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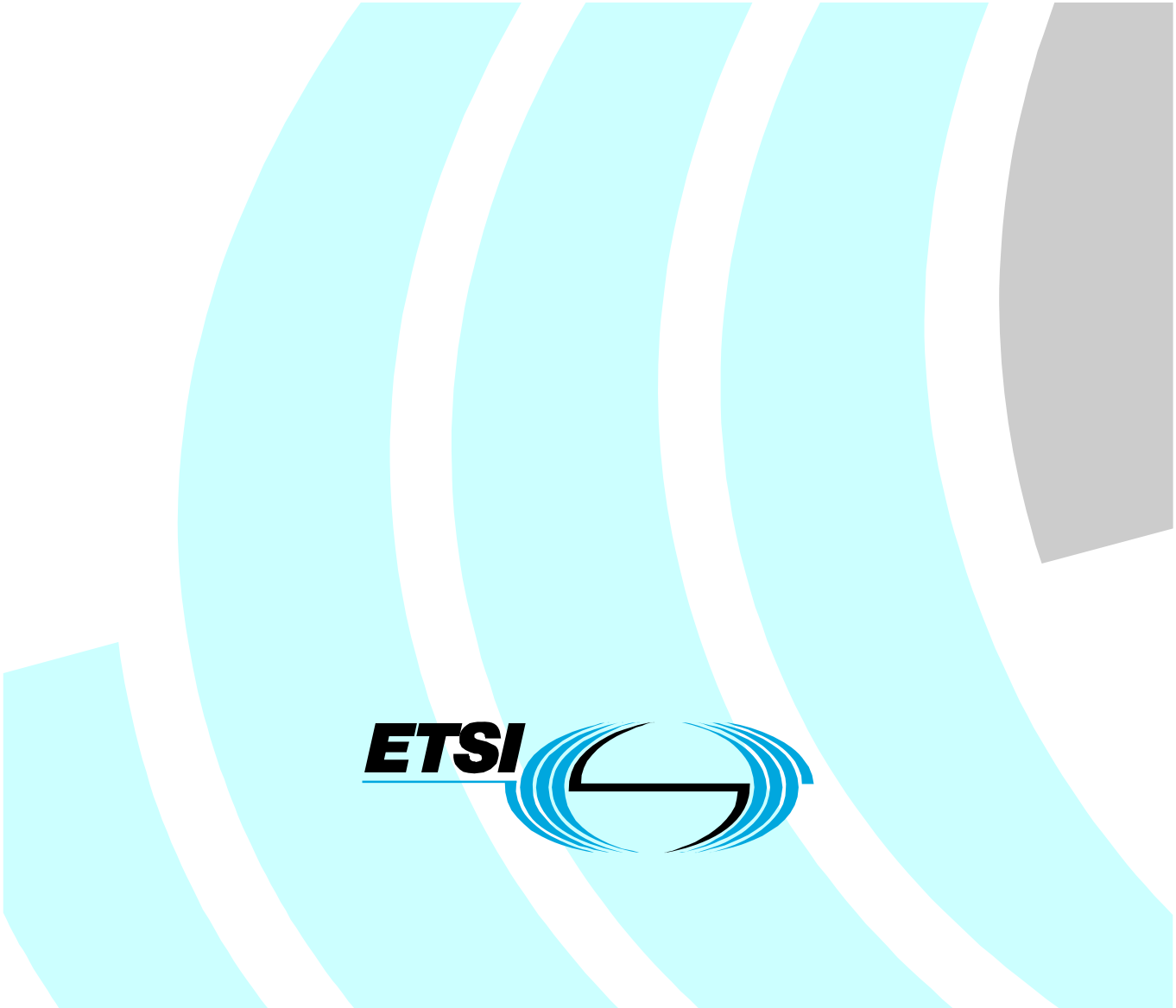
Technical Report

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); High level customer network architectures



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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

1 Scope

The objective of the present document is to analyse the possible architectures for the customer environment, combining different possibilities in terms of elements to be considered. In particular, the analysed architectures will cover the possibility of managing one or more than one entry points from the WAN side, using one or more than one customer gateway, or possibly excluding the adoption of a customer gateway. Different alternatives for Customer Network Gateway ownership will also be examined. The detailed architectures of customer devices and customer network gateways will be addressed in other WIs and will take into account the possible alternatives analysed in the present document.

The customer network is intended to support residential or small office scenarios, so that the scope of the document does not include corporate scenarios which are to be covered by other documents.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

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2.1 Informative references

[1] ETSI ES 282 001: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture Release 1".

[2] Home Gateway Initiative: "Home Gateway Technical Requirements: Release 1".

[3] ETSI TS 181 005: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Services and Capabilities Requirements".

[4] ETSI ES 282 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-system (RACS); Functional Architecture".

[5] ETSI ES 282 004: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture; Network Attachment Sub-System (NASS)".

[6] ETSI ES 282 007: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Functional architecture".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ES 282 003 [4], ES 282 004 [5], ES 282 007 [6] and the following apply:

Customer Network Device (CND): physical device enabling service(s) usage

NOTE. CNDs can be dedicated to the internet, conversational and audio-video services. But they could be also Consumer Electronics equipment and other devices which may have nothing to do with these premium services (e.g. services performing a content sharing within a CPN, typically between a PC and a music system, through the CNG).

Customer Network Gateway (CNG): gateway between the Customer Premises Network (CPN) and the Access Network able to perform networking functions from physical connection to bridging and routing capabilities, but also possibly implementing functions related to the service support

Customer Premises Network (CPN): in-house network composed by customer network gateway, customer network devices, network segments (physical wired or wireless connections between customer network elements), network adapters (performing a L1/L2 conversion between different network segments) and nodes (network adapters with L3 routing capabilities)

NOTE: Other terms used to identify CPN in TISPAN NGN R1 deliverables or outside TISPAN are Home Area Network (HAN), Home or Residential Network, Customer LAN (C-LAN).

Network Addapter (NA): Allows management of the home segment at the layer 2. NA is the master on the customer network segment for all the CNDs that want to access the media. It can be part of the CNG or a separate box providing an integration point for non-common technologies. These devices are called sometimes also "gateways".

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

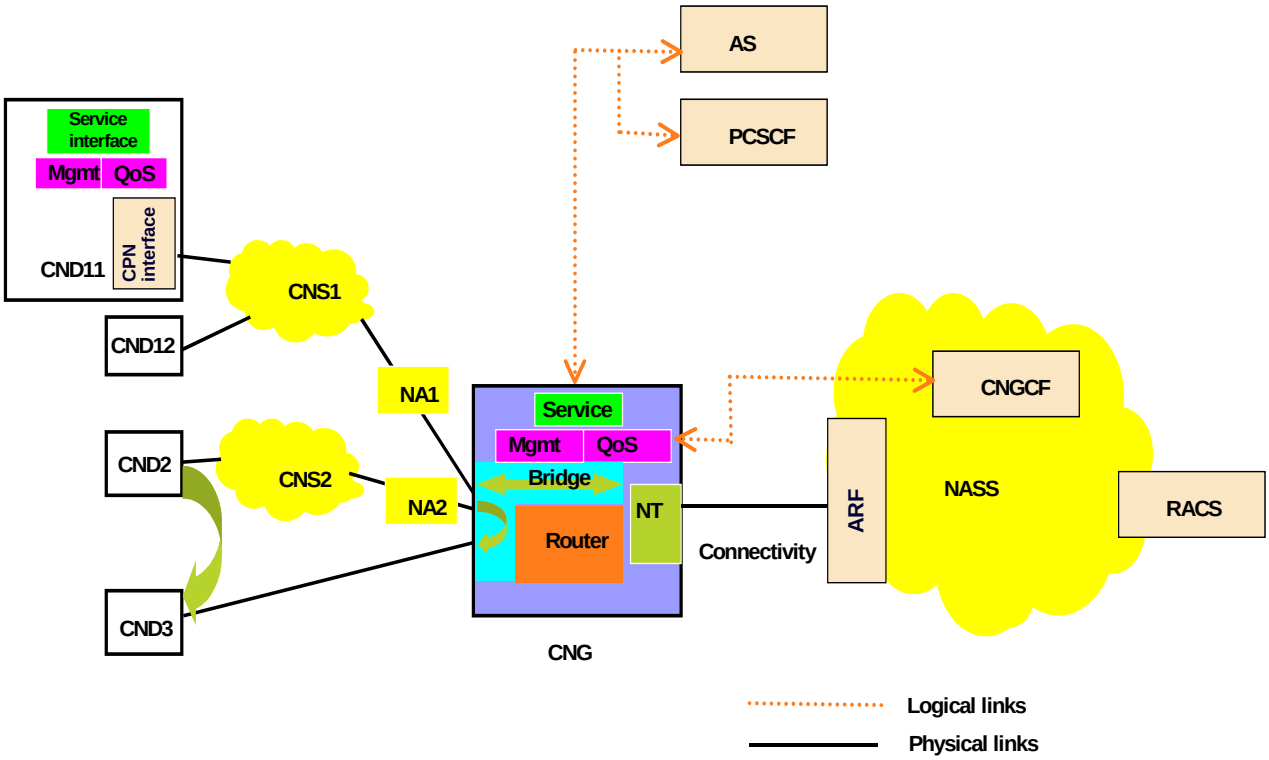
AN	Access Network
AP	Access Point
AS	Application Server
BR	Bridge
CND	Customer Network Device
CNG	Customer Network Gateway
CNGCF	Customer Network Gateway Control Function
CNS	Customer Network Segment
CPN	Customer Premises Network
Mgmt	Management
NA	Network Adapter
NASS	Network Attachment SubSystem
NAT	Network Address Translation
NGN	Next Generation Network
NSP	NGN Service Provider
NT	Network Termination
P-CSCF	Proxy-CSCF
PPPoE	Point to Point Protocol over Ethernet
PSTN	Public Switched Telephone Network
RACS	Resource and Admission Control Subsystem
QoS	Quality of Service
VoIP	Voice over IP

4 Overview of customer networks

4.1 Single service provider

4.1.1 Single customer gateway

Assuming a single access plus service provider offers its services in the customer network, via a single access technology and customer gateway, the following reference architecture is proposed [2].



Glossary:

NT:	Network Termination.
BR:	Bridge. Network adaptor that interconnects two or more home segments that are sharing the same data link layer.
CNDx:	Customer Network Device, the point of service usage for the end user (PC, TV+set top box, PDA etc.).
CNSx:	Customer Network Segment, that can be wired or wireless APx.
Mgmt:	Management.
CNS:	Customer Network Segment.
NA:	Network Adapter, it allows management of the home segment at the layer 2. NA is the master on the customer network segment for all the CNDs that want to access the media. It can be part of the CNG or a separate box providing an integration point for non-common technologies. These devices are called sometimes also "gateways".

Figure 1: Customer network architecture for single gateway, single service provider

The above architecture is access agnostic, and throughout the present document we will keep this assumption.

There are two possibilities for intra-CPN traffic:

- Centralized, where all traffic is forced via the CNG (this increases the complexity of the CNG, but allows the SP more control over the CPN). This means that all APs are integrated in the CNG itself.
- Distributed, which allows direct device-device communication without going via the CNG or via an AP that is not integrated in the CNG.

In figure 1 the green arrows illustrate that both cases are possible.

The CNG supports both bridged and/or routed models. There are several architectural solutions for the Customer Network to support these models [2].

The most complicated scenario is depicted in figure 2.

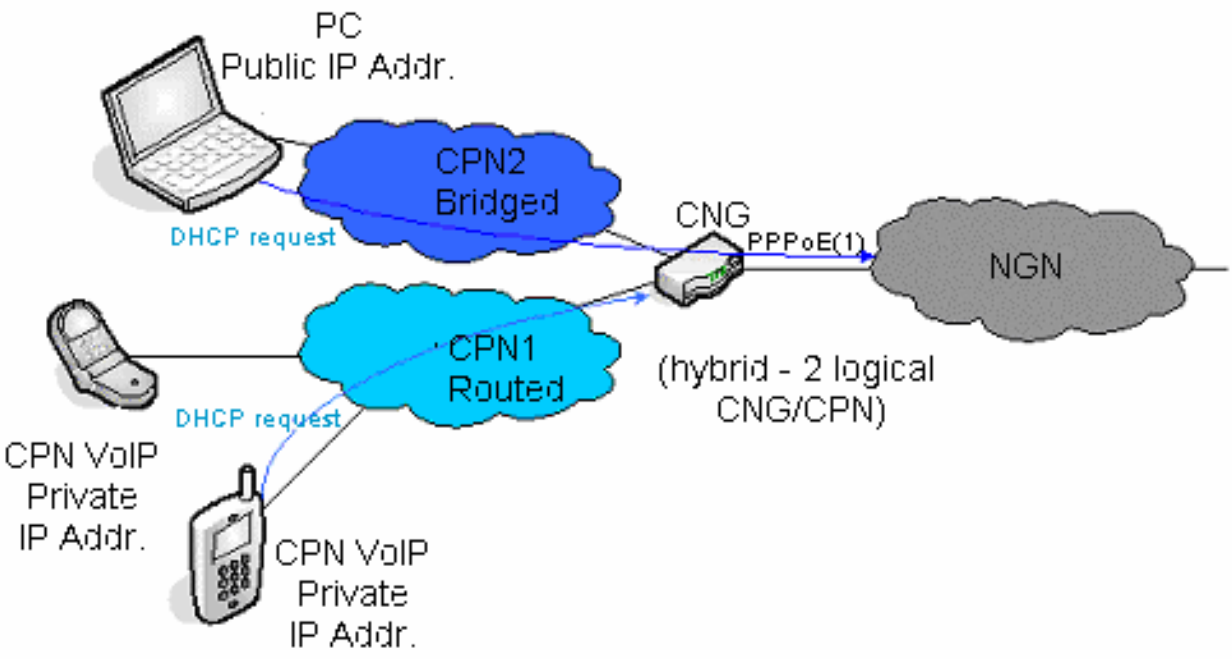


Figure 2: Hybrid model with separate physical networks

The hybrid model with separate physical networks offers two or more physically separated CPNs, one corresponding to the routed, and the other(s) to the bridged modes of operation. The CNG has distinct physical interfaces for each network type. Devices can only directly communicate with other devices on the same network segment. Communication between network segments is only possible via the Access Network.

More simplified architectures could include the presence of only one CPN (either routed or bridged), thus implementing the routed or bridged model separately. While the routed model supports fully intra-CPN connectivity, this is not the case for the purely bridged model.

A specific case of coexistence of the bridged and routed approaches is the following:

- Routed model with NAT + PPPoE Passthrough (L2 partial bridge): to support the case where a device on the CPN needs to be able to directly communicate (at L2) with a server on the AN. The L2 connectivity is limited to PPPOE traffic. The broadcast PPPoE set-up requests are recognized by the CNG, which sets up L2 bridging for all PPP traffic coming from that device. Intra-CPN communication can be fully supported in this case.

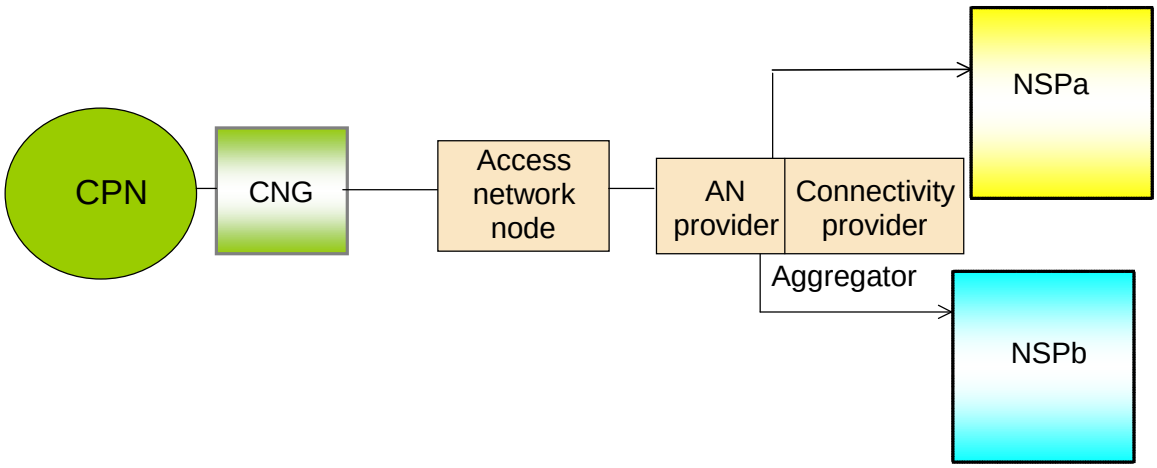
4.1.2 No gateways

- In case of PSTN replacement a device can be directly connected to NGN (PES or IMS core) to support voice services.
- A second case is the adoption of Femtocells, allowing the connection of a number of mobile customer devices directly to NGN. Intra-CPN communication could be supported in this case only using additional interfaces.
- A third case can be the presence of a single customer device in the CPN with an embedded modem and able to access the NGN, in order to consume a single service or a restricted subset of services (e.g. a videotelephone with an embedded modem).

4.2 Multiple service providers

With reference to contents of TS 181 005 [3] defining the operator roles, the following scenarios can be considered.

4.2.1 Single customer network gateway



Glossary:
NSPa/b: NGN Service Provider a and b.

Figure 3: Customer network architecture for single gateway, multiple service providers

The Customer Network has the architecture presented in clause 4.1.1.

4.2.2 Multiple gateways (separate Customer Networks)

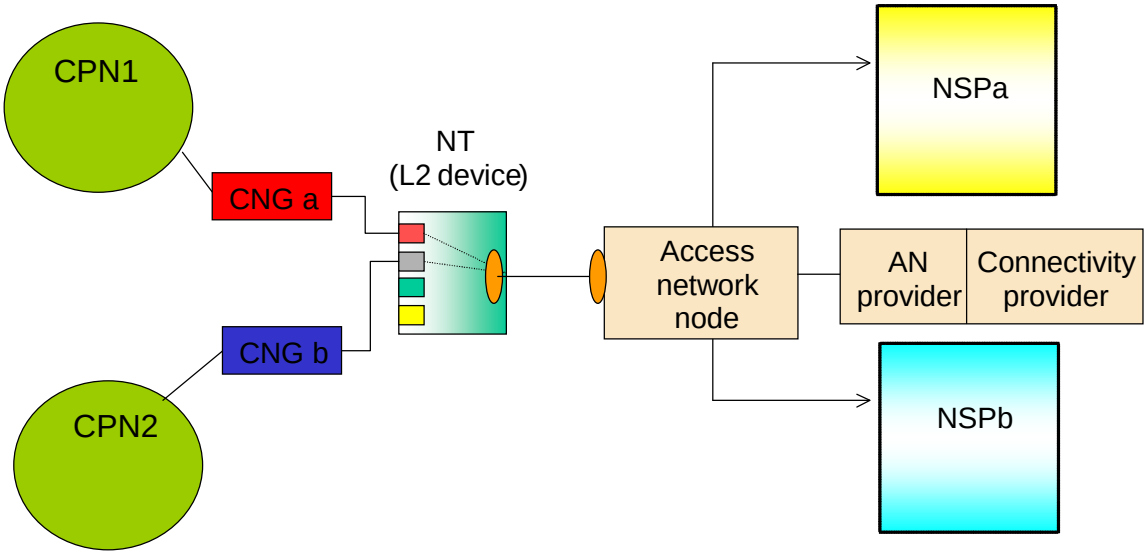


Figure 4: Customer network architecture for multiple gateways, multiple service providers

In figure 4, each NSP has its own CNG, which is connected to the NT. The two CNGs do not communicate to each other. At each CNG a Customer Premises Network (CPN) is connected, and each one can have the architecture presented in clause 4.1.1. In this configuration it is not possible to communicate from a device connected to CPN1 to a device connected to CPN2 unless via the NGN itself. Point to point connectivity between devices (at non IP level) can be established (e.g. infrared or Bluetooth communication). Each SP will manage its corresponding CNG and CPN, using for example DSL Forum's TR-069.

The different flows coming from the NSPs can be mapped by the NT with different ports on the CPN side, using a number of possible mechanisms, such as Ethernet VLANs, ATM PVCs, PPPoE, VPN sessions, etc.

4.2.3 Multiple gateways (communicating networks)

This is not a typical case for the customer environment, while this could happen in corporate scenarios when there is a need to manage separate networks through separated departments, possibly using different services (but directly communicating with each other, without passing through the NGN). It involves the management of different logical IP subnets, and as such does not fall within the scope of the present document.

4.2.4 No gateways

Having customers devices connected directly to the NGN without any gateway in case of multiple service providers automatically implies the usage of multiple entry points. As such, this case falls in the scenario described in clause 4.3.

4.3 Considerations on multiple network access providers (multiple WAN entry points)

Two CPNs behind two different access network terminations will not communicate to each other, unless via the NGN. Typical cases are XDSL or optical line plus Femtocells, XDSL or optical lines plus satellite connection or digital terrestrial connection, etc.

5 CPN technologies

Different technologies can be used and combined in order to build a CPN (e.g. Ethernet, WIFI, Powerline, etc.). Each of these technologies can have pros and cons, in relation to the following aspects:

- Actual bandwidth availability.
- Interference issues.
- Easy installation.
- Coverage.
- Bit error rate.
- QoS.
- Multicast support.

The reference document offering an overview of the possible CPN technologies (not an exhaustive description) is contained in clause 5.2.2.4 of the Home Gateway Initiative release 1 document [2].

History

Document history		
V1.1.1	August 2007	Publication