

Draft new Recommendation ITU-T Y.Arch_NGNe_ncp:

Architectural evolution for NGN control plane by applying SDN technology

Summary

<Optional – This clause should appear only if it contains information different from that in Scope >

This recommendation aims to create an evolved NGN control plane architecture which is scalable, modular and flexible by decoupling the signal handling functionality and the user plane control functionality and also treating the signalling as a user service (data) leading to uniform handling of services. This is followed by description of information flow for services such as network attachment, session establishment and registration etc. for the proposed architecture.

Keywords

Next Generation Network; NGN; Software-Defined Networking; SDN

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1 Scope

This draft Recommendation specifies an evolved NGN control plane architecture which is scalable, modular and flexible by decoupling the signal handling functionality and the user plane control functionality and also treating the signalling as a user service (data) leading to uniform handling of services.

The recommendation includes:

- Architecture to separate the end user-specific signalling exchange functionality from the user plane control (transport control) functionality for NGN architecture based on the SDN paradigm and network service model and also treating the signalling as a user service;
- Requirements of the evolved NGN control plane architecture; and
- Information flow for services such as network attachment, session establishment and registration;

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 X.yyy] Recommendation ITU-T X.yyy (date), *Title*.

3 Definitions

<Check in the ITU-T terms and definitions database at www.itu.int/go/terminology-database whether the term has already been defined in another Recommendation. It would be more consistent to refer to such a definition rather than to redefine the term>

3.1 Terms defined elsewhere

<Normally, terms defined elsewhere will simply refer to the defining document. In certain cases, it may be desirable to quote the definition to allow for a stand-alone document>

This Recommendation uses the following terms defined elsewhere:

3.1.1 <Term 1> [Reference]: <optional quoted definition>.

3.1.2 <Term 2> [Reference]: <optional quoted definition>.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 <Term 3>: <definition>.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

<abbr><expansion>

<Include all abbreviations and acronyms used in this Recommendation>

5 Conventions

In this Recommendation, requirements are classified as follows:

- The keywords "**is required to**" or "**are required to**" indicate a requirement/ requirement, which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed;
- The keywords "**is recommended**" indicate a requirement, which is recommended but which is not absolutely required. Thus, such requirements need not be present to claim conformance; and
- The keywords "**optionally**" or "**may**" indicate an optional requirement which is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option; it means the vendor may optionally provide the feature and still claim conformance with the specification.

6 Overview

The NGN architecture [ITU-T Y.2012] signal handling functionality" and the "transport control functionality" are both tightly coupled within the transport control functions. (as shown in Figure 1(a)) To decouple the "signal handling functionality" from the "transport control functionality", we propose to separate end user signaling from the transport control (as shown in Figure 1(b)) and further, to handle end user signalling via a service control function (in service stratum). (as shown in Figure 1(c)) End user signaling messages can be treated as another form of data flowing through the network.

One set of functionalities for the transport control functions involves controlling and managing transport functions, i.e., management of data sessions (data paths) in the user plane which can be decoupled as user plane control functions. The other set of functionalities, responsible for either directly providing or enabling the built-in services, can be a part of the signalling service functions. These signalling service functions may exchange signalling messages with end users to provide direct services such as authentication service or mobility service. These functions are other than those included as part of user plane control functions. However, the enabling of certain services may also require interaction between these two categories of functions. For example, in order to provide the connectivity service to an end user, signalling service functions may communicate with end user to collect the requirements for the session and request the user plane control functions to setup the data session through the transport functions. As in another example, such interactions may be required to support the mobility service, say, when an end user is moving, the signalling service functions, may interact with the mobile end user to get location update and provide to the transport control function for further processing.

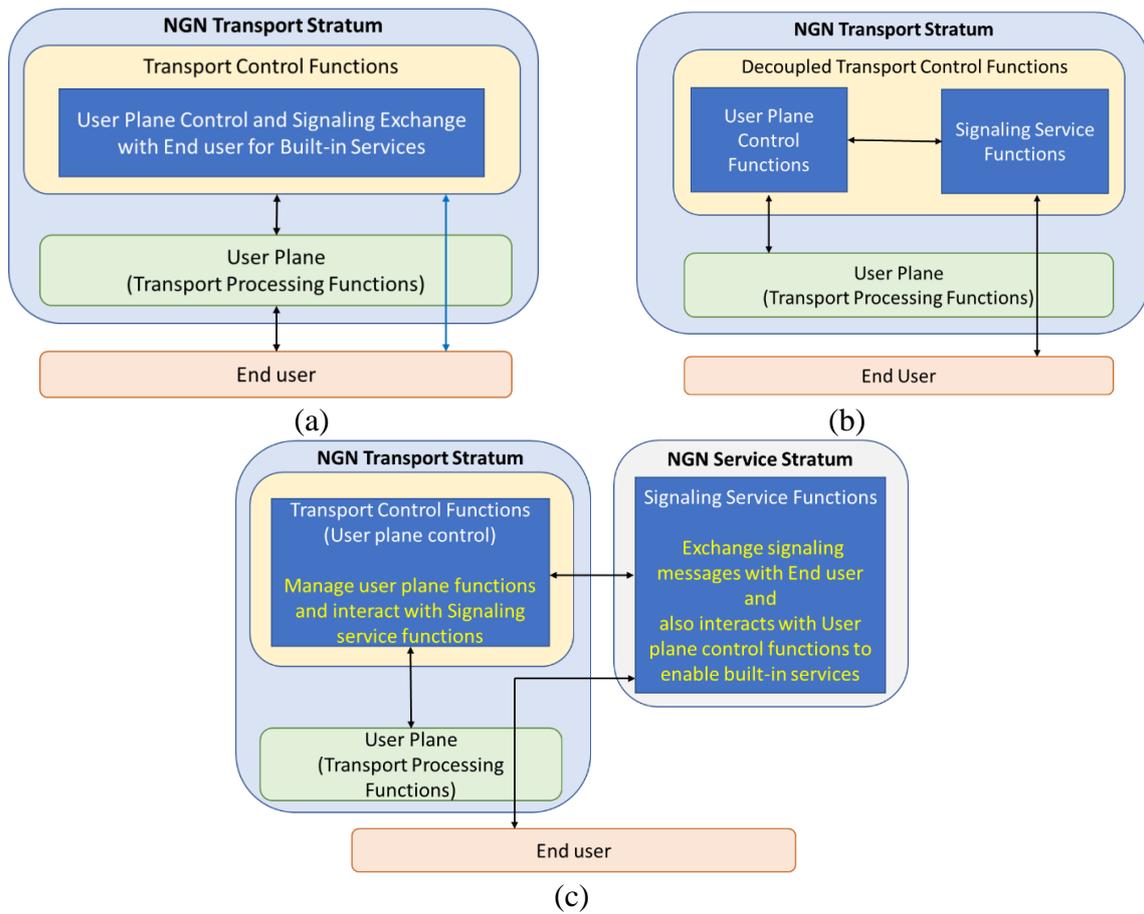


Figure 1: (a) Transport stratum in the existing NGN architecture (b) Decoupling of user plane control functions and Signaling service functions in the transport stratum. (c) Proposed concept - Decoupled built-in services from transport control functions.

We propose new signalling service functions (in service stratum) to handle exchange of signalling messages with end users. The transport control plane (modified) shall contain only the user plane control functionality as shown in Figure 1(c). These signalling service functions shall support certain services such as user authentication directly via exchange of signalling messages with end users and also enable other services such as data transfer or user mobility by collecting relevant information (requirements) from end users through signalling exchange and providing the information to the transport control functions to be used further for configuration of transport functions in order to support the appropriate service-aware behaviour.

Once decoupled, these signalling service functions can also be treated like external application-based services. Similar to the Application service-based architecture for service delivery, the signalling related to a built-in service can be exchanged with an end user over a data path (i.e., a signalling path) by signalling service functions. The transport control functions interact only with signalling service functions (and not with an end user directly) via service control functions and establish the required data path for a service, e.g., IP connectivity service or mobility etc.

7 Functional Architecture

We propose to separate signalling control from the user plane (transport) control and further to treat end user-specific signalling as a Signalling Service Function. Figure 2 shows overview of the existing NGN architecture. In this architecture, Mobility Management and Network Attachment Control Functions are part of transport control functions. These control functions need to collect information from end users to execute Mobility management and Network attachment procedures.

This control information exchange or signalling is currently tightly coupled with resource control protocols/interfaces in the existing architecture.

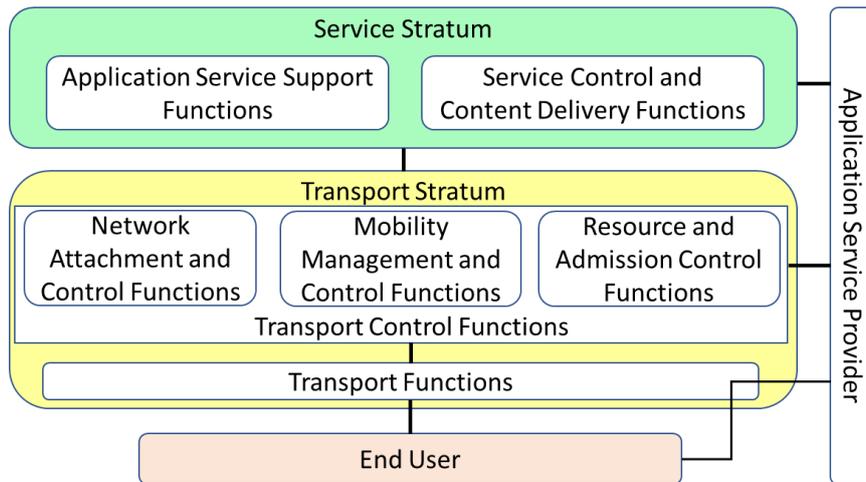


Figure 2: NGN architecture overview.

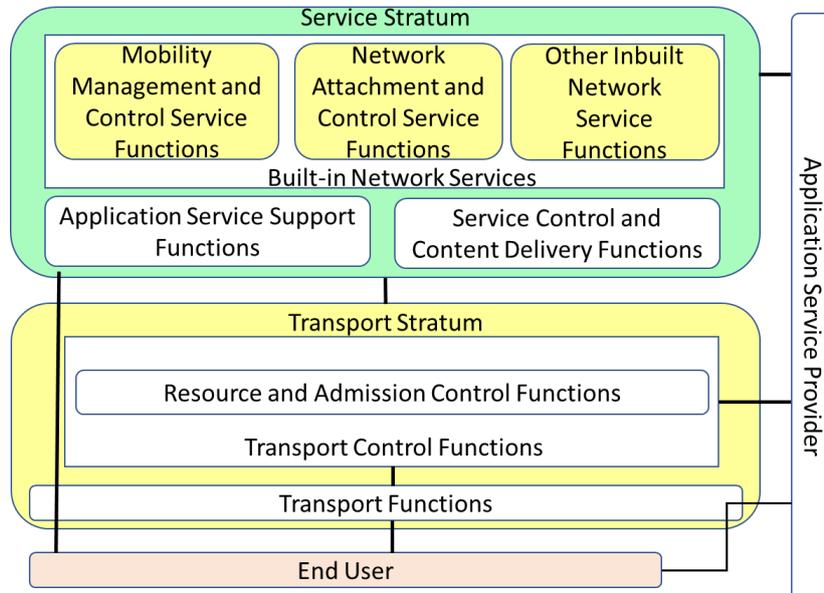


Figure 3: Architecture overview for evolved NGN control plane based on the proposed approach.

As shown in Figure 3, the proposed functional architecture provides improved segregation of functionality in the network control plane (transport control functions). Signalling functions for built-in services such as Mobility Management service and Network Attachment control service can be thought of as a signalling service function and can be moved to service stratum in this evolved architecture. The tasks of these service functions include requirement for a session establishment, sending request to user plane control (transport control) functions to setup data path through the network, and confirming back to the end user that the requirement has been met etc. Whereas user plane (transport) control functions includes resource and admission control function and only act as the SDN Controller to set up the data path through the transport functions. The proposal is better aligned with SDN Principles and can serve various functionalities of the network in simplified and modular manner that is to be explored further sections.

8 Requirements

<TBD>

9 Information flows

<TBD>

Appendix I

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

<TBD>

Bibliography

<TBD>

Annexure-I

A.1 Justification for proposed draft new Recommendation Y.Arch_NGNe_ncp

Question:	2/13	Proposed new ITU-T Recommendation	Geneva, 14-25 November 2022
Reference and title:	ITU-T Y.Arch_NGNe_ncp" Architectural evolution for NGN control plane by applying SDN technology"		
Base text:	TD 140/WP3	Timing:	2024 – Q3
Editor(s):	Ranjana Sivaram, Telecom Engineering Centre (TEC) India, ranjana.sivaram@gov.in Abhay Shanker Verma, Telecom Engineering Centre (TEC) India, as.verma@gov.in Rashmi Kamran Indian Institute of Technology Bombay India, rashmi.kamran@iitb.ac.in	Approval process:	AAP
<p>Scope (defines the intent or object of the Recommendation and the aspects covered, thereby indicating the limits of its applicability):</p> <p>This draft Recommendation specifies an evolved NGN control plane architecture which is scalable, modular and flexible by decoupling the signal handling functionality and the user plane control functionality and also treating the signalling as a user service (data) leading to uniform handling of services.</p> <p>The recommendation includes:</p> <ul style="list-style-type: none"> - Architecture to separate the end user-specific signalling exchange functionality from the user plane control (transport control) functionality for NGN architecture based on the SDN paradigm and network service model and also treating the signalling as a user service; - Requirements of the evolved NGN control plane architecture; and - Information flow for services such as network attachment, session establishment and registration; 			
<p>Summary (provides a brief overview of the purpose and contents of the Recommendation, thus permitting readers to judge its usefulness for their work):</p> <p>This recommendation aims to create an evolved NGN control plane architecture which is scalable, modular and flexible by decoupling the signal handling functionality and the user plane control functionality and also treating the signalling as a user service (data) leading to uniform handling of services. This is followed by description of information flow for services such as network attachment, session establishment and registration etc. for the proposed architecture.</p>			
<p>Relations to ITU-T Recommendations or to other standards (approved or under development):</p> <p>a) ITU-T Y.2011: describes general principles and reference model of NGN. It details separation of services and transport and also includes further control and user plane separation in service and transport stratum. However, there is no disaggregation considered for signalling exchange tasks (with end-user) from the control plane functionality and signalling exchange task is tightly coupled with control of user plane (transport functions). However, in proposed New Work Item (NWI), there shall be disaggregation of (end-user) signalling exchange task from the control plane by considering it as a service to achieve improved modularity and flexibility in the architecture.</p> <p>b) ITU-T Y.2012 : describes the functional requirements and architecture of NGN and does not distinguish between control of user plane (transport functions) and signalling exchange (with end-users) tasks and both these are included as part of the "transport control functions". The proposed NWI aims to achieve improved alignment with SDN technology in NGN control plane by decoupling these two categories of functionalities and separating them via a standardized interface, which is an extension of the existing NGN architecture. The proposal intends to treat the functionality of signalling exchange with end-users as a service.</p> <p>c) ITU-T Y.2014 : describes high level concepts of the Network Attachment Control Functions (NACF) along with details of reference points. As per the proposed NWI, by considering network attachment control function as an inbuilt service, it facilitates direct reference point between end user and network attachment control service function through conventional IP connectivity (as payload).</p> <p>d) ITU-T Y.2018 : provides the architecture level details of mobility management and control functions for NGN transport stratum and also contains information flows in case of various access scenarios. Although ITU-T Y.2018 considers mobility management and control function as a service, however, the same is not considered as a part of service stratum. In the proposed NWI, it has been aimed to simplify mobility management related information flows by employing decoupling of mobility management related signalling exchange tasks from other transport control functions and by</p>			

considering mobility management service as a part of service stratum.

e) **ITU-T Y.2201** : specifies high level requirements and capabilities of NGN for the development of ITU-T recommendations that constitutes NGN. Objective of the proposed NWI is aligned with the requirements and capabilities provided in ITU-T Y.2201 and specially focused on facilitating an environment for enhanced, flexible and open service creation and provisioning within the service stratum requirements.

f) **ITU-T Y.3300** : provides a framework of Software-Defined Networking (SDN), in which control layer controls the behaviour of data transport and processing functions in the resource layer. Typically, the functionality of exchange with end-users is handled by the application/ service layer. The concept of decoupling end-user signalling exchange from user plane control, in the proposed NWI, is an extension of the SDN in evolved NGN control plane architecture, which makes NGN control plane architecture better aligned with the SDN technology.

g) **ITU-T Y.3321**: covers requirements and capability framework for NICE using SDN [which is called as S-NICE]; it details how S-NICE Capability framework maps to SDN architecture [Y.3300]. However, the proposed NWI considers some network functions (MMCF, NACF) as internal services and manage them in the same way as services are handled in SDN [ITU-T Y.3300]. Further, the proposed NWI works at transport control stratum i.e., control functions are organized as per SDN technology following decoupling of the signalling exchange (with end user) functionality and user plane control functionality leading to increased modularity. Networks that follow evolved NGN control plane architecture as in proposed NWI may also adopt the S-NICE architecture for additional benefits.

h) **ITU-T Y.3322**: deals with Functional architecture for NICE implementation making use of SDN technologies in which the architectural framework is divided into S-NICE infrastructure, S-NICE controller and S-NICE orchestration. However, the proposed NWI considers some network functions (MMCF, NACF) as internal services and manage them in the same way as services are handled in SDN [ITU-T Y.3300]. Further, the proposed NWI works at transport control stratum i.e., control functions are organized as per SDN technology following decoupling of the signalling exchange (with end user) functionality and user plane control functionality leading to increased modularity. Networks that follow evolved NGN control plane architecture as in proposed NWI may also adopt the S-NICE architecture for additional benefits.

From the above, it is noted that there is no overlap between any of the above recommendations and the proposed NWI. However, there is some relationship with the above ITU-T Recommendations for its requirements, functional architecture and information flow.

Liaisons with other study groups or with other standards bodies:

SG11, SG15, 3GPP, ETSI

Supporting members that are committing to contributing actively to the work item:

India (Republic of), China Telecom