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SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Ethernet linear protection switching

ITU-T G-series Recommendations – Supplement 54

International Telecommunication Union

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Supplement 54 to ITU-T G-series Recommendations

Ethernet linear protection switching

Summary

Supplement 54 to ITU-T G-series Recommendations provides supplemental information to Recommendation ITU-T G.8031/Y.1342. It provides examples of network application scenarios involving Recommendation ITU-T G.8031/Y.1342.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G Suppl. 54	2015-07-03	15	11.1002/1000/12574

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Ethernet linear protection switching

1 Scope

Supplement 54 to ITU-T G-series Recommendations provides supplemental information to [ITU-T G.8031]. It provides examples of network application scenarios involving [ITU-T G.8031].

2 References

[ITU-T G.984.1] Recommendation ITU-T G.984.1 (2008), *Gigabit-capable passive optical networks (GPON): General characteristics*.

[ITU-T G.7710] Recommendation ITU-T G.7710/Y.1701 (2012), *Common equipment management function requirements*.

[ITU-T G.8013] Recommendation ITU-T G.8013/Y.1731 (2015), *OAM functions and mechanisms for Ethernet based networks.*

[ITU-T G.8031] Recommendation ITU-T G.8031/Y.1342 (2015), *Ethernet linear protection switching*.

[ITU-T G Suppl. 51] Supplement ITU-T G Suppl. 51 (2012), *Passive optical network protection considerations*.

3 Definitions

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AIS Alarm Indication Signal

APS Automatic Protection Switching

BNG Broadband Network Gateway

CCM Continuity Check Message

C-EC Customer Ethernet Connection

CPE Customer Premises Equipment

EC Ethernet Connection

ETH ETHernet MAC Layer

FOP Failure Of Protocol

GPON Gigabit-capable Passive Optical Network

MAC Media Access Control

MEG Maintenance Entity Group

MEP Management entity group End Point

MEPID MEG End Point Identifier

OAM Operations, Administration and Maintenance

OLT	Optical Line Termination
ONU	Optical Network Unit
PON	Passive Optical Network
S-EC	Service Ethernet Connection
SF	Signal Fail
SNC/N	Subnetwork Connection protection with Non-intrusive monitoring
SNCP	Subnetwork Connection Protection
SNC/S	Subnetwork Connection protection with Sub-layer monitoring
S-VID	Service VLAN Identifier
TCM	Tandem Connection Monitor
UNI	User Network Interface
VLAN	Virtual Local Area Network

5 Conventions

None.

6 Introduction

This Supplement provides supplemental information to [ITU-T G.8031]. It describes the suitability of [ITU-T G.8031] for network technologies (e.g., gigabit-capable passive optical network dual parenting protection [ITU-T G.984.1]).

7 Ethernet linear protection to support dual parenting protection

Figure 7-1 shows an Ethernet connection between customer premises equipment (CPE) and a broadband network gateway (BNG) over a passive optical network (PON) system and an aggregation backhaul/metro network. The optical line termination (OLT) is the head-end chassis that terminates the PON system on the network side using Ethernet interfaces and the optical network unit (ONU) terminates the PON system on the customer side. Each ONU has one or more user network interfaces (UNIs; Ethernet interfaces) to connect to different CPEs. Although the Ethernet traffic passes through the PON system transparently, the PON system controls the transmissions at a lower layer between the two Ethernet interfaces.

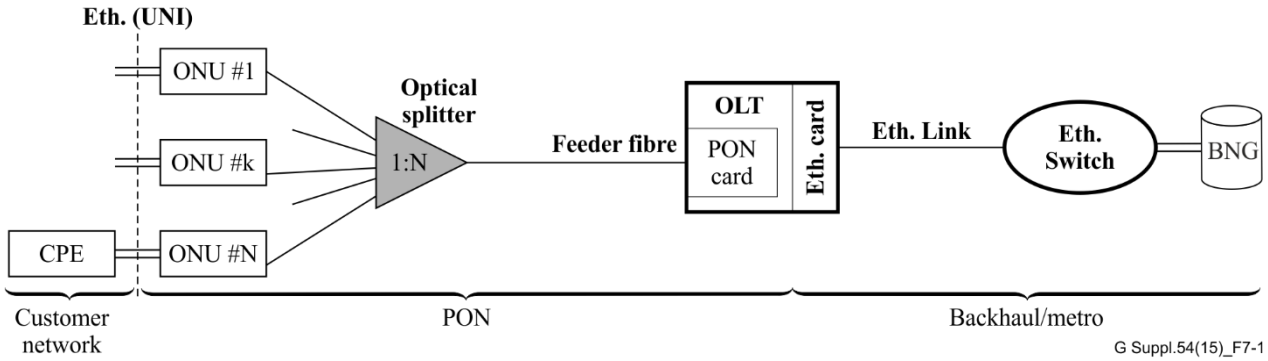

Figure 7-1 – Elements of a connection between CPE and a BNG over a PON and backhaul

In a dual parented type B PON protection configuration (Figure 7-2), a 2:N optical splitter is used to connect the ONUs to two different OLTs.

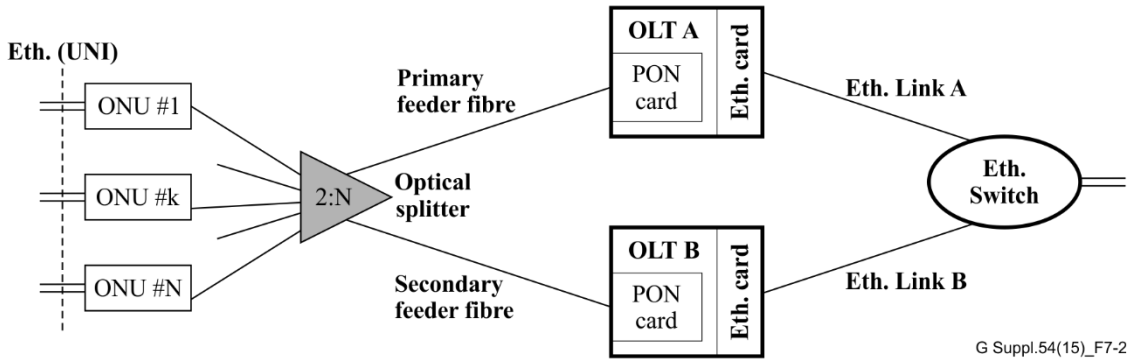

Figure 7-2 – General physical configuration of a dual parented type B PON protection

7.1 Protected Ethernet connection configuration over a PON system

Figure 7-3 illustrates the initial connection configuration between ONUs and the aggregation Ethernet switch on the network side.

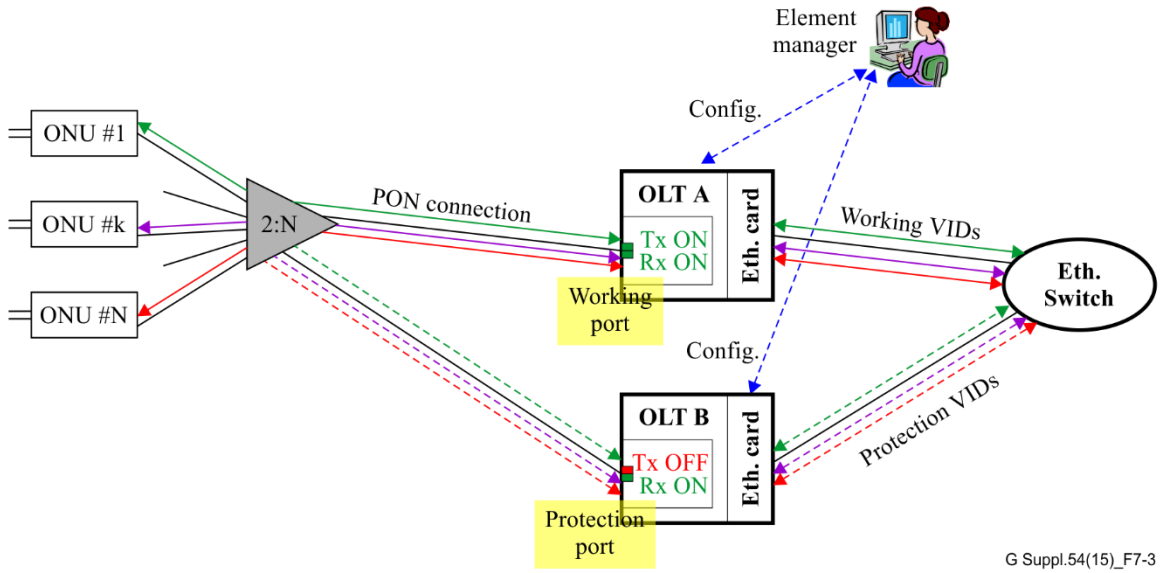

Figure 7-3 – Initial PON system connection configuration and protected Ethernet connections

The ONUs are activated on the "working" port of OLT A, and the service traffic will flow between ONUs and the Ethernet switch through OLT A. The "protection" port in OLT B will be on standby, thus not transmitting, but listening to upstream optical power from all ONUs. Therefore, OLT B in the "protection" state behaves like an open switch for all Ethernet traffic. It is important to stress that, at any given time, either none or at most one OLT PON port is active and passing Ethernet traffic through the OLT. Therefore the optical power splitter, together with the OLT PON ports, is equivalent to a selector bridge and a merging selector.

On the backhauling/metro links, a protected Ethernet connection is configured between the Ethernet switch and the Ethernet UNI at the ONU via the two OLTs. Ethernet operations, administration and maintenance (OAM) messaging must also be configured on all Ethernet connections using [ITU-T G.8013]. Management entity group end points (MEPs) must be configured at each active UNI

of each ONU and a maintenance entity group (MEG) formed with its opposite peer or peers in the Ethernet switch.

As shown in Figure 7-4, the two ports connecting the Ethernet switch to the two OLTs are associated in a 1:1 subnetwork connection protection (SNCP) switching using [ITU-T G.8031]. Continuity check messages (CCMs) flow between the two MEPs over the Ethernet connections. To detect the signal fail condition in the upper part of Figure 7-4, the Ethernet switch has two Ethernet MEP sink functions that monitor non-intrusively the working and protection input ports. In the lower part of Figure 7-4, the Ethernet switch has an Ethernet MEP function on the working and protection input ports. Note that the path through OLT B is interrupted (open connection) as the PON transmitter is turned OFF and the Ethernet traffic is blocked in both directions.

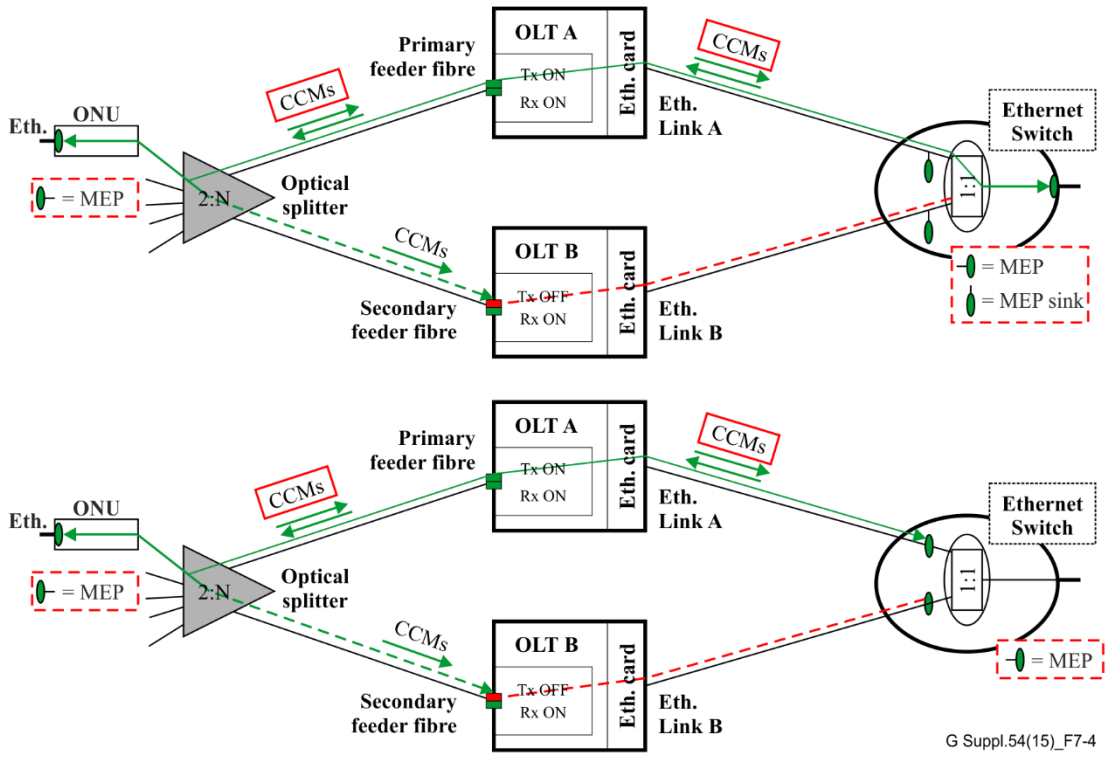

Figure 7-4 – Ethernet OAM and MEP association for 1:1 SNCP with non-intrusive monitoring (SNC/N) (upper) and 1:1 SNCP with sub-layer monitoring (SNC/S) (lower) protection configurations

The Ethernet connections between the UNI and the port at the Ethernet switch are identified by a service virtual local area network (VLAN) identifier (S-VID). Such service Ethernet connections (S-EC) may carry a user signal, or an aggregate of customer Ethernet connection (C-EC) signals, each one identified by a customer VLAN identifier. The S-ECs are protected.

7.2 Solution description

The restoration solution is illustrated in Figure 7-5. Upon failure, loss of signal (from all active ONUs) is detected at the active and standby OLT PON ports. The active OLT PON port transits to standby state and turns its transmitter off, thus stopping all Ethernet traffic passing through the OLT, including all CCMs associated with the affected S-ECs. The OLT PON port that was on standby also detects the loss of signal and transits to active state where it turns its transmitter on and takes control of all ONUs in the PON (refer to [ITU-T G Suppl. 51]). Once the ONUs are reconnected to OLT B, the Ethernet traffic flow on the protection route is restored and the CCM flows resume over the protection route back to the Ethernet edge switch.

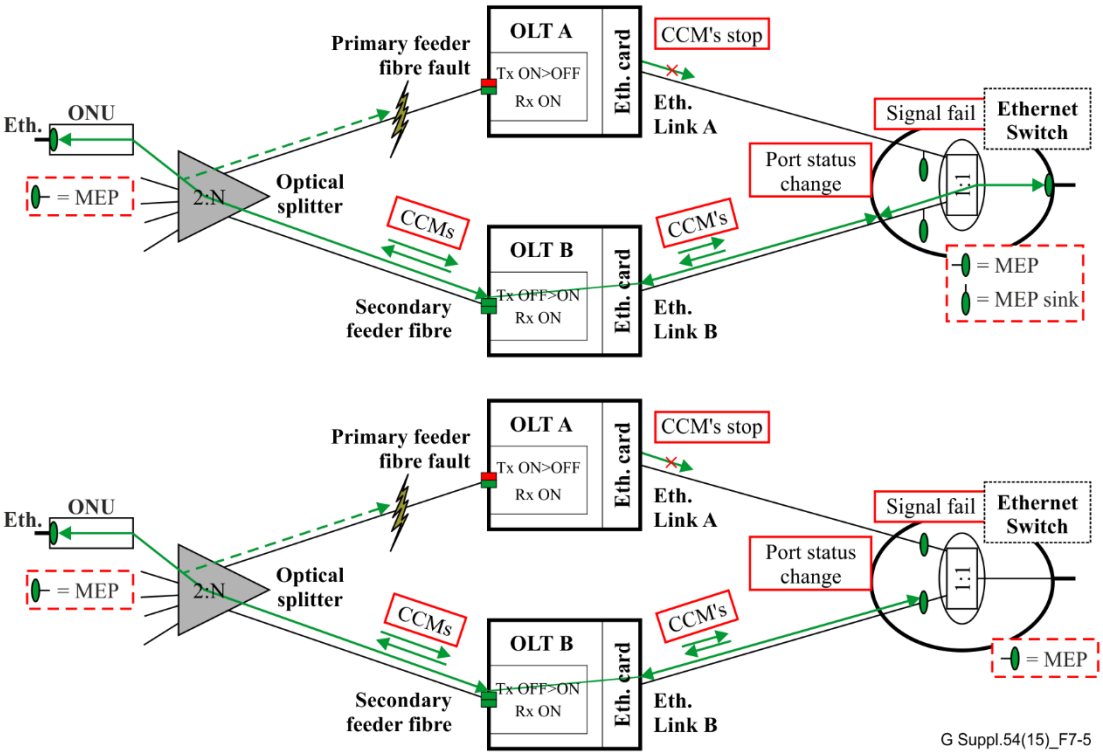

Figure 7-5 – Restoration solution at a glance for 1:1 SNC/N (upper) and 1:1 SNC/S (lower) protection configurations

The Ethernet edge switch asserts a signal fail (SF) condition for those S-ECs where CCMs have stopped being received and switches both directions of affected S-ECs traffic together over to the protection route.

It is important to note that individual ONUs in the PON are not protected; protection switching is triggered only when the entire PON (i.e., all ONUs) or OLT fails.

7.3 Ethernet elements in a protected Ethernet connection over a dual parented PON

The two associated OLT PON ports in a dual parented PON, controlled by their state within the PON system, can interrupt traffic in both directions. At any one time, the PON internal protocol only allows one of them to be active and transmitting and receiving traffic, while the associated PON port will be on standby blocking all traffic in both directions.

In order to establish a protected Ethernet connection, a 1:1 SNCP should be configured in the Ethernet switch. The defect conditions are detected by the MEP sink function, which are the inputs to the protection switching process, i.e., based on the local signal OK/failed condition information. On the access side of the protected Ethernet connection, the optical splitter and the two OLT PON ports perform the selector bridge/merging selector process where automatic protection switching (APS) is not configured. Therefore the ETH_C function in the Ethernet switch, due to the absence of incoming APS messages, will detect the defect failure of protocol (FOP) time out. Although this defect does not result in any consequent action, the associated alarm severity should be configured to "not alarmed" (see clause 7.1.3.1 of [ITU-T G.7710]).

When holding down the link, the protecting OLT will insert an Ethernet media access control (MAC) layer alarm indication signal (ETH AIS) in the Ethernet connection. The ETH MEP_Sk function will detect then the ETH AIS defect. Because this is not a primary alarm condition, its severity should be set to "Not Alarmed" so that no unnecessary alarm is present.

The Ethernet elements for this application are illustrated in Figure 7-6.

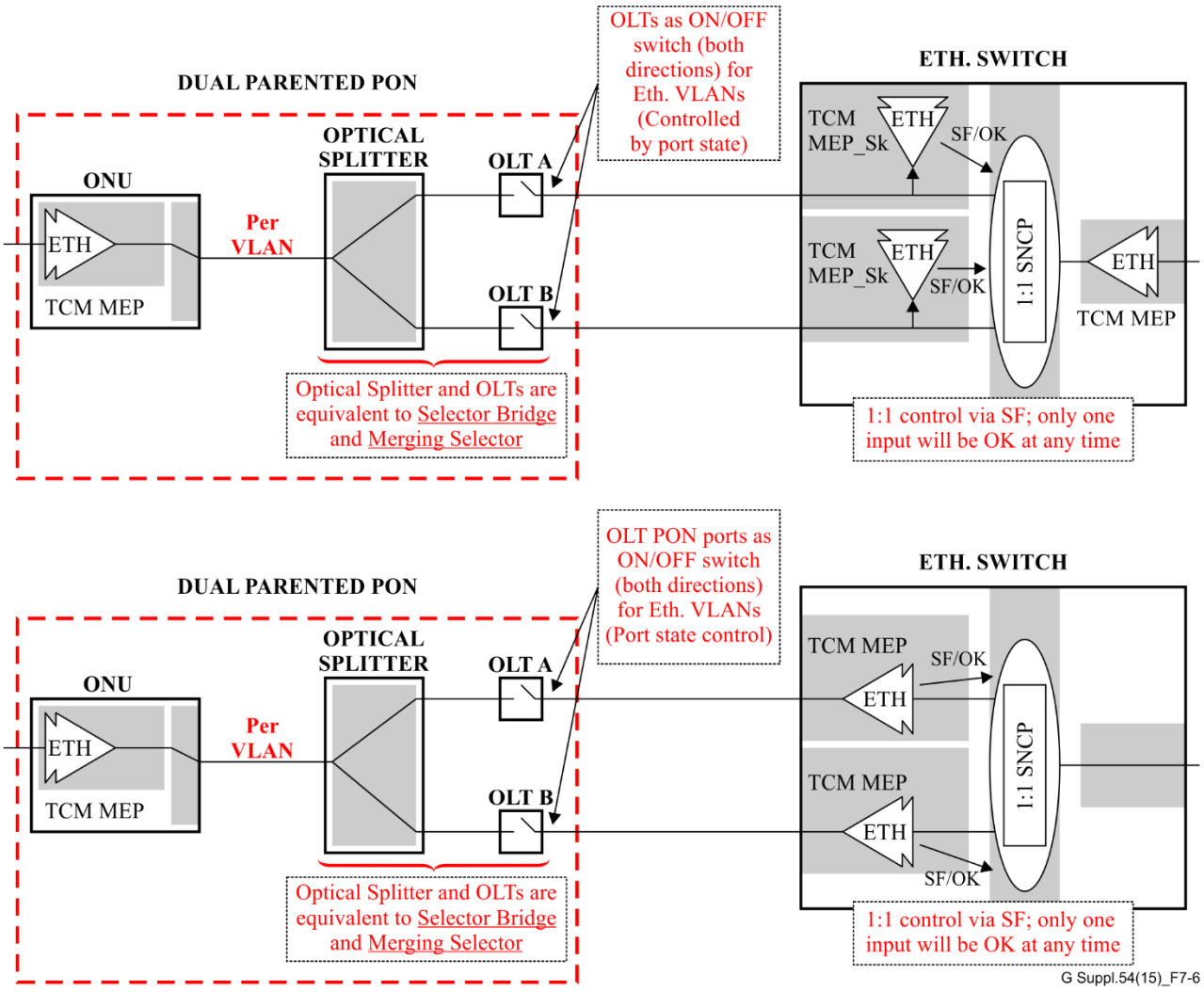

Figure 7-6 – Ethernet elements in a protected connection over a dual parented PON for 1:1 SNC/N (upper) and 1:1 SNC/S (lower) protection configurations

For the SNC/N protection scenario, the two tandem connection monitor MEPs (TCM MEP) associated with the same MEG are configured in the Ethernet customer port interface of the ONU and in the up (network facing) port of the Ethernet switch. Unidirectional switching requires the configuration of a TCM MEP sink (TCM MEP_Sk) function on each of the Ethernet switch ports facing the OLT. This TCM MEP_Sk function non-intrusively monitors the signal. These TCM MEP_Sk functions should be added to the same MEG as the two TCM MEP_So functions.

For the SNC/S protection scenario, the three MEPs (TCM MEP) associated with the same MEG are configured in the Ethernet customer port interface of the ONU and in the two ports of the Ethernet switch. Due to the presence of one MEP in the customer port interface and two MEPs in the two ports of the Ethernet switch, the MEG end point identifier (MEPID) of the two MEP Source functions in the Ethernet switch should be configured with the same MEP ID value to prevent the detection of an unexpected MEP defect in the MEP Sink at the customer port interface.

The SNCP function will respond to the TCM MEP_Sk SF information, which can only have the combinations OK/SF, SF/OK, or SF/SF. The combination OK/OK is not possible because of the OLT PON ports conditions, where only one can be active at any given time.

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