

ALTICE LABS MANUAL



User Manual – FGW GR140DG Wi-Fi 6

GR140DG

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1 Table of Contents

1 Table of Contents	5
Index of Figures	9
Index of Tables	11
2 FiberGateway	15
2.1 Summary	15
2.2 Technical Description	15
2.2.1 FiberGateway Main Functionalities	15
2.2.2 FiberGateway Application Scenario	16
2.2.3 Interoperability	16
2.2.4 Interfaces	18
2.3 General Features	18
2.4 General Architecture	21
2.4.1.1 GPON	21
2.4.1.2 Ethernet	21
2.4.1.3 IPTV	21
2.4.1.4 Supported VoIP specifications:	21
2.4.1.4.1 Supported interfaces	21
2.4.1.4.2 Logical interface (VLAN encapsulation)	22
2.4.1.4.3 Physical interface (FXS ports)	22
2.4.1.5 Wi-Fi	22
2.4.1.5.1 Interfaces and features	24
2.4.1.5.2 Data Rates	24
2.4.1.5.3 Antennas	24
2.5 Multiple QoS per VLAN	24
2.6 Policing/Rate Limiting	24
2.6.1 Downstream QoS	24
2.6.2 Upstream QoS	25
2.6.3 Dynamic Bandwidth Allocation (DBA)	26
2.6.4 Upstream QoS scenarios	27
3 Technical specifications	28
3.1 Interfaces	28
3.1.1 GPON	28
3.1.1.1 Optical Interfaces	28
3.1.2 Ethernet	29
3.1.3 Interface FXS	29
3.1.4 Wi-Fi	30
3.2 General Features	31
3.3 General Service Description	32
3.4 Optical metering	33
3.5 Wavelength filtering	33
3.6 GPON/Ethernet characteristics	34
3.7 GPON - Management	35
3.8 Standards	35
4 Setup	37
4.1 Equipment Connectivity	37
4.2 FiberGateway LEDs	38
4.3 Typical FiberGateway usage scenario	39
4.4 Before installing the FiberGateway equipment	40
4.4.1 Safety Warnings	40
4.4.2 Wireless network installation best practices	41
4.5 Connections	41
4.6 FiberGateway Setup	41
4.6.1 Network Provider Connection	42

4.6.2	Mains connection and power up	43
5	Configuration	45
5.1	Costumization.....	45
5.2	Software download from the OLT	45
6	WebGUI.....	47
6.1	General access	47
6.1.1	Equipment Menu.....	49
6.1.2	Functional Menu.....	50
6.1.3	Main Window.....	51
6.2	Equipment menu	52
6.2.1	FGW FiberGateway	52
6.2.2	LAN (<i>Local Area Network</i>)	54
6.2.2.1	Caracteristics	54
6.2.2.1.1	DHCP Server.....	56
6.2.2.1.2	IPv6 Information.....	57
6.2.2.1.3	Interfaces	57
6.2.2.2	Devices	58
6.2.2.3	Statistics.....	59
6.2.2.4	Static Leases	59
6.2.3	WAN <i>Wide Area Network</i>	61
6.2.3.1	Caracteristics	61
6.2.3.1.1	General information	62
6.2.3.1.2	Informação de IPv6	62
6.2.3.1.3	Optical interface information	63
6.2.3.2	Statistics.....	64
6.2.3.3	Routing table	65
6.2.4	Wi-Fi.....	66
6.2.4.1	Features.....	67
6.2.4.1.1	Wi-Fi Settings	68
6.2.4.1.1.1	General Settings.....	68
6.2.4.1.1.2	Primary network.....	69
6.2.4.1.1.3	Guest network	70
6.2.4.2	Security	71
6.2.4.2.1	2.4GHz / 5GHz MAC Filtering	72
6.2.4.3	Dispositivos	73
6.2.4.3.1	Display filters	74
6.2.4.4	Statistics.....	75
6.2.4.5	Neighbors	75
6.2.4.5.1	2.4GHz Neighbors	75
6.2.4.5.2	5GHz Neighbors	76
6.2.4.6	Noise	77
6.2.4.6.1	2.4GHz Noise	78
6.2.4.6.2	5GHz Noise	78
6.2.4.7	Channel capacity	79
6.2.4.7.1	Channel capacity of 2.4GHz	79
6.2.4.7.2	Channel capacity of 5GHz	79
6.2.5	Voice	80
6.2.5.1	Caracteristics	80
6.2.5.1.1	SIP Account	80
6.2.6	Television	81
6.2.6.1	Set top Boxes / IGMP Clients	81
6.3	Functional Menu.....	83
6.3.1	Security	84
6.3.1.1	Settings	84
6.3.1.1.1	Firewall and DMZ.....	85
6.3.1.2	Access window	86
6.3.1.2.1	Port forwarding	87
6.3.1.2.2	Ports activation	89
6.3.2	Services	90

6.3.2.1	Dynamic DNS	91
6.3.2.2	UPnP	91
6.3.3	Tools	92
6.3.4	My account	94
6.3.4.1	User settings	94
7	Operational indicators	96
7.1	FiberGateway	96
7.1.1	LED Status Indicators	96
7.1.2	Troubleshooting FiberGateway	98
8	Glossary	99

Index of Figures

Figure 1: FTTx architecture	16
Figure 2: Link Layer Configuration and Management	17
Figure 3: FiberGateway equipment Configuration	17
Figure 4: IP Based services-TR069 Configuration	18
Figure 5: Optical fiber Internet service user access	19
Figure 6: Stack of protocols for GPON architecture	20
Figure 7: TR-142 Framework	20
Figure 8: FiberGateway circuit block diagram	23
Figure 9: Downstream QoS diagram	25
Figure 10: Upstream QoS diagram	26
Figure 11: Traffic distribution by service/client	27
Figure 12: FiberGateway connectivity general view	37
Figure 13: FiberGateway Status LEDs	38
Figure 14: FiberGateway Typical usage scenario - Home network connections	40
Figure 15: Network provider connection	42
Figure 16: Login to FiberGateway	47
Figure 17: FiberGateway management window	48
Figure 18: Menu Equipamento	49
Figure 19: Functional Menu	50
Figure 20: Main page	51
Figure 21: Equipment Menu – FGW	52
Figure 22: Information about FiberGateway	53
Figure 23: Equipment Menu – LAN	54
Figure 24: LAN (<i>Local Area Network</i>) – Caracteristics	55
Figure 25: DHCP Server Primary Networks - Edition	56
Figure 26: IPv6 Information	57
Figure 27: Interfaces	57
Figure 28: LAN (<i>Local Area Network</i>) - Devices I	58
Figure 29: LAN (<i>Local Area Network</i>) - Devices II	58
Figure 30: LAN (<i>Local Area Network</i>) - Statistics	59
Figure 31: LAN (<i>Local Area Network</i>) – Static Leases	59
Figure 32: LAN (<i>Local Area Network</i>) – <i>Lease</i> estático Criar	60
Figure 33: Equipment Menu - WAN	61
Figure 34: WAN (<i>Wide Area Network</i>) – General information	62
Figure 35: WAN (<i>Wide Area Network</i>) – Informação IPv6	63
Figure 36: WAN (<i>Wide Area Network</i>) – Optical interface	63
Figure 37: WAN (<i>Wide Area Network</i>) – Statistics	64
Figure 38: WAN (<i>Wide Area Network</i>) – Routing table	65
Figure 39: Equipment Menu - Wi-Fi	66
Figure 40: Wi-Fi – Charateristics	66
Figure 41: Wi-Fi - Features	67
Figure 42: FiberGateway Sticker	67
Figure 43: General Settings	68
Figure 44: Wi-Fi 2.4GHz and 5GHz – Primary Network Edition	69
Figure 45: Wi-Fi 2.4GHz and 5GHz – Guest Network Edition	70

Figure 46: Wi-Fi Security	71
Figure 47: Wi-Fi Security - Add MAC Filter	72
Figure 48: Wi-Fi – Devices I	73
Figure 49: Wi-Fi – Devices II	73
Figure 50: Wi-Fi – Display filter	74
Figure 51: Wi-Fi – Statistics.....	75
Figure 52: Wi-Fi – Neighbors.....	75
Figure 53: Neighbors 2.4GHz.....	76
Figure 54: Neighbors 5GHz.....	77
Figure 55: Wi-Fi – Neighbors.....	77
Figure 56: 2.4GHz Noise	78
Figure 57: 5GHz Noise	78
Figure 58: Channel capacity	79
Figure 59: Channel capacity of 2.4GHz	79
Figure 60: Channel capacity of 5GHz	79
Figure 61: Equipment Menu - Voice	80
Figure 62: Voice - Details	80
Figure 63: Equipment Menu - Television.....	81
Figure 64: Television - Details	82
Figure 65: Functional Menu.....	83
Figure 66: Functional Menu - Home	83
Figure 67: Functional Menu - Security	84
Figure 68: Functional Menu - Security Settings	85
Figure 69: Security - Firewall and DMZ.....	85
Figure 70: Functional Menu - Access	86
Figure 71: Access – Port forwarding	87
Figure 72: Access - Create port forwarding rule	88
Figure 73: Access - Create port activation rule	89
Figure 74: Create port activation rule	90
Figure 75: Functional Menu - Services.....	90
Figure 76: Dynamic DNS - general settings	91
Figure 77: UPnP - Enable.....	92
Figure 78: Menu Funcional – Ferramentas	92
Figure 79: Tools - Resets	93
Figure 80: Tools – Software upgrade	93
Figure 81: Tools – Diagnostics tools	94
Figure 82: Functional Menu - My Account.....	94
Figure 83: My Account - User Settings.....	94
Figure 84: FiberGateway status LEDs	96

Index of Tables

Tabel 1: T-CONT types definition	26
Tabel 2: Alloc-ID's distribution by T-CONT type.....	27
Tabel 3: Optical interfaces specifications	29
Tabel 4: FXS interface specifications FXS ⁰	30
Tabel 5: WI-FI specification	31
Tabel 6: General Features.....	32
Tabel 7: Wavelength planning	34
Tabel 8: Standards compliance.....	36
Tabel 9: FiberGateway connectivity description.....	38
Tabel 10: LEDs Status information.....	39
Tabel 11: LEDs Status information (PON LINK & PON AUTH)	39
Tabel 12: Connections description	40
Tabel 13: material required for instalation	41
Tabel 14: FiberGateway Parameter Information	53
Tabel 15: DHCP Server - Parameters	56
Tabel 16: AN (Local Area Network) - Parameters.....	57
Tabel 17: LAN (<i>Local Area Network</i>) – Devices.....	58
Tabel 18: LAN (<i>Local Area Network</i>) – Statistics	59
Tabel 19: LAN (<i>Local Area Network</i>) – lease Static.....	60
Tabel 20: WAN (<i>Wide Area Network</i>) – General information.....	62
Tabel 21: WAN (<i>Wide Area Network</i>) – IPv6 Information	63
Tabel 22: WAN (<i>Wide Area Network</i>) – Optical interface	64
Tabel 23: WAN (<i>Wide Area Network</i>) – Parameters	64
Tabel 24: WAN (<i>Wide Area Network</i>) – Routing table	65
Tabel 25: Wi-Fi 2.4GHz 5GHz Rede primária – Parâmetros	69
Tabel 26: Wi-Fi 2.4GHz e 5GHz Rede guest – Parâmetros	70
Tabel 27: Wi-Fi Security - Parameters	73
Tabel 28: Wi-Fi Devices - Parameters	74
Tabel 29: Wi-Fi Statistics - Parameters.....	75
Tabel 30: 2.4GHz Neighbors – Parameters	76
Tabel 31: 5GHz Neighbors - Parameters	77
Tabel 32: Voice - Parameters.....	81
Tabel 33: Television - Parameters	82
Tabel 34: Security - Parameters.....	86
Tabel 35: Security - Port forwarding	89
Tabel 36: Security - Access.....	90
Tabel 37: Dynamic DNS - general settings	91
Tabel 38: UPnP – parameters	92
Tabel 39: Tools – Resets.....	93
Tabel 40: User settings.....	95
Tabel 41: LEDs Status information.....	97
Tabel 11: LEDs Status information (PON LINK & PON AUTH)	97
Tabel 43: Troubleshooting FiberGateway	98

This User Manual is applicable to the equipment FiberGateway Altice GR140DG with the FCC ID: 2ACJF-FGW-GR140DG

FCC NOTICE

This device complies with FCC part 15 rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference and
2. This device must accept any interference, including interference that may cause undesired operation of the device

Caution:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device meets the FCC requirements for RF exposure in public or uncontrolled environments.

RF Exposure Statement

Note: This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

This equipment should be installed and operated with a minimum distance of 7.9 inches (20 cm) between the radiator and your body.

This system has been evaluated for RF exposure for humans in reference to ANSI C 95.1 (American National Standards Institute) limits.

The evaluation was based in accordance with FCC OET Bulletin 65C rev 01.01 in compliance with Part 2.1091 and Part 15.27.

The minimum separation distance from the antenna to general bystander is 7.9 inches (20 cm) to maintain compliance.

2 FiberGateway

2.1 Summary

The FiberGateway is an Optical Terminal Equipment (ONT) unit for Passive Optical Networks (PON) termination in a FTTH (Fiber-To-The-Home) service delivery architecture. FiberGateway 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), video (IPTV) and WPS (WI-FI Protected Setup). The use of the GPON fiber access technology does allow a significant service delivery increase when compared with traditional xDSL technologies.

The FiberGateway 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), an optical network 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 FiberGateway the most efficient option for passive optical network topologies, when integrated service delivery is an issue.

Together with multi-vendor OLT interoperability, other differentiated features of the FiberGateway product include the use of an embedded optical reflective component that increases probing resolution in case of FTTH probing. The FiberGateway is also one of the first single household integrated CPE solution (ONT+GATEWAY).

As opposed to the point-to-point architecture, in which there is one physical port per client in the Central Office, in GPON point-to-multipoint architecture there is only a single laser and photo-detector in the Central Office (CO) to serve up to 128 CPEs. All the Optical Distribution Network is built by means of passive equipment modules with a long live MTBF standards and very low OPEX

2.2 Technical Description

2.2.1 FiberGateway Main Functionalities

The FiberGateway 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 broadband service pack.

Broadband service applications are commonly referred as below:

- High speed internet (HSI);
- Voice (VoIP) services (SIP/MEGACO H.248);
- TV (IPTV);
- WI-FI.

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

2.2.2 FiberGateway Application Scenario

The next figure shows a possible gateway scenario for FiberGateway equipments when in an FTTx architecture.

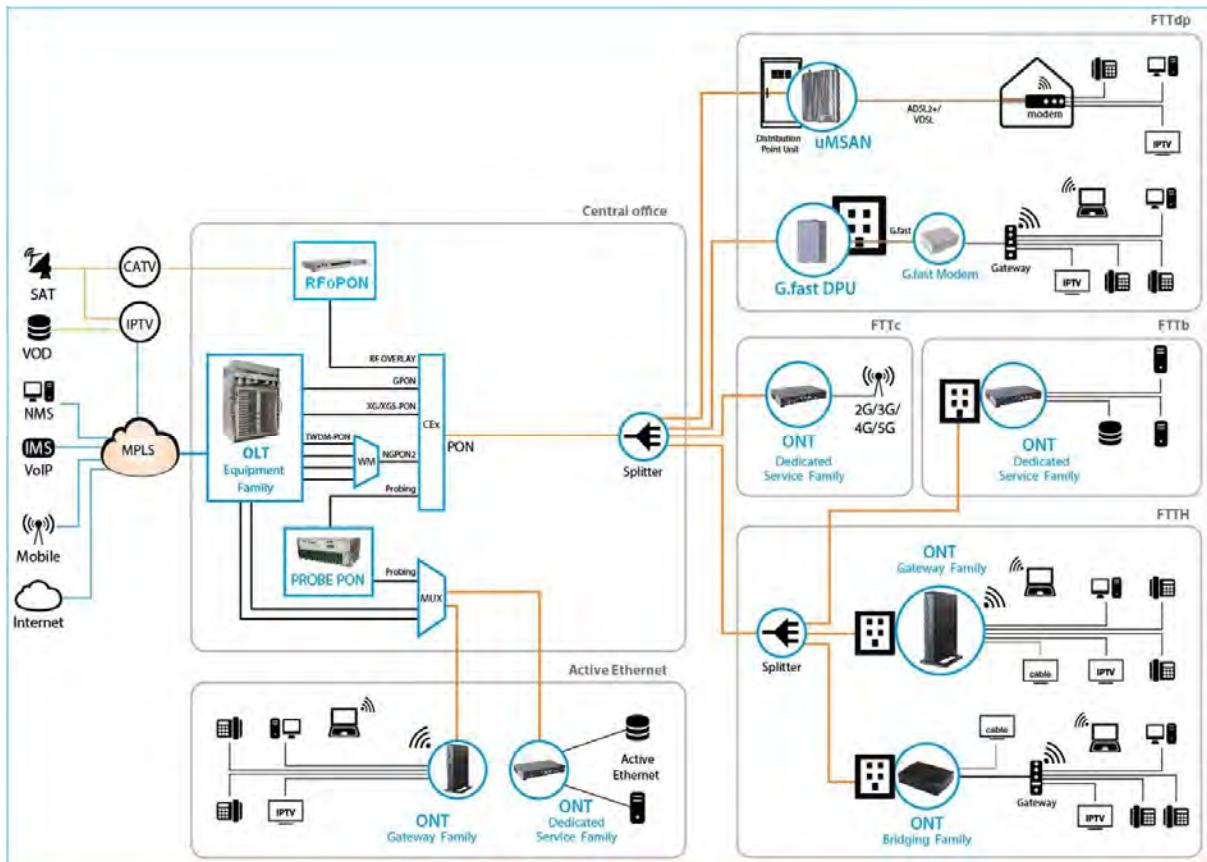


Figure 1: FTTx architecture

2.2.3 Interoperability

FiberGateway equipment complies with ITU-T G.984.x recommendation as like as G.984.4 (OMCI) ensuring multi-vendor OLT interoperability with major GPON OLT vendors, as defined in BBF.247 ONU certification program.

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

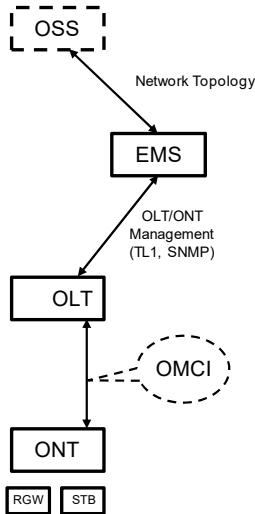


Figure 2: Link Layer Configuration and Management

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.

ONT gateway family equipments integrate gateway functionalities. Link layer Configuration and management is achieved by the use of OMCI, while IP-based services (RG functionality and Voice over IP) are configured and managed by TR-069.

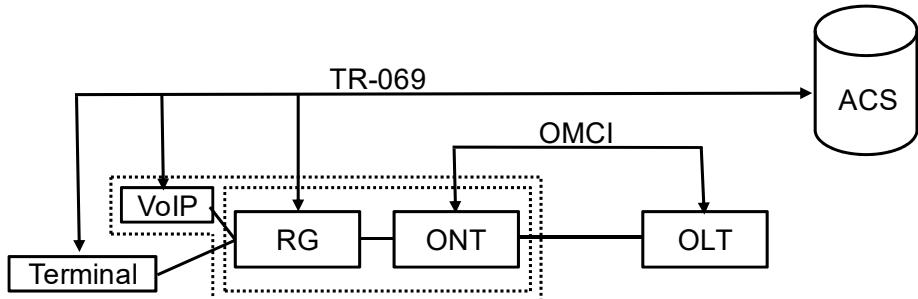


Figure 3: FiberGateway equipment Configuration

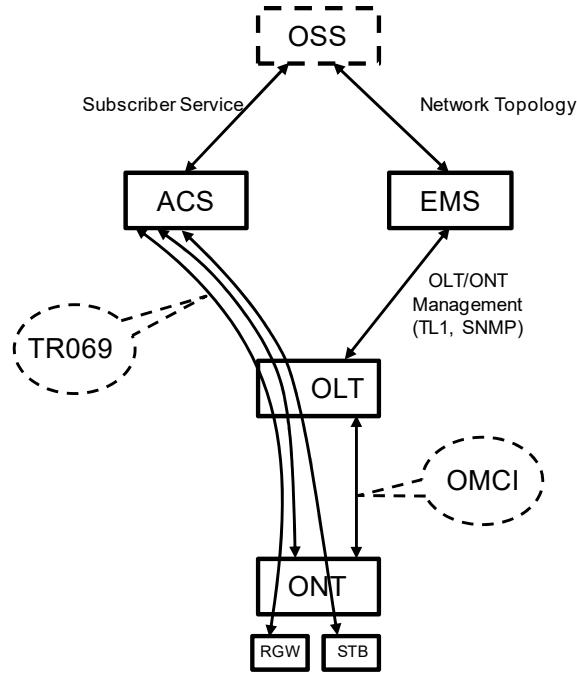


Figure 4: IP Based services-TR069 Configuration

2.2.4 Interfaces

Client interface options are of type:

- 4x 10/100/1000Base-T for Ethernet network connection (RJ45 connectors);
- 1x FXS channels (RJ11 connectors);
- Wi-Fi (dual-band concurrent):
 - SISO 1x1 @ 2.4GHz (802.11b)
 - MIMO 4x4 @ 2.4GHz wireless interfaces (802.11 g/n/ax);
 - MIMO 4x4 @ 5.0 GHz wireless interfaces (802.11 a/n/ac/ax);
- 1x USB 3.1 Type C;
- Control switches for power and Wi-Fi;

Network interface option is of type:

- GPON SC/APC Optical connector (B+/C+).

2.3 General Features

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 terminals in order to provide time slot assignments for upstream communication.

In Figure 5 it is shown a scenario for a multi-service user domain basic architecture through an ISP.

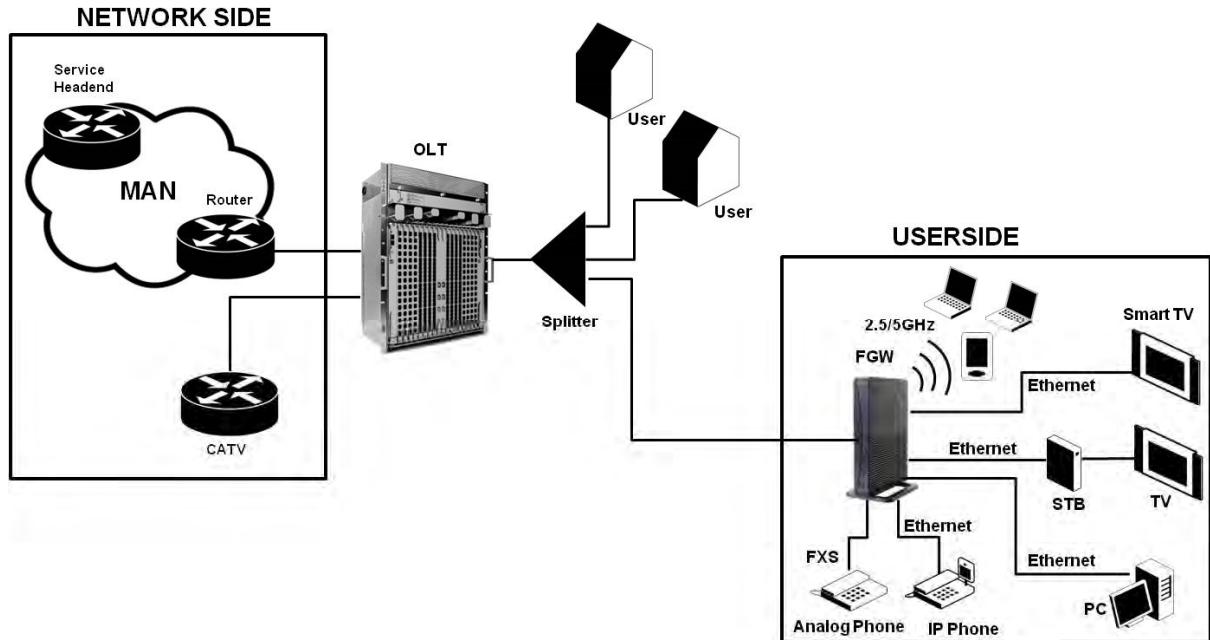


Figure 5: Optical fiber Internet service user access

In the upstream direction, the FiberGateway is connected to the optical splitter and respectively to the OLT through the PON port to provide integrated access services through the service headend.

In the downstream direction, the FiberGateway is connected to various terminals through the following LAN-side ports to implement multi-play services:

- Four 10/100/1000M Base-T Ethernet ports, which can be connected to terminals such as PCs, STBs, and video phones to provide the high-speed data and video services;
- One FXS ports, which can be connected to telephone sets to provide VoIP services;
- Four Wi-Fi antennas, which can connect to Wi-Fi terminals wirelessly to provide a secure and reliable high-speed wireless network;
- One USB port, which can be connected to a USB storage device to provide convenient storage and file sharing services within a home network;

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 next figure

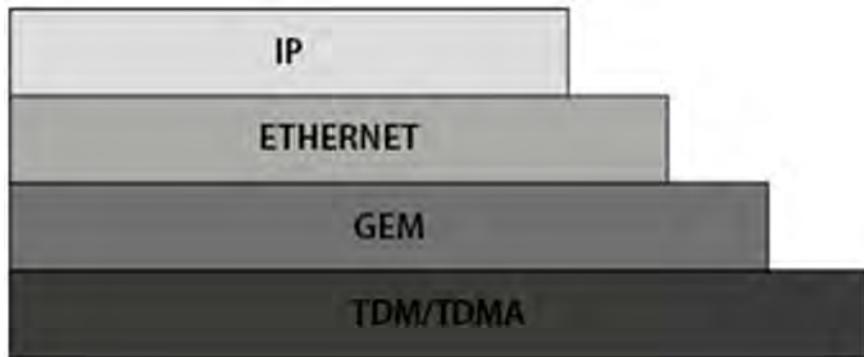


Figure 6: Stack of protocols for GPON architecture

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.

FiberGateway complies with Broadband Forum TR-142 Technical Report, which defines a framework for the remote configuration and management of IP-based services over PON (Passive Optical Network) and fiber access technology.

TR-142 framework uses TR-069 which is the protocol of choice for the remote management and configuration of IP services over PON and fiber access networks. TR-069 is intended to be used for the remote configuration and management of IP services running over ONT, as well as for some aspects of ONT management.

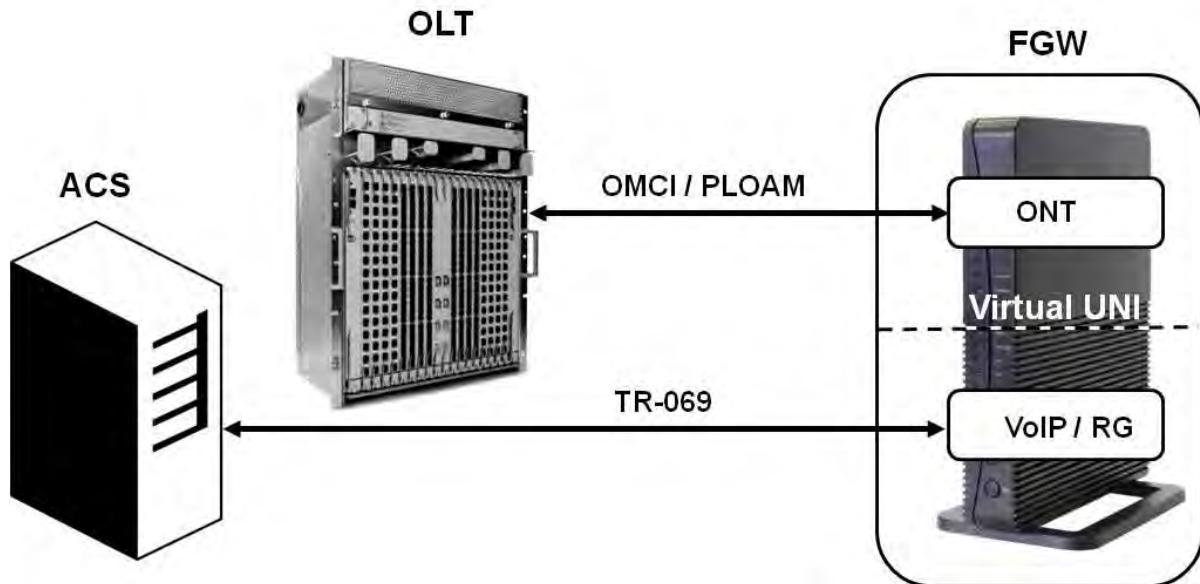


Figure 7: TR-142 Framework

TR-142 framework defines a virtual UNI between the OMCI (ONT Management Control Interface) and TR-069 management domains.

This framework allows PON CPE with L3 layer capabilities to be mass remotely configured, troubleshoot and managed by an ACS (Auto Configuration Server) using TR-069 CPE WAN Management Protocol.

2.4 General Architecture

The GPON IC Processing unit is the core component inside FiberGateway. It is responsible for the interconnection and processing between client side interfacing and optical GPON Uplink interface.

2.4.1.1 GPON

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

2.4.1.2 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 FiberGateway equipment both WAN and LAN type of physical interfaces is 10/100/1000BASE-T AUTO-MIX Ethernet type over RJ45 connectors.

2.4.1.3 IPTV

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

2.4.1.4 Supported VoIP specifications:

- Call control: SIPv1/v2;
- T.38 Fax relay;
- Fax/Data bypass;
- Echo canceller;
- Echo canceller length;
- Jitter buffer;
- Caller ID generation;
- G.711 PCMU;
- G.711 PCMA;
- G.723.1;
- G.726;
- G.729;
- VAD and CNG;
- Caller ID and call waiting;
- RTP/RTCP packet encapsulation;
- RFC 2833 Support;
- In-band signaling detection and generation (DTMF, call progress tones).
- Automatic Tone generation (dial, busy, ring back, stutter, distinctive ring);
- 3-Way conferencing.

2.4.1.4.1 Supported interfaces

FiberGateway voice service provisioning could be made through OLT configurations over OMCI messages or could be downloaded (FTP) from the OLT up to the FiberGateway after its registration on

the PON network. FiberGateway equipments have the ability to deliver the Voice service over two types of interface:

2.4.1.4.2 Logical interface (VLAN encapsulation)

If the FiberGateway 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. FiberGateway 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.

2.4.1.4.3 Physical interface (FXS ports)

The FiberGateway has physical RJ11 FXS interface. In this version of the FiberGateway equipment, voice interface is 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 FiberGateway will allow VoIP or NGN (Next Generation Network) traffic from devices connected to the RJ11 or RJ45 interfaces, towards the same internal VLAN.

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

The FiberGateway equipment has a DHCP client to get an IP address, alternatively the FiberGateway could be configured with a static IP. The configuration of the static IP or DHCP client is related to the WAN side and is enabled by the OLT.

2.4.1.5 WI-FI

FiberGateway circuit block diagram is presented in the figure bellow showing all oscillators in the device and its frequencies, Figure 8. Intentional radiators in the circuit and radio signal path between circuit blocks are also shown.

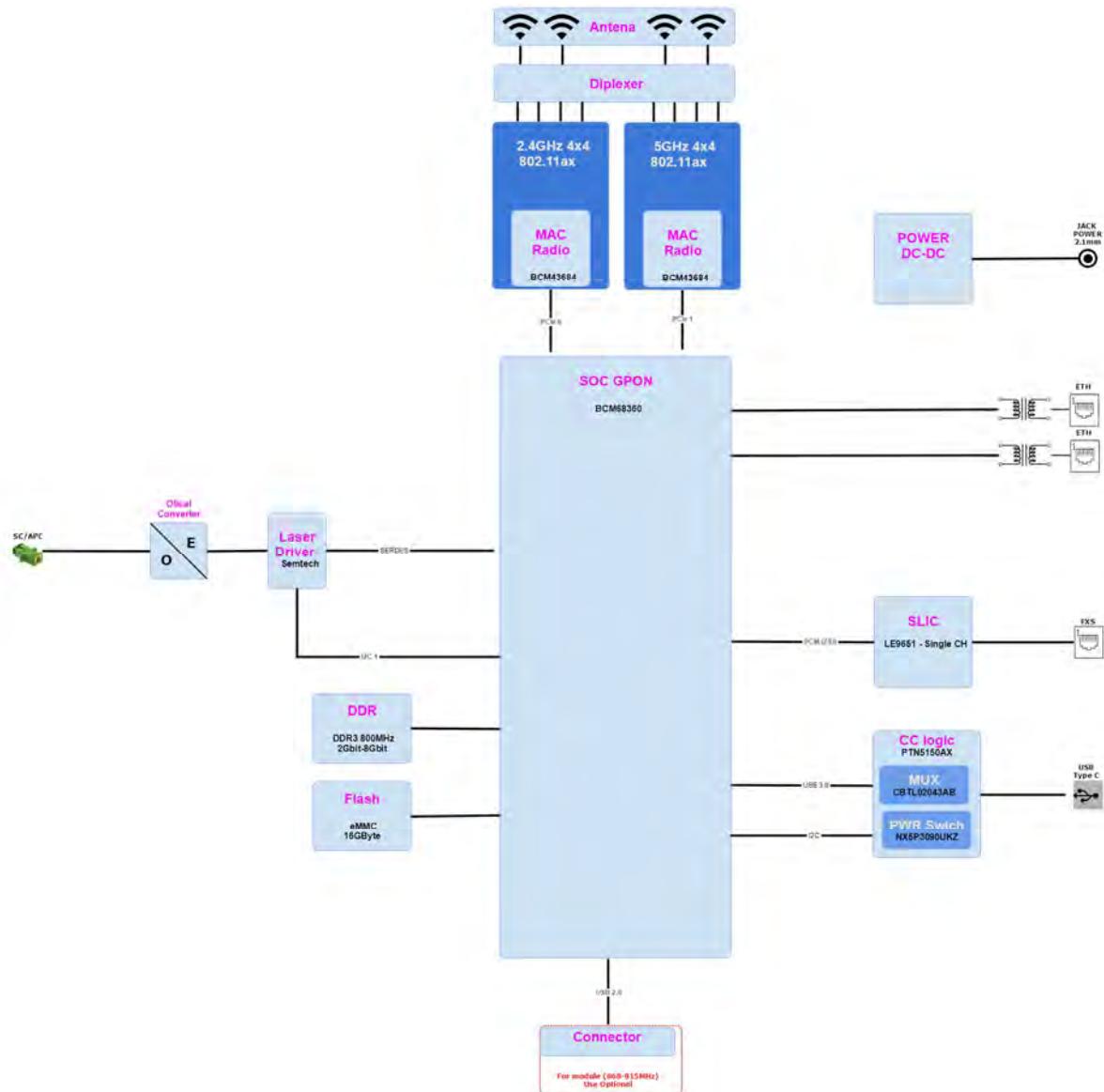


Figure 8: FiberGateway circuit block diagram

FiberGateway supports WI-FI, with a WIFI interface Functionalities:

- 802.1x Authentication; External RADIUS Authentication;
- WPA / WPA2 Protected access; 64/128 Bits WEP;
- Cryptography; AES and TKIP encryption;
- Wi-Fi multimedia support: WMM and WMM-PS;
- Multiple profiles of SSIDs;
- Integrated MAC address filtering;
- WPS (key and PIN entry);
- Hotspot 2.0

2.4.1.5.1 Interfaces and features

- Concurrent mode 2.4GHz + 5GHz via 4 dual-band internal antennas
- 2.4GHz: Compatible with IEEE 802.11b 1x1 SISO and 802.11g/n/ax 4x4 MIMO
- 5GHz: Compatible with IEEE 802.11 a/n/ac/ax 4x4 MIMO
- Channel bandwidth: 20, 40, 80 MHz
- Multi User MIMO for best performance per user

2.4.1.5.2 Data Rates

- 802.11a : 6,9,12,18,24,36,48,54 Mbps
- 802.11b : 1, 2, 5.5, 11 Mbps
- 802.11g : 6,9,12,18,24,36,48,54 Mbps
- 802.11n : up to 600 Mbps
- 802.11ac : up to 1733 Mbps
- 802.11ax : up to 4800 Mbps

2.4.1.5.3 Antennas

- 4x4 MIMO antennas
- Internal antennas with 4~5dBi antenna gain

2.5 Multiple QoS per VLAN

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

2.6 Policing/Rate Limiting

2.6.1 Downstream QoS

The OLT system supports traffic classification at the ingress ports (ETH, LAGs, PON, etc) based on P-Bits, IP DSCP and IP.

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/DSCP is mapped in one of eight queues of each port.

For each 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.

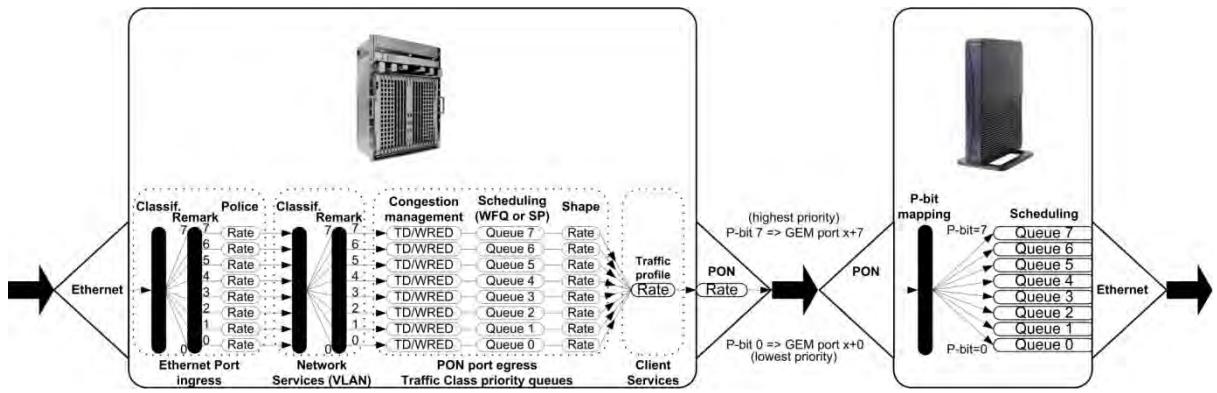


Figure 9: Downstream QoS diagram

In the downstream direction, Figure 9, the ingress traffic can be firstly classified. It passes by a policer and is configured to each ONT service, which is defined by one or two tags. It is remarked and policed per-CoS rate (port profile).

After this, Network services (per VLAN) classification determine the PON port queue where packets will wait for a transmission opportunity, and can remark the CoS (P-bits in VLAN PCP). The traffic is put in a queue according with the p-bit/DSCP->Traffic Class mapping.

Each of these Traffic Classes is associated with a scheduler (WRR or SP) and a policer.

Queue congestion management is used to prevent the queue from overflowing and is performed based on Tail Drop or WRED.

Each queue is served by either a priority or weighted scheduler and rate controlled.

Then Traffic Classes to P-bit remarking is done and the traffic flows to the GPON interface.

Destination ONU/ONT client service downstream profile defines traffic classless policing. The overall PON port may be limited to a percentage of its capacity.

Traffic arriving to the ONU/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 10: Upstream QoS diagram

2.6.2 Upstream QoS

In the upstream, Figure 11: Traffic distribution by service/client

, for each T-CONT DBA 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, (in case the ingress traffic is untagged a DSCP->p-bit mapping is performed).

These queues have a Strict Priority Scheduler. Packets are stored at the intended T-CONT priority queue, which is scheduled according to ONT configuration.

The ONT “waits” until the OLT assigns a transmission timeslot for that T-CONT, according to DBA, so that the most prioritized queues are the ones that transmit first.

In the OLT PON ingress port, traffic is remarked and can be policed per-CoS. The traffic is put into a Traffic Class according with what is defined in the p-bit/DSCP->queue mapping.

Each of these Traffic Classes has an associated scheduler and policer. Queue management is performed based on Tail Drop or WRED. Then Traffic Classes to P-bit remarking is done and the traffic is sent to the uplink, Figure 11: Traffic distribution by service/client

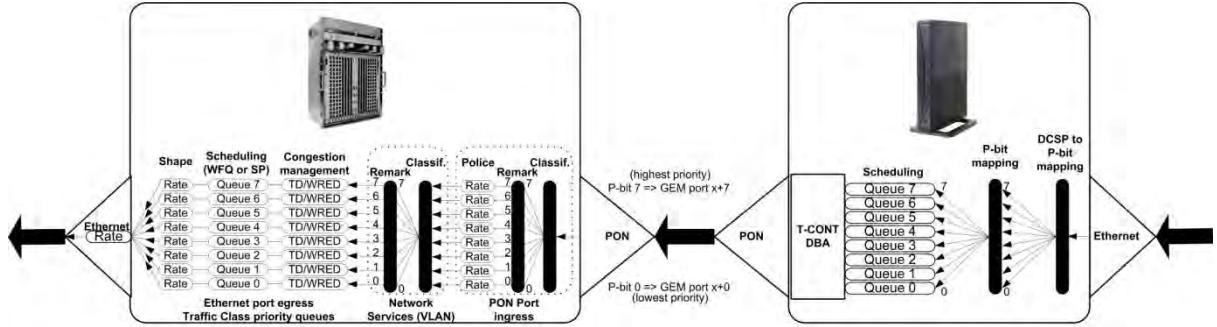


Figure 10: Upstream QoS diagram

2.6.3 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 Bandwidth

T-CONT (Bandwidth)	Type 1	Type 2	Type 3	Type 4	Type 5	Uni.
Fixed - R_F	R_{F1}	0	0	0	R_{F5}	[b/s]
Guaranteed - R_A	0	R_{A2}	R_{A3}	0	R_{A5}	[b/s]
Maximum - 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	Not Assured - R_{NA}	Best effort - R_{BE}	R_{NA} / R_{BE}	

Tabel 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

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

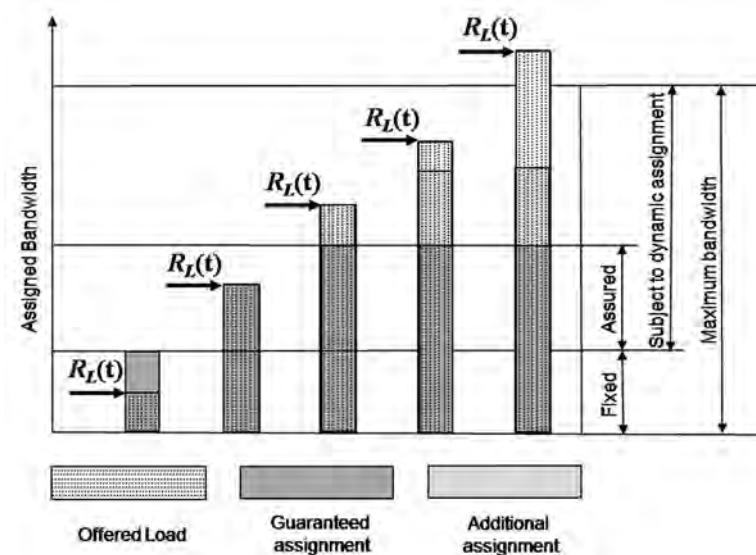


Figure 11: Traffic distribution by service/client

2.6.4 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)

3 Technical specifications

3.1 Interfaces

3.1.1 GPON

The FiberGateway GPON G.984.x layer uses 1490nm downstream and 1310nm upstream optical wavelengths, with 2.488Gbps downstream and 1.244Gbps upstream by using an SC/APC protected optical connector

3.1.1.1 Optical Interfaces

Items	Unit	B+	C+
		FiberGateway Tx	FiberGateway 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
		FiberGateway Rx	FiberGateway 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

Items	Unit	B+	C+
Bit error ratio	--	<-10 ⁻¹⁰	<-10 ⁻¹⁰
Minimum sensitivity	dBm	-27	-30 ⁽¹⁾
Minimum overload	dBm	-8	-8 ⁽²⁾
Upstream optical penalty	dB	0.5	0.5
Consecutive identical digit immunity	bit	>72	>72
Tolerance to reflected optical power	dB	<10	<10

Tabel 3: Optical interfaces specifications

3.1.2 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 FiberGateway equipment the LAN type of physical interfaces is 10/100/1000BASE-T AUTO-MIX Ethernet type over RJ45 connectors.

3.1.3 Interface FXS

Items	State	Description
DC voltage (V)	48V (21 to 56.5V)	According to ANSI/TI A-1063
Ringer voltage (V)	DC offset: 12 Vdc AC Voltage: 56 Vac rms Frequency: 20 Hz	Max Vac + Vdc: 68 pk
Ringing signal cadence	normal ringing	2 sec ring / 4 sec pause
REN	ringer equivalence numbers	Maximum ringer load: 5
Loop Current Characteristics (A)	25 mA (max)	-

¹ ONT RX= -8~ -30 dBm (The equipment 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+ diplexer is embedded on the FiberGateway 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).

Optical Metering – G.984.2 Amd 2 Table IV.1/G.984.2 – Optical Line Supervision related measurement specifications (the measurement accuracy is +/- 3dBm maximum).

² idem

Hook flash	on-hook - register recall/hook flash	150 msec	Minimum time of recognition of “on-hook” when hook-flash feature does not exist
	on-hook - register recall/hook flash	1100 msec	Minimum time “on-hook” recognition when hook-flash feature does exist
	off-hook	40 msec	minimum time “off-hook” recognition
	interval	300 msec – 1100 msec	Time calibrated break pulse duration for register recall recognition
Pulse Dialing Detection	Pulse Frequency: 10 Hz (8 Hz to 12 Hz) Pulse Relation (%): 60/40	-	
DTMF Dialing Detection	-	According to ANSI/TI A-1063	
Clip	-	According to ANSI/TI A-1063	
Clip on Call Waiting	-	According to ANSI/TI A-1063	

Tabel 4: FXS interface specifications FXS⁽³⁾

3.1.4 Wi-Fi

Items	Compliance	Description
	IEEE 802.11 b/g/n/ac/ax	-
Bit Rates	802.11 b/g	1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48 and 54Mb/s
	802.11 n	Up to 600Mb/s over four spatial streams in the 2.4GHz band; Up to 600Mb/s over four spatial streams in the 5GHz band
	802.11 ac	Up to 1733Mb/s over four spatial streams in the 5GHz band
	802.11 ax	Up to 4800Mb/s over four spatial streams in the 5GHz band
SSID	-	Up to 8
Operation Frequencies	-	2.4GHz (ISM) or 5GHz (UNII-1)
Channel Bandwidths	-	20MHz and 40MHz channels in the 2.4GHz band; 20MHz, 40MHz, 80MHz channels in the 5GHz band
MIMO	-	4x4
MCS	-	Supported values: 0-31 and 32 for 802.11n 0-9 for 802.11ac - Proprietary 10 -11 (1024QAM) 0-11 for 802.11ax

³ The values of the specific parameters of the FXS interface vary according to the standards adopted by the country. The values in the FiberGateway FXS Interface Specifications table are configurable in the web management interface in the Voice menu, item ConSIG Basic Settings, selecting the location (Country) where FiberGateway will be used. See SIP section for details on this setup.

Items	Compliance	Description
Wireless Security	WEP	40bit secure key and 24 bit as defined in 802.11-2007
	WPA	
	WPA2	
	AES	encryption/de-encryption coupled to TKIP (as defined in 802.11-2007 and 802.1X)
Short Guard Interval	SGI support	-
Space-Time Block Coding	STBC support	-
Transmit Power (e.ir.p.)	-	Up to +34dBm in the 2.4GHz band; Up to +34dBm in the 5GHz band;
Receive Sensitivity	Mode b (8% PER)	1Mb/s: -96dBm 11Mb/s: -88dBm
	Mode g (10% PER)	6Mb/s: -90dBm 12Mb/s: -89dBm 54Mb/s: -75dBm
	Mode n/2.4GHz (10% PER)	1Mb/s: -96dBm 54Mb/s: -75dBm M0/20MHz: -88 dBm M0/40MHz: -85 dBm M7/20MHz: -66 dBm M7/40MHz: -63 dBm
	Mode n/5GHz (10% PER)	6Mb/s: -89 dBm 54Mb/s: -74 dBm M0/20MHz: -87 dBm M0/40MHz: -83 dBm M7/20MHz: -64 dBm M7/40MHz: -61 dBm
	Mode ac/5GHz (10% PER)	M0/20MHz: -87 dBm M0/40MHz: -83 dBm M0/80MHz: -80 dBm M9/20MHz: -58 dBm M9/40MHz: -55 dBm M9/80MHz: -52 dBm

Tabel 5: WI-FI specification

3.2 General Features

Features	FiberGateway
GPON	1x Singlemode Optical Fiber Cable (SC/APC Connector)
Ethernet 10/100/1000Base-T	4x Ethernet UTP CAT5E direct or crossover AUTO-MDIX cable (RJ45)
FXS Ports	2x voice / fax RJ11 connector
USB Ports	1x USB 2.0
Wi-Fi (802.11a/b/g/n/ac)	Yes
ON/OFF button	Yes
RESET button	Yes

Features	FiberGateway
OLT Interoperability (BBF.247)	Yes
DHCP Client	Yes
Number of GEM ports	256
Number of T-CONT	32
Primary Power Connection (VDC)	12 ($\pm 15\%$)
Primary Power Connection (VAC)	120V AC 60Hz $\pm 2\text{Hz}$
AC/DC Adapter Max Power (W)	48
AC/DC Adapter Energy Efficiency	European Code of Conduct on Energy Consumption of External Power Supplies V5 U.S. Department of Energy (DoE) Level VI
Energy Efficiency	European Code of Conduct on Energy Consumption of Broadband Equipment V6 Energy Star - Small Network Equipments v1.0
MTBF (h)	800416
Size (HxWxD) (mm/")	35 x 244 x 202mm / 1.38" x 9.61" x 7.95"
Temperature ($^{\circ}\text{C}/^{\circ}\text{F}$)	+5 $^{\circ}\text{C}$ to +40 $^{\circ}\text{C}$ / 41 $^{\circ}\text{F}$ to 104 $^{\circ}\text{F}$
Humidity (%)	5 - 85%

Tabel 6: General Features

3.3 General Service Description

GPON layer per G984.x	<ul style="list-style-type: none"> > Comply with GPON standard: ITU-T G984.1/G984.2/G984.3/G984.4; > GPON Encapsulation Method (GEM) supports Ethernet; > ConFigureble AES Downstream and FEC Downstream and Upstream; > Bitrates: 2488 Gbps (downstream) / 1244 Gbps (upstream). 	<ul style="list-style-type: none"> > Class B+ optics (28 dB); > T-CONT:32; > GEM-Port-IDs: 32.
L2/L3 layer	<ul style="list-style-type: none"> > VLAN-ID to GEM port-ID mapping (per WT-156): N:1 VLAN; 1:1; > Transparent VLAN; > Classification: IDSCP/TOS, 802.1p TCI, VLAN ID, MAC address; > Traffic Management: up to 8 queues per T-CONT in Priority-controlled mode or up to 16 queues per T-CONT in Rate-controlled scheduling mode. 	<ul style="list-style-type: none"> > 802.1q VLAN processing: Q-in-Q, tagging, removing tag, replacing tag or transparent forwarding; > Routing: Network Access Translation (NAT) and Network Access Port Translation (NAPT); > Firewall; > VPN; > DHCP Client and Server; > PPPoE Client; > Performance: 1000 Mbps Bidirectional.
IPTV	<ul style="list-style-type: none"> > IGMP v1/v2/v3 snooping; > IGMP processing per VLAN ID to support group of channels; > Interactive services (Video On Demand); > IPTV streams forwarding simultaneous: 128; > IPTV prioritization using Quality of Service (QoS) using 802.1p. 	-

VoIP	<ul style="list-style-type: none"> > T.38 Fax Relay; > Fax/Data Bypass; > Echo Canceller; > Echo Canceller Length; > Jitter Buffer; > Caller ID Generation; > G.711 PCMU; > G.711 PCMA; > G.711 VAD and CNG; > G.723.1; > G.726 ADPCM; > G.729 Annex A. > G.729 Annex B 	<ul style="list-style-type: none"> > Caller ID and Call waiting; > RTP/RTCP packet encapsulation; > RFC 2833 support; > In-band signaling detection and generation (DTMF, call progress tones);; > Automatic Tone generation (dial, busy, ring back, stutter, distinctive ring); > 3-Way Conferencing; > RFC 3261 support (SIPv1/v2).
Ethernet	<ul style="list-style-type: none"> > RJ-45 10/100/1000BASE-T; > Support Auto-negotiation; > Support auto MDI/MDIX. 	-
Wi-Fi	<ul style="list-style-type: none"> > IEEE 802.11 a/b/g/n/ac/ax 	<ul style="list-style-type: none"> > 802.11 b/g: 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48 and 54Mb/s; > 802.11n up to 600Mb/s. > 802.11ac up to 1733,3Mb/s > 802.11ax up to 4800,0Mb/s
Management	<ul style="list-style-type: none"> > Remote management over the OMCI, PLOAM, OAM and TR-069, TR-098, TR-104, TR-111, TR-140, TR-142, TR-143, TR-181. 	<ul style="list-style-type: none"> > Secure software download upgrade via OMCI or TR-069; > Embedded Telnet server for remote management, > SNMP V3;

3.4 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, FiberGateway has also the chance to have an embedded 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.

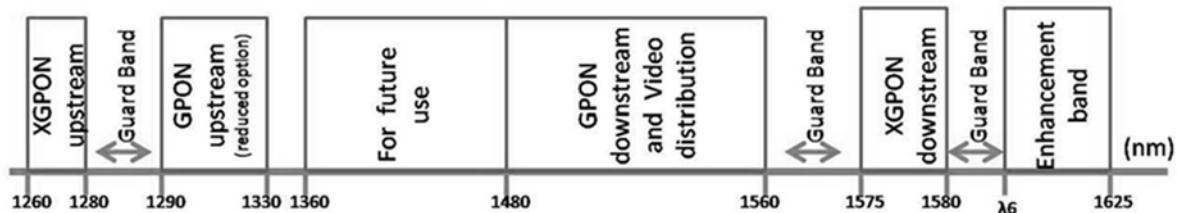
3.5 Wavelength filtering

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 terminal 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:



Tabel 7: 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 this requirement into account, 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, XGPON needs to support IPv6.

3.6 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 Residential 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 FiberGateway start in case the software download fails, to enable a new software update.

3.7 GPON - Management

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

Specifically the following functionalities are obtained through OMCI for diagnosis (counters and alarms):

- FiberGateway verification of provisioning of provisioned services;
- 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 available only per port;
- Configuration parameters of the provisioned services in FiberGateway: T-CONT, GEMPORT, VLAN and GPON MAC Tables;
- Alarms / events included in the above standards.

3.8 Standards

EMC	Standards	EMC Directive 89/336/EEC, EMC Addendum Directive 92/31/EEC, EMC Addendum Directive 91/263/EEC (Telecommunications Terminal Equipment Directive)
	Emissions	EN50081-1, EN55032
	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
Energy Consumption		European Code of Conduct on Energy Consumption of Broadband Equipment V3
Safety and Protection		EN/IEC 62368-1
Mechanical Resistance		EN300019
Quality		CE - Conformité Européenne
		RoHS 2002/95/EC Directive Compliance
Certification		BBF.247 G-PON

EMC	Emissions	FCC CFR 47 Part 15 Subpart B Section 15.107 Conducted Emissions – Class B FCC CFR 47 Part 15 Subpart B Section 15.109 Radiated Emissions – Class B
Radio	2.4 GHz	FCC CFR 47 Part 15 Subpart C Section 15.247
	5 GHz	FCC CFR 47 Part 15 Subpart E Section 15.407 (UNII-1)
Safety		Conforms to UL Standard 62368-1
Certifications		<p>ETL Intertek Listing Certification</p>  <p>Intertek 5018284 I.T.E.</p>
		FCC Certification

Tabel 8: Standards compliance

4 Setup

4.1 Equipment Connectivity

FiberGateway connections are located at the back side of the equipment; WPS and INFO (for status LEDS information) push buttons, are located at the front side of the equipment, Figure 12: FiberGateway connectivity general view



Figure 12: FiberGateway connectivity general view

Number	Name	Description
9	RESET	Configuration RESET button
10	TEL (1)	1x RJ11 – FXS Ports
11, 12, 13, 14	LAN (1, 2,3,4)	4 x RJ45 Ports - 10/100/1000Base-T Ethernet with AUTO-MDIX
15	USB	1x USB 3.0 port
16	ON OFF	ON/OFF button
17	PWR	12V DC Power Supply Connector
18	PON	Equipment Optical port GPON; SC/APC
7	WPS	Wi-Fi Protected Set-up Button; • Switches on/off Wi-Fi if pressed for 5 seconds • With the Wi-Fi interface on, in order to connect a device the interface, pressing the WPS

Number	Name	Description
		button for 1second will start the association process.
8	INFO	Energy saving button. In order to verify the status of all LEDS press the button. If not pressed only POWER and Radio Signal LEDs (WPS, WIFI 5G and WIFI2.4G) have updated status information.

Tabel 9: FiberGateway connectivity description

4.2 FiberGateway LEDs



Figure 13: FiberGateway Status LEDs

LED	Identification	LEDs Status		Description
11, 12,13,14 ⁽¹⁾	LAN	ON		With Ethernet connection (green)
		OFF		No Ethernet connection
		Flashing		Ethernet IN/OUT activity (green)
2 ⁽¹⁾	INTERNET	ON		With Internet connection (green)
		OFF		Inactive port
		Flashing		Internet IN/OUT activity (green)
1 ⁽¹⁾	PON LINK	See table bellow		
3 ⁽¹⁾	WPS	ON		WPS active (blinking green)
		OFF		WPS inactive
4 ⁽²⁾	WIFI	ON		Wi-Fi Radio Signal active
		OFF		Wi-Fi Radio Signal inactive
5	TEL	ON		Service configured and authenticated (green)
		OFF		Service not configured or registration failure
		Flashing		Telephone off the hook
6 ⁽²⁾	POWER	ON		Power supply ON (green)

	OFF	Power supply OFF
--	-----	------------------

NOTES:

- (1) To obtain these status LEDS information INFO button must be pressed.
- (2) These status LEDS are always update (pressing INFO button is not required).

Tabel 10: LEDs Status information

ONT FiberGateway Status	LEDs Status	Description
	PON LINK	
1. Initial	OFF	Initial Status
2. Standby	Flashing	ONT is waiting for initial configuration by the OLT
3. Serial Number	Flashing	The OLT is configuring the ONT
4. Ranging	Flashing	ONT and OLT synchronization
5. Operation	ON	ONT normal operational status

Tabel 11: LEDs Status information (PON LINK & PON AUTH)

4.3 Typical FiberGateway usage scenario

Figure 14 bellow, shows a FiberGateway Type usage scenario showing Home Network connections for triple play service provisioning. FiberGateway connectors' description can be found in Tabel 9: FiberGateway connectivity description

and connecting cables are described in Tabel 12: Connections description

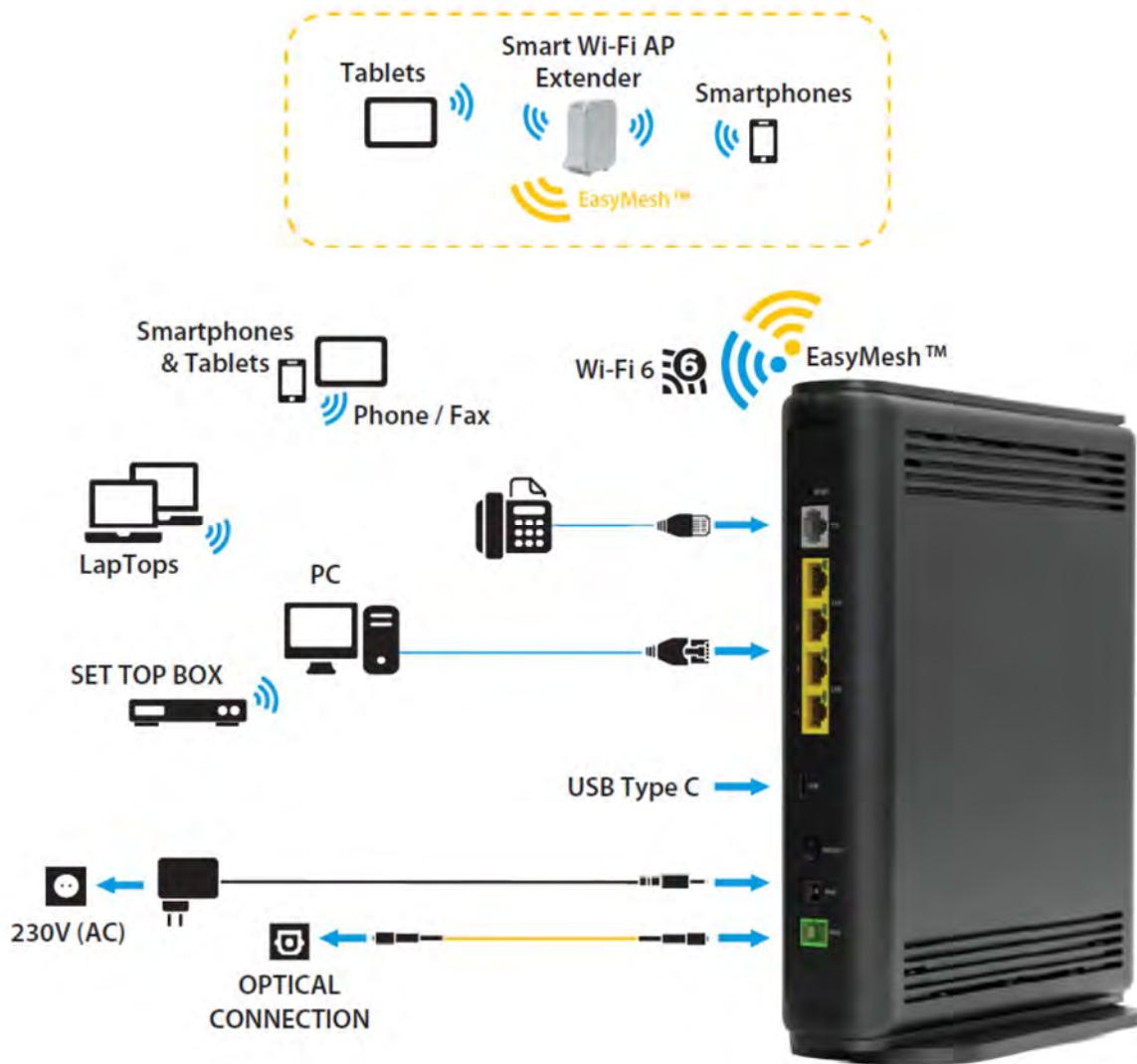


Figure 14: FiberGateway Typical usage scenario - Home network connections

Connection	Description
C1	RJ11 Telephone cable
C2	Ethernet Cable UTP CAT5,6 cable (direct or crossover)
C3	12V DC Adapter
C4	Single-mode Optical Cable with SC/APC Connector (GPON)
W1	Wi-Fi

Table 12: Connections description

4.4 Before installing the FiberGateway equipment

4.4.1 Safety Warnings

- 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. To prevent equipment overheating do not obstruct the ventilation grids on the equipment;

- The FiberGateway device is not designed for outdoor setup. Please place it in a convenient indoor/cabinet environment;
- Use only the provided power kit. The use of a third party power adapter may not guarantee its proper operation;
- To avoid eye hazard, never look directly into a fiber optic port or connector;

4.4.2 Wireless network installation best practices

In order to achieve FiberGateway wireless network best performance the following installation rules should be observed:

- FiberGateway front side should be oriented towards the area where the wireless network is to be used;
- FiberGateway installation place should be at least 1 meter high and without :
 - Interference sources nearby, such as Microwave ovens, DECT 2.4 GHz phones, Audio/Video transmitters, Bluetooth equipment, Baby Monitors, etc.
 - Obstacles such as walls, stairs, ceilings, doors, Metal Objects, Windows, etc between the installation place and the Wi-Fi usage area.

4.5 Connections

FiberGateway connections are located at the back side of the equipment; WPS and INFO (for status LEDS information) push buttons, are located at the front side of the equipment, Figure 12: FiberGateway connectivity general view

4.6 FiberGateway Setup

FibeGateway is intended to be installed on a flat surface.

The following table identifies the set of materials that may be required to install the equipment, depending on the home network scenario.

Installation phase	Item	Supplied	Mandatory
Powering	Power Adapter and Power Cord 230VAC/50Hz or 110VAC/60Hz 12VDC (4A) + 15%	(1)	✓
Network Provider Connection	Optical Patchcord (SM fibre ITU-T G.657B3) with connectors SC/APC	(1)	✓
	Optical connector cleaning kit	-	✓
Home Network Connections	Ethernet cables CAT6 568B	(1)	(2)
	RJ11 Telephone Cable	(1)	(2)
	Device with Wi-Fi connectivity (laptop/smartphone/ ...)	-	(2)

Tabel 13: material required for instalation

(1) Depending on the ordered model

(2) Home network scenario dependent

4.6.1 Network Provider Connection

An Optical Patchcord (SM fibre ITU-T G.657B3) with connectors SC/APC, Figure 15: Network provider connection

b), and Optical connector cleaning material will be required.



Figure 15: Network provider connection

- Clean the optical connectors of the optical patchcord, Figure 15: Network provider connection
- b), of the equipment PON port, Figure 15: Network provider connection
- a), and the optical wall socket, Figure 15: Network provider connection
- before connecting using appropriate optical connector cleaning material;
- Plug one of the patchcord cleaned SC/APC optical connectors on the FiberGateway PON port, Figure 15: Network provider connection
- a), observing the alignment mechanism, (a click indicates the connector is secure into place)
- Plug the other end optical patchcord SC/APC connector on the optical wall socket
- Accommodate the patchcord excessive length avoiding small bend radius on the patchcord (30mm minimum bend radius).

4.6.2 Mains connection and power up

- Connect the power adaptor output connector to the 12-VDC power port on the equipment;
- Plug the power adaptor appropriate power cord into an approved 100 to 230 VAC outlet, Figure 15: Network provider connection
- ;
- Switch on the equipment, ON-OFF button
- After executing a power-up sequence the equipment will be ready for operation.

5 Configuration

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

5.1 Costumization

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 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 FiberGateway 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 FiberGateway is rebooted, it is loaded and executed;
- Active - if it is loaded and it is being executed in the FiberGateway.

There can be only one active image and only one committed image at a given moment. The FiberGateway 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 FiberGateway state through a series of commands:

- Start download
 - It starts the software download sequence. This action is only valid for inactive and non-committed 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 FiberGateway 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 WebGUI

6.1 General access

To configure the FiberGateway, you must place the network terminal, for example a personal computer, connected to the LAN, whose network configuration mode must be automatic. In this mode the personal computer will receive an IP address between 192.168.1.64/24 and 192.168.1.253/24 in addition to the other necessary network parameters. Then enter the URL address, <http://192.168.1.254> in a Web browser, where you will have access to the following page:

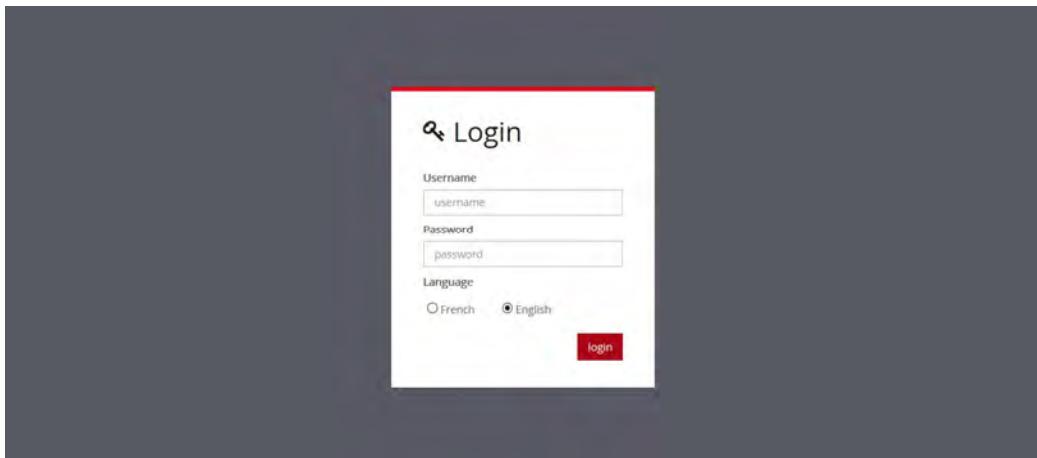


Figure 16: Login to FiberGateway

Fill in with username and password.

- User: admin
- Password: 123asd

Choose the language to be used in the Web interface. After entering, the main window will be displayed that will be maintained throughout the session, a window that is structured in three areas, one of selection of equipment configurations, another of functionalities, and the third area is a work area where the various parameters of each of the selected configurations can be viewed and changed. The three areas will be named:

1. Equipment menu on the left side of the window;
2. Functional menu, at the top of the window;
3. Main window in the center of the window.

The information presented in the main window (area 3), results from the selection made in the other two areas, is identified by a blue bar that underlines the option made in the functional menu (area 2), or that is vertical menu item (area 1).

The following figure shows the areas identified on the main page. In the work area the content selected in the "Home" header is displayed, which is underlined in red.



Figure 17: FiberGateway management window

These three windows are shown below.

Whenever inactivity in the WEB interface is greater than one minute, the session is terminated. The access home page is activated again.

6.1.1 Equipment Menu



Figure 18: Menu Equipamento

This area, (area 1, Menu Equipment) located on the left side of the window, contains all the information about the equipment and its connectivity, is maintained throughout the session, allowing the selection of each item, showing in the window detailed information regarding the selected item.

- FiberGateway
 - Software version
 - Serial number
 - MAC Address
 - UpTime
- LAN - Local Area Network
 - Port status
 - Default Gateway
 - DHCP
- WAN - Wide Area Network
 - Port Status
 - RX Optical Power
 - TX Optical power
- Wi-Fi
 - Wi-Fi 2.4GHz
 - SSID
 - Wi-Fi 5GHz
 - SSID
- Voice
 - Account status
 - Extension
- Television
 - IPTV

The detail and functionalities accessible in these windows are described in chapter 6.2

6.1.2 Functional Menu

This area, (Area 2, Functional Menu), allows access to FiberGateway global features, and remains unchanged throughout the session.

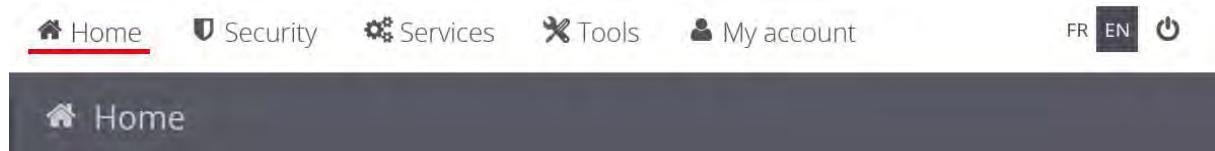


Figure 19: Functional Menu

In the Home Functional Menu window you can access five windows namely:

- Home
 - Displays the network diagram allowing access to each of the network elements
 - Internet
 - LAN
 - Wi-Fi 2.4GHz
 - Wi-Fi 5GHz
 - Voice
- Security
 - Settings
 - Access
- Services
- Tools
- My account

Quick links

- Dynamic DNS
- DMZ (Demilitarized Zone)
- Firewall
- Universal Plug'n'Play (UPnP)

The detail and functionalities accessible in these windows are described in chapter 6.3

6.1.3 Main Window

This window, Figure 21, shows all the information related to the menu item Equipment or Functional Menu selected, allowing its change.

The initial window, after login in the equipment, shows a network diagram, being able to directly access each of the network elements making their selection. There is also a set of quick links for viewing / changing.



Figure 20: Main page

LAN (Local Area Network) is a local network of devices that are interconnected through a physical medium (ethernet). It is a set of hardware and software that allows individual computers to communicate with each other, exchanging and sharing information and resources. Such networks are called sites because they cover only a limited area (typically distances less than 100 meters).

Wi-Fi is a technology for wireless local area networks with devices based on the IEEE 802.11 standards. The WLAN standard has been defined in the IEEE 802.11 working group. Wi-Fi is a trademark of the Wi-Fi Alliance, which restricts the use of the term Wi-Fi Certified to products that successfully complete interoperability certification tests. Devices that can use Wi-Fi technology include personal computers, video game consoles, smartphones, digital cameras, tablet computers, digital audio players and modern printers. FiberGateway supports both IEEE 802.11 bands; Wi-Fi 2.4GHz and Wi-Fi 5GHz. FiberGateway is certified by the Wi-Fi Alliance.

Voice Voice service is implemented using IP network (VoIP) technologies, supported by the SIP protocol

6.2 Equipment menu

The equipment menu contains six information / access fields:

FGW FiberGateway, LAN Local Area Network, WAN Wide Area Network, Wi-Fi, Voice, Television

6.2.1 FGW FiberGateway

Access to FiberGateway information is done by selecting the field next to the vertical blue line identified by FGW Fiber Gateway.

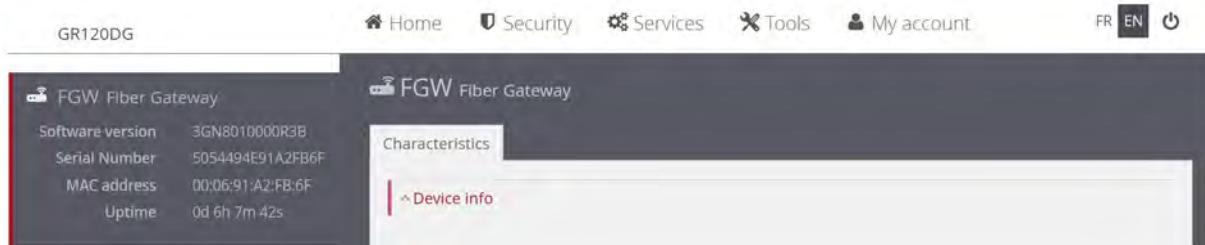


Figure 21: Equipment Menu – FGW

By selecting the FiberGateway symbol on the left side of the management window, top of the Equipment and connectivity menu, Figure 21, is shown in the main window more information about the FiberGateway equipment, Figure 22.

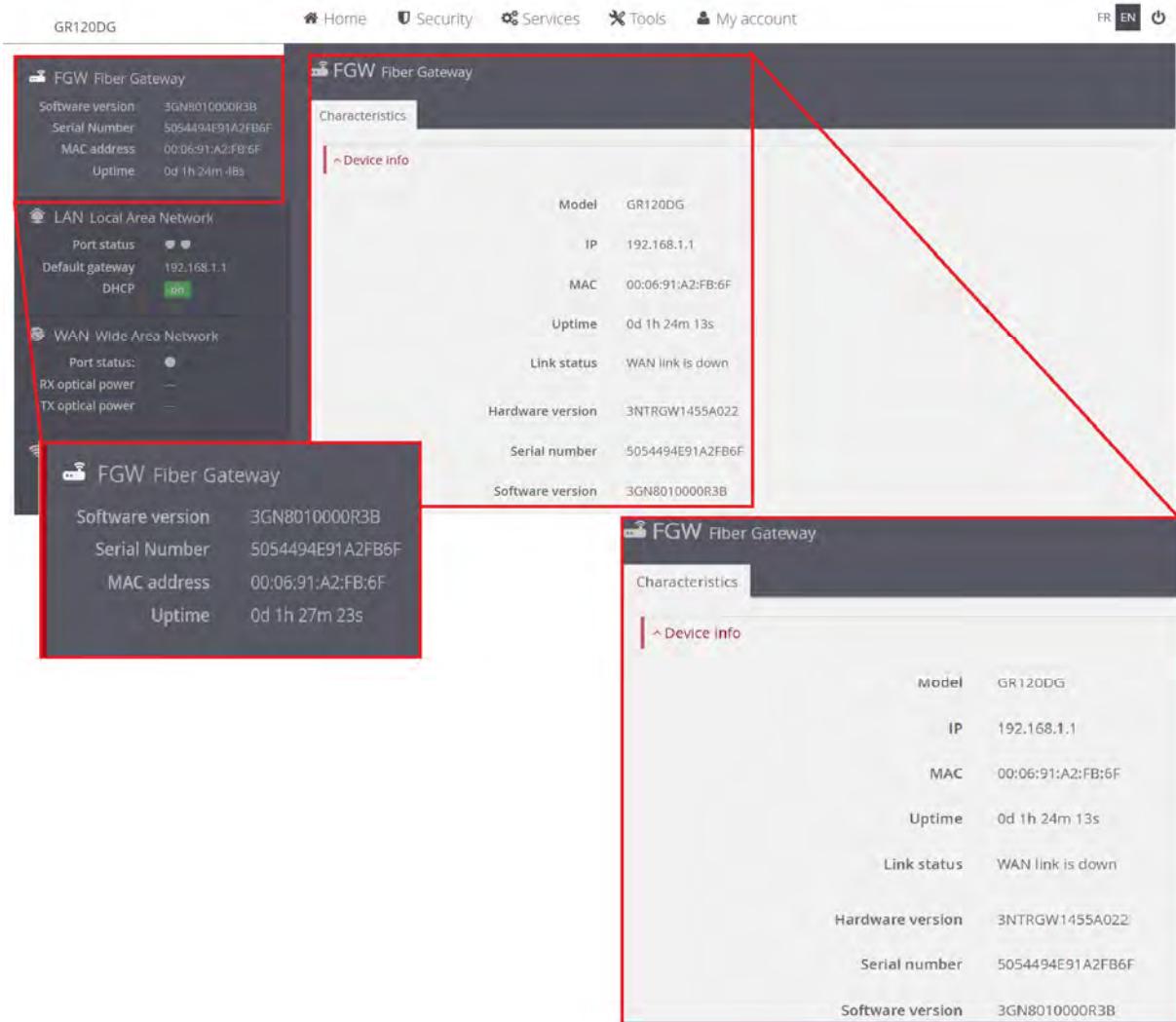


Figure 22: Information about FiberGateway

Group	Parameter	Description
Device Information	Model	Equipment model Ex:GR120DG
	LAN IPv4 Address	FiberGateway IP address on LAN; Ex: 192.168.1.254
	MAC	FiberGateway MAC Address; Ex: 00:06:91:1d:6e:c2
	Uptime	FiberGateway uptime; Ex: 2d 3h 32m 33s
	Connection status	On/Off IPv4: 144.64.83.52 IPv6: 2001:8a0:ee8e:f100::1
	Hardware version	Installed hardware version of FiberGateway; Ex: ONTRGW1405A001
	Serial number	FiberGateway Serial Number Ex: 5054494E911D6EC2
	Software version	Software version installed on FiberGateway; Ex: 3RGW040000r044

Tabel 14: FiberGateway Parameter Information

6.2.2 LAN (Local Area Network)

Access to LAN information and editing is done by selecting the field next to the vertical red line identified by LAN Local Area network.

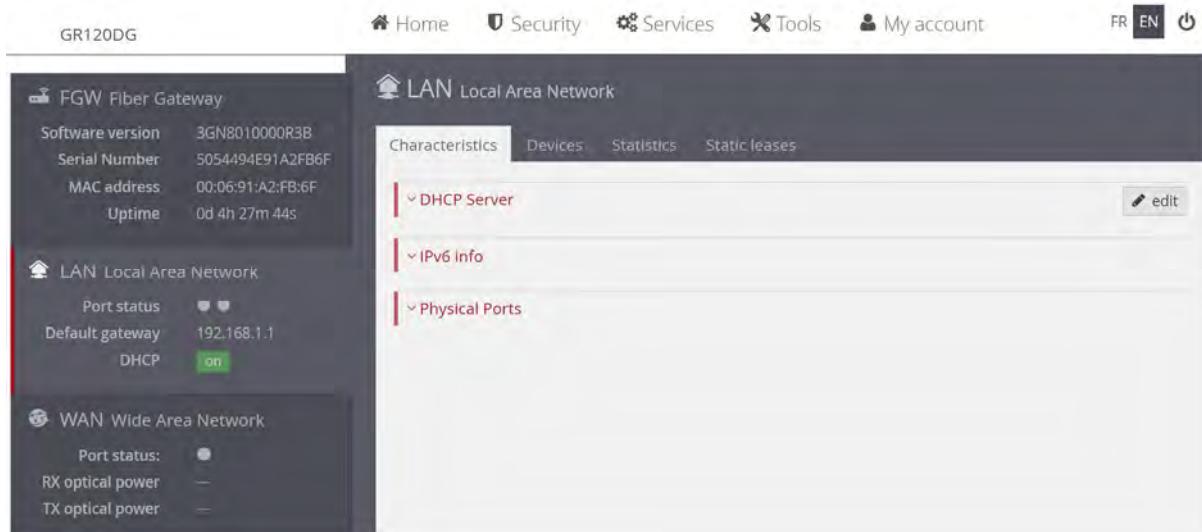


Figure 23: Equipment Menu – LAN

After this selection, it shows in the work window more information (with possibility of editing), about LAN connectivity.

On the left side of the Equipment Menu window, a set of information related to the local network is shown;

1. State of ports; Active / inactive (color green / gray color)
2. Default gateway IP address (ex: 192.168.1.254)
3. DHCP DHCP server active / inactive (on / off)

In this window there is access to four new windows:

- Characteristics
 - Detail in sub-cap 6.2.2.1
- Devices
 - Detail in sub-cap 6.2.2.2
- Statistics
 - Detail in sub-cap 6.2.2.3
- Static leases
 - Detail in sub-cap 6.2.2.4

6.2.2.1 Characteristics

Window where you can view and edit LAN features, Figure 25. This window shows three subgroups:

- Characteristics
 - DHCP Server

- Information about the DHCP server and the possibility of editing the various server parameters
- IPv6 Information
 - FiberGateway IPv6 addresses on the WAN interface
- Interfaces
 - LAN interface Ethernet states

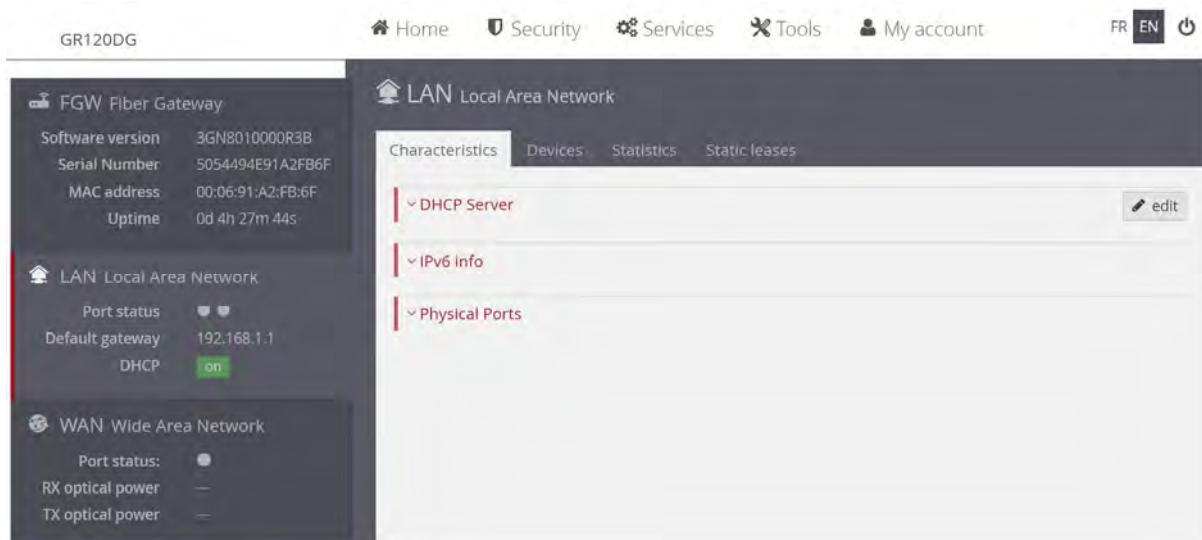


Figure 24: LAN (Local Area Network) – Characteristics

6.2.2.1.1 DHCP Server

The Dynamic Host Configuration Protocol (DHCP) server provides on-demand IP addresses to a terminal (host) in the local area network (LAN). In this window, Figure 26, you can configure the range of addresses to be assigned in the local network and the address lease time (in hours).

In this example, whenever a terminal on the local network requests addresses using the DHCP protocol, the server will indicate that the Default gateway has the 192.168.1.254 address with a 24-bit mask (255.255.255.0); you will be assigned an address available in the range 192.168.1.64 through 192.168.1.253, with that mask and a one-hour lease time.

By default there are no static DNSs associated with LAN devices, and the DNS address of the router is used, which will forward the DNS requests according to the configured by the operator.

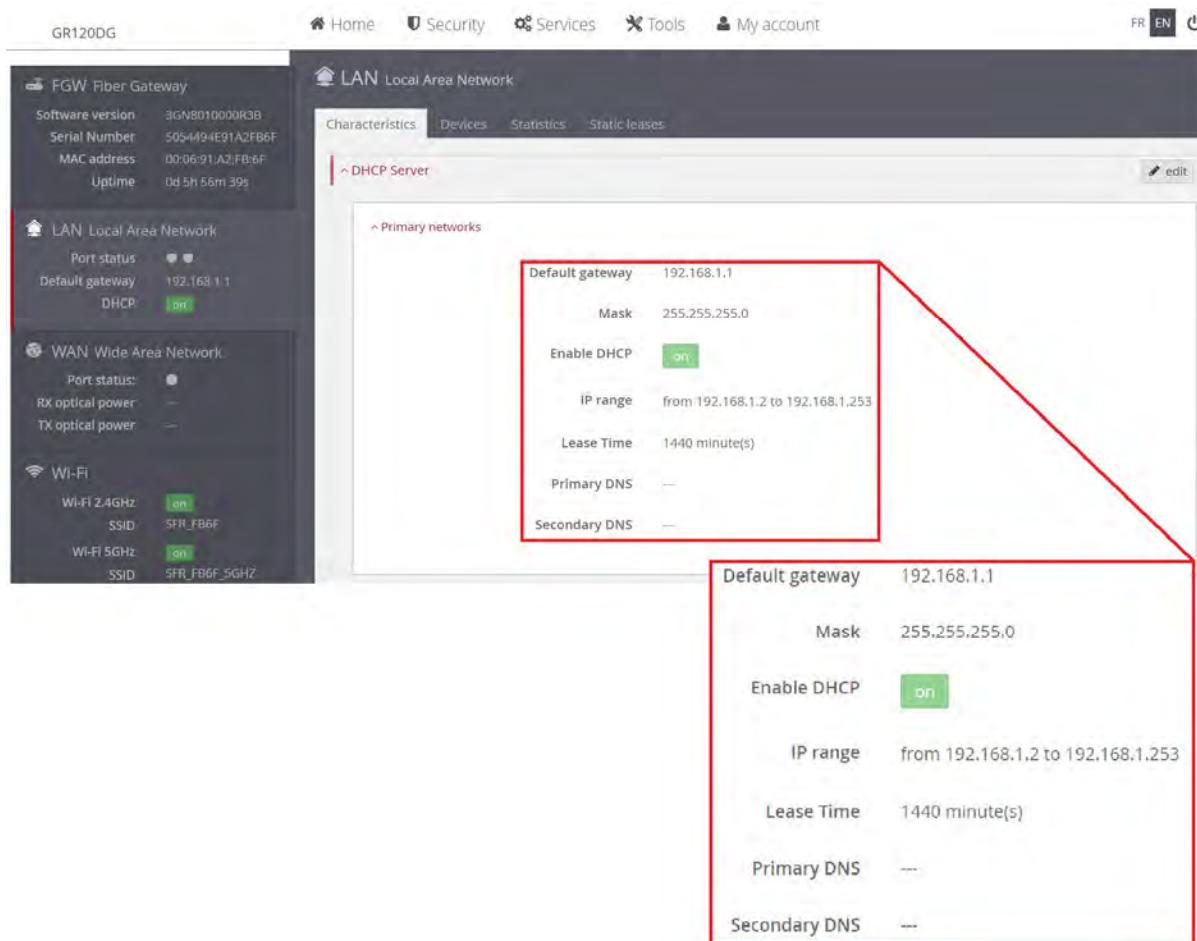


Figure 25: DHCP Server Primary Networks - Edition

Group	Parameter	Description
DHCP server	Default gateway	LAN Default gateway: 192.168.1.254 192.168.2.254
	Mask	255.255.255.0
	Enable DHCP	Enable DHCP Indicates server activation: on / off
	Range of IPs	Server managed IP addresses
	Lease time	IP Address lease Time

Tabel 15: DHCP Server - Parameters

6.2.2.1.2 IPv6 Information

This window shows information about the IPv6 address, the IPv6 prefix, and the IPv6 Local-Link. These parameters can not be changed. The link-local is an IPv6 address built based on the FiberGateway MAC Address.



Figure 26: IPv6 Information

Group	Parameter	Description
Informação de IPv6	IPv6	Ligado/desligado
	Endereço IPv6	Endereço IPv6
	Prefixo IPv6	Prefixo IPv6
	Link local IPv6	Link local IPv6

Tabel 16: IPv6 Information - Parameters

6.2.2.1.3 Interfaces

The Interfaces window shows information about the four Ethernet interfaces (LAN 1, LAN 2) of the LAN. For each interface, its status (disconnected / connected), speed (Mbps) and mode of operation are displayed.

The screenshot shows the 'Physical Ports' section of the LAN configuration. It lists two ports: LAN 1 (Disconnected) and LAN 2 (Connected). The table includes columns for Port, Status, Speed (Mbps), and Mode.

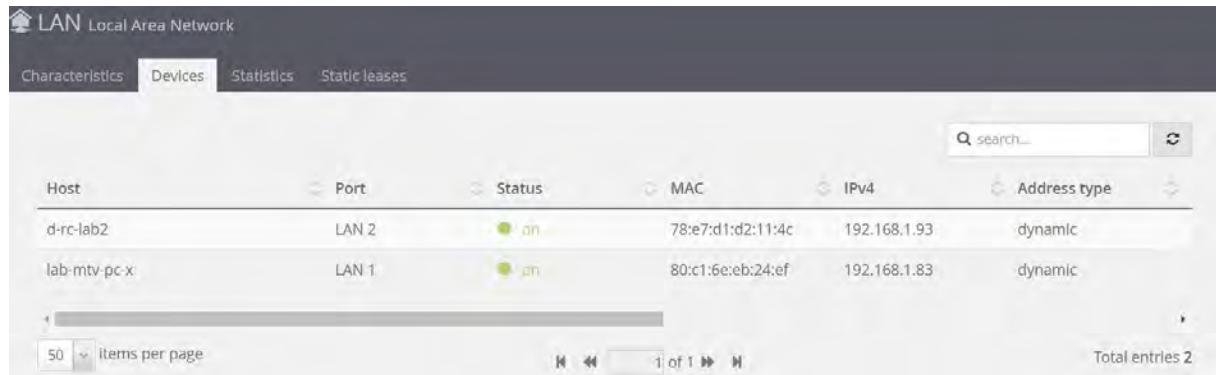
Port	Status	Speed (Mbps)	Mode
LAN 1	Disconnected	---	---
LAN 2	Connected	100	Full duplex

Figure 27: Interfaces

6.2.2.2 Devices

This window, Figure 28 and following, shows all the devices installed on the local network.

For each device there is a set of information; Host Name, Port Name, Status, MAC, IPv4, Lease Time, IPv6, Local IPv6 Link.



Host	Port	Status	MAC	IPv4	Address type
d-rc-lab2	LAN 2	on	78:e7:d1:d2:11:4c	192.168.1.93	dynamic
lab-mtv-pc-x	LAN 1	on	80:c1:6e:eb:24:ef	192.168.1.83	dynamic

Figure 28: LAN (Local Area Network) - Devices I



Address type	Lease time	IPv6	Link local IPv6
dynamic	22 hours, 22 minutes, 11 seconds	—	fe80::7586:1a38:4372:5d60
dynamic	22 hours, 21 minutes, 58 seconds	—	fe80::702c:5c71:58e2:525b

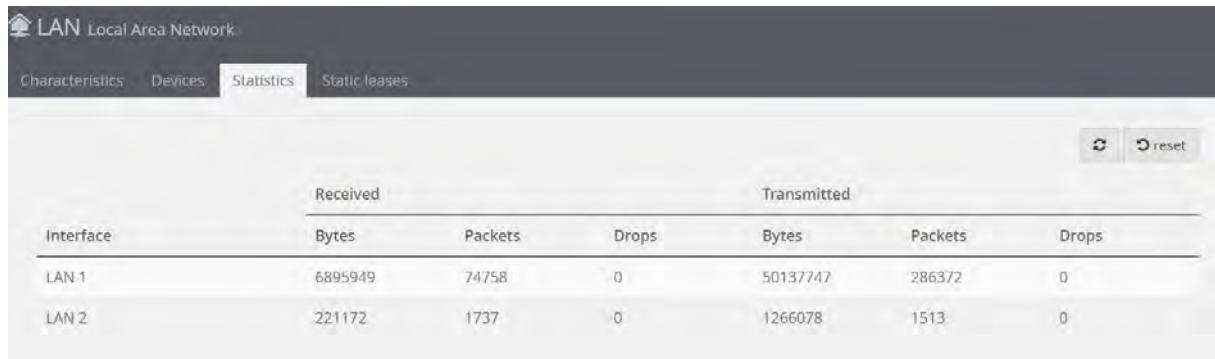
Figure 29: LAN (Local Area Network) - Devices II

Group	Parameter	Description
Devices	Host	Terminal name on the LAN
	Port	LAN Ethernet interface name
	Status	Device status (on / off)
	MAC	Terminal MAC address
	IPv4	Terminal IPv4 address
	Address type	Address type: dynamic / static
	Lease time	Current IP address rental time
	IPv6	Terminal IPv6 address
	Link local IPv6	IPv6 local link

Tabel 17: LAN (Local Area Network) – Devices

6.2.2.3 Statistics

This window, shows the value of multiple counters in ethernet ports on the local network. Counters are grouped into two groups; received data and sent data.



Interface	Received			Transmitted		
	Bytes	Packets	Drops	Bytes	Packets	Drops
LAN 1	6895949	74758	0	50137747	286372	0
LAN 2	221172	1737	0	1266078	1513	0

Figure 30: LAN (Local Area Network) - Statistics

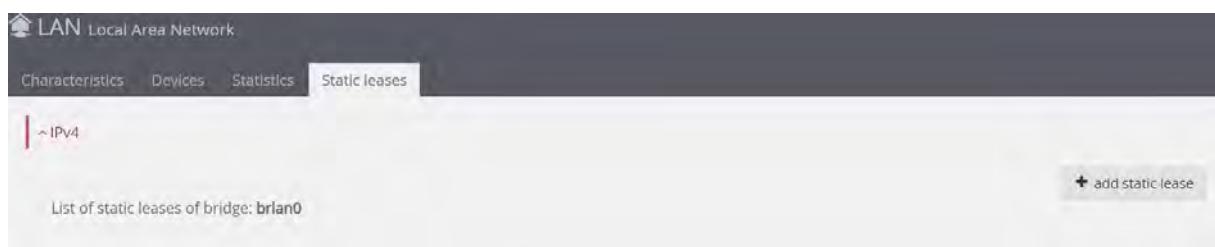
Group	Parameter	Description
Statistics	Interface	LAN 1, LAN 2
Received	Bytes	Received bytes
	Packets	Packets Received
	Drops	Packets Drops
Transmitted	Bytes	Transmitted bytes
	Packets	Packets Transmitted
	Drops	Packets Drops

Tabel 18: LAN (Local Area Network) – Statistics

In this window, you can perform two actions by using the buttons in the top right corner of the page: refresh the page and restart the counters.

6.2.2.4 Static Leases

In this window, Figure 32, it is possible to assign an IP address to an ethernet interface of a device on the LAN, in a static way. This means that the DHCP server will always assign the IP address to the Ethernet interface with the identified MAC address.



~IPv4

List of static leases of bridge: brian0

+ add static lease

Figure 31: LAN (Local Area Network) – Static Leases

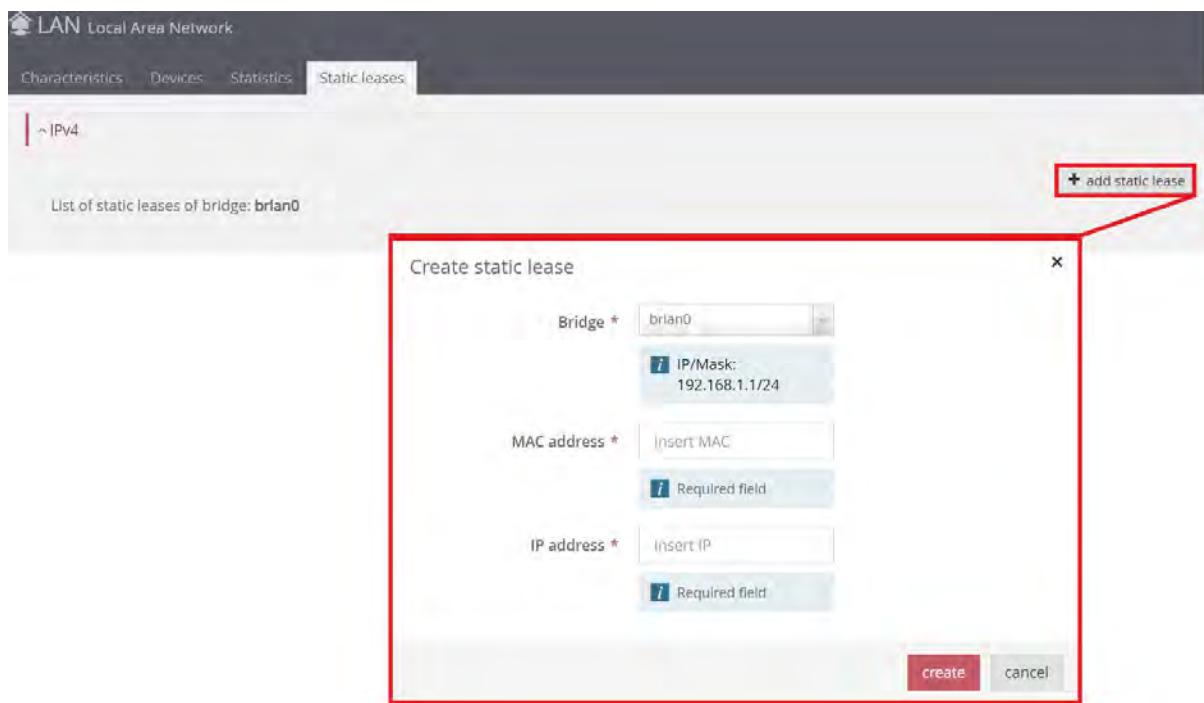


Figure 32: LAN (Local Area Network) – Create Static Lease

Group	Parameter	Description
Create static lease	Bridge	Bridge where the static lease will be created. IP and mask are shown
	MAC address	MAC address if interface
	IP address	IP assigned to the interface

Tabel 19: LAN (Local Area Network) – Lease Static

FiberGateway internally contains a second DHCP server, which provides IP addresses for the guest network on the WLAN. The range of addresses managed by this server is different from the LAN address range. The IP network in this case is 192.168.2.0/24. It is also possible to set the assignment of an IP address of this network to a device in the guest network. In this case the BR_GUEST bridge must be selected in the "create static lease" window.

6.2.3 WAN Wide Area Network

Access to WAN information and editing is done by selecting the field next to the vertical blue line identified by the WAN Wide Area Network

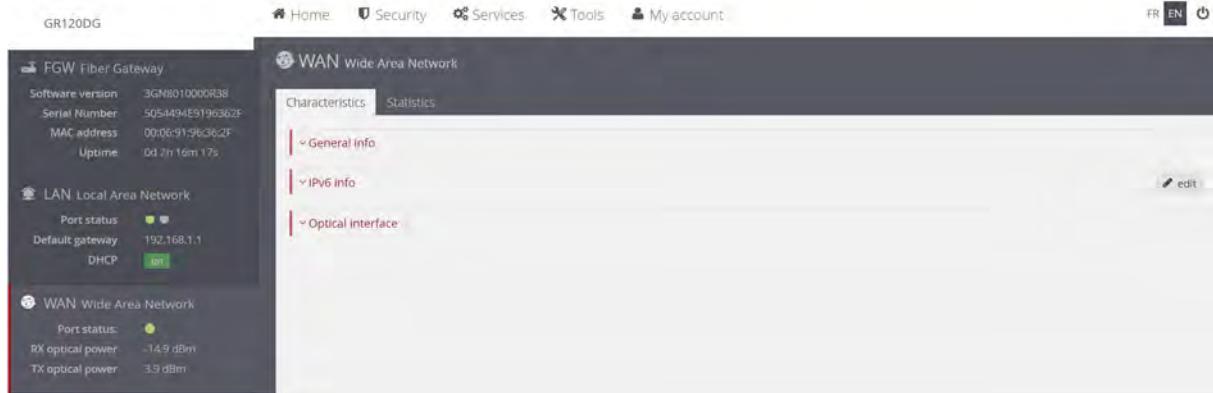


Figure 33: Equipment Menu - WAN

The WAN selection on the left side of the window, the Equipment menu, Figure 34, shows in the main window more information, with possibility of editing, on WAN connectivity. The Wide Area Network (WAN), a long-distance network, is a terminal network that covers a large geographical area, often a country or continent. A classic example of a typical WAN network is the Internet itself because it covers a global geographic area, interconnecting terminals in countries and continents.

On the left side of the Equipment and Connectivity Menu window, a set of information related to the WAN is shown:

1. State of the port; Active/inactive (green color / gray color)
2. Optical Power RX ex: -14,9 dBm
3. Optical power TX ex: 3,9 dBm

In this window there is access to two new windows:

- Characteristics no sub-chap. 6.2.3.1
- Statistics, sub-chap. 6.2.3.2

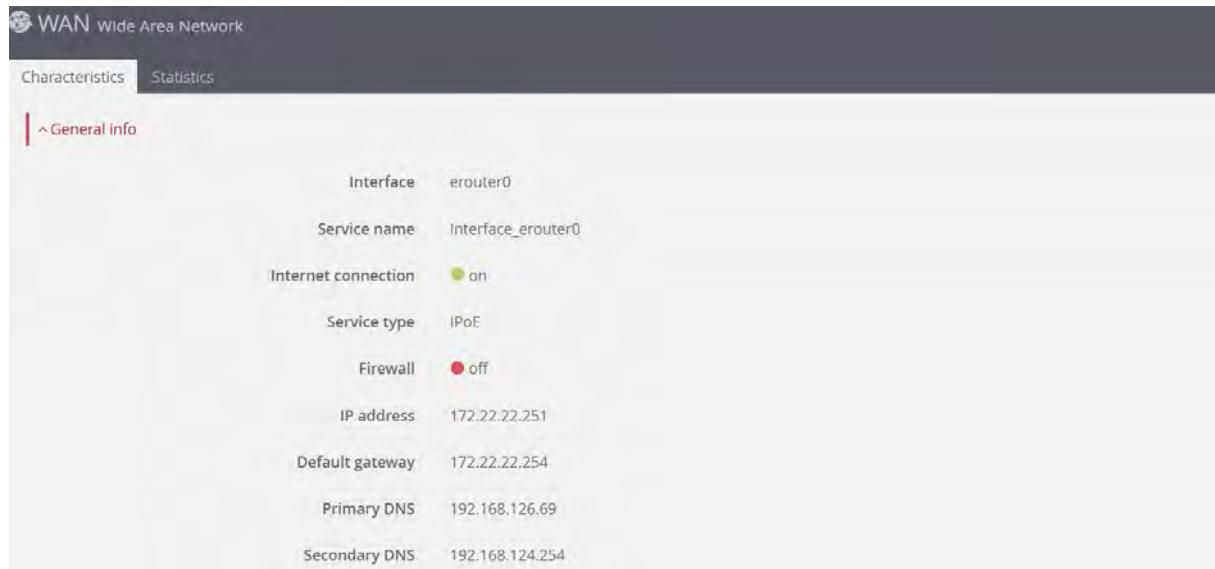
6.2.3.1 Characteristics

Window where you can view and edit WAN features. This window shows two subgroups:

- Characteristics
 - General info
 - IPv6 info
 - Optical Interface

6.2.3.1.1 General information

The general information consists of the following information fields; Interface, Service name, Internet connection, Service type, Firewall, IP address, Default gateway, Primary DNS, Secondary DNS.



Parameter	Description
Interface	WAN Interface. Ex: erouter0
Service name	Service name in the WAN. Ex: Interface_erouter0
Internet connection	Connection status: On / Off
Service type	Type of service in the WAN. Ex: IPoE
Firewall	Firewall Status. On off
Default gateway	Address of the WAN output router; Ex. 172.22.22.254
Primary DNS	IP address of the first choice DNS server; Ex. 192.168.126.69
Secondary DNS	IP address of the second-choice DNS server; Ex. 192.168.124.254

Figure 34: WAN (Wide Area Network) – General information

Group	Parameter	Description
General information	Interface	WAN Interface. Ex: erouter0
	Service name	Service name in the WAN. Ex: Interface_erouter0
	Internet connection	Connection status: On / Off
	Service type	Type of service in the WAN. Ex: IPoE
	Firewall	Firewall Status. On off
	Default gateway	Address of the WAN output router; Ex. 172.22.22.254
	DNS primário	IP address of the first choice DNS server; Ex. 192.168.126.69
	DNS secundário	IP address of the second-choice DNS server; Ex. 192.168.124.254

Tabel 20: WAN (Wide Area Network) – General information

6.2.3.1.2 Informação de IPv6

The IPv6 information consists of the following information fields; IPv6, IPv6 Address, IPv6 Prefix, Default gateway, Primary DNS, Secondary DNS.

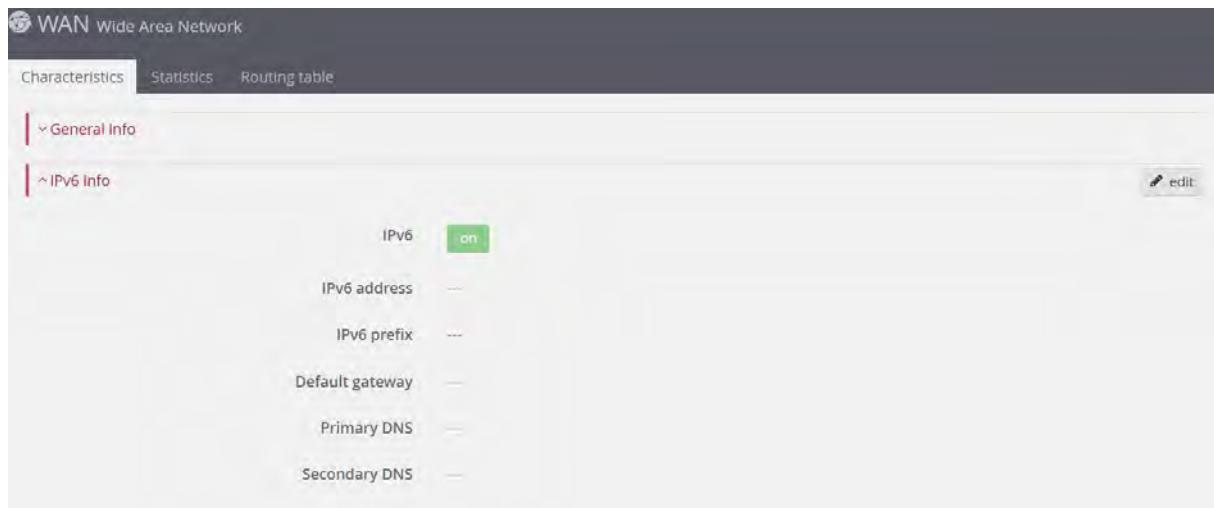


Figure 35: WAN (Wide Area Network) – Informação IPv6

Group	Parameter	Description
IPv6 Information	IPv6	Pv6 status. On off
	IPv6 Address	IPv6 Address
	IPv6 Prefix	IPv6 Prefix
	Default gateway	Default gateway
	Primary DNS	Primary DNS
	Secondary DNS	Secondary DNS

Tabel 21: WAN (Wide Area Network) – IPv6 Information

6.2.3.1.3 Optical interface information

The optical interface information consists of the following information fields; Connection status, optical reception power, optical transmission power.

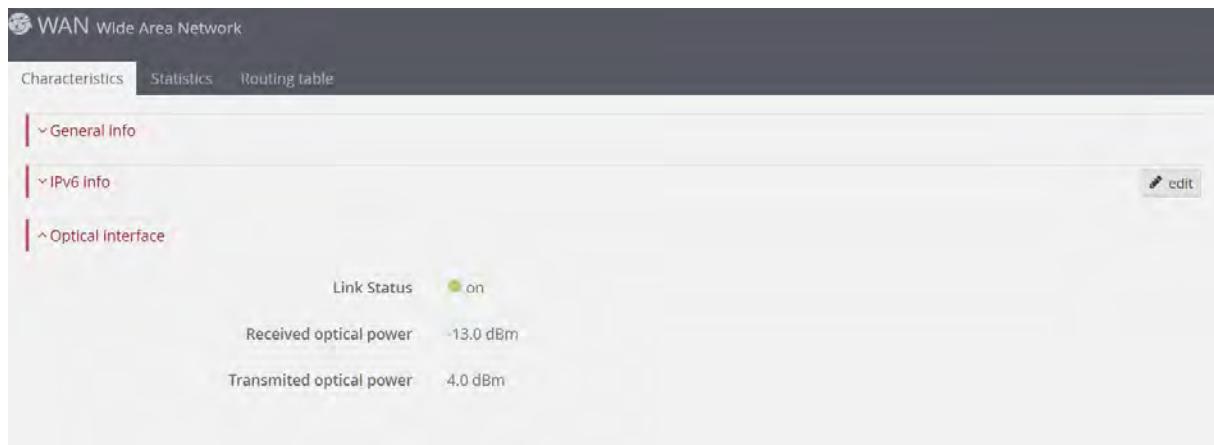


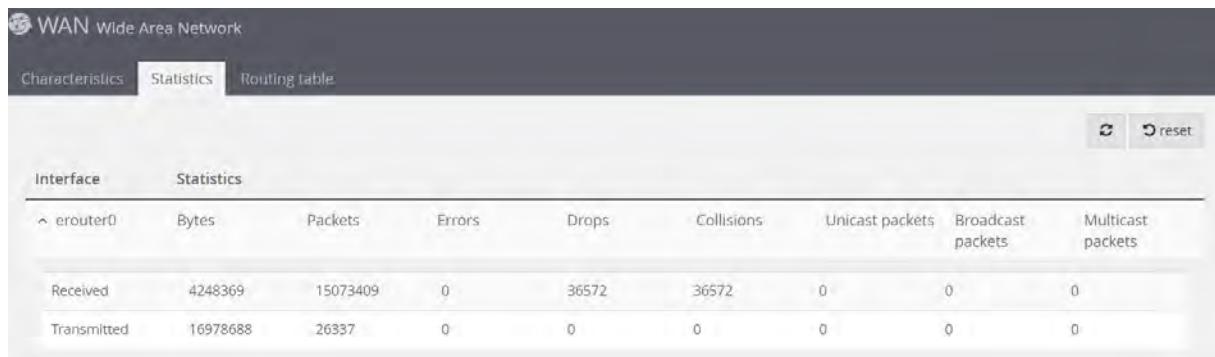
Figure 36: WAN (Wide Area Network) – Optical interface

Group	Parameter	Description
Optical interface	Link status	Optical link state. On off
	Received optical power	Received optical power; Ex. -13,0 dBm
	Transmited optical power	Transmited optical power; Ex. 4,0 dBm

Tabel 22: WAN (Wide Area Network) – Optical interface

6.2.3.2 Statistics

This window shows the value of several counters in the WAN port, interface erouter0.



The screenshot shows a network monitoring interface for a WAN port. The top navigation bar includes 'WAN Wide Area Network', 'Characteristics', 'Statistics' (which is selected), and 'Routing table'. Below the navigation is a toolbar with a refresh icon and a 'reset' button. The main content is a table titled 'Statistics' with the following data:

Interface	Bytes	Packets	Errors	Drops	Collisions	Unicast packets	Broadcast packets	Multicast packets
Received	4248369	15073409	0	36572	36572	0	0	0
Transmitted	16978688	26337	0	0	0	0	0	0

Figure 37: WAN (Wide Area Network) – Statistics

Group	Parameter	Description
Statistics	Interface	WAN Interface. Ex: erouter0
Received	Bytes	Received bytes
	Pakects	Packages at the reception
	Errors	Errors
	Drops	Discarded packages
	Collisions	Collisions
	Unicast packets	Unicast packets
	Broadcast packets	Broadcast packets
	Multicast packets	Multicast packets
Transmitted	Bytes	Transmited bytes
	Pakects	Packages at the transmition
	Errors	Errors
	Drops	Discarded packages
	Collisions	Collisions
	Unicast packets	Unicast packets
	Broadcast packets	Broadcast packets
	Multicast packets	Multicast packets

Tabel 23: WAN (Wide Area Network) – Parameters

In this window you can perform two actions: refresh the page , and restart the counters. 

6.2.3.3 Routing table

This window shows the routing table.

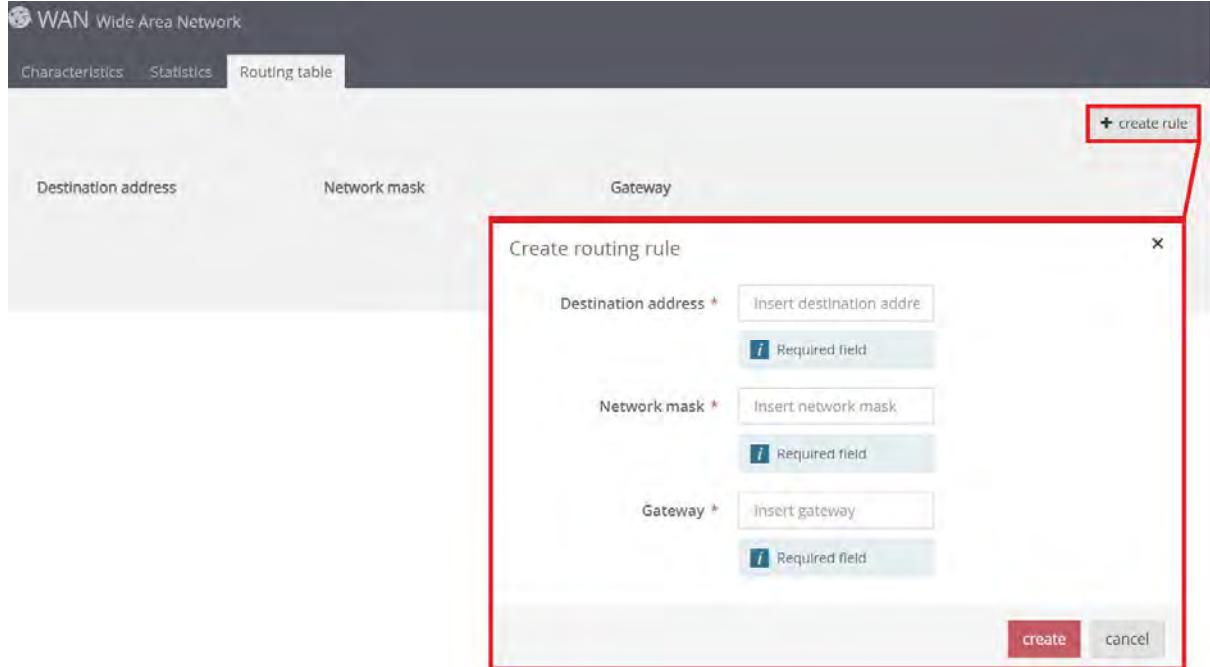


Figure 38: WAN (Wide Area Network) – Routing table

Group	Parameter	Description
Routing table	Destination address	Interface WAN. Ex: veip0.1
	Network mask	Bytes recebidos
	Gateway	Pacotes na receção

Tabel 24: WAN (Wide Area Network) – Routing table

6.2.4 Wi-Fi

Access to Wi-Fi information and editing is done by selecting the field next to the vertical blue line identified by Wi-Fi.

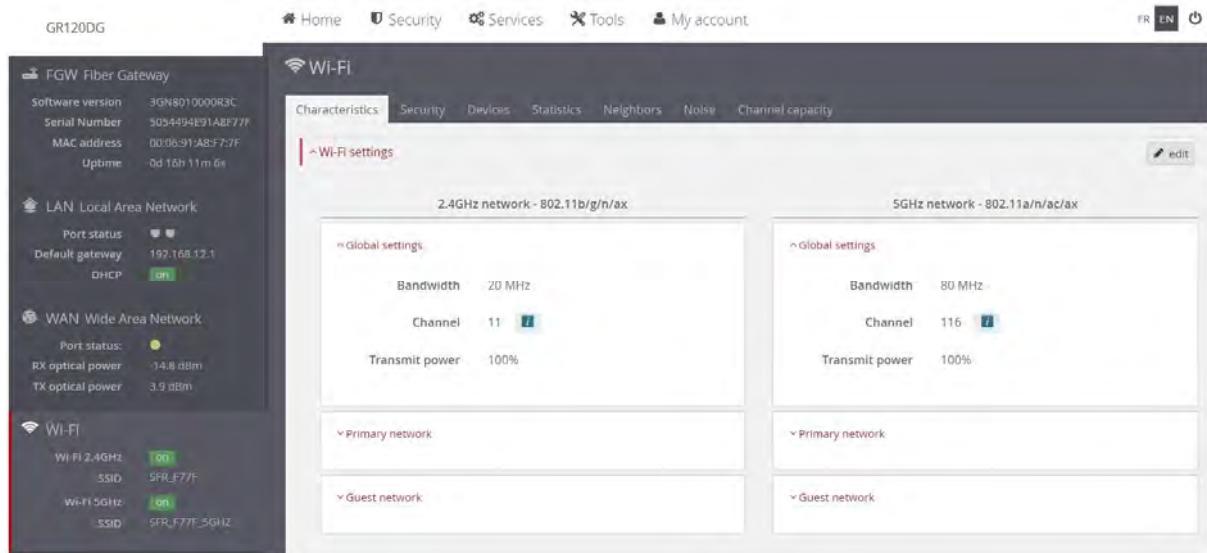


Figure 39: Equipment Menu - Wi-Fi

The Wi-Fi selection on the left side of the window, the equipment and connectivity menu, Figure 39, shows in the main window more information, with possibility of editing, about Wi-Fi connectivity.

On the left side of the management window, Equipment and Connectivity Menu, Figure 39, a set of information related to the Wi-Fi network is shown:

1. Wi-Fi 2.4GHz Active / inactive
2. SSID Name of the network in the band 2.4GHz
3. Wi-Fi 5GHz Active / inactive
4. SSID Name of the network in the 5GHz band

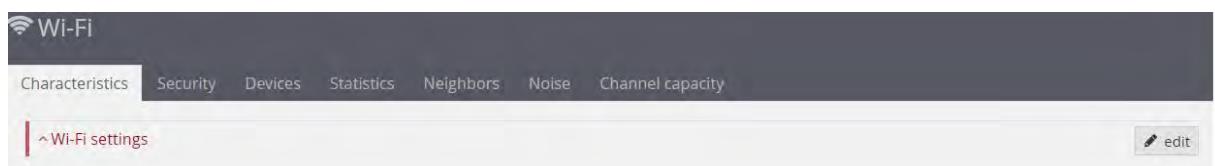


Figure 40: Wi-Fi – Charateristics

In the Wi-Fi window there is access to eight new windows:

- Characteristics; sub-chap. 6.2.4.1
- Security; sub-chap. 6.2.4.2
- Devices; sub-chap. 6.2.4.3
- Statistics; sub-chap. 6.2.4.4
- Neighbors; sub-chap. 6.2.4.5
- Noise; sub-chap. 6.2.4.6
- Chanel capacity; sub-chap. 6.2.4.7

6.2.4.1 Features

In the Features window it is possible to do the expansion of two connections namely; 2.4GHz - 802.11b/g/n/ax Network Settings and 5GHz - 802.11a/n/ac/ax Network Settings.

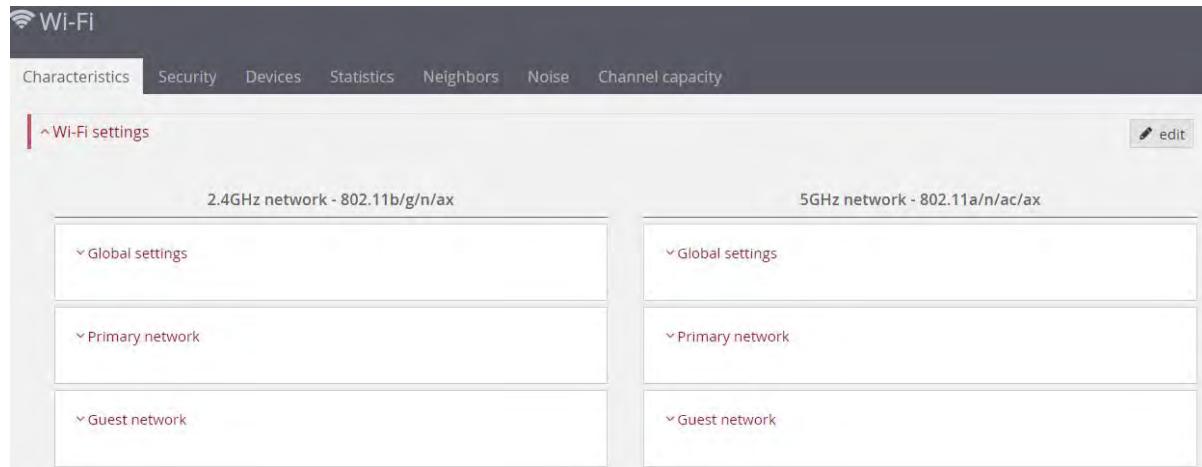


Figure 41: Wi-Fi - Features

On the outside of the FiberGateway there is a label with information on presets of the Wi-Fi interface, Figure 42.



Figure 42: FiberGateway Sticker

6.2.4.1.1 Wi-Fi Settings

Area where you can view and edit Wi-Fi features, Figure 44.

Feature settings:

Smart Wi-Fi: A Smart Wi-Fi network consists of two or more nodes (FGW + N extender APs) that communicate with each other and work in a coordinated fashion to expand the Wi-Fi signal and ensure the best performance to each client / STA device according to their position. In a Smart Wi-Fi network, intelligence is also available to improve spectrum management, load balancing, and interference management. In addition, the steering decision (which consists of the choice of the band or the AP with the best performance, AP (band steering and AP steering) is done in a coordinated way, and there is an internal entity that concentrates this information and decides at every instant what is the best bandwidth and what is the best AP for each associated client / STA.

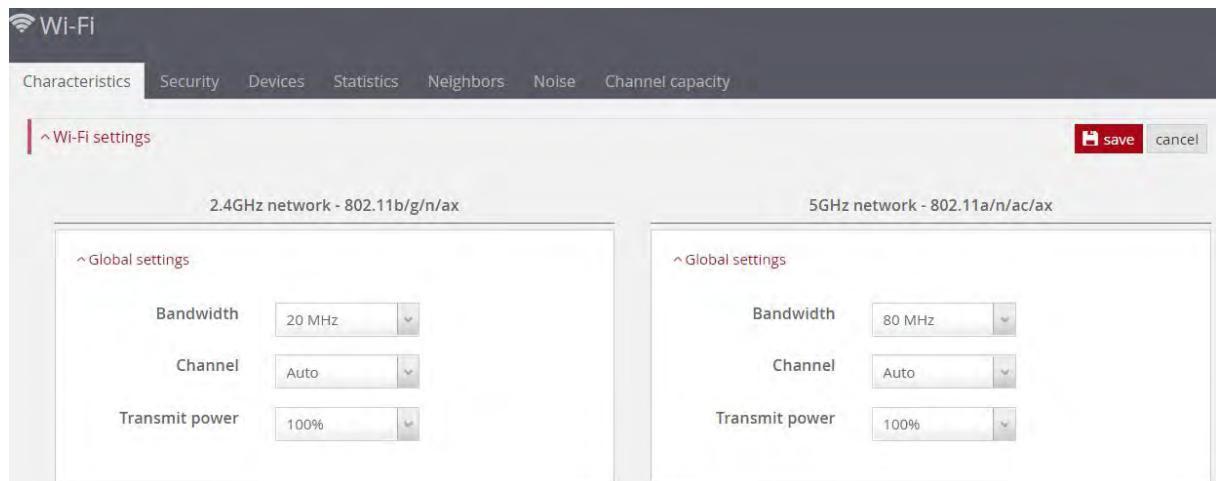
Band steering: It is one of the processes used by Smart Wi-Fi to maximize the performance of the client devices, directing them to the frequency band (2.4 or 5 GHz) that guarantees better conditions. Currently, this process is mostly influenced by the RSSI of client devices.

Wi-Fi Handover: In Smart Wi-Fi networks this feature occurs when a client / STA device is directed by Smart Wi-Fi to use a better-networked network AP / AP by changing its association to that node. This functionality is also referred to as AP steering.

In FGW, if the Smart Wi-Fi Topology feature is active, it is forced to deactivate the band steering in the FGW itself because this functionality will be controlled by Smart Wi-Fi itself.

6.2.4.1.1 General Settings

After the Edit symbol is selected, access to editing Wi-Fi 2.4GHz, 5GHz and Wi-Fi network configuration variables is enabled; Bandwidth, Channel, Transmit power, these variables common to the primary network and the Guest network.



The screenshot shows the 'Wi-Fi' settings page with the 'General Settings' tab selected. The interface is divided into two main sections: '2.4GHz network - 802.11b/g/n/ax' and '5GHz network - 802.11a/n/ac/ax'. Each section contains 'Global settings' and configuration for 'Bandwidth', 'Channel', and 'Transmit power'. The '2.4GHz' section has a bandwidth of 20 MHz, channel set to Auto, and transmit power at 100%. The '5GHz' section has a bandwidth of 80 MHz, channel set to Auto, and transmit power at 100%. A 'save' button is visible in the top right corner.

Network	Protocol	Bandwidth	Channel	Transmit power
2.4GHz	802.11b/g/n/ax	20 MHz	Auto	100%
5GHz	802.11a/n/ac/ax	80 MHz	Auto	100%

Figure 43: General Settings

6.2.4.1.1.2 Primary network

The configuration parameters of the primary network are; Enable Network, SSID, SSID Announce, Network Authentication, Enable Wi-Fi Protected Setup (WPS), Encryption Mode, Password.

Figure 44: Wi-Fi 2.4GHz and 5GHz – Primary Network Edition

Group	Parameter	Description
2.4GHz 5GHz network configuration	Largura de banda	Largura de banda dos canais: 2.4GHz - 20MHz, 40MHz 5GHz - 20MHz, 40MHz, 80MHz
	Channel	Channel ID: 2.4GHz; Auto, 1,2,3,... ..11 5GHz; Auto, 36,40,44,48
	Transmission power	Potência de transmissão: 100%, 50%, 25%, 12,5%
Primary network	Enable network	Enable / disable network; on / off
	SSID	Primary Wi-Fi network name
	Announce SSID	Announce SSID; on / off
	Network authentication	Authentication mode: Open, Shared, Radius, WPA, WPA2, WPA2-PSK, Mixed WPA2 / WPA-PSK, Mixed WPA / WPA2
	Enable Wi-Fi Protected Setup (WPS)	Enable / disable WPS (Wi-Fi Protected Setup); on / off
	Encryption mode	Encryption mode: AES, TKIP + AES
	Password	Access password

Tabel 25: Wi-Fi 2.4GHz 5GHz Primary network - Parameters

6.2.4.1.1.3 Guest network

The guest network allows the user to activate a network with a distinct LAN address, allowing a higher number of Wi-Fi devices.

This is a wireless network distinct from the primary network, with another SSID and can be configured either as public (open) or as secure (password controlled access). In this way it is possible to access, without transferring the credentials of the primary network, to the internet but not to the client's private network.

In this window, Figure 45, you can configure the parameters related to the Guest Network Configuration (or network for guests).

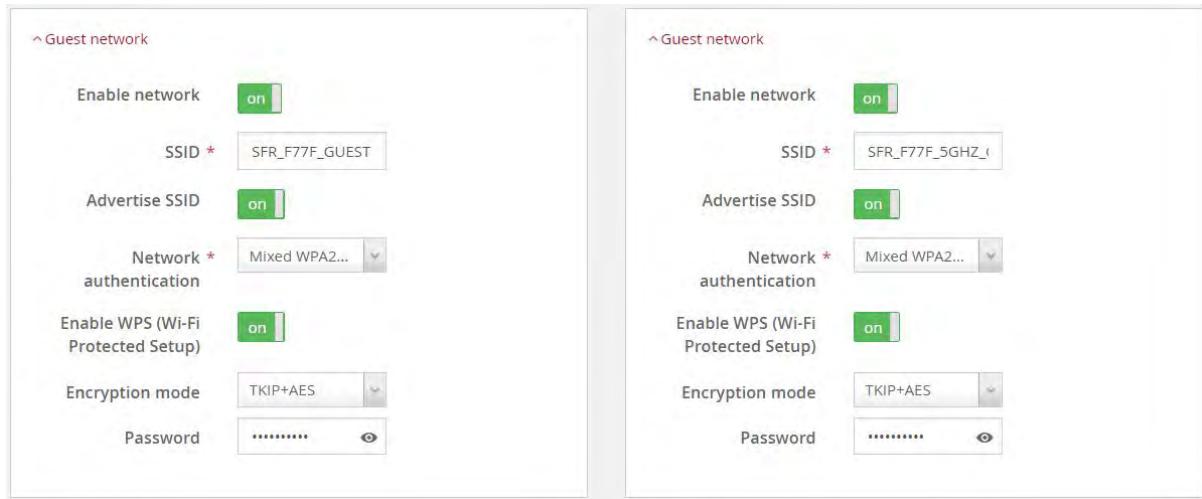


Figure 45: Wi-Fi 2.4GHz and 5GHz – Guest Network Edition

Group	Parameter	Description
Guest network	Enable network	Enable / disable network; on / off
	SSID	Primary Wi-Fi network name
	Announce SSID	Announce SSID; on / off
	Network authentication	Authentication mode: Open, Shared, Radius, WPA, WPA2, WPA2-PSK, Mixed WPA2 / WPA-PSK, Mixed WPA / WPA2
	Enable Wi-Fi Protected Setup (WPS)	Enable / disable WPS (Wi-Fi Protected Setup); on / off
	Encryption mode	Encryption mode: AES, TKIP + AES
	Password	Access password

Tabel 26: Wi-Fi 2.4GHz e 5GHz Guest network – Parameter

6.2.4.2 Security

In this window, Figure 46, all parameters relevant to the security of Wi-Fi access are configured by using filters that define which MAC addresses are authorized or disabled for either the primary network or the guest network in the two bands: Wi-Fi 2.4GHz and 5GHz

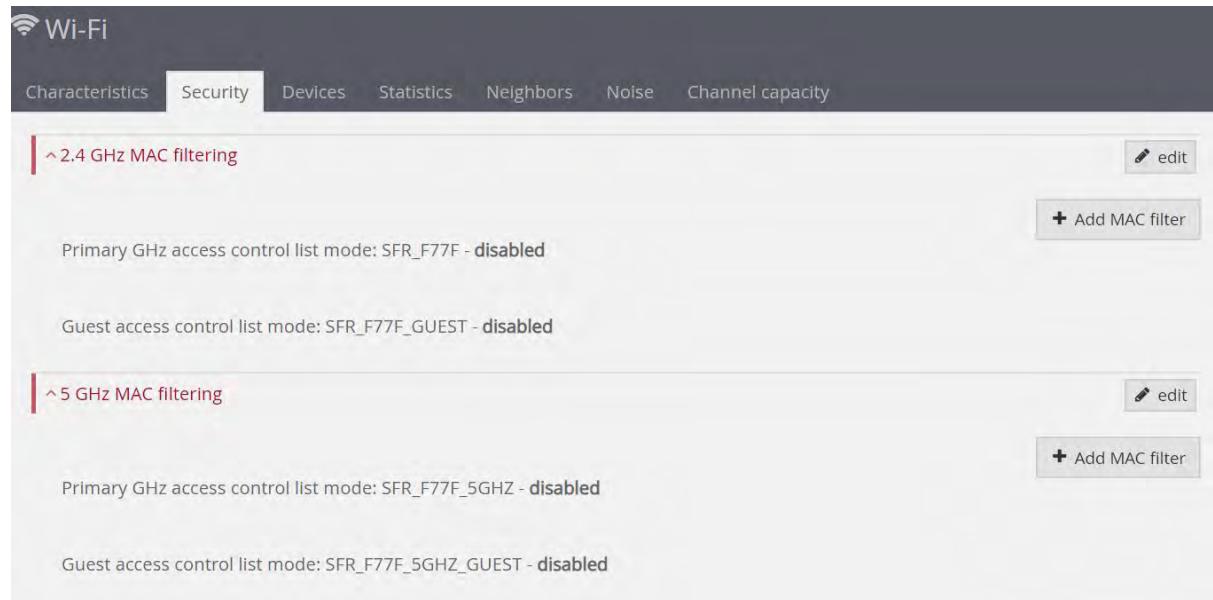


Figure 46: Wi-Fi Security

6.2.4.2.1 2.4GHz / 5GHz MAC Filtering

2.4GHz / 5GHz MAC filtering allows you to edit the control mode by selecting the "Edit" icon, and create a MAC filter by selecting the "+ Add MAC filter"

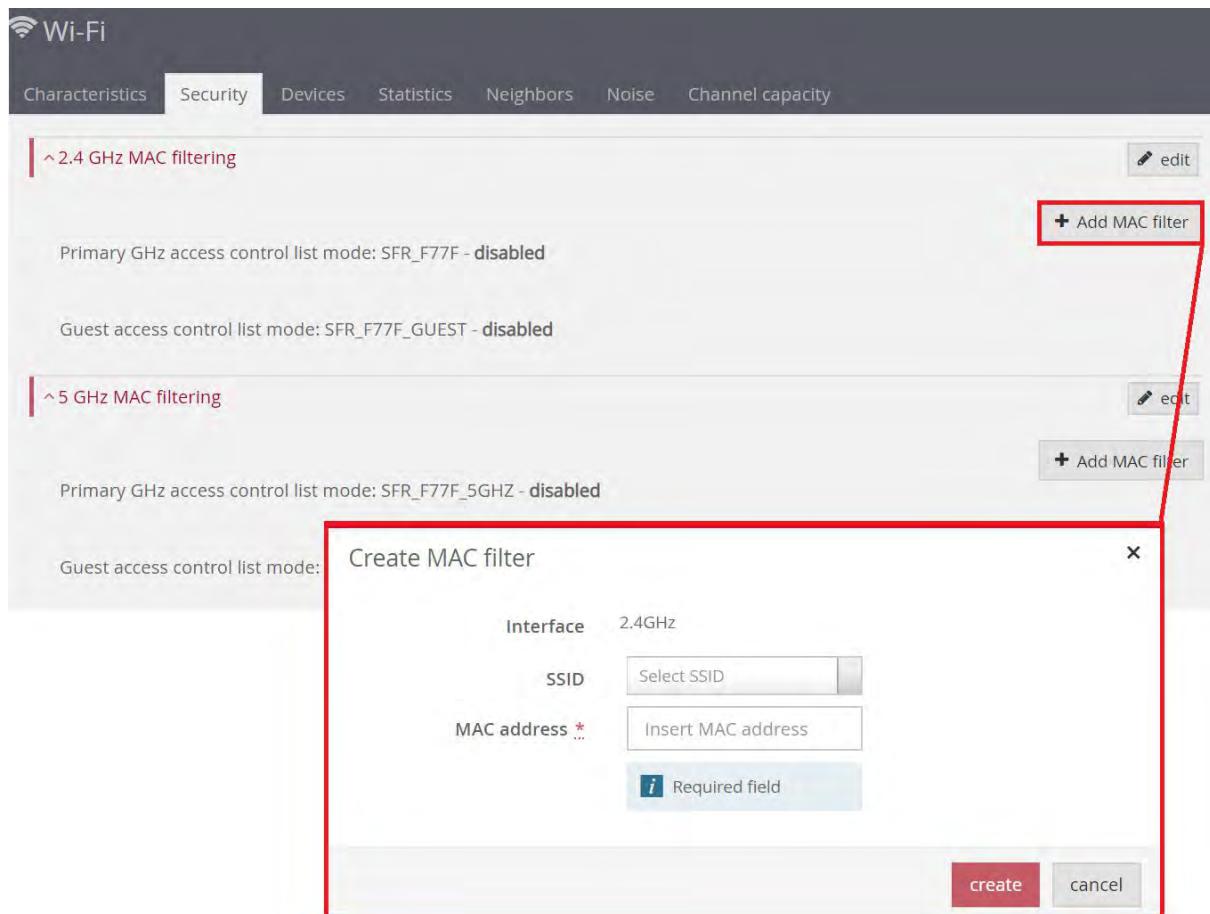


Figure 47: Wi-Fi Security - Add MAC Filter

The possible modes to configure are:

- Allowed - Means the rule will be used
- Blocked - Means the rule blocks
- Disabled - Rule disabled

Using the Permitted mode means that only the devices whose MAC address are found in the filter will have access to the Wi-Fi network, implying that all other possible MAC addresses are blocked

Using Locked Mode means that devices whose MAC addresses are in the Filter will be blocked, implying that all other possible MAC addresses are allowed.

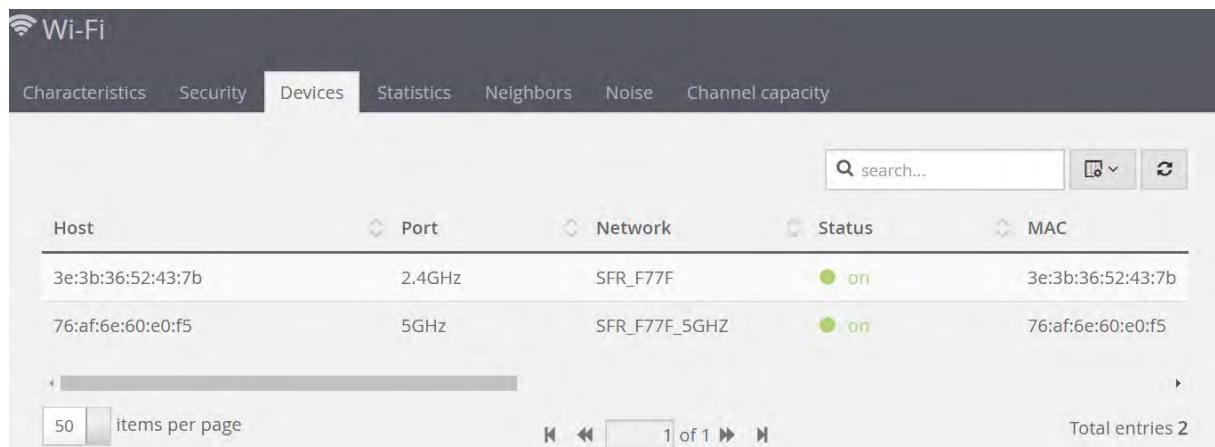
Group	Parameter	Description
2.4GHz / 5GHz MAC Filtering	Primary network access control list mode	Disabled, allowed, blocked (s)
	Network access control list mode guest	Disabled, allowed, blocked (s)
Create MAC filter	Interface	Interface Wi-Fi; 2.4GHz
	SSID	Wi-Fi network name
	Endereço MAC	Enter MAC address

Tabel 27: Wi-Fi Security - Parameters

6.2.4.3 Dispositivos

In this window, Figure 48 and following shows all the devices connected in the Wi-Fi network, in the two 2.4GHz and 5GHz bands. For each device the name (host), Wi-Fi network name, status, device MAC address, and IP address are shown. By default, 50 devices per page are shown.

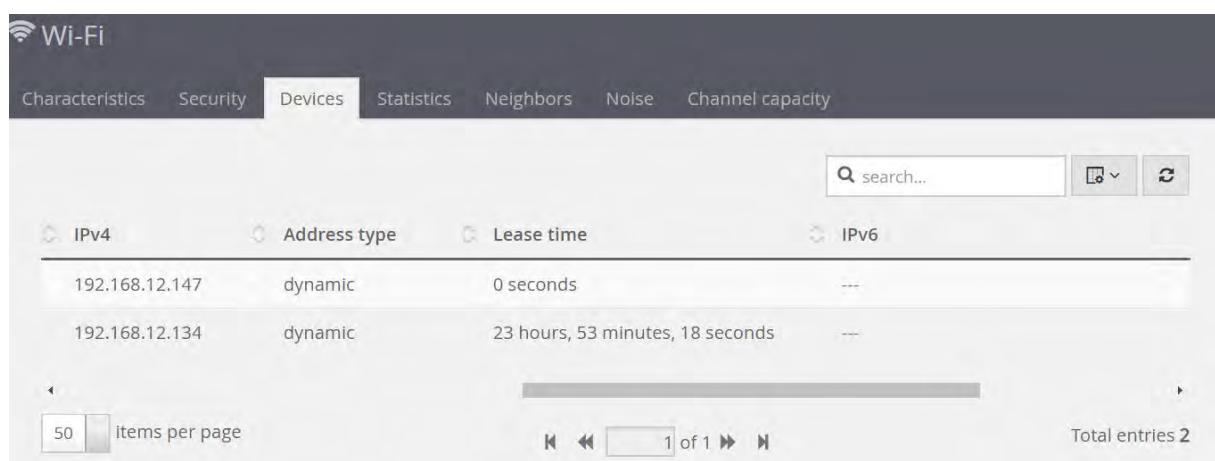
You can search for a device that is either not connected or not.



Host	Port	Network	Status	MAC
3e:3b:36:52:43:7b	2.4GHz	SFR_F77F	on	3e:3b:36:52:43:7b
76:af:6e:60:e0:f5	5GHz	SFR_F77F_5GHz	on	76:af:6e:60:e0:f5

50 items per page 1 of 1 Total entries 2

Figure 48: Wi-Fi – Devices I



IPv4	Address type	Lease time	IPv6
192.168.12.147	dynamic	0 seconds	---
192.168.12.134	dynamic	23 hours, 53 minutes, 18 seconds	---

50 items per page 1 of 1 Total entries 2

Figure 49: Wi-Fi – Devices II

Group	Parameter	Description
Parameters	Host	Name of the connected terminal
	Port	Wi-Fi port name: 2.4GHz / 5GHz
	Network	Wi-Fi network name
	Status	Status
	MAC	MAC address of the connected terminal
	IPv4	IPv4 address of the terminal
	Address type	Address type
	Lease time	IP address lease time
	IPv6	IPv6 address of the terminal
	Link local IPv6	Link local IPv6

Tabel 28: Wi-Fi Devices - Parameters

6.2.4.3.1 Display filters

In this window, the following figure shows all the devices connected in the Wi-Fi network, in the two 2.4GHz and 5GHz bands. The information to display can be chosen by selecting the icon. After the selection, the following possible parameters are displayed:

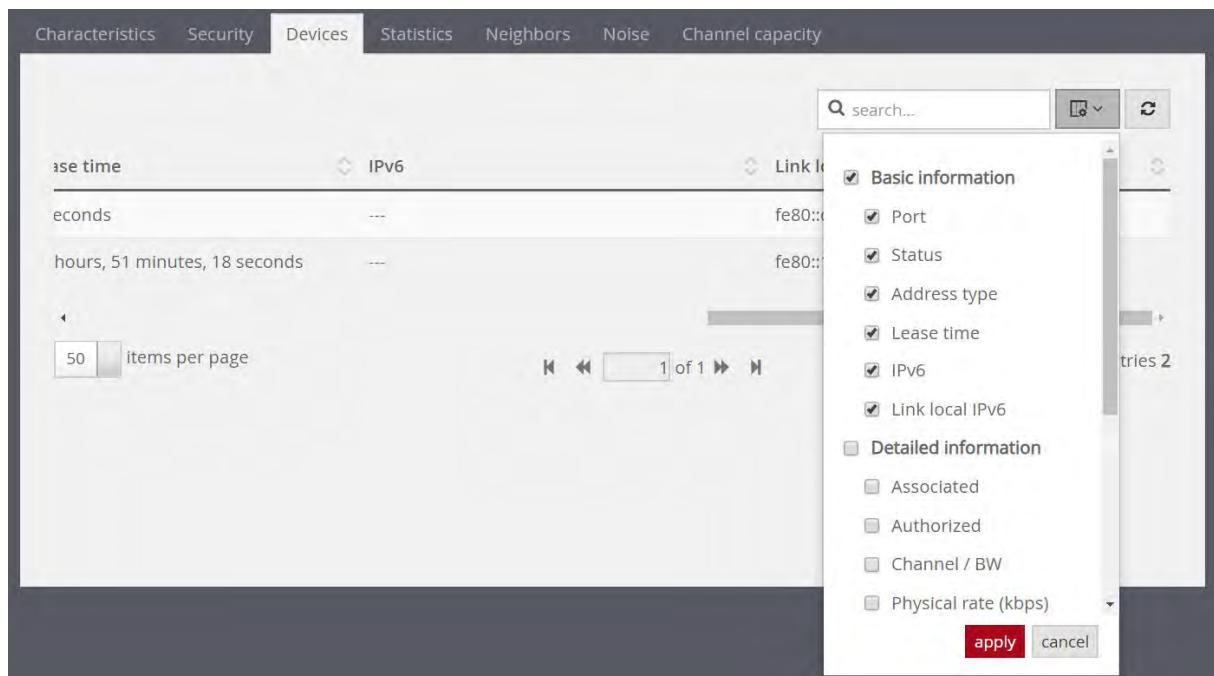
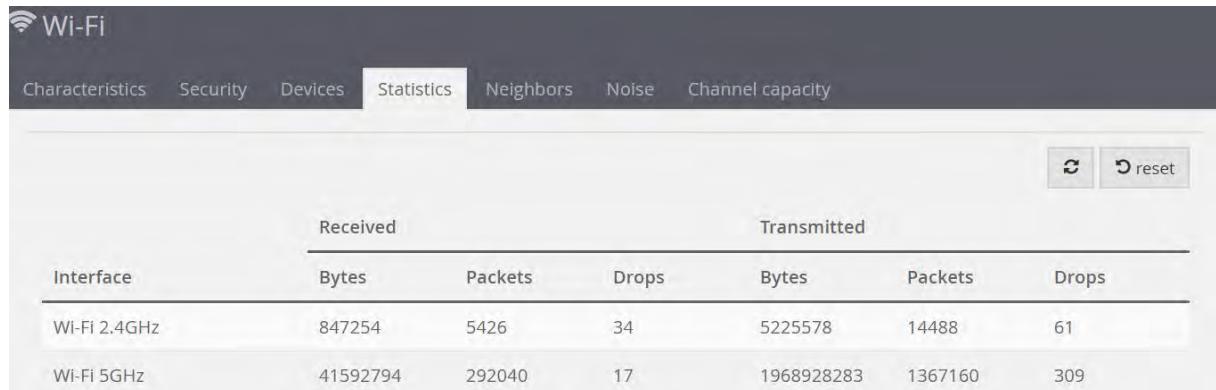


Figure 50: Wi-Fi – Display filter

6.2.4.4 Statistics

In this window, Figure 51, shows statistical data for bytes sent and received and packets and packages discarded (errors) on the Wi-Fi network in the two bands: Wi-Fi 2.4GHz and 5GHz.



Interface	Received			Transmitted		
	Bytes	Packets	Drops	Bytes	Packets	Drops
Wi-Fi 2.4GHz	847254	5426	34	5225578	14488	61
Wi-Fi 5GHz	41592794	292040	17	1968928283	1367160	309

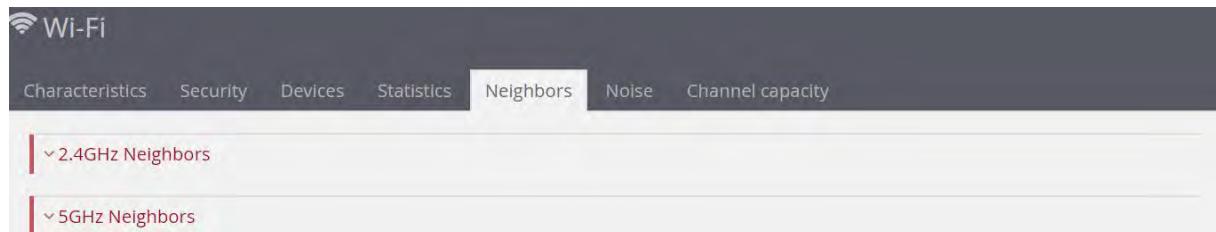
Figure 51: Wi-Fi – Statistics

Group	Parameter	Description
Statistics	Interface	Interface Wi-Fi: 2.4GHz 5GHz
Recebido	Bytes	Received bytes
	Packets	Received packets
	Drops	Discarded packets
Transmitido	Bytes	Transmited bytes
	Packets	Transmited packets
	Drops	Discarded packets

Tabel 29: Wi-Fi Statistics - Parameters

6.2.4.5 Neighbors

In this window FiberGateway neighboring Wi-Fi access points are shown.



2.4GHz Neighbors
5GHz Neighbors

Figure 52: Wi-Fi – Neighbors

6.2.4.5.1 2.4GHz Neighbors

In this window, Figure 53, FiberGateway neighbors Wi-Fi access points are shown in the 2.4GHz band.

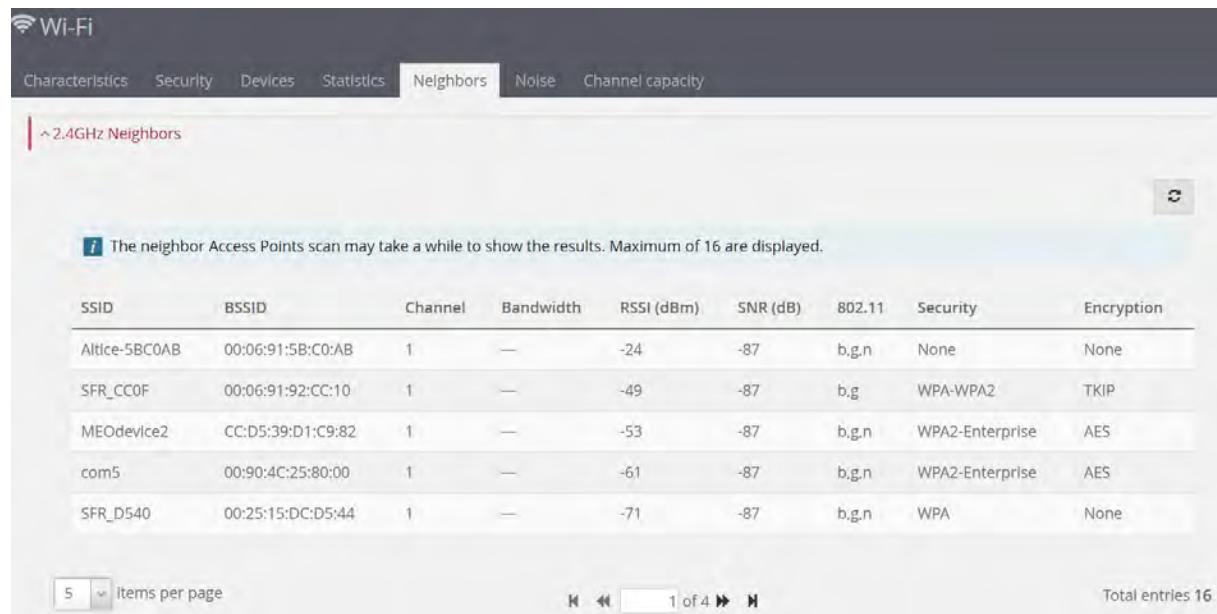


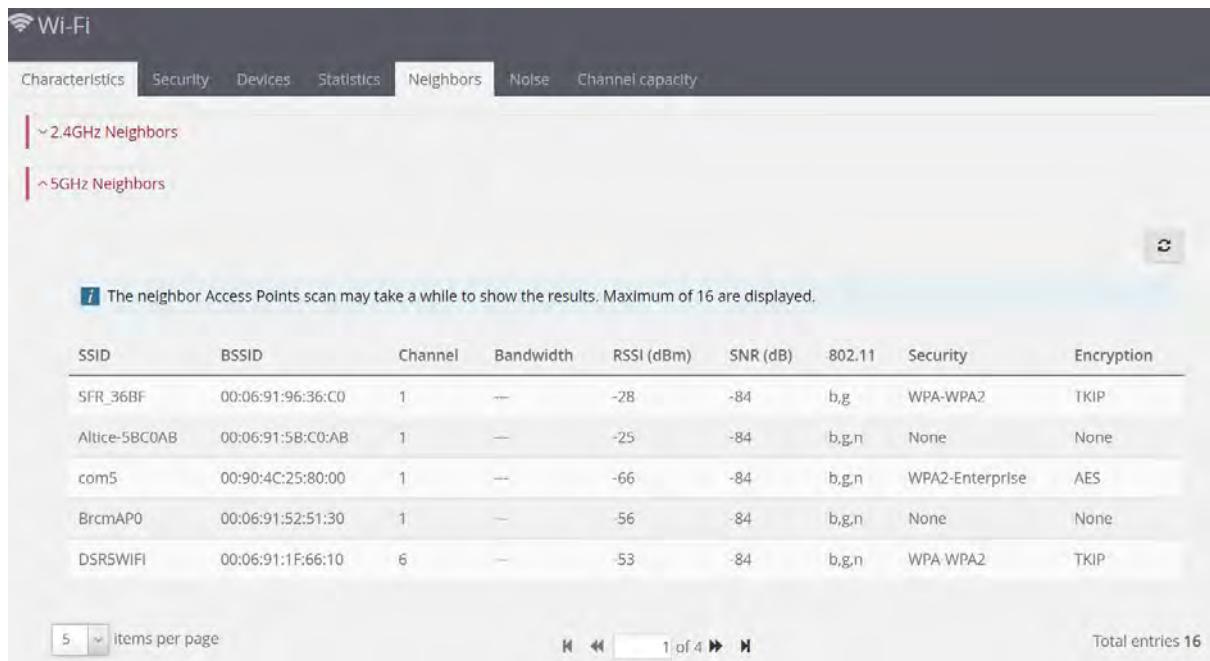
Figure 53: Neighbors 2.4GHz

Group	Parameter	Description
Neighbors 2.4GHz	SSID	Identification of access
	BSSID	Physical address
	Channel	Radio channel
	Bandwidth	Radio channel bandwidth
	RSSI(dBm)	Noise
	SNR(dB)	Signal to noise ratio
	802.11	Standard version
	Security	WPA, WPA2, WEP, <i>none</i>
	Encryption	TKIP, AES, TKIP/AES

Tabel 30: 2.4GHz Neighbors – Parameters

6.2.4.5.2 5GHz Neighbors

In this window, Figure 54, FiberGateway neighbors Wi-Fi access points are shown in the 5GHz band.



The screenshot shows a table titled 'Neighbors 5GHz' with 16 entries. The columns are: SSID, BSSID, Channel, Bandwidth, RSSI (dBm), SNR (dB), 802.11, Security, and Encryption. The entries are as follows:

SSID	BSSID	Channel	Bandwidth	RSSI (dBm)	SNR (dB)	802.11	Security	Encryption
SFR_36BF	00:06:91:96:36:C0	1	—	-28	-84	b,g	WPA-WPA2	TKIP
Altice-5BC0AB	00:06:91:5B:C0:AB	1	—	-25	-84	b,g,n	None	None
com5	00:90:4C:25:80:00	1	—	-66	-84	b,g,n	WPA2-Enterprise	AES
BrcmAP0	00:06:91:52:51:30	1	—	-56	-84	b,g,n	None	None
DSRSWIFI	00:06:91:1F:66:10	6	—	-53	-84	b,g,n	WPA-WPA2	TKIP

At the bottom, there are buttons for '5 items per page', '1 of 4', and 'Total entries 16'.

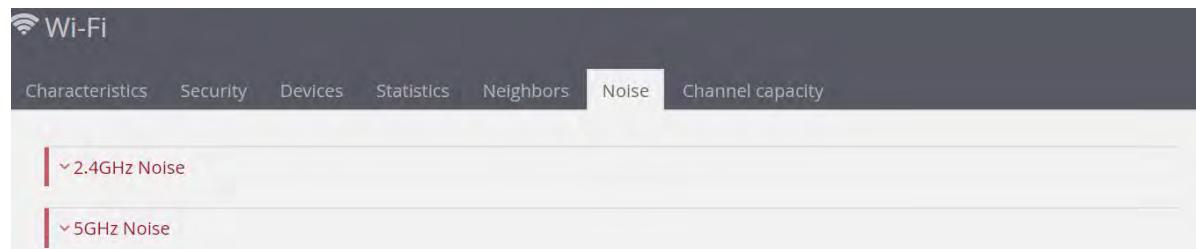
Figure 54: Neighbors 5GHz

Group	Parameter	Description
Neighbors 5GHz	SSID	Identification of access
	BSSID	Physical address
	Channel	Radio channel
	Bandwidth	Radio channel bandwidth
	RSSI(dBm)	Noise
	SNR(dB)	Signal to noise ratio
	802.11	Standard version
	Security	WPA, WPA2, WEP, <i>none</i>
	Encryption	TKIP, AES, TKIP/AES

Tabel 31: 5GHz Neighbors - Parameters

6.2.4.6 Noise

In this window FiberGateway noise Wi-Fi are shown.



The screenshot shows a table titled 'Noise' with 2 entries. The columns are: 2.4GHz Noise and 5GHz Noise. The entries are as follows:

2.4GHz Noise	5GHz Noise
—	—

Figure 55: Wi-Fi – Noise

6.2.4.6.1 2.4GHz Noise

In this window, the following figure shows the noise levels (dBm) in FiberGateway Wi-Fi channels, in the 2.4GHz band. Channel selection shows the noise value in dBm.

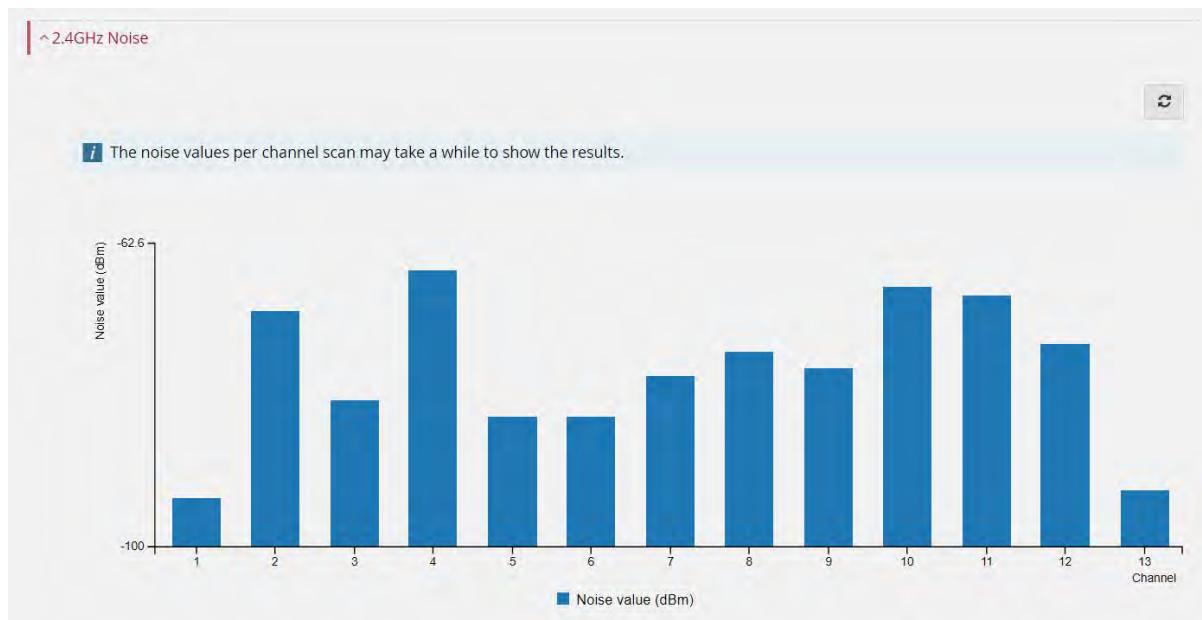


Figure 56: 2.4GHz Noise

6.2.4.6.2 5GHz Noise

In this window, Figure below, the noise levels (dBm) on FiberGateway Wi-Fi channels in the 5GHz band are shown. The channel selection shows the noise value in dBm.

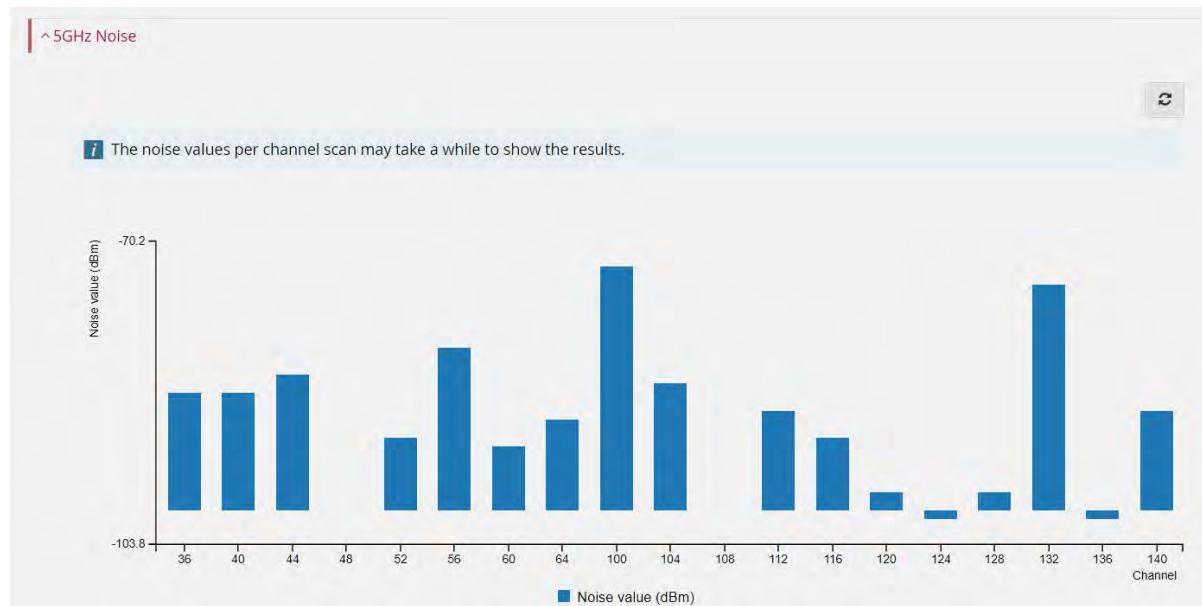


Figure 57: 5GHz Noise

6.2.4.7 Channel capacity

In this window FiberGateway channel capacity are shown.

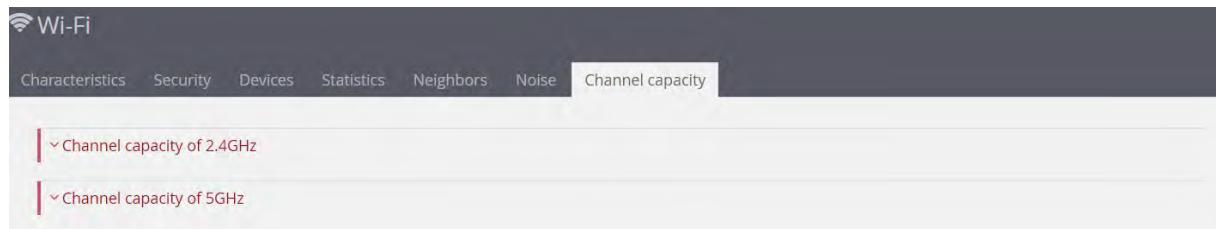


Figure 58: Channel capacity

6.2.4.7.1 Channel capacity of 2.4GHz



Figure 59: Channel capacity of 2.4GHz

6.2.4.7.2 Channel capacity of 5GHz



Figure 60: Channel capacity of 5GHz

6.2.5 Voice

Access to information and editing of the Voice service is done by selecting the field next to the vertical red line identified by Voice.

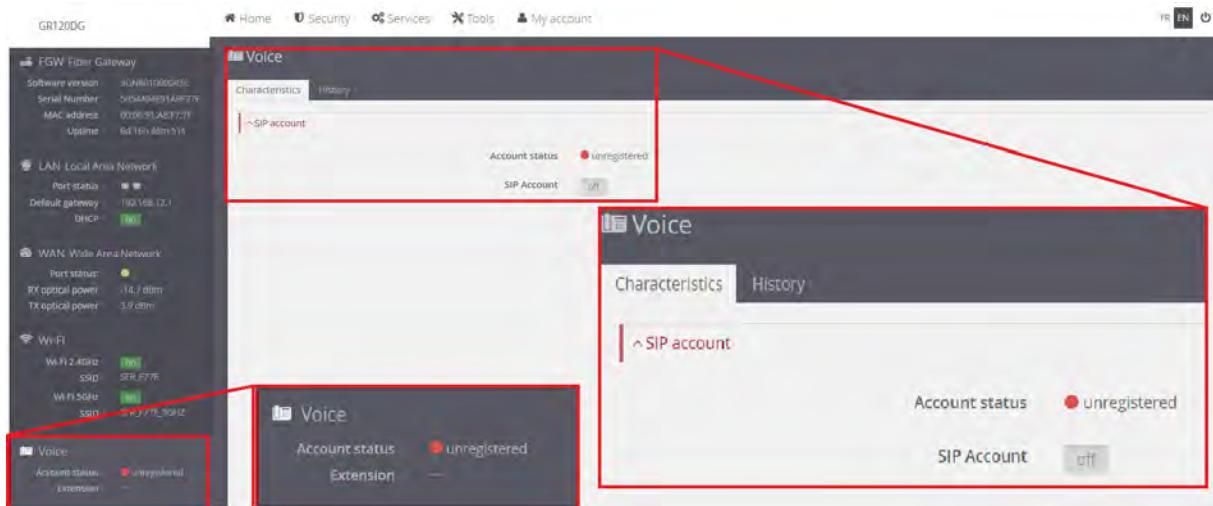


Figure 61: Equipment Menu - Voice

The Voice selection on the left side of the equipment window, Figure 61, shows in the main window more information about the Voice service, Figure 62.

6.2.5.1 Characteristics

Window where you can see the characteristics of the Voice. This window shows a subgroup:

- Characteristics
- SIP Account

6.2.5.1.1 SIP Account

The following figure shows all relevant parts associated with the voice service, such as whether or not the service is registered, and the number of the voice service. None of the accessible parameters can be edited.

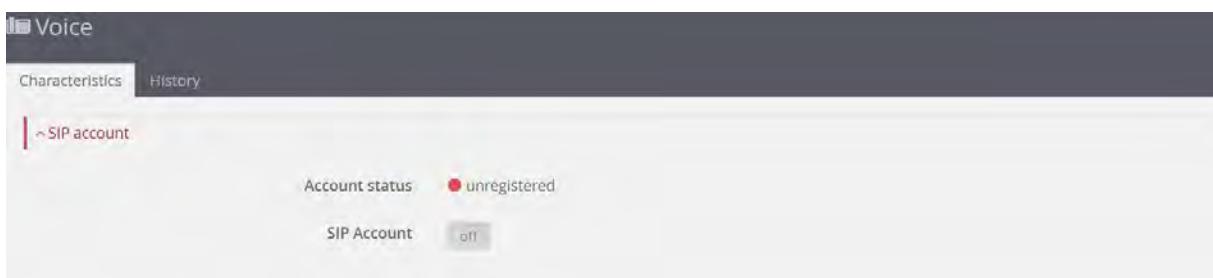


Figure 62: Voice - Details

Group	Parameter	Description
SIP Accounts	Account status	Registered / unregistered
	SIP account 1	On / Off
	Extension	Voice service identification
	Display name	Display name
	Authentication name	SIP authentication name
	Password	Access password
	Physical terminal	Phone physical plug: FXS0, FXS1

Tabel 32: Voice - Parameters

6.2.6 Television

The TV selection on the left side of the management window, equipment menu, Figure 63, shows in the main window more information about the Television service, Figure 64.

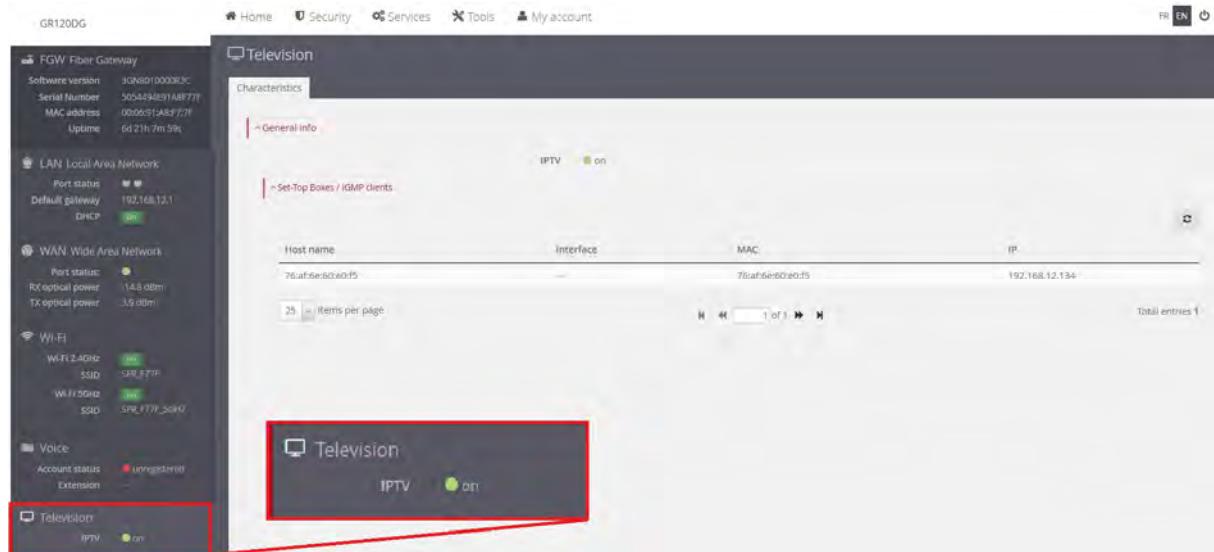


Figure 63: Equipment Menu - Television

In this area you can view the characteristics of the television service. This window shows a subgroup:

- Features
 - General information
 - Set top Boxes

On the left side of the management window, Equipment Menu, Figure 63, a set of information related to the television service is shown:

Service status On / Off

6.2.6.1 Set top Boxes / IGMP Clients

In this area, Figure 64, the STB (Set-top Box) information, namely the Ethernet Interface and / or the WLAN interface in the 5GHz band are displayed, where they are connected and the respective IP address.

Host name	Interface	MAC	IP
76:af:6e:60:e0:f5	---	76:af:6e:60:e0:f5	192.168.12.134

Figure 64: Television - Details

Group	Parameter	Description
General information	IPTV	On/off
Set top box	Hostname	Name of STB
	Interface	Physical interface: LAN 1, LAN 2, Wi-Fi 5GHz primary
	MAC	MAC Address
	IP	STB IP Address

Tabel 33: Television - Parameters

6.3 Functional Menu

In this area (area 2, Functional Menu) we have the possibility to access five windows where parameters related to security, services, tools and access to My account can be viewed and edited.



Figure 65: Functional Menu

Selecting the Start window displays the following page:

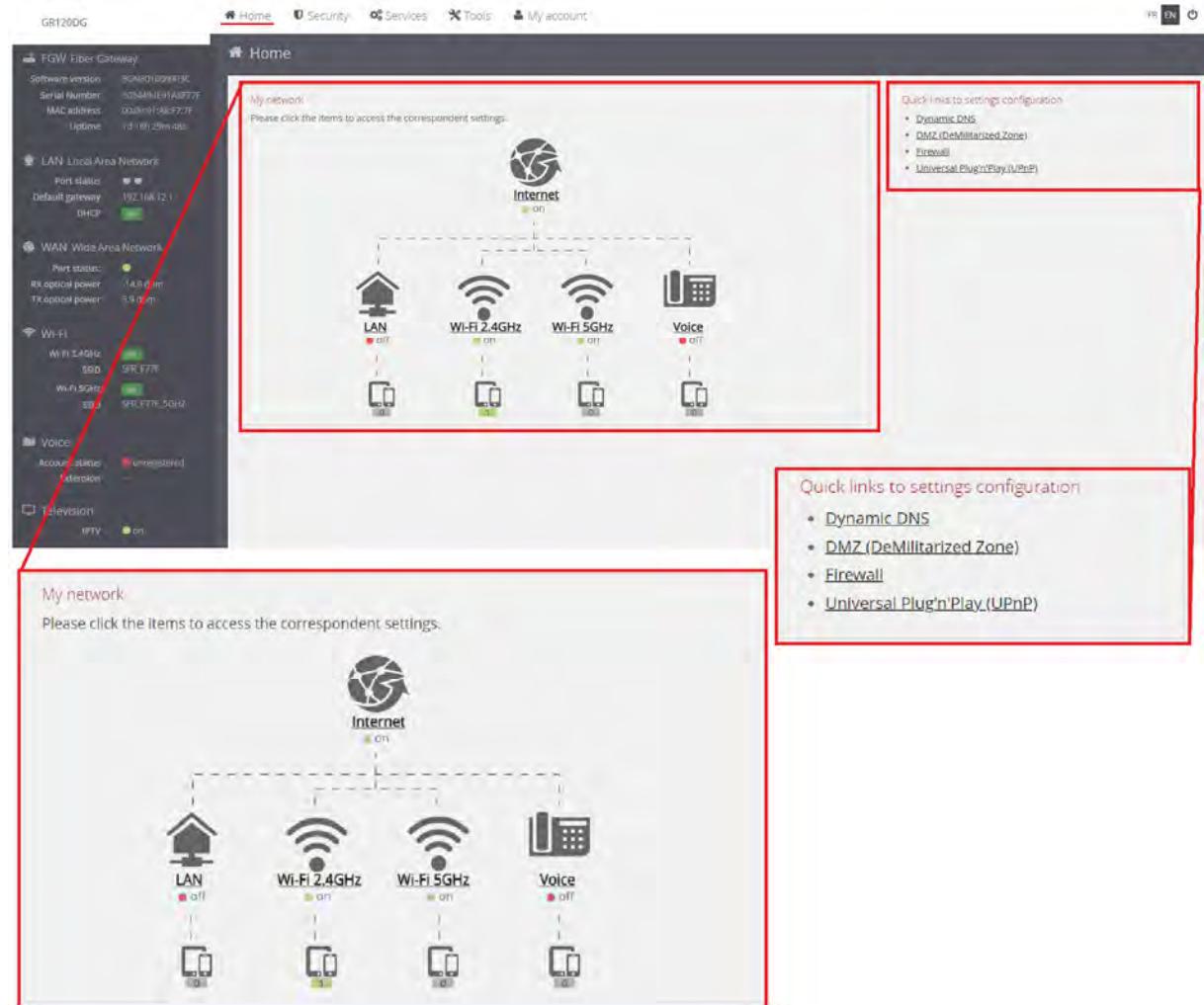


Figure 66: Functional Menu - Home

In this window the following information is displayed:

- Internet connection status: On / Off
- Number of terminals connected on the LAN
- Number of terminals connected on the 2.4GHz Wi-Fi network
- Number of terminals connected on the 5GHz Wi-Fi network
- Voice service status: On / Off

Also in this window is a set of quick connections to applications

- Dynamic DNS
- DMZ (Demilitarized Zone)
- Firewall
- Universal Plug'in'Play (UPnP)

6.3.1 Security

This window, figure below, is displayed when the menu item Security is selected.

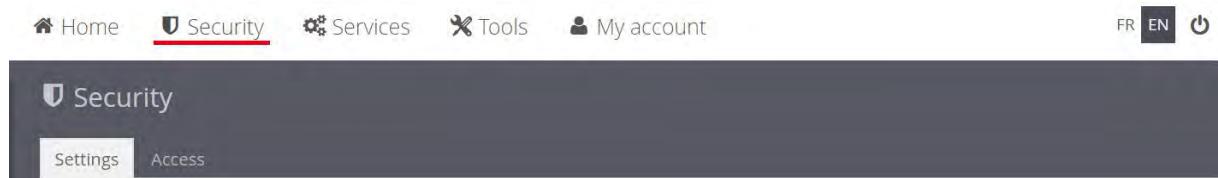


Figure 67: Functional Menu - Security

This window allows access to two new windows: Settings and Access

In the Settings window you can view / change parameters in:

1. URL Filters
2. Firewall and DMZ

In the Access window you can view / change parameters in:

1. Port forwarding
2. Activation of ports

In this window you can access information related to security, define / change new rules and security mechanisms, namely:

- Uniform Resource Locator (URL) filter.

You can set URL addresses, which are not accessible from the local network.

- Firewall and DMZ.

Firewall is an application that controls all incoming and outgoing accesses to the communication ports of the TCP and UDP transport protocols. It is therefore possible to block or unblock these ports for any of the transport protocols.

A DMZ or demilitarized zone (DMZ), also known as a perimeter network, is a physical and/or logical subnet that contains and exposes an organization's external border services to a larger, unreliable network, typically the Internet. Any devices in this area, that is, between the trusted network (usually the local private network) and the untrusted network (usually the Internet), are in the demilitarized zone. The function of a DMZ is to keep all services that have external access (such as HTTP, FTP, e-mail servers, etc.) together on a local network. To achieve this goal, computers in a DMZ must not contain any form of LAN access.

6.3.1.1 Settings

The security settings information in effect on FiberGateway is displayed in this window when it is selected or the functional menu item - "Security", Figure below. This information is organized into two groups:

- URL Filters
- Firewall and DMZ

The existing settings in the device are shown in each group.

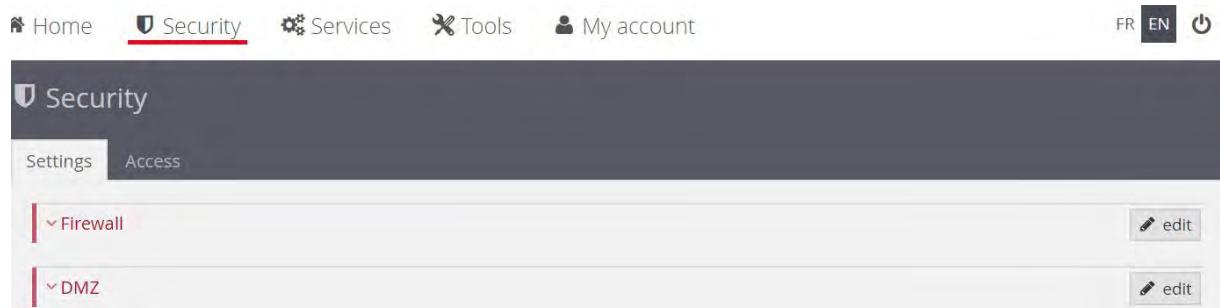


Figure 68: Functional Menu - Security Settings

The Security Configuration, "Firewall and DMZ" is done directly in the security window, Settings, selecting the edit button and configuring its parameters. Setup is completed by using the save button visible on the right side of its security subgroup, Figure 69.

6.3.1.1.1 Firewall and DMZ

The firewall (IPv4 and IPv6) and the DMZ can be enabled or disabled on the page shown in the following figure, selecting the "edit" field, then selecting the on / off field.

Activating the DMZ is obligatory to indicate the DMZ server.



Figure 69: Security - Firewall and DMZ

Group	Parameter	Description
Firewall and DMZ	Enable firewall	Flag: On – Active Firewall Off – Inactive Firewall
	Enable firewall IPv6	Flag: On – Active Firewall Off – Inactive Firewall
	Ativa/inativa DMZ On/Off	Flag: On – DMZ active Off – DMZ inactive
	DMZ server	DMZ Server IP Address

Tabel 34: Security - Parameters

6.3.1.2 Access window

The Security Access information in effect on FiberGateway is displayed in the main window when the security submenu item, "Access" is selected.

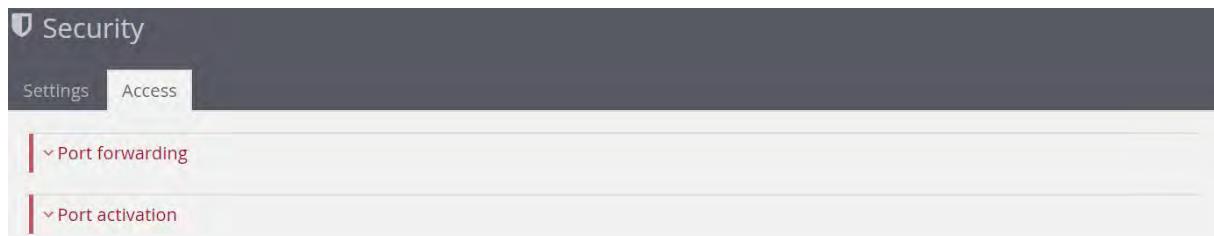


Figure 70: Functional Menu - Access

In this window it is possible to route ports and their activation. Note that: "The abuse of port ranges may reduce the performance of the device. The maximum allowed range is 100 ports".

The Security Access information in effect on FiberGateway is displayed in the window, Figure 52 when the Security submenu item, "Access" is selected. This information is organized into two groups:

- Port forwarding
- Activation of ports

In each group, the safety access rules (respectively, Port Forwarding Tabel and Port Activation Tabel) in force are shown in each group.

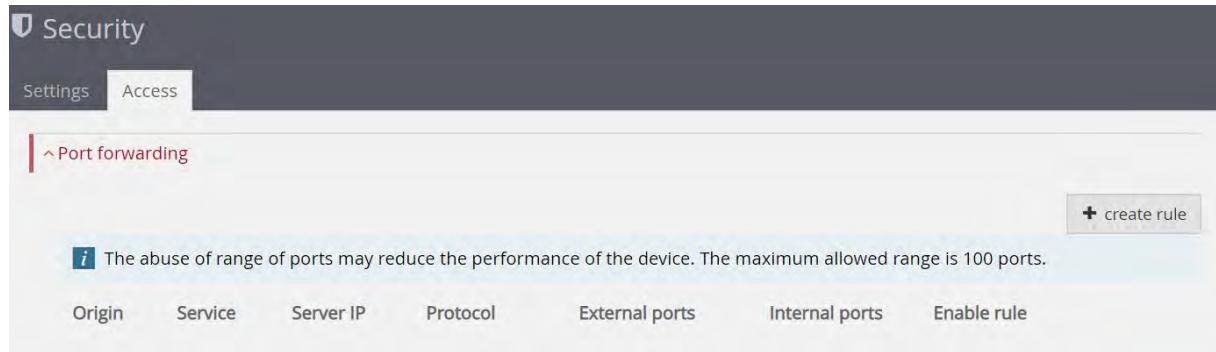
Editing security accesses and creating new access rules is possible in each group by using the "+ create rule" buttons.

The "+ create rule" buttons when selected open an edit window where you can enter the values of the parameters of the new access rule configuration (mandatory input parameters are checked). The creation of the new rule will be completed by the "create" button in the lower right corner of the edit window.

6.3.1.2.1 Port forwarding

In the port forwarding window it is possible to map internal and external ports. It means that it is possible for an external port to be routed to a different internal port. As is evident if no routing is done the internal port is equal to the external port. In Anglo-Saxon terminology the term used for port forwarding is port mapping.

In Figure 71, the existing routing is shown. The "Origin" field identifies the person responsible for creating the port forwarding rule.



The screenshot shows a web-based configuration interface for port forwarding. At the top, there is a navigation bar with a shield icon labeled 'Security' and two tabs: 'Settings' and 'Access'. The 'Access' tab is selected and highlighted in blue. Below the tabs, a sub-menu titled '^ Port forwarding' is visible. On the right side of the page, there is a button labeled '+ create rule' with a plus sign icon. A small informational message at the top left of the main content area states: 'i The abuse of range of ports may reduce the performance of the device. The maximum allowed range is 100 ports.' Below this message, there is a table with the following columns: 'Origin', 'Service', 'Server IP', 'Protocol', 'External ports', 'Internal ports', and 'Enable rule'. The table currently contains one row of data, which is a placeholder for a new rule.

Figure 71: Access – Port forwarding

Figure 72 shows all the possible fields to be changed, referring to port routing. To access this functionality, select the "+ create rule" field. The interface where these routing is done is the WAN interface erouter0.

By selecting the "Service Name" field, a set of predefined applications is available, as well as the possibility of creating a new application. In this case, it is necessary to define the name of the application in the field "Define a service". In all other fields the parameters to be changed are the same as those of the predefined applications. The parameters to be changed are "External ports", protocol (TCP / UDP, TCP, UDP), and "Internal ports". The associated IP address is also required.

Note that abuse of port ranges can reduce device performance.

The screenshot shows the MikroTik WebGUI interface for port forwarding. The main window displays a table of existing port forwarding rules. A red box highlights the "+ create rule" button in the top right corner of the table header. A red arrow points from this button to the "Service name" field in the "Create port forwarding rule" dialog box, which is also highlighted with a red box. The dialog box contains fields for "Interface" (set to "erouter0"), "Service name" (a dropdown menu with "select a pre-defined service" and a "Required field" message), "Server IP address" (a dropdown menu with "Insert Server IP address" and a "Required field" message), and "Protocol" (dropdown menu with "select"). Below the dialog, another "Create port forwarding rule" dialog is partially visible, showing similar fields and a note about performance.

Figure 72: Access - Create port forwarding rule

Group	Parameter	Description
Port Forwarding	Interface	Identification of the WAN interface.
	Service	Identification of the service
	Server IP address	Service server address
	Protocol	Transport Protocol
	External ports	External ports ID
	Internal ports	ID of internal ports

Tabel 35: Security - Port forwarding

6.3.1.2.2 Ports activation

In the port activation window it is possible to activate internal and external ports and protocols (TCP, UDP). It means that it is possible for one protocol and external port to be activated different internal port.

In Anglo-Saxon terminology the term used for port activation is port triggering

Application name	Active protocol	Active ports	Forward protocol	Forward ports	Enable rule
Aim Talk	TCP	4099 • 4099	TCP	5191 • 5191	<input checked="checked" type="button"/> on  

Figure 73: Access - Create port activation rule

The following figure shows all the possible fields to be changed, related to the activation of ports. To access this functionality, select the "+ create rule" field. The interface where these routing is done is the WAN interface eroute0.

By selecting the "Application name" field, a set of predefined applications is available, as well as the possibility of creating a new application. In this case it is necessary to define the application name in the "Define an application" field. In all other fields the parameters to be changed are the same as those of the predefined applications.

The parameters to be changed are "Active Ports", protocol (TCP/UDP, TCP, UDP), "Forward Ports" and Enable rule.

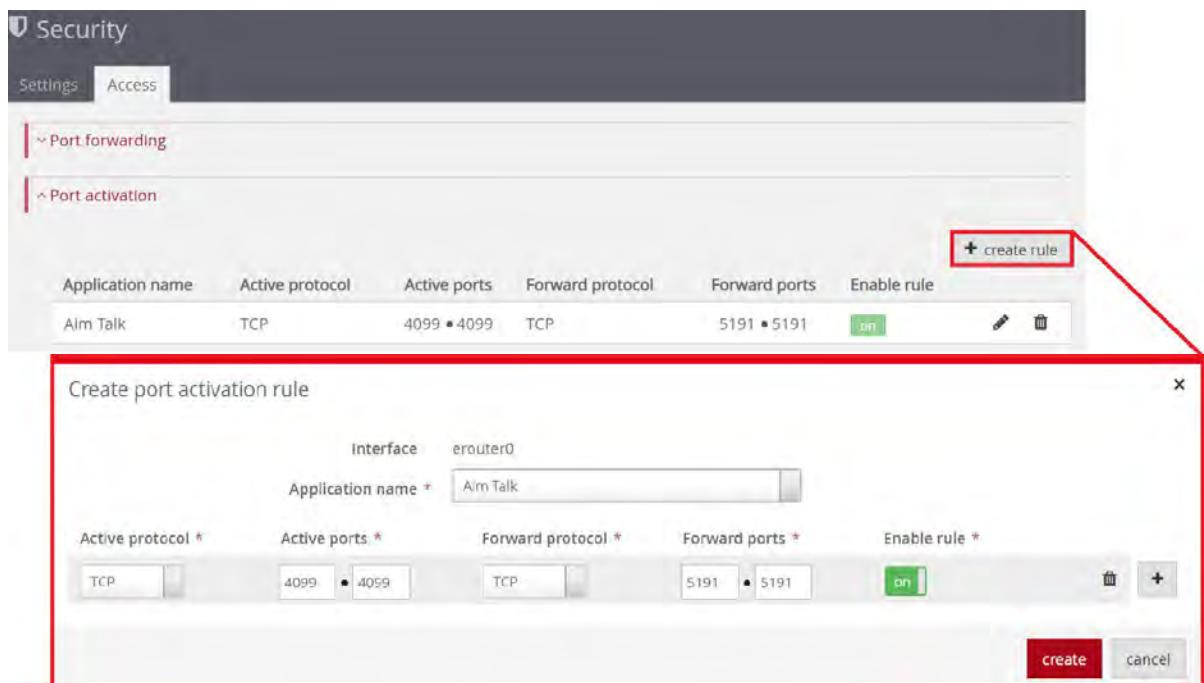


Figure 74: Create port activation rule

Group	Parameter	Description
Ports activation	Application name	Application name
	Active protocol	Active protocol
	Active ports	Active ports
	Forwarding Protocol	Forwarding Protocol
	Forwarding ports	Forwarding ports

Tabel 36: Security - Access

6.3.2 Services

The selection of Services in the top functional menu, Figure 75, shows in the window more information, with possibility of editing, on the Configuration of Services.

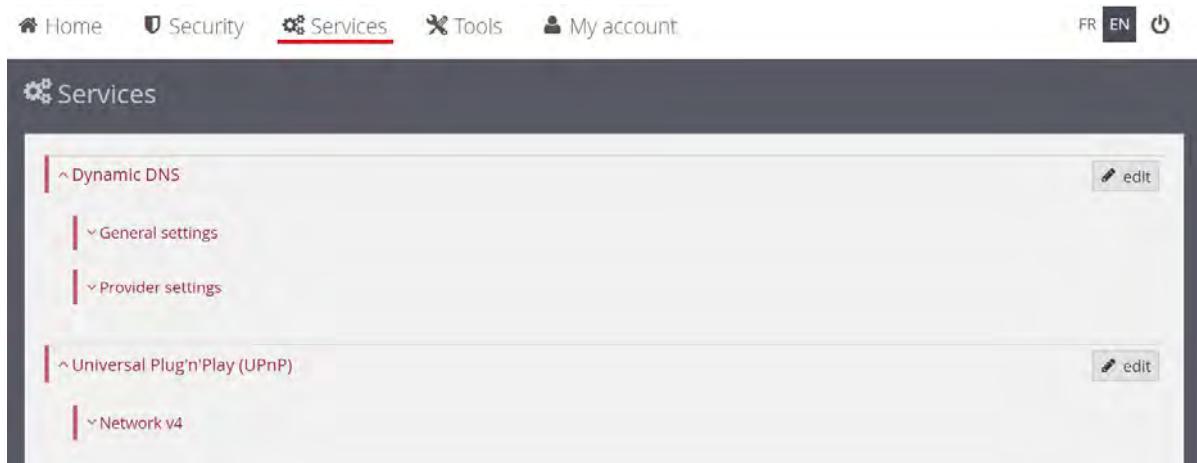


Figure 75: Functional Menu - Services

This window allows access to two new windows, Dynamic DNS, and UPnP.

In this window you can access information related to services, define/change them.

6.3.2.1 Dynamic DNS

Dynamic DNS (DDNS or Dynamic DNS) is a method of automatically updating a name server in Domain Name System (DNS). With DDNS enabled, Configuration of configured hostnames, addresses, or other information is updated whenever there is a change. This application is described in RFC 2136.

By selecting the "edit" field we can enable or disable dynamic DNS, the host name where the dynamic DNS server is located.

The screenshot shows a web-based configuration interface for Dynamic DNS. At the top, there is a navigation bar with a gear icon labeled 'Services'. Below it, a red header bar says '^ Dynamic DNS'. The main content area has a red sidebar on the left with sections '^ General settings' and '^ Provider settings'. Under '^ General settings', there is a 'Enable Dynamic DNS' switch set to 'off', a 'Hostname' input field with a placeholder 'Insert host name' and a note 'Required field', and a 'Provider' dropdown menu with a placeholder 'Select provider' and a note 'Required field'. At the top right of the content area are 'save' and 'cancel' buttons.

Figure 76: Dynamic DNS - general settings

Group	Parameter	Description
Settings	Enable Dynamic DNS	Enable / disable On / Off
	Hostname	DNS Server Name
	Provider	DNS service provider

Tabel 37: Dynamic DNS - general settings

6.3.2.2 UPnP

Universal Plug and Play is a set of computer network protocols created by the UPnP Forum to simplify the implementation of home and office local networks. "Connect and Use" technology enables dynamic and direct connection between a computer and a device. Devices on a UPnP network can be connected using any communication medium, including wireless, telephone line, power line, IrDA, Ethernet and IEEE 1394. The only concern should be whether the medium used supports the bandwidth required for the intended use.



Figure 77: UPnP - Enable

Group	Parameter	Description
UPnP	Enable UPnP	Enable / disable On/Off

Table 38: UPnP – parameters

6.3.3 Tools

The selection of Tools in the Functional Menu, Figure 78, shows in the main window more information, with the possibility of editing, about the Tools Configuration.

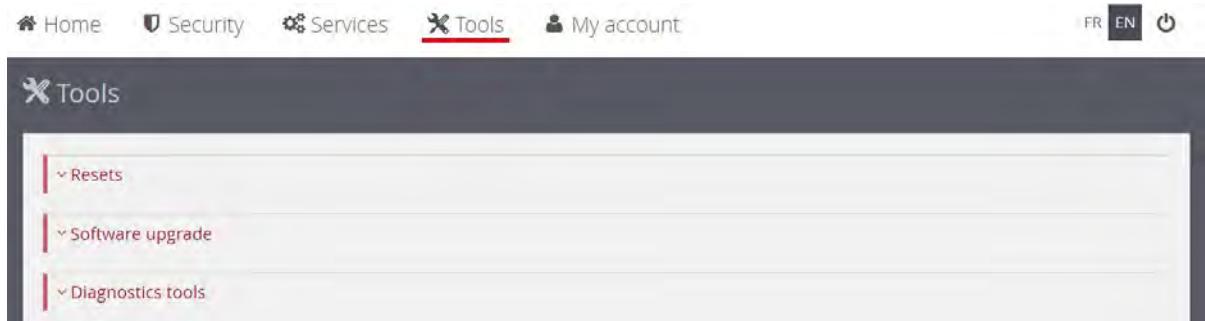


Figure 78: Functional Menu - Tools

You can restore FiberGateway with pre-set and stable settings (factory settings). Any existing settings to date will be lost. Partial restoration of original settings can be made while keeping settings changed. This option restores original settings except for changes made by the client, namely:

- Resets
- Software upgrade
- Diagnostic tools

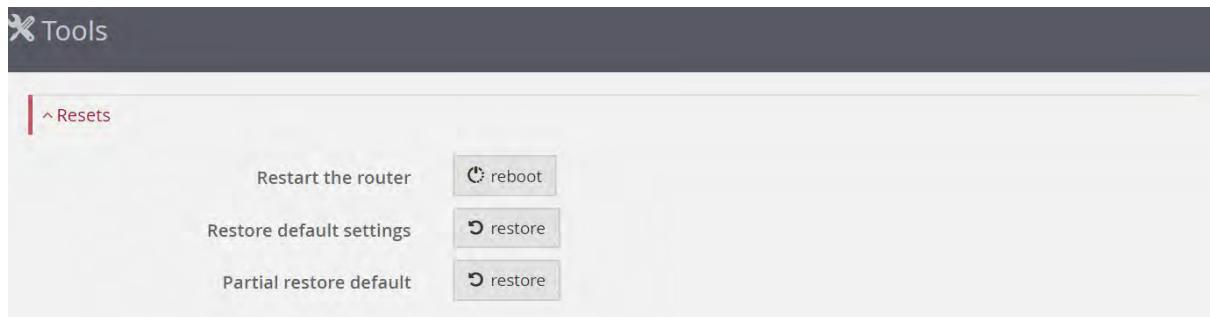


Figure 79: Tools - Resets

Group	Parameter	Description
Resets	Restart the router	Restart FiberGateway
	Restore default settings	Reset original settings
	Partial restore default	Resets original settings while maintaining client settings

Tabel 39: Tools – Resets

The software can be updated by selecting the respective file and pressing the symbol "upgrade"

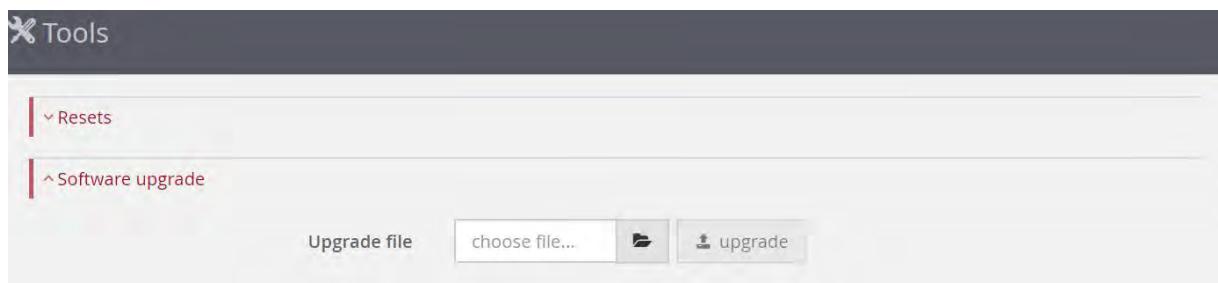


Figure 80: Tools – Software upgrade

There are two network diagnostics tools: Ping and Traceroute. With the ping tool we can test the connectivity between FGW and another IP network element. With the Traceroute tool it is possible to know all routers between FGW and another IP network element.

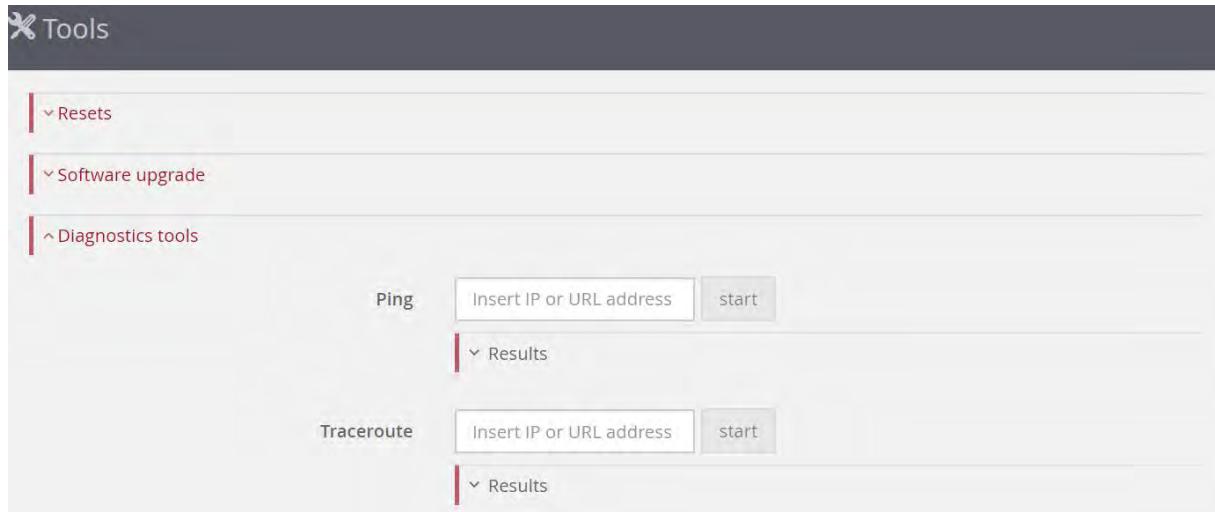


Figure 81: Tools – Diagnostics tools

6.3.4 My account

This window, Figure 82, is displayed when the window header item, My Account, is selected.

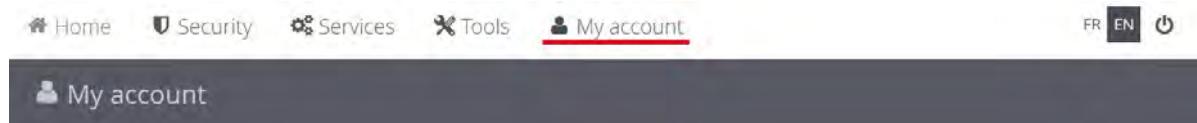


Figure 82: Functional Menu - My Account

6.3.4.1 User settings

In this area it is possible to view and change the access parameters to FiberGateway.

Selecting My Account from the Functional Menu, Figure 82, shows more information, with possibility of editing, on the User Account Setup in the main window, Figure 83. This area provides information about the user account available on FiberGateway.

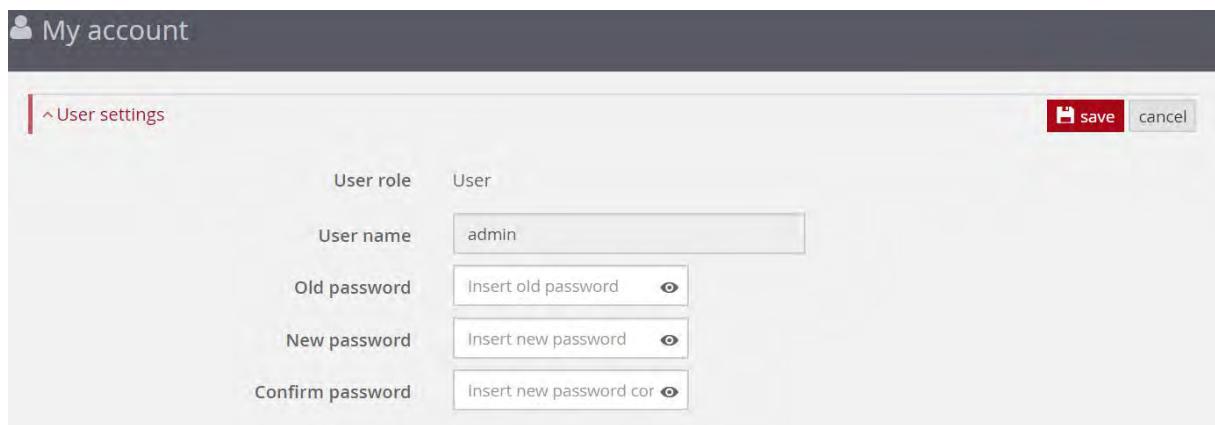


Figure 83: My Account - User Settings

Group	Parameter	Description
User settings	User role	Profile chosen
	User name	admin
	Old password	Enter old password
	New password	Enter new password
	Confirm password	Re-enter new password

Tabel 40: User settings

The current version of FiberGateway only allows you to change the password.

7 Operational indicators

7.1 FiberGateway

The FiberGateway has fourteen LEDs to indicate the operating status.

7.1.1 LED Status Indicators

The following figure shows the location of the fourteen FiberGateway LEDs, Table 40 contains the description and meaning of each LED



Figure 84: FiberGateway status LEDs

LED	Identification	LEDs Status		Description
11, 12, 13, 14 ⁽¹⁾	LAN	ON		With Ethernet connection (green)
		OFF		No Ethernet connection
		Flashing		Ethernet IN/OUT activity (green)
2 ⁽¹⁾	INTERNET	ON		With Internet connection (green)
		OFF		Inactive port
		Flashing		Internet IN/OUT activity (green)
1 ⁽¹⁾	PON LINK	See table below		
3 ⁽¹⁾	WPS	ON		WPS active (blinking green)
		OFF		WPS inactive

4 ⁽²⁾	WIFI	ON	Wi-Fi Radio Signal active
		OFF	Wi-Fi Radio Signal inactive
5	TEL	ON	Service configured and authenticated (green)
		OFF	Service not configured or registration failure
		Flashing	Telephone off the hook
6 ⁽²⁾	POWER	ON	Power supply ON (green)
		OFF	Power supply OFF

NOTES:

- (1) To obtain these status LEDS information INFO button must be pressed.
- (2) These status LEDS are always update (pressing INFO button is not required).

Tabel 41: LEDs Status information

ONT FiberGateway 4x4 Status	LEDs Status	Description
	PON LINK	
1. Initial	OFF	Initial Status
2. Standby	Flashing	ONT is waiting for initial configuration by the OLT
3. Serial Number	Flashing	The OLT is configuring the ONT
4. Ranging	Flashing	ONT and OLT synchronization
5. Operation	ON	ONT normal operational status

Tabel 42: LEDs Status information (PON LINK & PON AUTH)

7.1.2 Troubleshooting FiberGateway

The table below, according to the state of the LEDs, identifies a possible cause and describes the procedure to correct the problem.

LED	State	Possible cause	Solution
POWER (6)	OFF	No power supply for FiberGateway	<ul style="list-style-type: none"> - Check that the power cord is properly connected to the equipment and the adapter to the electrical outlet. - Check that the equipment switch is in the ON position.
ETHERNET (11, 12)	OFF	Incorrectly connected ETHERNET cable	<ul style="list-style-type: none"> - Verify that the Ethernet cable is properly connected to the Ethernet port of the machine. - Replace the Ethernet cable. - Check that the machine is switched on.
PON LINK (1)	OFF	Fiber optic signal anomaly	<ul style="list-style-type: none"> - Check that the optical cable is correctly inserted in both the optical connector of the equipment and the optical outlet. - Check that the optical connectors are in good condition and clean. - Check that the optical cord is intact, not cut or twisted.
TEL (5)	OFF	VoIP disabled on Fiber Gateway	
PON LINK (1)	Intermittent	Error in FiberGateway authentication.	

Tabel 43: Troubleshooting FiberGateway

8 Glossary

AC	<i>Alternating Current</i>	ITU-T	<i>International Telecommunication Union-Telecommunications</i>
AC	<i>Access Concentrator</i>	LAN	<i>Local Area Network</i>
AES	<i>Advanced Encryption Standard</i>	LED	<i>Light Emitting Diode</i>
AS	<i>Autonomous System</i>	MAC	<i>Media Access Control</i>
AP	<i>Access point</i>	MAN	<i>Metropolitan Area Network</i>
AUTO-MDIX	<i>Medium Dependent Interface Crossover Automatic Choice</i>	MTBF	<i>Mean Time Between Failures</i>
BBF	<i>Broadband Forum</i>	OLT	<i>Optical Line Terminal</i>
CAT5E	<i>Category 5 Cable</i>	ONT	<i>Optical Network Terminal</i>
CATV	<i>Cable TV</i>	PC	<i>Personal Computer</i>
CO	<i>Central Office</i>	PON	<i>Passive Optical Network</i>
CPE	<i>Customer-Premises Equipment</i>	PSK	<i>Phase-Shift Keying</i>
DC	<i>Direct Current</i>	RF	<i>Radio Frequency</i>
DDNS	<i>Dynamic DNS</i>	RJ11	<i>Registered Jack model 11</i>
DHCP	<i>Dynamic Host Configuration Protocol</i>	RJ45	<i>Registered Jack model 45</i>
DNS	<i>Domain Name System</i>	SC/APC	<i>SC/APC optical connector</i>
FTP	<i>File Transfer Protocol</i>	SIP	<i>Session Initiation Protocol</i>
FTTH	<i>Fiber-To-The-Home</i>	SSID	<i>Service Set Identifier</i>
FXS	<i>Foreign eXchange Station</i>	STB	<i>Set Top Box</i>
GEM	<i>GPON Encapsulation Module</i>	T-CONT	<i>Transmission Container</i>
GPON	<i>Gigabit-capable Passive Optical Network</i>	TCP	<i>Transmission Control Protocol</i>
GW	<i>Gateway</i>	TKIP	<i>Temporal Key Integrity Protocol</i>
HG	<i>Home Gateway</i>	TV	<i>Television</i>
ID	<i>Identification</i>	UDP	<i>User Datagram Protocol</i>
HSI	<i>High Speed Internet</i>	URL	<i>Uniform Resource Locator</i>
IEEE	<i>Institute of Electrical and Electronics Engineers</i>	USB	<i>Universal Serial Bus</i>
IMS	<i>IP Multimedia Subsystem</i>	UTP	<i>Unshielded Twisted Pair</i>
IP	<i>Internet Protocol</i>	VoIP	<i>Voice over Internet Protocol</i>
IPTV	<i>Internet Protocol Television</i>	WAN	<i>Wide Area Network</i>
IPv4	<i>Internet Protocol version 4</i>	WEP	<i>Wired Equivalent Privacy</i>
IPv6	<i>Internet Protocol version 6</i>	Wi-Fi	<i>Wireless Fidelity</i>
ISP	<i>Internet Service Provider</i>	WLAN	<i>Wireless Local Area Network</i>
		WPA	<i>Wi-Fi Protected Access</i>
		WPS	<i>Wi-Fi Protected Setup</i>



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FEDERAL COMMUNICATION COMMISSION (FCC) INTERFERENCE STATEMENT

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC CAUTION:

The grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment. IEEE 802 11b or 802 11g operation of this product in the USA is firmware limited to channel 1~11.

This device is restricted for indoor use.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body. This device and its antennas(s) must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

5GHz Wireless Statement:

For operation within the 5.15~5.25GHz frequency ranges, this device is restricted to indoor environments. This device meets all the other requirements specified in Part 15E, Section 15.407 of the FCC Rules.

Safety Warnings:

- CAUTION: do not look into the end of the fiber connector as this can cause eye damage.
- This device uses passive cooling, with ventilation holes in its faces. To avoid overheating, please do not block these holes.
- Install this device in a site that meets the following conditions:
 - Temperature (41°F - 104°F)
 - Humidity (0% to 95%)

DECLARATION OF CONFORMITY



<https://www.alticelabs.com/en/connectivity.html>



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