Televes®

Ref. 769503

EN **GPON ONT STANDARD**

User´s Manual

Televes

Index

1.Summary

The ONT is an Optical Terminal Equipment unit for Passive Optical Networks (PON) termination in a (Fiber-To-The-Home) FTTH / (Fiber-To-The-Cell) FTTC service delivery architecture. ONT communicates with the OLT (Optical Line Terminal) for the PON side and with the customer's premises for the client side. This equipment supports triple-play services - high speed internet (HSI), voice (VoIP) and video (IPTV and/or RF Overlay) as like as implementing the mobile backhaul service in the access component in the FTTC architecture. The use of the GPON fiber access technology standard architecture does allow a significant service delivery increase when compared with traditional xDSL technology.

The ONT equipment technology is based on GEM (GPON Encapsulation Method), and complies with ITU-T G.984.x. recommendation as like as G.984.4 (OMCI) ensuring interoperability with major GPON OLT vendors.

These base functionalities, together with the support for bit rates of up to 2.5 Gbps (downstream) and 1.24 Gbps (upstream), a splitting ratio of up to 1:64 in a single fiber and a distance range of up to 60 km, make the GPON technology and the ONT the most efficient option for passive optical network topologies.

Together with multi-vendor OLT interoperabily (BBF.247 certified), other differenciated features of the ONT product family are the embeeded RF Video Overlay as well as the chance to have several TV channel packs by means of using remote managed analog RF video overlay filters. The use of an embeeded optical reflective component also increases probing resolution in case of FTTH probing.

As opposed to the point-to-point architecture, in which there is one physical port per client in the Central Office, in this GPON point-to-multipoint architecture there is one single laser and photo-detector in the Central Office (CO) to serve up to 64 CPEs. All the Optical Distribution Network is built by means of passive equipment modules with a long MTBF value and very low OPEX costs. This leads to a significant cost reduction in this kinf of networks rollout.

2.Technical Description

2.1 ONT Main Functionalities

The ONT is aimed for customer premises and complies with the ITU-T G.984.x recommendation in order to transport (over GPON) and deliver (to premises domain) the full pack of broadband services.

Broadband service applications are commonly referred as below:

- High speed internet (HSI);
- Voice (VoIP) services (SIP/MEGACO H.248);
- TV (whether IPTV or analog RF video overlay);
- Mobile Backhaul.

The multiplay environment is thus reinforced when combining the upper reffered services.

2.1.1 Application Scenario

The Figure 2-1 shows possible bridging scenarios for ONT equipment when in an end-to-end PON architecture.

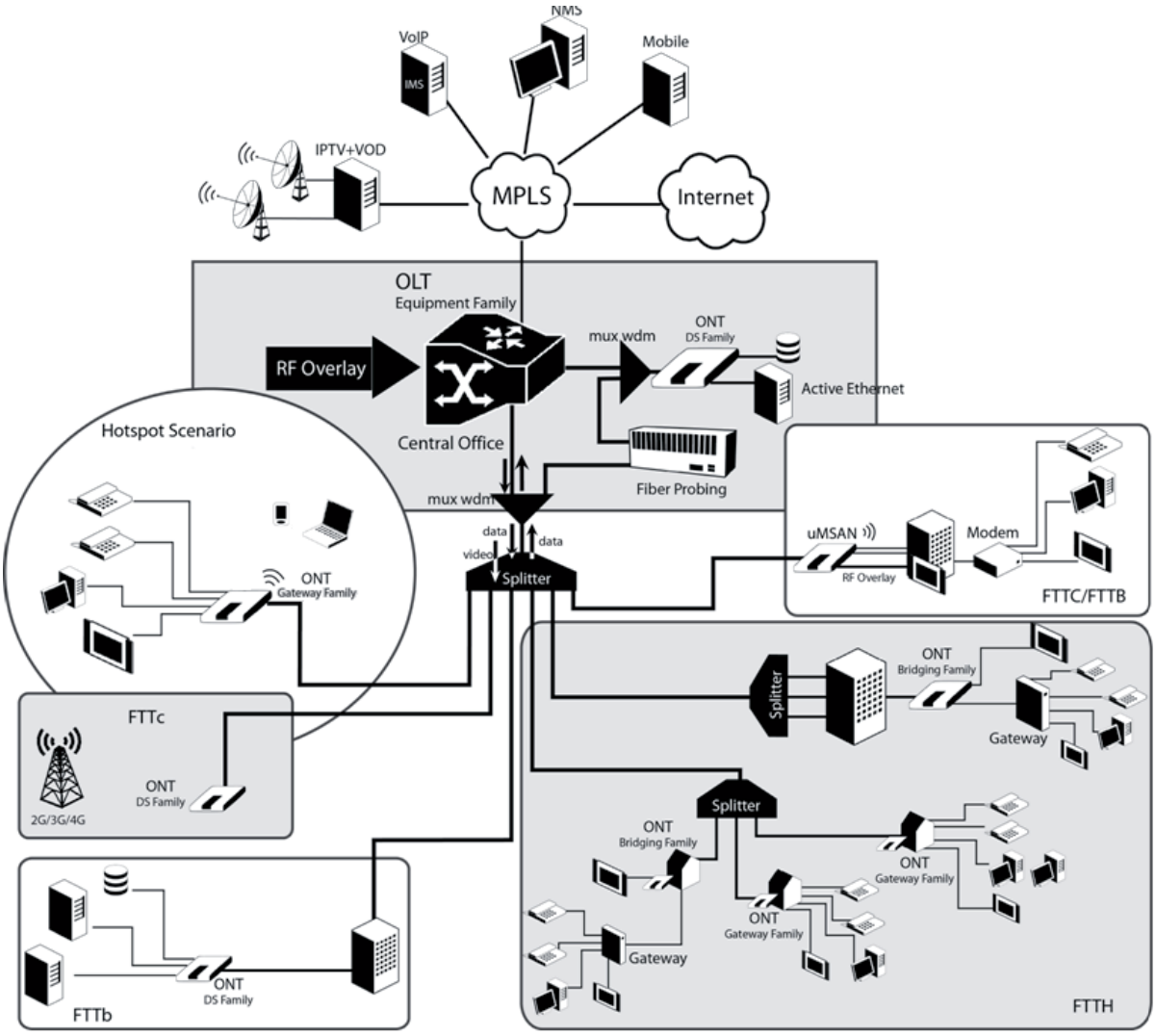

Figure 2-1: ONT applications scenario

2.1.2 Interoperability

The ONT bridging family equipment complies with ITU-T G.984.x. recommendation as like as G.984.4 (OMCI) ensuring multi-vendor OLT interoperabily with major GPON OLT vendors.

The ONT bridging family equipment is certified by BBF.247 ONU certification program.

BBF.247 ONU certification program certifies ONT link layer configuration and management protocol, OMCI, Figure 2-2, as defined by ITU-T G.984.3, ITU-T G.984.4 and ITU-T G.988.

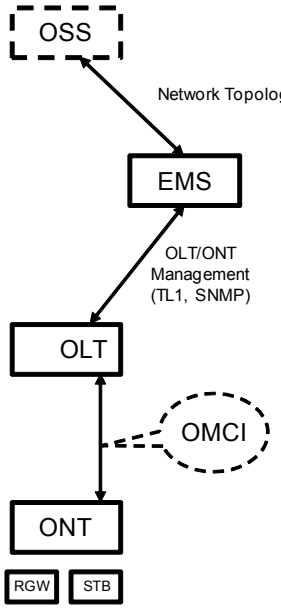

Figure 2-2: Link Layer Configuration and Management

IP-based services configuration and management is achieved by means of the TR-069 protocol as defined by Broadband Forum. This procedure takes for granted that previously the link layer connectivity has been achieved.TR-069 is then transparent to the OLT, since the TR-069 connections are established between the ACS and the ONTs,Figure 2-3.

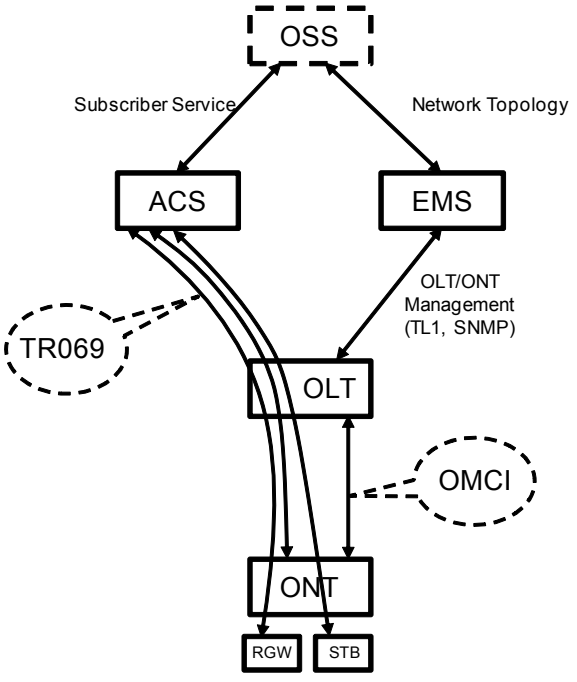

Figure 2-3: IP Based services-TR069 configuration

2.1.3 Services

The ONT supports the following services:

- Voice over IP (VoIP) service;
- Broadband Internet Access:
  - High bit rate data for High Speed Internet service – HSI;
  - IPTV service;
- Analog video service (RF Overlay);
- Mobile Backhaul service.

2.1.3.1 Internet over GPON

GPON is a point-to-multipoint passive optical network, in which unpowered optical splitters are used to enable a single optical fiber to serve multiple premises, typically 1-64.

A PON consists of an optical line terminal (OLT) at the central office and a number of optical network terminals (ONT) at the customer premises. Downstream signals are broadcasted to all premises sharing multiple fibers. Encryption can prevent eavesdropping. Upstream signals are combined using a multiple access protocol (Time Division Multiple Access - TDMA). The OLT queues data to the various ONT terminas in order to provide time slot assignments for upstream communication.

In Figure 2-4 it is shown a scenario for Internet service user access through an ISP network.

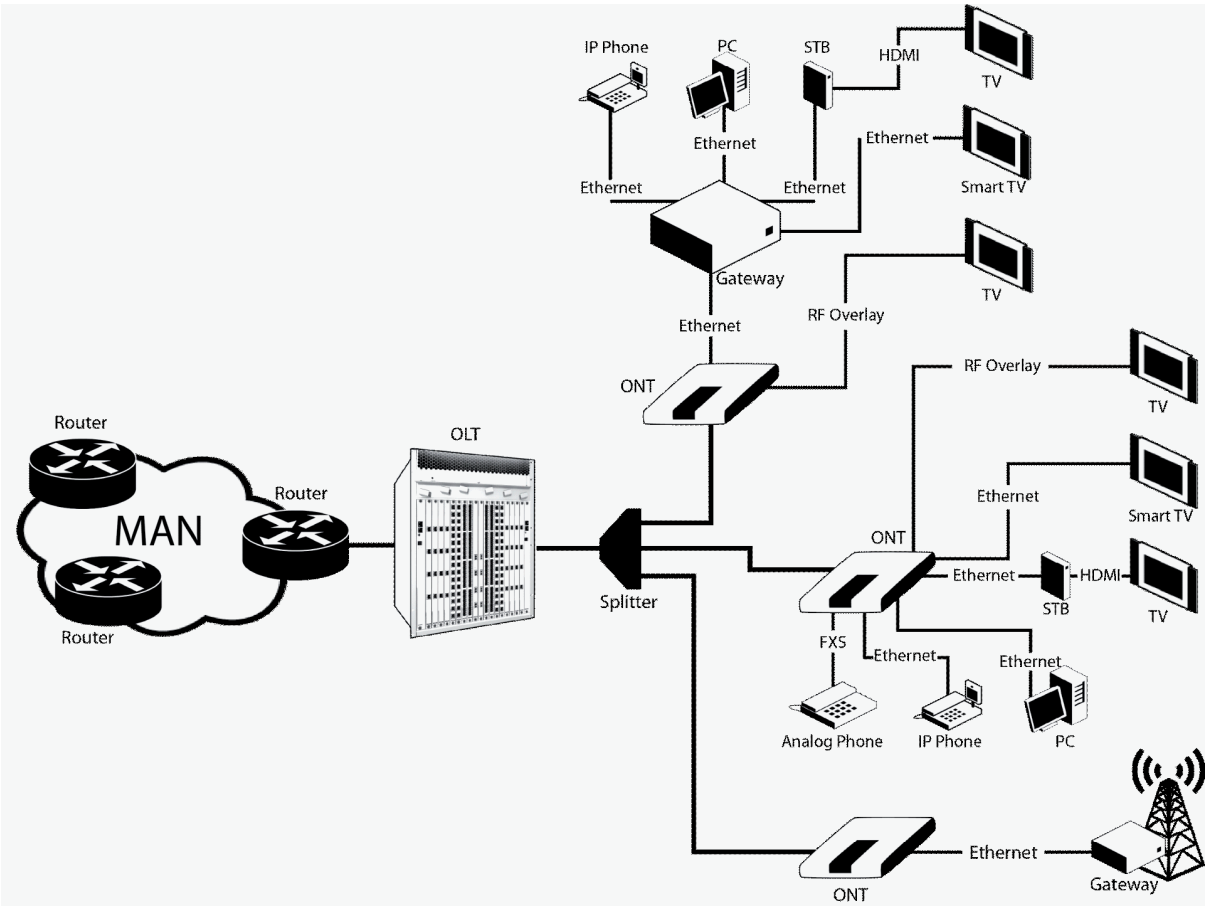

Figure 2-4: Optical fiber Internet service user access

The communication between client equipment (ONT) and the ISP access routers (MAN edge) is made by an optical fiber-based passive architecture (ITU-T G.984 Recommendation). The GPON network acts as a Layer 2 Ethernet metropolitan network. Access network assures and controls the media (MAC) communication through a TDMA scheme, introducing GEM (GPON Encapsulation Method) in between to adapt TDM layer to Ethernet.

The used protocol stack is shown in Figure 2-5.

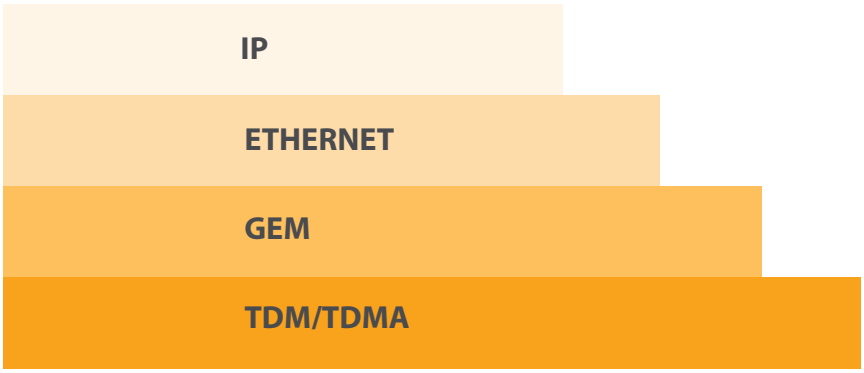

Figure 2-5: Stack of protocols for GPON architecture

Several transmission containers (T-CONT) are assigned to each user. Each T-CONT has an associated GEM port and each GEM port has a VLAN identifier and an 802.1p priority level.

The ONT classifies the traffic depending on the VLAN and the marked priority, and routes it over the corresponding T-CONT/GEM port. Thus for frame multiplexing, GEM and T-CONT ports are used for uplink while the downlink only use the GEM ports feature.

The CPE architecture is shown in Figure 2-6.

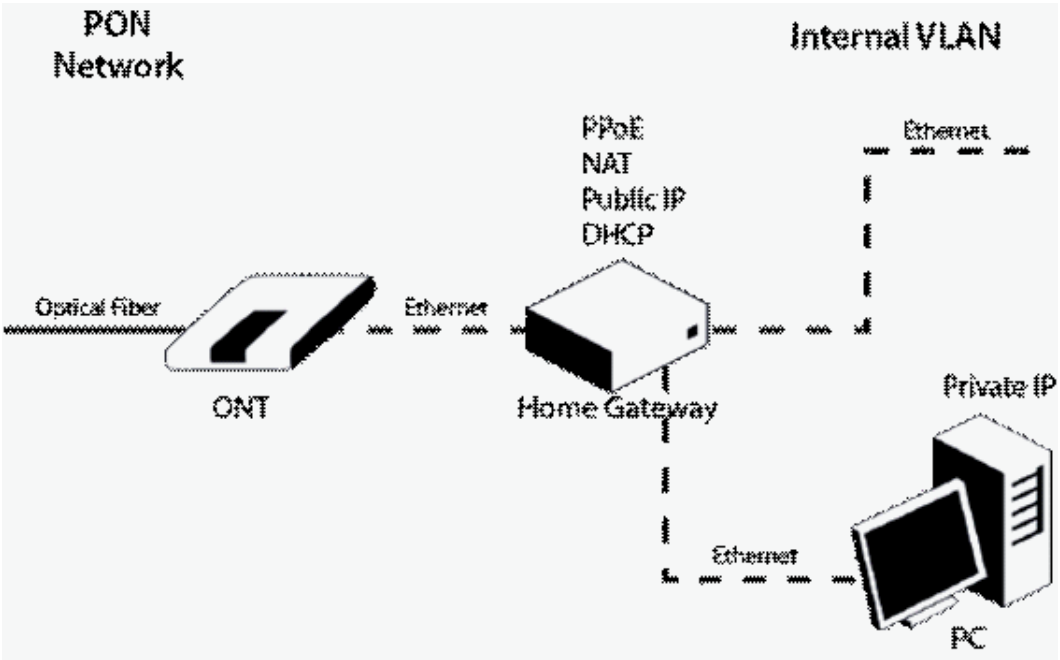

Figure 2-6: CPE architecture

Internet access is provided through the Home Gateway (HG) to obtain a public Internet IP.

The home gateway allocates a private IP address to each client through DHCP, making the addresses conversion through NAT for Internet output.

The home gateway establishes PPPoE session with the ISP network, which authenticates the user for Internet access. The user must be a service subscriber and the service must be provisioned at the OLT where the ONT is connected to.

2.1.3.2 IPTV service

For the IPTV service the ONT also behaves like a Layer 2 bridging device. For this service, the ONT has a specific GEM PORT for Multicast. This same GEM PORT is requested by the user in order have access to the various IPTV channels. Every time a user request a new channel, the ONT will send to OLT a IGMP packet requesting that Channel. The ONT is also responsible for implementing the snooping for the channels that the user requests.

2.1.3.3 RF Video Overlay

PON RF video overlay service is the way to deliver a broadcast TV service over a PON fiber network. This video overlay service is foreseen to provide mainly broadcast video transmission in contrast to unicast and/or multicast IP video transmission which is used for IPTV and/or Video-On-Demand having the need for a Set-Top-Box or a Smart TV at the customer premises.

Standardization bodies (ITU for GPON and IEEE for GEPON) have excluded the use of the 1550 -1560nm wavelength window for IP transmission on PONs and have even continued with this approach for the upcoming 10GPON and 10GEPON standards. The 1550-1560nm wavelength window is thus exclusively reserved for the video overlay transmission and by that mean an option to of¬foad unicast and/or multicast video transmission from the IP PON transmission link.

Within the ONT RF Video Overlay feature implementation is also an option to deliver a flavoured TV channel pack service by the use of a group of embeeded RF analog filters that can be remotely managed (NMS) in order to enable each individual commercial TV Channel pack, Figure 2-7.

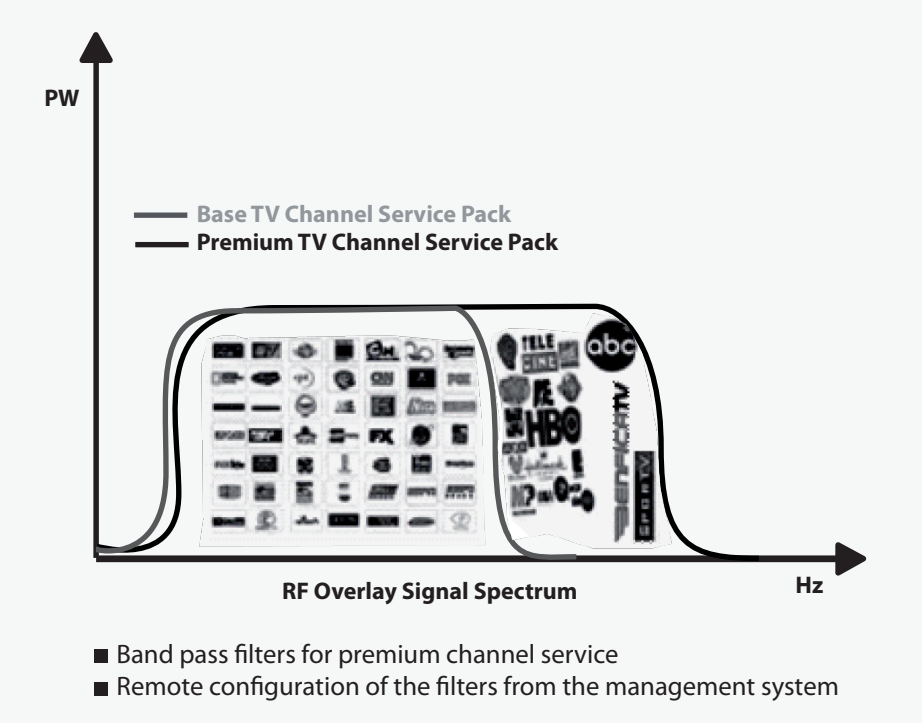

Figure 2-7: RF Overlay analog filter feature

Tipically an extra fiber testing signal (1650nm) for optical network probing is also added to the PON optical communication link.

2.1.3.4 Voice

ONT voice service provisioning could be made through OLT configurations over OMCI messages or could be downloaded (FTP) from the OLT up to the ONT after the ONT registration on the PON network.The ONT bridging family equipments have the ability to deliver the Voice service over two types of interface:

Logical interface (VLAN encapsulation)

If the ONT has no FXS ports and the VoIP service is transparently forwarded from the OLT up to the Home Gateway (and vice versa) within a previously defined voice VLAN. ONT respects the defined priority and implements the traffic encapsulation from its own Ethernet interface into a specific T-CONT/GEM-Port over the PON interface and up to the OLT equipment.

Physical interface (FXS ports)

The ONT has physical RJ11 FXS interfaces. In this version of the ONT equipment, voice interfaces are terminated in the equipment by means of FXS (RJ11) connections.The RJ11 analog terminals adapter function is auto/self-configured, integrated (analog/VoIP) and associated with a defined SIP or Megaco (H.248) user.

The ONT will allow VoIP or NGN (Next Generation Network) traffic from devices connected to the RJ11 or RJ45 interfaces, towards the same internal VLAN.

Appart of the SIP and Megaco (H.248) self-configuration, it is also possible to make modifications in the voice service configurations by updating the ONT SW through download from the OLT via OMCI.

The ONT equipment has a DHCP client (ONT 769503-4GE-2FXS) to get an IP address, alternatively the ONT could be configured with a static IP (ONT 769503-4GE-2FXS). The configuration of the static IP or DHCP client is related to the WAN side and is enabled by the OLT.

2.1.3.5 Multiple QoS per VLAN

The ONT supports 802.1p QoS per VLAN services in which several flows (one per allowed pbit) are embedded in the same VLAN. According to the applied configuration, the ONT performs a per-flow QoS policy: dropping traffic marked with not allowed pbits and limiting to the configured value the data rate of the allowed flows.

The ONT performs transparent VLAN translation. It is transparent to upper layer protocols, such as ARP, RIP, DHCP, IGMP, PPP, etc.

2.1.3.6 Mobile Backhaul

Due to the large increase on the bandwidth demand of the mobile backhaul networks to support 3G/4G services, PON networks are a natural option for its access component. ONT also supports this mobile backhaul service by mean of a Layer 2 bridging communication channel. Depending on the interconnection of the mobile backhaul network architecture, ONT transports mobile data traffic over a defined combination of VLAN/GEM PORT/T-CONT. This same configuration should be known and provisioned at the OLT and upper layer network architecture.

2.1.4 Policing / Rate Limiting.

2.1.4.1 Downstream QoS

The OLT system provides several QoS mechanisms, that can be targeted to the flow characterized by one or two VLAN according with the type of service, or can be targeted to the packets priority, where each p-bit is mapped in one of eight queues of each port.

For each of OLT ports are associated eight queues, for each of these queues is possible to configure the p-bit mapping in one of the queues, the scheduler type (Strict Priority or Weighted Fair Queuing) and the minimum and maximum bandwidth of each queue.

In the downstream direction the ingress traffic first passes by a policer configured to each ONT service, which is defined by one or two tags. After this the traffic is put in a queue according with the p-bit/queue mapping. Each of these queues is associated with a scheduler and a policer. Then the traffic flows to the GPON interface and when it arrives to the ONT it will pass by a mapping block which will map the traffic in one of the eight queues according with the p-bits, these queues have a Strict Priority scheduler in order to guarantee that the most prioritized traffic passes first.

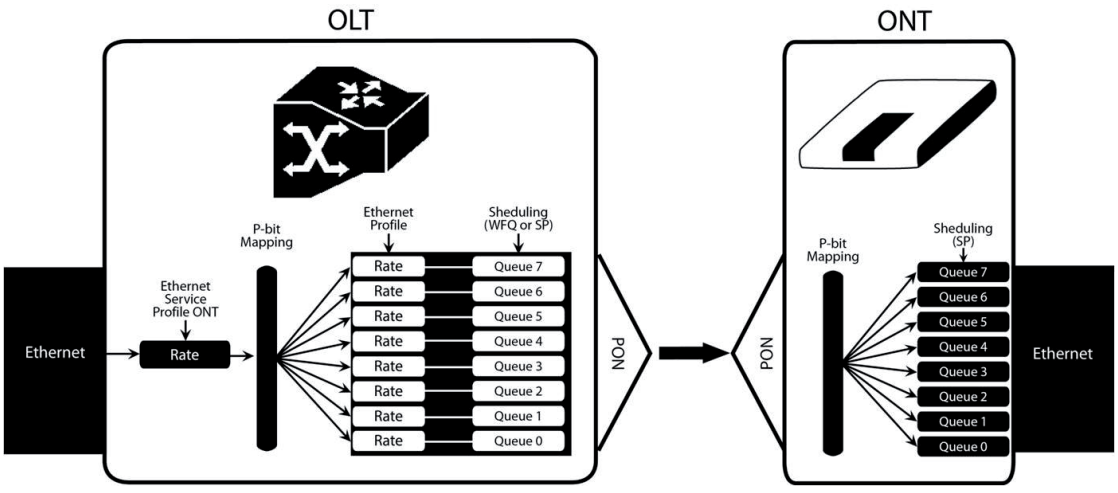

Figure 2-8: Downstream QoS Diagram

2.1.4.2 Upstream QoS

In the upstream direction, for each T-CONT the ingress traffic in the ONT passes by a mapping block that maps the traffic in one of the eight queues according with the p-bit, these queues have a Strict Priority Scheduler. The ONT "waits" until the OLT assigns a transmission timeslot for that T-CONT, so that the most prioritized queues are the ones that transmit first. In the OLT ingress, the traffic is put into a queue according with what is defined in the queue/p-bit mapping. Each of these queues has an associated scheduler and policer that control the traffic sent to the uplink.

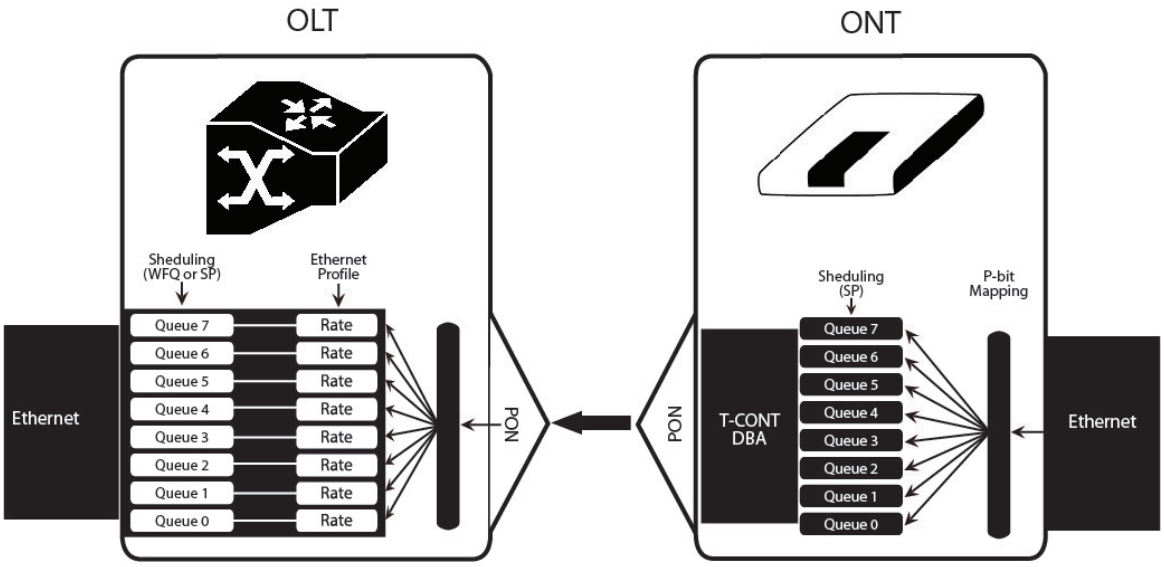

Figure 2-9: Upstream QoS Diagram

2.1.4.3 Dynamic Bandwidth Allocation (DBA)

The DBA (Dynamic Bandwidth Allocation) is available in order to optimize the upstream bandwidth. This mechanism consists in defining an adequate T-CONT to the service traffic in question. There are five types of T-CONT, defined by the Fixed, Assured and Maximum Parameters:

- Type 1: Only fixed Bandwidth;
- Type 2: Only Assured Bandwidth;
- Type 3: Assured+Maximum Bandwidth;
- Type 4: Only Maximum Bandwidth (Best Effort);
- Type 5: Fixed+Assured+Maximum Bandw

T-CONT	Type 1	Type 2	Type 3	Type 4	Type 5	Units
Fixed BW- R_F	R_{F1}	0	0	0	R_{F5}	[b/s]
Assured BW- R_A	0	R_{A2}	R_{A3}	0	R_{A5}	[b/s]
Max Bw - R_M	$R_{M1} = R_{F1}$	$R_{M2} = R_{A2}$	$R_{M3} > R_{A3}$	R_{M4}	$R_{M5} > R_{F5} + R_{A5}$	[b/s]
Bandwidth Eligibility	0	0	Non-Assured BW - R_{NA}	Best-Effort - R_{BE}	R_{NA} / R_{BE}	

Table 2-1: T-CONT types definition

In each GPON interface there is 1024 Alloc-ID (T-CONT identifiers) available, provided to manage ONT services. They are distributed in the following way:

Alloc-ID	Allocation Type
0-127	Default Alloc-ID (Dynamic or Static)
128-255	Reserved
256-639	Dynamic or Static
640-1023	Static

Table 2-2: Alloc-ID's distribution by T-CONT type

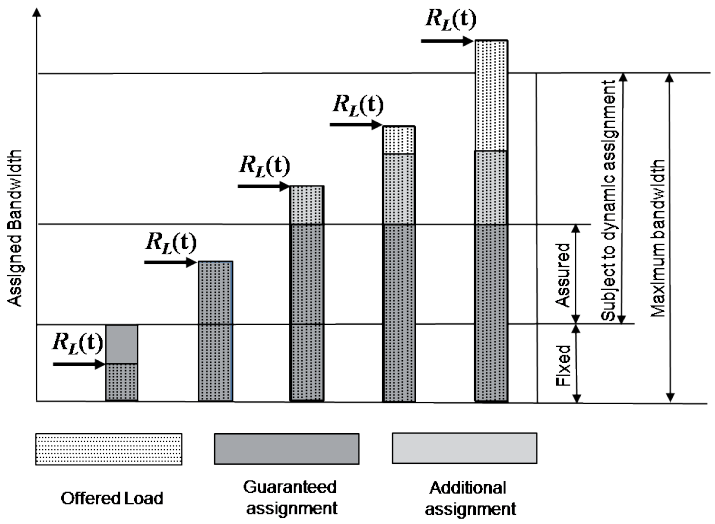

Figure 2-10: Traffic distribution by service/client

2.1.4.4 Upstream QoS scenarios Upstream QoS scenarios

- 8 priority queues
- Strict-priority
- Upstream Scheduling
  - Strict Priority (currently supported)
  - Strict Priority + rate controller (currently supported)
  - Strict Priority + WFQ (can be SW supported)

2.1.5 Interfaces

2.1.5.1 GPON

The ONT GPON layer as G.984.x uses 1490nm downstream and 1310nm upstream of the optical wavelengh, with 2,488Gbps downstream and 1,244Gbps upstream by using an SC/APC protected optical connector.

2.1.5.2 Ethernet

Ethernet is the wired LAN technology and is revised in the IEEE 802.3 standard. At the OSI reference system, Ethernet is at the Data Link layer. In the ONT equipment the LAN type of physical interface is 10/100/1000BASE-T AUTO-MIX Ethernet type over RJ45 conectors.

2.1.5.3 RF Overlay

Broadcast video signal travels over fiber from the CO in the 1550nm wavelength and is demuxed and converted in the ONT to a F conector (75 Ohm) RF Overlay interface to deliver a RF TV signal going from 47MHz up to 862MHz of bandwidth. As it was already referred in one of the previous sub-chapters, ONT may also implement multiple analog filtering of the RF Interface in order to turn the open RF Spectrum in a group of sliced TV channels packs that are remotely enabled from the NMS.

3. General Specifications

3.1 PON Optical Interfaces

Items	Unit	B+	C+
		ONT Tx	ONT Tx
Nominal bit rate	Mbps	1244.16	1244.16
Operating wavelength	nm	1260-1360	1260-1360
Line code	--	Scrambled NRZ	Scrambled NRZ
Minimum ORL of ODN	dB	>32	>32
Mean launched power MIN	dBm	+0.5	+0.5
Mean launched power MAX	dBm	+5	+5
Launched optical power without input to the Tx	dBm	Less than Min sensitivity -10	Less than Min sensitivity -10
Maximum Tx Enable		16	16
Maximum Tx Disable		16	16
Extinction ratio	dB	>8.2	>8.2
Tolerance to the Tx incident light power	dB	>-15	>-15
SLM Laser – MAX –20 dB width	nm	1	1
SLM Laser – MIN SMSR	dB	30	30
		ONT Rx	**ONT Rx**
Receiving bit rate	Mbps	2488.32	2488.32
Receiving wavelength	nm	1480-1500	1480-1500
Max reflectance of equipment, measured at Rx wavelength	dB	<-20	<-20
Bit error ratio	--	$<-10^{-10}$	$<-10^{-10}$
Minimum sensitivity	dBm	-27	-30*
Minimum overload	dBm	-8	-8*
Upstream optical penalty	dB	0.5	0.5
Consecutive identical digit immunity	bit	>72	>72
Tolerance to reflected optical power	dB	<10	<10
		ONT Rx Video	
Receiving wavelength	nm	1550-1560	

Table 3-1: Optical interfaces

* ONT RX= -8~-30 dBm (The ONT sensitivity assumes the use of the optional RS (255,239) FEC capability of the G-PON TC layer with the current class B+ ONU detector technology; The ONU overload is set at –8 dBm to be common with the class B+ value, even though in this application –10 dBm is sufficient).

Optical solution: B+ and C+.

Connector type: SC/APC.

IEC 60825-1: "Class 1 Laser Product".

The B+ and C+ triplexer is embedded on the ONT equipment version.

ONU Single Fiber - G.984.2 (03/2003) + G.984.2 Amd 1 (02/2006) and 2 (03/2008), G.983.3 (03/2001).

3.2 Optical Metering

The equipment measures the downstream received power from the OLT in 1490nm and reports this value through OMCI. The accuracy of the measurement is +/- 3dBm, maximum. Optionally, ONT has also the chance to have an embeded optical reflective component in order to increase the FTTH probing capabilities in a 50 centimeters resolution factor, which turns to have a single probing system to probe all GPON network ONTs even when its number increases over Million customers.

3.3 Wavelenght Filtering

The optical interface has WDM filters that allow GPON coexistence with RF video services (1550-1560nm) and the new generation of NGPON1 technology, according to G.984.5 Recommendation.

ITU-T Rec. G987.1 is also granted for XGPON, (following FSAN NG-PON2).

In order to face the final user´s demands, current GPON networks have to confront the first evolution in terms of terminals equipments and actual infrastructure. Migration will be available through a new wavelength planning, by allowing the co-existence of two different technologies over the same fiber. The ITU-T Rec. G987.1 provides a mechanism for GPON to XGPON migration with the possibility to achieve 2.5Gbps upstream path. Nominally downstream will be 10 Gbps.

The next figure depicts the wavelength planning of ITU-T Rec. G987.1

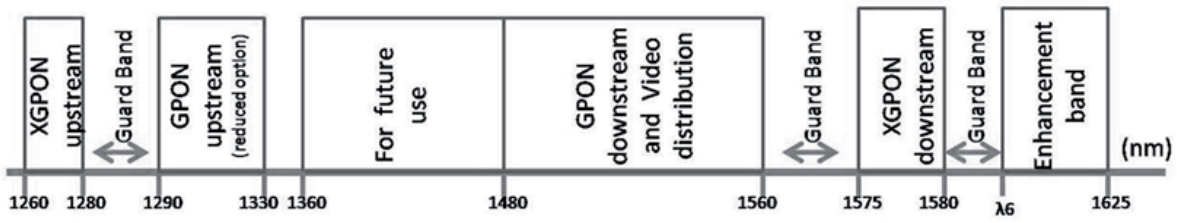

Figure 3-11: Wavelength planning

In order to accomplish to that plan, the upstream wavelength for GPON must be restricted to ONU (ONT) equipment based on the ordinary DFB lasers, while the XGPON downstream signal range is defined from 1575 nm to 1580 nm and the XGPON upstream signal from 1260 nm to 1280 nm. For the coexistence of XGPON and GPON over the same fiber, the CO requires a WDM filter that combines the downstream signal (1490 nm, 1555 nm and 1577 nm), isolating the 1310 nm and 1270 nm upstream signal, with the video signal. Also the wavelength of 1650 nm, used for fiber monitoring, has to be handled.

In addition, ONT devices require the use of a triplexer type transceiver that include an integrated filter or a discrete WDM filter to distinguish the different signals that may be present on the fiber. The current networks, equipped with ONT in accordance with the current ITU-T Rec. G984.5, will be easily updated to XGPON.

Class B+ optical budget are the nominal requirement for coexistence of GPON and XGPON over the same optical fiber. Taking in account this requirement, the fiber network architecture will not limit the future of the service provider business since GPON architectures, respecting B+ class of the GPON, are easily updated by placing newest terminal equipments, namely XOLT and XONT, and by replacing the current WDM filter by the new one in order to handle the new XGPON signals.

XGPON must support/emulate all GPON legacy services in case of total migration.

Like GPON, XGPON is required to support triple play services (data, voice and video), as well as mobile backhauling (accurate frequency/phase/time synchronization) application through its high quality of service and high bit rate feature capabilities. Access to Ethernet services such as point-to-point, multipoint-to-multipoint and rooted-multipoint Ethernet Virtual Connection services should be provided. Finally, as a global requirement, XG-PON needs to support IPv6.

3.4 GPON/Ethernet characteristics

GPON/Ethernet characteristics supported, both functional level and GTC-OMCI configuration, corresponds with the general mandatory characteristics defined in ITU-T G.984.3, G.984.4 and G.988 Recommendation:

- PON interface: downstream operating rate 2.488 Gbits/s, upstream operating rate 1.244 Gbits/s;

- 32 T-CONT and 256 simultaneous GEM ports;
- 1:64 SR is granted once optical power transmission from the OLT side is up from -27/30dBm;Unmarked or marked bandwidth management;
- Upstream and downstream FEC;
- Downstream AES encryption;
- Ethernet flow control in client´s port: 802.3x and 802.3ab;
- Ability to classify and modify VLAN labels (single or double labeling);
- Ability to support multiple VLAN tags per service (Internet, IPTV, VoIP, ACS, etc) from Residencial Gateway. And ability to translate those VLAN to one specific service VLAN on OLT side, like, IPTV service VLAN, Internet Service VLAN (SVLAN and CVLAN), and VoIP Service VLAN;
- 802.1 DSCP for CoS support;
- IEEE 802.1Q and 802.1p support;
- Multicast snooping support IGMPv2 and IGMPv3;
- Firmware upgrade through the PON interface following the mechanisms specified in the ITU-T G.984.4 and G.988, including a safe dual firmware updates image system and the ability of back-up, allowing the SINGLE PORT ONT start in case the software download fails, to enable a new software update.

3.5 GPON management

The system supports the configuration according to the recommendations described in ITU-T, G.984, G.988 and BBF TR-156.

Specifically the next functionalities are obtained via OMCI for diagnostic (counters and alarms):

- ONT configuration checking of the services provisioned;
- Acquisition of the physical parameters of the SINGLE PORT GPON ONT interface;
- Traffic counters, statistics, errors, GPON interface status: by VLAN, by traffic type, by priority;
- Traffic counters, statistics, errors, GbE interface status are only available by port;
- Configuration parameters of services provisioned in the ONT: T-CONT, GEMPORT, VLAN and GPON MAC tables;
- Alarms/events included in the standards mentioned above.

3.6 RF TV Channel slicing characteristics

ONT Model	ONT 769503-SFU B	ONT 769503-SFU C	ONT 769503-SFU D	ONT 769503-SFU E	ONT 769503-SFU F
Number of channels	-	15	15	15	15
	-	-	-	-	25
	-	-	-	-	35

Table 3-2: Overlay characteristics

Up to 3 TV channel packs may be implemented with 15, 25 and 35 channels each in a total bandwidth of 47MHz-862MHz.

3.7 General Features

Features	ONT 769503-SFU	ONT 769503-4GE-2FXS	ONT 769503-MBH
GPON Singlemode Optical Fiber Cable (SC/APC Connector)	1x	1x	1x
Ethernet 10/100/1000Base-T Direct or crossover AUTO-MDIX UTP CAT5E cable (RJ45)	1x	4x	1x
FXS Ports Voice / Fax RJ11 connector	N.A.	2x	N.A.
Video RF connector F Type	1x	1x	N.A.
Primary Power Connection (VDC) (1)	12 (± 15%)	12 (± 15%)	-48 (± 20%)
Primary Power Connection (VAC) (1)	230 (50Hz ±2Hz)	230 (50Hz ±2Hz)	230 (50Hz ±2Hz)
Power Supply (W)	8.4 (model B) 7 (model D/E)	15	8
MTBF (h)	200000	190000	250000
Size (mm)	210x210x40	210x210x40	240x420x136
Temperature (^{0}C)	-5 to +70	-5 to +70	-5 to +70
Humidity (%)	0 to 95	0 to 95	0 to 95

NOTES:

(1) An LPS power source is used to power the ONT equipment:

US/Canada:

The ONT must be powered by an external Listed Limited Power Source (LPS) or Class 2 Power source. The external power adapter must be LPS certified.

Rest of the World:

The ONT must be powered by an External CB approved Limited Power Source (LPS).

Table 3-3: General Features

EMC	Standards	EMC Directive 89/336/EEC, EMC Addendum Directive 92/31/EEC, EMC Addemdum Directive 91/263/EEC (Telecommunications Terminal Equipment Directive)
	Emissions	EN50081-1, EN55022
	Immunity	EN50082-1, EN61000-4-2, EN61000-4-3, EN61000-4-4
Operating Limits	Temperature	EN300019
	Relative humidity, maximum	EN300019
Environmental Standards	Acoustic noise	ISO 3743 (<45dBa)
Power and Grounding		ETSI EN 300 132-2 V2.1.1 (2003-01)
ETSI ETS 300 253: January 1995		
Optical Safety		ALS - Automatic Laser Shutdown
Safety and Protection		EN/IEC 60950-1
Mechanical Resistance		EN300019
Quality		CE - Conformité Européenne
Certification		BBF.247 G-PON

Table 3-4: Standards

4. Setup

4.1 Before installing your ONT device

- Check for site's environmental conditions and look for power and optical access points nearby.
- Do not install the device in environments where the temperature or humidity exceeds the standard limits.
- This device is a passive cooling device. There are thermal holes in the surface of the box. To prevent the overheating do not obstruct these thermal holes.
- The ONT device is not designed for outdoor setup. Pleae place it in a convenient indoor/cabinet environment.
- Use only the provided power kit. The use of a 3rd party power adapter may not guarantee its proper operation.
- To avoid any hazard or damage in your eyes, please never look directly into a fibre optic connector.
- Never assume that the laser beam is inactive or that the optical fibre is switched off.

4.2 How to Setup your ONT

The ONT may be installed horizontally on a flat surface, wall mounted and ETSI rack (ONT 769503-MBH), quick steps for both of these setups are described below.

Wall-mount

- Remove the ONT lower cover;
- Mount the cover on the wall using two screws inserted into the mountings shown in Figure 41(c). The lower mounting is used to regulate the spatial orientation of the box. The space between the two screws should be about 4.8 cm;
- Place the optical cable in one of the openings, (a) or (b) shown in Figure 4-12;
- Pass the optical cable, in a clockwise direction, round the circular guide inside the ONT, wrapping it round as many times as necessary;
- Fit the ONT into the cover as shown in Figure 4-12;
- Attach the fiber to the optical connector inside the ONT;
- Place a 3 mm plastic clip round the support and the optical cable before the point at which the cable exits the box Figure 4-12(d). Tighten this just enough to ensure the optical fiber will not move;
- Close the ONT

Figure 4-12: Optical cable installation –wall mount

Horizontal position

- Open the ONT lower cover;
- Place the optical cable in one of the openings, (a) or (b) shown in Figure 4-13;
- Pass the optical cable, in a clockwise direction, round the circular guide inside the ONT, wrapping it round as many times as necessary;
- Attach the fibre to the optical connector inside the ONT;
- Place a 3 mm plastic clip round the support and the optical cable before the point at which the cable exits the box Figure 4-13(c). Tighten this just enough to ensure the optical fibre will not move;
- Close the ON

Figure 4-13: Optical cable installation – Horizontal mount

ETSI rack

- Remove the ONT cover;
- Mount the equipment on a ETSI 19" rack using the 4 supplied screws.
- Place the optical patchcord (SC/PC termination) in the rack fiber accomodation structure in order to promote a correct cabling management up to the equipment optical interface connector.
- Place the electrical CAT5E ethernet cable in the rack electrical cabling accomodation structure in order to promote a correct cabling management up to the equipment ethernet interface connector.
- Place the power cabling (reduntant paths) from the power box up to the TRIDENT power cord connectors.

Figure 4-14: ONT Rack Mount (ONT 769503-MBH)

4.3 Interface connection

4.3.1 ONT 769503-SFU

- Connect the optical cable (C4) from the ONT 769503-SFU to the optical socket;

Figure 4-15: ONT 769503-SFU interfaces connection 1 (PON Interface)

- Connect the Ethernet UTP CAT5E (C1) cable (direct or crossover) from the ONT 769503-SFU Ethernet port (B1) to the Home Gateway's WAN port (B6);

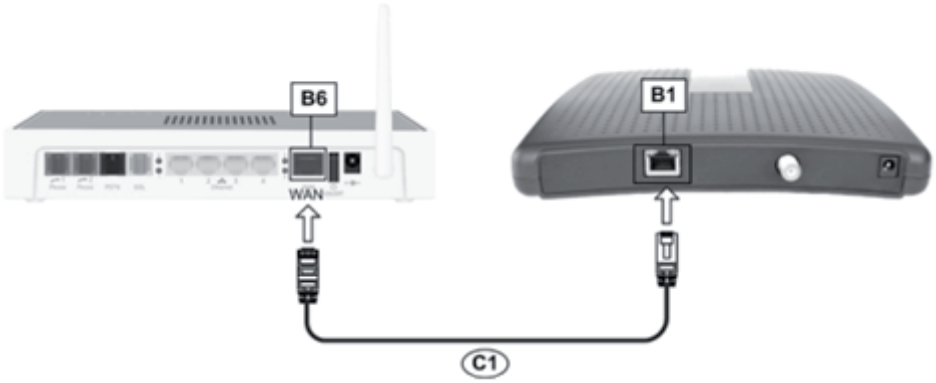

Figure 4-16: ONT 769503-SFU interfaces connection 2 (WAN interface)

- Connect the coaxial RF cable (C2) from the F-type connector (B2) on the ONT 769503-SFU to the RF input of a TV or the RF input of the local CATV network;

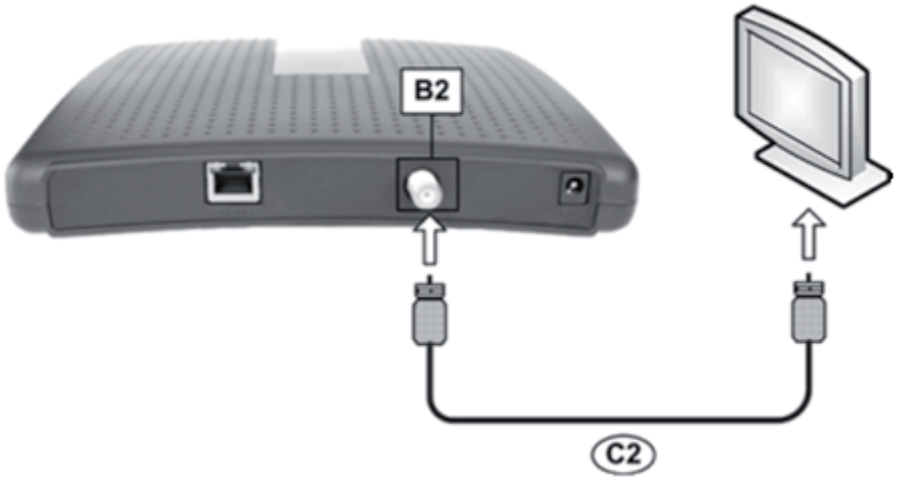

Figure 4-17: ONT 769503-SFU interfaces connection 3 (RF Overlay Interface)

- Connect the DC connector from the supplied (C3) converter (230V AC/12V DC) to the DC input on the ONT 769503-SFU (B3) and connect the adapter to a 230V AC electrical socket.

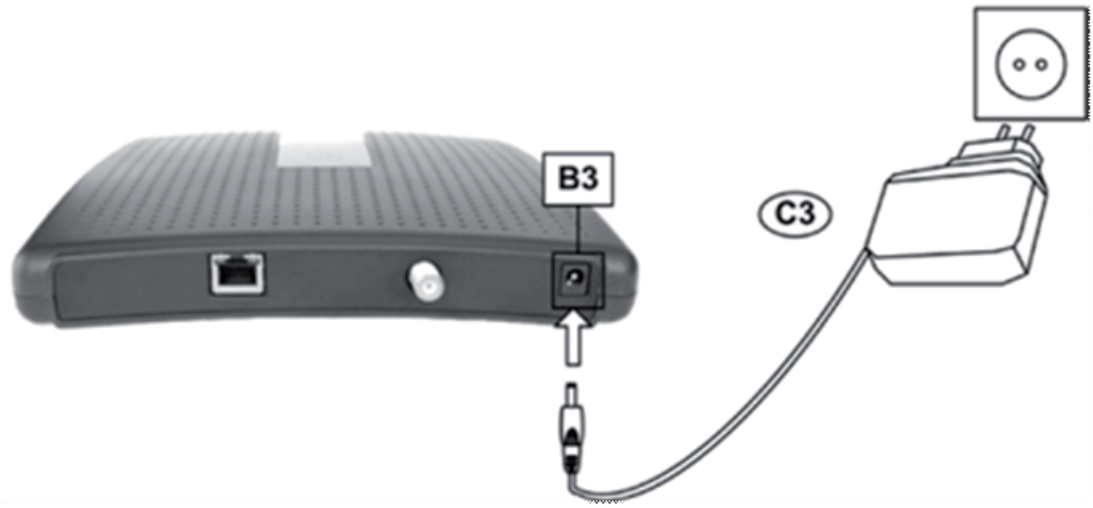

Figure 4-18: ONT 769503-SFU interfaces connection 5 (Power Interface)

4.3.1.1 General Overview of ONT 769503-SFU Connections

The following figure shows the connections to be made between the ONT 769503-SFU and the Home Gateway.

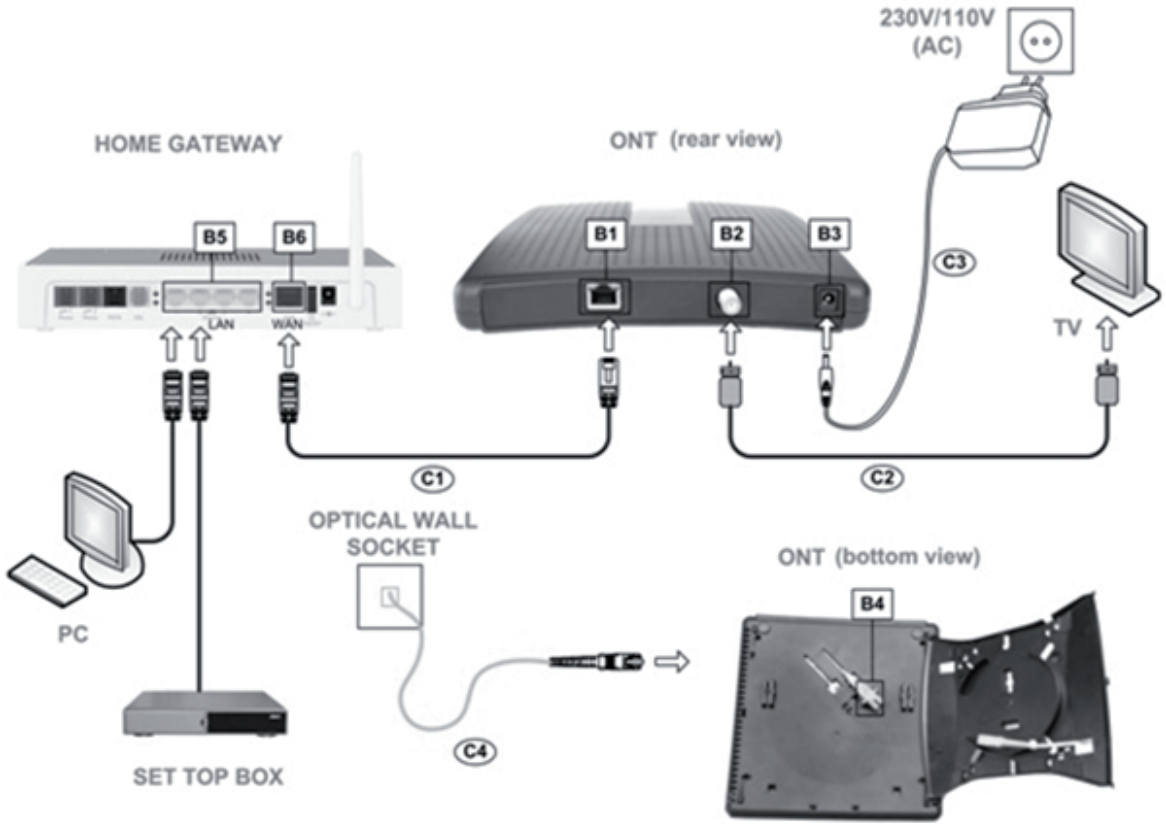

Figure 4-19: ONT 769503-SFU connections

Nº	Description
B1	RJ45 Port - 10/100/1000Base-T Ethernet with AUTO-MDIX
B2 (1)	Video RF Connector, F type
B3	12VDC Power Connector
B4	SC/APC ONT's Internal Connector
B5	RJ45 LAN Ports (Home Gateway)
B6	RJ45 WAN Port (Home Gateway)
C1	Ethernet UTP CAT5E Cable (straight or crossover)
C2	Cable with F-type connectors, Coaxial 75 Ohm
C3	12VDC / 1A Power Adapter
C4	Single-mode Optical Cable with SC/APC Connector (GPON)

Notes:

(1) –Optional. Depends on the ONT 769503 SFU model

Table 4-1: ONT 769503-SFU connectors and cables

4.3.2 ONT 769503-4GE-2FXS

- Connect the optical cable (C4) from the ONT 769503-4GE-2FXS to the optical socket;

Figure 4-20: ONT 769503-4GE-2FXS interfaces connection 1 (PON Interface)

- Connect the Ethernet UTP CAT5E (C1) cable (direct or crossover) from the ONT 769503-4GE-2FXS's Ethernet port (B2) to the Home Gateway's WAN port (B7) and/or an Ethernet port from the PC/Set Top Box;

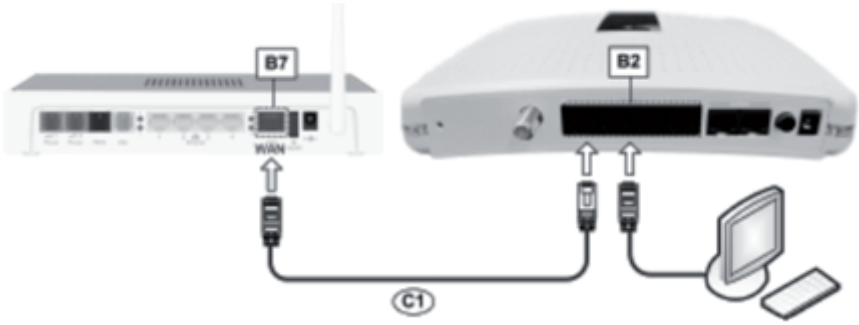

Figure 4-21: ONT 769503-4GE-2FXS interfaces connection 2 (WAN + LAN interfaces)

- Connect the coaxial RF cable (C3) from the F-type connector (B1) on the ONT 769503-4GE-2FXS to the RF input of a TV or the RF input of the local CATV network;

Figure 4-22: ONT 769503-4GE-2FXS interfaces connection 3 (RF Overlay Interface)

- Connect the telephone cable (C2) to one of the RJ11 FXS ports on the ONT 769503-4GE-2FXS (B3) to a telephone/fax;

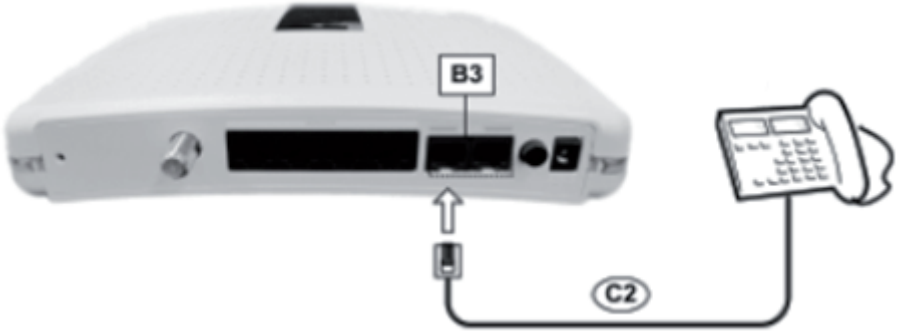

Figure 4-23: ONT 769503-4GE-2FXS interfaces connection 5 (FXS Interface)

- Connect the DC connector from the supplied (C5) converter (230V AC/12V DC) to the DC input on the ONT 769503-4GE-2FXS (B5) and connect the adapter to a 230V AC electrical socket. Press the ON/OFF button (B4) to power on the device;

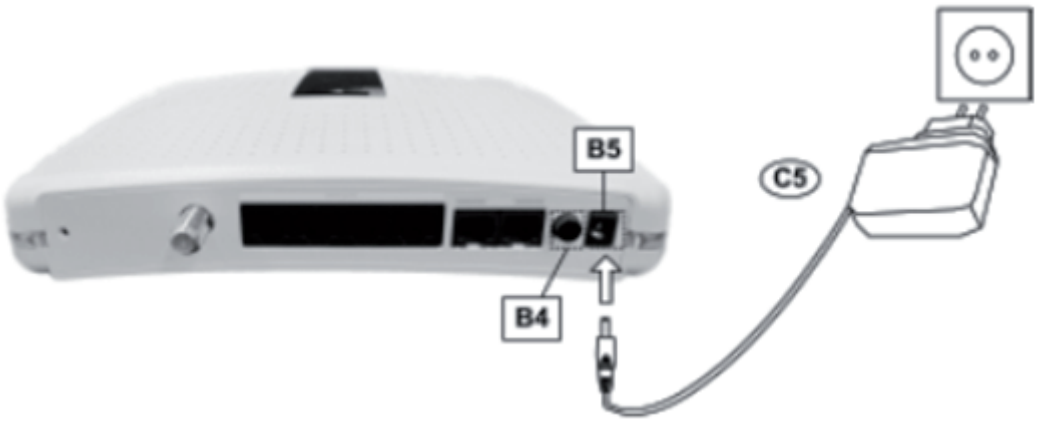

Figure 4-24: ONT 769503-4GE-2FXS interfaces connection 6 (Power Interface)

4.3.2.1 General Overview of ONT 769503-4GE-2FXS Connections

The following figure shows the connections to be made between the ONT 769503-4GE-2FXS and the home gateway.

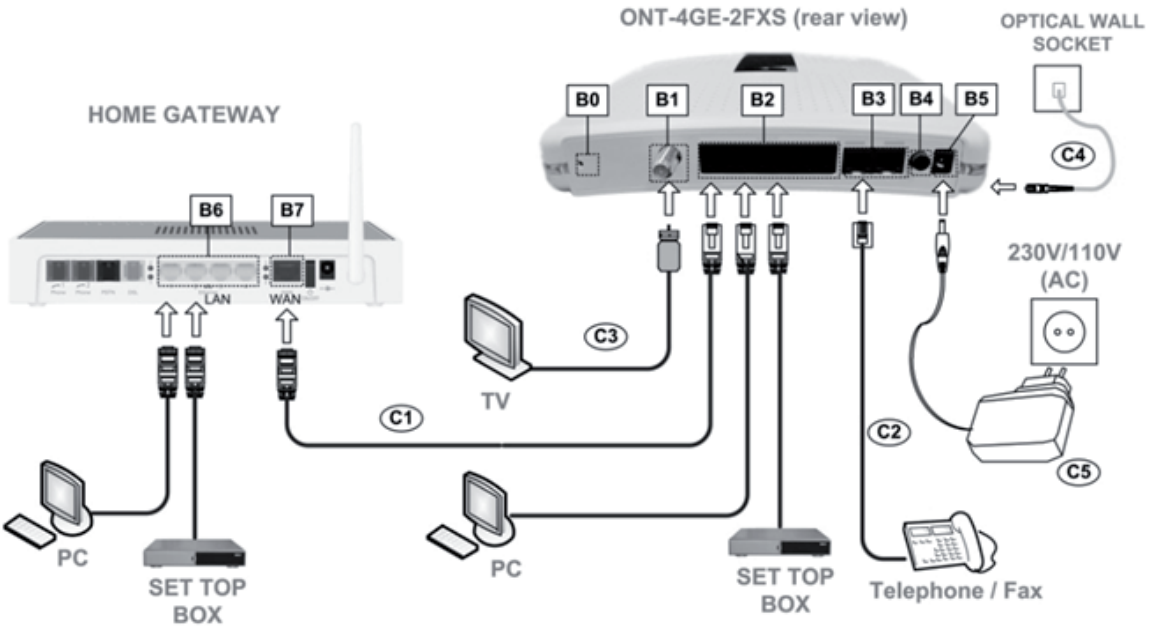

Figure 4-25: ONT 769503-4GE-2FXS Connections

Nº	Description
B0	RESET button
B1(1)	Video RF Connector, F type
B2	4x RJ45 Ports - 10/100/1000Base-T Ethernet with AUTO-MDIX
B3	2x RJ11 – FXS Ports
B4	ON/OFF button
B5	12V DC Power Supply Connector
B6	LAN RJ45 Ports (Home Gateway)
B7	WAN RJ45 Port (Home Gateway)
C1	Ethernet Cable UTP CAT5E cable (direct or crossover)
C2	RJ11 Telephone cable
C3 Cable with F-type Connectors, Coaxial 75 Ohm	
C4	Single-mode Optical Cable with SC/APC Connector (GPON)
C5	12V DC Adapter

Notes:

(1) –Optional. Depends on the ONT 769503 SFU model

Figure 4-26: ONT 769503-4GE-2FXS setup notes

4.3.3 ONT 769503-MBH ONT 769503-MBH

4.3.3.1 General Overview of ONT 769503-MBH Connections

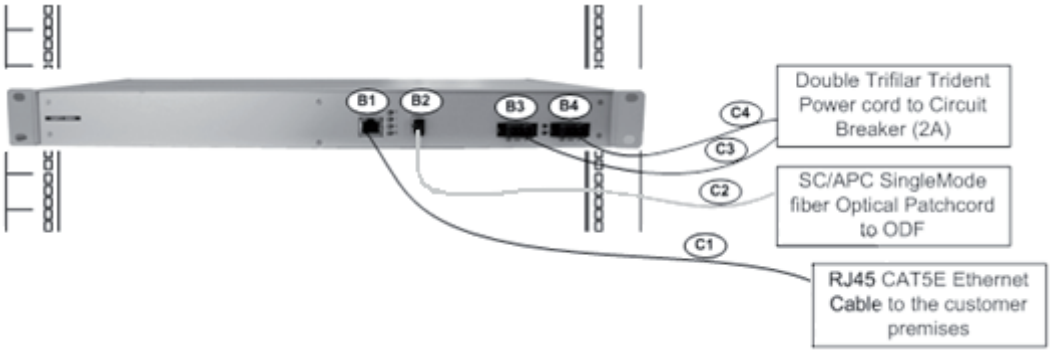

Figure 4-27: ONT 769503-MBH front pannel

Nº	Description
B1	RJ45 Port - 10/100/1000Base-T Ethernet with AUTO-MDIX
B2	SC/APC ONT's Internal Connector
B3	-48VDC TRIDENT Power Connector (a)
B4	-48VDC TRIDENT Power Connector (b)
C1	Ethernet UTP CAT5E Cable (straight or crossover)
C2	Single-mode Optical Cable with SC/APC Connector (GPON)
C3	Trifilar power cord
C4	Trifilar power cord

Figure 4-28: ONT 769503-MBH connectors and cables

5. Configuration

5.1 ONT activation

The ONT activation process has a distributed set of procedures that allow the connection of a inactive equipment to a PON network. This configuration is done following the procedure described in the OMCI protocol.

5.2 Customization

For customization process, the requirements specified in the G.984.4, G.984.5 and 'Implementer's Guide' in the G.984.4 v1 are taken into account.

5.2.1 Software download from the OLT

The software download is made following the OMCI-based procedure included in the 'Implementer's Guide' of the G.984.4 Recommendation.

The Managed Entity (ME) in charge of managing the software download is named Software Image. Per each ME containing independently-manageable software, the ONT creates two software images. Each image will have three attributes:

- Valid - if it has been verified that it's content is an image with executable code;
- Committed - if once the ONT is rebooted, it is loaded and executed;
- Active - if it is loaded and it is being executed in the ONT.

There can be only one active image and only one commited image at a given moment. The ONT goes through a series of states in order to download and activate a software image. Each state is defined according to the states of the variables of both images. The OLT controls the ONT state through a series of commands:

- Start download
  - It starts the software download sequence. This action is only valid for inactive and non-commited software images;
- Download section
  - It downloads a section of a software image. This action is only valid for an image that is being downloaded;
- End download
  - It indicates the end of a download sequence, providing the CRC and information about version for the final verification of the downloaded software image. This action is only valid for a software image that is being downloaded;
- Activate image
  - It loads/executes a valid software image. When this action is applied to an inactive software image, the execution of the current code image is suspended, the associated software image is loaded from the non-volatile memory and the execution of the new code image is started. When this action is applied over a software image that is active, a reboot is executed;
- Commit image
  - It selects a valid SW image to be loaded and executed by default when the ONT is restarted;
- Composition of the Software Image
  - A software image is divided into sections of 31 bytes, with one section per OMCC message and each section protected by the CRC of the OMCC. A group of sections makes up a window, and a group of windows constituting the image..

6. Operation indicators

6.1 ONT 769503-SFU

6.1.1 Status

The ONT 769503-SFU has seven LEDs to indicate its operational status.Example Heading 3

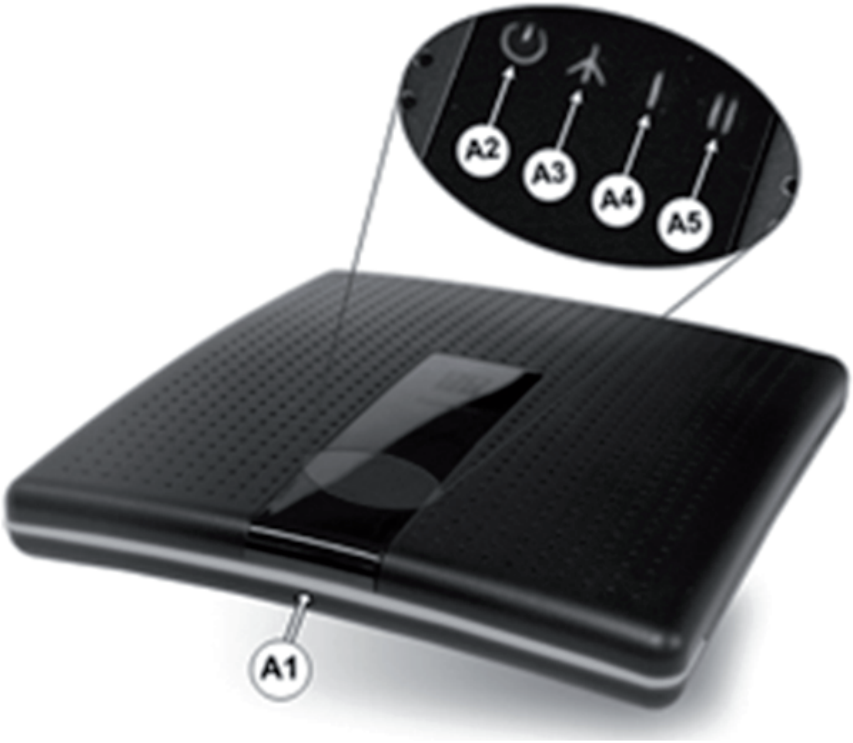

Figure 6-29: ONT 769503-SFU status LEDs

Figure 6-30: ONT 769503-SFU Ethernet port LEDs

LED	Identification	LED Status	Description
A1	READY	ON	Registration in progress
		OFF	Successfully registered by the OLT
A2	POWER/PROC	ON	Power supply ON
		OFF	Power supply OFF
A3	GPON LINK	Refer to the next table	
A4	AUTH (I)		
A5	CATV (II)	ON	Port administratively connected
		Flashing	Port administratively connected with CAT V
		OFF	Port administratively disconnected
A6	ETHERNET (Left)	ON	With Ethernet connection
		OFF	No Ethernet connection
A7	ETHERNET (Right)	Flashing	Ethernet IN/OUT activity

Table 6-1: ONT 769503-SFU LED status

The following combination of GPON LINK (A3) and AUTH (A4) LEDS reflects the various states that the ONT is in during the process of configuration and communication with the OLT (Optical Line Terminal).

ONT Status	LED Status				Description
	A3	GPON Link	A4	Auth	
1 - Initial	OFF		OFF		Initial State
2 - *Standby*	Flashing		OFF		ONT 769503-SFU is waiting for initial configuration by the OLT
3 - *Serial-Number*	Flashing		Flashing		The OLT is configuring the ONT 769503-SFU
4 - *Ranging*	Flashing		ON		ONT 769503-SFU and OLT synchronisation
5 - Operation	ON		ON		ONT 769503-SFU's normal operational status
6 - *POPUP*	Flashing		OFF		Loss of optical signal detected
7 - *Emergency-Stop*	ON		OFF		Anomalous event

Table 6-2: ONT 769503-SFU states

6.1.2 Final checks

Check, using the following table, if the ONT 769503-SFU has been successfully registered on the network

LED	LED Status	Device
A1	ON > OFF	**ONT 769503-SFU**
A2, A3, A4 and A6	ON	
A5	Flashing*	
'Power', 'Broadband' and 'Internet'	ON	Home-Gateway

Note: * When the RF video server is active.

Table 6-3: ONT 769503-SFU LED final checks

6.1.3 Troubleshooting

The table below, according to the LEDs status, identifies a possible cause and describes the procedure to fix the problem.

LED	State	Probable Cause	Solution
POWER (A2)	OFF	ONT 769503-SFU not powered	Verify that the DC power jack is correctly connected to the ONT 769503-SFU and the power adapter at the wall power socket.
ETHERNET (Left) (A6)	OFF	ETHERNET cable not connected correctly	Verify that the ETHERNET cable is correctly connected to the ONT 769503-SFU's ETHERNET Port and to the WAN Port at the Home Gateway (and not to a LAN Port for e.g.). Use another Ethernet cable
GPON LINK (A3)	OFF	Anomaly in the optical fiber signal	Verify that the optical cable is correctly connected to the ONT 769503-SFU's internal optical port and to the optical wall socket. Verify that the fiber is intact, it is clean, without cuts, scratches or bends.
AUTH (A4)	OFF		
GPON LINK (A3)	ON	ONT 769503-SFU deactivated by the network administrator	Contact the technical support.
AUTH (A4)	OFF		
CATV (A5)	OFF	CATV deactive at the ONT 769503-SFU	Contact the technical support.
GPON LINK (A3)	Blinking	Authentication Error at the ONT 769503-SFU	Contact the technical support.
AUTH (A4)	OFF or Blinking		

Table 6-4: ONT 769503-SFU troubleshooting

6.2 ONT 769503-4GE-2FXS

The ONT 769503-4GE-2FXS has several LEDs to indicating the equipment operational status.

6.2.1Status

Figure 6-31: ONT 769503-4GE-2FXS LEDs

LED	ID	LED Status	Description
A1	POWER	ON	Power supply ON
		OFF	Power supply OFF
A2 to A5	ETHERNET	ON	With Ethernet connection
		OFF	No Ethernet connection
		Flashing	Ethernet IN/OUT activity
A6 to A7	VOIP	OFF	Service not configured or registration failure
		ON	Service configured and authenticated
		Flashing	Telephone off the hook
A10	GPON LINK	See table below	
A11	AUTH		
A13	CATV	ON	Port administratively connected
		OFF	Port administratively disconnected
		Flashing	Port administratively connected to CATV
A8, A9, A12, A14 and A15	Not used		

Table 6-5: ONT 769503-4GE-2FXS LED status

The following combination of GPON LINK (A10) and AUTH (A11) LEDS reflects the various states that the ONT 769503-4GE-2FXS is in during the process of configuration and communication with the OLT (Optical Line Terminal).

ONT 769503-4GE-2FXS Status	LED Status				Description
	A10	GPON Link	A11	Auth	
1 - Initial	OFF		OFF		Initial State
2 - *Standby*	Flashing		OFF		ONT 769503-4GE-2FXS is waiting for initial configuration by the OLT
3 - *Serial-Number*	Flashing		Flashing		The OLT is configuring the ONT 769503-4GE-2FXS
4 - *Ranging*	Flashing		ON		ONT 769503-4GE-2FXS and OLT synchronisation
5 - Operational	ON		ON		ONT 769503-4GE-2FXS's normal operational status
6 - *POPUP*	Flashing		OFF		Loss of optical signal detected
7 - *Emergency-Stop*	ON		OFF		Anomalous event

Table 6-6: ONT 769503-4GE-2FXS states

6.2.2 Final checks

Check, using the following table, if the ONT 769503-4GE-2FXS has been successfully registered on the network.

LED	LED Status	Device
A1, (A2/A3/A4/A5), A10 and A11	ON	**ONT 769503-4GE-2FXS**
A13	Flashing*	
A6/A7, 'Power', 'Broadband' and 'Internet'	ON**	
	ON	Home-Gateway

Table 6-7: ONT 769503-4GE-2FXS LED final checks

* When the RF video server is active.

** When the VoIP service is active.

6.2.3 Troubleshooting

The table below, according to the LEDs status, identifies a possible cause and describes the procedure to fix the problem.

LED	State	Possible Cause	Solution
POWER (A1)	OFF	No power supply to the ONT 769503-4GE-2FXS	- Check that the power cable is correctly connected to both the ONT 769503-4GE-2FXS and the adapter at the electrical socket.
ETHERNET (A2 to A5)	OFF	ETHERNET cable incorrectly connected	- Check that the ETHERNET cable is properly connected to the ONT 769503-4GE-2FXS's ETHERNET port and the Home Gateway's WAN port and not, for example, to a LAN port. - Change the ETHERNET cable.
GPON LINK (A10)	OFF	Anomaly in the optical fibre signal	- Check that the optical cable is correctly inserted in both the ONT 769503-4GE-2FXS's internal optical connector and the optical socket. - Check that the fibre is intact, is not dirty and has not been cut or twisted.
AUTH (A11)	OFF		
GPON LINK (A10)	ON	ONT 769503-4GE-2FXS deactivated by the administrator.	Contact the technical support.
AUTH (A11)	OFF		
CATV (A13)	OFF	CATV deactivate in the ONT 769503-4GE-2FXS.	
VOIP (A6 to A7)	OFF	VoIP deactived in the ONT 769503-4GE-2FXS	
GPON LINK (A10)	Blinking	Error in ONT 769503- 4GE-FXS authentication.	

Table 6-8: ONT 769503-4GE-2FXS Troubleshooting

6.3 ONT 769503-MBH

The ONT 769503-MBH has several LEDs to indicate the equipment operational status.

6.3.1 Status

Figure 6-32: ONT 769503-MBH status LEDs

LED	Identification	LED Status	Description
A2	POWER/PROC	ON	Power supply ON
		OFF	Power supply OFF
A3	GPON LINK	Refer to the next table	
A4	AUTH (I)		
A5	Not Available		
A6	ETHERNET (Left)	ON	With Ethernet connection
		OFF	No Ethernet connection
A7	ETHERNET (Right)	Flashing	Ethernet IN/OUT activity

Table 6-9: ONT 769503-MBH states

6.3.2 Final Checks

Check, using the following table, if the ONT has been successfully registered on the network.

LED	LED Status	Device
A2, A3, A4 and A6	ON	**ONT 769503-MBH**
A5	Flashing	

Table 6-10: ONT 769503-MBH LED final checks

6.3.3 Troubleshooting

The table below, according to the LEDs status, identifies a possible cause and describes the procedure to fix the problem.

LED	State	Probable Cause	Solution
POWER (A2)	OFF	ONT not powered	Verify that the DC power TRIDENT connector is correctly connected to the ONT 769503-MBH and the circuit breakers are all up and running.
ETHERNET (Left) (A6)	OFF	ETHERNET cable not connected correctly	Verify that the ETHERNET cable is correctly connected to the ONT 769503-MBH's ETHERNET Port and to the WAN Port of the premises equipment. Use another Ethernet cable
GPON LINK (A3)	OFF	Anomaly in the optical fiber signal	Verify that the optical patchcord is correctly connected to the ONT 769503-MBH's internal optical port and to the local ODF. Verify that the fiber is ok, it is clean, without cuts, scratchings or bendings.
AUTH (A4)	OFF		
GPON LINK (A3)	ON	ONT 769503-MBH deactivated by the network administrator	Contact the technical support.
AUTH (A4)	OFF		
(A5)	Not Available	Not Available	Not Available
GPON LINK (A3)	Blinking	Authentication Error at the ONT 769503-MBH	Contact the technical support.
AUTH (A4)	OFF or Blinking		

Table 6-11: ONT 769503-MBH troubleshooting

7. Glossary of Terms and Abbreviations

3G	Third generation mobile telecommunications
AAA	Authentication, Authorization and Accounting
AC	Alternating Current
AC	Access Concentrator
ACL	Access Control List
ARP	Address Resolution Protocol
AS	Autonomous System
AUTO-MDIX	Medium Dependent Interface Crossover Automatic Choice
BGP	Border Gateway Protocol
CAT5E	Category 5 Cable
CATV	Cable TV
CLI	Command-line interface
CO	Central Office
CPE	Customer-Premises Equipment
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
EAP-SIM	Extensible Authentication Protocol Method for GSM Subscriber Identity Module
FTP	File Transfer Protocol
FTTH	Fiber To The Home
FTTC	Fiber-To-The-Cell
FXS	Foreign eXchange Station
GbE	Gigabit Ethernet
GEM	GPON Encapsulation Module
GPON	Gigabit-capable Passive Optical Network
GSM	Global System for Mobile Communications
GW	Gateway
HG	Home Gateway
HSI	High Speed Internet
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPTV	Internet Protocol Television
ISP	Internet Service Provider
ITU-T	Telecommunications International Telecommunication Union
L2	OSI Layer 2
L3	OSI Layer 3
LAN	Local Area Network
LED	Light Emitting Diode
MAC	Media Access Control
MAP	Mobile Application Part
MBH	Mobile Backhaul
ME	Managed Entity

MEGACO	Media Gateway Control Protocol
MRU	Maximum Receive Unit
MTBF	Mean Time Between Failures
NAS	Network Access Server
NAT	Network Address Translation
NGN	Next Generation Network
NMS	Network Management System
OLT	Optical Line Terminal
OMCI	ONT Management Control Interface
ONT	Optical Network Terminal
OPEX	Operational Expenditure
OSI	Open Systems Interconnection
PC	Personal Computer
PON	Passive Optical Network
PPPoE	Point-to-Point Protocol over Ethernet
PWLAN	Public Wireless LAN
RADIUS	Remote Authentication Dial In User Service
RF	Radio Frequency
RGW	Residential Gateway
RJ11	Registered Jack model 11
RJ45	Registered Jack model 45
SC/APC	SC/APC optical connector
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SS7	Signalling System No. 7
SSID	Service Set IDentifier
STB	Set Top Box
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TR-069	Technical Report 069
TV	Television
UDP	User Datagram Protocol
URL	Uniform Resource Locator
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair
VAP	Virtual Access Point
VID	VLAN Identifier
VLAN	Virtual Local Area Networks
VoIP	Voice over Internet Protocol
WAN	Wide Area Network
WEP	Wired Equivalent Privacy
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network
WPA	Wi-Fi Protected Access
xBASE-T	Ethernet ovr twisted pair technologies


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