# ITU-D/ITU-T Seminar on Standardization and Development of Next Generation Networks for the Arab Region

**Manama (Bahrain) 29 April – 2 May 2007**

## *PSTN/ISDN evolution to NGN*

*Riccardo Passerini, ITU-BDT*

1

## Migration towards NGN

In markets with a high growth in traditional voice services (which is the case for most developing countries), substantial extensions will be required to the existing telephony network in order to cover the huge need for new lines. Established Service Providers will have to decide on how to extend their networks: using more traditional circuit-switched solutions or implementing a distributed network architecture, with a common, packet-based transport layer for voice and data.

2

## Evolution principles

**Evolution to NGN should allow continuation of the existing network capabilities and in addition facilitate implementation of new capabilities. Evolution to NGN should respect the integrity of services provided by the existing networks and should facilitate introduction of new services. Considering that provision of NGN is an evolutionary process it is necessary to define a step-by-step approach leading to the NGN as a target network.**

3

## Evolution principles

- This approach should consider the following objectives:
- Separation of transport, control, management and service functions.
- Reduction of cost for the network infrastructure and its maintenance
- Maximum reuse of the existing resources
- Achieving comparable QoS level as provided in the existing network
- Optimum use of the new technologies
- Rapid implementation of new services and technologies enabling introduction of new applications
- Provision of mechanisms enabling user's full utilisation of the applications and network resources.

4

## Aspects to consider

**Network operators will potentially choose a different evolution path depending their actual resources. While considering the evolution path it is essential the following aspects be considered:**

- **Simplified analysis of the current networks**
- **Management**
- **Signalling**
- **Bearer services**
- **Billing**
- **Leased line provisioning**
- **Security**
- **Services which are required by regulatory bodies**
- **Supplementary services**
- **Technical aspects of naming, numbering, addressing**
- **Access technology evolution**

5

## Priorities

**Network and service providers may choose different evolution path based on their existing and forecasted resources. This approach may encompass different technologies and have different priorities.**

6

## Security considerations

**Evolution of network security should allow continuation of the existing network security capabilities and in addition provide new resistance capabilities against new security threats.**
**Several aspects may be considered:**

- **Achieving acceptable security level by combination of different layer security methods**
- **Similar user security experience while evolving networks to NGN**
- **No over-provision of security measures.**

7

## Evolution of PSTN/ISDN to NGN

**NGN (Next Generation Network) is believed to provide new opportunities for and capabilities to the network and service providers. Considering that existing networks have different life span and vast amount of capital has been spent on them, complete replacement of their components is not considered to be either advisable or possible. So, a phased approach should be considered for evolution of existing networks to NGN.**

**PSTN/ISDN ( Public Switched Telephone Network/Integrated Services Digital Network) being one of the first networks, is considered to be prime candidate for evolution. For PSTN/ISDN evolution to NGN a phased approach is considered**

8

## ITU-T Recommendation Y.2261 - PSTN/ISDN evolution to NGN

Describes possible ways of evolving PSTN/ISDN to NGN. Both IP multi-media sub-system (IMS-based) and call server (CS-based) are described. It describes aspects, which need to be considered including evolution of transport, management, signalling and control parts of PSTN/ISDN to NGN. Examples of evolution scenarios are also provided in this Recommendation.

9

## Examples: Core Network evolution to NGN

**a) CS-based evolution to NGN**

The call server (CS) is the core element for PSTN/ISDN emulation. It is responsible for call control, gateway control, media resource control, routing, user profile and subscriber authentication, authorization and accounting. The Call Server may provide PSTN/ISDN basic service and supplementary services, and may provide value added services through service interaction with an external service control point (SCP) and/or application server (AS) in the service/application layer.

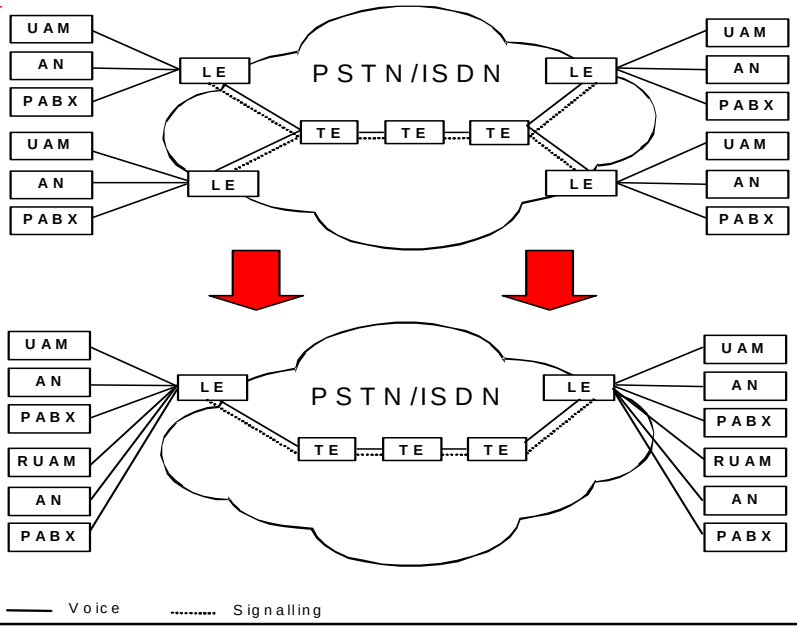
10

## Consolidation of local and remote exchanges preparing the evolution to NGN

- In order to prepare the PSTN/ISDN for the evolution to a packet switched network (PSN) and as an initial step some of the local exchanges (LEs) are removed and all their functionalities such as control, accounting, etc. are transferred to those remaining LEs. Affected user access module (UAM), private automatic branch exchange (PABX), and access network (AN) are connected to the remaining LEs. Further consolidation occurs when user access modules (UAM) become remote user access modules (RUAM), which, are connected to the remaining LEs.

11

## Preparation for evolution to NGN




12

## Scenario 1 – PSTN/ISDN and PSN co-exist

- The most likely initial approach for evolution of PSTN/ISDN to PSN will involve a path that requires the PSTN/ISDN to co-exist with PSN during a transition period. This scenario follows that approach. There are two steps in this scenario.

13

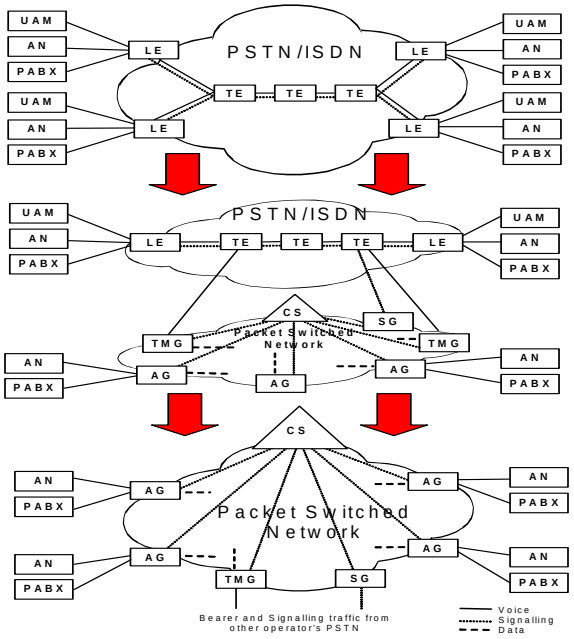
## Scenario 1 – PSTN/ISDN and PSN co-exist

- **Step 1**
- In this step, some of the LEs are replaced by AGs. Functions originally provided by the removed LEs are now provided by the AGs and the CS. In addition, some of the access elements such as UAMs, RUAMs, and PBXs, which were originally connected to the removed LEs, are now directly connected to AGs. Additional AGs may also be deployed to support new subscribers that directly connect to them. The TMGs and SGs are deployed for interconnection between the PSN and the TEs of the legacy network as well as other operators' PSTNs/ISDNs. The AGs and TMGs are all controlled by the

- **Step 2**
- In this step, the remaining LEs are replaced by the AGs, and the TEs are removed and their control functions are performed by CS. The TMGs and SGs are deployed for interconnection between PSN and other operators' PSTNs/ISDNs. The AGs and TMGs are all controlled by the CS.

14

## Scenario 1: Co-existence of PSTN/ISDN and PSN




15

## Scenario 2 – Immediate use of PSN, initially via SGs and TMGs

- In this scenario PSTN/ISDN is immediately replaced by the PSN. LEs are connected to SGs and TMGs first, then they are eliminated.
-

16

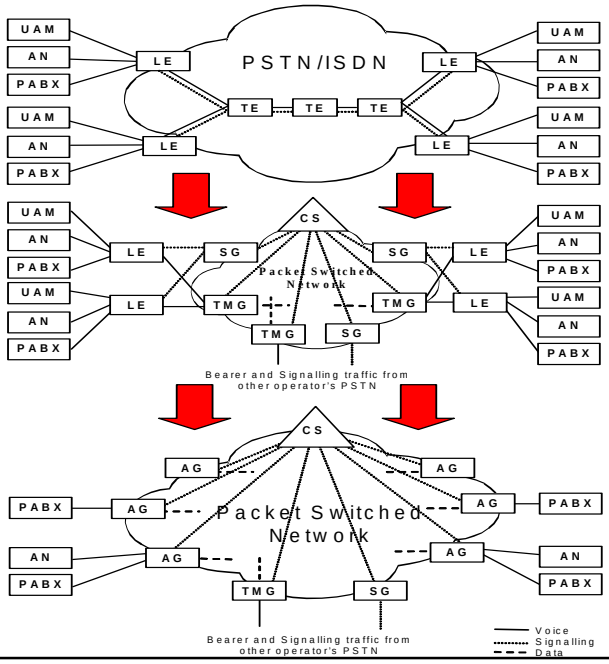
# Scenario 2 – Immediate use of PSN, initially via SGs and TMGs

- **Step 1**
- In this step PSTN/ISDN is replaced by PSN and the TE functions are performed by the TMGs and the SGs under the control of the call server (CS). The local exchanges (LEs) are connected to the PSN via transit media gateways (TMGs) and Signalling Gateways (SGs). The Transit and Signalling Media Gateways (TMGs & SGs) are also deployed for interconnection between PSN and other operators' PSTNs/ISDNs.

- **Step 2**
- In this step the local exchanges (LEs) and some of the access elements such as user access modules (UAMs) and remote user access modules (RUAMs) are removed and their functions are provided by the access gateways (AGs) and call server (CS). The private automatic branch exchanges (PABXs) are directly connected to access gateways (AGs). The access networks (ANs) are either replaced by the access gateways (AGs) or are connected to the access gateways (AGs). The transit and signalling gateways (TMGs & SGs) are deployed for interconnection between PSN and other operators' PSTNs/ISDNs. The access and the transit (AGs & TMGs) are all controlled by call server (CS).

17

## Scenario 2: immediate use of PSN



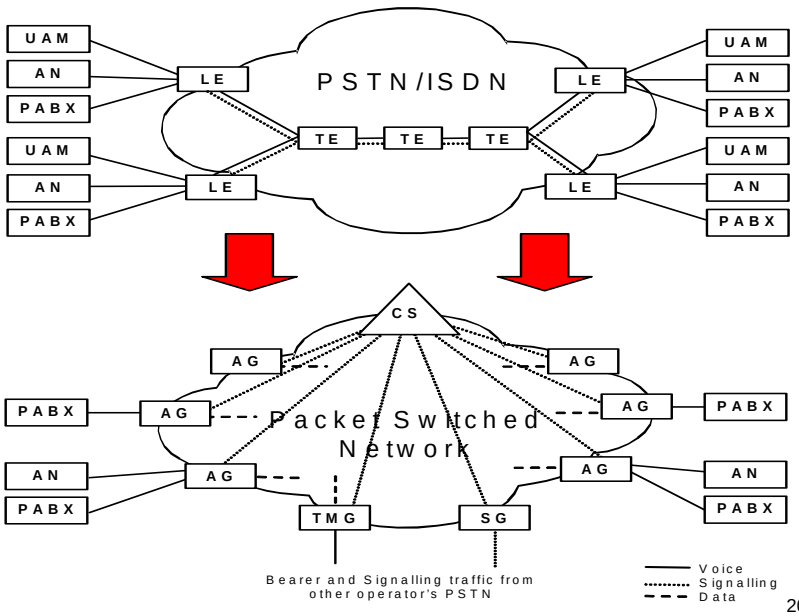

18

# Scenario 3 – The one-step approach

- In this scenario the PSTN/ISDN is replaced with packet switched network (PSN) in only one step. The local exchanges (LEs) are replaced by the access gateways (AGs) and their functions are divided between the AGs and the call server (CS). Specifically the call control and accounting functions are all transferred to the call server (CS). All access elements such as user access modules (UAMs), remote user access modules (RUAMs), and private automatic branch exchanges (PABXs) are connected to access gateways (AGs). The access networks (ANs) are either replaced by the access gateways (AGs) or are connected to packet based network (PBN) through the AGs. The transit gateways (TMGs) under the control of the call server (CS), and the signalling gateways (SGs), are deployed to replace the TE functions and provide interconnection between PSN and other operators' PSTNs/ISDNs.

19

## Scenario 3: one-step approach




20

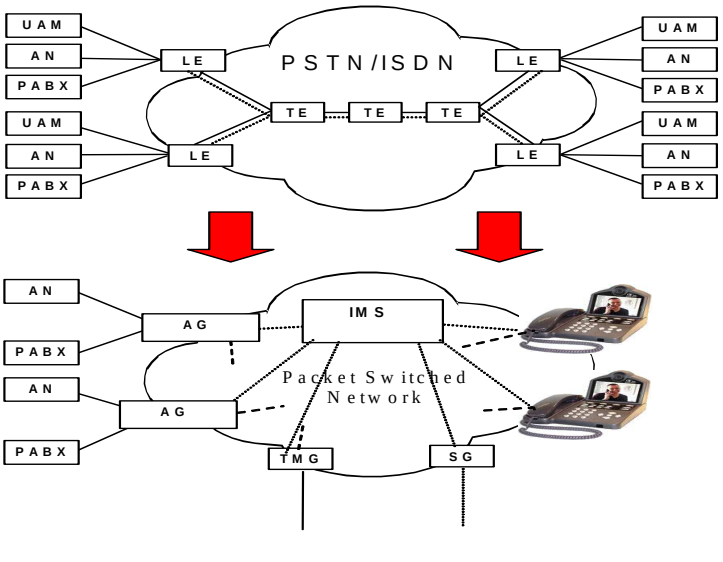
## b) IMS-based evolution to NGN

- **In this scenario PSTN/ISDN evolves directly to a PSN based on the IMS core network architecture**. The end-users access the network using NGN user equipment or legacy user equipment connected via an AG. The transit and signalling gateways (TMGs & SGs) are deployed for interconnection between the NGN and other operators' PSTNs/ISDNs.

- **Concurrent CS-based and IMS-based evolution to NGN** implementations can occur when an existing operator deploys a separate IMS-based network for new services and supports the remainder of the services using a CS-based approach. These two types of network implementations need to interoperate. Interoperation is possible if SIP is used, but this is beyond the scope of this Recommendation.

21

### IMS-based PSTN/ISDN evolution to NGN




22

# Examples: Access Network evolution

## Evolution of xDSL access to NGN

**Evolution of Access Network is shown in three possible steps**.

**Step 1**

- Traditional AN/UAM interfaces include: POTS, ISDN and V5.1/2 [G.964] and [G.965]. Such interfaces connect subscribers to the core PSTN/ISDN via LE.
- Legacy voice users may also have access to broadband services for example via xDSL (see [G.995.1]). In this case, the customer-located equipment is an xDSL modem and the service provider equipment is a digital subscriber line access multiplexer (DSLAM). Since xDSL interfaces enable users to connect to the Internet, these interfaces may be utilized to connect such users to NGNs.
- AN, for another user domain with V5.x [G.964] and [G.965] interface can be left as it is shown in Figure I.6 or it can be completely replaced by AG connected to NGN directly.

**Step 2**

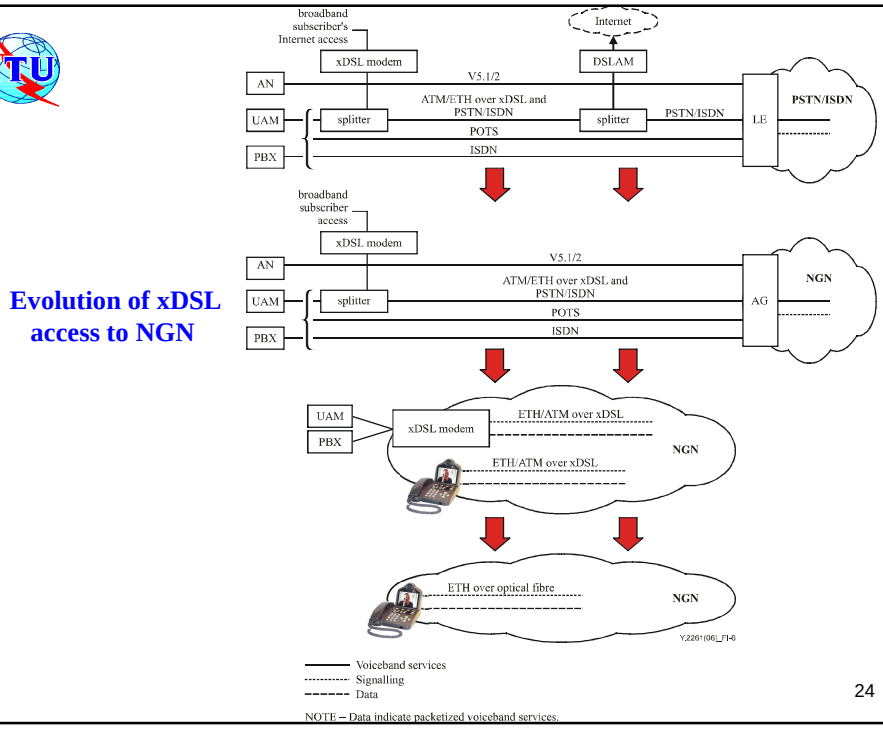
- The xDSL modem supports legacy subscribers and may enable them broadband access to NGN. An IP user may also use xDSL interface as the transport medium to an NGN. Protocol for xDSL interface may be Ethernet which enables broadband data flows and services, e.g., VoD, IPTV, VoIP and Internet.

**Step 3**

- In this step, the legacy end systems are replaced by NGN end systems and twisted copper lines are replaced by optical fibre, either fibre-to-the-curb (FTTC) or fibre-to-the-home (FTTH) to increase transmission speed. Protocol for this transmission medium may be Ethernet.

23

**Evolution of xDSL access to NGN**




24

# Definitions and Abbreviations

## Terms and Definitions

- **Media Server (MS):** A network element providing the media resource processing function for telecommunication services in NGN.
- **AG:** Access Gateway, that allows end users with various accesses (e.g., PSTN, ISDN, V5.x) connection to the packet node of
- **Remote User Access Module (RUAM**): A unit that physically terminates subscriber lines and converts the analogue signals into a digital format. The RUAM is physically remote from the Local Exchange.
- **User Access Module (UAM):** A unit that physically terminates subscriber lines and converts the analogue signals into a digital format. The UAM is collocated with a Local Exchange, and is connected to the Local Exchange.
- **Trunking Media Gateway (TMG):** A unit that provides interfaces between the packet node of NGN and the circuit-switched nodes (e.g. transit exchange, local exchange, international exchange) of PSTN/ISDN for bearer traffic
- **Signalling Gateway (SG):** A unit that provides out-of-band call control signalling conversion between the NGN and other networks (e.g., between a call server in NGN and an STP or SSP in SS7)

## Abbreviations and acronyms

- This draft uses the following abbreviations.
- ACS Access Call Server
- AG Access Gateway
- AS Application Server
- AN Access Network
- ATM Asynchronous Transfer Mode
- BCS Breakout Call Server
- BICC Bearer Independent Call Control
- BTV Broadband TV
- CAS Channel Associated Signalling
- CBR Constant Bit Rate
- CC Content of Communication
- CCS Common Channel Signalling
- CDR Call Detail Record
- CPE Customer Premise Equipment
- CS Call Server
- DSL Digital Subscriber Line
- DSLAM Digital Subscriber Line Access Multiplexer
- ETS Emergency Telecommunications Services
- FTTC Fibre-To-The-Curb
- FTTH Fibre-To-The-Home
- GCS Gateway Call Server
- GoS Grade of Service
- ICS Interworking Call Server
- IMS IP Multimedia Subsystem
- IN Intelligent Network
- INAP Intelligent Network Application Part

25

# Definitions and Abbreviations (cont.)

- IP Internet Protocol
- IRI Intercept Related Information
- ISDN Integrated Service Digital Network
- LE Local Exchange
- LEA Law Enforcement Agencies
- LL Leased Line
- MS Media Server
- OSS Operations Support System
- PABX Private Automatic Branch Exchange
- PCM Pulse Code Modulation
- POTS Plain Old Telephone Service
- PRI Primary Rate Interface
- PSAP Public Safety Answering Point
- PSN Packet Switched Network
- PSTN Public Switching Telephone Network
- QoS Quality of Service
- RUAM Remote User Access Module
- SCE Service Creation Environment
- SCP Service Control Point
- SG Signalling Gateway
- SIP Session Initiation Protocol
- SSF Service Switching Function
- SSP Service Switching Point
- STP Signalling Transfer Point
- TDM Time Division Multiplexing
- TDR Telecommunications for Disaster Relief
- TE Transit Exchange
- TMG Trunking Media Gateway
- TMN Telecommunication Management Network
- UAM User Access Module
- VOD Video On Demand
- VoIP Voice over IP
- xDSL any DSL

26

**THANK YOU VERY MUCH FOR YOUR ATTENTION**

Riccardo Passerini, ITU-BDT NGN Focal Point
riccardo.passerini@itu.int

27