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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Next Generation Networks – Service aspects: Interoperability of services and networks in NGN

PSTN/ISDN emulation and simulation

ITU-T Recommendation Y.2262

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ITU-T Recommendation Y.2262

PSTN/ISDN emulation and simulation

Summary

ITU-T Recommendation Y.2262 describes principle aspects of evolving PSTN/ISDN to NGN. It discusses emulation and simulation of PSTN/ISDN. Emulation provides PSTN/ISDN service capabilities and interfaces using adaptation to an IP infrastructure while simulation provides PSTN/ISDN-like service capabilities using session control over IP interfaces and infrastructure.

Source

ITU-T Recommendation Y.2262 was approved on 14 December 2006 by ITU-T Study Group 13 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

Emulation, ISDN, NGN, PSTN, simulation.

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ITU-T Recommendation Y.2262

PSTN/ISDN emulation and simulation

1 Scope

The public switched telephone network/integrated services digital network (PSTN/ISDN) being one of the first telecommunication networks, is considered to be a prime candidate for evolution to Next Generation Networks (NGN).

The PSTN/ISDN provides many features that a service provider can offer to the end-users. As such, when evolving to NGN, there is the expectation that all or at least some of these features may continue to be provided.

The PSTN/ISDN emulation could potentially provide PSTN/ISDN service capabilities and interfaces and maintain the end-user experience unchanged irrespective of the changing of the core network.

PSTN/ISDN simulation could potentially provide PSTN/ISDN-like service capabilities that fulfil the end-users need. However, there is no guarantee that PSTN/ISDN simulation can provide all features that have been available to the PSTN/ISDN user. Simulated PSTN/ISDN may provide additional new features and capabilities that have not been available to the users of PSTN/ISDN.

This Recommendation describes PSTN/ISDN emulation and simulation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.964] ITU-T Recommendation G.964 (2001), *V-interfaces at the digital local exchange (LE) – V5.1 interface (based on 2048 kbit/s) for the support of access network (AN)*.

[ITU-T G.965] ITU-T Recommendation G.965 (2001), *V-interfaces at the digital local exchange (LE) – V5.2 interface (based on 2048 kbit/s) for the support of access network (AN)*.

[ITU-T I.411] ITU-T Recommendation I.411 (1993), *ISDN user-network interfaces – Reference configurations*.

[ITU-T I.413] ITU-T Recommendation I.413 (1993), *B-ISDN user-network interface*.

[ITU-T I.610] ITU-T Recommendation I.610 (1999), *B-ISDN operation and maintenance principles and functions*.

[ITU-T Q.1741.4] ITU-T Recommendation Q.1741.4 (2005), *IMT-2000 references to release 6 of GSM evolved UMTS core network.*

[ITU-T Y.1411] ITU-T Recommendation Y.1411 (2003), *ATM-MPLS network interworking – Cell mode user plane interworking*.

[ITU-T Y.1541] ITU-T Recommendation Y.1541 (2006), *Network performance objectives for IP-based services*.

[ITU-T Y.1710] ITU-T Recommendation Y.1710 (2002), *Requirements for Operation & Maintenance functionality for MPLS networks.*

[ITU-T Y.2031] ITU-T Recommendation Y.2031 (2006), *PSTN/ISDN emulation architecture.*

[ITU-T Y.2261] ITU-T Recommendation Y.2261 (2006), *PSTN/ISDN evolution to NGN.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 interworking [ITU-T Y.1411]: The term "interworking" is used to express interactions between networks, between end systems, or between parts thereof, with the aim of providing a functional entity capable of supporting an end-to-end communication. The interactions required to provide a functional entity rely on functions and on the means to select these functions.

3.1.2 access gateway [ITU-T Y.2031]: A unit that allows end-users with various accesses (e.g., PSTN, ISDN and V5.x) connection to the packet node of NGN.

3.1.3 residential gateway [ITU-T Y.2031]: A unit that interworks PSTN/ISDN user equipments to a packet network. A residential gateway is located at the customer premises.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 PSTN/ISDN emulation: Provides PSTN/ISDN service capabilities and interfaces using adaptation to an IP infrastructure.

NOTE – Not all service capabilities and interfaces have to be present to provide an emulation.

3.2.2 PSTN/ISDN simulation: Provides PSTN/ISDN-like service capabilities using session control over IP interfaces and infrastructure.

NOTE – This definition allows for the possibility of simulation providing a complete mapping of the PSTN/ISDN service set (complete simulation).

3.2.3 user equipment: A device or devices allowing a user access to network services. This term refers to a terminal (e.g., dedicated voice terminal or multipurpose personal computer) that is connected to an NGN, which may be through a user network or other devices.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACS Access Call Server

ADF Adaptation Function

AG Access Gateway

BCS Breakout Call Server

BICC Bearer Independent Call Control

CAS Channel Associated Signalling

CDR Call Detail record

CS Call Server

CT Content of Telecommunication

GCS	Gateway Call Server
GoS	Grade of Service
HG	Home Gateway
ICS	Interworking Call Server
IF	Interface
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IRI	Intercept Related Information
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IUA	ISDN Q.921-User Adaptation Layer
IW	Interworking
LEA	Law Enforcement Agencies
MGC-SS	Media Gateway Control SIP Server
NGN	Next Generation Network
NNI	Network-Network Interface
PBX	Private Branch Exchange
PES	PSTN/ISDN Emulation Subsystem
PGC-SS	Packet Gateway Control SIP Server
PLMN	Public Land Mobile Network
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RTCP	RTP Control Protocol
RTP	Real-Time Transport Protocol
SC-SS	Session Control SIP Server
SG	Signalling Gateway
SIP	Session Initiation Protocol
SIP-I	SIP with encapsulated ISUP
SS7	Signalling System No. 7
TDMoIP	Time Division Multiplexing over Internet Protocol
TDR	Telecommunications for Disaster Relief
TMN	Telecommunication Management Network
UNI	User-Network Interface

5 Conventions

None.

6 PSTN/ISDN evolution to NGN

PSTN/ISDN offers a number of features and capabilities to the end users. Thus, when evolving to NGN, there is the expectation that all or at least some of these features may continue to be provided.

For further information regarding evolution of PSTN/ISDN to NGN, refer to [ITU-T Y.2261].

6.1 PSTN/ISDN emulation and simulation

PSTN/ISDN emulation provides most of the existing PSTN/ISDN service capabilities and interfaces using adaptation to an IP infrastructure. Although PSTN/ISDN emulation supports all PSTN/ISDN supplementary services, individual carriers may choose to deploy PSTN/ISDN emulation with support for only a sub-set of PSTN/ISDN supplementary services.

PSTN/ISDN simulation could also provide PSTN/ISDN-like service capabilities that potentially fulfil the same end-user need as existing PSTN/ISDN services. However, there is no guarantee that PSTN/ISDN simulation would provide all features that have been available to the PSTN/ISDN user. In addition, simulated PSTN/ISDN may provide additional new features and capabilities that have not been available to the users of PSTN/ISDN.

Figure 6-1 provides a high-level presentation of how emulation and simulation is performed and the relationship between different networks and NGN.

As shown in Figure 6-1, there are several ways that user equipment can be connected to an NGN providing either emulation or simulation of PSTN/ISDN.

Pattern 1: In this case, the legacy user equipment is connected to an NGN through an adaptation function (e.g., ADF2) at the network side of the user-network interface (UNI). This configuration is used to emulate PSTN/ISDN. In this case the legacy user equipment continues to be used.

Pattern 2: In this case, the legacy user equipment is connected to an NGN through an adaptation function (e.g., ADF1) at the user side of the UNI. This configuration is used when there is a desire to use legacy user equipment while PSTN/ISDN is being simulated. In this case, the legacy user equipment continues to be used.

Pattern 3: In this case, the NGN user equipment directly connects to NGN.

An example of this network structure based on these three classifications is provided in Appendix II.

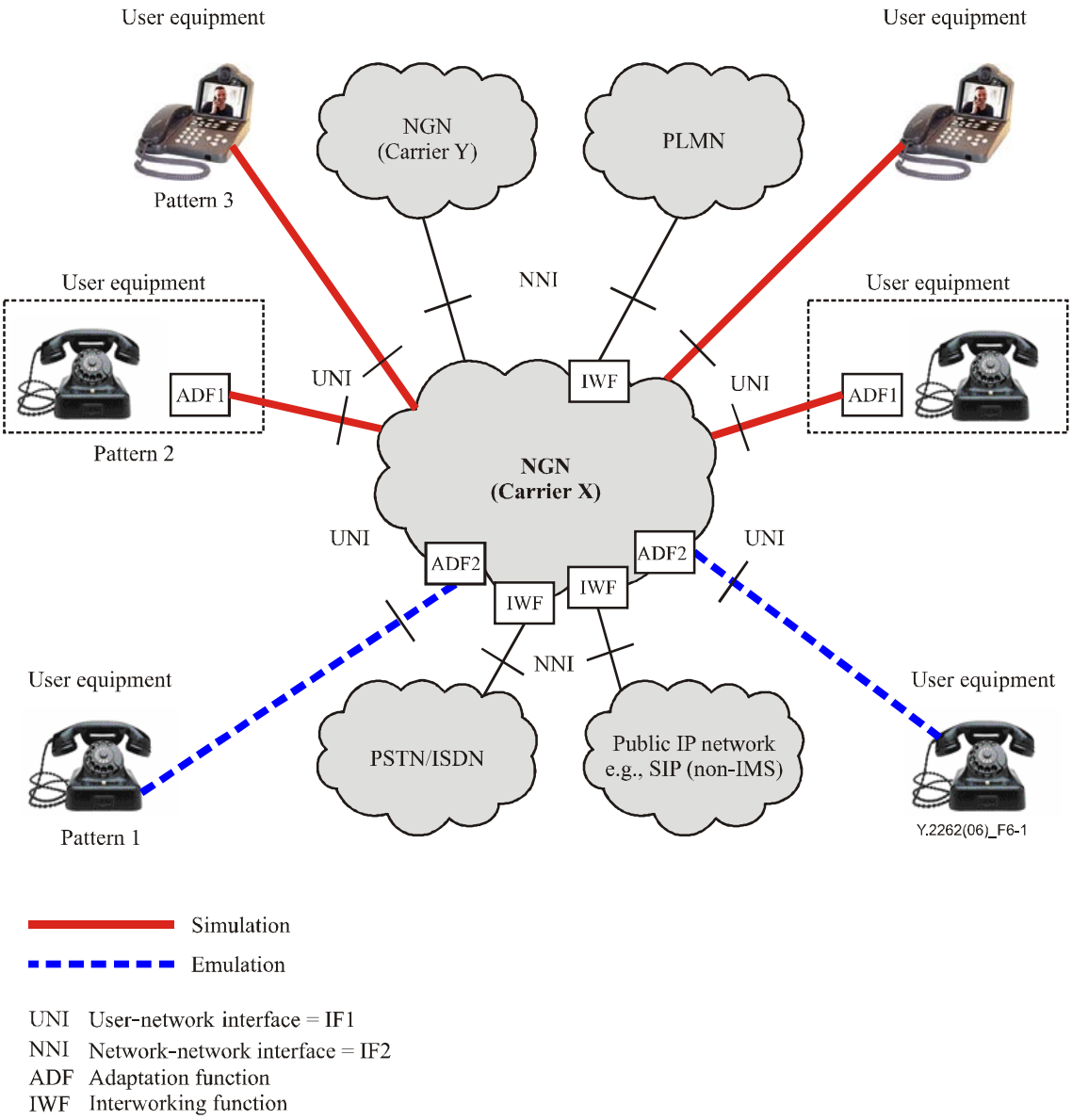

Figure 6-1 – Emulation, simulation, interoperability and interworking with NGN

6.2 Interfaces

In discussing PSTN/ISDN emulation and simulation, several different networks are considered to accommodate both IMS-based and non-IMS-based scenarios. Two interfaces are to be dealt with. These are the user-network interface (UNI) and the network-network interface (NNI). The following provides details for these interfaces.

Interface type 1, IF_1: This interface is between the user equipment and a network element in NGN or non-NGN networks which may also contain an adaptation function. This is a user-network interface (UNI). It can be:

- between an NGN user equipment and the NGN;
- between an IP user equipment and the public IP network;
- analogue telephone interface between the legacy user equipment and PSTN/ISDN;
- S, T or coincident S/T reference point for ISDN basic rate via a network termination 1 (NT1) [ITU-T I.411];

- S_B, T_B or coincident S_B/T_B reference point for ISDN primary rate via a network termination 1 (NT1) [ITU-T I.413];
- access networks using access nodes (e.g., multiplexer, concentrator) with V5 signalling, PSTN interface provided according to national mappings, V5.1 [ITU-T G.964] and V5.2 [ITU-T G.965] interfaces for support of access network (AN);
- national variants of the above.

Interface type 2, IF_2: This is a network-network interface (NNI). It can be between:

- NGNs;
- an NGN and the PSTN/ISDN;
- an NGN and a public IP network;
- an NGN and public land mobile network (PLMN).

6.3 Adaptations

The adaptation function may be implemented in the access gateway or the residential gateway. This function interfaces to IP multimedia component using SIP and to PSTN/ISDN terminals, and provides PSTN/ISDN emulation and simulation services. This function contains both a media gateway function and a media gateway controller function and supports the provision of voice-based services to analogue lines and ISDN lines. The function is "call control aware" (due to the termination of SIP) as opposed to "call control agnostic" H.248-based access media gateways.

Adaptation function type 1 (ADF1): ADF1 allows the NGN to provide a full NGN account, including user and service profiles, to the user equipment. From an NGN perspective, the user is receiving a normal NGN service that is essentially indistinguishable from any other NGN service. (As is the case with all NGN services, in practical implementations it is still subject to limitations of the user equipment). ADF1 is typically implemented in a residential gateway.

Adaptation function type 2 (ADF2): ADF2 allows the user equipment to receive a standard PSTN/ISDN service, which is essentially indistinguishable from the PSTN/ISDN service provided by legacy technologies. From an NGN perspective, a "PSTN/ISDN emulation" service is being provided. In general, user and service profiles will not be associated with this account. ADF2 is typically implemented in access gateway.

7 Aspects to consider

7.1 Transport

Transport is an important part of any network. It encompasses functions related to:

- user premises equipments (e.g., terminals, PBXs, routers);
- the access network equipments (e.g., line terminating modules, remote or local concentrators, multiplexers); and
- the core network equipments (e.g., local exchanges, transmission facilities, transit and international exchanges).

All transport-related aspects, which may be affected by evolution to NGN, should be considered.

7.2 Signalling and control

PSTN/ISDN uses signalling systems such as analogue line signalling, channel-associated signalling (CAS) like signalling systems R1 [b-ITU-T Q.310-Q.332], R2 [b-ITU-T Q.400-Q.490], and common channel signalling (CCS) like SS7 or DSS1 [b-ITU-T Q.931]. All these signalling systems are for the circuit switched networks. Since NGN transport is packet-based (and call and bearer are decoupled), other suitable types of signalling (e.g., BICC, SIP-I [b-ITU-T Q.1912.5], etc.) may be

required. Also, the signalling function and the call control function may reside in more than one NGN element.

Since the NGN has to work with the PSTN/ISDN and other networks, interworking between NGN signalling systems and the legacy network signalling systems is required.

Signalling aspects within the next generation corporate network shall remain independent from NGN access or core network signalling.

It is further anticipated that signalling aspects for access and core networks be independent in order to have the possibility of a step-wise approach for evolution to NGN.

Examples of signalling for PSTN/ISDN emulation and simulation are provided in Appendix III.

7.3 Management

The management system of PSTN/ISDN includes exchange network management, access network management, intelligent network management and operation support system (OSS). [b-ITU-T M.3010] and [b-ITU-T M.3400] provide management principles for PSTN/ISDN.

Referring to the management module defined in the telecommunication management network (TMN), the NGN management system is comprised of three planes, namely the network element management plane, the network control plane and the service management plane. The three planes each implement corresponding management functions to each layer in the NGN layered model. Standard interfaces between these planes will be defined.

7.4 Services

In this clause, bearer services, teleservices and supplementary services are discussed. It is also anticipated that PSTN/ISDN emulation and simulation would support both narrow-band and broadband services to the extent possible.

7.4.1 Bearer service

7.4.1.1 Overview

While evolving from PSTN/ISDN to NGN, continuity of bearer services should be provided.

In this Recommendation, only bearer services defined for PSTN and narrow-band ISDN (N-ISDN) are discussed. Bearer services are inherently characterized by transport and lower layer capabilities. It is inevitable to have different bearer services in the NGN environment when simulating or emulating PSTN and ISDN bearer services. This fact is indicated by the terms "simulation" and "emulation". The principal difference is primarily a result of intrinsic differences concerning grade of service (GoS) and QoS properties related to the bearer technology. This is because, for example, the end-to-end one-way delay is typically greater for simulated or emulated bearer services versus the native bearer services.

PSTN/ISDN simulation provides functionality that is similar but not identical to existing N-ISDN bearer services.

PSTN/ISDN emulation shall provide support for all bearer services offered by PSTN/ISDN. However, there is no requirement for NGN to support all N-ISDN bearer services identified in I.230 series of ITU-T Recommendations.

Use of the NGN to interconnect two PSTN/ISDN networks (note that this is an emulation scenario) shall be transparent for all bearer services.

An optimal simulation or emulation could be achieved by trying to get the same QoS/GoS performance by the specific NGN transport stratum.

7.4.1.2 Emulation of bearer services

Bearer service characteristics are influenced by selected transport technologies. Examples for the emulation of PSTN and N-ISDN bearer services are provided in Appendix IV.

7.4.1.3 Simulation of bearer services

Bearer service characteristics are influenced by selected transport technologies. Examples for the simulation of PSTN and N-ISDN bearer services: the emulation approach can be applied in principle as well (see above; for instance in all cases of RTP-based applications or teleservices), but there are typically also alternatives, i.e., other IP-based transport options.

7.4.1.4 Potential enhancements of bearer services in simulation or emulation environments

A simulated or emulated bearer service may be principally enhanced due to the dependencies of a bearer service on QoS/GoS and network performance parameters. Potential enhancements may include:

- operating an RTP session in a resource-reservation-oriented manner (e.g., constant bitrate support in case of simulation or emulation of I.231.1);
- dedicated QoS support for RTP session;
- forward error correction in order to minimize bit errors;
- redundant transport of RTP packets in order to mitigate losses of RTP/UDP/IP packets;
- packet loss concealment mechanisms;
- specific RTP profile (e.g., AVP versus SAVP).

7.4.2 Teleservices

Teleservices as defined in the I.240 series of ITU-T Recommendations.

7.4.2.1 Emulation of teleservices

NGN does not redefine any of the PSTN/ISDN teleservices.

7.4.2.2 Simulation of teleservices

This is for future study.

7.4.3 Supplementary services

ISDN supplementary services are defined in the I.250 series of ITU-T Recommendations.

7.4.3.1 Emulation of supplementary services

NGN does not redefine any of the PSTN/ISDN supplementary services.

Although PSTN/ISDN emulation could potentially support all PSTN/ISDN supplementary services, individual carriers may choose to deploy PSTN/ISDN emulation which supports only a sub-set of PSTN/ISDN supplementary services.

7.4.3.2 Simulation of supplementary services

When ISDN simulation is performed, some of these services may be provided though the services themselves may not necessarily have the full functionality defined in the above referred-to service specifications.

The following PSTN/ISDN supplementary services may be simulated in the NGN:

- calling line identification presentation/restriction (CLIP/CLIR);
- connected line identification presentation/restriction (COLP/COLR);
- malicious call identification (MCID);

- call diversion services;
- call hold;
- conference (CONF);
- message waiting indicator (MWI);
- anonymous call rejection (ACR);
- explicit call transfer.

In case of interworking of multiple networks, it is desirable to provide, as much as possible, transparency for affected supplementary services.

NOTE – "Simulation" is said to be "based-on" PSTN/ISDN services in order to provide PSTN/ISDN-like services.

Additional services, e.g., SIP-based, may also be available.

7.5 Operation, administration and maintenance (OAM)

OAM functionality is used to verify network performance, and to reduce operational costs by minimizing service interruptions, service degradation and operational downtimes. OAM functionality and objectives are described for the legacy and IP networks in [ITU-T I.610] and [ITU-T Y.1710] plus several other Recommendations covering all layers and strata.

As a minimum when performing PSTN/ISDN emulation or simulation, the ability of detecting faults, defects and failures such as lost, errored or misinserted frames should be provided. Additionally, there should be mechanisms to indicate connectivity status and provide support for performance monitoring.

Since in emulation and simulation, multiple networks are involved, it is necessary to identify and report which network or network provider is responsible for the defect so that proper action and remedy can be provided.

7.6 Naming, numbering and addressing

PSTN/ISDN emulation and simulation should ensure that the sovereignty of ITU Member States with regard to country code numbering, naming, addressing and identification plans is fully maintained. Also, as a minimum, support should exist for Internet IP addressing schemes including E.164 telephone uniform resource identifiers (TEL URIs), e.g., tel: +98 765 4321 1111 and/or SIP uniform resource identifiers (SIP URIs), e.g., sip:my.name@company.org.

All this should be accomplished without affecting the services provided to end users.

7.7 Accounting, charging and billing

It is generally accepted that the introduction of NGN will result in changes to the existing "accounting, charging and billing" procedures. However, these changes will not be immediate. During the transition period, maintaining the existing procedures, to the extent practical, may be required.

Evolution from existing networks to NGN will also imply replacement of the existing sources of the accounting data generation. New business models for NGN services may increase number of business roles involved in charging.

Thus the following accounting aspects may be affected:

a) information content;

b) interfaces to other systems;

c) data format;

d) data security, i.e., data protection, transmission security and confidentiality.

7.7.1 Considerations

The NGN shall support both offline and online charging. For evolution to NGN, the following factors shall be considered. However, this does not constitute a comprehensive list.

- Information content – The information contained in the call detail records (CDRs) shall be consistent with the information already provided in PSTN/ISDN. In particular, the following data should be provided:
  - calling and/or called user identification;
  - date and time of the start of the event;
  - type of the service or event;
  - date and time of the end of the event (to allow for calculation of call duration or session duration).

  It is also necessary to provide new NGN specific, information such as:
  - bandwidth;
  - QoS;
  - media type.
- Data sources
  - call server;
  - media server;
  - access gateway;
  - trunking media gateway;
  - application server.
- Data format requirements
  - optimal encoding complexity;
  - convenience of data collection and record construction;
  - optimal data size;
  - efficient data storage.
- Interfaces to other systems
  - for real time and bulk methods of collecting accounting data;
  - for on-line and off-line charging;
  - for other services such as advice of charge and credit limit.

Further information can be found in other ITU-T Recommendations or in [b-ETSI TS 122 115].

7.8 Interworking

Interworking as defined in [ITU-T Y.1411] is used to express interactions between networks, between end-systems, or between parts thereof, with the aim of providing a functional entity capable of supporting an end-to-end communication. PSTN/ISDN evolution to NGN should take the following into consideration:

- ability to inter-work with IMS-based or non-IMS-based networks such as other PSTN/ISDN, public IP networks (e.g., NGN, Internet);
- ability for inter-domain, inter-area or inter-network interworking;
- support for authentication and authorization;
- ability to perform call admission control;
- capability to support network performance parameters as defined in [ITU-T Y.1541];

- support for accounting, charging and billing.

NOTE – The above list is not an exhaustive list.

8 Service requirements by national regulatory bodies

Where required by national/regional regulation or law, an NGN service provider shall provide:

- the basic telephone service with the same or better quality and availability as the existing PSTN/ISDN;
- the capability for accurate charging and accounting;
- capabilities to support number portability;
- capability for the user to select the carrier for local and long-distance calls;
- the availability of directory inquiry service for PSTN/ISDN and the NGN users;
- support of emergency telecommunications as stated in clause 9;
- support for disaster recovery capabilities and procedures;
- support for all users, including the disabled. Support should provide at least the same capabilities as the existing PSTN/ISDN. NGN offers the opportunity for more advanced support, e.g., network capabilities for text to speech;
- privacy of the users and their information;
- mechanisms to support lawful interception and monitoring of various media types of telecommunications such as voice, data, video, e-mail, messaging, etc. Such a mechanism may be required of a network provider for providing access to content of telecommunication (CT) and intercept related information (IRI) by law enforcement agencies (LEA), to satisfy the requirements of administrations and international treaties;
- interoperability between NGN and other networks, e.g., PSTN/ISDN and PLMN.

The list of required services in public telecommunications systems in each country is based on national regulations. This Recommendation does not address detailed national regulatory requirements.

9 Emergency telecommunications in NGN

It is desirable that NGN provides:

- capability to support priority mechanisms for emergency telecommunications in multimedia services (e.g., voice, data and video). Emergency telecommunications include:
  a) individual-to-individual telecommunications;
  b) individual-to-authority telecommunications, i.e., calls to emergency service providers;
  c) authority-to-authority telecommunications. Telecommunications for disaster relief (TDR); and
  d) authority-to-individual telecommunications;
- support for calls to emergency service providers which may be free of charge for the calling user. Such calls should include information on how to enable emergency services to call back the calling user, and including at least the accurate location information about the calling user at the time of call initiation, e.g., to be provided to the emergency response centres, routing of the call to the public safety answering point (PSAP) – regardless of whether the user is fixed, mobile or nomadic. Accurate location may be such information as postal address, geographic coordinates or other information like cell indicators. Both network and user location information shall be provided, if available;

- the capability to ensure that calling line identification presentation (or the equivalent information in IMS) is not ruled out on a per-call, per-line or per-identity basis for calls to the emergency call number;
- network integrity, as far as possible, in order to support critical telecommunications such as TDR support in a crisis situation.

10 Security aspects of evolution

The NGN shall provide at least the same security level as for the existing PSTN/ISDN. As PSTN/ISDN is transitioning to NGN, new concerns and threats, unknown in PSTN/ISDN, may be encountered. Therefore, additional measures may be required to guarantee at least the current security level.

Different security dimensions, depending on the access method, shall be taken into account to fulfil this demand:

- authentication;
- non-repudiation;
- data confidentiality;
- telecommunication security;
- data integrity;
- availability;
- privacy.

NGN security mechanisms should be sufficient to secure PSTN/ISDN simulation and emulation scenarios. The complete list of requirements for NGN security is beyond the scope of this Recommendation.

Appendix I

PSTN/ISDN emulation and simulation scenarios

(This appendix does not form an integral part of this Recommendation)

I.1 Emulation scenarios

Scenario 1: Legacy user equipments connected through an NGN

In this scenario, the core network of a traditional PSTN/ISDN is replaced with an NGN, but the legacy user equipments at both sides remain unchanged. The legacy user equipment is connected to NGN using an adaptation function, identified here as ADF2. Adaptation is done after the UNI (i.e., IF1). Emulation should provide support for all PSTN/ISDN services. However, individual carriers may choose to deploy PSTN/ISDN emulation with support for only a subset of PSTN/ISDN supplementary services.

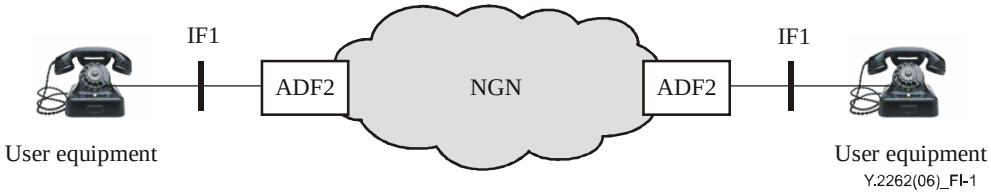

Figure I.1 – PSTN/ISDN emulation

I.2 Simulation scenarios

All scenarios in this clause are based on the IP multimedia subsystem (IMS) model with the addition of a core transit network. Originating/terminating networks and the originating/terminating subscriber's home networks are respectively called "visiting network" and "home network" in IMS terminology as in [b-ETSI TS 123 228]. Scenarios shown here are samples of what can be present. Depending on what network is present, other scenarios can be constructed.

The following scenarios could provide PSTN/ISDN-like service capabilities. Simulated PSTN/ISDN may provide additional new features and capabilities that have not been available to the users of PSTN/ISDN. However, there is no guarantee that all existing features available to the PSTN/ISDN end users would continue to be provided.

Interface IF1 is the general UNI interface which represents either the network interface to legacy terminal or to the NGN terminal. The interface to legacy terminal is already specified in existing PSTN and ISDN-related Recommendations. The interface to the NGN terminal is a new interface to be developed.

Scenario 1: All networks present

This is a scenario with all networks present.

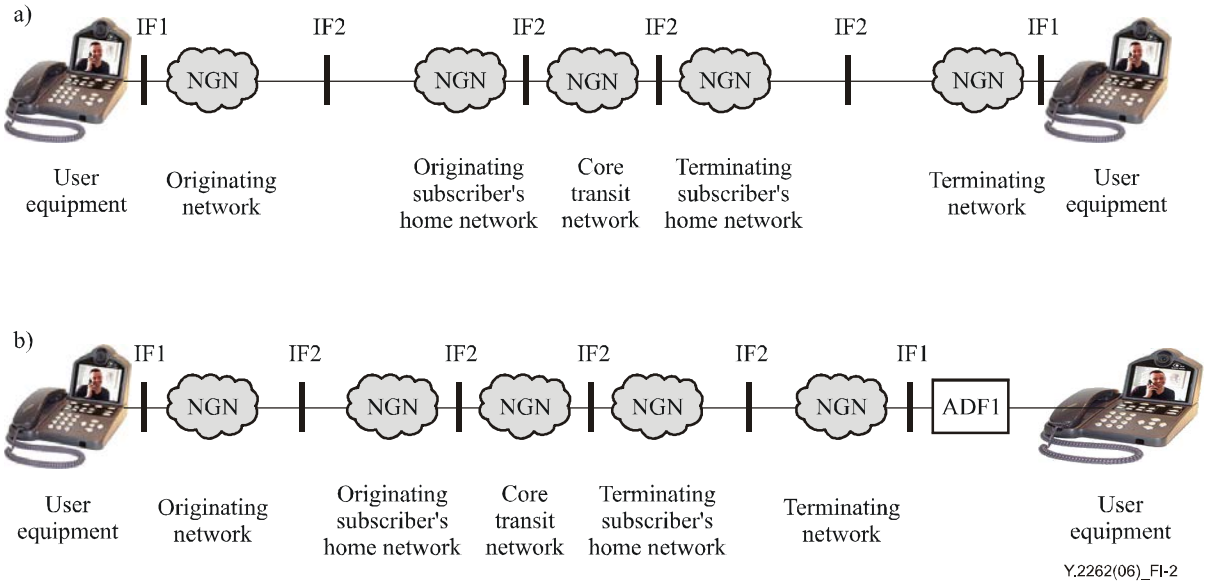

Figure I.2 – PSTN/ISDN simulation – All networks present

Scenario 2: Core transit network not present

This scenario is as the previous one less the core transit network. This scenario is identical to the IMS model.

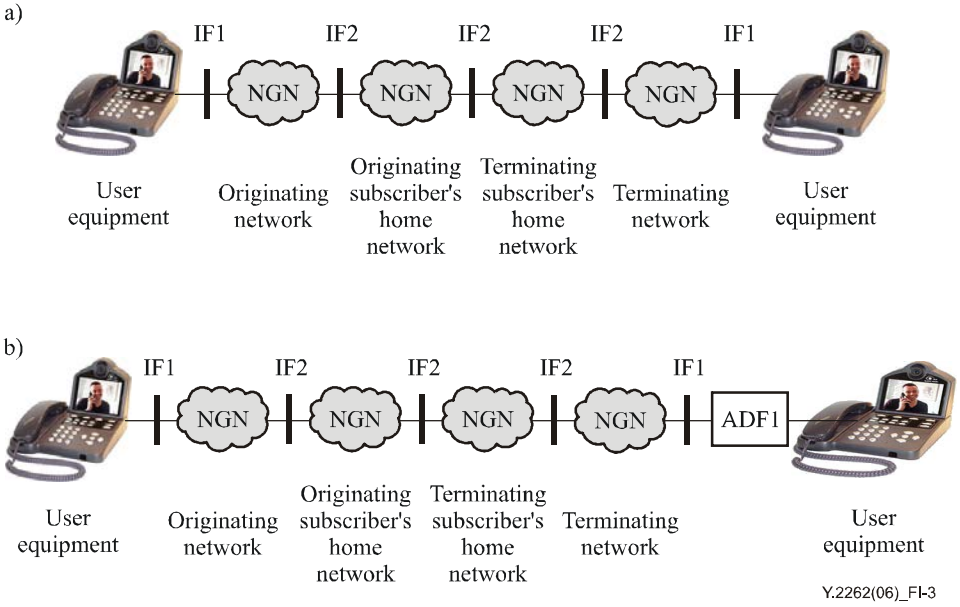

Figure I.3 – PSTN/ISDN simulation – Core transit network not present

Scenario 3: Single network scenario

This is the simplest possible scenario in which there is only one network behaving as the originating, transit and termination network.

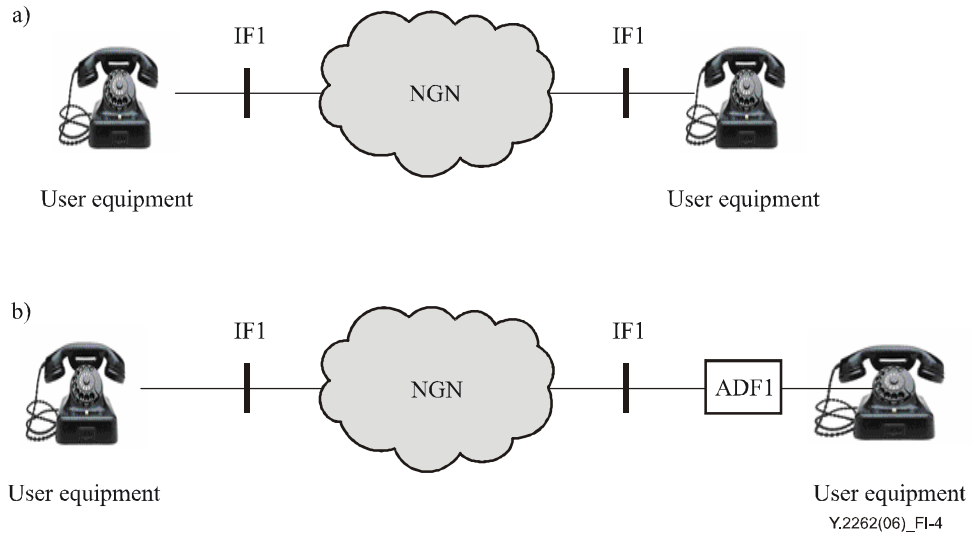

Figure I.4 – PSTN/ISDN simulation – Originating and terminating networks the same

I.3 Legacy and NGN user equipment connected through an NGN

This scenario presents a case in which one user equipment is a legacy while the other is an NGN user equipment. Other scenarios involving these user equipments are possible depending if the NGN is core transit, terminating (originating) or terminating (originating) subscriber's home network or any combination of them. For the NGN user equipment only PSTN/ISDN-like services are supported. ADF2 provides mapping from PSTN/ISDN to NGN. Thus, this scenario supports only PSTN/ISDN-like services.

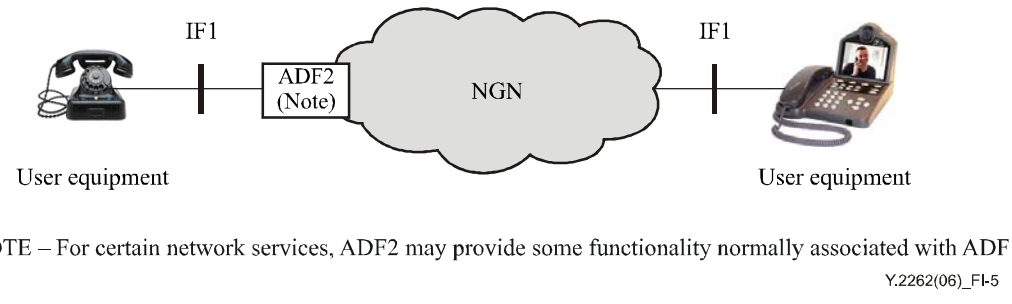

Figure I.5 – Legacy and NGN end systems connected through an NGN

I.4 Scenarios involving interworking

Interworking occurs when there are two networks of different nature communicating with each other.

I.4.1 NGN and PSTN/ISDN

NGN and PSTN/ISDN – Scenario 1

In this scenario, one user equipment is NGN and the other is a legacy user equipment. The legacy user equipment is directly connected to PSTN/ISDN. Here PSTN/ISDN is mapped to NGN and vice versa. Considering that PTSN/ISDN simulation supports PSTN/ISDN-like services, therefore, this would be the limiting factor and only those PSTN/ISDN services are supported that can also be supported (or provided) by simulated PSTN/ISDN.

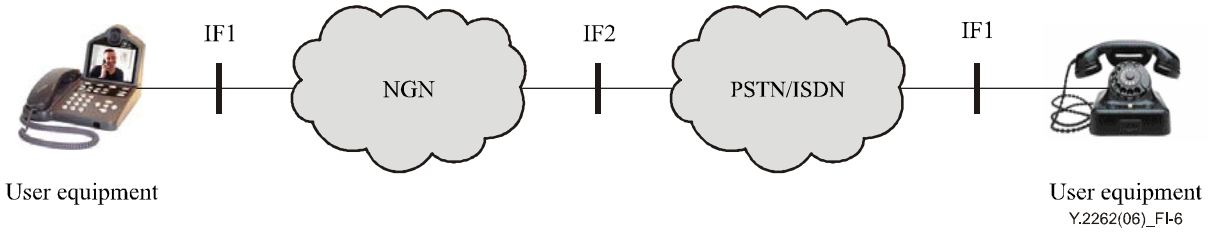

Figure I.6 – PSTN/ISDN interworking with NGN – Scenario 1

NGN and PSTN/ISDN – Scenario 2

In this scenario, the legacy user equipment is located at each of the two ends. However, one is connected directly to PSTN/ISDN and the other goes through an NGN via adaptation, i.e., ADF2. The NGN supports PSTN/ISDN emulation to support end-to-end PSTN/ISDN services.

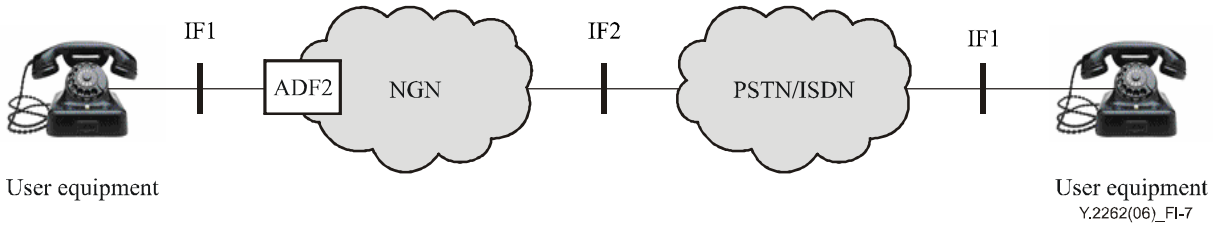

Figure I.7 – Interworking between PSTN/ISDN and NGN – Scenario 2

I.4.2 NGN and public IP network

NGN and public IP network – Scenario 1

In this scenario, one end is NGN user equipment and the other end is IP user equipment going through a public IP network. The public IP network may be, but is not limited to, Internet and IP cable network. The NGN would support only PSTN/ISDN-like services. Services supported by public IP network may be similar to NGN or may differ. Thus, only services are supported which are similar in the two networks.

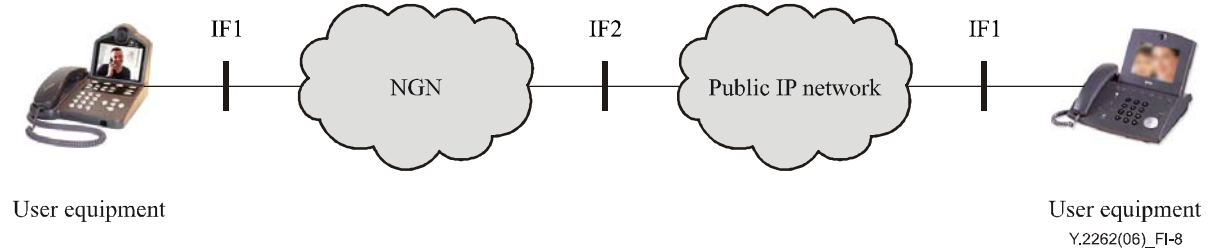

Figure I.8 – NGN interworking with public IP network – Scenario 1

NGN and public IP network – Scenario 2

In this scenario, one end is legacy user equipment going through an NGN through an adaptation function, and the other end is IP user equipment going through a public IP network. The public IP network may be, but is not limited to, Internet and IP cable network. ADF2 provides mapping from PSTN/ISDN to NGN. The end-to-end service provided is PSTN/ISDN-like service. Services supported by public IP network may be similar to NGN or may differ. Thus, like in the previous scenario, only simulation services, which are similar in two networks can be supported.

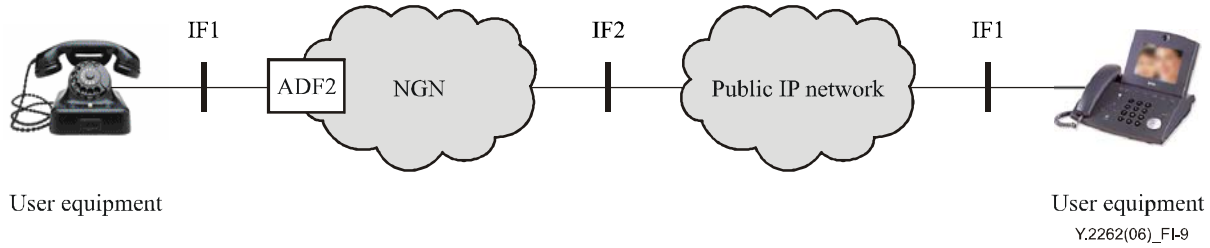

Figure I.9 – NGN interworking with public IP network – Scenario 2

I.4.3 Interworking between CS-based and IMS-based NGN

This scenario describes the network evolution using both emulation and simulation. This can happen when an operator deploys an IMS-based network and another operator uses CS-based emulation. There is a need for interworking between the CS-based and IMS-based networks. This is possible by SIP, but this is beyond the scope of this Recommendation.

I.5 Emulation and simulation scenarios involving customer networks

In this scenario, an NGN customer network connects directly to an NGN via a type 1 interface (IF1).

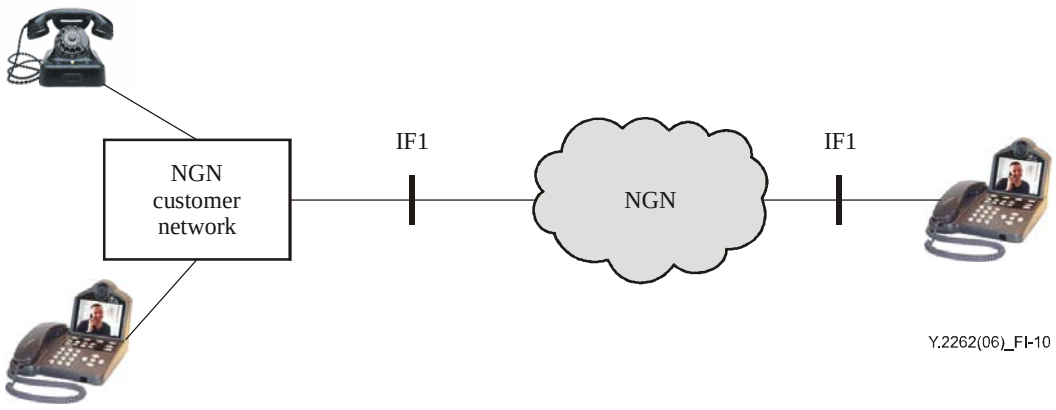

Figure I.10 – An NGN customer network connected to an NGN

Appendix II

Examples of emulation and simulation network structure

(This appendix does not form an integral part of this Recommendation)

II.1 Examples of emulation and simulation network structure

Examples of network structures based on the above classifications will now be given. Including the following descriptions in this Recommendation will facilitate easier understanding between emulation and simulation network structures.

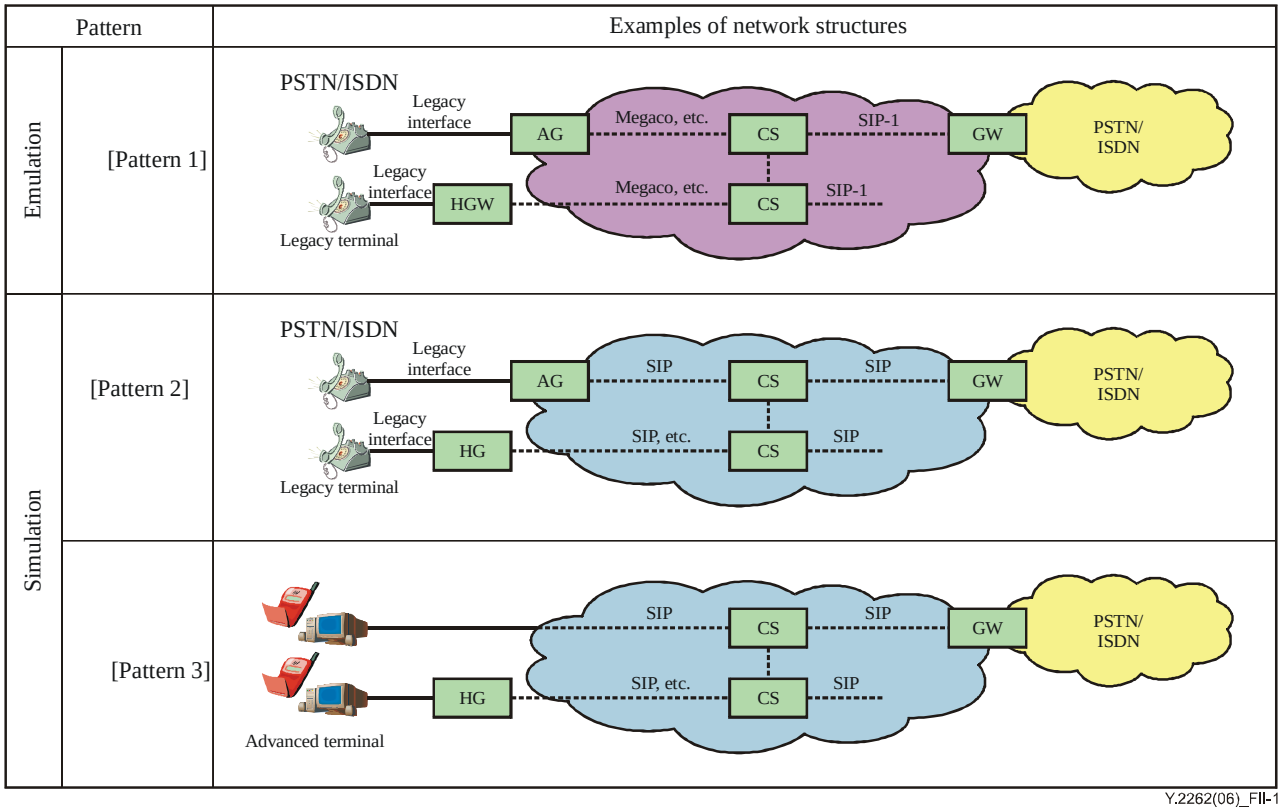

Figure II.1 – Examples of emulation and simulation network structures

II.2 Basic connection patterns

The basic connection patterns are determined based on emulation/simulation and whether or not there is interworking with PSTN/ISDN. In the case that they are first divided into category A or B according to whether interworking with PSTN/ISDN or not, the basic connection patterns are classified as follows.

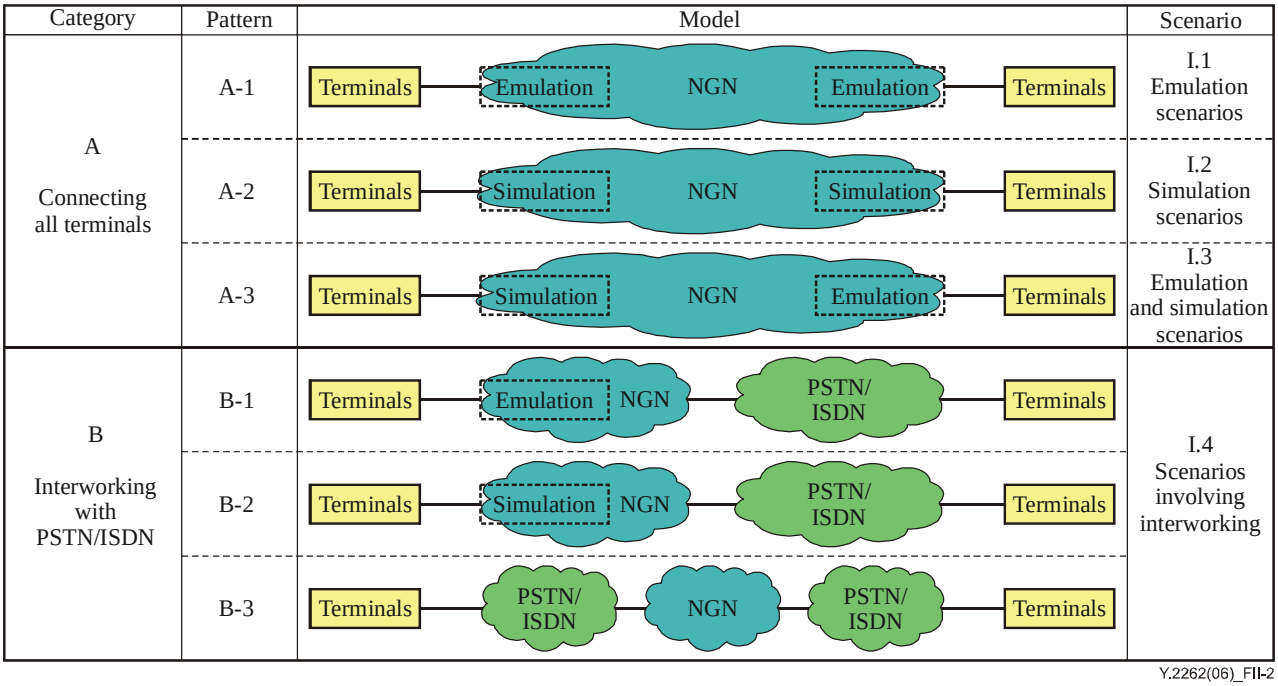

Figure II.2 – The basic connection patterns

Category A

In the category A, NGN connects all terminals directly.

- Pattern A-1: NGN connects all terminals using emulation.
- Pattern A-2: NGN connects all terminals using simulation.
- Pattern A-3: NGN connects some terminals using emulation and others using simulation.

Category B

In the category B, NGN interworks with PSTN/ISDN.

- Pattern B-1: NGN connects some terminals using emulation, and interworks with PSTN/ISDN.
- Pattern B-2: NGN connects some terminals using simulation, and interworks with PSTN/ISDN.
- Pattern B-3: NGN interworks with two different PSTN/ISDNs.

Appendix III

Examples of signalling protocols for emulation and simulation

(This appendix does not form an integral part of this Recommendation)

III.1 Signalling for PSTN/ISDN emulation

The following examples of signalling protocols are used to show how PSTN/ISDN emulation is performed using call servers.

The H.248 protocol is used by ACS (access call server) to control access media gateway.

The SIGTRAN architecture for signalling gateways with its protocols for "user adaptation" is used for interaction between BCS (breakout call server) and SG (signalling gateway). The ISUP protocol is used by the SG for interworking between the SG and the PSTN/ISDN network.

The SIP-I protocol is used by the GCS (gateway call server) for interoperability between different PES domains.

The SIP protocol is used by the ICS (interworking call server) for interoperability between PES and IMS components.

The signalling used among ACS, BCS, GCS and ICS is the SIP-I or BICC protocol.

ISDN Q.921-user adaptation layer (IUA) protocol is used in-between AG and ACS.

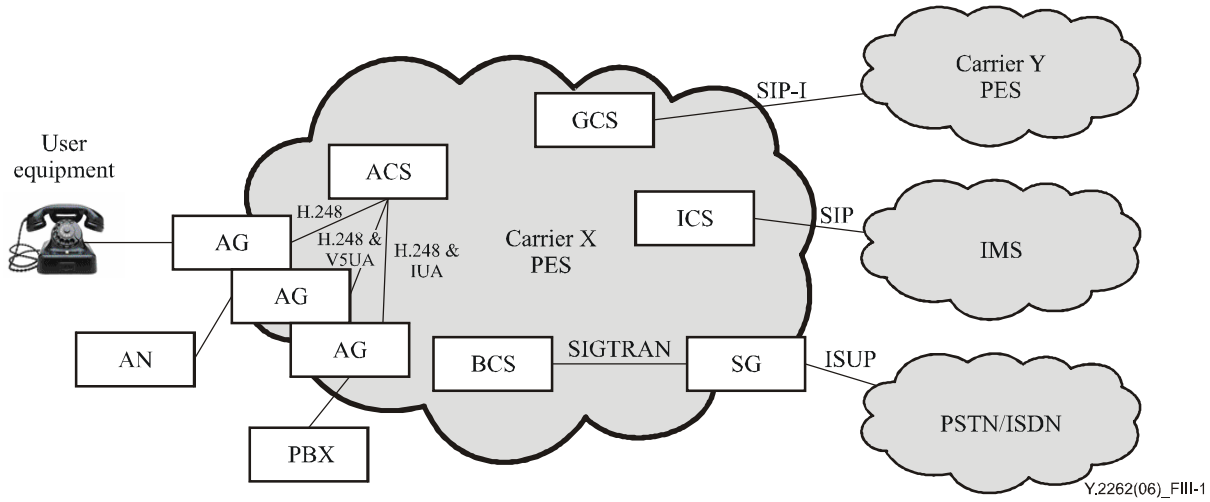

Figure III.1 – Signalling for PSTN/ISDN emulation

III.2 Signalling for PSTN/ISDN simulation

The following examples of signalling protocols are used to show how PSTN/ISDN simulation is performed using SIP servers.

In Figure III.2, the SIP server which is responsible for session control is named as session control SIP server (SC-SS). The SIP server which realizes interworking with PSTN/ISDN network is named as media gateway control SIP server (MGC-SS). The SIP server which realizes interoperability with other NGN domains or other packet-based networks is named as packet gateway control SIP server (PGC-SS).

The SIP protocol is used by SC-SS to control NGN end system (e.g., SIP phone) or NGN-access gateway (e.g., SIP access gateway).

The SIGTRAN protocol is used for interaction between MGC-SS and SG.

The ISUP protocol is used by the SG for interworking between the SG and the PSTN/ISDN network.

The SIP protocol is used by the packet gateway control SIP server (PGC-SS) for interoperability between different IMS domains, or between IMS and PES components, or between IMS and other IP networks.

The signalling used among SC-SS, MGC-SS and PGC-SS is the SIP protocol.

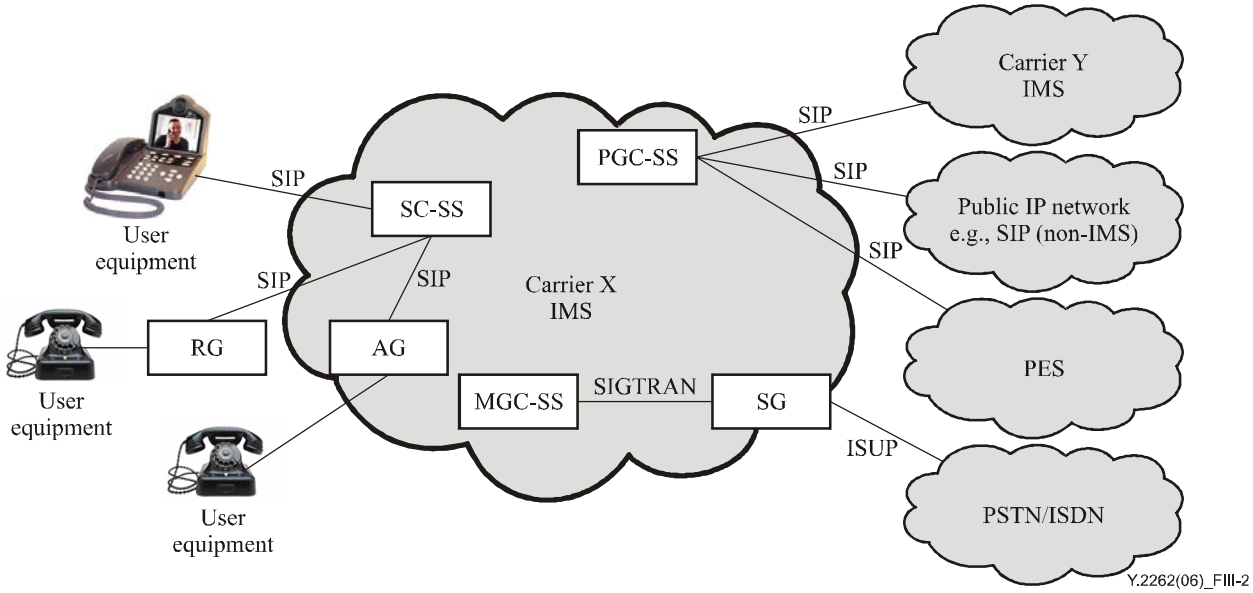

Figure III.2 – Signalling for PSTN/ISDN simulation

Appendix IV

Examples of emulation of PSTN and N-ISDN bearer services

(This appendix does not form an integral part of this Recommendation)

Examples for the emulation of PSTN and N-ISDN bearer services are provided:

1) Monorate bearer services (= 1 × 64-kbit/s digital bearer in PSTN/ISDN)
   - ITU-T Recommendations I.231.2 and I.231.3 may be emulated by a single RTP session, with or without RTP control protocol (RTCP), using an RTP profile according to IETF RFC 3551.
   - ITU-T Recommendation I.231.1 may be emulated by a single RTP session, with or without RTCP, using RTP clearmode according to IETF RFC 4040.
2) Multirate bearer services (= N × 64-kbit/s digital bearer in PSTN/ISDN; N greater than one)
   - ITU-T Recommendations I.231.4 to I.231.10 may be emulated by TDMoIP described in ITU-T Recommendation Y.1453.

Appendix V

Billing system evolution scenarios

(This appendix does not form an integral part of this Recommendation)

Three following scenarios are considered when evolving to NGN. The timing or preference for selection of these scenarios is service provider dependent.

Mediation (MED) is an entity which allows transfer and processing of call detail records (CDRs) from the PSTN/ISDN to the NGN billing system or from the NGN to PSTN/ISDN billing system.

Scenario 1

For this scenario, an NGN billing system is considered to handle both PSTN/ISDN and the NGN. For this case, all accounting aspects are affected.

Scenario 2

For this scenario, a new billing system is developed for NGN while keeping the existing PSTN/ISDN billing system. For this case, all accounting aspects are to be considered for NGN.

Scenario 3

For this scenario, a legacy billing system is considered to handle both PSTN/ISDN and the NGN. For this case, all accounting aspects are affected.

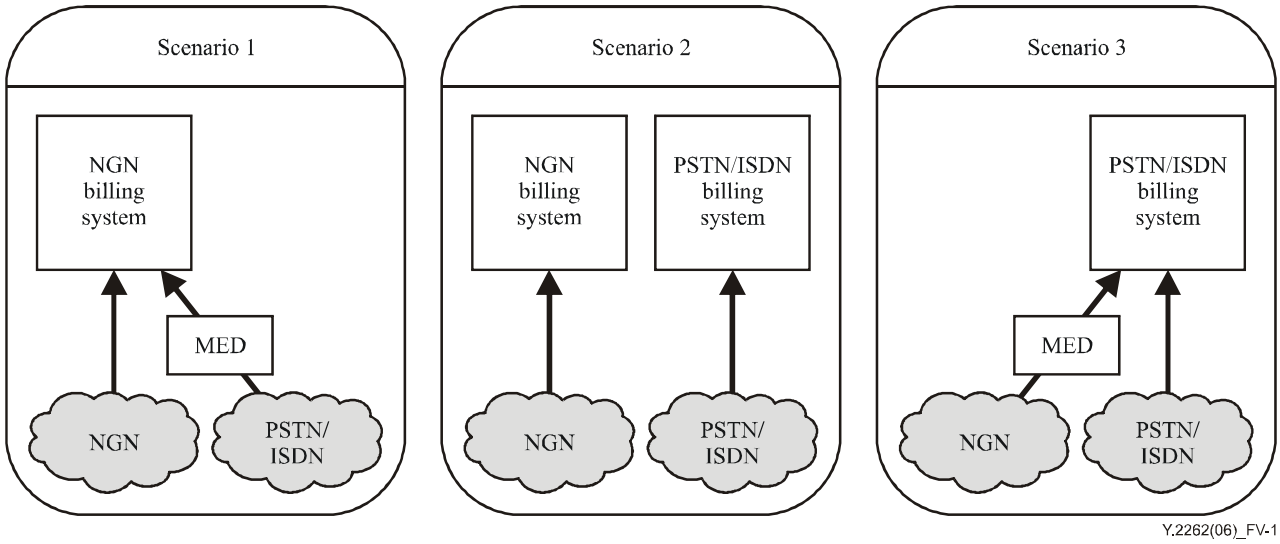

Figure V.1 – Billing system evolution scenarios

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