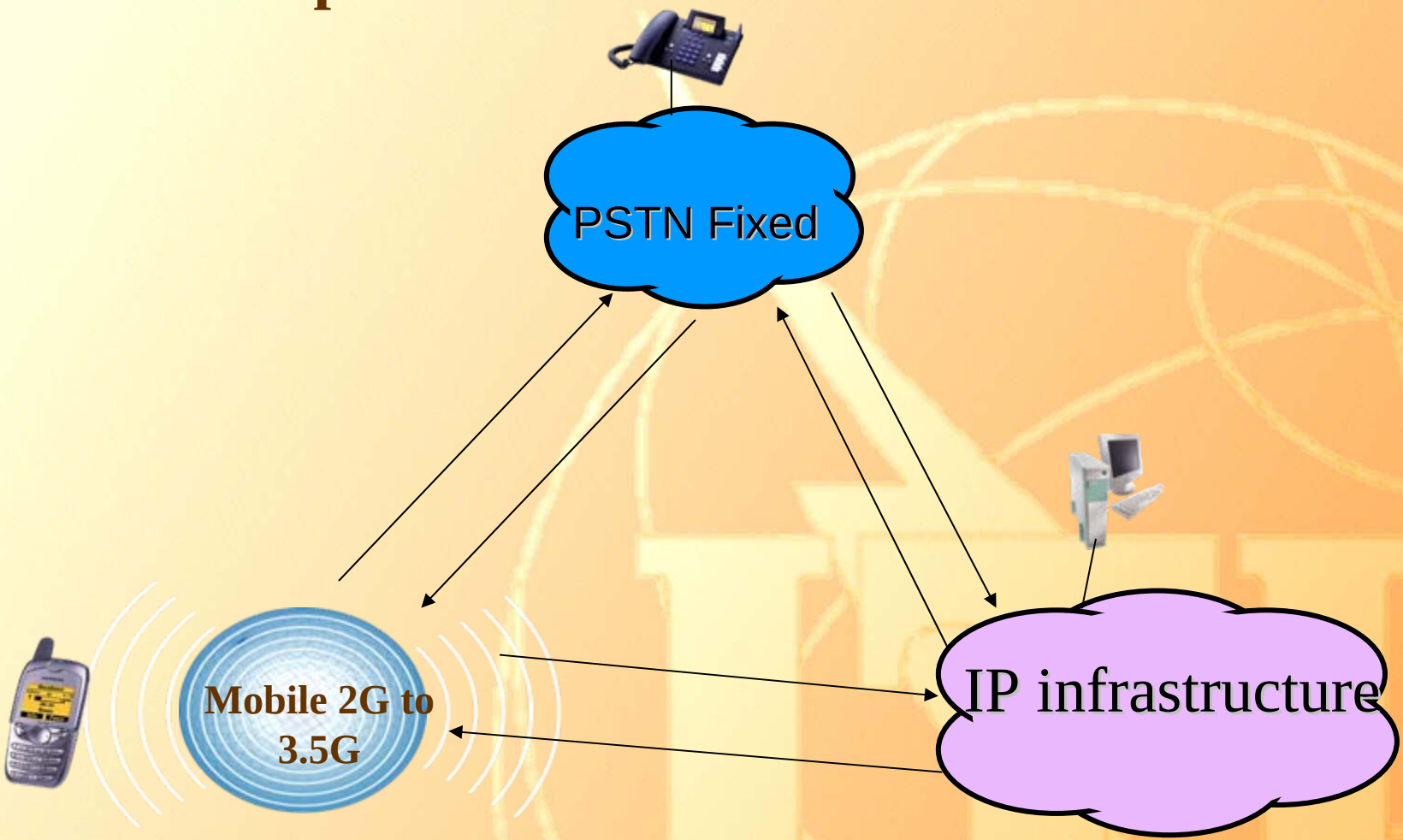
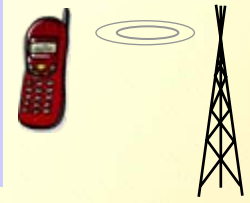
TODAY

- We have different networks offering different services.
- Networks with Different architectures.
- For voice application today Networks use common and standardized signaling protocols.
- Networks offering certain guarantees in terms of security and quality of service.
- Interconnection interfaces are standardized.
- Common addressing schemes.
- Call routing schemes are optimized and deterministic.

TODAY: Networks interconnection fairly “mastered” from technical, costing and legal standpoints



Legacy networks interconnection



Mobile network

IT

IS

Fixed network1

NTT

TS

NTT

LS

Fixed network2

NTT

TS

LTT

NTT

LS

LS

LS

JT

RCU

SOHO

Residential Voice users

Residential Voice users

Clients Entreprises

Residential Internet users

Near Future and tomorrow: One Broadband Managed IP Network

Aspects impacting interconnection (1)

- One network offering different services.
- Different types of accesses but one metro (eventually) and one core Network.
- Different signaling protocols developed by different standardization entities.
- Guarantees in terms of security and quality are not yet equivalent to those offered by legacy networks .

Near Future and tomorrow: One Broadband Managed IP Network

Aspects impacting interconnection (2)

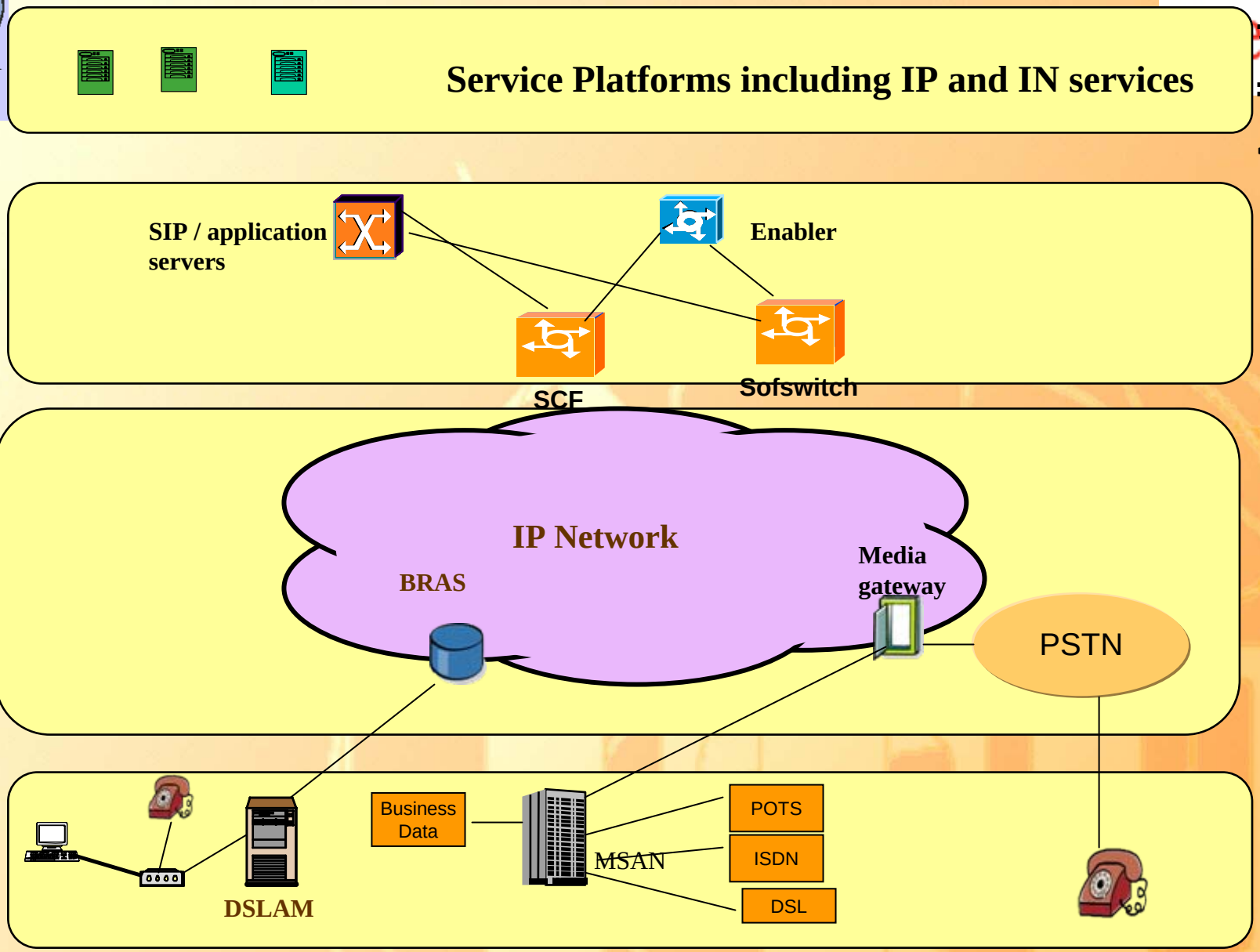
- Interconnection interfaces are under standardization process.
- Different addressing schemes suggested.
- Call routing schemes are to be optimized.
- Flat architecture and small Number of POIs as compared to legacy interconnection topology.
- Different interconnection topology according to the legacy – NGN migration scenario.

NGN: Different definitions given by different standardization players

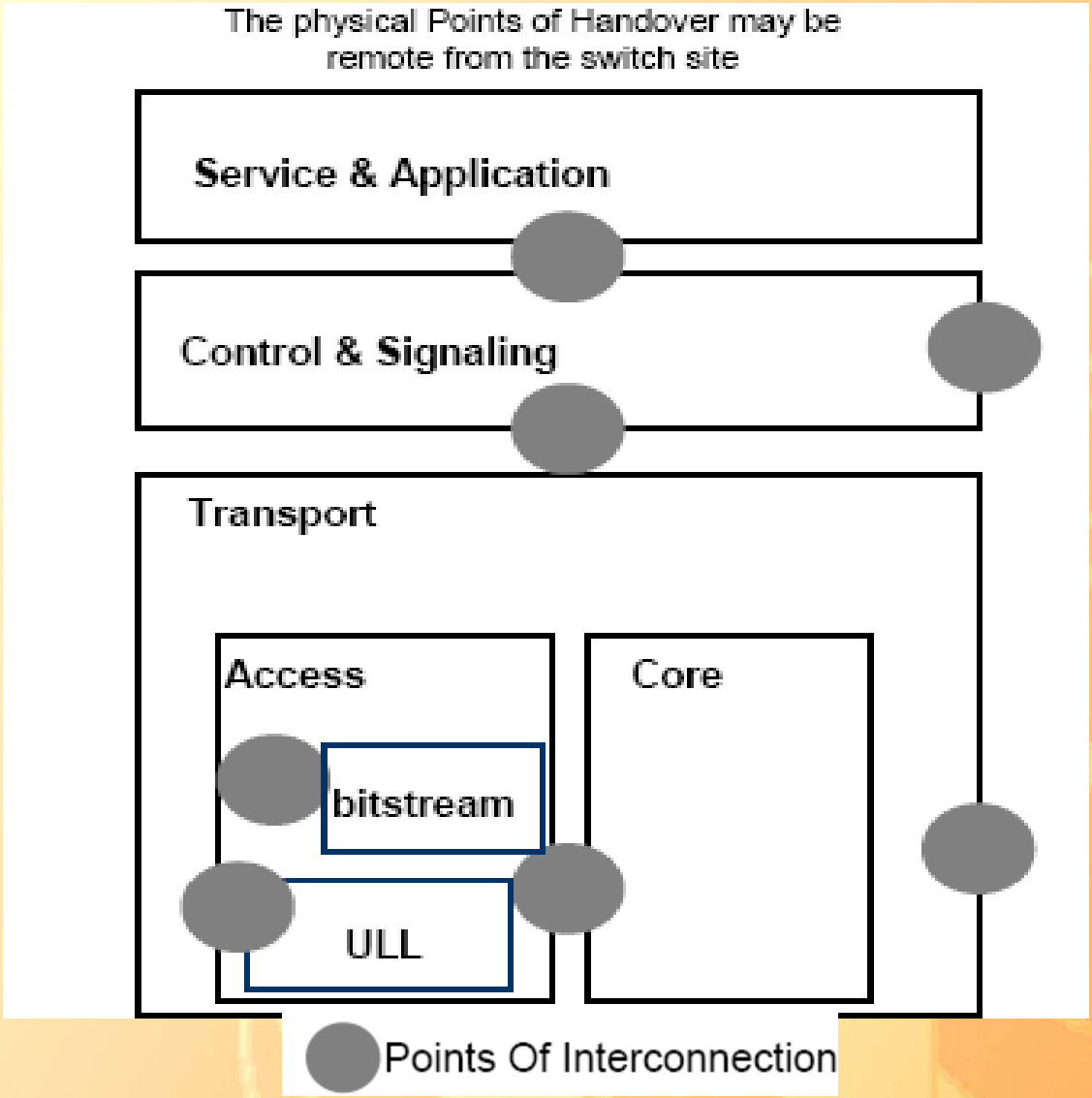
Next Generation Network (NGN) as defined by ITU:
A packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which **service-related functions are independent from underlying transport-related technologies**.

It enables **unfettered access for users** to networks and to competing service providers and/or services of their choice. It supports **generalized mobility** which will allow consistent and **ubiquitous** provision of services to users.

NGN: Generic layered architecture



NGN: Generic Interconnection architecture



Source: www.thinktel.org

NGN architecture : Aspects impacting interconnection (3)

• An outstanding difference between TDM networks and NGN networks is the fact that voice traffic does not transit physically through softswitches but through Core IP routers and media gateways. The Softswitch is responsible for call control.

• This means that the switching function (call control) is completely disassociated from the physical routing.

NGN architecture : Aspects impacting interconnection (4)

- An operator through softswitches deployment for its voice network reduces drastically the number of links between its network. This induces a clear decrease in its costs.
- The softswitch has a much greater capacity as compared to a TDM switch. Therefore a greater number of subscribers may be managed by the softswitch and consequently the number of switching sites is reduced. This will impact certainly the CAPEX and OPEX and the interconnection cost as well.

NGN architecture : Aspects impacting interconnection (5)

• The change in incumbents networks topology oblige new entrants to interconnect at different POPs, leading to induced additional costs for them. The regulator should solve the question regarding the entity (ies) required to cover such costs.

• On the other hand, new services using Voice over IP require that carriers should connect to exchange new content such as information relating to subscribers, to their presence or their characteristics. Terms and conditions for such interconnection, for a purpose other than voice, should be determined.

NGN architecture : Aspects impacting interconnection (6)

Given that NGN are multi-services networks able to support different convergent services, some issues related to interconnection emerge, affecting :

- **Signaling.**
- **Quality of service.**
- **Addressing and naming.**
- **Security.**

NGN architecture : Aspects impacting interconnection (7)

Issues linked to signaling

Different protocols may be used by the softswitch to manage the media gateway :

- MGCP (Media Gateway Control Protocol)
- MEGACO
- SIGTRAN
- SIP

NGN architecture : Aspects impacting interconnection (8)

Issues linked to signaling

• Interconnection with an operator using one of these solutions should then be based on the use of a common signaling protocol. For TDM networks this common signaling protocol is SS7 system.

• On the other hand, it is clear that during migration to a NGN, given the number of available protocols, a specific attention should be given to the intelligent services network migration as it was based on SS7 in the TDM world.

NGN architecture : Aspects impacting interconnection (9)

Issues linked to signaling

• Some equipments like softswitches should use SS7 protocol , in order to interface with a PSTN network and support call termination in a legacy network.

• In the same time, equipments like routers, media gateways and softswitches “talk” different languages as MGCP or SIP.

• Furthermore, other issues are inherent to the use of the MGCP protocol as it necessitate much more messages to set or terminate a call as compared to SS7.

NGN architecture : Aspects impacting interconnection (10)

Issues linked to QoS

• IP networks deliver the service on the basis of “the best effort” principle and no QoS guarantee is provided for real time application like voice or video streaming.

• In this regard, QoS Mechanisms developed by IETF and presented by previous sessions are used by IP networks such as:

✓RSVP (Resource Reservation Protocol).

✓ DiffServ (Differentiated Service).

✓ MPLS (Multi-Protocol Label Switching).

NGN architecture : Aspects impacting interconnection (11)

Issues linked to QoS

• Given the advantages and drawbacks for each one of these mechanism carriers should negotiate the use of a convenient method and the level of solicited QoS to be included in the interconnect contract.

• Beside QoS mechanisms, different CODECs are available and used by each interconnected party. The interconnect contract should ensure their compatibility in order to guarantee the maximum usage comfort to the subscriber.

NGN architecture : Aspects impacting interconnection (12)

Issues linked to QoS

• Some QoS factors could be part of the interconnection contract:

✓Call processing delays;
✓Processing and look-up delays associated with security issues;
✓Delays in accessing back-end services, and in the Gateway;
✓The choice of speech codec;

NGN architecture : Aspects impacting interconnection (13)

Issues linked to QoS

✓The performance of the speech codec to various types of network degradation (including effects of any error concealment mechanisms present in the coder);

✓Signal processing delays;

✓Call processing delays;

✓The packetisation method used;

NGN architecture : Aspects impacting interconnection (14)

Issues linked to QoS

✓Processing delays associated with security issues;

✓The performance of jitter buffers;

✓Delays through the audio or digital media paths;

✓The performance of network echo-canceling Devices.

NGN architecture : Aspects impacting interconnection (15)

Issues linked to QoS

In conclusion:

- Packet loss, latency and jitter are parameters describing the network performance and hence quality characteristics of IP-traffic to be included in the interconnect contract.
- They are of paramount importance for bidirectional real time services such as voice or video streaming.
- Special attention should be drawn to guaranteeing QoS requirements across interconnected network borders.

NGN architecture : Aspects impacting interconnection (16)

Issues linked to addressing and naming

• Taking under account that the killer application will be the IP telephony service, the deployment of an IP network allowing the connection of many types of terminals and offering many types of services, has a great impact on the attribution of numbers and IP addresses as well as on the universal directory.

• In the long run, the best solution would be to use a common management scheme dealing with numbers and IP addresses in order to come out with a universal identification method applied to all NGN clients using convergent services .

NGN architecture : Aspects impacting interconnection (17)

Issues linked to addressing and naming

- Today E.164 is the ITU standard used for numbering used by all telecommunications carriers.
- ENUM tElephone NUmber Mapping) protocol using a DNS server allows the mapping of telephone numbers using SIP protocol.
- As IMS and the SIP standard “have more and more the upper hand”, it seems normal that such protocol is the answer to a common numbering scheme to be adopted for interconnection purposes.

NGN architecture : Aspects impacting interconnection (18)

Issues linked to addressing and naming

• To achieve the deployment of ENUM in the public domain, it is of paramount importance that numbering administrators in the telephony community and those in the Internet community should get together to reach a consensus in terms of numbers/ addresses management.

NGN architecture : Aspects impacting interconnection (19)

Issues linked to Security

• TDM networks use border control points to allow traffic flow and secure information such as call information or interconnection costs information as well.

• Therefore, for NGN the Session Border Controller (SBC) is a key element in the deployment of a softswitch . The user IP terminal is generally protected by a “fire wall” and use a private IP address. Then for interconnected networks the main SBC function is to allow the crossing of the “fire wall” and NAT equipments.

• SBC guarantees as well the protection of the softswitch from « signaling overloads », denials of service attacks and other attacks well known in the IP world coming from intruders including interconnected peers.

NGN architecture : Aspects impacting interconnection (20)

Issues linked to Security

While NGN provide greater robustness and resiliency as well reliability through redundancy of devices and servers, some security concerns are :

a) Signaling data can be exposed to illicit alteration, capture, disruption or falsification.
b) NGN is more and more exposed to remote attacks given their global interconnectivity.
c) The fact that Data protection and the security responsibility is more and more shifted from the system to the users would increase the risk of external attack if the said protection is not provided sufficiently.

NGN architecture : Aspects impacting interconnection (21)

Issues linked to Security

Areas of Critical Risk Are mainly gateways and control systems.

Gateways:

• Likely, NGN being open networks like Internet that do not assume authorization from access to the "control space" as it is the case for PSTN
Non-secure gateways could lead to great damage from intruders.

• On the other hand, Different convergent networks using different security models and present different vulnerability levels may put the burden on gateways interconnecting different networks in terms of security.

NGN architecture : Aspects impacting interconnection (22)

Issues linked to Security

Border Control:

• Next-generation service providers peering architectures should lead to security level negotiations, through the interconnection contract, for different services delivery (voice, video, and multimedia).

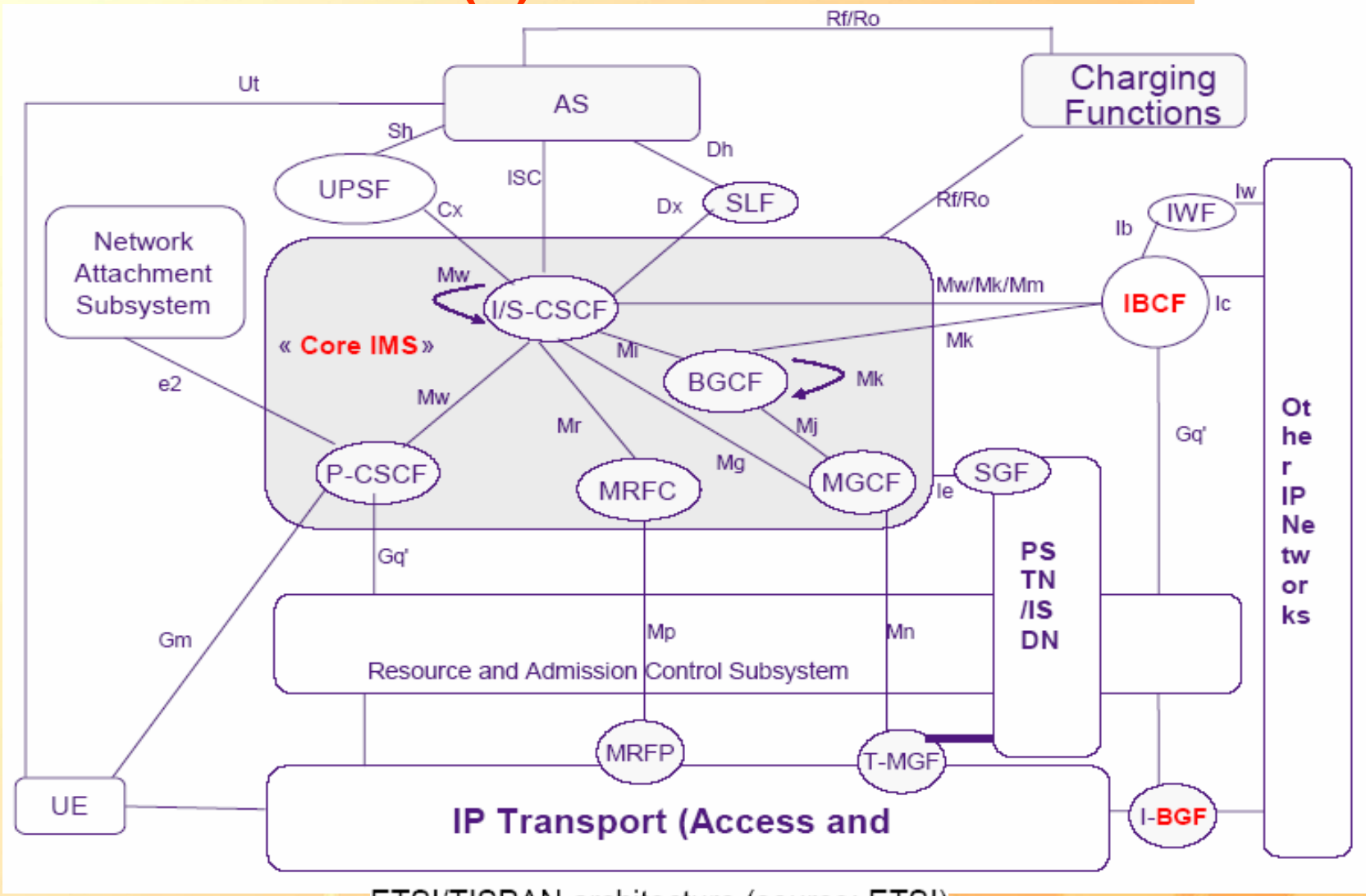
• In this regard, Border Control play a major role and should be designed to provide security, service assurance, and meet regulatory demands such as legal intercept requirements and the enforcement of inter-provider SLAs.

NGN architecture : Aspects impacting access

The MSAN is a natural evolution of DSLAMs. In most of NGN architectures the MSAN is the point of entry to the access networks of the operators. The difference between an MSAN and the DSLAM is that the latter can support uniquely xDSL cards, while the MSAN is multi-use equipment supporting all sort of access cards including ISDN, Ethernet, FTTx or X25 cards.

Types of NGN interconnection :

TISPAN model (1)



ETSI/TISPAN architecture (source: ETSI)

Types of NGN interconnection :

TISPAN model (2)

The TISPAN NGN architecture allows for peering points towards PSTN and with other IP networks:

• Interconnection to PSTN is done through media gateways controlled by **MGCF**
(Media Gateway Control Function).

• Interconnection to other IP networks happens to border gates controlled by **IBCF**
(Interconnection Border Control Function).

Types of NGN interconnection :

TISPAN model (3)

• It should be noticed that PSTN traffic may transit over different interconnected IP networks to be terminated either in an IP network or a PSTN.

• IMS can be used as a transit network for its own non-IMS users, for interconnecting enterprises and for other network operators providing connectivity to both PSTN and IP endpoints.

• It can be anticipated that gradually interconnection with PSTN will migrate in the short run to a full IP connectivity in developed countries and in the long run in the LDCs.

Types of NGN interconnection :

TISPAN model (4)

ETSI TISPAN defines two distinct interconnection models:

• Service-oriented Interconnection (SoIx): the physical and logical linking of NGN domains that allows carriers and service providers to offer services over NGN platforms with control, signaling (i.e. session-based), which provides defined levels of interoperability.

• Connectivity-oriented Interconnection (CoIx): the physical and logical linking of carriers and service providers based on simple IP connectivity irrespective of the levels of interoperability.

Types of NGN interconnection :

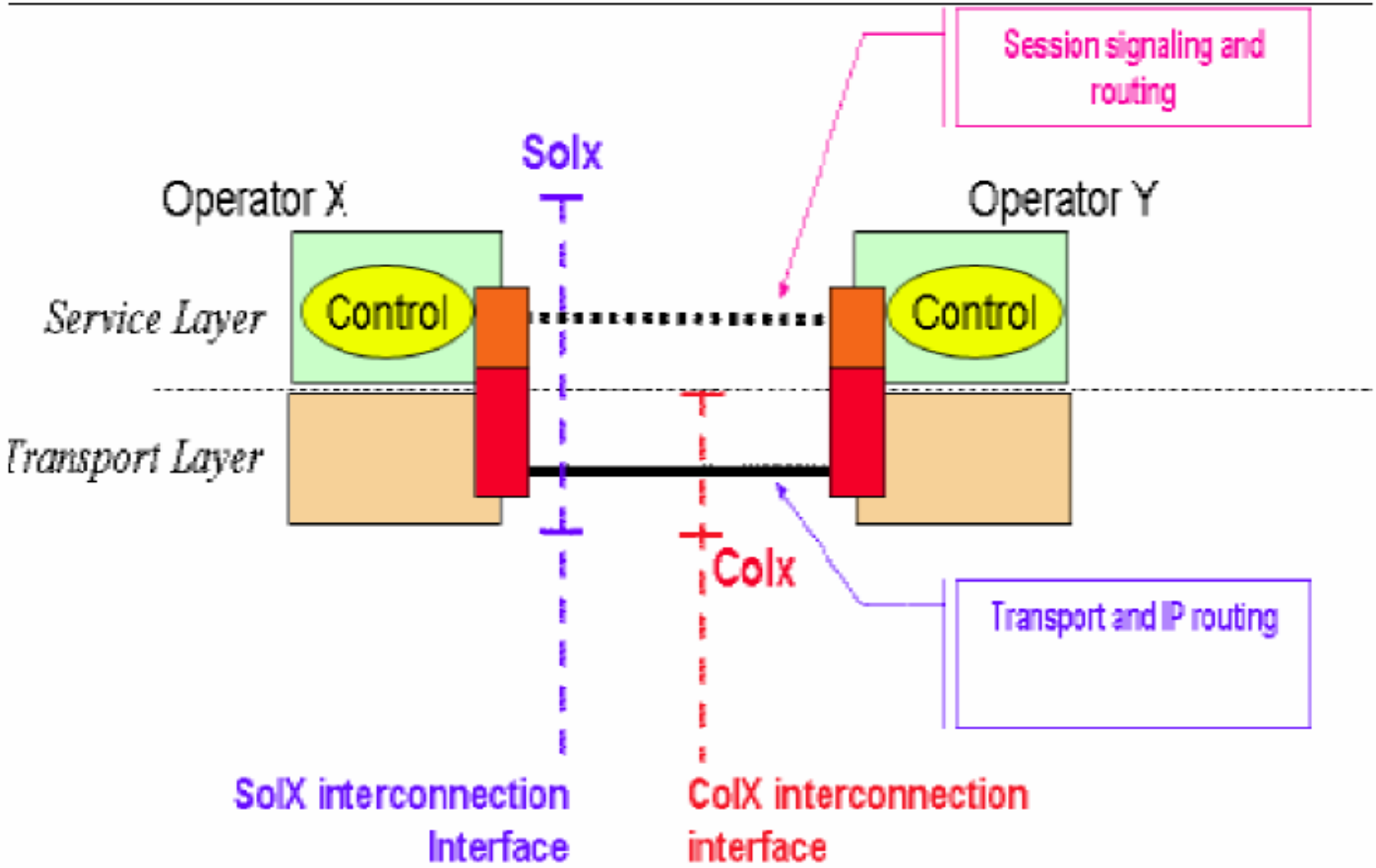
TISPAN model (5)

SoIx interconnection is typically characterized by the presence of two types of information exchanged between the two interconnected domains:

- Service-related signaling information that allows to identify the end-to-end service that has been requested.
- Transport information, that carries the bearer traffic.

Types of NGN interconnection :

TISPAN model (6)



Simplified model of SoIx and CoIx interconnection (source: TISPAN WG4)

Migration to NGN : impact on national interconnection

- It is obvious that according to the migration scenario, interconnection between carriers will be at least technically different and the interconnection contract will be re-negotiated while the migration process is going on.
- Regulators and operators alike should consult each other and set a working group responsible for giving the players the necessary visibility in order to achieve harmoniously the interconnect process from the technical standpoint while the migration process is going on.

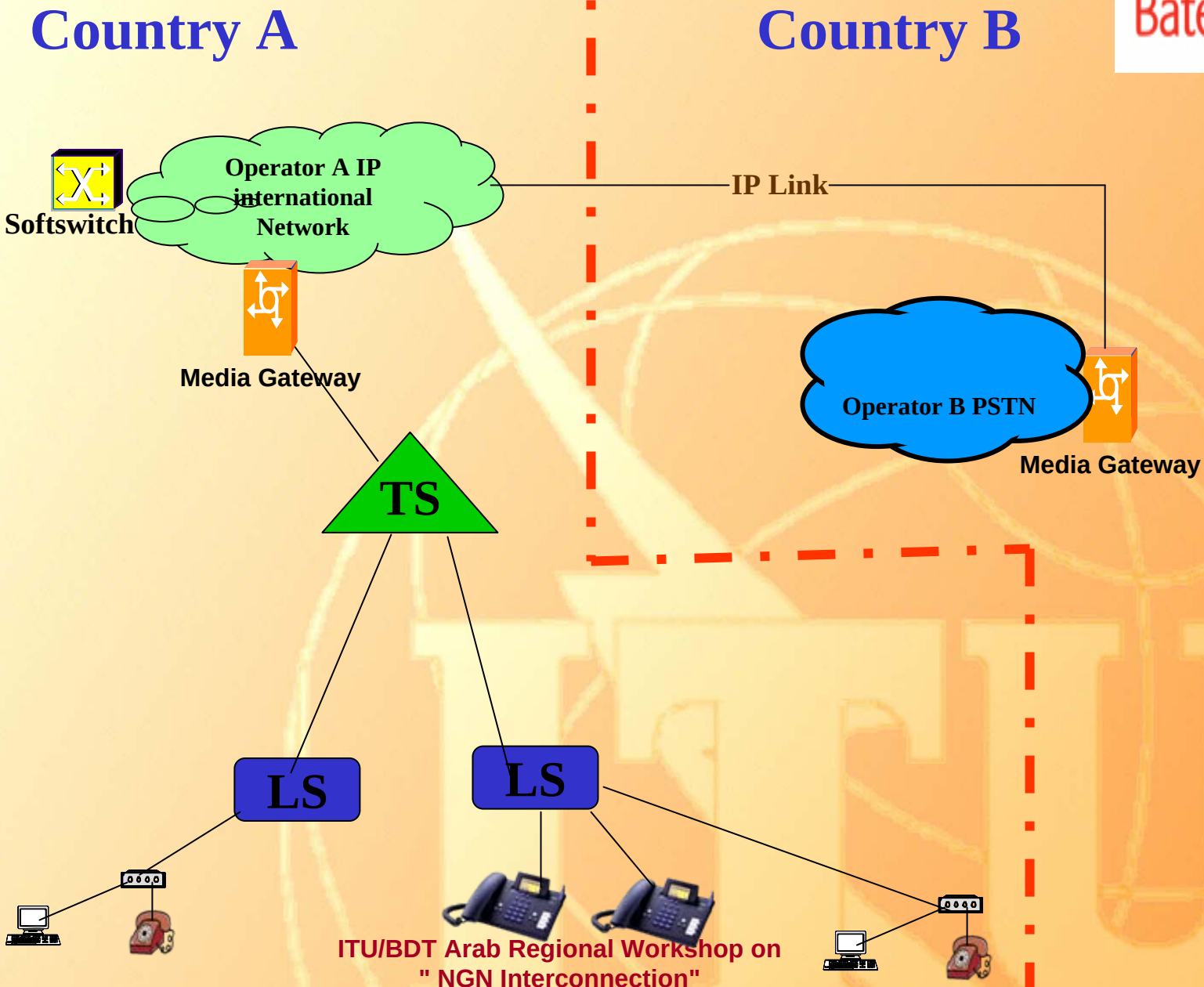
Migration to NGN : impact on international interconnection (1)

A carrier wishing to offer its customers a VoIP service for international calls will merely implement :

- A softswitch responsible for calls control, traffic routing and signaling management. It will replace the international TDM Switch (s).

- Media gateways installed with point of presence located within the countries where the said carrier wishes to connect to TDM networks.

Impact on international interconnection (2)



Conclusion and recommendations

- The most fundamental question is that all interconnection and access services offered through legacy networks should be offered by NGN (or equivalent services) besides new convergent services.

- Regarding access and interconnection services offered in LDC, the migration to a NGN is not so problematic as only few services are available.

Conclusion and recommendations

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•However, it seems that is unlikely that the same services package offered by legacy systems could be offered by NGN as the offer of legacy products could induce exorbitant costs.

For instance:

- Narrow band Leased lines may be replaced at an efficient cost with large band links or through A virtual IP capacity.
- VPNs for Voice services could be replaced by IP VPNs.
- SDH leased lines could be replaced at an efficient cost by Ethernet leased lines.

Conclusion and recommendations

BDT

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• POIs open for interconnection by carriers, specifically by incumbent, may be “wiped out” for the following reasons:

- As it has been said in slide number 6 NGN architecture is « flat » and use less POIs.
- It is unlikely that interconnection could be offered at local switches for a full NGN network (this question is addressed in the costing presentation).
- POIs may be created or not according to the topology optimization algorithms.
- As a consequence the « migrant » incumbent may benefit from legacy to NGN migration while alternative operators may support additional costs.

Conclusion and recommendations

• The migration process may be complex.
It is recommended that this transition be managed in a transparent manner allowing the maximum visibility for all the players under the auspices of the regulator in order to avoid major obstacles leading to a major competition distortion.

However, it is important that:

- The regulator be aware of the NGN deployment and migration plans of all the carriers.
- Alternative operators as well as ISPs be advised beforehand regarding changes that may affect interconnection and access services (new type of interconnection, suppression of some types of interconnection or access …etc.).

Conclusion and recommendations

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Most of the technical problems may find a viable solution through technical committees negotiations and with the help of the industry.

However, the regulator should be sufficiently prepared in order to anticipate problems through eventually a revision of the regulatory framework, specifically the interconnection and access framework. Regarding NGN The regulator should make sure that its staff is sufficiently trained.

It is recommended that the regulator consult as frequently as needed all the market players in order to anticipate problems and achieve successful commercial negotiations between carriers in a prompt manner.

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Thank you for your attention