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- (71) **Applicant (for all designated States except US):** **ALCATEL LUCENT** [FR/FR]; 3, avenue Octave Gréard, F-75007 Paris (FR).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** **VENUGOPAL, Murugan** [IN/IN]; Alcatel-lucent India Limited, RR Towers IV Thiruvika Industrial Estate, G, Chennai 600032 (IN). **KARTHICK, Rajapandiyam** [IN/IN]; Alcatel-Lucent India, RR Tower III, Plot Super B1 Thiruvika Industrial Estate, G, Chennai 600032 (IN). **ENGLISH, Bobby** [US/US]; Alcatel-Lucent USA, M/S SUGAR-RAL Room 2B020, 2301 Sugar Bush RD Ste 300, Raleigh, NC 27612 (US).
- (74) **Agent:** **NICOLLE, Olivier**; Alcatel Lucent, 32 avenue Kléber, F-92700 Colombes (FR).
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(54) **Title:** OPTIMIZED METHOD TO FORWARD BROADCAST TRAFFIC TO DESTINED USER NETWORK INTERFACE (UNI) PORTS IN A PASSIVE OPTICAL NETWORK (PON)

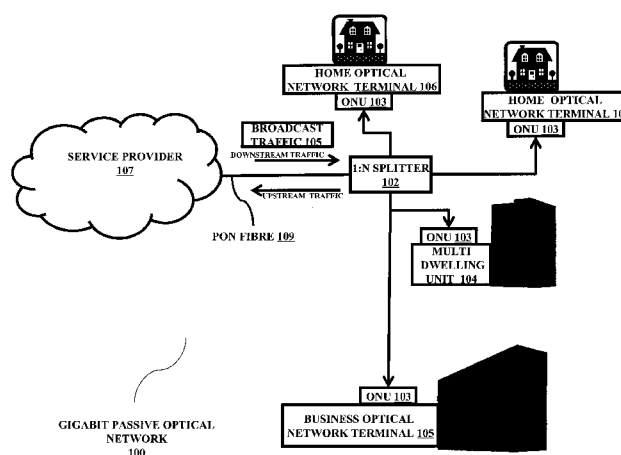


FIG. 1

(57) **Abstract:** Optimized technique to forward broadcast traffic to destined user network interface ports in a passive optical network. The present invention relates to forwarding broadcast traffic in a gigabit passive optical network (GPON) and, more particularly, to an optimized technique for forwarding broadcasting traffic to destined user network interface (UNI) port in an optical network unit (ONU) of a GPON. The broadcast traffic is generally replicated and flooded to all the UNI ports, leading to overloading of the ONU software/hardware. Also data security gets compromised as broadcast traffic is flooded to all the UNI ports and can traffic may be spoofed by any person sharing the same ONU. A network VLAN is added to the broadcast frame, and a network customer VLAN mapping is used to categorize, replicate and forward received broadcast traffic to destined UNI ports configured by the service provider after performing configured egress behavior for each customer VLAN.



PROCÉDÉ OPTIMISÉ POUR TRANSFÉRER UN TRAFIC DE DIFFUSION GÉNÉRALE À DES PORTS D'INTERFACE RÉSEAU UTILISATEUR (UNI) DÉFINIS, DANS UN RÉSEAU OPTIQUE PASSIF (PON)

TECHNICAL FIELD

[001] The present invention relates to forwarding broadcast traffic in a gigabit passive optical network (GPON) and, more particularly, to an optimized technique for forwarding broadcasting traffic to destined user network interface (UNI) port in an optical network unit (ONU) of a GPON.

BACKGROUND

[002] A gigabit passive optical network (GPON) is a point-to-multipoint, fiber to premises network architecture called as optical distribution network (ODN), in which a single optical fiber is used to provide triple play services like telephone, internet data and video services to multiple customers. A GPON network may include an optical line terminal (OLT) at the service provider end and one or more optical network unit (ONU) at the customer premises. An unpowered optical splitter allows a single fiber from a network end to be shared among a number of subscriber ONU's in the order of 1:N, where N can be 64, 128 or such. ONU's can be broadly classified as home optical network terminal (H-ONT), multi Dwelling Units (MDU), business optical network terminal (B-ONT) and many such types. Customers avail their eligible services through many user network interfaces (UNI) ports available on the ONUs. Each home optical network terminal (H-ONT) may comprise of 2/4 user network interfaces (UNI), but often all UNI's terminate into a single customer premises. Multi dwelling units (MDU's) may comprise of 8 to 24 or such UNI's, wherein data services are provided to multiple individual customers in an apartment

/small community etc. Business ONTs may comprise of 4 to 8 UNI's and like, where in data and T1/E1 trunk services are provided to offices. Each ONU is unique and a single OLT PON interface can communicate with multiple ONU's connected on the PON. The upstream data is sent by an ONU to the OLT using a multiple access protocol like time division multiple access (TDMA). Downstream data is sent from an OLT to all the ONT's associated with the PON fiber using a shared time domain multiplexing (TM) channel through periodic slots. A GPON encapsulation port (GEM port) is used forward data from OLT to ONU.

[003] When downstream broadcast data(broadcast means all Ethernet frames with destination mac address FF:FF:FF:FF:FF:FF) is being sent to one ONU in a GPON network, the broadcast traffic comprises of GEM header and broadcast frame, sent to all the ONU's in the GPON network. ONU further floods the broadcast traffic towards all UNI interfaces on the ONU. This leads to overloading of all the UNI ports of all the ONU's connected in a GPON. OMCI (ONT management and control interface) channel configures the shared GEM port in all ONU's on the PON to receive broadcast traffic.

[004] Each ONU connected to the PON receives the downstream broadcast traffic from shared broadcast gem port and strips gem header.. The ONU then replicates and forwards the broadcast data to all the UNI's connected to it. In case of home ONT or small ONU's that is connected to single customer premises this works very well as there are only 2-4 UNI ports. However for a MDU in a GPON network, sending data to all the UNI's which may range from 8-24 ports or even more in future, leads to an overload on the ONU hardware/software as well as individual UNI ports. Another major concern is data security, as broadcast traffic flooded to all the UNI ports can be spoofed by any other person or customer sharing the MDU.

SUMMARY

[005] In view of the foregoing, an embodiment herein provides a technique to forward broadcast traffic to destined UNI ports in an ONU.

5 [006] Embodiments further disclose a GPON system which forwards broadcast traffic from an OLT at the network side to ONU's in the network over a PON fiber. A network side VLAN is also encapsulated along with GEM header and broadcast frame. This broadcast traffic is sent over a shared broadcast channel using a shared broadcast GEM port to all ONU's on the PON. The service provider
10 configures in addition to broadcast gem port via OMCI channel, also configures network side VLAN per UNI, network – customer VLAN mapping table per UNI and customer side VLAN list (with egress behavior) per UNI for each and every ONU. Thus each network side VLAN has a corresponding customer side VLAN (with individual egress behavior). On the ONU, the received network side VLAN is mapped
15 on to a corresponding customer side VLAN and broadcast traffic is sent only to the specific UNI ports mapped to that VLAN. Thus the received broadcast traffic is replicated and transmitted only to respective UNI ports using the VLAN

[007] Embodiments herein also disclose a method of forwarding downstream broadcast traffic to UNI ports in an ONU. Each UNI port has a list of customer side
20 VLAN's. The OMCI channel provides a network side VLAN list for each UNI, network- customer VLAN mapping information and customer side VLAN (with egress behavior) list for each UNI and in addition to shared GEM port info for every ONT. The received network side VLAN is compared with the network side VLAN list for every UNI of the ONU. The matched network side VLAN's are then compared
25 with network customer VLAN mapping information for that UNI to get respective

customer side VLAN. Then using the obtained customer side VLAN, the customer VLAN (with egress behavior) list per UNI is searched to obtain individual egress behavior of that customer side VLAN. . The received frame with network side VLAN is replicated and replaced with customer side VLAN. Before transmission of
5 broadcast traffic to respective UNI ports, the configured egress behaviour for each customer vlan/priority bits for a UNI is applied. This method is repeated for all UNI ports available on the ONU.

[008] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following
10 description and the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

[009] The embodiments herein will be better understood from the following detailed description with reference to the drawings, in which:

15 [0010] FIG. 1 illustrates the environment through which broadcast traffic is forwarded in a GPON network, according to the embodiments as disclosed herein;

[0011] FIG. 2 illustrates the an optical line terminal on the service provider end, according to the embodiments as disclosed herein ;

20 [0012] FIG. 3 illustrates an optical network unit at the customer end, according to the embodiments disclosed herein;

[0013] FIG. 4 illustrates how broadcast traffic is forwarded to UNI's through an MDU in a GPON network, according to the embodiments disclosed herein;

[0014] FIG. 5 depicts a broadcast frame, according to the embodiments disclosed herein;

25 [0015] FIG.6 illustrates a network and customer side VLAN mapping table,

according to the embodiments disclosed herein

[0016] FIG. 7 is a flowchart FIG. 7 is a flowchart describing a method of forwarding downstream broadcast traffic to UNI ports in an ONU, according to the embodiments disclosed herein;

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DETAILED DESCRIPTION OF EMBODIMENTS

[0017] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

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[0018] The embodiments herein disclose a system and method of forwarding broadcast traffic to destined UNI ports in an ONU. Referring now to the drawings, and more particularly to FIGS. 1 through 7, where similar reference characters denote corresponding features consistently throughout the figures, there are shown embodiments.

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[0019] FIG. 1 illustrates the environment through which broadcast traffic is forwarded in a gigabit passive optical network (GPON) 100, according to the embodiments as disclosed herein. A GPON 100 is a high bandwidth shared fiber access technology. A GPON 100 offers higher bit rates and better efficiency for carrying different type of services over a network. An optical line terminal (OLT) is

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used at the service provider 107 end and installed in a central office. This broadcast traffic from an OLT 101 is sent across from a single PON fiber 109 to multiple optical network units (ONU's) 103 using a 1: N splitter 102. The splitter 102 allows single fibre from OLT to be shared among multiple users in 1:64 or 1:128 or more. The broadcast traffic may be sent to ONU's like multi dwelling unit (MDU) 104, business optical network units (BONT) 105 or home optical network terminals (ONT) 106 The upstream and downstream broadcast traffic may use two different wavelengths. The downstream wavelength may be 1490nm and transmits data at 2.488 Gbps. The upstream wavelength may be 1310nm and transmits data at 1.244 Gbps.

10 [0020] FIG. 2 illustrates an optical line terminal (OLT) in the service provider 107 end, according to the embodiments as disclosed herein. The OLT 201 receives the broadcast traffic 105 from network 107 using a receiver 202. The OLT 101 then encapsulates a corresponding network side VLAN 204 for each downstream broadcast frame 203 configured by the service provider. A network side VLAN 202 transfer's
15 broadcast traffic 105 from one point of the network to another. This network side VLAN 204 is identified by the ONU at the customer end and broadcast traffic is forwarded to the corresponding customer VLAN using a transmitter 203. The transmitter combines all the broadcast traffic and sends it to all ONU's 103 in the GPON 100 using a shared broadcast GPON encapsulation module port which is also
20 called incidental broadcast GEM.

[0021] FIG. 3 illustrates an optical network unit 103 at the customer end, according to the embodiments disclosed herein. The receiver 301 of an ONU 103 receives the downstream broadcast traffic 105. A processor 302 stores the received broadcast frame 203 and determines the customer side VLAN (with egress behaviour)
25 in the UNI's 103. The received network VLAN 202 is matched against the network

side VLAN list 303 for each UNI 103 to identify the matching network side VLAN 303 in the UNI's 103. From the matched network VLAN, the corresponding customer side VLAN (with egress behavior) 305 is found using the network customer VLAN mapping table 304.

5 [0022] FIG. 4 illustrates how broadcast traffic 105 is forwarded to UNI's 103 through an MDU 104 in a GPON network, according to the embodiments disclosed herein. The OLT 101 sends the broadcast traffic 105 from a shared GPON encapsulation module (GEM) port 202 through a PON fiber 109 to the ONU's 103 over the GPON 100 using a GEM header. The GEM port 202 provides a method
10 through which different type of services (voice, video, etc) can reach a customer over GPON 100 in an efficient manner. The downstream broadcast traffic 105 is sent from the OLT to the ONU's using the shared downstream only broadcast channel 401. The ONT management and control interface (OMCI) protocol 401 is used by OLT to configure all the ONU's 103.. The OMCI protocol 401 configures the GEM port 202
15 with the network side VLAN 303 list per UNI, customer side VLAN (with egress behavior) list per UNI 305 and network customer VLAN mapping table 304 to all the UNI's 103 so that received broadcast traffic 105 can be categorized at the customer end. Each MDU 104 may have 8/16/24 or more UNI ports. The broadcast traffic 105 is received by the MDU 104 which already has the network side VLAN list per UNI
20 303, customer side VLAN with egress behavior list per UNI 305 and network customer VLAN mapping table information 304 for all the UNI's. The received network side VLAN 202 is matched against the network side VLAN 303 list for each UNI 402 to identify the matching network VLAN in the UNI's 402. From the matched network VLAN, corresponding customer side VLAN (with egress behavior)
25 305 is found using the network customer VLAN mapping table 304. The broadcast

traffic is replicated and the network side VLAN 202 is replaced with the customer side VLAN (with egress behavior). The broadcast traffic is then modified based on the unique egress behavior which has been configured for each customer VLAN for a UNI. Finally the broadcast traffic is sent to the customer side VLAN. The egress behavior can be used in various ways. The egress behavior may allow the broadcast frame to be sent along with the customer VLAN, may remove the customer VLAN from the broadcast frame, may swap the customer VLAN with any other valid VLAN from 0-4094, and the priority bits as configured by the service provider may also be swapped to any value between 0-7.

[0023] FIG. 5 depicts a broadcast frame 203, according to the embodiments disclosed herein. The downstream broadcast traffic like ARP, RIP, OSPF, IPv4, IPv6, PPPoE, Ethernet broadcast, etc with destination MAC address as FF:FF:FF:FF:FF:FF) consists of a GEM header 501, network side VLAN 202 and the normal Ethernet broadcast frame 203. Ethernet frame can range from 64 to 1518 bytes and more for jumbo frames. The GEM header 501 consists of a port ID field which is basically the destination address of an ONU 103 in a GPON 100. The GEM header 501 may also consist of header error control, payload to differentiate the type of broadcast traffic etc. The network side VLAN 202 may have values from 0-4095. This network side VLAN 202 is encapsulated into the broadcast traffic 105 by the OLT 101. Each Network side VLAN 303 has a corresponding customer side VLAN (with egress behavior) 305 for a UNI 402 port on the customer end. The network side VLAN 202 helps in identifying the correct customer UNI 402 port to which the broadcast traffic 105 is being sent. At the customer end, in an ONT 106 /MDU 104 /BONT 105, the network side VLAN 202 can be identified for each UNI 402 and data can be sent to corresponding customer VLAN (with egress behavior) using

network customer VLAN mapping table.. The broadcast frame comprises of an L2 header 502 with destination MAC address (DMAC) FF:FF:FF:FF:FF:FF, source MAC address(SMAC), ether type/length and a VLAN header. The VLAN header consists of the tag protocol identifier (TPID) 0x8100, priority bits (0-7), canonical
5 format indicator and a unique VLAN identifier (0-4095). The IP header comprises of data to be transmitted (DATA), the type of data etc. The IP header comprises of the source IP address (SA), destination IP address (DA), data to be transmitted and so on.

[0024] FIG.6 illustrates a network and customer VLAN mapping table 304, according to the embodiments disclosed herein. The network customer VLAN
10 mapping table 304 is configured in an ONU's 103 through an OMCI 401 protocol. The network side VLAN 303 list of each UNI 402 is compared against the received network side VLAN 202 to find a match. Once a match is found the corresponding customer side VLAN (with egress behavior) 303 is found using the network customer VLAN mapping table 304 of each UNI. The broadcast frame 203 is then replicated
15 and the network side VLAN 202 is replaced with customer side VLAN (with egress behavior). Before transmission of broadcast traffic 105 to respective UNI 402 ports, the configured egress behavior for each customer side VLAN/priority bits for a UNI is applied.

[0025] FIG. 7 is a flowchart describing a method (700) of forwarding
20 downstream broadcast traffic to UNI ports in an ONU 103, according to the embodiments disclosed herein. The ONU 103 may be an ONT 106, a MDU 104 or a BONT 105 or such. The downstream broadcast traffic 105 is received by all the ONU's 103 in the GPON 100 using a shared GEM port 202. The GEM header 501 is stripped (701) off to obtain the downstream broadcast frame 203. From the broadcast
25 frame 203 the network VLAN 202 is obtained (702) and compared (702) against

network side VLAN 303 list for each UNI port 303 using an UNI index. For each
UNI port this comparison is formed by incrementing (708) the UNI index 208. This
process is repeated till the maximum port index is reached (707). If the received
network side VLAN 202 does not match against any VLAN in the network side
5 VLAN list per UNI 303, the frame is dropped (709). If the received network side
VLAN 202 matches against any of the Network side VLAN list 303 of the ONU 103,
the customer side VLAN (with egress behavior)303 corresponding to the network side
VLAN 202 is obtained (704) from a network customer VLAN mapping table 304 of
that UNI. The broadcast frame 203 is replicated (705) and the network side VLAN
10 202 is replaced (705) by the customer side VLAN (with egress behavior) 303. The
egress behavior associated with the customer side VLAN is then applied (706) to the
broadcast frame. The broadcast frame is then transmitted (710) to the UNI port, where
the matching network side VLAN was found. In case where the network VLAN 202
matches for network VLAN in more than one UNI, broadcast frame is forwarded to
15 all the matched UNI's.

[0026] The embodiments disclosed herein can be implemented through at least
one software program running on at least one hardware device and performing the
functions described in the above description. The network elements OLT and ONU
shown in detail in Figure 2 and 3 include blocks which can be at least one of a
20 hardware device, or a combination of hardware device and software module.

[0027] The foregoing description of the specific embodiments will so fully
reveal the general nature of the embodiments herein that others can, by applying
current knowledge, readily modify and/or adapt for various applications such specific
embodiments without departing from the generic concept, and, therefore, such
25 adaptations and modifications should and are intended to be comprehended within the

meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the
5 embodiments herein can be practiced with modification within the spirit and scope of the claims as described herein.

CLAIMS

What is claimed is:

1. A method of transmitting downstream broadcast traffic in a gigabit passive optical network through a shared gigabit passive optical network encapsulation module port, from an optical line terminal at the network end to a user network interface port of an optical network unit at the customer end by using virtual local area network in each user network interface, the method comprising of :

optical line terminal encapsulating downstream broadcast traffic with a network virtual local area network;

optical line terminal applying an egress behavior to each of customer side virtual local area network using an optical network terminal management channel and interface;

optical line terminal transmitting the downstream broadcast traffic to the optical network unit's in the gigabit passive optical network using a shared gigabit passive optical network encapsulation module port header;

optical network unit's receiving the downstream broadcast traffic and stripping a gigabit passive optical network encapsulation module header from the broadcast traffic;

optical network units decoding the received broadcast traffic; and

optical network unit transmitting the broadcast traffic to the destined user network interfaces.

2. The method of claim 1, wherein the optical network unit's decoding of the received downstream broadcast traffic , the method further comprising of:

optical network unit's comparing the received network virtual local area network with a network side virtual local area network list to find matching network side virtual local area network in the user network interfaces,

optical network unit's finding a customer side virtual local area network (with egress behavior) of the matched user network interface using a network-customer virtual local area network mapping information table;

optical network unit replacing the network side virtual local area network with customer side virtual local area network; and

optical network unit applying the egress behavior associated with the customer side virtual local area network using the customer side virtual local area network (with egress behavior) list.

3. The method of claim 2, wherein said egress behavior is unique for each customer virtual local area network.
4. The method of claim 2, wherein said egress behavior for each customer virtual local area network may comprise of :

allowing the broadcast traffic to be sent to the user network interface with customer virtual local area network;

removing the customer virtual local area network broadcast traffic before sending the broadcast traffic to user network interface;

swapping the customer virtual area network with any other valid customer virtual area network (with egress behavior);

swapping of priority bits sent by a service provider with other values.

5. The method of claim 1, wherein an optical network unit may be an home optical network terminal, multi dwelling unit or a business optical network terminal

6. The method of claim 1, wherein the downstream broadcast traffic includes a gigabit passive optical network encapsulation module header, network virtual local area network and the broadcast frame.
7. The method of claim 1, wherein encapsulation of broadcast frame with network virtual local area network per user network interface is done by the optical line terminal using a network side virtual local area network list.
8. The method of claim 1, wherein optical network unit's receive a network side virtual local area network list per user network interface, a customer side virtual local area network (with egress behavior) list per user network interface and network-customer virtual local area network mapping information table from the optical network terminal management and channel interface..
9. A passive optical network transmitting downstream broadcast traffic from an optical line terminal to multiple user network interfaces of multiple optical network units in a gigabit passive optical network using an shared gigabit passive optical network encapsulation module port and virtual local area network id of each user network interface in the network; the network comprising of at least one means adapted for:
 - encapsulating the downstream broadcast traffic with a network virtual local area network per user network interface;
 - applying an egress behavior to each of customer side virtual local area network using an optical network terminal management channel and interface;
 - transmitting the downstream broadcast traffic to all the optical network units in the gigabit passive optical network using a shared gigabit passive optical network encapsulation module port for broadcast;

receiving the downstream broadcast traffic and stripping a gigabit passive optical network encapsulation module header from the broadcast traffic;

processing logic to decode the received broadcast; and

transmitting the downstream broadcast traffic to the user network interface port.

10. The passive optical network of claim 9, wherein said egress behavior for each customer virtual local area network may comprise of :

allowing the broadcast traffic to be sent to the user network interface with customer virtual local area network;

removing the customer virtual local area network broadcast traffic before sending the broadcast traffic to user network interface;

swapping the customer virtual area network with any other valid customer virtual area network (with egress behavior);

swapping of priority bits sent by a service provider with other values.

11. The passive optical network of claim 10, wherein the processing logic further comprises means adapted for:

comparing the received network virtual local area network with a network side virtual local area network list in each user network interface to find matching network side virtual local area network;

finding a customer side network virtual local area network (with egress behavior) matching the network side virtual local area network using a network customer virtual local area network mapping information table;

replacing the network side virtual local area network with customer side virtual local area network (with egress behavior); and

applying the egress behavior associated with the customer side virtual local area network using the customer side virtual local area network (with egress behavior) list.

12. The passive optical network of claim 10, wherein said optical network unit may be an optical network terminal, multi dwelling unit or business optical network terminal.
13. The passive optical network of claim 10, wherein the downstream broadcast traffic includes a gigabit passive optical network encapsulation module header, network virtual local area network and the broadcast frame.
14. The passive optical network of claim 10, wherein the optical network terminal management and channel interface channel is a common control path used for broadcasting traffic from the optical line terminal to the optical network unit
15. The passive optical network of claim 10, wherein encapsulation of broadcast frame with network side virtual local area network per user network interface is done by the optical line terminal using a network side virtual local area network list.
16. The passive optical network of claim 10, wherein optical network units receive a network side virtual local area network list per user network interface, a customer side virtual local area network egress behavior list per user network interface and network-customer virtual local area network mapping information table from the optical network terminal management and channel interface along with the broadcast traffic.
17. A optical line terminal in a gigabit passive optical network, the optical line terminal comprising at least one means adapted for:

encapsulating a network virtual local area network in the broadcast traffic;

applying an egress behavior to each of customer side virtual local area network using an optical network terminal management channel and interface;

configuring the gigabit passive optical network encapsulation module port of the optical line terminal to send network related information along with broadcast traffic; and

transmitting broadcast traffic to all the optical network units in the gigabit passive optical network network.

18. A optical network unit in a gigabit passive optical network, the optical network unit comprising at least one means adapted for:

comparing a network virtual local area network in the received broadcast traffic with network side virtual local area network list per user network interface in the optical network unit to find user network interface with matching virtual local area network;

finding customer side virtual local area network (with egress behavior) using a network customer virtual local area network mapping table for the matched user network interfaces;

replicating the broadcast frame by changing the network virtual local area network with customer virtual local area network (with egress behavior);

applying the egress behavior associated with the customer side virtual local area network using the a customer side virtual local area network (with egress behavior) list; and

transmitting the downstream broadcast traffic to the user network interface port.

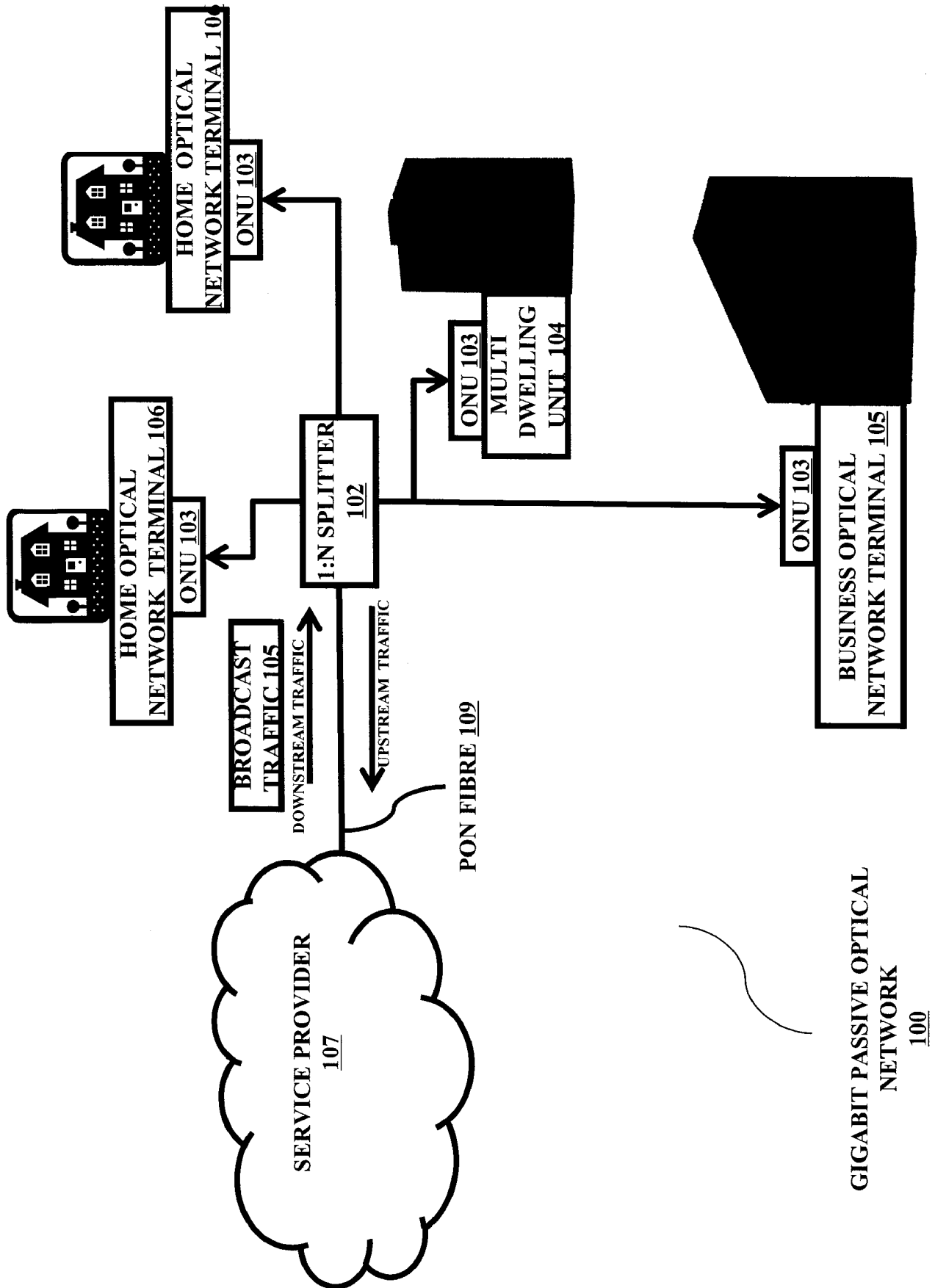


FIG. 1

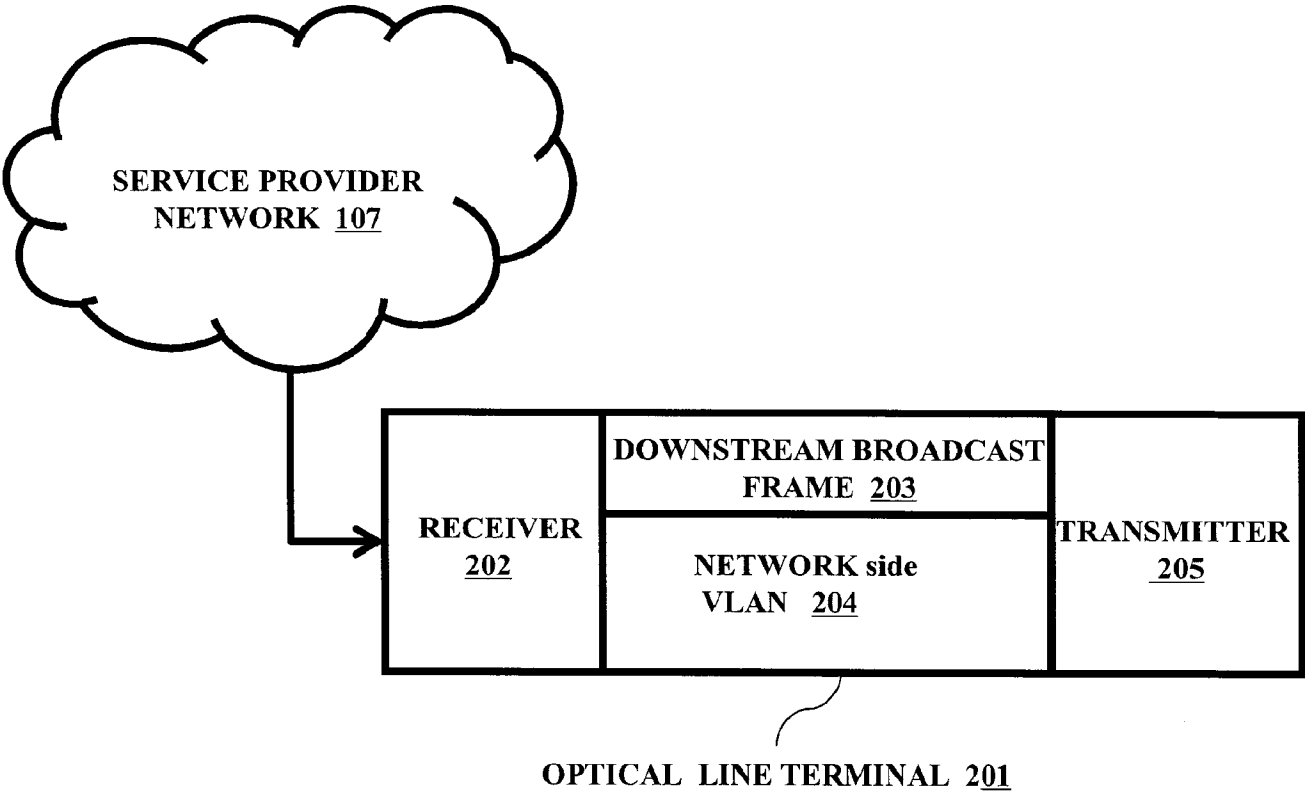


FIG. 2

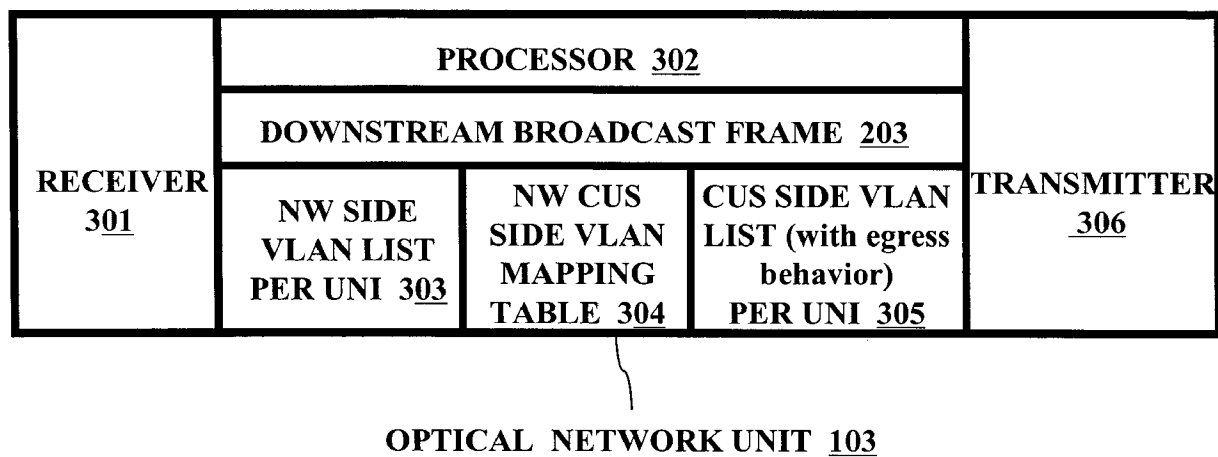


FIG. 3

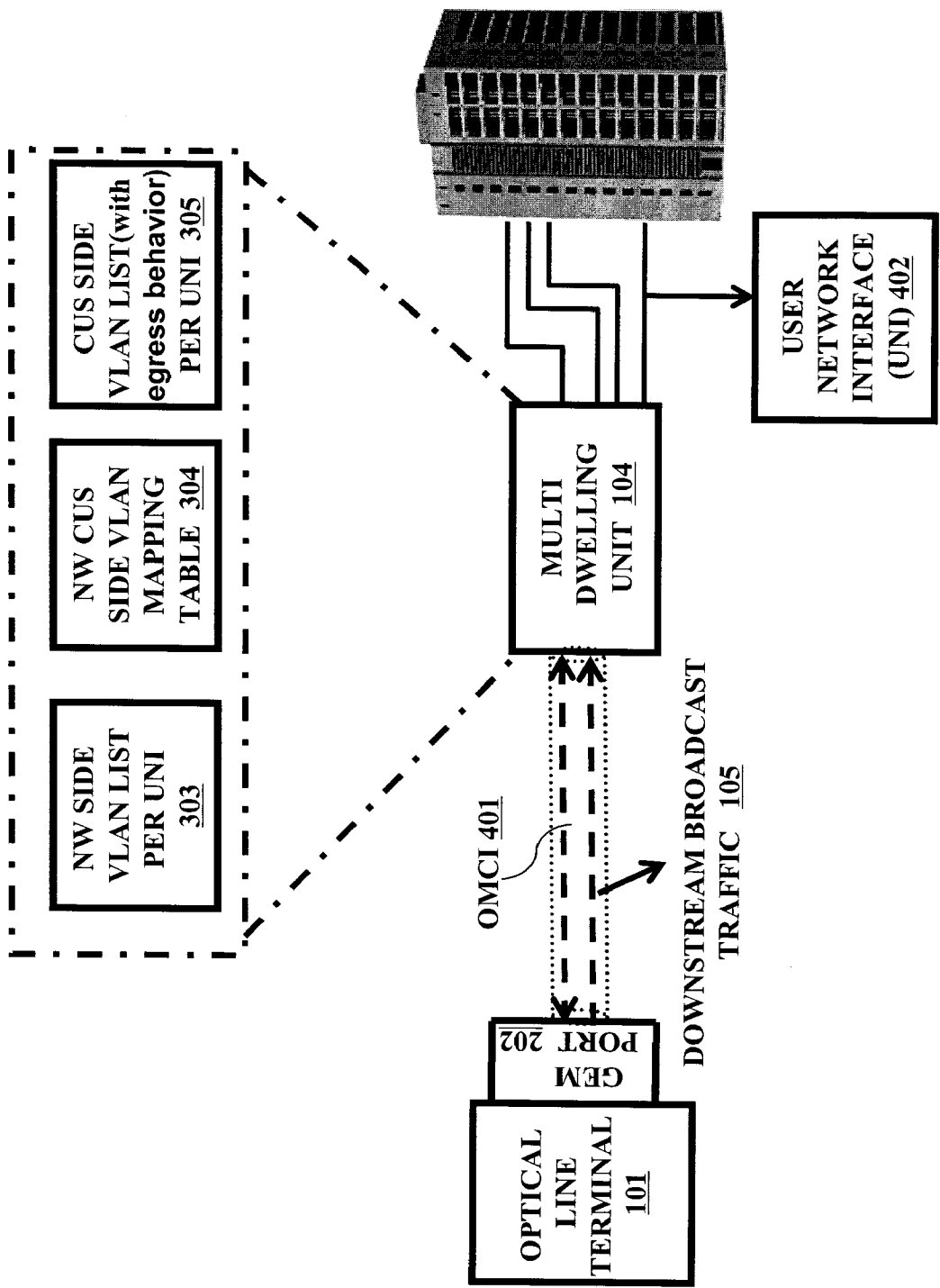


FIG. 4

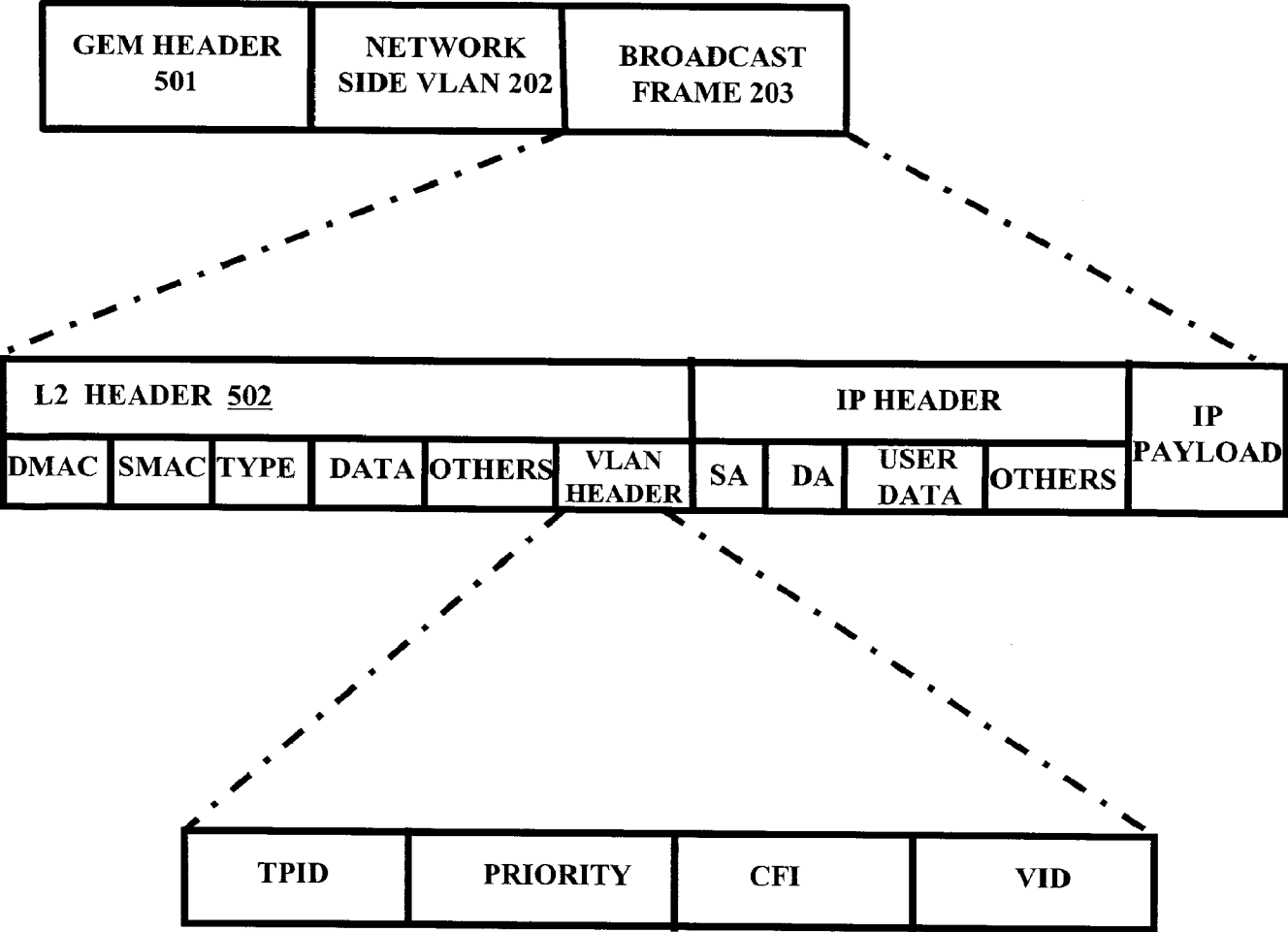


FIG. 5

FOR UNI 2 of an ONU		
Network Side VLAN list <u>303</u>	Customer Side VLAN list (with egress behaviour) <u>303</u>	
	VLAN list	Egress Behaviour
1	1A	Allow CVLAN tag (TAG)
4	4A	Swap VLAN ID (SWAP)
5	5A	No CVLAN tag (Untag)
9	9A	Allow CVLAN tag (TAG) and swap priority bits
12	12A	No CVLAN tag (Untag)
300	300A	Swap VLAN ID (SWAP) and swap priority bits

NW CUS SIDE VLAN
MAPPING TABLE 304

FIG. 6

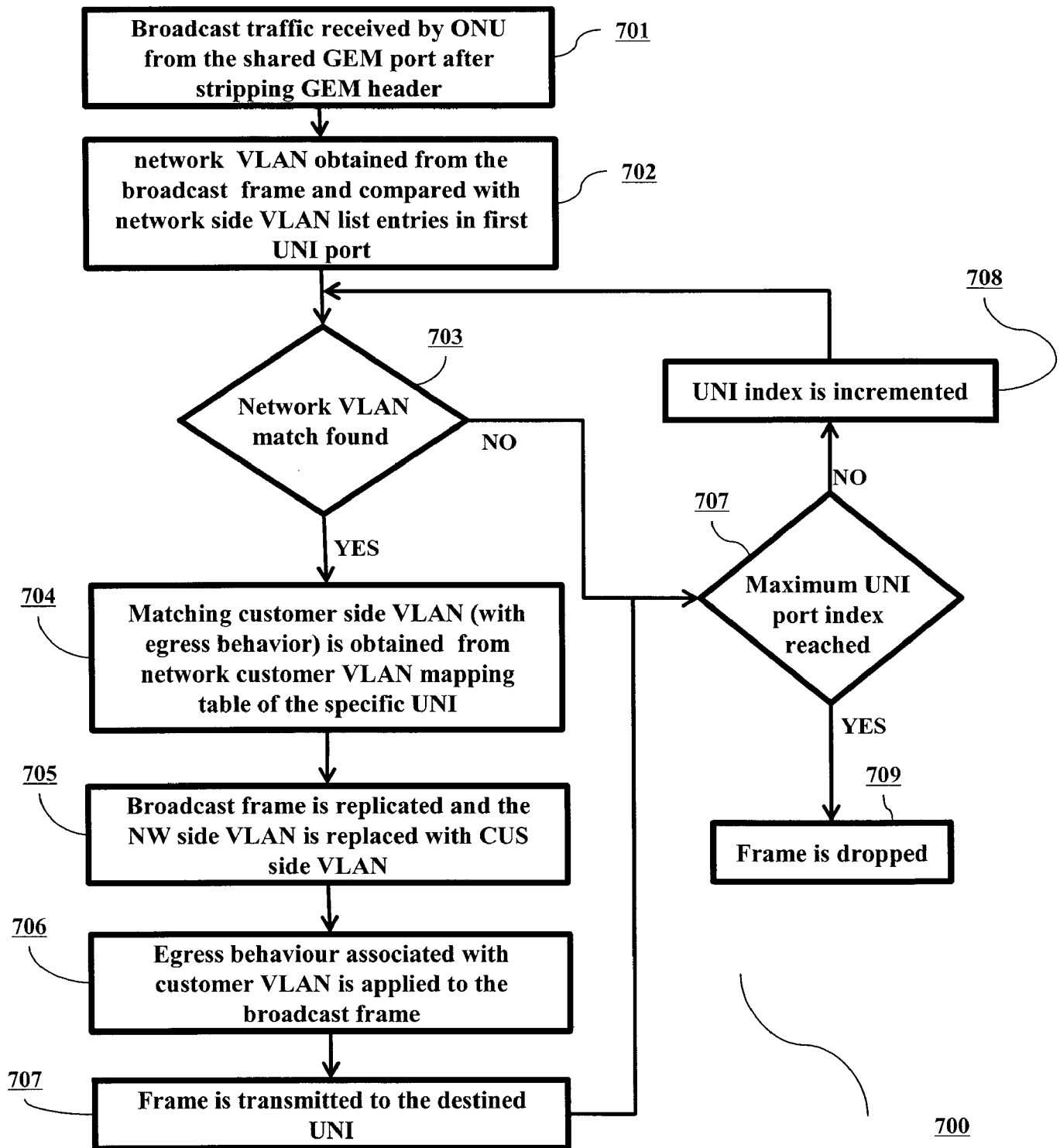


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/051787

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04H20/69
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2007/051488 A1 (TELECOM ITALIA SPA [IT]; CAPURSO ALESSANDRO [IT]; MERCINELLI ROBERTO []) 10 May 2007 (2007-05-10)	1,9,17
A	page 2, line 10 - line 24 page 3, line 20 - page 5, line 5 page 7, line 23 - line 27 page 8, line 8 - line 25 -----	6,13
Y	US 2010/104288 A1 (ZHENG RUOBIN [CN]) 29 April 2010 (2010-04-29) paragraph [0044] -----	1,9,17
X	US 2007/230481 A1 (IKEDA HIROKI [JP] ET AL) 4 October 2007 (2007-10-04) paragraphs [0060], [0 78], [0 88], [0 89], [0 91] -----	18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

De Haan, Aldert

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2011/051787

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