

International Telecommunication Union

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**Series Y**

**Supplement 6**

(09/2008)

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

---

**ITU-T Y.2000-series – Supplement on the use of  
DSL-based systems in next generation networks**

ITU-T Y-series Recommendations – Supplement 6



ITU-T Y-SERIES RECOMMENDATIONS  
**GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-  
GENERATION NETWORKS**

GLOBAL INFORMATION INFRASTRUCTURE

General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899

INTERNET PROTOCOL ASPECTS

General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899

NEXT GENERATION NETWORKS

Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Numbering, naming and addressing	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899

*For further details, please refer to the list of ITU-T Recommendations.*

## **Supplement 6 to ITU-T Y-series Recommendations**

### **ITU-T Y.2000-series – Supplement on the use of DSL-based systems in next generation networks**

#### **Summary**

Supplement 6 to ITU-T Y-series Recommendations describes how the set of specifications developed by the DSL Forum may be used in the context of next generation networks.

#### **Source**

Supplement 6 to ITU-T Y-series Recommendations was agreed on 12 September 2008 by ITU-T Study Group 13 (2005-2008).

#### **Keywords**

Broadband remote access server, digital subscriber line, DSL forum, internet protocol, next generation networks.

## FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

## NOTE

In this publication, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this publication is voluntary. However, the publication may contain certain mandatory provisions (to ensure e.g., interoperability or applicability) and compliance with the publication is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the publication is required of any party.

## INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this publication may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the publication development process.

As of the date of approval of this publication, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this publication. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2009

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

## CONTENTS

	<b>Page</b>
1 Scope .....	1
2 References.....	1
3 Terms and definitions .....	2
4 Abbreviations.....	2
5 Reference point configuration architecture .....	4
6 Multi-service, multi-provider, multi-user, multi-device operation.....	4
7 Use case scenarios and related information flows.....	6
8 Broadband remote access server (BRAS) requirements document.....	6
8.1 Protocols to and from end users .....	7
8.2 Protocols used to and from NSPs and ASPs .....	7
9 Multi-service delivery framework for home networks.....	8
10 Management of customer premises equipment (CPE) .....	9
11 LAN-side DSL CPE configuration.....	10
12 Functional requirements residential gateways.....	11
13 Quality of service considerations.....	11
14 Summary of applicable DSLF technical reports.....	13
15 Mappings to [ITU-T Y.2012] (FRA).....	14
15.1 NGN generalized architecture .....	14
15.2 DSL Forum architecture .....	16
16 Mappings to [ITU-T Y.2014] (NACF).....	17
Bibliography.....	18



## Supplement 6 to ITU-T Y-series Recommendations

### ITU-T Y.2000-series – Supplement on the use of DSL-based systems in next generation networks

#### 1 Scope

The scope of this supplement is to describe the application of DSL Forum specifications in next generation networks (NGNs) that involve a DSL-based access network. The digital subscriber line (DSL) technology itself is outside the scope of this supplement but it is assumed to be the underlying transport network to support next generation network architectures. This supplement is concerned with the architecture(s) superimposed over DSL transport to provide IP-based services and related applications for next generation networks.

#### 2 References

- [ITU-T Y.2012] Recommendation ITU-T Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.
- [ITU-T Y.2014] Recommendation ITU-T Y.2014 (2008), *Network attachment control functions in next generation networks*.
- [DSL Forum TR-058] DSL Forum TR-058, *Multi-Service Architecture & Framework Requirements*.  
<<http://www.broadband-forum.org/technical/download/TR-058.pdf>>
- [DSL Forum TR-059] DSL Forum TR-059, *DSL Evolution – Architecture Requirements for the Support of QoS-enabled IP Services*.  
<<http://www.broadband-forum.org/technical/download/TR-059.pdf>>
- [DSL Forum TR-064] DSL Forum TR-064, *LAN-Side DSL CPE Configuration*.  
<<http://www.broadband-forum.org/technical/download/TR-064.pdf>>
- [DSL Forum TR-069] DSL Forum TR-069, *CPE WAN Management Protocol v1.1*.  
<<http://www.broadband-forum.org/technical/download/TR-069Amendment2.pdf>>
- [DSL Forum TR-092] DSL Forum TR-092, *Broadband Remote Access Server (BRAS) Requirements Document*.  
<<http://www.broadband-forum.org/technical/download/TR-092.pdf>>
- [DSL Forum TR-094] DSL Forum TR-094, *Multi-Service Delivery Framework for Home Networks*.  
<<http://www.broadband-forum.org/technical/download/TR-094.pdf>>
- [DSL Forum TR-098] DSL Forum TR-098, *Gateway Device Version 1.1 Data Model for TR-069, Amendment 1*.  
<[http://www.broadband-forum.org/technical/download/TR-098\\_Amendment\\_2.pdf](http://www.broadband-forum.org/technical/download/TR-098_Amendment_2.pdf)>
- [DSL Forum TR-101] DSL Forum TR-101, *Migration to Ethernet-Based DSL Aggregation*.  
<<http://www.broadband-forum.org/technical/download/TR-101.pdf>>
- [DSL Forum TR-102] DSL Forum TR-102, *Service Interface Requirements for TR-058 Architectures*.  
<<http://www.broadband-forum.org/technical/download/TR-102.pdf>>
- [DSL Forum TR-104] DSLHome™ TR-104, *Provisioning Parameters for VoIP CPE*.  
<<http://www.broadband-forum.org/technical/download/TR-104.pdf>>
- [DSL Forum TR-106] DSLHome™ TR-106, *Data Model Template for TR-069 Enabled Devices*.  
<<http://www.broadband-forum.org/technical/download/TR-106.pdf>>

- [DSL F TR-111] DSLHome™ TR-111, *Applying TR-069 to Remote Management of Home Networking Devices*.  
<<http://www.broadband-forum.org/technical/download/TR-111.pdf>>
- [DSL F TR-124] DSL Forum TR-124, *Functional Requirements for Broadband Residential Gateway Devices*.  
<<http://www.broadband-forum.org/technical/download/TR-124.pdf>>
- [DSL F TR-133] DSL Forum TR-133, *TR-064 Extensions for Service Differentiation*.  
<<http://www.broadband-forum.org/technical/download/TR-133.pdf>>
- [DSL F TR-135] DSL Forum TR-135, *Data Model for TR-069 Enabled STB*.  
<<http://www.broadband-forum.org/technical/download/TR-135.pdf>>
- [DSL F TR-140] DSL Forum TR-140, *TR-069 Data Model for Storage Service Enabled Devices*.  
<[http://www.broadband-forum.org/technical/download/TR-140\\_Issue1.1.pdf](http://www.broadband-forum.org/technical/download/TR-140_Issue1.1.pdf)>
- [DSL F TR-141] DSL Forum TR-141, *Protocol Independent Management Model for Access Nodes Supporting TR-101*.  
<<http://www.broadband-forum.org/technical/download/TR-141.pdf>>
- [DSL F TR-144] DSL Forum TR-144, *Broadband Multi-service Architecture & Framework Requirements*.  
<<http://www.broadband-forum.org/technical/download/TR-144.pdf>>

### 3 Terms and definitions

No new terms are defined in this supplement.

### 4 Abbreviations

This supplement uses the following abbreviations:

ABG-FE	Access Border Gateway Functional Entity
ACS	Auto-Configuration Server
Agg	Aggregator
AN-FE	Access Node Functional Entity
AR-FE	Access Relay Functional Entity
ASP	Application Service Provider
ATM	Asynchronous Transfer Mode
BRAS	Broadband Remote Access Server
CPE	Customer Premises Equipment
CWMP	CPE WAN Management Protocol
DAVIC	Digital Audio Visual Council
DCP	Device Control Protocol
DSCP	Diff-Serv Code Point
DSL	Digital Subscriber Line
DSL F	DSL Forum
EMS	Element Management System

EN-FE	Edge Node Functional Entity
FE	Functional Entity
GPON	Gigabit-capable Passive Optical Network
HTTP	HyperText Transfer Protocol
IMS	IP Multimedia Subsystem
IP	Internet Protocol
ISP	Internet Service Provider
L2TP	Layer 2 Tunnelling Protocol
L2TS	Layer 2 Tunnelling Server
LAC	L2TP Access Concentrator
LAN	Local Area Network
MPLS	MultiProtocol Label Switching
NAPT	Network Address and Port Translation
NMS	Network Management System
NSP	Network Service Provider
PE	Provider Edge
PHY	Physical Media
PPP	Point-to-point Protocol
PPPoA	PPP over ATM
PPPoE	PPP over Ethernet
QoS	Quality of Service
RAN	Regional/Access Network
RFC	Request for Comment (IETF document)
RG	Routing Gateway (sometimes also known as Residential Gateway)
RPC	Remote Procedure Call
SMS	Subscriber Management System
SOAP	Simple Object Access Protocol
SSL	Secure Socket layer
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TR	Technical Report
UDA	UPnP Device Architecture
UPnP	Universal Plug and Play
VLAN	Virtual LAN
VoD	Video on Demand
VoIP	Voice over IP

VPN            Virtual Private Network  
 WAN            Wide Area Network

## 5 Reference point configuration architecture

The reference points identified by the DSL Forum (DSL F) in [DSL F TR-144] are shown in Figure 5-1.

The W, V, U and T reference points correspond to their traditional ITU-T usage. The A10 reference point corresponds to the usage in DAVIC [b-DAVIC 1.4.1].

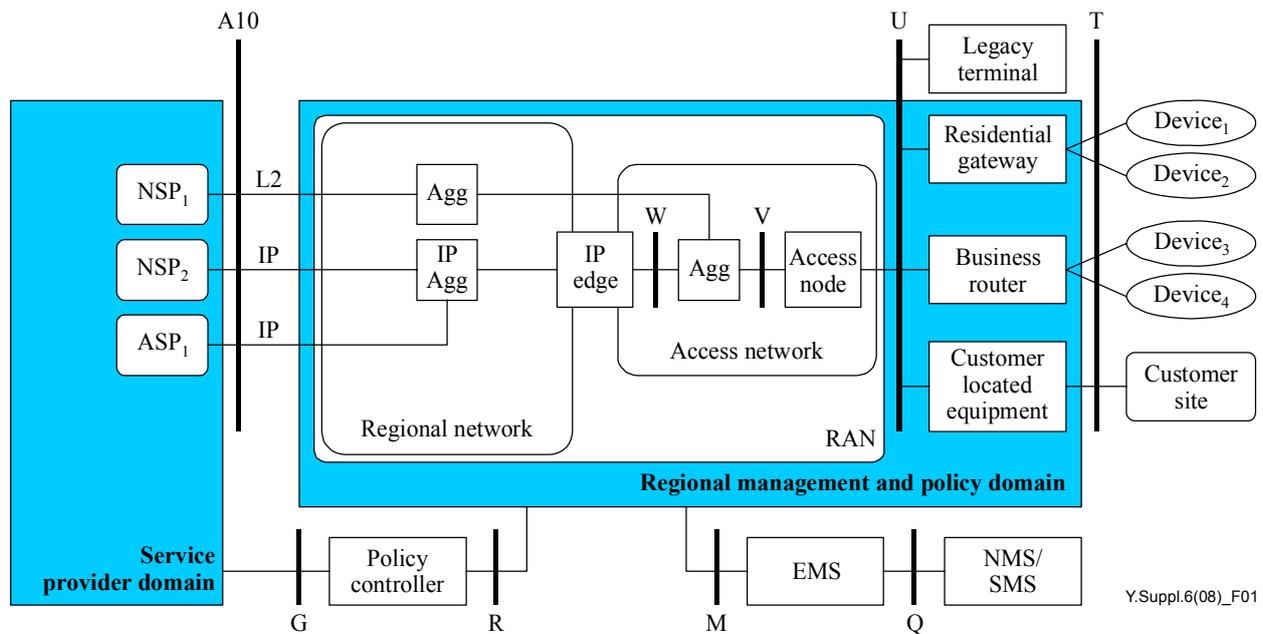
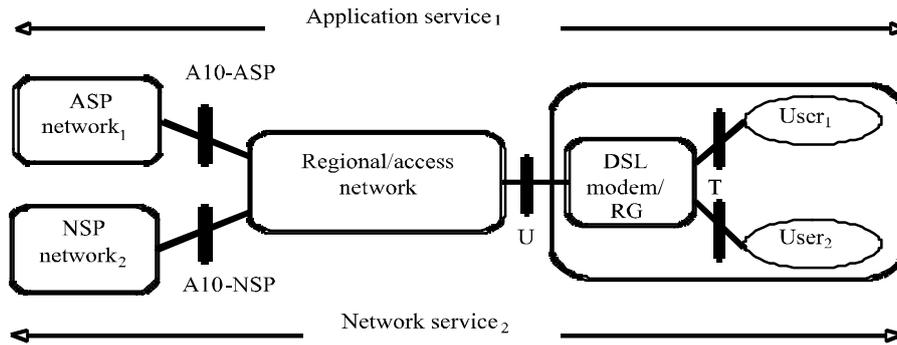


Figure 1 – Reference point model

## 6 Multi-service, multi-provider, multi-user, multi-device operation

The reference model shown in Figure 1 allows each instance of the service invocation to be individually distinguished by the controller and to be allocated with a distinct session and bearer. This capability will allow several real time multimedia services to operate simultaneously, each controlled separately. This is shown in Figure 2.



Y.Suppl.6(08)\_F02

**Figure 2 – Simultaneous access to many service providers**

The [DSL TR-144] architecture increases the types and number of access sessions that a subscriber would typically establish to a service provider. Whereas previously there had been just one access session to an ISP, the [DSL TR-144] architecture identifies multiple access sessions with three basic types as shown in Figure 3.

**Community NSP** – Shown in Figure 3 as the solid line between the routing gateway (RG) and NSP<sub>1</sub>, this type of access session is established between an RG and a network service provider (NSP). It is called the *Community* NSP connection because all the devices within the customer premises network share the connection to the NSP using the network address and port translation (NAPT) feature of the RG. Because the community NSP connection is given the *Default Route* at the RG, there can be only one. This connection is typically set up to an Internet service provider (ISP) in order to provide Internet access to all the devices in the customer premises network.

**Personal NSP** – Shown in Figure 3 as the dashed line between User<sub>1</sub> (Device<sub>1</sub>) and NSP<sub>2</sub>, this type of access session is established between a device within the customer premises network and an NSP. It passes through the RG at the Ethernet (PPPoE) level. It is called the *Personal* NSP connection because only the device within the customer premises network from which the connection was established can access the NSP. This avoids using the network address and port translation (NAPT) feature of the RG. This connection is typically set up to an ISP or a corporation in order to provide private or personalized access, or any access that cannot traverse the NAPT sharing mechanism at the RG.

**ASP** – Shown in Figure 3 as the dotted line between the RG and ASP<sub>1</sub>, this type of access session is established between an RG and the ASP network. It is always a single connection and is always shared by all the ASPs. Because the community NSP connection is given the *Default Route* at the RG, the ASP connection must provide the RG with a list of routes to the ASP network. Also because there is not a default route to the ASP network, it is not possible to provide typical Internet access through the ASP connection. This connection is typically set up to the ASP network in order to provide application-specific and QoS-enabled access among all the applications in the ASP network and all the devices in the customer premises network.

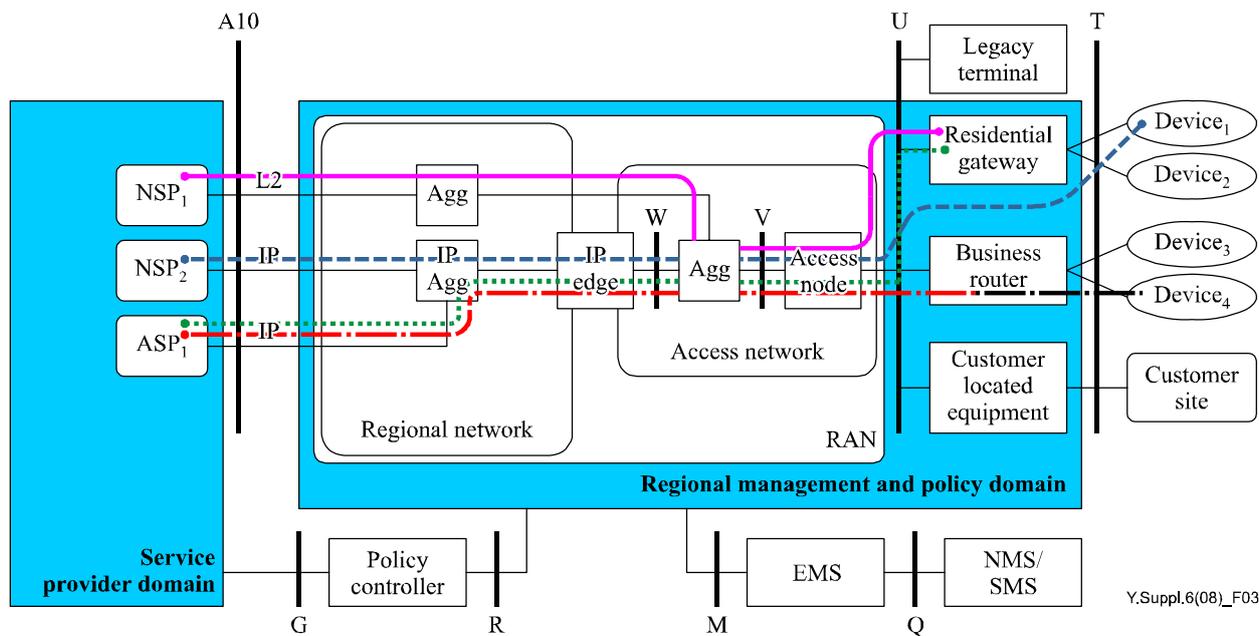


Figure 3 – Access session types

## 7 Use case scenarios and related information flows

[DSL F TR-102] contains a number of usage cases and specifies the related information flows.

Clause 4 of [DSL F TR-102] describes five exemplary usage cases that demonstrate the operational application framework, namely:

- Videoconferencing;
- video on demand;
- turbo button;
- gaming;
- VoIP.

In clause 5, the high level application flows from the usage cases of section 4 are broken down into a common set of detailed network flows that show how the activities involving the regional/access network (RAN) might be accomplished. This includes new information on the involvement of network elements (DSL service manager, database, etc.). In particular, the message interface is seen as a simple and accessible interface to a potentially more complex policy management framework, like IMS (IP multimedia subsystem – defined by 3GPP).

Clause 6 defines the message interfaces and a basic set of QoS and bandwidth capabilities in conjunction with the A10 interface, to get at the variable services provided by [DSL F TR-144].

## 8 Broadband remote access server (BRAS) requirements document

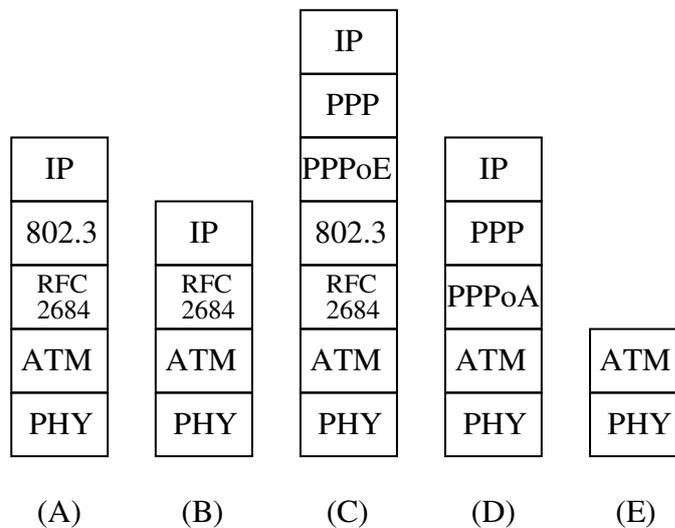
Requirements for the BRAS are contained in [DSL F TR-092].

The BRAS can perform several logical functions (e.g., L2TP access concentrator (LAC), IP router, or MPLS PE router) as it aggregates user sessions from the access network. The requirements included in [DSL F TR-092] should be applied broadly across all of these logical functions, unless explicitly stated. In addition to providing basic aggregation capabilities, the BRAS is also the injection point for providing policy management and IP QoS in the regional and access networks.

The BRAS is the last IP aware device between service providers (ASPs and NSPs) and the customer network, and as such is leveraged to manage the IP traffic through the layer 2 access network. To accomplish this, the BRAS will need to provide a congestion management function that will allow the synthesis of IP QoS through downstream elements that are not QoS aware, which enables DSL providers to support enhanced IP applications.

### 8.1 Protocols to and from end users

The DSL Forum specifies five different protocol stacks for the U interface for accessing data networks. These are shown in summary in Figure 4.

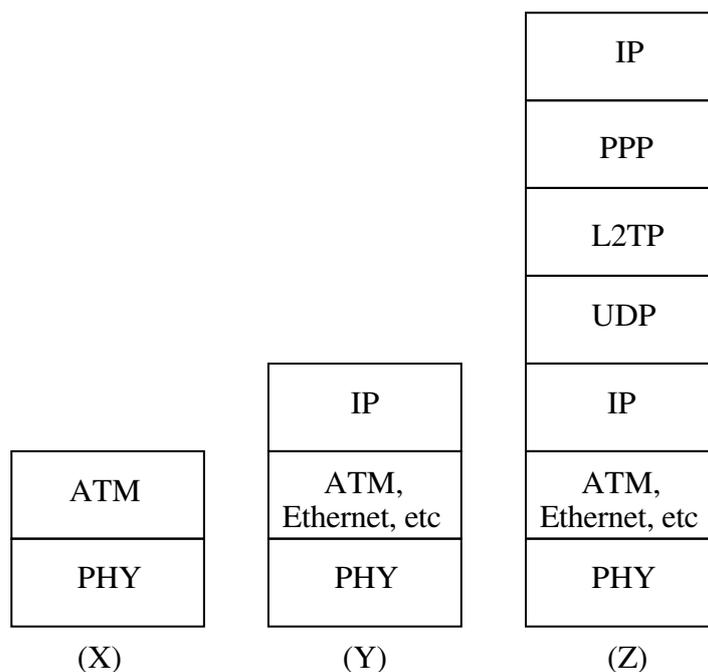


**Figure 4 – Protocols to and from end users**

[DSL Forum TR-092] specifies the requirements for using the protocols shown in Figure 4. These requirements make normative reference to other relevant DSL Forum TRs as well as relevant IETF RFCs and IEEE standards.

### 8.2 Protocols used to and from NSPs and ASPs

The protocols used to and from NSPs and ASPs are shown in Figure 5, and again [DSL Forum TR-092] specifies the requirements for using these protocols. These requirements make normative reference to other relevant DSL Forum TRs as well as relevant IETF RFCs and IEEE standards.



**Figure 5 – Protocols to and from NSPs and ASPs**

## 9 Multi-service delivery framework for home networks

[DSLTF TR-094] specifies the multi-service delivery framework for home networks, providing:

- the ability to support multiple logical data connections on the same physical access technology; and,
- the ability to tailor those connections with different qualities of transmission characteristics (i.e., quality of service (QoS)).

The broadband remote access server (BRAS) is a key network-side component.

The BRAS performs multiple functions in the network. Its most basic function is to provide aggregation capabilities between the regional/access network and the NSP/ASP. For the aggregation Internet traffic, the BRAS serves as a L2TP access concentrator (LAC) tunnelling multiple subscriber PPP sessions directly to an NSP or switched through a L2TS. It also performs aggregation for terminated PPP sessions or routed IP session by placing them into IP VPNs or 802.1Q VLANs. The BRAS also supports ATM termination and aggregation functions.

Beyond aggregation, the BRAS is also the injection point for providing policy management and IP QoS in the regional and access networks. The BRAS is fundamental to supporting the concept of many-to-many access sessions.

Policy information can be applied to terminated and non-terminated sessions. For example, a bandwidth policy may be applied to a subscriber whose PPP session is aggregated into an L2TP tunnel and is not terminated by the BRAS. However, sessions that terminate on (or are routed through) the BRAS can receive per flow treatment because the BRAS has IP level awareness of the session. In this model, not only can the aggregate bandwidth for a customer be controlled but also the bandwidth and treatment of traffic on a per application basis.

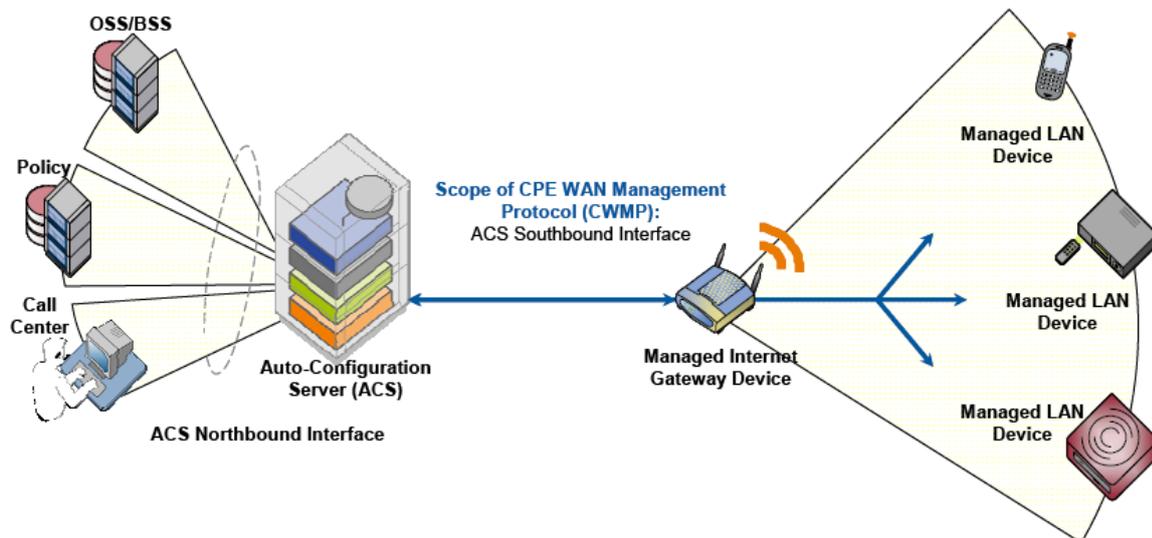
[DSLTF TR-094] identifies a number of applications that the home network will be expected to support, the functionality that a home network must deliver to meet the application requirements, and the reference architecture for a home network that will deliver such functionality.

[DSL TR-094] covers the three primary service areas associated with the "triple play" of voice, video, and data services. In particular, the following areas are addressed:

- Best effort Internet access (simple web surfing)
- Derived voice lines (VoIP based)
- Near video on demand – VoD (store and forward)
- Video on demand – VoD (streaming video)
- Audio, image and video distribution
- Bandwidth on demand (turbo button)
- Multiplayer gaming using either PCs or console devices
- Home automation (telemetry and control)
- Remote education

## 10 Management of customer premises equipment (CPE)

The basic framework for managing the equipment on the customer premises is specified in [DSL TR-069] as shown in Figure 6 (taken from [DSL TR-069]).



**Figure 6 – Framework for management of customer premises equipment**

The ACS is a server that resides in the network and manages devices in the subscriber premises. It uses the methods, or RPCs, defined in [DSL TR-069] to get and set the state of the device, initiate diagnostic tests, download and upload files, and manage events. [DSL TR-069] defines those objects applicable to management of an Internet gateway device delivering broadband service.

The Internet gateway device data model follows the conventions defined in [DSL TR-064] for versioning of data models and the use of profiles.

The CPE WAN management protocol defines a mechanism that encompasses secure auto-configuration of a CPE, and also incorporates other CPE management functions into a common framework.

The protocol architecture specified in [DSLIF TR-069] is shown in Figure 7.

CPE/ACS Management Application
RPC Methods
SOAP
HTTP
SSL/TLS
TCP/IP

**Figure 7 – Management protocol architecture**

The RPC method specification is specified in Annex A of [DSLIF TR-069] and defines a generic mechanism by which an ACS can read or write parameters to configure a CPE and monitor CPE status and statistics. The particular list of defined parameters for an Internet gateway device is specified in Annex A of [DSLIF TR-069].

It should be noted that TR-098 [DSLIF TR-098] specifies an extended set of parameters for [DSLIF TR-069] for the gateway device, particularly with respect to advanced QoS-based services.

## 11 LAN-side DSL CPE configuration

[DSLIF TR-064] describes a specific implementation to be used for DSL CPE LAN-side configuration. It describes the protocol stack, discovery, security, and the XML structure to be used.

The device control protocol (DCP) is compliant with UPnP Device Architecture 1.0 (UDA) [b-UPnP 1.0.1].

Aspect	Solution
Management Protocol	Standards based XML over SOAP protocol.
Parameter Model	Parameters defined using UPnP model as base, disallowing values and parameters that are inconsistent with DSL model, and adding objects as needed for DSL CPE.
Security	HTTP Digest Authentication; optional SSL 3.0 or TLS 1.0 encryption.
CPE Type	Supports Bridge/Router/PPPoE on-board IP pass-thru CPEs.
Management Usage	CPE turn-up, status determination, monitoring, diagnostics.
CPE discovery	Standards-based DHCP and SSDP device discovery.
OS Support	CPE management app with integrated XML over SOAP stack to operate on any OS, native XML/SOAP OS support is not required or desired.
Proprietary/Open	Standards-based with open interface published.

**Figure 8 – General features of LAN-side DSL CPE configuration**

## **12 Functional requirements residential gateways**

[DSLIF TR-124] specifies a superset of requirements for broadband residential gateway devices that are capable of supporting a full suite of voice, data, broadcast video, video on demand and two-way video applications in broadband networks.

This document specifies a baseline for a residential gateway device and the application functions needed to support service delivery in routed and bridged broadband network architectures. Devices can be specified that will operate on any of the different types of DSL Forum defined network architectures. This allows service providers to configure a residential gateway device supporting specified TR-124 modular requirements locally via TR-064 and web graphical user interface or remotely via TR-069. The requirements for a number of other related implementation features are specified, such a number of sessions to be supported, device related information, etc.

[DSLIF TR-124] provides optional requirements modules for various physical broadband interfaces (e.g., xDSL, Ethernet, GPON) and home networking (LAN) interfaces which may be implemented on residential gateways to meet local service provider needs.

Appendices C and D provide many example configurations showing simultaneous use of session types by various CPE devices. Appendix F contains a product profile template.

It should also be noted that [DSLIF TR-111] specifies the application of [DSLIF TR-069] to the remote management of home networking devices, and contains a number of related information flows.

## **13 Quality of service considerations**

[DSLIF TR-098] provides mappings between layer 2 and layer 3 QoS parameters for automatic marking of DSCP (layer 3) based upon Ethernet priority (layer 2) and vice versa.

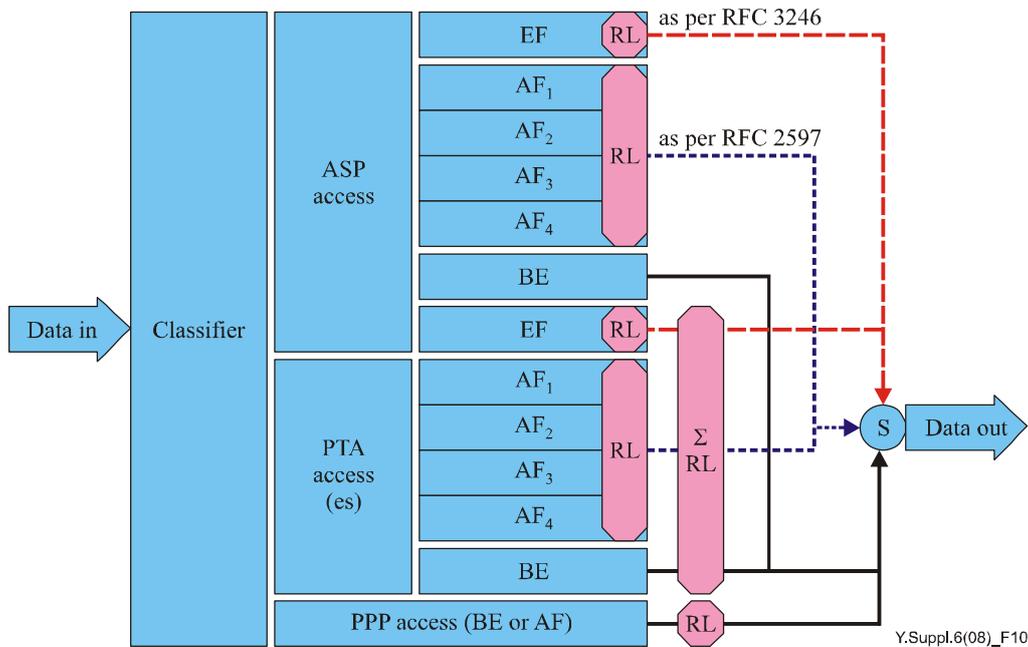
Layer 2		Layer 3	
Ethernet Priority	Designation	DSCP	Per Hop Behavior
001 (1)	BK	000000 (0x00)	Default
010 (2)	spare	000000 (0x00)	
000 (0)	BE	000000 (0x00) 000000 (0x00)	Default CS0
011 (3)	EE	001110 (0x0e) 001100 (0x0c) 001010 (0x0a) 001000 (0x08)	AF13 AF12 AF11 CS1
100 (4)	CL	010110 (0x16) 010100 (0x14) 010010 (0x12) 010000 (0x10)	AF23 AF22 AF21 CS2
101 (5)	VI	011110 (0x1e) 011100 (0x1c) 011010 (0x1a) 011000 (0x18)	AF33 AF32 AF31 CS3
110 (6)	VO	100110 (0x26) 100100 (0x24) 100010 (0x22) 100000 (0x20)	AF43 AF42 AF41 CS4
110 (6)	VO	101110 (0x2e) 101000 (0x28)	EF CS5
111 (7)	NC	110000 (0x30) 111000 (0x38)	CS6 CS7

NOTE – Greyed items are added to allow two-way mapping between layer-2 and layer-3 QoS.

**Figure 9 – Default layer 2/3 QoS mapping**

Shaping and rate limiting should also take place at the entry into the access network, rather than allowing the last mile to be uncontrolled. Additionally, it allows services to be based on a "policed/manageable" service level agreement with the customer. The following example is taken from [DSLIF TR-059].

There are multiple access sessions supported in this model, however, all traffic is classified and scheduled in a monolithic system. So, while it might appear at first that the Diffserv queuing and scheduling might apply only to IP-aware access – in fact all access, IP, Ethernet, or PPP is managed by the same system that adheres to the Diffserv model.

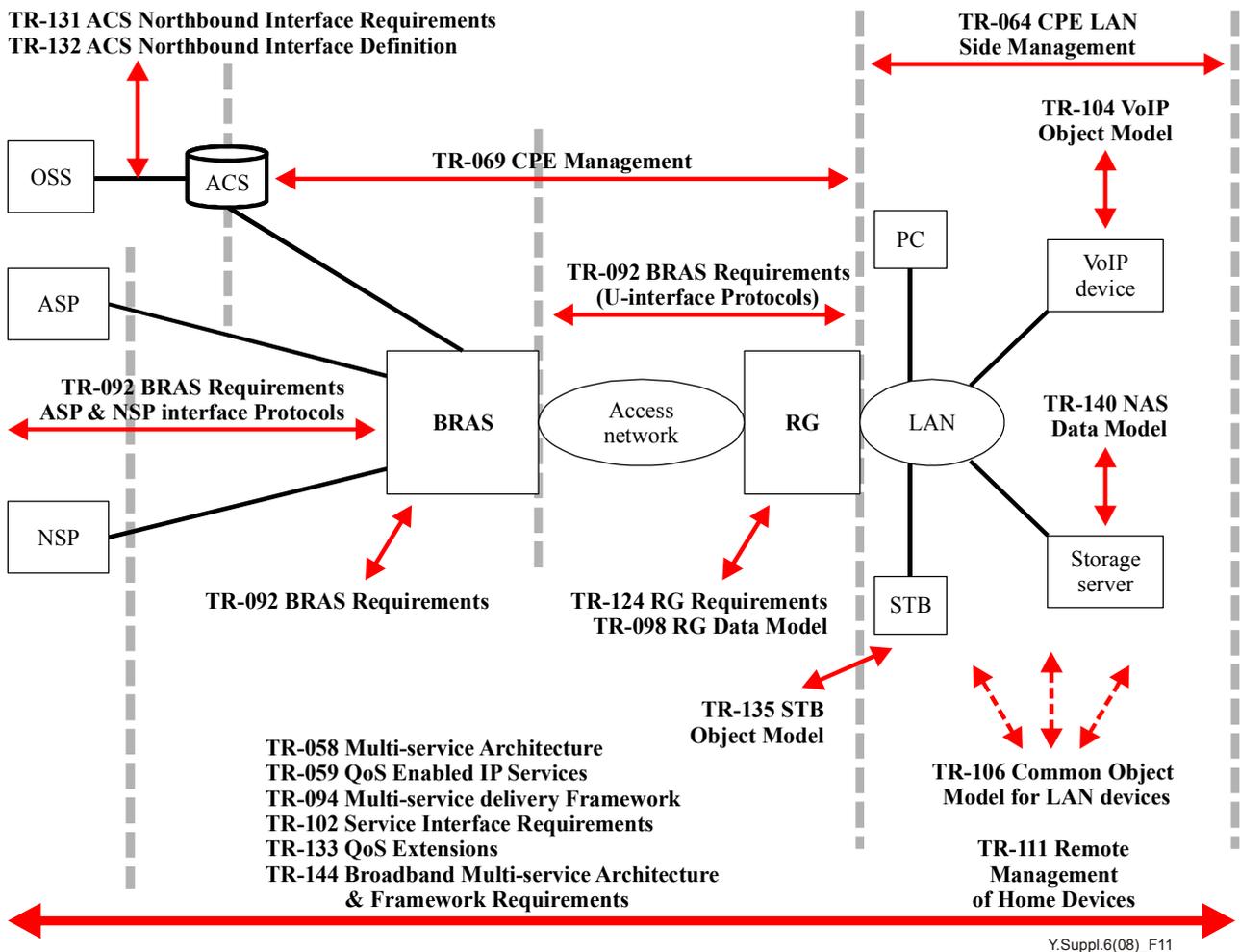


ASP – Application Service Provider  
 PTA – PPP Terminated Aggregation  
 PPP – Point-to-Point Protocol  
 EF – Expedited Forwarding – as defined in [b-IETF RFC 3246]  
 AF – Assured Forwarding – as defined in [b-IETF RFC 2597]  
 BE – Best Effort forwarding  
 RL – Rate Limiter  
 $\Sigma$ RL – Summing Rate Limiter (limits multiple flows)  
 S – Scheduler

**Figure 10 – Queuing and scheduling example for RG**

## 14 Summary of applicable DSLF technical reports

Figure 11 below provides a pictorial illustration of applicable DSL Forum documents and their relationship to the distribution of physical components.



**Figure 11 – Applicable DSL forum technical reports**

This figure is not exhaustive in identifying all the relevant Technical Reports. Some of the TRs shown above make reference to other applicable TRs.

TRs 131 and 132 in Figure 11 represent work in progress within the Broadband Forum. For a current perspective on the progress of work within the Broadband Forum, consult <http://www.broadband-forum.org/technical/technicalwip.php>.

## 15 Mappings to [ITU-T Y.2012] (FRA)

This clause provides the mappings/equivalences between the DSL Forum architecture and the functional entities specified in [ITU-T Y.2012].

### 15.1 NGN generalized architecture

The generalized functional architecture specified in [ITU-T Y.2012] is shown in Figure 12.

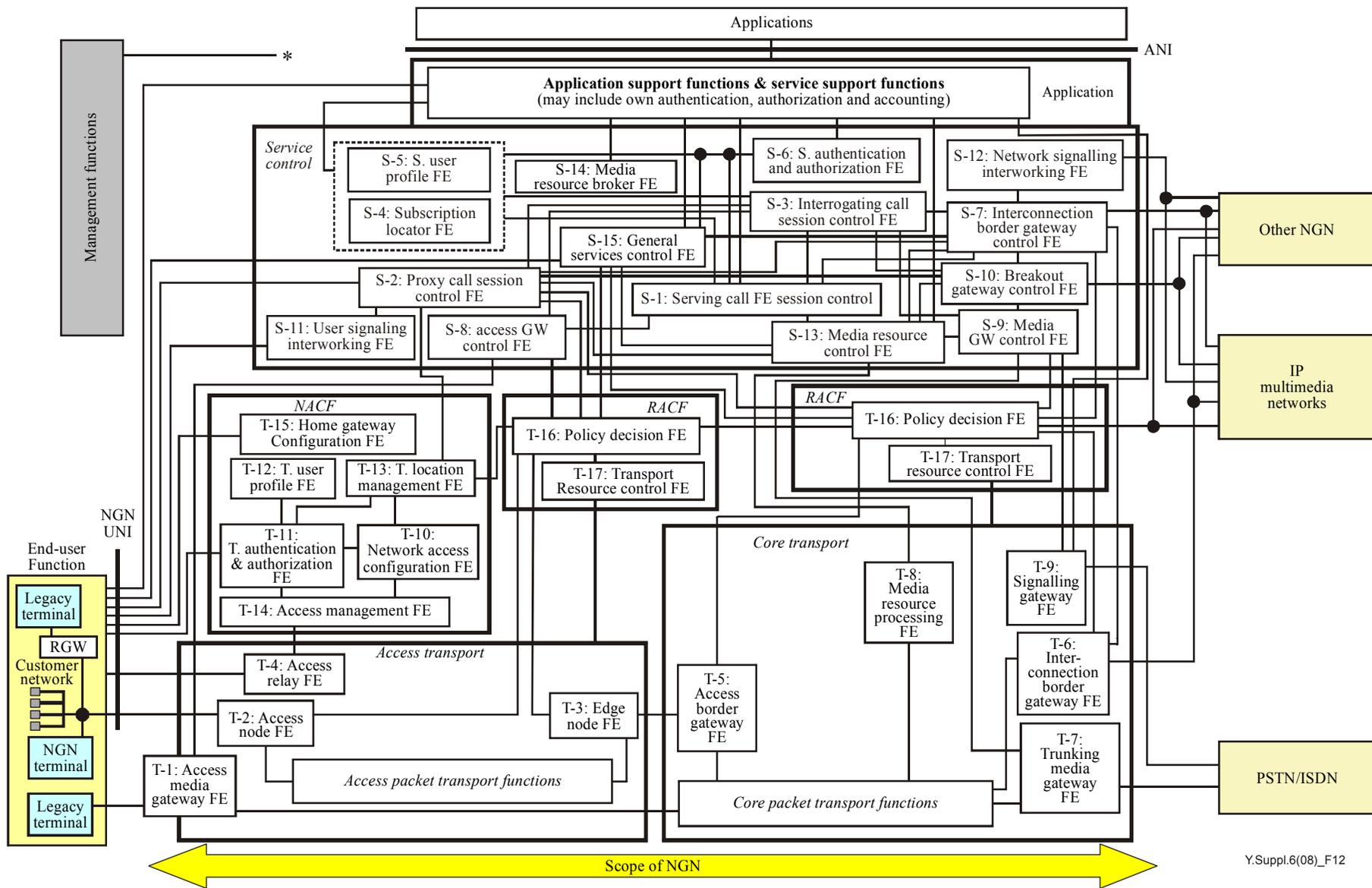


Figure 12 – NGN generalized functional architecture (from [ITU-T Y.2012])

## 15.2 DSL Forum architecture

The DSL architecture specifies three different protocol architectures and session types illustrated in Figure 13. Thus, the mapping to the Y.2012 components will vary according to the architectural instance under consideration. For example, the BRAS may act as an AN-FE, EN-FE or ABG-FE depending on:

- the session type under consideration;
- the physical distribution of network elements;
- the number of organizations involved/supplying network segments.

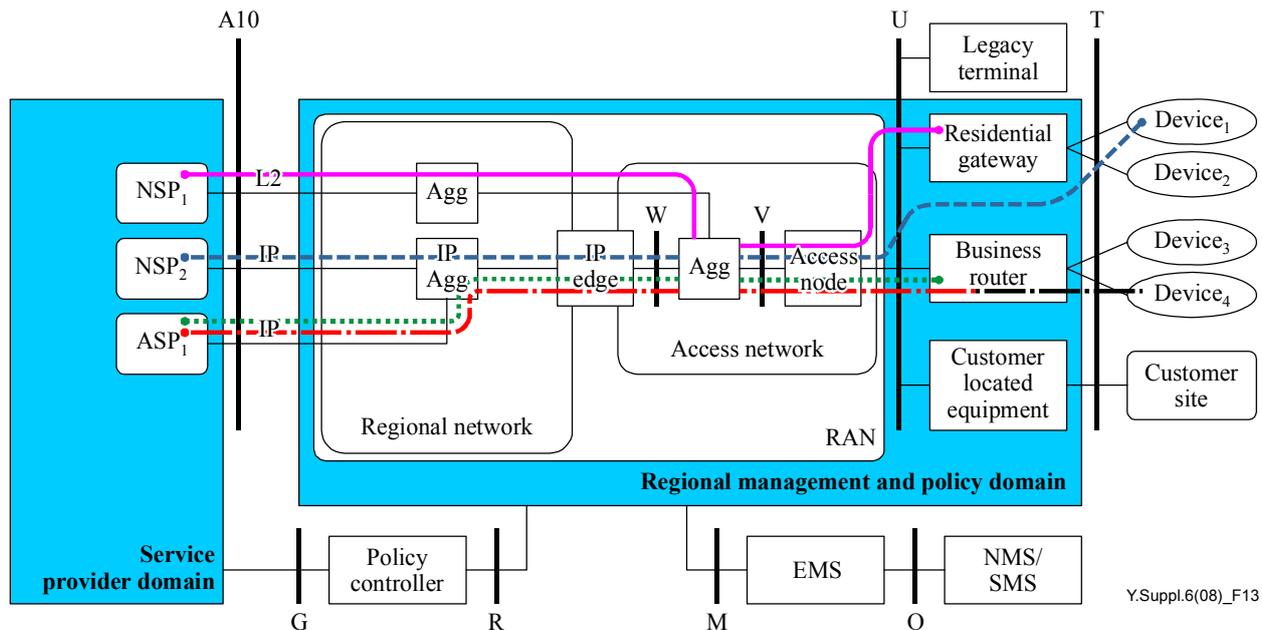


Figure 13 – Access session types

### 15.2.1 Community NSP (solid pink line)

The solid line shows a path between the RG and NSP<sub>1</sub>. This type of access session is established between an RG and an NSP. It is called the *Community* NSP connection because all the devices within the customer premises network share the connection to the NSP using the NAPT feature of the RG. Because the community NSP connection is given the *Default Route* at the RG, there can be only one. This connection is typically set up to an ISP in order to provide Internet access to all the devices in the customer premises network.

In this case layer 2 access is extended to the NSP. Thus, the EN-FE functionality would reside within the NSP provider domain. However, AN-FE and AR-FE functionalities would be present in the path.

### 15.2.2 Personal NSP (dashed line)

This case assumes the use of a PPP session from a device at the customer premises to a terminating BRAS. There may be several sub-cases within this one case. Several possibilities are in fact described in [ITU-T Y.2012] Appendix II, Scenario 2.

In the case of scenario 2, of [ITU-T Y.2012], Appendix II, three BRASs are shown in tandem.

In this scenario, the first BRAS acts only as a layer 2 device, i.e., AN-FE and AR-FE.

In the scenario depicted, the PPP protocol is terminated at the third BRAS, and is responsible for user authentication to establish a PPP session, and for routing encapsulated packets to the corresponding NSP. In this case, a BRAS may act as ABG-FE, as well as EN-FE.

As indicated in the scenario, there may be an intermediate BRAS, which would act as an L2TP device to tunnel aggregated PPP streams to the third BRAS. In this situation, the BRAS corresponds to the AN-FE in [ITU-T Y.2012]. Additionally, it may include some AR-FE functionality.

In a more simple case, there might be only one BRAS (with no intermediates), which would terminate PPP and perform the functions of an EN-FE and ABG-FE.

This type of session is called the *Personal* NSP connection because only the device within the customer premises network from which the session was established can access the NSP. This avoids using the NAPT feature of the RG. This connection is typically set up to an ISP or a corporation in order to provide private or personalized access, or any access that cannot traverse the NAPT sharing mechanism at the RG. A particular NSP may be identified for a given PPP session, and multiple sessions may be established.

### 15.2.3 ASP

The ASP access is shown by the dotted lines between the RG and ASP<sub>1</sub>. This type of access session is established between an RG and the ASP network. It is always a single connection and is always shared by all the ASPs.

Because the community NSP connection is given the *Default Route* at the RG, the ASP connection must provide the RG with a list of routes to the ASP network. Also because there is no default route to the ASP network, it is not possible to provide typical Internet access through the ASP connection. This connection is typically set up to the ASP network in order to provide application-specific and QoS-enabled access among all the applications in the ASP network and all the devices in the customer premises network.

## 16 Mappings to [ITU-T Y.2014] (NACF)

This clause provides the mappings/equivalences between the DSL Forum architecture and the functional entities specified in [ITU-T Y.2014].

The RG in the DSL Forum architecture corresponds to the HGW in NACF. The ACS in DSL Forum architecture (shown in Figure 6) corresponds to HGWC-FE in [ITU-T Y.2014]. The HGWC-FE is used during initialization and update of the HGW via T-Ux. It also provides the HGW with additional configuration information (e.g., configuration of a firewall internally in the HGW, QoS marking of IP packets, etc.).

It can be seen that the DSLF ACS has northbound links to a policy server. This will correspond to the TC-TC1 link from NACF to the PD-FE of RACF for policy purposes.

## Bibliography

- [b-DAVIC 1.4.1] DAVIC 1.4.1 Specification Part 2, *System Reference Models and Scenarios*.  
<[http://www.davic.org/Download/Spec1\\_2/part02.pdf](http://www.davic.org/Download/Spec1_2/part02.pdf)>
- [b-UPnP 1.0.1] UPnP Device Architecture, Version 1.0.1, May 6, 2003  
<<http://www.upnp.org/download/Clean%20UPnPDA101-20030506.doc>>
- [b-IETF RFC 2597] IETF RFC 2597 (1999), *Assured Forwarding PHB Group*.
- [b-IETF RFC 3246] IETF RFC 3246 (2002), *An Expedited Forwarding PHB (Per-Hop Behavior)*.



## SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
<b>Series Y</b>	<b>Global information infrastructure, Internet protocol aspects and next-generation networks</b>
Series Z	Languages and general software aspects for telecommunication systems