

TLN WRO Specification type Document

< IP interconnect interface specification for
connection of AO IP backbone network to TLN
network >



Document Housekeeping

Document Category and type

CAT	TYPE	DOC ID	Comment
Broadband	SPEC	TLN-WRO-TA-B-S-PAAD	Specification type documents (-SPEC) are documents specifying logical / physical interfaces / protocols, etc..., to which AO equipment/systems need to comply

Document Authorization

EDITION	DATE	APPRAISAL AUTHORITY	STATUS	ORIGINATOR
0.6	21.09.2012	Director TLN Wholesale	Draft	TLN WRO Engineering

Document Maturity State

EDITION	DATE	APPRAISAL AUTHORITY	STATUS	ORIGINATOR
0.6	21.09.2012	Director TLN Wholesale	Draft(DR)	TLN WRO Engineering
0.9	xx.xx.2012	Director TLN Wholesale	Final Submit(FS)	TLN WRO Engineering
1.0	xx.xx.2012	Director TLN Wholesale	Approval(AP)	TLN WRO Engineering

Document Effective Date

This document has come into effect as of xx/xx/2012 and remains valid until a valid subsequent Telenet Wholesale Reference offer, substituting this document is published.

Legal Disclaimer

"This document constitutes an integral part of the Telenet Reference Offer for Basic TV / IDTV / BB and should be fully complied with by the Beneficiary at all times. Non compliance, incomplete or deviating application of this document by the Beneficiary, or his authorized agent, results in the suspension and ultimately termination of the Contract between Telenet and the Beneficiary.

At any time this document is susceptible to change by Telenet, Regulator's decision or by decision of a relevant judicial authority. Changes to this document will, depending on the circumstances for change, be appropriately notified to the Beneficiary and published on the Telenet website.

Telenet has appealed the CRC decisions of the VRM, BIPT and CSA of 1 July 2011 concerning the market analysis of the broadcasting market in Belgium and it consequently reserves all its rights in relation to this document."

Table of Contents

1	Abstract	5
2	Glossary and Abbreviations	6
3	AO IP Interconnect Solution Functional Description	7
4	AO IP Interconnect Solution Functional Requirements	7
4.1	GENERAL ARCHITECTURE	7
4.2	REGIONAL INTERCONNECT ZONES	8
4.2.1	<i>Regional Interconnect Zones General Requirements</i>	8
4.2.2	<i>Regional Interconnect Zones Geographical View</i>	8
4.2.3	<i>Regional Interconnect Zones List of Head-Ends</i>	9
4.2.4	<i>Regional Interconnect Zones Traffic Routing Rules</i>	11
4.3	AO INTERCONNECT LINKS	12
4.3.1	<i>AO Interconnect Links General Requirements</i>	12
4.3.2	<i>AO Interconnect Links Physical Connections</i>	12
4.3.3	<i>AO Interconnect Links Traffic Routing</i>	12
4.3.4	<i>AO Interconnect Links Redundancy</i>	12
4.4	AO IP RANGE/ADDRESS SPACE	13
4.4.1	<i>AO IP Range/Address Space General Requirements</i>	13
4.4.2	<i>AO IP Pool Management</i>	13
4.5	GRE TUNNEL CONCENTRATOR (GTC)	14
4.5.1	<i>GTC General Requirements</i>	14
4.5.2	<i>GTC Functions and Protocols</i>	14
4.5.3	<i>GTC Accounting</i>	14
4.6	AO DATA AND MANAGEMENT LINKS	15
4.6.1	<i>AO Data Link</i>	15
4.6.2	<i>AO Management Link</i>	15
4.7	AO TRAFFIC MANAGEMENT	16
4.7.1	<i>AO Traffic Management General Description</i>	16
4.7.2	<i>AO Traffic Management General Architecture</i>	16
4.8	RESTRICTIONS	17
4.9	OPERATIONAL PROCEDURES	17

Table of Figures

Figure 4-1	7
Figure 4-2	8
Figure 4-3	9
Figure 4-4	9
Figure 4-5	10
Figure 4-6	10
Figure 4-7	11
Figure 4-8	16

List of Appendixes

This document may refer to further detailed documents that are added in Appendixes to this document.

A reference to an appendix is in this document highlighted with grey background.

None.

List of References

This document may refer to external documents or information sources.

A reference to an external document or information source is in this document highlighted with grey background.

The list of referred external documents or information sources in this document:

Reference 1 : TLN WRO CAT: Broadband: TLN-WRO-TA-B-C-PAAD

Reference 2 : TLN WRO CAT: Technical: TLN-WRO-TA-T-T-PAAF

Restricted information

This document may contain sections that are not public information and that can be made available only to parties that have executed specific NDA`s.

Information that is subject to NDA is marked in this document as follows:

NDA
NDA

The information in this text box is available only under NDA

Before conversion to PDF format for publication of the document, the information will be made unreadable by converting the background of the text box to black.

1 Abstract

This document provides the requirement specifications to which the physical and logical level backbone network interconnections must comply in order to provide an IP interconnect system between the AO and TLN IP networks carrying traffic in the data, control and OAM plane, supporting all services of the TLN WRO. It also specifies routing policies on AO AS numbers, geographical traffic routing aspects and redundancy and fail-over considerations.

This document has a corresponding certification document with reference: **TLN-WRO-TA-B-C-PAAD** which is used to test AO WO equipment compliance against this specification.

The feasibility of the technical designs and methods described in this document are subject to verification by a Proof of Concept (POC) test organized by Telenet and may be changed or updated depending on the outcome of this POC.

2 Glossary and Abbreviations

ACK: Acknowledge Packet
API: Application Programming Interface
AS: Autonomous System
BB: Broadband
BGP: Border Gateway Protocol
BSS: Billing Support Systems
BW: Bandwidth
CE: Conformité Européenne (European Conformity)
CM: Cable modem
CMTS: Cable Modem Termination System
CoC: Code of Conduct
CPE: Customer Premises Equipment
DB: Database
DHCP: Dynamic Host Configuration Protocol
DOCSIS: Data over Cable Service Interface Specification
DS: Downstream
EC: European Committee
EEA: European Economic Area
EN: European Standards
GRE: Generic Routing Encapsulation
GTC: GRE Tunnel Concentrator
HFC: Hybrid Fiber Coax
HW: Hardware
ID: Identifier
IEC: International Engineering Consortium
IP: Internet Protocol
IETF : Internet Engineering Task Force
L2GRE: Layer 2 GRE Tunnel
LAG: Link Aggregation Group
LACP: Link Aggregation Control Protocol
LED: Light Emitting Diode
MAC: Media Access Control
MIB: Management Information Base
MUX: Multiplex
NCP: Network Control Platform
NE: Network Element
NIU: Network Interface Unit
OAM: Operations and Maintenance
OSS: Operation Support Systems
PEP : Policy Enforcement Point
RIZ: Regional Interconnect Zones
RoHS: Restriction of Hazardous Substances Directive
RPOI: Regional point of interconnection
RFC: Request for Comment
SID: System Identifier
SNMP: Single Network Management Protocol
SO: Switching Offices
TFTP: Trivial File Transfer Protocol
US: Upstream
WEEE: Waste Electrical and Electronic Equipment Directive

3 AO IP Interconnect Solution Functional Description

- (1) This section describes the physical and logical backbone network interconnections on a functional level to which the solution must comply in order to provide an IP interconnect system between the AO and TLN IP networks carrying traffic in the data, control and OAM plane, supporting all services of the TLN WRO. It also specifies routing policies on AO AS numbers, geographical traffic routing aspects and redundancy and fail-over considerations.
- (2) Further it also discusses traffic management policies on the interconnect links as well as handling regional aspects of AO end-user IP address allocation techniques.

4 AO IP Interconnect Solution Functional Requirements

4.1 General Architecture

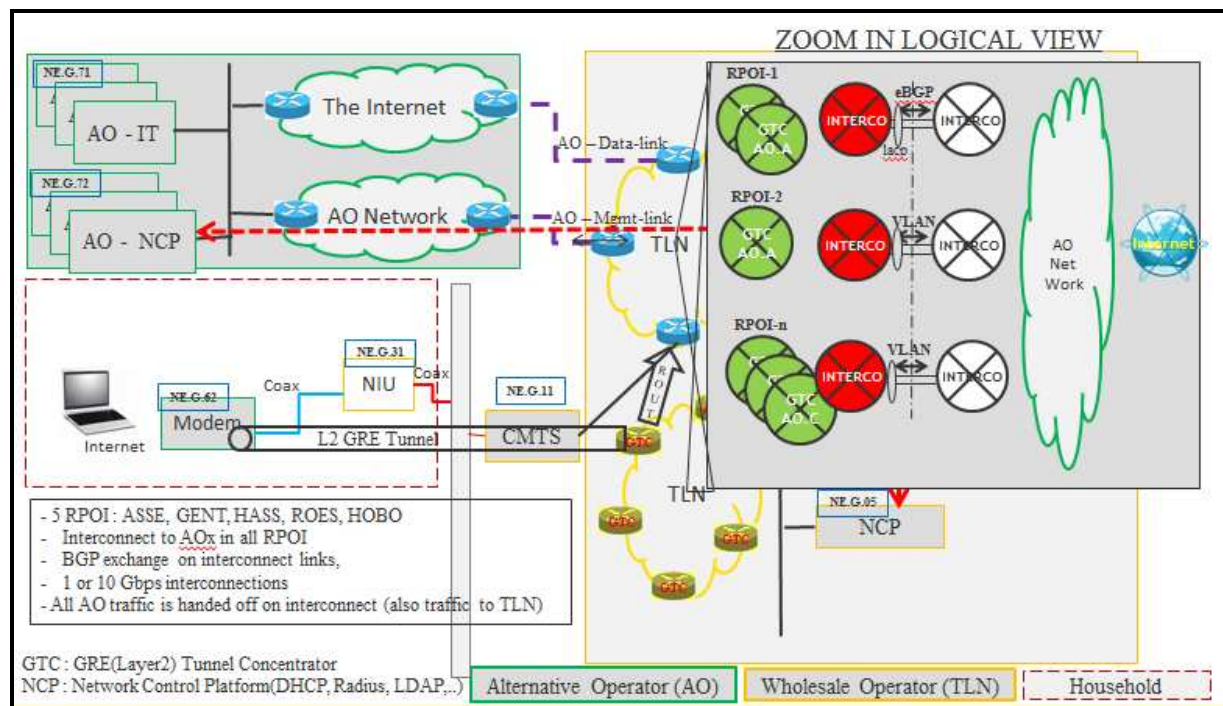


Figure 4-1

- (3) As shown in figure 4.1, AO CPE Traffic is carried through a L2GRE tunnel which is terminated on a GRE Tunnel Concentrator (GTC). The GTC then routes traffic towards the correct AO interconnect link. The eBGP routing protocol is used to exchange routing information on the physical interconnect link in minimum one of the 5 RPOIs'. All the traffic from 5 RPOIs will be like in the document [TLN-WRO-T-T-PAAF](#). Traffic originating from the AO domain, and with as destination an end-user of the AO, will be offered by the AO Interconnect router towards the Telenet Interconnect router in the correct RPOI based on this VLAN information. The correct RPOI corresponds to the geographical location of the end-user. The GTC will then "GRE encapsulate" the data and deliver it via the correct tunnel towards the AO end-user.

- (4) The “AO-Data link” is used to carry AO CPE’s US/DS data and control plane traffic. The “AO-Mgmt-link”, which will be realized as an IP-VPN or IPSec type connection is used to carry management type of traffic like CDR file transfers, configuration file uploads, etc. between AO and TLN.

4.2 Regional Interconnect Zones

- (5) There are 5 Regional Interconnect Zones (RIZ) which correspond to the location of the 5 TLN switching Offices (SO). Those RIZ are identified by a list of HE which together constitutes a RIZ. Each HE serves a number of communities that are identified by postal zip codes.

4.2.1 Regional Interconnect Zones General Requirements

- (6) Telenet operates in 5 Regional Interconnect Zones (RIZ) and can provide services to the end users in each zone. An AO must have interconnection in each of the five RPOI’s.

4.2.2 Regional Interconnect Zones Geographical View

- (7) An approximate Geographical coverage is view for the 5 TLN RIZ can be seen in below figure.

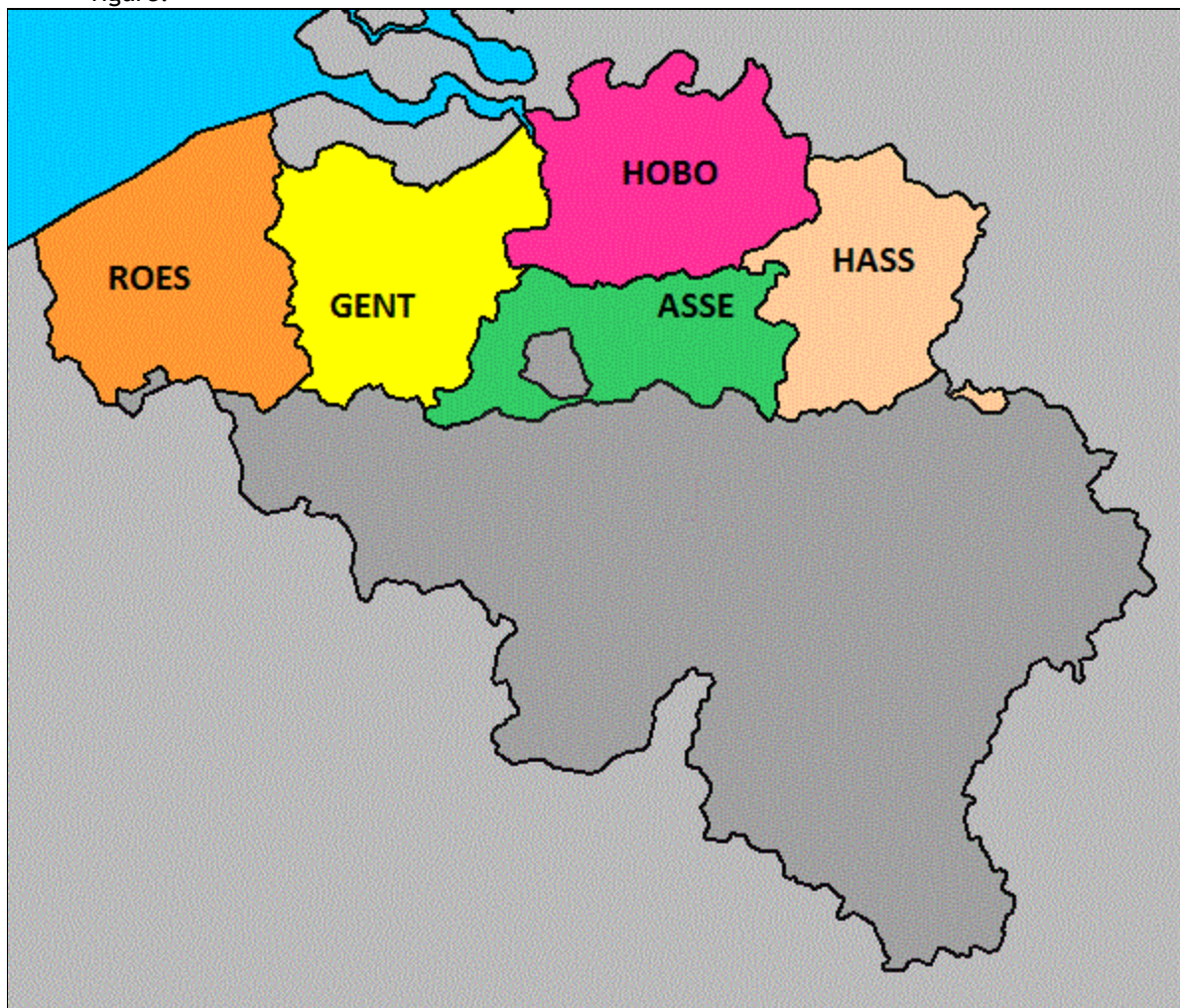


Figure 4-2

(8) Also the physical Locations for 5 the RPOI can be seen in below figure.



Figure 4-3

4.2.3 Regional Interconnect Zones List of Head-Ends

(9) The lists of Head-Ends for each of the five Regional Interconnect Zones (ASSE, GENT, HASS, HOB0 and ROES) are as shown below.

SO	Name	SiteType	SO	Name	SiteType	SO	Name	SiteType	SO	Name	SiteType
ASSE	Beersel	HE	GENT	St Niklaas	HE	HOB0	Beerse	HE	ROES	Ieper	HE
ASSE	Brussegem	HE	GENT	Zottegem	HE	HOB0	Geel	HE	ROES	Koekelare	HE
ASSE	Duisburg	HE	HASS	Aarschot	HE	HOB0	Herenthout	HE	ROES	Kortrijk	HE
ASSE	Herfelingen	HE	HASS	Beringen	HE	HOB0	Hoboken	HE	ROES	Melle	HE
ASSE	Lennik	HE	HASS	Bilzen	HE	HOB0	Hove	HE	ROES	Menen	HE
ASSE	Leuven	HE	HASS	Genk	HE	HOB0	Mechelen	HE	ROES	Middelkerke	HE
ASSE	Perk	HE	HASS	Hasselt	HE	HOB0	Schoten	HE	ROES	Oudenaarde	HE
ASSE	Schaarbeek	HE	HASS	Maaseik	HE	HOB0	Stabroek	HE	ROES	Roeselare	HE
GENT	Aalst	HE	HASS	Overpelt	HE	HOB0	Turnhout	HE	ROES	Roksem	HE
GENT	Dendermonde	HE	HASS	St Joris Winge	HE	HOB0	Zoersel	HE	ROES	St Elooi	HE
GENT	Gent	HE	HASS	St Truiden	HE	ROES	Brugge	HE	ROES	Veurne	HE
GENT	Lochristi	HE	HASS	Wommersom	HE	ROES	Eeklo	HE	ROES	Waregem	HE

Figure 4-4

(10) Postal zip codes of communities belonging to the service area for each Head-End are shown below.

HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC
Aalst	1730	Aarschot	3202	Beringen	2430	Bilzen	3740	Brussegem	1730	Duisburg	1560	Eeklo	9910	Geel	2470	Gent	9830
Aalst	1790	Aarschot	3270	Beringen	2431	Bilzen	3742	Brussegem	1731	Duisburg	1930	Eeklo	9920	Geel	2480	Gent	9831
Aalst	9280	Aarschot	3271	Beringen	3510	Bilzen	3746	Brussegem	1745	Duisburg	1932	Eeklo	9921	Geel	2490	Gent	9840
Aalst	9300	Aarschot	3272	Beringen	3530	Bilzen	3770	Brussegem	1785	Duisburg	1933	Eeklo	9930	Geel	2491	Hasselt	3500
Aalst	9308	Beerse	2340	Beringen	3540	Brugge	8000	Brussegem	1850	Duisburg	1950	Eeklo	9931	Geel	2800	Hasselt	3501
Aalst	9310	Beerse	2350	Beringen	3545	Brugge	8020	Brussegem	1851	Duisburg	1970	Eeklo	9932	Geel	3530	Hasselt	3510
Aalst	9320	Beersel	1500	Beringen	3550	Brugge	8200	Brussegem	1852	Duisburg	2800	Eeklo	9940	Genk	3600	Hasselt	3511
Aalst	9340	Beersel	1501	Beringen	3560	Brugge	8210	Brussegem	1853	Duisburg	3040	Eeklo	9950	Genk	3665	Hasselt	3512
Aalst	9400	Beersel	1502	Beringen	3580	Brugge	8211	Brussegem	1860	Duisburg	3060	Eeklo	9960	Genk	3668	Hasselt	3520
Aalst	9401	Beersel	1600	Beringen	3581	Brugge	8300	Brussegem	1861	Duisburg	3061	Eeklo	9961	Genk	3960	Hasselt	3530
Aalst	9402	Beersel	1601	Beringen	3582	Brugge	8301	Dendermonde	1745	Duisburg	3070	Eeklo	9968	Gent	9000	Hasselt	3550
Aalst	9403	Beersel	1602	Beringen	3583	Brugge	8310	Dendermonde	1785	Duisburg	3071	Eeklo	9970	Gent	9030	Hasselt	3570
Aalst	9404	Beersel	1620	Beringen	3945	Brugge	8340	Dendermonde	1840	Duisburg	3078	Eeklo	9971	Gent	9031	Hasselt	3590
Aalst	9406	Beersel	1630	Beringen	3970	Brugge	8370	Dendermonde	1861	Duisburg	3080	Eeklo	9980	Gent	9032	Hasselt	3600
Aalst	9420	Beersel	1640	Beringen	3971	Brugge	8377	Dendermonde	2830	Duisburg	3090	Eeklo	9981	Gent	9040	Hasselt	3720
Aalst	9450	Beersel	1650	Beringen	3980	Brugge	8380	Dendermonde	2870	Eeklo	8340	Eeklo	9982	Gent	9041	Hasselt	3721
Aalst	9451	Beersel	1651	Bilzen	3590	Brugge	8400	Dendermonde	2880	Eeklo	9000	Eeklo	9988	Gent	9042	Hasselt	3722
Aalst	9470	Beersel	1652	Bilzen	3620	Brugge	8420	Dendermonde	2890	Eeklo	9042	Eeklo	9990	Gent	9050	Hasselt	3723
Aalst	9472	Beersel	1653	Bilzen	3621	Brugge	8421	Dendermonde	9200	Eeklo	9060	Eeklo	9991	Gent	9051	Hasselt	3724
Aalst	9473	Beersel	1654	Bilzen	3690	Brugge	8450	Dendermonde	9220	Eeklo	9800	Eeklo	9992	Gent	9052	Hasselt	3730
Aarschot	2230	Beersel	1730	Bilzen	3700	Brugge	8730	Dendermonde	9250	Eeklo	9850	Geel	2260	Gent	9060	Hasselt	3740
Aarschot	2800	Beersel	1740	Bilzen	3717	Brugge	9990	Dendermonde	9255	Eeklo	9880	Geel	2400	Gent	9080		
Aarschot	3200	Beersel	1741	Bilzen	3730	Brussegem	1082	Dendermonde	9280	Eeklo	9881	Geel	2440	Gent	9090		
Aarschot	3201	Beersel	1742	Bilzen	3732	Brussegem	1702	Dendermonde	9310	Eeklo	9900	Geel	2450	Gent	9820		

Figure 4-5

HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC
Herenthout	2200	Herfelingen	1760	Hove	2500	Ieper	8908	Kortrijk	8511	Lennik	1770	Lochristi	9180	Mechelen	2570	Melle	9420
Herenthout	2220	Hoboken	2000	Hove	2520	Ieper	8920	Kortrijk	8520	Leuven	3000	Lochristi	9185	Mechelen	2580	Melle	9520
Herenthout	2221	Hoboken	2018	Hove	2530	Ieper	8950	Kortrijk	8540	Leuven	3001	Lochristi	9230	Mechelen	2650	Melle	9521
Herenthout	2222	Hoboken	2020	Hove	2531	Ieper	8951	Kortrijk	8550	Leuven	3010	Lochristi	9240	Mechelen	2800	Melle	9820
Herenthout	2223	Hoboken	2030	Hove	2540	Ieper	8952	Kortrijk	8551	Leuven	3012	Lochristi	9260	Mechelen	2801	Melle	9860
Herenthout	2230	Hoboken	2040	Hove	2547	Ieper	8953	Kortrijk	8552	Leuven	3018	Lochristi	9270	Mechelen	2811	Menen	8501
Herenthout	2235	Hoboken	2050	Hove	2550	Ieper	8954	Kortrijk	8553	Leuven	3020	Lochristi	9290	Mechelen	2812	Menen	8560
Herenthout	2250	Hoboken	2060	Hove	2560	Ieper	8956	Kortrijk	8554	Leuven	3078	Maaseik	3630	Mechelen	2820	Menen	8930
Herenthout	2260	Hoboken	2550	Hove	2570	Ieper	8957	Kortrijk	8572	Leuven	3110	Maaseik	3631	Mechelen	2830	Menen	8940
Herenthout	2270	Hoboken	2600	Hove	2600	Ieper	8958	Kortrijk	8580	Leuven	3111	Maaseik	3640	Mechelen	2860	Middelkerke	8430
Herenthout	2275	Hoboken	2620	Hove	2610	Ieper	8970	Kortrijk	8581	Leuven	3118	Maaseik	3650	Mechelen	2861	Middelkerke	8431
Herenthout	2460	Hoboken	2627	Hove	2630	Ieper	8972	Kortrijk	8582	Leuven	3150	Maaseik	3660	Mechelen	3020	Middelkerke	8432
Herenthout	2580	Hoboken	2640	Hove	2640	Ieper	8978	Kortrijk	8583	Leuven	3300	Maaseik	3670	Mechelen	3120	Middelkerke	8433
Herenthout	2590	Hoboken	2660	Hove	2650	Ieper	8980	Kortrijk	8587	Leuven	3320	Maaseik	3680	Mechelen	3140	Middelkerke	8434
Herenthout	3120	Hoboken	2830	Hove	2840	Koekelare	8470	Lennik	1602	Leuven	3321	Maaseik	3960	Mechelen	3150	Middelkerke	8600
Herenthout	3140	Hoboken	2840	Hove	2850	Koekelare	8600	Lennik	1700	Leuven	3360	Mechelen	1840	Mechelen	3190	Middelkerke	8620
Herfelingen	1540	Hoboken	2845	Hove	9100	Koekelare	8610	Lennik	1701	Leuven	3370	Mechelen	1850	Mechelen	3191	Oudenaarde	9600
Herfelingen	1541	Hoboken	2850	Ieper	8640	Koekelare	8680	Lennik	1702	Lochristi	9040	Mechelen	1880	Melle	9032	Oudenaarde	9630
Herfelingen	1570	Hove	2018	Ieper	8647	Koekelare	8810	Lennik	1703	Lochristi	9041	Mechelen	1910	Melle	9050	Oudenaarde	9636
Herfelingen	1670	Hove	2150	Ieper	8650	Koekelare	8820	Lennik	1730	Lochristi	9042	Mechelen	1980	Melle	9070	Oudenaarde	9660
Herfelingen	1671	Hove	2160	Ieper	8900	Koekelare	8830	Lennik	1740	Lochristi	9060	Mechelen	1981	Melle	9090	Oudenaarde	9667
Herfelingen	1673	Hove	2170	Ieper	8902	Kortrijk	8500	Lennik	1750	Lochristi	9070	Mechelen	1982	Melle	9230	Oudenaarde	9680
Herfelingen	1674	Hove	2280	Ieper	8904	Kortrijk	8501	Lennik	1760	Lochristi	9080	Mechelen	2223	Melle	9260	Oudenaarde	9681
Herfelingen	1755	Hove	2288	Ieper	8906	Kortrijk	8510	Lennik	1761	Lochristi	9160	Mechelen	2500	Melle	9340	Oudenaarde	9688

Figure 4-6

HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC	HE	AP_PC
Oudenaarde	9690	Perk	1831	Schoten	2060	Sint-Joris-Winge	3128	Sint-Niklaas	9170	Turnhout	2321	Waregem	8700	Wommersom	3450	Zottegem	9506
Oudenaarde	9700	Perk	1850	Schoten	2100	Sint-Joris-Winge	3130	Sint-Niklaas	9190	Turnhout	2322	Waregem	8710	Wommersom	3454	Zottegem	9550
Oudenaarde	9750	Perk	1910	Schoten	2110	Sint-Joris-Winge	3200	Sint-Niklaas	9250	Turnhout	2323	Waregem	8720	Wommersom	3460	Zottegem	9551
Oudenaarde	9770	Roeselare	8480	Schoten	2140	Sint-Joris-Winge	3210	Sint-Truiden	3540	Turnhout	2328	Waregem	8740	Wommersom	3470	Zottegem	9552
Oudenaarde	9771	Roeselare	8740	Schoten	2520	Sint-Joris-Winge	3211	Sint-Truiden	3700	Turnhout	2330	Waregem	8755	Wommersom	3471	Zottegem	9570
Oudenaarde	9772	Roeselare	8750	Schoten	2600	Sint-Joris-Winge	3212	Sint-Truiden	3720	Turnhout	2360	Waregem	8760	Wommersom	3472	Zottegem	9571
Oudenaarde	9790	Roeselare	8755	Schoten	2900	Sint-Joris-Winge	3220	Sint-Truiden	3800	Turnhout	2370	Waregem	8770	Wommersom	3473	Zottegem	9572
Oudenaarde	9800	Roeselare	8800	Schoten	2910	Sint-Joris-Winge	3221	Sint-Truiden	3803	Turnhout	2380	Waregem	8780	Zoersel	2240	Zottegem	9620
Oudenaarde	9810	Roeselare	8810	Schoten	2930	Sint-Joris-Winge	3290	Sint-Truiden	3806	Turnhout	2381	Waregem	8790	Zoersel	2242	Zottegem	9660
Oudenaarde	9870	Roeselare	8840	Schoten	2950	Sint-Joris-Winge	3293	Sint-Truiden	3830	Turnhout	2382	Waregem	8791	Zoersel	2243	Zottegem	9661
Oudenaarde	9890	Roeselare	8850	Schoten	2960	Sint-Joris-Winge	3294	Sint-Truiden	3832	Turnhout	2387	Waregem	8792	Zoersel	2280		
Overpelt	3900	Roeselare	8851	Schoten	2970	Sint-Joris-Winge	3390	Sint-Truiden	3840	Turnhout	2470	Waregem	8793	Zoersel	2288		
Overpelt	3910	Roeselare	8870	Schoten	9111	Sint-Joris-Winge	3391	Sint-Truiden	3850	Turnhout	2990	Waregem	8850	Zoersel	2290		
Overpelt	3920	Roeselare	8890	Sint-Eloois-Winkel	8500	Sint-Joris-Winge	3460	Sint-Truiden	3870	Veurne	8630	Waregem	9790	Zoersel	2310		
Overpelt	3930	Roksem	8400	Sint-Eloois-Winkel	8530	Sint-Joris-Winge	3461	Sint-Truiden	3890	Veurne	8647	Waregem	9800	Zoersel	2390		
Overpelt	3940	Roksem	8420	Sint-Eloois-Winkel	8531	Sint-Joris-Winge	3560	Sint-Truiden	3891	Veurne	8660	Waregem	9870	Zoersel	2520		
Overpelt	3950	Roksem	8460	Sint-Eloois-Winkel	8560	Sint-Niklaas	2070	Stabroek	2180	Veurne	8670	Wommersom	3350	Zoersel	2531		
Overpelt	3990	Roksem	8470	Sint-Eloois-Winkel	8860	Sint-Niklaas	9100	Stabroek	2920	Veurne	8690	Wommersom	3380	Zoersel	2550		
Perk	1702	Roksem	8490	Sint-Eloois-Winkel	8880	Sint-Niklaas	9111	Stabroek	2940	Veurne	8691	Wommersom	3381	Zoersel	2960		
Perk	1785	Roksem	8680	Sint-Joris-Winge	3050	Sint-Niklaas	9112	Stabroek	2950	Waregem	8540	Wommersom	3384	Zoersel	2970		
Perk	1800	Schoten	2000	Sint-Joris-Winge	3051	Sint-Niklaas	9120	Stabroek	2990	Waregem	8570	Wommersom	3400	Zoersel	2980		
Perk	1818	Schoten	2018	Sint-Joris-Winge	3052	Sint-Niklaas	9130	Turnhout	2300	Waregem	8572	Wommersom	3401	Zoersel	2990		
Perk	1820	Schoten	2030	Sint-Joris-Winge	3053	Sint-Niklaas	9140	Turnhout	2310	Waregem	8573	Wommersom	3404	Zottegem	9404		
Perk	1830	Schoten	2040	Sint-Joris-Winge	3054	Sint-Niklaas	9150	Turnhout	2320	Waregem	8581	Wommersom	3440	Zottegem	9500		

Figure 4-7

4.2.4 Regional Interconnect Zones Traffic Routing Rules

- (11) The AO end-user modem (or STB) will only work in a region where the AO has already an implemented and tested connection in the RPOI of that region. An AO must implement interconnection in each of the five RIZ's. AO modems (or STB's) will be unable to get service, if they are moved in another region then where they were initially installed. In case of a permanent move for AO end-user Modem (or STB), the CM (or STB) needs to be re-registered in the TLN NCP for the new specific region. In no case a modem (or STB) will get services in a region where the AO is not interconnected.

4.3 AO Interconnect Links

4.3.1 AO Interconnect Links General Requirements

- (12) Telenet delivers all aggregated BB traffic of AO end-users towards AO via TLN to AO interconnect link, distributed over 5 RPOI's based on geographic origin of traffic.

4.3.2 AO Interconnect Links Physical Connections

- (13) AO to TLN interconnectivity is established in minimum 1 of the 5 regional POI's (AO-RPOI) which are physically based in the Telenet switching office locations (Asse, Hoboken, Gent, Roeselare, Hasselt). Telenet offers 1Gbps, multiple 1Gbps or 10 Gbps link connections. If the link between AO and TLN is multiple 1 Gbps Link, LAG support is required with LACP.
- (14) This link will have BB traffic which is aggregated for all RPOI traffics carried by VLANs. There will be a restriction for the aggregated bandwidth of logical RPOI links which is 1 Gbps. If these links exceed 1 Gbps, more physical RPOI connections will be added.
- (15) The AO must order "standard lines" from the TLN carrier division portfolio in order to realize the required physical link for the interconnect link to pick-up its traffic in minimum one of the 5 RPOI. These lines will be optical leased lines of the (x) WDM type with above specified bandwidth options.

4.3.3 AO Interconnect Links Traffic Routing

- (16) AO BB Traffic will be routed towards the AO backbone through TLN to AO interconnect link. The eBGP routing protocol will be used on the interconnect link to exchange routes between TLN and AO.
- (17) Even if the destination of traffic is in the TLN network, the traffic will always be routed to the AO network primarily and it will be, the responsibility of the AO network to route it back to destination which is in TLN network in this case.

4.3.4 AO Interconnect Links Redundancy

- (18) Telenet offers link redundancy, based on redundant interface cards for AO interconnections to ensure that networks continue to function in the presence of single points of link failure.

4.4 AO IP Range/Address Space

4.4.1 AO IP Range/Address Space General Requirements

- (19) Telenet does not offer IP address ranges for AO end-users. The AO has to provide sufficient IP address ranges for each of 5 RPOIs and has to own an AS by itself. TLN needs to be informed about IP address ranges for each specific region.

4.4.2 AO IP Pool Management

- (20) TLN participates in IP pool management and IP address assignment services for AO end-users. The effective dynamic IP address assignment to individual AO end-users customers is the responsibility of the AO NCP. The AO uses its own IP address range for each of 5 RPOIs and Telenet configures IP-ranges (containing sufficient IP addresses and communicated upfront by the AO to Telenet and subject to appropriate change management as described in the relevant procedures in the TLN WRO) in the appropriate NE on a per RPOI basis. The AO needs to assign “dynamic” IP addresses to its individual end-users that are selected via a dynamic algorithm (e.g. round robin) from the AO IP ranges configured for a particular RPOI. The address “lease-time” needs to be of limited duration (maximum 24H). In addition the “lease-time” should not be lower than 30 minutes to avoid excessive network overhead. The AO dynamic IP address selection algorithm should be in at least 95% of the cases, select a different address for two consecutive leases of the same modem.

4.5 GRE Tunnel Concentrator (GTC)

4.5.1 GTC General Requirements

- (21) The GRE Tunnel Concentrator (GTC) terminates AO end-user traffic which is tunneled via GRE encapsulation through the TLN access network. GRE defines a protocol encapsulation of an arbitrary protocol over another arbitrary network layer.
- (22) The tunnel end points for AO's are enforced by TLN (NCP) implemented via the modem configuration file.

4.5.2 GTC Functions and Protocols

- (23) The GRE Tunnel Concentrator functions as a bidirectional tunnel endpoint. It can receive IP data packets, encapsulate them, route them into the correct tunnel, and send them to the other end of the tunnel where they are de-capsulated and sent to their final destination; or it can receive encapsulated packets, de-capsulate them, and send them to the AO network.
- (24) The GRE protocol is specified in IETF RFC-2784.

4.5.3 GTC Accounting

- (25) Telenet provides CDR type info about traffic usage of AO end-users for billing purpose. Implementing specific volume limits for individual end-users is the responsibility of AO.

4.6 AO Data and Management Links

4.6.1 AO Data Link

(26) The “AO Data Link” Interface between AO and TLN is used to carry all the traffic originated from / destined to AO end-users.

4.6.2 AO Management Link

(27) This interface is used for management purposes applications between AO and TLN. Since the link carries sensitive traffic, it is secured by using IP-VPN or IPsec type connections.

4.7 AO Traffic Management

4.7.1 AO Traffic Management General Description

(28) In order to guarantee a fair use of the available bandwidth in the network among all end-users Telenet performs traffic management to ensure that also in peak load situations end-users will have a good broadband service experience.

4.7.2 AO Traffic Management General Architecture

UNDER NDA

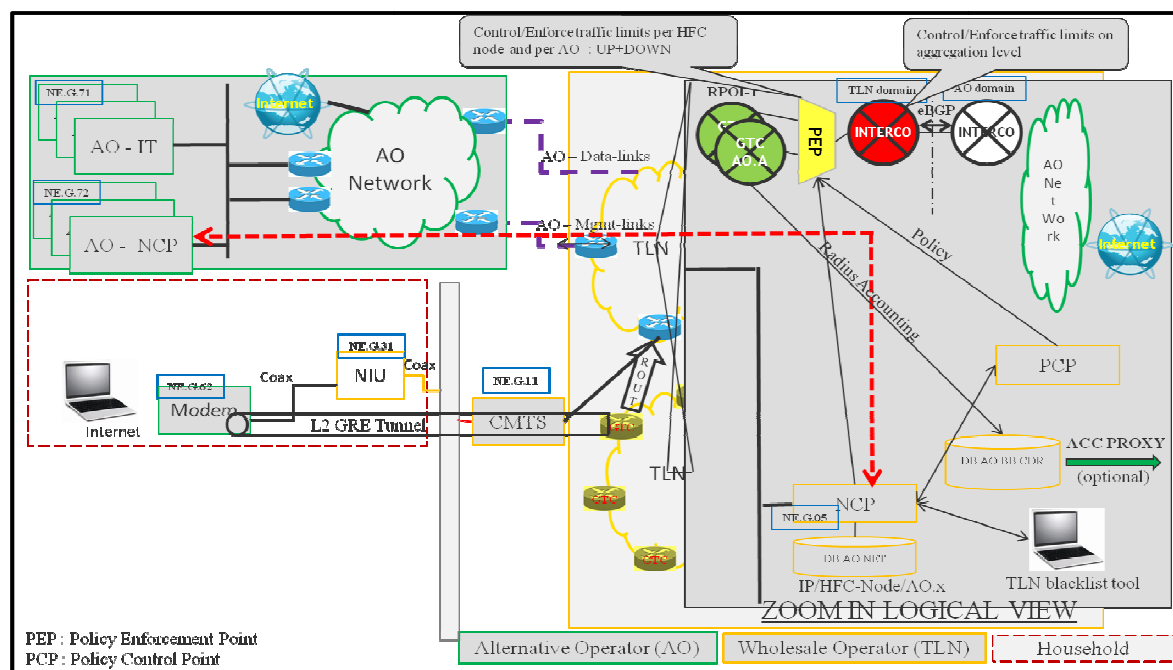


Figure 4-8

(29) Telenet will apply bandwidth management to both AO and TLN end-users equally. Bandwidth limitations are applicable on two levels: HFC node level and aggregation level.

(30)HFC node level restrictions are implemented on the PEP. PEP is the logical entity or place in the TLN network that enforces policies for admission and bandwidth control. Practically it is implemented in different network elements. This type of traffic management is performed to avoid congestion and depends on the specific broadband product tier.

(31) Besides HFC node level traffic management, also aggregation level restrictions are applicable. For traffic related to AO end-users this aggregation level based traffic management will be performed on the interconnection links between the AO and TLN Networks.

4.8 Restrictions

(32) The broadband interconnection service explicitly excluded below listed services that belong to the AO domain as the ROBB service offered by Telenet is restricted to the delivery / pick-up of the traffic from/ to the interconnect links at the RPOI :

- Value added services like (but not limited to) : E-mail, Web space hosting, Virus scan, Personal firewalling, TLN Hot-spot access, TLN Home-spot access, Network based backup
- My Telenet type subscription management functionality
- Telemeter service
- Re-direction towards landing page, offering volume block up-sell or choice for continue in narrowband services
- AO end-user e-mail notification services on network events (e.g. high usage, ...)

4.9 Operational Procedures

(33) Telenet will execute from time to time operational changes on the IP interconnect infrastructure. An AO making use of the TLN WRO part should be prepared at all time to adapt its infrastructure, devices and systems, as well as its operational procedures to handle those changes. In addition it is strongly recommended by TLN that AO will take this into account in the design of its solution, so that impact of future changes will be limited. Below a non exhaustive list is given, showing some examples of operational changes that TLN has executed in the past and which will be repeated likely in the future :

- Creation of new RIZ, or re-organisation of existing ones
- Updates and changes to the routing protocols and routing policies
- Updates and changes to the traffic management
- Updated and changes to the IP address allocation and sub-netting requirements