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

ITU-T Y.2000-series – Supplement 21: NGN requirements for interworking with legacy IP-based networks

ITU-T Y-series Recommendations – Supplement 21

International Telecommunication Union

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Supplement 21 to ITU-T Y-series Recommendations

ITU-T Y.2000-series – Supplement 21

NGN requirements for interworking with legacy IP-based networks

Summary

Supplement 21 to ITU-T Y-series Recommendations describes requirements for interworking between next generation networks (NGNs) and legacy IP-based networks. It provides a general overview of interworking between NGNs and legacy IP-based networks and describes requirements for NGN capabilities in order that they interwork with legacy IP-based networks.

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NGN requirements for interworking with legacy IP-based networks

1 Scope

This supplement describes requirements for interworking between next generation networks (NGNs) and legacy IP-based networks. It focuses on requirements for NGN capabilities to support interworking with legacy IP-based networks.

This supplement provides:

- general description of interworking between NGNs and legacy IP-based networks;
- requirements for NGN capabilities in order to interwork with legacy IP-based networks.

2 References

[ITU-T I.510] Recommendation ITU-T I.510 (1993), *Definitions and general principles for ISDN interworking*.

[ITU-T Y.1251] Recommendation ITU-T Y.1251 (2002), *General architecture model for interworking*.

[ITU-T Y.1401] Recommendation ITU-T Y.1401 (2008), *Principles of interworking*.

[ITU-T Y.2001] Recommendation ITU-T Y.2001 (2004), *General overview of NGN*.

[ITU-T Y.2011] Recommendation ITU-T Y.2011 (2004), *General principles and general reference model for Next Generation Networks.*

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of next generation networks*.

3 Definitions

3.1 Terms defined elsewhere

This supplement uses the following terms defined elsewhere:

3.1.1 adaptation function [ITU-T Y.1251]: A processing function which adapts the client layer network characteristic information into a form suitable for transport over a trail in the server layer network.

3.1.2 interworking [ITU-T I.510]: 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.

3.1.3 interworking function (IWF) [ITU-T Y.1401]: These functions are referred to in the interworking definition, which include the conversion between protocols and the mapping of one protocol to another. The functionality required between networks can be separated from the functionality, if any, required in end systems.

3.1.4 IP-based network [ITU-T Y.1401]: A network in which IP is used as one of the Layer 3 protocols.

3.1.5 network interworking [ITU-T Y.1401]: In network interworking, the PCI of the protocol used in network 1 and network 2 and the payload information are transferred transparently by an IWF. Typically the IWF encapsulates (known as tunnelling in some specifications) the information which is transmitted by means of an adaptation function and transfers it transparently to the other network.

3.1.6 next generation network (NGN) [ITU-T Y.2001]: 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.

3.1.7 NGN service stratum [ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer service-related data and the functions that control and manage service resources and network services to enable user services and applications.

3.1.8 NGN transport stratum [ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer data and the functions that control and manage transport resources to carry such data between terminating entities.

3.1.9 service interworking [ITU-T Y.1401]: In service interworking, the IWF terminates the protocol used in network 1 and translates (i.e., mapping) the PCI to the PCI of the protocol used in network 2 for User, Control and Management Plane functions to the extent possible. In general, since not all functions may be supported in one or other of the networks, the translation of PCI may be partial or non-existent. However, this should not result in any loss of user data since the payload is not affected by PCI conversion at the service interworking IWF.

NOTE – Protocol Control Information (PCI) has the following meanings:

1. the queries and replies among communications equipment to determine the respective capabilities of each end of the communications link,
2. for layered systems, information exchanged between entities of a given layer, via the service provided by the next lower layer, to coordinate their joint operation.

3.1.10 service node interface (SNI) [ITU-T Y.2012]: An interface which provides a channel for interactions and exchanges between an NGN and other service providers.

3.2 Terms defined in this supplement

None.

4 Abbreviations and acronyms

This supplement uses the following abbreviations and acronyms:

AF Adaptation Function

ANI Application-Network Interface

IP Internet Protocol

IWF Interworking Function

IWU Interworking Unit

NGN Next Generation Network

NNI Network-Network Interface

PCI Protocol Control Information

POI Point Of Interconnection

QoS Quality of Service

SNI Service Node Interface

5 Conventions

None.

6 Overview of interworking between NGNs and legacy IP-based networks

The concept of an NGN [ITU-T Y.2001] has been introduced as an answer to the increasing demand for new multimedia services, general mobility and convergence of networks and services. In providing those services, new capabilities have been defined for NGNs to aid the creation, deployment and management of various services either existing or not yet created. Also a new feature of the NGN has been introduced for decoupling the service and transport layers into two strata allowing them to be provided separately and evolved independently. As a result of this approach, new interworking [ITU-T I.510] scenarios have emerged between NGNs and legacy IP-based networks.

Legacy IP-based networks have been deployed generally to provide Internet services. They have been using legacy transport technologies and high aggregation in the access network to serve as many customers as possible.

However, recent customers' demands for new multimedia services (e.g., IP broadcasting, VoD and multimedia communications) have been continuously increasing, so the NGN and legacy IP-based network interconnection should be correctly defined to avoid service discontinuity [ITU-T Y.1251].

Legacy IP-based networks are IP-based networks which cannot fully support NGN capabilities such as a guaranteed quality of service (QoS), service continuity, security, and multimedia services.

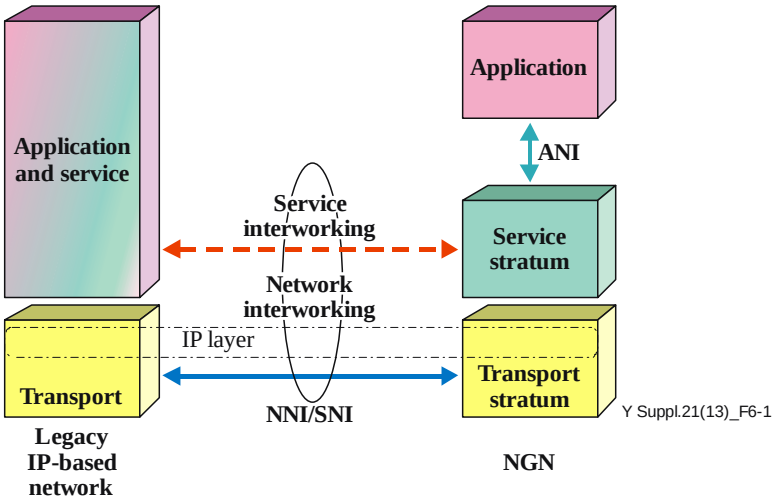

Figure 6-1 – Interworking model between an NGN and a legacy IP-based network [ITU-T Y.2011]

The objective of interworking is to provide end-to-end communications and services, as well as to support protocol interactions between a legacy IP-based network and an NGN.

An interworking model of a legacy IP-based network and an NGN based on IP connectivity consists of service interworking and network interworking [ITU-T Y.1401] constituted by protocol discontinuity. As shown in Figure 6-1, the IP layer is a common layer which is used in both networks within the corresponding transport/transport stratum. There is no protocol discontinuity on the IP layer level between the two networks.

If there is any protocol discontinuity above the IP layer, it is necessary to have service interworking. If there is any protocol discontinuity below the IP layer, it is required to have network interworking. This discontinuity may occur within one or more layers between the legacy IP-based network and the NGN.

Figure 6-1 depicts the interworking model, in which the service interworking on the service level and the network interworking on the transport level appear through the service node interface (SNI) and the network-network interface (NNI) respectively [ITU-T Y.2012].

Application and service of the legacy IP-based network is required to be mapped and translated into the application and service stratum of the NGN.

7 Requirements for interworking between an NGN and a legacy IP-based network

To interwork with a legacy IP-based network, an NGN is required to have the following interworking capabilities [b-ITU-T Y.2201]:

- QoS interworking;
- mobility and accessibility interworking;
- security interworking;
- signalling interworking;
- numbering, naming and/or addressing interworking;
- user and terminal profile information exchange.

NOTE – Provided capabilities for interworking between a legacy IP-based network and an NGN are a minimum set of features that should be provided by both networks. In the event that one of the networks cannot provide some of these features, there should be a special module placed at the border of the network responsible for adaptation (see Appendix II for more details).

Interworking between a legacy IP-based network and an NGN may result in a limited end-to-end service capability.

Different versions of the IP may be considered to interwork between a legacy IP-based network and an NGN.

7.1 Support of end-to-end QoS

It is required to support at least best effort end-to-end QoS between a legacy IP-based network and an NGN provided by multiple operators to ensure the minimum requirements of service level for users or applications. An NGN is required to support at least one level of QoS, which may be common between the user and provider and/or between NGN and legacy IP-based network providers.

It is recommended to support multiple levels of QoS in order to increase the service level negotiation. To ensure a minimum QoS service level between an NGN and a legacy IP-based network, the following aspects need to be considered:

- use of resource and admission control mechanisms;
- traffic class differentiation;
- priority management;
- QoS signalling mechanisms;
- performance measurement and management for quality insurance;
- overload/congestion control.

End-to-end QoS is required to have the capabilities to:

- translate the QoS information of application data from a legacy IP-based network to that of an NGN in forward link;
- classify the packets which are exchanged between a legacy IP-based network and an NGN or its application layers;
- control the uplink or downlink traffic using the QoS information;
- perform the service class mapping of QoS parameters between the legacy IP-based network and the NGN;
- support packet scheduling to rearrange the transmission order according to the service class;
- support QoS parameter mapping and translation between the QoS parameters of legacy IP-based network and NGN;
- support QoS service class mapping between legacy IP-based network and NGN.

7.2 Support of mobility and accessibility

The NGN and the legacy IP-based network are IP-based. It is required to adopt the mobility and mobility management protocols for the NGN [b-ITU-T Q.1706] to legacy IP-based protocols, or at least to assure that they are well-harmonized. Such protocols allow support of the mobility and controls accessibility of users/terminals by one or more location management functions whenever they move. It is also recommended to reuse the existing mobility and mobility management technologies for the interworking legacy IP-based network and the NGN. In harmony with the overall IP-based structure envisaged, it is recommended that location management support an IP-specific approach.

It is recommended that mobility interworking be realized by mobile IP protocols described in [b-IETF RFC 5944], [b-IETF RFC 4721] for IPv4 and [b-IETF RFC 6275] for IPv6.

Interworking functions are required to provide accessibility that meets the standards of the NGN. Accessibility in the NGN to provide services to users with communication-related disabilities is required to be covered since legacy IP-based networks do not have any similar mechanisms and leave mentioned users with no support.

A single subscription can optionally be supported for accessing services through both the NGN and the legacy IP-based network.

7.3 Support of security

In terms of network interworking, the security of the legacy IP-based network still needs to be improved to avoid becoming the source of threats for the existing NGN. As a legacy IP-based network is not well secured, interworking with an NGN may cause new concerns and threats which are currently unknown in the legacy IP-based network. To guarantee the NGN security level, it is recommended to place an additional security function at the network borders.

Due to common security problems in legacy IP-based networks, the proper use of authorization is important. When interworking with the NGN, it is recommended to locate a dedicated security function at the NNI/SNI. Such a function covers all security functions, including authorization and data confidentiality.

There is no need to apply a similar function at the application-network interface (ANI) – some services have built-in ANI support for the NGN, others will use the adaptation function to interwork with the NGN.

The NGN security capability can be applied to secure the legacy IP-based network with new implemented service scenarios.

7.4 Support of signalling, naming and addressing

It is required to support the proper exchange of naming and addressing information.

To support addressing interworking it is recommended to use the following schemes [b-WP-1]:

- schemes that send address resolution messages when a call/packet arrives ("pull" information);
- schemes in which address resolution information is sent in routing or routing-like protocols ("push" information);
- schemes that use administered cross-office address translation tables at gateways;
- schemes that use encapsulated/mapped addresses;
- schemes based on IPv4 and IPv6 protocols interworking.

It is required that the following schemes be supported in the interworking function (IWF) to provide the procedures of protocol translation during the interworking of services to keep signalling, naming and addressing understandable for the NGN and the legacy IP-based network.

It is required to provide undisturbed transfer of signalling information. For signalling information, it is required to use high priority of transfer to guarantee continuity of service and information flow.

It is recommended to use the session initiation protocol (SIP) [b-IETF RFC 3261] as the IP signalling protocol.

7.5 Support of user and terminal profile information exchange

It is required to support the exchange of profile information for users and terminals. The legacy-IP network is supposed to provide a means of transport for user and terminal profile information e.g., user availability and data for call establishment.

In addition, it is required that the information be protected from unauthorized access. This can be achieved with the security function described in clause 7.3.

It is also recommended to support the exchange of network capability information e.g., available NGN-based functionalities and utilized protocols, through the control or management plane of each network.

Appendix I

An example of interworking between a legacy IP-based network and NGN

Legacy IP-based networks known as Internet are an open medium for data transport and service-client base services. This sort of network may have many interfaces to different networks. NGN is one of the networks which may be connected with legacy IP-based networks. Due to the fact that NGN has two standardized interfaces, NNI and ANI, interworking between NGN and legacy IP-based networks occurs over NNI and ANI. An adaptation function can be used to reuse existing service on the legacy IP-based network as depicted on Figure I.1.

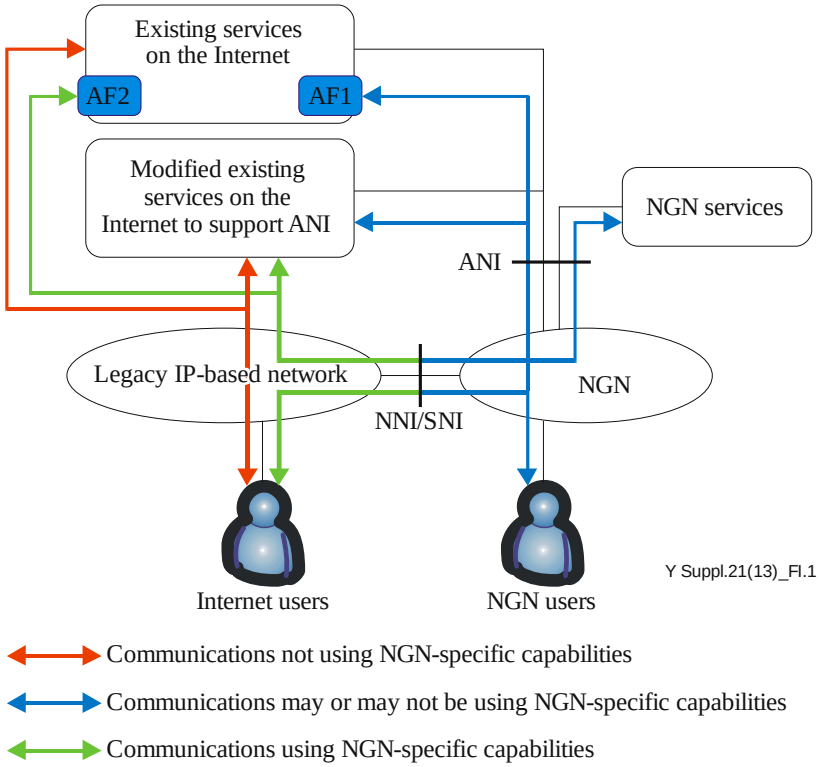

Figure I.1 – An example of interworking between legacy IP-based network and NGN

NNI is considered to be the physical interface between NGNs and legacy IP-based networks. It is controlled separately by the transport control functions of both interworking networks. The interface describes transport capabilities like bandwidth guarantee, QoS as well as service/application capabilities delivered to the end users. The NNI interface may support the process of exchanging information between legacy IP-based networks and NGN services/applications. It is required AF2 for realization of existing legacy IP-based networks services over NNI.

ANI is considered to be the logical channel for interactions and exchange between NGN and legacy IP-based services/applications. Existing service on the IP-based networks may be utilized by NGN with AF1 which is implemented on legacy IP-based networks side. It allows of realization existing legacy IP-based network services over ANI. Modified services on the legacy IP-based networks are adapted to interwork with NGN through ANI.

Depending on allowed service/application, the service may be realized over NNI or/and ANI.

Internet users may utilize existing and modified legacy IP-based network services all the time.

Internet users can use NGN services if these do not require NGN capability. NGN services may or may not require NGN capabilities.

Appendix II

Interworking function between NGN and legacy IP-based network

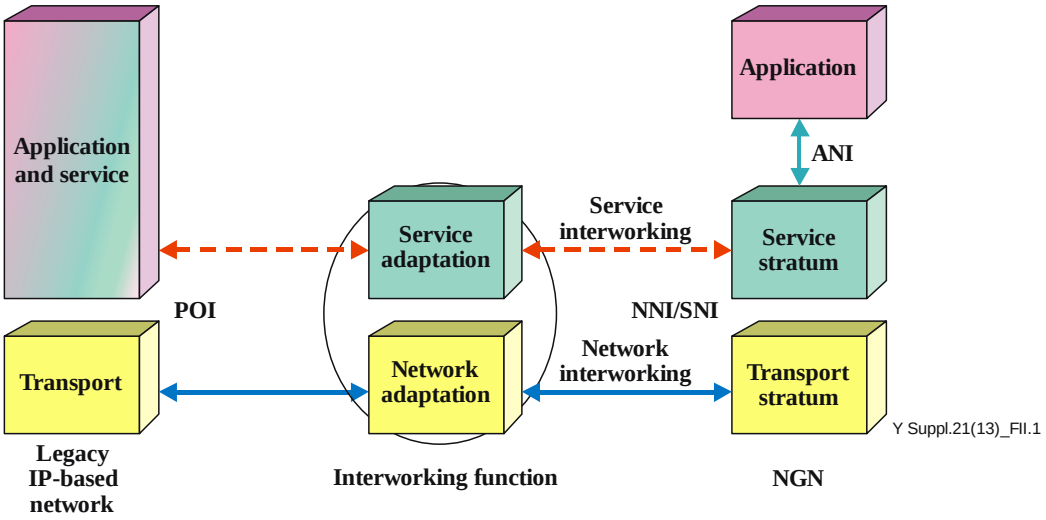

Figure II.1 – Interworking function between legacy IP-based network and NGN

Figure II.1 shows the interworking function, on which service interworking in service level and network interworking in transport level appear through NNI or SNI interfaces between NGN and interworking function. The current point of interconnection (POI) should be used for interworking between the legacy IP-based network and the interworking function.

Application and service of legacy IP-based network should be mapped and translated into application and service of application and service stratum of NGN, in the interworking function.

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