International Telecommunication Union

# ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

# Y.2291

(01/2011)

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

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

## Architectural overview of next generation home networks

Recommendation ITU-T Y.2291

International Telecommunication Union

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# Recommendation ITU-T Y.2291

## Architectural overview of next generation home networks


**Summary**

Recommendation ITU-T Y.2291 provides an architectural overview of next generation home networks (NGHN). In line with Recommendation ITU-T Y.2011 and Recommendation ITU-T Y.2012 principles, an implementation-independent approach is adopted.



**History**

| Edition | Recommendation | Approval | Study Group |
|---|---|---|---|
| 1.0 | ITU-T Y.2291 | 2011-01-28 | 13 |

**Keywords**

Home network, next generation home network (NGHN), next generation network (NGN).

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# Recommendation ITU-T Y.2291

## Architectural overview of next generation home networks

### 1 Scope

The objective of this Recommendation is to provide the architectural overview of next generation home networks (NGHN) identifying overall features and functions of home network using an implementation independent approach using [ITU-T Y.2011] and [ITU-T Y.2012] principles.

NGHN are intended to support NGN capabilities as per [ITU-T Y.2201].

### 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 H.622] Recommendation ITU-T H.622 (2008), *A generic home network architecture with support for multimedia services*.

[ITU-T X.1111] Recommendation ITU-T X.1111 (2007), *Framework of security technologies for home network*.

[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*.

[ITU-T Y.2111] Recommendation ITU-T Y.2111 (2008), *Resource and admission control functions in next generation networks*.

[ITU-T Y.2201] Recommendation ITU-T Y.2201 (2009), *Requirements and capabilities for ITU-T NGN*.

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

[ITU-T Y.2720] Recommendation ITU-T Y.2720 (2009), *NGN identity management framework*.

### 3 Definitions

#### 3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

**3.1.1 federation** [ITU-T Y.2720]: Establishing a relationship between two or more entities or an association comprising any number of service providers and identity providers.

**3.1.2 home network** [ITU-T H.622]: A home network is the collection of elements that process, manage, transport and store information, thus enabling the connection and integration of multiple computing, control, monitoring, communication and entertainment devices in the home.

NOTE – In this Recommendation, entities are end users, terminals and services.

## 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

**3.2.1 home network application network interface**: Interface between home network applications and the next generation home network (NGHN).

**3.2.2 home network terminal network interface**: Interface between terminal equipment and the next generation home network (NGHN).

# 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

| | |
|---|---|
| ANI | Application Network Interface |
| ASF&SSF | Application Support Function and Service Support Functions |
| CDF | Content Delivery Functions |
| H-ANI | NGHN ANI |
| H-ASF&SSF | NGHN ASF&SSF |
| H-CDF | NGHN CDF |
| H-IdM | NGHN IdM |
| H-MF | NGHN Management Functions |
| H-MMCF | NGHN Mobility Management Control Functions |
| HN | Home Network |
| H-NACF | NGHN NACF |
| H-RACF | NGHN RACF |
| H-SCF | NGHN SCF |
| H-TCF | NGHN Transport Control Functions |
| H-TrF | NGHN Transport Functions |
| H-TNI | Home network Terminal Network Interface |
| IdM | Identity Management |
| IP | Internet Protocol |
| ISDN | Integrated Services Digital Network |
| NACF | Network Attachment Control Functions |
| NAT | Network Address Translation |
| NGHN | Next Generation Home Network |
| NGN | Next Generation Network |
| PSTN | Public Switched Telephone Network |
| QoS | Quality of Service |
| RACF | Resource and Admission and Control Functions |
| SCF | Service Control Functions |
| SLA | Service Level Agreement |

TF Terminal Functions

UNI User Network Interface

## 5 Conventions

None.

## 6 Overview of next generation home network (NGHN)

### 6.1 General characteristics of next generation home network (NGHN)

Next generation home network (NGHN) aims at providing the following characteristics:

- Packet-based transfer, in particular support of Internet protocol (IP) as the protocol used at layer 3 in NGHN;
- NGHN can be viewed as an IP-based home network;
- User access to a wide range of services and applications (including real time/non-real time and multimedia services);
- Seamless environment for acquiring, sharing, storing and accessing digital media and content within the home network;
- Use of multiple broadband (wired and/or wireless), QoS-enabled transport technologies;
- Support of fixed and mobile terminals, including support of legacy terminals (e.g., PSTN/ISDN terminals);
- Automatic discovery and management of terminals attached to the home network.

Thus, features in NGHN architecture are to enhance home network capabilities described in [ITU-T H.622].

### 6.2 Connectivity to the NGHN

Figure 6-1 shows the different connectivity provided by a next generation home network (NGHN).

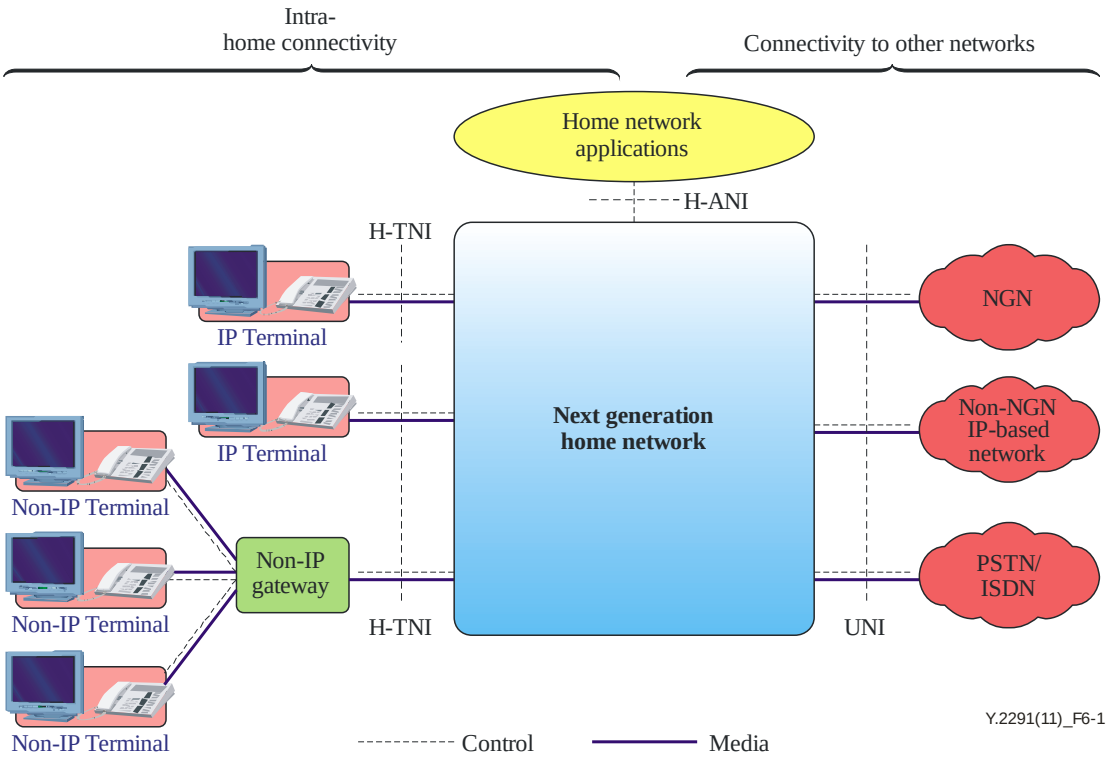



**Figure 6-1 – Connectivity to NGHN**

NGHN provides two types of connectivity:

- **Intra-home connectivity** covers the connectivity of terminals within the home network. This includes connectivity of IP terminals at the home network terminal network interface (H-TNI) and connectivity of non-IP terminals via a non-IP gateway at the H-TNI;
- **Connectivity to other networks** covers the connectivity of NGHN at the UNI to other external networks such as NGN, non-NGN IP-based networks or PSTN/ISDN.

Considering these two types of connectivity, there are two major roles for the home network, i.e., extending the other networks (such as NGN) and their access network as well as interconnecting terminals in the NGHN itself. The portion working as an extension of the access networks must be aligned with the technical requirements of the network provider.

Requirements regarding connection and access to the NGN are captured in particular in clauses 17.1 and 17.2 of [ITU-T Y.2201].

## 7 Overview of the NGHN architecture

### 7.1 Overview of functional framework

Figure 7-1 shows an overview of the NGHN architecture. The NGHN architecture follows a similar decomposition as the one defined for the NGN architecture as defined in [ITU-T Y.2012].

The NGHN functional architecture supports the UNI, H-TNI and H-ANI reference points shown in Figure 6-1.

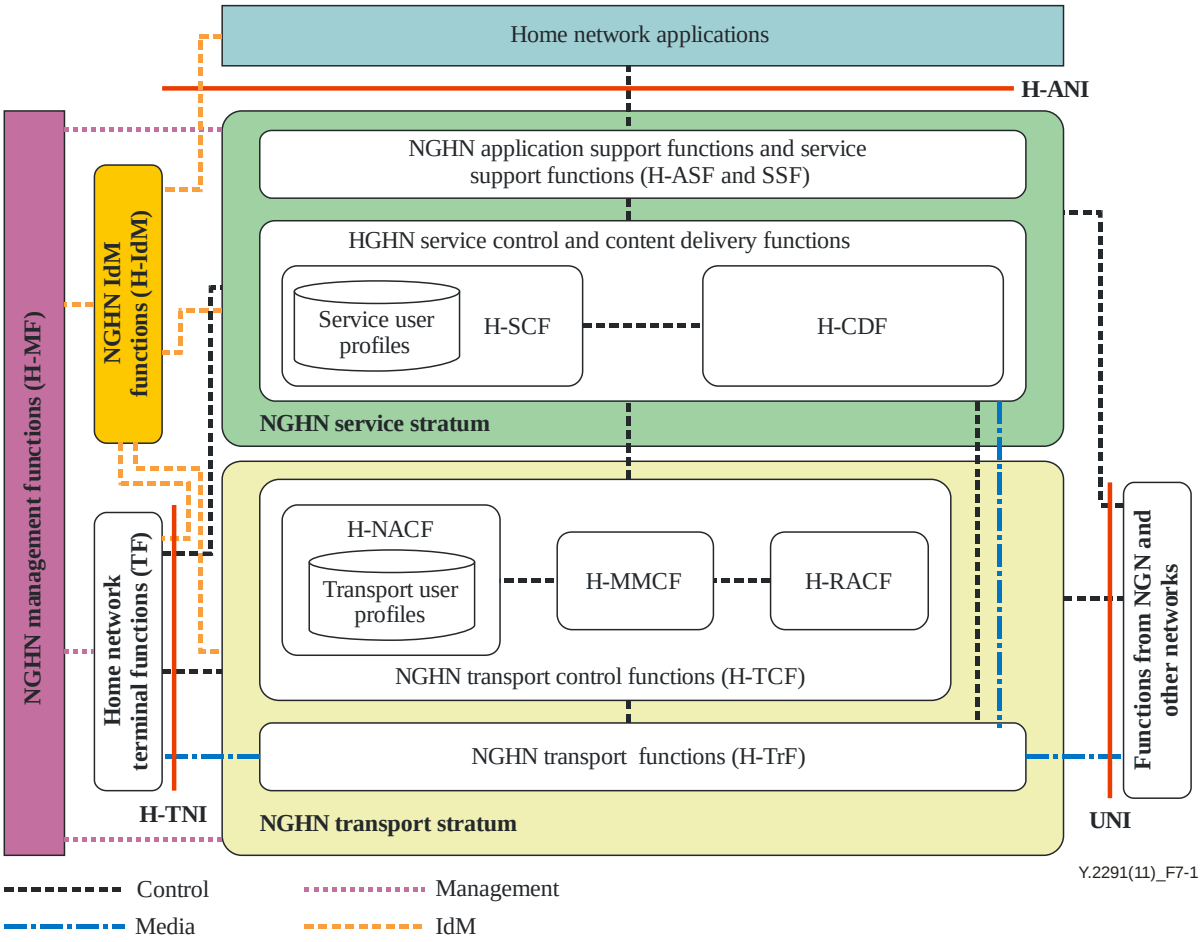
The NGHN functions are divided into service stratum functions and transport stratum functions according to the principles described for NGN in [ITU-T Y.2011].

The NGHN service stratum 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.

The NGHN transport stratum provides the user functions that transfer data and the functions that control and manage transport resources to carry such data between terminating entities.

The delivery of services/applications to the end user is provided by utilizing the application support functions and service support functions and related control functions.

The transport stratum provides IP connectivity services to NGHN users under the control of transport control functions within the NGHN, including the network attachment control functions (H-NACF), resource and admission control functions (H-RACF) and mobility management and control functions (H-MMCF).




NOTE 1 – The user network interface (UNI), NGHN application network interface (H-ANI) and home network terminal network interface (H-TNI) are to be understood as general NGHN reference points that can be mapped to specific physical interfaces depending on the particular physical implementations.
NOTE 2 – Boxes in Figure 7-1 identify high level functional groups, for which overall descriptions are given later in this clause.
NOTE 3 – The control links between the functional groups represent high-level logical interactions.
NOTE 4 – User profiles in both the service stratum and the transport stratum are shown as separate functional databases. Depending on the implementation in place, these two functional databases can optionally be co-located.
NOTE 5 – The NGN-UNI line shows the functional aspect only and should not make any pre-decision about an ownership domain.
NOTE 6 – It is possible for NGHN identity management functions (H-IdM) to reside in different planes (e.g., user, control and management) and different strata of the distributed architecture (e.g., service stratum and transport stratum). Although IdM functions are shown in a standalone group of functions, this is not intended to impose any implementation design and restrictions for IdM.
NOTE 7 – Although IdM functions are shown on the left side of Figure 7-1, this does not mean that IdM functions are located on the H-TNI side or part of the terminal functions.
NOTE 8 – Although not shown in Figure 7-1, IdM functions can be connected to functions from other networks using the UNI reference point.

**Figure 7-1 – NGHN architectural overview**

## 7.2 NGHN functions at transport stratum

The transport stratum functions include transport functions and transport control functions in [ITU-T Y.2011].

### 7.2.1 NGHN transport functions (H-TrF)

The H-TrF provide the connectivity for all components and physically separated functions within the NGHN. These functions provide the support for unicast and/or multicast transfer of media information, as well as the transfer of control and management information.

The H-TrF also provide capabilities to interwork with terminals and/or other networks (such as NGN, non-NGN IP based networks, PSTN/ISDN).

### 7.2.2 NGHN transport control functions (H-TCF)

#### 7.2.2.1 NGHN attachment control functions (H-NACF)

The H-NACF provide transport stratum level identification/authentication, manage the IP address space of the NGHN, and authenticate access sessions. These functions may also announce the contact point of NGHN functions in the service stratum to the terminal. The H-NACF provides the following functionalities:

- dynamic provisioning of IP addresses and other user equipment configuration parameters;
- provisioning of non-IP gateway connecting to non-IP terminals;
- by endorsement of end-user, auto-discovery of user terminal capabilities and other parameters;
- authentication of end-user/terminal and home network at the IP layer (and possibly other layers).

The H-NACF include the transport user profile which takes the form of a functional database representing the combination of a user/terminal's information and other control data.

#### 7.2.2.2 NGHN resource and admission control function (H-RACF)

Within the NGHN architecture, the resource and admission control functions (RACF) act as the arbitrator between service control functions and transport functions for QoS-related transport resource control. The decision is based on transport subscription information, service level agreements (SLAs), network policy rules, service priority, and transport resource status and utilization information.

The RACF provides an abstract view of transport network infrastructure to service control functions (SCF) and makes service stratum functions agnostic to the details of transport facilities such as network topology, connectivity, resource utilization and QoS mechanisms/technology.

The H-RACF provides real-time application-driven and policy-based transport resource management for a wide range of services and for a variety of transport technologies in the NGHN.

#### 7.2.2.3 NGHN mobility management and control functions (H-MMCF)

The H-MMCF provide functions for the support of IP-based/non-IP mobility in the transport stratum. These functions allow the support of mobility of a terminal. H-MMCF provide mechanisms to achieve seamless mobility among various terminals with heterogeneous interfaces and different coverage.

### 7.3 NGHN functions at service stratum

#### 7.3.1 NGHN service control functions (H-SCF)

The H-SCF include resource control, registration, and authentication and authorization functions at the service level for both mediated and non-mediated services. They can also include functions for controlling media resources, i.e., specialized resources and gateways at the service-signalling level.

The H-SCF accommodate service user profiles which represent the combination of user information and other control data into user profile function in the service stratum, in a form of functional databases. These functional databases may be specified and implemented as a set of cooperating databases with functionalities residing in any part of the NGHN.

#### 7.3.2 NGHN content delivery functions (H-CDF)

The H-CDF store, process, and deliver contents to the terminal functions under control of the H-SCF.

#### 7.3.3 NGHN application support functions and service support functions (H-ASF&SSF)

The H-ASF&SSF include functions such as registration, authentication and authorization functions at application level within the NGHN. These functions are available to the "home network applications" and "terminal" functional groups in NGHN. The H-ASF&SSF work in conjunction with the H-SCF to provide end users and applications with the services within NGHN.

Through the H-TNI, the H-ASF&SSF provide reference points to the terminal functions. Application interactions with the H-ASF&SSF are handled through the H-ANI reference point.

### 7.4 NGHN management functions (H-MF)

Support for management is fundamental to the operation of the NGHN. These functions provide the capabilities to manage the NGHN in order to provide services with the expected quality, security, and reliability.

Management functions apply to the NGHN service and transport strata. For each of these strata, they cover: QoS management, security management, performance monitoring and diagnostics and troubleshooting, terminal management and accounting management.

#### 7.4.1 QoS management function

The QoS management function supports:

- QoS-related transport resources management within the home network with incorporation of RACF in NGN;
- application-driven QoS management for the home network;
- per-flow, per-session, per-service-class QoS control granularity.

#### 7.4.2 Security management function

For protection of unauthorized access into the home network and provision of the privacy of data, security management function provides manageable security to enhance the confidence of the end user through the firewall and network address translation (NAT) capabilities. Optionally, it provides the ability to hide terminals from the service provider so as not to have full visibility of the home network.

#### 7.4.3 Performance monitoring, diagnostics and troubleshooting function

System level fault (e.g., hardware, operating system and software related) can optionally be detected and communicated to the service or network provider. Performance monitoring, diagnostics and troubleshooting supports:

- remote diagnostic tests to check the state of the different components of the home network;

  NOTE – These tests are either scheduled periodically or launched by system-operator request.
- performance monitoring to see statistics at network level;
- generation of event to detect a possible fault within the system.

### 7.4.4 Terminal management function

Terminal management function provides capabilities to manage and control terminals in the NGHN. Terminal management capabilities are used for:

- configuration management, such as terminal hardware information, media capabilities, software version;
- local performance monitoring and maintenance;
- remote fault diagnosis;
- remote identification of manageable terminal.

### 7.4.5 Accounting management function

Accounting management function identifies who is using the resources of the NGHN and to what extent, and allocates cost to those users on the basis of their usage. It supports the users of the NGHN resources to absorb the cost thereof in an agreed-upon manner.

## 7.5 NGHN identity management functions (H-IdM)

The H-IdM are related to service features to be provided. The H-IdM include the following functions in accordance with [ITU-T Y.2720]:

- identification of federations for home network services;
- identification of customer-oriented service for fairly new service concept and model;
- provision of abstract identity framework for customer-oriented dynamic identification;
- provision of identity for alliance between home network users to cooperate with;
- provision of home network trust with identity to guarantee privacy.

## 7.6 Home network terminal functions (TF)

The TF are related to various types of terminals including IP terminals/non-IP terminals. These terminals have heterogeneous interfaces, including fixed/mobile for accessing NGHN. These functions support capabilities to provide connectivity with NGHN and support various services through H-TNI.

# 8 Security considerations

Major security requirements for NGHN are:

- authentication of the communication entities for policy requests in NGHN;
- data confidentiality and integrity among NGHN users;
- availability and accessibility in NGHN, upon demand by an authorized entity;
- availability of mechanisms of non-repudiation for preventing one of the entities or parties in communication from denying participation in the whole or part of the communication falsely.

The security considerations in the NGHN should be in accordance with the security requirements in [ITU-T X.1111] and [ITU-T Y.2701].

# Appendix I

## Federation of NGHNs

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

Figure I.1 shows a configuration of a federation of NGHNs. The home network domain comprises heterogeneous home environments with NGHN functions. The NGHN functions support multiple different capabilities in accordance with needs of home network users and a federated configuration among multiple entities in the home networks.

The federation between/among multiple entities in the NGHNs creates physical, logical group environments or service/user community.

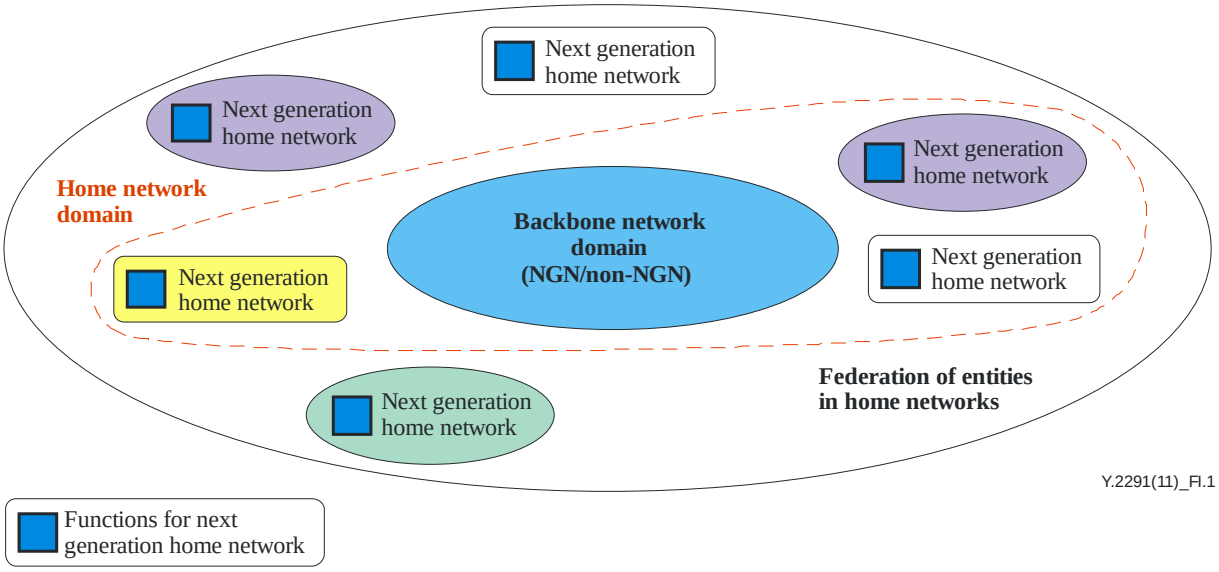



**Figure I.1 – Configuration of a federation of NGHNs**

NOTE – The home network domain includes several NGHNs. Home network domain and NGN/non-NGN backbone network domain are involved to create a federation of entities in home networks.

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Printed in Switzerland
Geneva, 2011