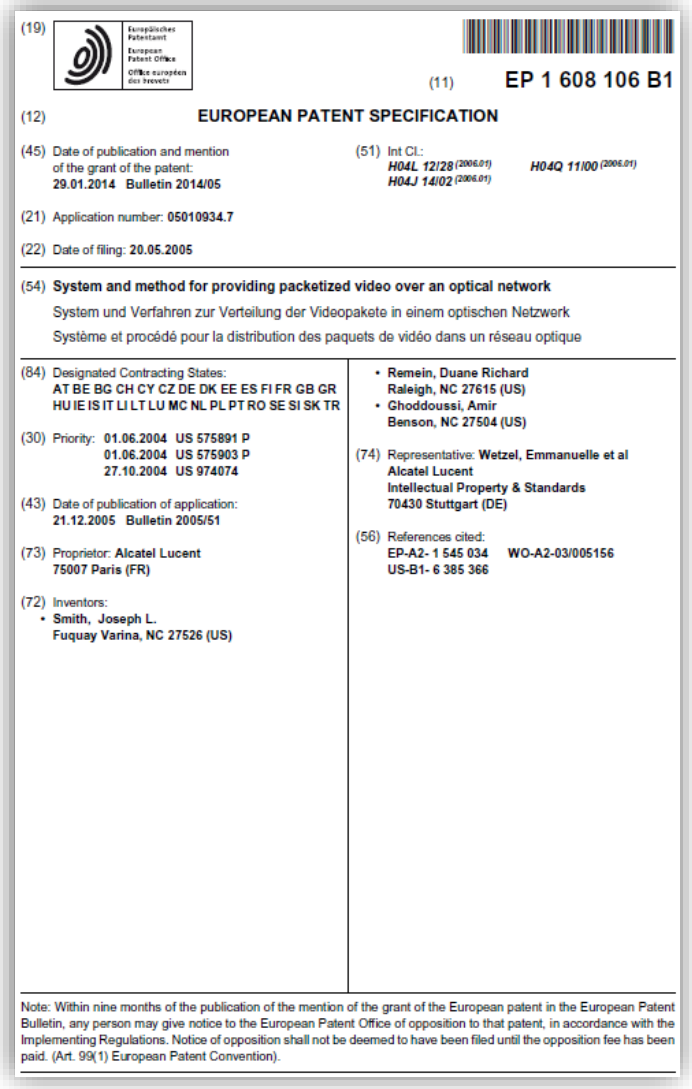
EP 1608106 B1 (Family ID: 139250)

System and method for providing packetized video over an optical network

Exemplary of:

GPON Optical Network Terminal



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(54) **System and method for providing packetized video over an optical network**

System und Verfahren zur Verteilung der Videopakete in einem optischen Netzwerk

Système et procédé pour la distribution des paquets de vidéo dans un réseau optique

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(56) References cited:
EP-A2- 1 545 034 **WO-A2-03/005156**
US-B1- 6 385 366

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8. Optical network terminal, ONT, (310; 622) for a video distributing system comprising a distributive optical network (600),

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

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

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

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

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

Source: https://www.multicominc.com/wp-content/uploads/Televes%20-%20769503_EN.pdf , p 6

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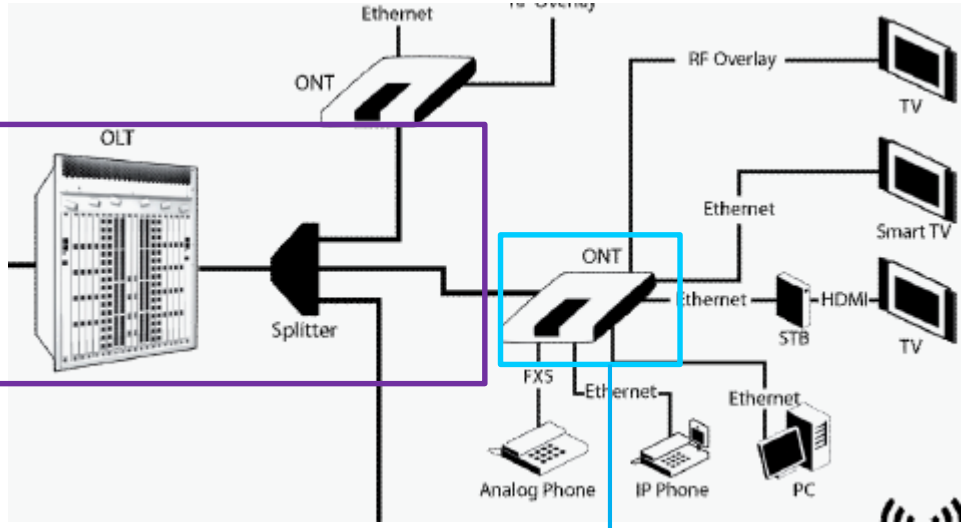

2.1 ONT Main Functionalities

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

Broadband service applications are commonly referred as below:

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

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

Source: https://www.multicominc.com/wp-content/uploads/Televes%20-%20769503_EN.pdf, pp 7, 9

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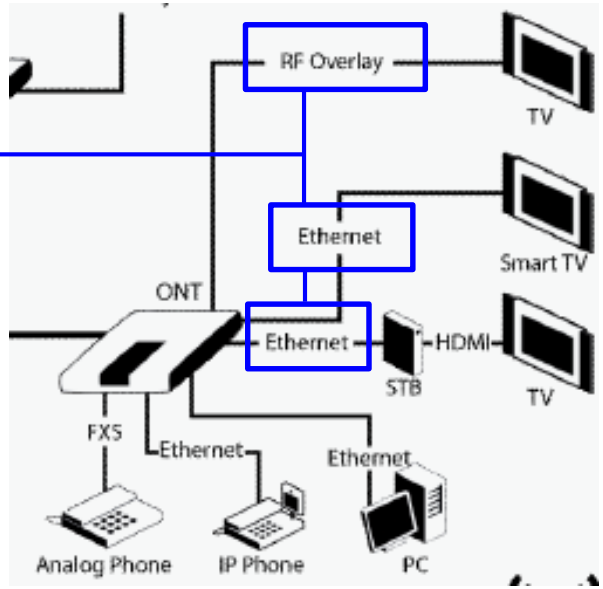

Several transmission containers (T-CONT) are assigned to each user. Each T-CONT has an associated GEM port and each GEM port has a VLAN identifier and an 802.1p priority level.

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.

2.1.3.2 IPTV service

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

2.1.5.3 RF Overlay

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

Source: https://www.multicominc.com/wp-content/uploads/Televes%20-%20769503_EN.pdf, pp 7, 11, 14

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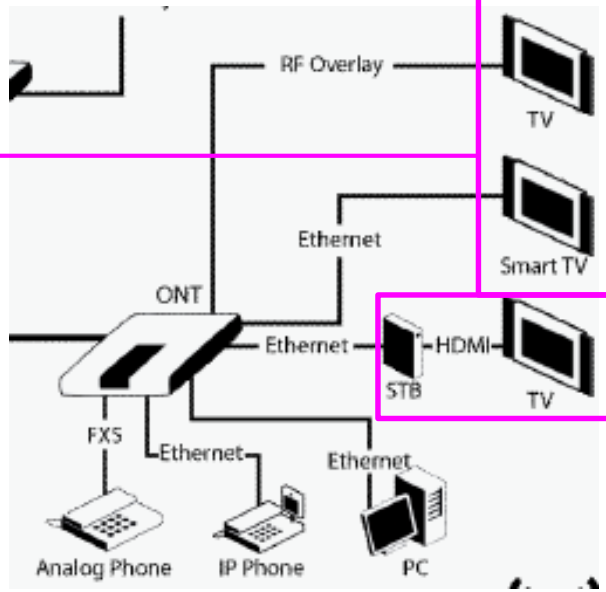
wherein the ONT (310; 622) comprises a triplexer (400) for converting the combined optical signal into electrical signals,

wherein said ONT (310; 622) further comprises an Ethernet physical layer, PHY, module (401) for receiving digital signals from the triplexer (400), and an Ethernet switch (402) for receiving digital signals from the PHY module (401) and parsing selected video streams therethrough wherein the ONT does not acknowledge said received IP video data.



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wherein the ONT (310; 622) **comprises a triplexer** (400) **for converting the combined optical signal into electrical signals**,

wherein said ONT (310; 622) further comprises an Ethernet physical layer, PHY, module (401) for receiving digital signals from the triplexer (400), and an Ethernet switch (402) for receiving digital signals from the PHY module (401) and parsing selected video streams therethrough wherein the ONT does not acknowledge said received IP video data.

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.

1.Summary

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

2.1.3 Services

The ONT supports the following services:

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

Source: https://www.multicominc.com/wp-content/uploads/Televes%20-%20769503_EN.pdf, pp 6, 9, 16

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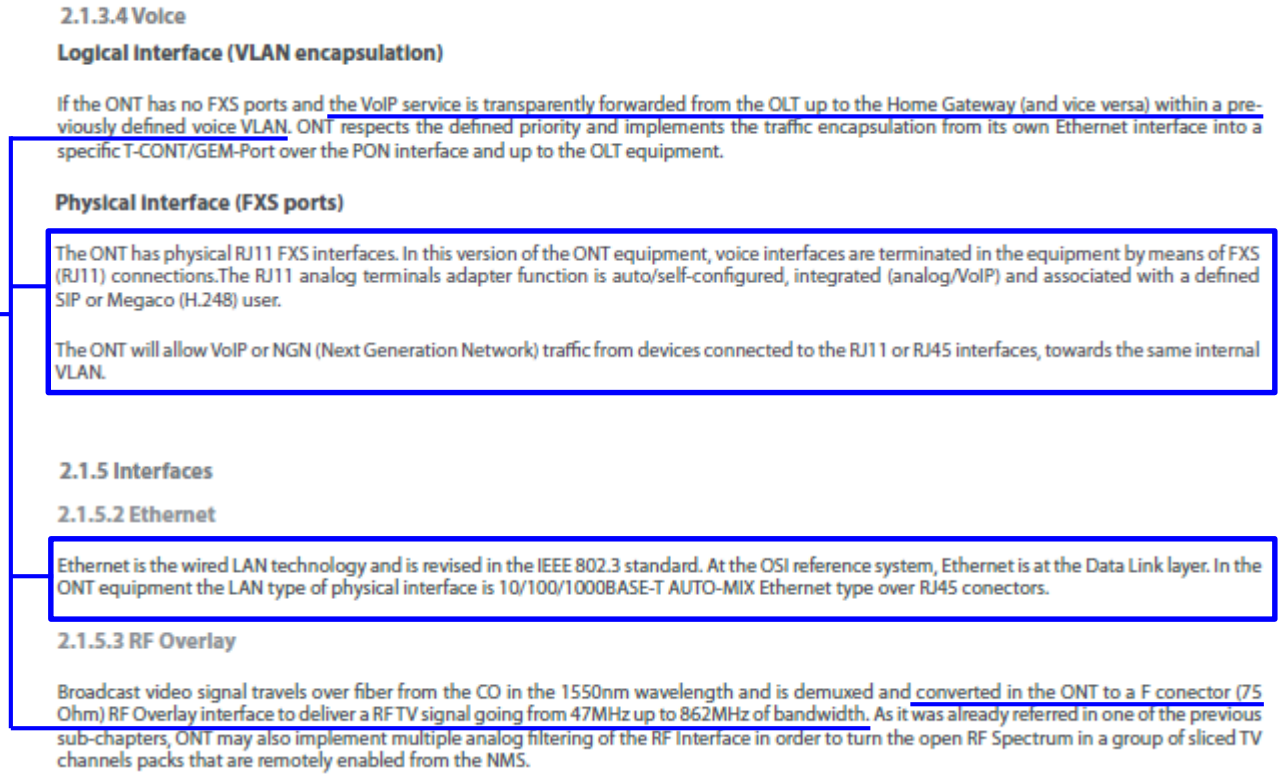

2.1.3.4 Voice

Logical Interface (VLAN encapsulation)

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

Physical Interface (FXS ports)

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

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

2.1.5 Interfaces

2.1.5.2 Ethernet

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

2.1.5.3 RF Overlay

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

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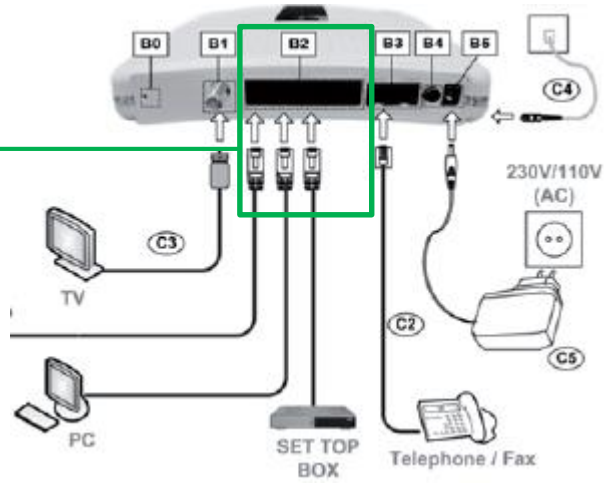

Nº	Description
B0	RESET button
B1[1]	Video RF Connector F type
B2	4x RJ45 Ports - 10/100/1000Base-T Ethernet with AUTO-MDIX

Source: https://www.multicominc.com/wp-content/uploads/Televes%20-%20769503_EN.pdf, pp 14, 26

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3.4 GPON/Ethernet characteristics

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

Source: https://www.multicominc.com/wp-content/uploads/Televes%20-%20769503_EN.pdf, p 16

IV.1 Network overview

This Recommendation considers networks that use G-PON systems that include a video overlay. This system provides a bidirectional GEM transport service and a unidirectional video or data downstream broadcast or unicast service. If only broadcast video services are desired, then the only video transport required is the third wavelength, as shown in Figure IV.1-1. The ONT converts the signals on the third wavelength to electrical signals on a coaxial output, suitable for video appliances such as televisions.

11.3.1 Prioritized protocol entities

This clause specifies the behaviour of the ONT more precisely than in the preceding clause with respect to the prioritized request mechanism of the OMCC.

When the ONT receives a GEM packet via the GEM port associated with the management channel, it shall calculate the CRC and compare it with the value found in the OMCI trailer. If the values do not match, the ONT shall discard the message. It is recommended that this event be logged by the ONT and possibly communicated to the OLT by some out-of-band mechanism but, as far as the protocol is concerned, the message is discarded silently.

Messages with a correct CRC are then placed into either of two distinct incoming FIFO-based message queues, according to the priority level (i.e., high or low) of the associated command. Note that the priority level of a given command is encoded using the most significant bit of the transaction correlation identifier field. If the associated incoming message queue is already full, the ONT must simply discard the message. It is recommended that this event be logged by the ONT and possibly communicated to the OLT by some out-of-band mechanism but, as far as the protocol is concerned, the message is discarded silently.

Rec. ITU-T G.984.4 (02/2008), pp 342, 410