Oferta określająca ramowe warunki dostępu do lokalnej pętli abonenckiej poprzez dostęp do węzłów sieci telekomunikacyjnych na potrzeby sprzedaży usług szerokopasmowej transmisji danych

INFORMACJE OGÓLNE

Lista lokalizacji PDU poziomu Dostępu – DSLAM, IP DSLAM, OLT

- załącznik nr 1_ ATM

- załącznik nr 1_ IP

- załącznik nr 1_OLT

SO przyporządkowane poszczególnym PDU poziomu dostępu ATM (lokalnego i regionalnego) wraz z zakresem numeracji,

- załącznik nr 2 – ATM

SO przyporządkowane poszczególnym PDU poziomu dostępu IP wraz z zakresem numeracji

- załącznik nr 2 – IP

SO przyporządkowane poszczególnym PDU poziomu dostępu FTTH

- załącznik nr 2 – OLT

Parametry techniczne, jakie powinny spełniać Modemy oraz Mikrofiltry/Splittery w celu prawidłowej realizacji szerokopasmowej transmisji danych

1. Wymagania techniczne dla modemu SHDSL

1.1 Warstwa transmisyjna SHDSL

Urządzenia CPE SHDSL współpracujące z siecią OPL muszą:

- spełniać wymagania normy ITU –T G.991.2
- spełniać wymagania normy ITU –T G.994.1
- spełniać wymagania normy ETSI TS 101 524
- umożliwiać transmisję na poziomie ATM (ITU – T I.432.1.)

Lista wymaganych testów zgodnie z TR – 060:

- PSD tests
- PBO test
- loop tests
- noise performance tests

Testy powinny być przeprowadzone z następującymi urządzeniami centralowymi:

DSLAM	LINE CARD	MANUFACTURER	SOFTWARE
Stinger FS+	stgr-lim-sl-72	Lucent	9.11.1m02 (9.11-282.1c0)
Stinger FS+	stgr-lim-ima-48	Lucent	9.11.1m02 (9.11-282.1c0)

UMX4MSHD	M:SUSHDSL:32:PAM16	Siemens	V2_0_4_1_POLAND
ASAM R5	SMLT –C	Alcatel - Lucent	5.1.42
ISAM	NSLT-A	Alcatel - Lucent	4.2.04a
Huawei MA5600T	SHLM	Huawei	V800R007C01 + patch: SPC100 + SPH318 + CP1017 + HP1019 + CP1026
Huawei MA5616T	SHLH	Huawei	V800R308C01 + patch: SPC200 + SPH509 + HP2109

1.2 Warstwa transmisyjna ATM

Urządzenie CPE SHDSL musi spełniać wymagania normy ITU – T I.432.1. B-ISDN user-network-interface – Physical layer specification: General charcteristics odnośnie transmisji ATM na interfejsie UNI. Zdolność urządzenia do transmisji komórek ATM ma być potwierdzona w testach:

- TR – 060; ATM conectivity tests

1.3 Podstawy metodologiczne wykonania testów

- Norma ETSI TS 101 524
- Technical specification ST/FTR&D/7804 August 2011 Edition 12.3

1.4 Terminy

ATM	Asynchronous Transfer Mode
CPE	Customer Premises Equipment
DSLAM	Digital Subscriber Line Access Multiplexer
ETSI	European Telecommunications Standards Institute
IMA	Inverse Multiplexing over ATM
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
NTU	Network Termination Unit
PBO	Power Back Off
PS	Power Status
PSD	Power Spectral Density
SDSL	Symmetrical single pair high bit rate Digital Subscriber Line
SHDSL	Single-pair High-speed Digital Subscriber Line
STU-C	SDSL Termination Unit – Central Office (DSLAM)
STU-R	SDSL Termination Unit – Remote (CPE)

2. Wymagania techniczne dla modemu ADSL

2.1. Warstwa transmisyjna ADSL

Urządzenia ADSL CPE współpracujące z siecią OPL muszą:

- spełniać wymagania normy ITU-T G.992.1 Annex A – dla ADSL
- spełniać wymagania normy ITU-T G.992.3 Annex A – dla ADSL2
- spełniać wymagania normy ITU-T G.992.5 Annex A – dla ADSL2+
- spełniać wymagania norm G.994.1, G.997.1,
- umożliwiać transmisję ATM (ITU-T I.361 oraz G.992.1 punkt 5.2.2, 6.2 i 8.2)
- spełniać wymagania zalecenia Broadband Forum TR-067 – dla ADSL
- spełniać wymagania zalecenia Broadband Forum TR-100 – dla ADSL2/2+
- spełniać wymagania zalecenia Broadband Forum TR-105 – dla ADSL2/2+

2.2. ADSL2+ splitters and microfilters must be compliant with:

a) ETSI TS 101 952-1 V1.1.1 (2009-06):
   - Reference impedances:

    - Z_r = 600 Ω
    - Z_{DSL}= 150 nF + (100 Ω // 470 µH) + 150 nF
    - Z_{RHF} = 120 Ω + (150 Ω // 47 nF) + (750 Ω // 150 nF)
    - Z_{RefDSL} = 100 Ω
- DC resistance to earth (p.6.2.1):
    - > 999 MΩ
- DC insulation resistance between A-wire and B-wire (p.6.2.2):
    - > 999 MΩ
- DC series resistance RDC (p.6.2.3):
    - < 50 Ω
- Low impedance On-Hook POTS pass band insertion loss (p.6.4.2.1):
    - > - 1 dB @ 1 kHz
- Low impedance On-Hook POTS pass band insertion loss distortion:
    - < 1 dB from 200 Hz to 2,8 kHz (p.6.4.2.2)
- Off-Hook POTS pass band insertion loss (p.6.5.1):
    - > - 1 dB @ 1 kHz
- Off-Hook POTS pass band insertion loss distortion (p.6.5.2):
    - < 1 dB from 200 Hz to 4 kHz
- POTS pass band return loss requirements- Off-Hook, LINE port (p.6.6.2):
    - > 14 dB @ 300 Hz **->** > 18 dB @ 500 Hz
    - > 18 dB from 500 Hz to 2 kHz
    - > 18 dB @ 2 kHz **->** > 14 dB @ 3,4 kHz
- POTS pass band return loss requirements- Off-Hook, POTS port (p.6.6.2):
    - > 14 dB @ 300 Hz **->** > 18 dB @ 500 Hz
    - > 18 dB from 500 Hz to 2 kHz
    - > 18 dB @ 2 kHz **->** > 14 dB @ 3,4 kHz
- Unbalance of the low pass part (p.6.8.1)
    - > 40 dB from 50 Hz to 600 Hz
    - > 46 dB from 600 Hz to 3,4 kHz
    - > 40 dB from 3,4 kHz to 4 kHz
    - > 40 dB from 4 kHz to 32 kHz
    - > 50 dB from 32 kHz to 2,2 MHz
    - > 30 dB from 2,2 MHz to 5 MHz
- xDSL signal loss: IL LINE port to xDSL port (p.6.9.4):
    - > -3 dB from 32 kHz to 50 kHz
    - > -1 dB from 50 kHz to 2,2 MHz
- Unbalance of the high pass part (p.6.8.2):
    - > 45 dB from 32 kHz to 2,2 MHz
    - > 30 dB from 2,2 MHz to 5 MHz
- xDSL band isolation between LINE and POTS port – ON-HOOK (p.6.9.1)
    - < -34 dB from 32 kHz to 350 kHz
    - < -51 dB from 350 kHz to 2,2 MHz
- xDSL band isolation between LINE and POTS port – OFF-HOOK (p.6.9.1)
    - < -45 dB from 32 kHz to 138 kHz
    - < -55 dB from 138 kHz to 2,2 MHz
- Group delay distortion (p.6.12):
    - < 250 µs from 300 Hz to 600 Hz
    - > 200 µs from 600 Hz to 3,2 kHz
    - > 250 µs from 3,2 kHz to 4 kHz

Supplier MUST deliver the splitter/microfilter together with ADSL2+ modem.

Lista wymaganych testów zgodnie z Broadband TR-067 – dla ADSL:

- 8.1.1 Basic Functional Bit Swap Test
- 8.1.3 Check ADSL Diagnostic tools
- 8.1.4 Dying gasp

- 8.1.8 ATU-R Register Reporting via EOC8.4 Stress Test (ETSI loop), time is reduced to 4 hours
- 8.5.1 Analog Front End Power
- 8.5.2 PSD Measurements
- A.2.1 CPE Margin verification tests
- A.2.1.2 Margin Verification for CPE
- A.2.3 Loop Tests with Ports Set for Adaptive Rate
- A.2.3.1 European Adaptive Rate White Noise
- A.2.3.2 European Adaptive Rate FB Noise
- A.2.4 Loop Tests with Ports Set For Fixed Rate
- A.2.4.1 Fixed Rate, FB Noise

Lista wymaganych testów zgodnie z Broadband Forum TR-100/WT-105/TR-067 – dla ADSL2/2+:

I. TR-100 (z TR-100 Corrigendum 1):
- 7.1 - Bitswap performance test for ADSL2 and ADSL2+, line conditions shall be modified in order to synchronise at data rates around 14 MB/s, test profile A2P_RA_F_30000K shall be use. RFI shall be applied to tones between 260 and 300.
- 7.3 - Stress Test, the test time can be reduced to 4 hours, ADSL2+annex A, using A2P_RA_F_30000k test profile. The line length shall be 1500 meters of PE 0,4 mm.
- A.2.2 - CPE margin verification test: A.2.2.2, A.2.2.4 (test time can be reduced to 30 min)
- A.2.2.6
- A.2.5 - Loop tests with ports set for adaptive rate
- A.2.6 - Loop tests with ports set for fixed rate
- A 2.8 - REIN

II. RT-105:
- 5.5.2 “Seamless rate adaptation test”, for systems supporting SRA
- 5.8 “Low power (L2) mode”, with parameter sets 1 and 2
- 5.9.1 “PSD mask”, ADSL2 Annex A, ADSL2 Annex L, ADSL2+ Annex A, ADSL2+ Annex M(for systems supporting this Annex);
- 5.9.2 “Aggregate transmit power”, ADSL2 Annex A, ADSL2 Annex L, ADSL2+ Annex A,ADSL2+ Annex M
- 5.13 “EOC communication test” for ADSL2 and ADSL2+ Annex A.
- 5.12 “ATU-R inventory information test” for ADSL2+ Annex A. Note: contents of the Inventoryfields, including xTU-R version and serial numbers, shall be compliant with G.997.1 [9]
- 7.1 “Performance Monitoring Counters for Code Violations and Errored Seconds”: Table 7-2 – Interleaved mode
- 7.2 “Performance Monitoring Counters for SES”; Note: REIN noise shall be defined also in theupstream band for this test; improved Expected Results shall be used for this test, as per Annex F
- 7.3 “Performance Monitoring Counters for Full Initialization, LOSS-L and LOSS-LFE”
- 7.4 “Performance Monitoring Counters for Unavailable Seconds”
- 7.5 “Performance Monitoring Counters for Failed Full Initialization”

III. TR-067
- TR-067 & 8.1.4 „ Dying gasp” adapted to ADSL2+ Annex A.

Testy powinny być przeprowadzone z następującymi urządzeniami centralowymi.

ADSL:

ADSL: DSLAM	Line card	Manufacturer	Software
Stinger FS+	STGR-LIM-AD-72	Lucent	9.11.1m02
Stinger FS+	STGR-LIM-A2P-72	Lucent	9.11.1m02
Stinger FS+	STGR-LIM-A2P72-HBI	Lucent	9.11.1m02

Singer MRT2+	MRT2U-AP-72S	Lucent	9.11.1m02
UMX4MSHD	SUADSL:64PXA	Siemens	V2_0_4_1_POLAND
UMX4MSHD	SUADSL:64PTI	Siemens	V2_0_4_1_POLAND
UMX4MS	SUADSL:32P	Siemens	VI_2_2_125
AnyMedia	LPA 416	Lucent	1.29.01.01
AnyMedia	LPA 833	Lucent	1.29.01.01
ASAM R5	ABLT-D	Alcatel	5.1.42
ISAM7302	NALT-C	ALU	SW R4204a
ISAM7302	NALT-J	ALU	SW R4204a
ISAM7302	NALS-A	ALU	SW R4204a
ISAM7330FTTN	NALT-C	ALU	SW R4204a
ISAM7330FTTN	NALT-J	ALU	SW R4204a
ISAM7330FTTN	NALS-A	ALU	SW R4204a
ISAM7356REM	NALT-C	ALU	SW R4204a
ISAM7356REM	NALT-J	ALU	SW R4204a
ISAM7356REM	NALS-A	ALU	SW R4204a
MA5600/03	ADPD	HUAWEI	SW V8R7
MA5616	ADLE	HUAWEI	SW V8R308

ADSL2+:

ADSL2+ DSLAM	Line card	Manufacturer	Software
Stinger FS+	STGR-LIM-AD-72	Lucent	9.11.1m02
Stinger FS+	STGR-LIM-A2P72-HBI	Lucent	9.11.1m02
Singer MRT2+	MRT2U-AP-72S	Lucent	9.11.1m02
UMX4MSHD	SUADSL:64PXA	Siemens	V2_0_4_1_POLAND
AnyMedia	LPA 833	Lucent	1.29.01.01
ASAM R5	ABLT-D	Alcatel	5.1.42
ISAM7302	NALT-C	ALU	SW R4204a
ISAM7302	NALT-J	ALU	SW R4204a
ISAM7302	NALS-A	ALU	SW R4204a
ISAM7330FTTN	NALT-C	ALU	SW R4204a
MA5600/03	ADPD	HUAWEI	SW V8R7
MA5616	ADLE	HUAWEI	SW V8R308

2.2 Warstwa transmisyjna ATM

Urządzenie CPE operatora korzystającego musi spełniać wymagania normy *ITU-T I.361 B-ISDN ATM Layer Specification* odnośnie transmisji ATM na interfejsie UNI (User-Network Interface). Zdolność urządzenia CPE do transmisji komórek ATM musi zostać potwierdzona w testach :

- TR-67 8.4 Stress Test (ETSI Loop). – dla ADSL
- TR-100v0 7.3 - Stress Test (ETSI Loop). – dla ADSL2/2+

Urządzenie CPE operatora korzystającego, dołączane do sieci OPL powinno umożliwiać zestawienie połączenia ATM PVC z numeracją VPI, VCI określoną w umowie z operatorem.

3. Wymagania techniczne dla modemu VDSL

The RGW MUST be compliant with the following ITU-T standards:

- VDSL2 (ITU-T G.993.2) with all latest Amendments and corrigenda
- G.Ploam (ITU-T G.997.1) with all latest Amendments and corrigenda

The DSL RGW MUST ensure VDSL2 interoperability towards OPL SA DSLAMs (list to be communicated separately) according to Broadband Forum and FT Group documents, as described in

- BBF - TR-114 Issue 1 with all corrigendums
- BBF - TR-115 Issue 1 with all corrigendums
- FT/RD/RESA/10/07/99 July 2010 Technical specification Edition 3.0 Test suite for introducing VDSL2 devices in FT Group network

The DSL RGW MUST support following

- VDSL2 Annex B (Europe)
- 998 bandplan
- Profile 8b, 12a, 17a
- US0 support (according to ITU-T G.993.2)
- Bitswap
- UPBO
- PTM mode
- Dying Gasp

The DSL RGW SHOULD support following features

- SOS – Save Our Showtime (Optional in standard, Amendment 3)
- INM – Impulse Noise Monitoring (Optional in standard, Amendment 3)
- Erasure Decoding
- G.INP – Physical Layer Retransmission (according to ITU-T G.998.4)
- DPBO
- ADSL backward compatibility

The RGW MUST support the following encapsulation modes over the ATM link layer:

- Bridge connection shall be in accordance with RFC 2684 bridge mode using LLC/SNAP without FCS (ex OTV PVC in bridge mode)
- Translated routed connection protocol stack with PPPoA are based on IP / PPP / RFC 2364 (VC mux) / AAL-5 / ATM / DSL
- Translated routed connection protocol stack with PPPoE are based on IP / PPP / PPPoE RFC 2516 / Ethernet / RFC 2684 bridged (LLC/SNAP) / AAL-5 / ATM / DSL
- Translated routed connection protocol stack for IP over Ethernet over ATM connection are based on IP / Ethernet / RFC 2684 bridged (LLC/SNAP) / AAL-5 / ATM / DSL

Translated routed connection protocol stack for IP over ATM connection are based on IP / RFC 2684 routed (VC mux) / AAL-5 / ATM / DSL

Testy powinny być przeprowadzone z następującymi urządzeniami kartami:

DSLAM	LINE CARD	MANUFACTURER	SOFTWARE
Alcatel 7302	NVLT-G	Alcatel	R4003
Alcatel 7330FTTN	NVLT-G	Alcatel	R4003
Alcatel 7356REM	NVLT-G	Alcatel	R4003
Huawei MA5600T	VDMF	Huawei	MA5600V800R007C01 + Patche SPC318
Huawei MA5603T	VDMF	Huawei	MA5600V800R007C01 + Patche SPC318
Huawei MA5616	VDSE	Huawei	MA5616V800R308C01 + Patche SPC509

3.1 Splitter

3.1.1 VDSL2 splitters and microfilters must be compliant with:

a) ITU-T K21
b) EN 60950
c) ETS 300 386-1-1 / EN 55022 / 55024
d) ETSI TS 101 952-1 V1.1.1 (2009-06):
   - Reference impedances:
     - Z_r = 600 Ω
     - Z_{DSL}= 150 nF + (100 Ω // 470 µH) + 150 nF
     - Z_{RHF} = 120 Ω + (150 Ω // 47 nF) + (750 Ω // 150 nF)
     - Z_{RefDSL} = 100 Ω
   - DC resistance to earth (p.6.2.1):
     - > 999 MΩ
   - DC insulation resistance between A-wire and B-wire (p.6.2.2):
     - > 999 MΩ
   - DC series resistance RDC (p.6.2.3):
     - < 50 Ω
   - Low impedance On-Hook POTS pass band insertion loss (p.6.4.2.1):
     - > - 1 dB @ 1 kHz
   - Low impedance On-Hook POTS pass band insertion loss distortion:
     - < 1 dB from 200 Hz to 2,8 kHz (p.6.4.2.2)
   - Off-Hook POTS pass band insertion loss (p.6.5.1):
     - > - 1 dB @ 1 kHz
   - Off-Hook POTS pass band insertion loss distortion (p.6.5.2):
     - < 1 dB from 200 Hz to 4 kHz
   - POTS pass band return loss requirements- Off-Hook, LINE port (p.6.6.2):
     - > 14 dB @ 300 Hz **->** > 18 dB @ 500 Hz
     - > 18 dB from 500 Hz to 2 kHz
     - > 18 dB @ 2 kHz **->** > 14 dB @ 3,4 kHz
   - POTS pass band return loss requirements- Off-Hook, POTS port (p.6.6.2):
     - > 14 dB @ 300 Hz **->** > 18 dB @ 500 Hz
     - > 18 dB from 500 Hz to 2 kHz
     - > 18 dB @ 2 kHz **->** > 14 dB @ 3,4 kHz
   - Unbalance of the low pass part (p.6.8.1)
     - > 40 dB from 50 Hz to 600 Hz
     - > 46 dB from 600 Hz to 3,4 kHz
     - > 40 dB from 3,4 kHz to 4 kHz
     - > 40 dB from 4 kHz to 32 kHz
     - > 50 dB from 32 kHz to 2,2 MHz
     - > 45 dB from 2,2 MHz to 12 MHz
     - > 45 dB @ 12 MHz **->** > 30 dB @ 30 MHz
   - xDSL signal loss: IL LINE port to xDSL port (p.6.9.4):
     - > -3 dB from 32 kHz to 50 kHz
     - > -1 dB from 50 kHz to 30 MHz
   - Unbalance of the high pass part (p.6.8.2):
     - > 45 dB from 32 kHz to 12 MHz
     - > 45 dB @ 12 MHz **->** > 30 dB @ 30 MHz
   - xDSL band isolation between LINE and POTS port – ON-HOOK (p.6.9.1)
     - < -34 dB from 32 kHz to 350 kHz
     - < -51 dB from 350 kHz to 30 MHz
   - xDSL band isolation between LINE and POTS port – OFF-HOOK (p.6.9.1)
     - < -45 dB from 32 kHz to 138 kHz
     - < -55 dB from 138 kHz to 30 MHz
   - Group delay distortion (p.6.12):
     - < 250 µs from 300 Hz to 600 Hz
     - < 200 µs from 600 Hz to 3,2 kHz
     - < 250 µs from 3,2 kHz to 4 kHz

e) Line overvoltage protection included
f) EMI/RFI suppression
g) Specifications valid with DC current of up to 80mA
h) No external power required

Supplier MUST deliver the splitter/microfilter together with VDSL modem.

3.2 Wymagania techniczne dla modemów wspierających IPv6 w klacie UBR i C3

Technical specification to support IPv6 over PPP and IPv4 continuity for residential CPE in IP BSA NZ service in ADSL2/2+ and VDSL2 for B2C market

Abstract:

The objective of this document is to identify, describe and specify the required capabilities of CPEs to support IPv6 over PPP and IPv4 continuity for residential clients of BSA services.
This specification is dedicated to Poland.

This document was created based on “Project: DI - Home Network Infrastructure; Livebox technical specification to support IPv6 over PPP and IPv4 continuity” Ref, FT/R&D/HNI/67-2011/NeN, version 1.2 written by Nicolas Neyret RESA/ANA.

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1 Introduction

1.1 Objectives of this document

The document was created in order to present the requirements of IPv6 for B2C market which the Alternative Operator (OA) should implement in their CPEs to cooperate in a proper way with Orange / OPL's network in wholesale service IP BSA NZ (Bitstream Access) (pol. Usługa hurtowa IP BSA nie zarządzane) in ADSL2/2+ and VDSL2 mode.
Information included in this document can be used without additional consent as attachment of technical and functional requirements send by Alternative Operator (OA) to CPE suppliers.
In Poland, Orange is introducing IPv6 capabilities in the network and service infrastructures to access the Internet.
Orange uses a DS-lite architecture ([RFC6333]). This specification is dedicated to Poland and deals with residential Internet service only (like Neostrada service).
Considered access technologies are ADSL and VDSL.
IPv6 over PPP is considered.

1.2 Applicable RFCs

RFC number	Definition
2460	Internet Protocol, Version 6 (IPv6) Specification
2464	Transmission of IPv6 Packets over Ethernet Networks
2473	Generic Packet Tunneling in IPv6
2516	A Method for Transmitting PPP Over Ethernet (PPPoE)
3318	Authentication for DHCP Messages
3315	Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
3484	Default Address Selection for Internet Protocol version 6 (IPv6)
3596	DNS Extensions to Support IP Version 6
3633	IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6
3646	DNS Configuration options for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
3736	Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6
4242	Information Refresh Time Option for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
4291	IP Version 6 Addressing Architecture
4443	Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification
4861	Neighbor Discovery for IP version 6 (IPv6)
4862	IPv6 Stateless Address Autoconfiguration
5072	IPv6 over PPP
6106	IPv6 ROUTER ADVERTISEMENT OPTIONS FOR DNS CONFIGURATION
6333	Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion
6334	Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Option for Dual-Stack Lite

1.3 Acronyms

Acronym	Definition
ADSL	Asymmetric Digital Subscriber Line
AFTR	Address Family Transition Router
ATM	Asynchronous Transfer Mode
B4	Basic Bridging BroadBand
CPE	Customer Premise Equipment
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol version 6
DNS	Domain Name System
DS	Dual Stack
DSCP	Differentiated Service Code Point
DUID	DHCP Unique Identifier
EUI	Extended Unique Identifier
FTTH	Fiber To The Home
GUA	Global Unique Address
GUI	Graphic User Interface
GUP	Global Unique Prefix
IA_PD	Identity Association Prefix Delegation
ICMP	Internet Control Message Protocol
IP	Internet Protocol
IPv6	Internet Protocol version 6
LAN	Local Area Network
LLA	Link Local Address
MAC	Media Access Control
MTU	Maximum Transmission Unit
ORO	Option Request Option
PPP	Point-to-Point Protocol
PVC	Permanent Virtual Channel
QoS	Quality of Service
RA	Router Advertisement
RDNSS	Recursive Domain Name System Server
RGW	Residential GateWay
RS	Router Solicitation
SLAAC	Stateless Address Auto Configuration
URL	Uniform Resource Locator
VDSL	Very high bite rate Digital Subscriber Line
VLAN	Virtual Local Area Network

Acronym	Definition
WAN	Wide Area Network

1.4

1.5 Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].
This document makes use of the following key words in order to indicate requirement levels:
MUST / SHALL / REQUIRED / REQUESTED indicates that a feature is mandatory.
The negative form MUST NOT / SHALL NOT indicates that a feature is prohibited.
SHOULD / RECOMMENDED indicates that a feature is a nice to have feature.

Field	Value	Definition
Priority	P0-Essential	Requirement of essential priority
	P1-Important	Requirement of important priority
	P2-Normal	Requirement of normal priority
	P3-Optional	Requirement of optional priority
Category	Functional	Function requested from the product to meet a recipient need (expressed and implicit)
	Workload	Dependent on the number of users, requests...
	Availability	Aptitude to maintain its level of service, reliability, continuity of service, tolerance to the faults, possibility of recovery...
	SLA/Exploitability	Aptitude to maintain, exploit the product (to diagnose failures, to identify the elements to be modified, to cure the defects...) Installation,
	Interworking	Capacity to be interacted with systems given, to interface (the interfaces of the product: hardware, software, user...), compatibility...
	Performance	Quality, performance,
	Safety/Security	Ability to prevent from an unauthorized access (accidental or deliberated), confidentiality, vulnerability...
	Product Specific	Legal, lawful, durable development...

2 General requirements

CPEs deployed in Orange network have to be a dual stack router and must support both IPv4 and IPv6 protocol versions including all relevant companion protocols and applications.

2.1 Internet Protocol version 6

REQ ID _ TITLE	GEN_0001 – Internet Protocol Version 6					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support IPv6 [RFC2460]						

2.2 Neighbor Discovery for IPv6

REQ ID _ TITLE	GEN_0002 – Neighbor Discovery for IPv6					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support Neighbor Discovery for IPv6 [RFC4861]						

2.3 IPv6 Stateless Address Autoconfiguration

REQ ID _ TITLE	GEN_0003 – IPv6 Stateless Address Autoconfiguration					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support IPv6 Stateless Address Autoconfiguration [RFC4862]						

2.4 ICMP for the Internet Protocol Version 6

REQ ID _ TITLE	GEN_0004 – Default Address Selection for IPv6					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support ICMP for the Internet Protocol Version 6 (IPv6) [RFC4443]						

2.5 Support of IPv6 over Ethernet

REQ ID _ TITLE	GEN_0005 – Support of IPv6 over Ethernet					
	PRIORITY	**CATEGORY**				

	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support IPv6 over Ethernet [RFC2464]						

2.6 Default Address Selection for IPv6

REQ ID _ TITLE	GEN_0006 – Default Address Selection for IPv6					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support default address selection for IPv6 [RFC3484]						

2.7 IP Version 6 over PPP

REQ ID _ TITLE	GEN_0007 – IP Version 6 over PPP					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support IP Version 6 over PPP [RFC5072]						

3 Access Network

3.1 ADSL access network

REQ ID _ TITLE	ADSL_0001 – ADSL : PVC used					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The IPv6 connectivity is provided through internet PVC.						

3.2 VDSL access network

REQ ID _ TITLE	VDSL_0001 – VDSL : VLAN used					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The IPv6 connectivity is provided through internet VLAN.						

4 Internet connectivity procedure

After CPE boots, it must choose the IP version stack to launch (IPv4, IPv6 or both) according to access network configuration. To define it, the CPE should manage different local variables :

- IPCP.status: it indicates the status of the IPCP negotiation. The possible values are *OK* or *KO*.
- IPv6CP.status: it indicates the status of the IPv6CP negotiation. The possible values are *OK* or *KO*.
- DSlite.enable: this variable indicates id the DS-lite interface is enabled or disables. The possible values are *true* or *false*.
- DSlite.status: it indicates the status of the DS-lite interface. The possible values are *Disabled* or *Enabled*

4.1 Detection of IPv6 connectivity

REQ ID _ TITLE	ACT_0001 – IPv6 Process activation					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
After a boot, all the LAN IPv6 services are deactivated or not activated since DHCPv6 cycle ends successfully.						

REQ ID _ TITLE	ACT_0002 – CPE boot procedure for Internet connectivity					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
This process **MUST** be launched at every boot time.						

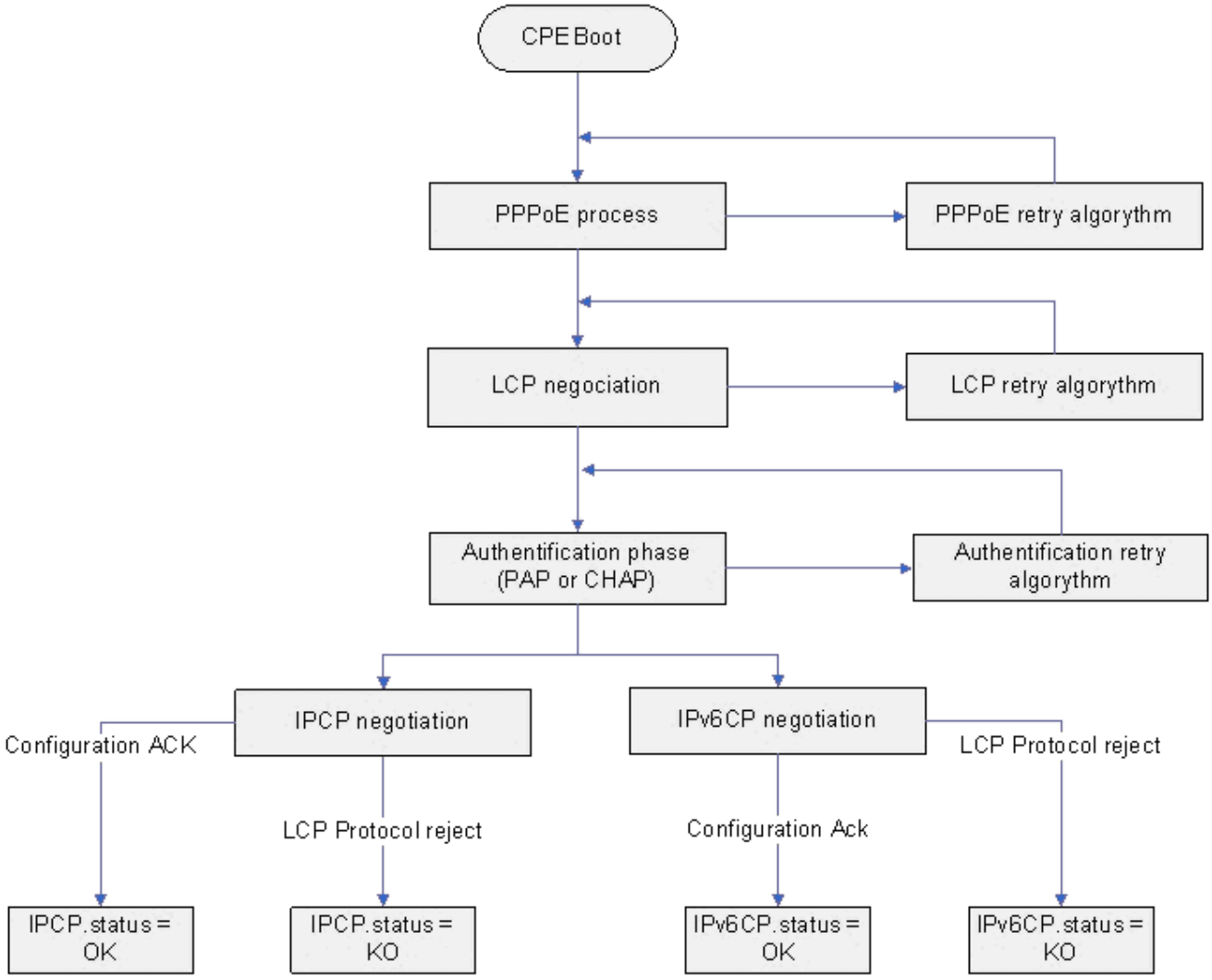

Figure 1. CPE boot procedure for Internet connectivity

4.2 CPE IP stack choice

The CPE must activate the IPv4 and IPv6 stack according to the requirement ACT_0002.

REQ ID _ TITLE	ACT_0003 – IPv4 mode					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** boot in IPv4 mode if local variables IPCP.status = OK and IPv6CP.status = KO. So IPv4 mode is launched. In this case, the local variable DSlite.enable is set to false and DSlite.status is set to disabled.						

REQ ID _ TITLE	ACT_0004 – Dual stack mode					
	PRIORITY	**CATEGORY**				
	P3-Optional	Functional				
DESCRIPTION						

The CPE **MUST** boot in Dual stack mode if local variables IPCP.status = OK and IPv6CP.status = OK. So IPv4 and IPv6 mode are launched. In this case, the local variable DSlite.enable is set to false and DSlite.status is set to disabled. **Note:** Dual stack mode isn't supported in in wholesale service BSA not managed.

REQ ID _ TITLE	ACT_0005 – DS-lite mode					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** boot in DS-lite mode if local variables IPCP.status = KO and IPv6CP.status = OK. So IPv6 mode is launched. In this case, the local variable DSlite.enable is set to true and DSlite.status is set to disabled.						

REQ ID _ TITLE	ACT_0006 – No IP mode found					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
If local variables IPCP.status = KO and IPv6CP.status = KO, the CPE **MUST** restart IPCP and IPv6CP negotiation.						

4.3 Technical requirement for FTTH RGW:

- The RGW MUST be compliant with the requirements of EMC harmonized standard **ETSI EN 300 386** [R7], **EN 55022, EN 55024, EN 60950-1, EN 41003**
- The RGW MUST be compliant with the requirements of **ETSI EN 300 019**
- The RGW SHALL be compliant with the Restriction of the use of Hazardous Substances in electrical and electronic equipment, the RoHS directive (RoHS 2002/95/EC).
- The temperature of the CPE casing MUST be compliant with EN 60950.
- The RGW MUST separate the streams corresponding to the various multi-play services into dedicated VLANs. At least 8 VLANs must be supported by the RGW. In Poland the following architecture is supported:

1. Internet + VoIP VLAN = 35

4.3 Launch IPv6 mode

REQ ID _ TITLE	ACT_0007 – Launch IPv6 mode					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						

When the detection of the Internet connectivity ends in IPv6 mode, the CPE **MUST** launch the following algorithm.

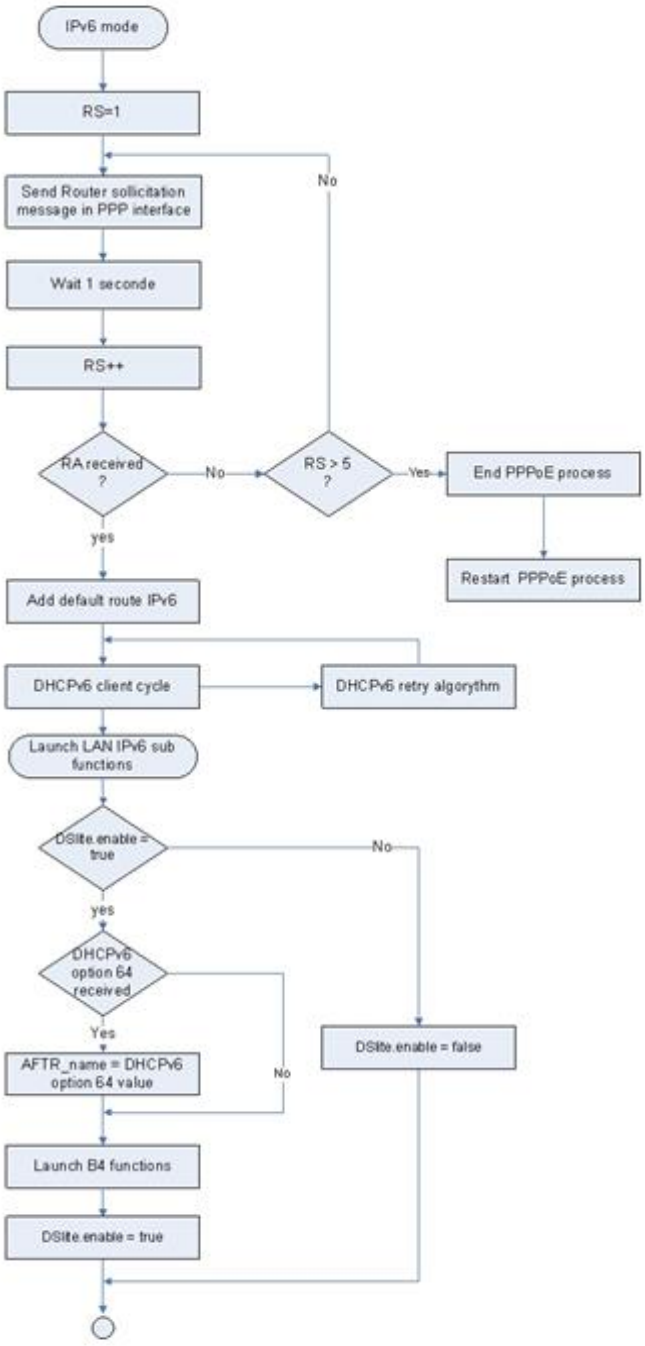

Figure 2. IPv6 mode algorithm

4.4 Launch LAN IPv6 sub-functions

REQ ID _ TITLE	ACT_0008 – Launch LAN IPv6 sub-functions					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						

The CPE **MUST** implement the following algorithm to launch the LAN IPv6 sub-functions.

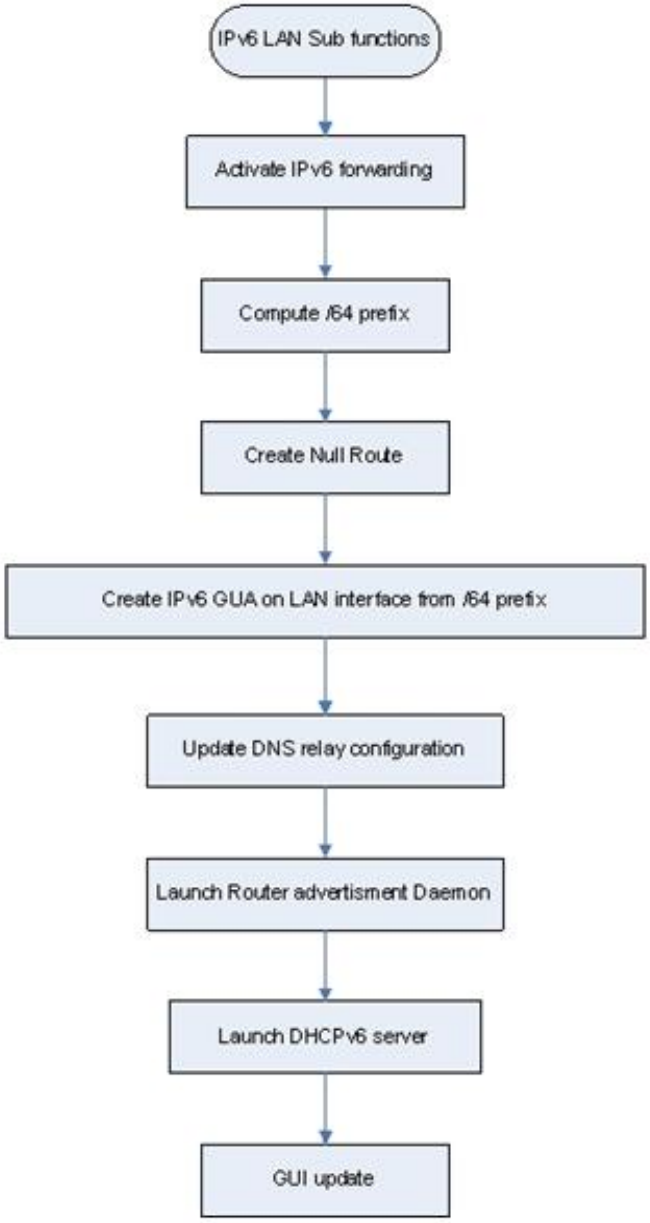

Figure 3. Launch LAN IPv6 sub-functions

5 WAN Requirements

5.1 PPP client

REQ ID _ TITLE	PPP_0001 – PPPoE					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support [RFC2516]: A Method for Transmitting PPP Over Ethernet (PPPoE).						

REQ ID _ TITLE	PPP_0002 – Point-to-Point Protocol (PPP)					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support [RFC1661]: The Point-to-Point Protocol (PPP).						

REQ ID _ TITLE	PPP_0003 – PPP LCP Extensions					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support [RFC1570]: PPP LCP Extensions.						

REQ ID _ TITLE	PPP_0004 – PPP Challenge Handshake Authentication Protocol (CHAP)					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support [RFC1994]: PPP Challenge Handshake Authentication Protocol (CHAP).						

REQ ID _ TITLE	PPP_0005 – PPP Password Authentication Protocol (PAP)					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support [RFC1334]: PPP Password Authentication Protocol (PAP).						

REQ ID _ TITLE	PPP_0006 – PPP Internet Protocol Control Protocol (IPCP)					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support [RFC1332]: The PPP Internet Protocol Control Protocol (IPCP).						

REQ ID _ TITLE	PPP_0007 – IPv6CP support					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** use IPv6CP to negotiate the interface identifier of the PPP interface, by using the option Interface-Identifier (type 1). The CPE **MUST** use this identifier to construct the IPv6 Link-local address of this interface.						

REQ ID _ TITLE	PPP_0008 – LLA of PPP interface					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support SLAAC ([RFC4862]) for address assignment on a PPP session.						

REQ ID _ TITLE	PPP_0009 – IPCP and IPv6CP over a single PPP connection					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** be able to negotiate simultaneously IPCP and IPv6CP over a single PPP connection.						

REQ ID _ TITLE	PPP_0010 – Act as a host					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** NOT act as a router for Neighbor Discovery protocols ([RFC4861]) on a PPP session. (see 5.2)						

REQ ID _ TITLE	PPP_0011– IPv6TCP MSS					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** adapt the TCP MSS of each IPv6 flows accordingly to the PPP MTU, to avoid packet fragmentation.						

5.2 IPv6 Host Behaviour

REQ ID _ TITLE	HOST_0001 – Host function					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** act as an IPv6 host (as defined in [RFC2460]) on the PPP interface.						

REQ ID _ TITLE	HOST_0002 – Sending Router Solicitation					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
When an interface becomes enabled, hosts may send Router Solicitation messages that request routers to generate Router Advertisements immediately rather than at their next scheduled time. The CPE **MUST** send Router Solicitation (RS) messages [RFC4861] when the WAN interface becomes up.						

REQ ID _ TITLE	HOST_0003 – Definition of MAX_RTR_SOLICITATION_DELAY					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
Before a host sends an initial solicitation, it SHOULD delay the transmission for a random amount of time between 0 and MAX_RTR_SOLICITATION_DELAY. [RFC4861] The value of MAX_RTR_SOLICITATION_DELAY **MUST** be set to 1 second.						

REQ ID _ TITLE	HOST_0004 – Definition of MAX_RTR_SOLICITATIONS					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
To obtain Router Advertisements quickly, a host SHOULD transmit up to MAX_RTR_SOLICITATIONS Router Solicitation messages. [RFC4861] The value of MAX_RTR_SOLICITATIONS **MUST** be set to 5.						

REQ ID _ TITLE	HOST_0005 – Definition of RTR_SOLICITATION_INTERVAL					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
To obtain Router Advertisements quickly, a host SHOULD transmit up to MAX_RTR_SOLICITATIONS Router Solicitation messages, each separated by at least RTR_SOLICITATION_INTERVAL seconds. [RFC4861] The value of RTR_SOLICITATIONS_INTERVAL **MUST** be set to 1 second.						

REQ ID _ TITLE	HOST_0006 – Default route – Router Advertisement					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
Routers advertise their presence together with various link and other parameters either periodically, or in response to a Router Solicitation message. Router Advertisements contain prefixes that are used for determining whether another address shares the same link (on-link determination) and/or address configuration, a suggested hop limit value, etc. The CPE **MUST** listen to the Router Advertisement (RA) messages [RFC4861] sent by the Next Router to install the default route.						

5.3 DHCPv6 Client

REQ ID – TITLE	DHCPV6C_0001 – DHCPv6 client					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
DHCPv6 client **MUST** be supported by the CPE. [RFC3315] [RFC3633] The DHCPv6 client **MUST** support running over a PPPoE session.						

5.3.1 DHCPv6 Client Process

5.3.1.1 DHCPv6 SOLICIT

REQ ID – TITLE	DHCPV6C_0002 – DHCPv6SOLICIT Message: algorithm					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
During DHCP Init, the CPE **MUST** send DHCPv6 SOLICIT Messages to all DHCP Relay Agents and Servers (FF02::1:2) until it receives one DHCPv6 ADVERTISE Message from the DHCPv6 Server (that is, the Delegating Router as per [RFC3633]). If the CPE does not receive response from a DHCPv6 Server it **MUST** implement the retransmission algorithm described in section 14 of [RFC 3315]. The CPE **MUST** use the following configuration parameters : • IRT (Initial retransmission time) : 4s • MRC (Maximum retransmission count) : 0 • MRT (Maximum retransmission time) : 128s • MRD (Maximum retransmission duration) : 0						

5.3.1.2 DHCPv6 RENEWING/REBINDING

REQ ID – TITLE	DHCPV6C_0003 – DHCP Renewing					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
At Renewing Time (T1) the CPE **MUST** send multicast DHCPv6 RENEW Message all DHCP Relay Agents and Servers (FF02::1:2). If the CPE receives no response it **MUST** implement the retransmission algorithm described in section 14 of [RFC 3315]. The CPE **MUST** use the following configuration parameters : • IRT (Initial retransmission time) : 480s • MRC (Maximum retransmission count) : 0 • MRT (Maximum retransmission time) : 3600s • MRD (Maximum retransmission duration) : Remaining time until T2						

REQ ID – TITLE	DHCPV6C_0004 – DHCPv6 Rebind

	PRIORITY	CATEGORY				
	P0-Essential	Functional				
DESCRIPTION						
At Rebinding Time (T2) the CPE **MUST** send a DHCPv6 REBIND Message. If the CPE receives no response it **MUST** implement the retransmission algorithm described in section 14 of [RFC 3315]. The CPE **MUST** use the following configuration parameters : • IRT (Initial retransmission time) : 300s • MRC (Maximum retransmission count) : 0 • MRT (Maximum retransmission time) : 3600s • MRD (Maximum retransmission duration) : Remaining time until valid lifetimes of the prefix assigned to the IA expire. At this time, the CPE **MUST** start a new DHPCv6 cycle						

Note : T1 and T2 are provided by the DHCPv6 Server in option 25.

5.3.1.3 DHCPv6 RELEASE

REQ ID _ TITLE	DHCPV6C_0005 – DHCPv6 Release support					
	PRIORITY	CATEGORY				
	P0-Essential	Functional				
DESCRIPTION						
The CPE DHCP Client **MUST** support DHCPv6 Release as described in [RFC3315].						

REQ ID _ TITLE	DHCPV6C_0006 – DHCPv6 Release on DHCP client down					
	PRIORITY	CATEGORY				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** send a DHCPv6 Release message when the CPE shuts down the DHCPv6 client.						

REQ ID _ TITLE	DHCPV6C_0007 – DHCPv6 Release on CPE reset or reboot					
	PRIORITY	CATEGORY				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** shutdown the DHCPv6 client before a software configuration reset, a voluntary reboot via GUI or a remote reboot.						

Note : the DHCPv6 release message must be sent before the termination process of PPP/PPPoE session.

5.3.1.4 DHCPv6 STATUS CODE MANAGEMENT

As defined in [RFC3315] and [RFC3633], a Status Code option may appear in the option field of a DHCP message and/or in the options field of another option. If the Status Code option does not appear in a message in which the option could appear, the status of the message is assumed to be Success.

IANA has recorded the status codes defined in the following table :

Name	Code	Description
Name	Code	Description
Success	0	Success.
UnspecFail	1	Failure, reason unspecified; this status code is sent by either a client or a server to indicate a failure not explicitly specified in this document.
NoAddrsAvail	2	Server has no addresses available to assign to the IA(s)
NoBinding	3	Client record (binding) unavailable.
NotOnLink	4	The prefix for the address is not appropriate for the link to which the client is attached.
UseMulticast	5	Sent by a server to a client to force the client to send messages to the server using the All_DHCP_Relay_Agents_and_Servers address.
NoPrefixAvail	6	Delegating router has no prefixes available to assign to the IAPD(s)

Figure 4. DHCPv6 status codes

REQ ID _ TITLE	DHCPV6C_0008 – DHCPv6 status code UnspecFail					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
If the CPE received a status code UnspecFail, the CPE **MUST** retransmit the original message to the same server to retry the desired operation. The retry algorithm applied is defined in DHCPV6C_0002.						

REQ ID _ TITLE	DHCPV6C_0009 – DHCPv6 status code NoBinding					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
If the CPE received a reply message with status code NoBinding in response to a Renew or Rebind message in the option field of a DHCP message or in the IAPD option field, the CPE **MUST** send a Request message.						

REQ ID _ TITLE	DHCPV6C_0010 – DHCPv6 status code NotOnLink					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
If the CPE received a status code NotOnLinkin the option field of a DHCP message or in the IAPD option field in response to a Request, Renew or Rebind message, the CPE **MUST** restart the DHCP server discovery.						

REQ ID _ TITLE	DHCPV6C_0011 – DHCPv6 status code UseMulticast					
	PRIORITY	**CATEGORY**				
	P0-	Functional				

	Essential					
DESCRIPTION						
If the CPE received a status code UseMulticast, the CPE **MUST** resend the original message using multicast. The CPE **MUST** retransmit the original message to retry the desired operation. The retry algorithm applied is defined in DHCPV6C_0002.						

REQ ID _ TITLE	DHCPV6C_0012 – DHCPv6 status code NoPrefixAvail					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
If the CPE received an advertise message with status code NoPrefixAvail in the option field of a DHCP message or in the IAPD option field, the CPE **MUST** ignore it. The CPE **MUST** retransmit the original message to retry the desired operation. The retry algorithm applied is defined in DHCPV6C_0002						

5.3.2 Parameters and Options

5.3.2.1 DHCP Unique Identifier type

REQ ID _ TITLE	DHCPV6C_0013 – DUID type					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE DHCPv6 client **MUST** support in the Client Identifier option the DUID Based on Link-layer Address DUID-LL [RFC3315] (option 1). The MAC address used to build the DUID-LL **MUST** be the MAC address of the CPE interface Printed on the CPE sticker.						

5.3.2.2 Option Request

REQ ID _ TITLE	DHCPV6C_0014 – Option Request Option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support Option Request Option [RFC3315] (ORO, option 6) to identify the list of options required.						

5.3.2.3 DNS IPv6 Address Option

REQ ID _ TITLE	DHCPV6C_0015 – DNS option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** request option "DNS Recursive Name Server option" [RFC3646] (Option 23) in the ORO.						

USER CLASS OPTION

REQ ID _ TITLE	DHCPV6C_0016 – User Class option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** send option "User Class" [RFC3315] (Option 15) The User Class Information (option15) value **MUST** be, according to format described in [RFC3315].						

5.3.2.4 VENDOR CLASS OPTION

REQ ID _ TITLE	DHCPV6C_0017 – Vendor Class option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** send option "Vendor Class" [RFC3315] (Option 16). The Vendor Class Information (option16) value **MUST** be : • enterprise-number : the hardware vendor's registered Enterprise Number as registered with IANA • vendor-class-data : RgwHardwareVendorName in lower-case,						

5.3.2.5 IA_PD OPTION

REQ ID _ TITLE	DHCPV6C_0018 – IA_PD option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The IA_PD option is used to carry a prefix delegation identity association, the parameters associated with the IA_PD and the prefixes associated with it. The CPE **MUST** support IA_PD option [RFC3633] (option 25).						

5.3.2.6 IA_PD PREFIX OPTION

REQ ID _ TITLE	DHCPV6C_0019 – IA_PD Prefix option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The IA_PD Prefix option is used to specify IPv6 address prefixes associated with an IA_PD. The CPE **MUST** support IA_PD Prefix option [RFC3633] (option 26) for DHCPv6 REQUEST, RENEW and REBIND messages. The CPE **MUST** not insert the IA_PD Prefix option in DHCPv6 solicit message.						

5.3.2.7 ELAPSED TIME OPTION

REQ ID _ TITLE	DHCPV6C_0020 – Elapsed Time Option					
	PRIORITY	**CATEGORY**				

	P0-Essential	Functional				
DESCRIPTION						
A client **MUST** include an Elapsed Time option in messages to indicate how long the client has been trying to complete a DHCP message exchange. The CPE **MUST** send Elapsed Time Option [RFC3315] (option 8).						

5.3.2.8 AFTR-NAME DHCPV6 OPTION

REQ ID _ TITLE	DHCPV6C_0021 – AFTR-Name DHCPv6 Option					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
A DHCPv6 option is used by a Dual-Stack Lite Basic Bridging BroadBand (B4) element to discover the IPv6 address of its corresponding Address Family Transition Router AFTR). The CPE **MUST** support AFTR-NameOption [RFC6334] (option 64).						

5.4 Basic Bridging BroadBand (B4) element

The CPE must implement a B4 element. The B4 element is a function implemented on a dual-stack-capable node that creates a tunnel to an AFTR.

REQ ID _ TITLE	B4_0001 – B4 activation					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
DSlite.enable is the default value for B4 function activation. For Poland, DSlite.enable **MUST** be set to true.						

REQ ID _ TITLE	B4_0002 – DSlite.EndpointName					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
DSlite.EndpointName is back-up value on firmware parameter for End point address of the DS-lite tunnel. For Poland, DSlite.EndpointName **MUST** be set to: “default.cgn.tpnet.pl”.						

REQ ID _ TITLE	B4_0003 – Tunnel type					
	PRIORITY	CATEGORY				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support a multipoint-to-point IPv4-in-IPv6 tunnel ending on a service provider AFTR as defined in [RFC 2473].						

REQ ID _ TITLE	B4_0004 – Source address of the tunnel					
	PRIORITY	**CATEGORY**				
	P0-	Functional				

	Essential					
DESCRIPTION						
The source address of the DS-lite tunnel **MUST** be the GUA of the CPE assigned to the LAN bridge interface.						

REQ ID _ TITLE	B4_0005 – End point address of the tunnel					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The end point address of the DS-lite tunnel **MUST** be the name resolution of the DHCPv6 AFTR-NameOption[RFC6334] (option 64). If option 64 is not received by the CPE, the end point address of the DS-lite tunnel **MUST** be the name resolution of the Dslite.EndpointName						

REQ ID _ TITLE	B4_0006 – Internet NAPT function deactivation					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
Since the DS-lite tunnel is up, the NAPT function of the CPE for Internet services **MUST** be deactivated.						

REQ ID _ TITLE	B4_0007 – IPv4 forwarding					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
Since the DS-lite tunnel is up, DS-lite tunnel interface **MUST** be the IPv4 default route.						

REQ ID _ TITLE	B4_0008 – DS-lite tunnel MTU					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The DS-lite tunnel MTU **MUST** be set dynamically to the PPP interface MTU minus the size of the tunnel headers (40 bytes).						

REQ ID _ TITLE	B4_0009 – DS-lite tunnel TCP MSS modification					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** modify the TCP MSS of each IPv4 flows accordingly to the tunnel MTU, to avoid packet fragmentation.						

5.5 PCP

REQ ID – TITLE	PCP_0001 – PCP support					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** support PCP (http://tools.ietf.org/html/draft-ietf-pcp-base-16) in case of port forwarding.						

REQ ID – TITLE	PCP_0002 – PCP server address					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The PCP server address of the DS-lite tunnel **MUST** be the name resolution of the DHCPv6 AFTR-NameOption [RFC6334] (option 64) or the name resolution of the Dslite.EndpointName if option 64 is not received by the CPE.						

5.6 Client DNS

REQ ID – TITLE	DNS_0001 – DNS Extensions to Support IP Version 6					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
DNS client **MUST** follow DNS Extension to Support IP Version 6 defined in [RFC3596].						

REQ ID – TITLE	DNS_0002 – DNS Queries type					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** send DNS query to retrieve AAAA record first. If no AAAA record exists, the CPE send DNS query to retrieve A record.						

REQ ID – TITLE	DNS_0003 – DNS Queries					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** first solicit the primary DNSv6 server and **MUST** solicit the secondary DNSv6 server only if the primary DNSv6 server doesn't reply.						

REQ ID – TITLE	DNS_0004 – DNS Queries scheduling					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				

DESCRIPTION
The way DNS is scheduling its different queries to the DNS **MUST** follow chapter 5.8.

5.7 DNS proxy

REQ ID _ TITLE	DNSP_0001 – DNS Proxy					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE DNS proxy **MUST** follow chapter 5.8						

5.8 DNS specifications

The CPE DNS relay acts as a DNS proxy for WAN IP address queries and as a DNS server for LAN IP address queries.

REQ ID _ TITLE	DNS_spec_0001 – Default DNS Servers					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The default DNS servers (primary and secondary) must be configured automatically with values received by PPP client or DHCP Client on "Internet" interface.						

REQ ID _ TITLE	DNS_spec_0002 – DNS request					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** forward DNS requests to primary Orange DNS server only if the hostname can't be resolved with local hostnames database or cache.						

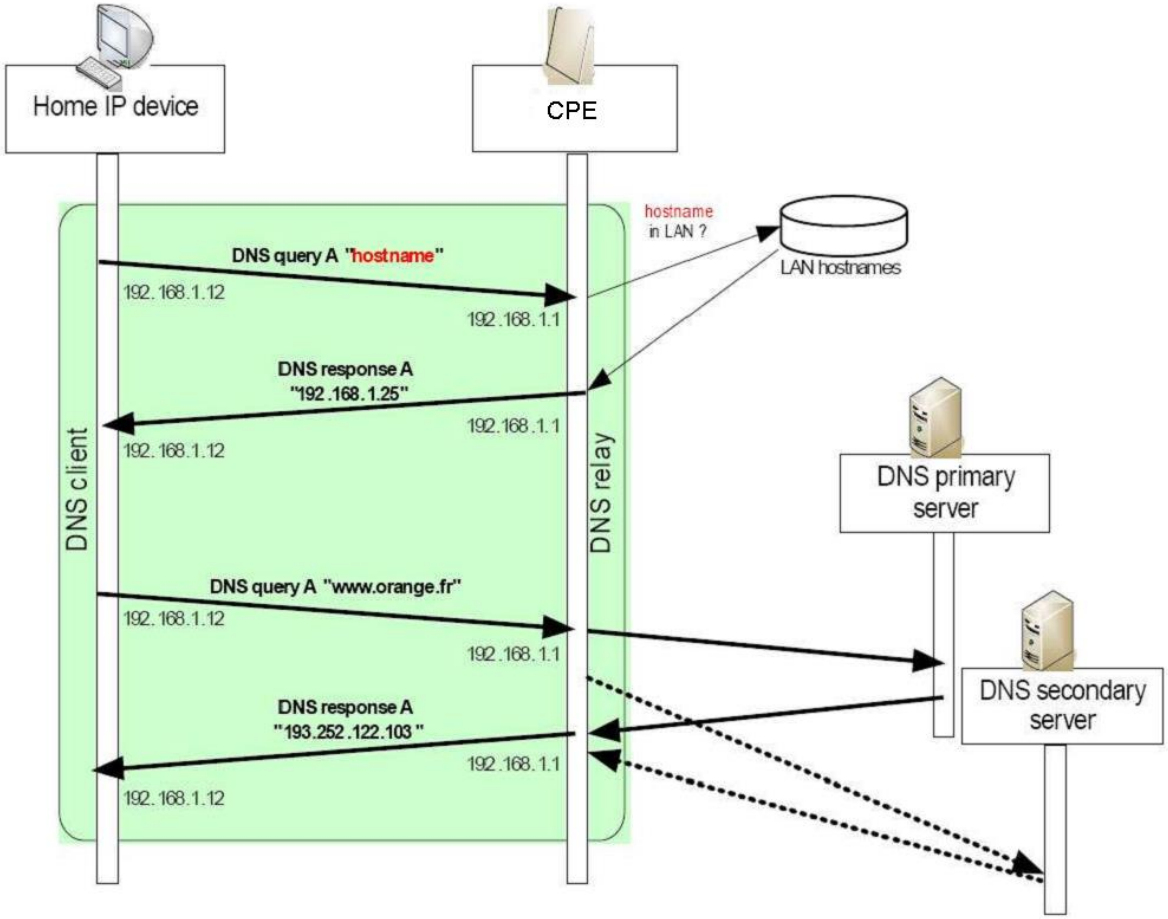

Figure 5. Example of DNS query

REQ ID – TITLE	DNS_spec_0003 – Caching of DNS replies					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
When receiving reply from Orange DNS server, the gateway shall cache the result for a period provided by the received TTL. During the TTL period, for entries already in the cache, the gateway will answer directly to endpoint DNS requester.						

REQ ID – TITLE	DNS_spec_0004 – Cache management					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The size of the cache **MUST** be limited to [MaxCacheEnties] entries. The cache shall not be stored in flash. It shall be empty after boot. The caching shall be remotely deactivated.						

REQ ID _ TITLE	DNS_spec_0005 – TTL of DNS replies					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
For each "non cached" reply, the CPE DNS relay **MUST** forward the received TTL value to the endpoint DNS requester without any modification.						

REQ ID _ TITLE	DNS_spec_0006 – Switch to DNS secondary					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE must forward DNS requests to the secondary Orange DNS server if the primary DNS does not reply before 0.8s. This value allows the second attempt of DNS request sent (after 1s) by the endpoint DNS requester to be forwarded by the gateway to the secondary DNS. After the switch to the secondary DNS, subsequent uncached request will be forwarded to secondary DNS for a period described in requirement DNS_spec_0008.						

REQ ID _ TITLE	DNS_spec_0007 – DNS retry					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** forward DNS requests to the primary Orange DNS server if the secondary DNS server does not reply before 0.8s						

REQ ID _ TITLE	DNS_spec_0008 – Back as soon as possible to DNS primary					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
If CPE is forwarding DNS Requests to the secondary Orange DNS Server, it shall forward DNS Requests to the Primary Orange DNS after a random timer from 300s to 600s for a new endpoint DNS request.						

REQ ID _ TITLE	DNS_spec_0009 – DNS cache parameters					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The DNS cache parameter MaxCacheEntries shall be configurable. The default value is 100.						

6 Address Assignment Requirements

As stated in RFC6204 the CPE router must support situation when there is or there is no (WAA-8) GUA assigned to WAN interfaces. They are WAN interface models called:

- Numbered model,
- Unnumbered model

Basically, the numbered model implies a GUA address to be acquired by the CPE router compared to the unnumbered model where a LLA address only is configured on the WAN interface of the CPE router.
CPE uses the unnumbered model ().

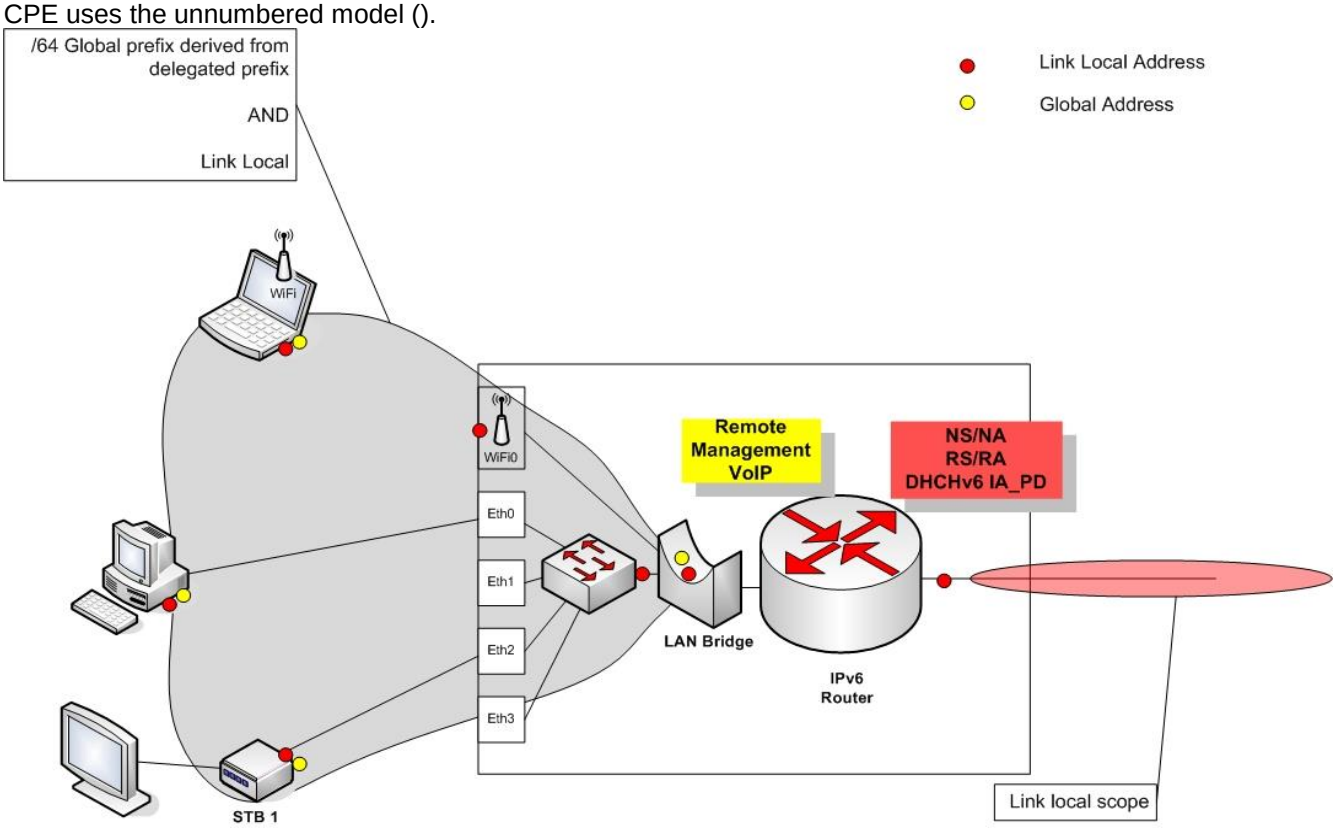

Figure 6. Unnumbered model

6.1 Link Local Addressing

REQ ID _ TITLE	LLA_0001 – WAN interface LLA					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The WAN (PVC or VLAN) Link Local Addressing (LLA) **MUST** be generated using the EUI-64 method [RFC4291]. The MAC address to be used is the one printed on the CPE sticker.						

REQ ID _ TITLE	LLA_0002 – LAN bridge interface LLA

	PRIORITY	CATEGORY				
	P0-Essential	Functional				
DESCRIPTION						
The LAN bridge interface LLA **MUST** be generated using the EUI-64 method [RFC4291] and **MUST** process Duplicate Address Detection according to [RFC4862] on the interface. The MAC address to be used is the one printed on the CPE sticker.						

REQ ID _ TITLE	LLA_0003 – PPPoE interface LLA					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** use IPV6CP to negotiate the interface identifier of the PPPoE interface, by using the option Interface-Identifier (type 1). The CPE **MUST** use this identifier to construct the IPv6 Link-local address of this interface.						

6.2 Prefix Operation

REQ ID _ TITLE	PREF_0001 – Prefix splitting					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** extract a /64 prefix from the /56 prefix obtained by DHCPv6 client. This prefix (/64) is called Global Unique Prefix (GUP). This prefix is obtained by concatenating the /56 obtained from the delegating router and 8 bits fixed to 00000000.						

6.3 Global Unique Addressing

REQ ID _ TITLE	GUA_0001 – LAN bridge interface GUA					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** assign a GUA for the LAN bridge interface, compliant with the EUI-64 format [RFC4291] and **MUST** process Duplicate Address Detection according to [RFC4862] on the interface. The MAC address to be used is the one printed on the CPE sticker.						

REQ ID _ TITLE	GUA_0002 – Route					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** have a directly connected route for the subnet defined by this /64 prefix via the LAN bridge interface.						

REQ ID _ TITLE	GUA_0003 – Null route					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
The CPE **MUST** configure a null route in order to avoid packets with addresses within the delegated prefix but currently not assigned to loop between the CPE and the first hop router. **Note:** The goal of that point is to avoid routing loop on WAN interface in case when there will be IPv6 packet with destination to delegated prefix but not to prefix assigned to CPE interface. It can be null route what is more convenient. The NULL route can be loopback interface or other interface which would drop traffic without analysing it. Example: CPE receive in DHCP Delegated Prefix 2001:DB80:0:100::/56. CPE will assign to the LAN interfaces Prefix 2001:DB8:0:0100::/64. Traffic with DA equal to: 2001:DB8:0:101::/64 2001:DB8:0:102::/64 2001:DB8:0:103::/64 … 2001:DB8:0:1ff::/64 has to be dropped. Solution could be insertion of following routing rule: connected 2001:DB8:0:0100::/64 to LAN static 2001:DB8:0:0100::/56 to NULL						

REQ ID _ TITLE	GUA_0004 – GUA deprecated					
	PRIORITY	**CATEGORY**				
	P0-Essential	Functional				
DESCRIPTION						
When both WAN link is down and DHCPv6 lease time has expired, GUA **MUST** be deprecated.						

7 ANNEX

7.1 Requirements List

4. Wymagane parametry techniczne filtrów abonenckich

Zakres stosowania wymagań

Wymagania odnoszą się do wszystkich splitterów abonenckich i mikrofiltrów przyłączanych do sieci OPL przez operatora podczas korzystania z usługi Bitstream.

Dokumenty przywołane

- Norma ETSI TS 101 952-1-1 wydanie 2004-12
- Norma ETSI TS 101 952-1-2 wydanie 2002-05
- Norma ETSI TS 101 952-1-5 wydanie 2006-10

Terminy, definicje

ADSL - Asymmetric Digital Subscriber Line

CPE - Customer Premises Equipment

DSL - Digital Subscriber Line

DSLAM - Digital Subscriber Line Access Multiplexer

POTS - Plain Old Telephone Service

OPL - Orange Polska

4.1 Splitter and microfilters

Opis parametrów

b) ETSI TS 101 952-1 V1.1.1 (2009-06):
- Reference impedances:
  - Z_r = 600 Ω
  - Z_{DSL}= 150 nF + (100 Ω // 470 µH) + 150 nF
  - Z_{RHF} = 120 Ω + (150 Ω // 47 nF) + (750 Ω // 150 nF)
  - Z_{RefDSL} = 100 Ω
- DC resistance to earth (p.6.2.1):
  - > 999 MΩ
- DC insulation resistance between A-wire and B-wire (p.6.2.2):
  - > 999 MΩ

- DC series resistance RDC (p.6.2.3):
    - < 50 Ω
- Low impedance On-Hook POTS pass band insertion loss (p.6.4.2.1):
    - > - 1 dB @ 1 kHz
- Low impedance On-Hook POTS pass band insertion loss distortion:
    - < 1 dB from 200 Hz to 2,8 kHz (p.6.4.2.2)
- Off-Hook POTS pass band insertion loss (p.6.5.1):
    - > - 1 dB @ 1 kHz
- Off-Hook POTS pass band insertion loss distortion (p.6.5.2):
    - < 1 dB from 200 Hz to 4 kHz
- POTS pass band return loss requirements- Off-Hook, LINE port (p.6.6.2):
    - > 14 dB @ 300 Hz **->** > 18 dB @ 500 Hz
    - > 18 dB from 500 Hz to 2 kHz
    - > 18 dB @ 2 kHz **->** > 14 dB @ 3,4 kHz
- POTS pass band return loss requirements- Off-Hook, POTS port (p.6.6.2):
    - > 14 dB @ 300 Hz **->** > 18 dB @ 500 Hz
    - > 18 dB from 500 Hz to 2 kHz
    - > 18 dB @ 2 kHz **->** > 14 dB @ 3,4 kHz
- Unbalance of the low pass part (p.6.8.1)
    - > 40 dB from 50 Hz to 600 Hz
    - > 46 dB from 600 Hz to 3,4 kHz
    - > 40 dB from 3,4 kHz to 4 kHz
    - > 40 dB from 4 kHz to 32 kHz
    - > 50 dB from 32 kHz to 1,1 MHz
    - > 30 dB from 2,2 MHz to 5 MHz
- xDSL signal loss: IL LINE port to xDSL port (p.6.9.4):
    - > -3 dB from 32 kHz to 50 kHz
    - > -1 dB from 50 kHz to 1,1 MHz
- Unbalance of the high pass part (p.6.8.2):
    - > 45 dB from 32 kHz to 1,1 MHz
    - > 30 dB from 2,2 MHz to 5 MHz
- xDSL band isolation between LINE and POTS port – ON-HOOK (p.6.9.1)
    - < -34 dB from 32 kHz to 350 kHz
    - < -51 dB from 350 kHz to 1,1 MHz
- xDSL band isolation between LINE and POTS port – OFF-HOOK (p.6.9.1)
    - < -45 dB from 32 kHz to 138 kHz
    - < -55 dB from 138 kHz to 1,1 MHz
- Group delay distortion (p.6.12):
    - < 250 µs from 300 Hz to 600 Hz
    - > 200 µs from 600 Hz to 3,2 kHz
    - > 250 µs from 3,2 kHz to 4 kHz

---

5 Lista Referencyjna modemów

Producent	Typ W ofercie OPL	Typ Nie w ofercie OPL	Referencja do rekomendacji ITU-T/ETSI
Alcatel		CellPipe 20-GX	G.992.1
Alcatel		CellPipe 50A	G.992.1
Aztech		Aztech 900E(B)	G.992.1
DGT		VDSL2 FG4	G.993.2
DGT		VDSL2 G 7466	G.993.2
Sagem		F@st 1201	G.992.1
Sagem		F@st 1400W	G.992.1
Sagem		F@st 1500	G.992.1
Sagem		F@st 1500WG	G.992.1
Sagem		F@st 800 USB	G.992.1

Siemens		SpeedStream 4100	G.992.5
Siemens		SpeedStream 4101	G.992.5
Siemens		SpeedStream 5100	G.992.1
Siemens		SpeedStream 5260	G.992.1
Siemens		SpeedStream 5660	G.992.1
Siemens		Xpresslink NT 1110	G.992.1
Thomson		SpeedTouch 330	G.992.1
Thomson		SpeedTouch 510	G.992.1
Thomson		SpeedTouch 516	G.992.1
Thomson		SpeedTouch 546	G.992.1
Thomson		SpeedTouch 608WL	G.992.5
Thomson		ST 605s	G.991.2
ZTE		COMBO ZTE ZXDSL 831AII	G.992.5
ZTE		ZxDSL852	G.992.1
Alcatel	CellPipe 7130RG		G.992.5
Cisco	HWIC-4SHDSL		G.991.2
Cisco	WIC-1 SHDSL V3		G.991.2
Comtrend	VI-3223u		G.992.5 / G.993.2
Comtrend	VR-3036u		G.992.5 / G.993.2
Comtrend	VI-3225u		G.992.5 / G.993.2
DGT		VDSL2 FG4 v2	G.993.2
Huawei	AR 18-33E		G.991.2
Huawei	MIM 1SHL-4W (Router: Quidway AR 28-09)		G.991.2
OneAccess	1424		G.991.2
OneAccess	LLB131		G.992.5
OneAccess	OA300D		G.991.2
RAD	LA210		G.991.2
Sagem		F@st2704	G.992.5
Sagem		F@st 3764	G.993.2
Sagem	Livebox 1.1		G.992.3
Sagem	FUNBOX2.0 FAST 5350 ORANGE		G.992.5 / G.993.2
Sagem	Orange FunBox 3.0	F@st 5656	**G.984.1**
Siemens	SpeedStream 4201		G.992.5
TP-LINK	TD-W8950N Wersja softu: TD-W8950Nv1_un_1_0_2_140910R51047_2014-09-10_14.52.13.		G.992.5
ZTE		Livebox 2.0	G.992.5
ZTE	Livebox 3.0		G.992.5 / G.993.2
ZTE		Wi-Fi ZTE ZXV10 W300	G.992.5
Zyxel	VMG8324-B10A		G.992.5 / G.993.2

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4 Listę oferowanych Opcji Usługi oraz wysokość miesięcznych opłat abonamentowych za Łącze Abonenckie dla poszczególnych Opcji

- załącznik nr 3

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5 Liczbę DSLAM-ów/OLT-ów przypisanych do poszczególnych PDU oraz technologię xDSL i xPON obsługiwaną przez (karty) te DSLAM/OLT (np. ADSL, ADSL2+, SDSL, VDSL itd.)

- załącznik nr 5 IP, - załącznik nr 5_ATM, załącznik nr 5_OLT

---

6 liczbę Łączy Abonenckich, w obszarach obsługiwanych przez poszczególne Punkty Dostępu do Usługi

- załącznik nr 6 IP, - załącznik nr 6 – ATM, załącznik nr 6 - FTTH

---

7 liczbę Łączy Abonenckich wyłączonych ze świadczenia Usługi w obszarach obsługiwanych przez poszczególne Punkty Dostępu do Usługi wraz ze wskazaniem przyczyn wyłączenia

-- załącznik nr 6 – IP, - załącznik nr 6 – ATM, załącznik nr 6 - FTTH

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8 parametry techniczne transmisji danych w Sieci ATM OPL

- Interface STM-1 lub STM-4
- styk UNI
- zakres VP: od 1 do 255
- na każdej VP włączony mechanizm zarządzania przeciążeniami: PacketWiseDiscard
- włączony AIS (Alarm Indication Signal) na każdej VP
- Interface STM-1 lub STM-4
- Styk NNI z protokołem AINI 1.0
- zakres VP: od 1 do 2047
- na każdej VP włączony mechanizm zarządzania przeciążeniami: PacketWiseDiscard
- włączony AIS (Alarm Indication Signal) na każdej VP
- Typy styków logicznych udostępnianych w PDU ATM:
  - UNI zgodny ze spec. ATM Forum 4.0
  - AINI ver. 1.0 zgodny ze spec. ATM Forum 4.0

parametry techniczne transmisji danych w Sieci IP/MPLS

- Interface 1GE (IEEE 802.3)
- styk UNI

parametry techniczne transmisji danych w Sieci Ethernet OPL

- Interface 1GE lub 10GE (IEEE 802.3)
- styk UNI
- VLAN tagging (IEEE 802.1q)
- EtherType = 0x8100
- MTU = 1526
- zakres VLAN: 1100 - 3999

---

9 parametry techniczne urządzeń OPL wykorzystywanych do realizacji przyłączenia sieci Operatora Korzystającego do sieci OPL

Dla portów STM1*:*

1pOC12 SM

Długość fali: 1261 nm - 1360 nm
Moc z jaką nadaje port: -15 - -8 dBm
Minimalna moc na wejściu: -28 dBm
Maksymalna moc na wejściu: -8 dBm
Zasięg dla tłumienia toru: 0-12 dB

Dla portów STM4:

4pOC12 SM

Długość fali: 1274 nm - 1356 nm
Moc z jaką nadaje port: -15 - -8 dBm
Minimalna moc na wejściu: -28 dBm
Maksymalna moc na wejściu: -8 dBm
Zasięg dla tłumienia toru: 0-12 dB

Dla portów STM16:

1pOC48

Długość fali: 1260 nm - 1360 nm
Moc z jaką nadaje port: 0 - -5 dBm
Minimalna moc na wejściu: -18 dBm
Maksymalna moc na wejściu: -0 dBm
Zasięg dla tłumienia toru: 0-12 dB

Dla portów 1GE (Ethernet)

Wkładka typu LX/LH, zasięg do 10km
Długość fali: 1310 nm
Moc nadawania (Tx): -3/-11,5 dBm
Moc na odbiorze (Rx): -3/-19 dBm
Zasięg dla tłumienia toru: 0 - 7,5 dB

Dla portów 10GE (Ethernet)

Wkładka LR, zasięg do 10km
Długość fali: 1550 nm
Moc nadawania (Tx): 0,5/-8,2 dBm
Moc na odbiorze (Rx): 0,5/-10,3 dBm
Zasięg dla tłumienia toru: 0 - 6,2 dB

Parametry techniczne urządzeń OPL wykorzystywanych do realizacji przyłączenia sieci Operatora Korzystającego do sieci IP/MPLS OPL

wkładka typu LX albo LX/LH, zasięg do 10km

światłowód jednomodowy
długość fali: 1310 nm
moc nadawania (Tx): -3/-9,5 dBm
moc na odbiorze (Rx): -3/-19 dBm