PHY-driven Silence Start

Han Hyub Lee and Hwan Seok Chung
ETRI

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Motivation

IEEE P802.3cp objectives

- Support full-duplex operation only
- Support bidirectional transmission over a single strand of single mode fiber using a single wavelength in each direction
- Support MAC data rates of 10 Gb/s, 25 Gb/s, and 50 Gb/s
- Support distances of at least 10 km, at least 20 km, and at least 40 km
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Support a BER of better than or equal to 10^{-12} at the MAC/PLS service interface (or the frame loss ratio equivalent)
- Support optional Energy-Efficient Ethernet operation
- Support silent start* operation to prevent bidirectional PHYs interfering with P2MP networks

* Silent start means that the upstream-facing PHY does not transmit unless a valid downstream signal is received. This prevents the bidirectional PHY from jamming transmission on the P2MP network in cases of unintentional connection

Introduction

- In this contribution, we introduce common methods of preventing jamming transmission from a rogue transceiver in the PON ONU.
  1. MAC-driven method
  2. ONU-driven method
- We discuss a PHY-driven method and a wavelength plan to prevent jamming transmission on the P2MP.

Rogue ONU: ITU-T G.Supplement 49 : Rogue optical network unit (ONU) considerations

2 Rogue condition causes and prevention

The key requirements in the standard that can be used to determine rogue behaviour are as follows: the ONU should only transmit at its specified "on power" in timeslots that are allocated to it by the OLT, and the ONU should emit less than the "off power" at all other times. (The exact values of the power levels are given in the PMD specification.) An ONU that emits power outside of its allocated timeslot is a rogue ONU. The following clauses describe several conditions that can cause a rogue ONU, and the measures that can be employed to stop them.

Rogue ONU conditions

1. Unauthorized transmission errors
2. Software errors
3. Media access control errors
4. Transceiver error ← Unintentional connection

Transceiver error

2.4 Transceiver error

The last link in the transmitter control chain is the transmitter itself. The transceiver is typically very simple, with only a handful of transistors between the Tx-enable pin and the laser. However, one can have a failed transistor, and the transmitter would nevertheless remain on. It is desirable that the transmitter be designed so that there is no single component failure that will allow the laser to emit. The ordinary burst-mode Tx-enable path would be the primary control of the laser, but there should be at least one additional path or means of control to disable the laser or indeed the entire transmitter. For example, this could involve turning the modulation or bias current sources off, or powering down the whole transmitter module. Such controls do not need to be fast (millisecond-scale speeds are sufficient). Additionally, such controls can also be useful for power saving features.

Control of the emergency shutdown circuit can come from multiple sources: the software, the MAC, and even the transceiver itself can detect the failure. It is desirable for each of these oversight functions to have an independent path to the Tx shutdown feature. In this way, if any entity believes rogue behaviour is happening, the Tx will be pulled down.

One final means of control is through the internal ONU signal path. It is desirable to cease transmitting a modulated signal if the Tx is stuck in the "on" position. A transmitter emitting CW light may disrupt the PON by degrading the receiver sensitivity. The degree of disruption and service impact to other ONUs on the PON may vary.

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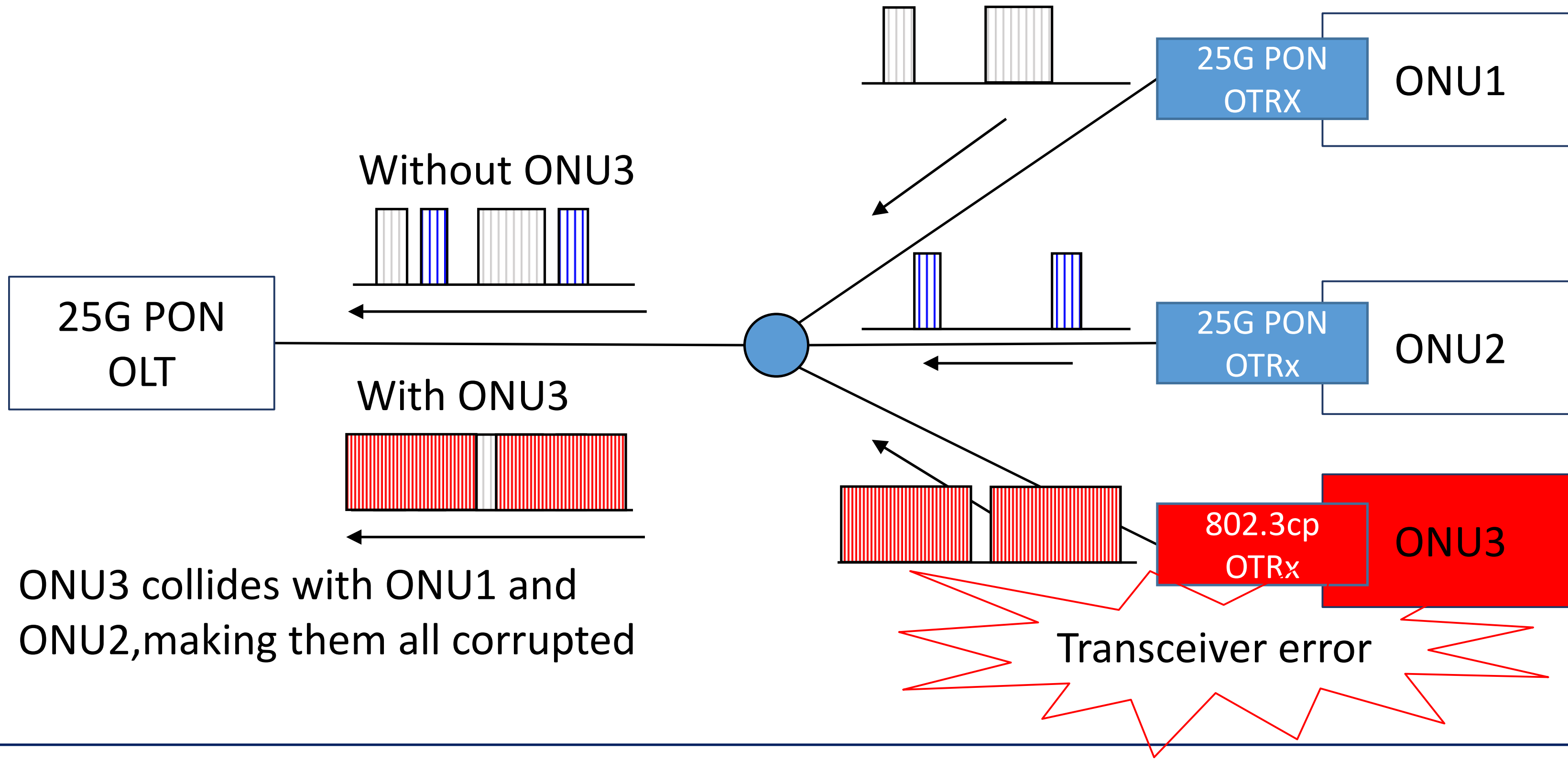
Problem: Rogue ONU with transceiver error



- A 802.3cp transceiver makes the ONU3 to be a rogue ONU which transmits unexpected burst lights or continuous light.
- The rogue ONU detection is a very important feature in the PON system.
- To identify and isolate the rogue ONU in the PON, both the OLT and the ONUs will do a procedure to isolate the rogue ONU.

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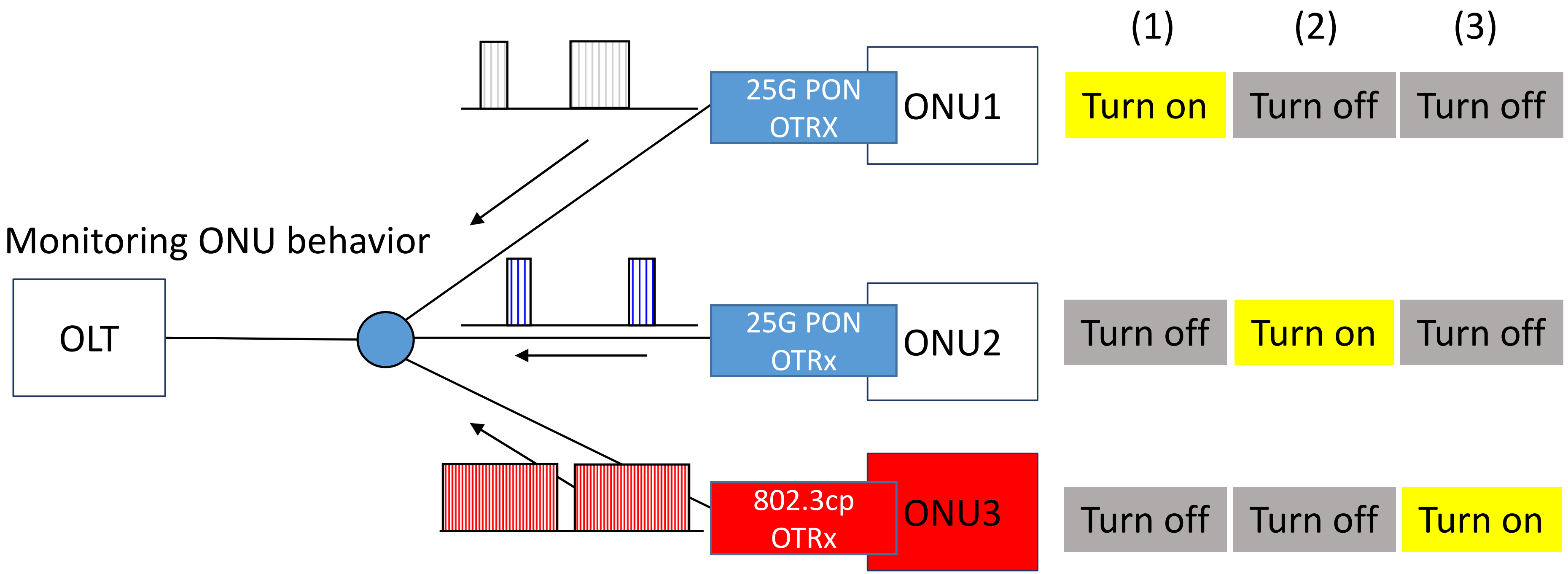
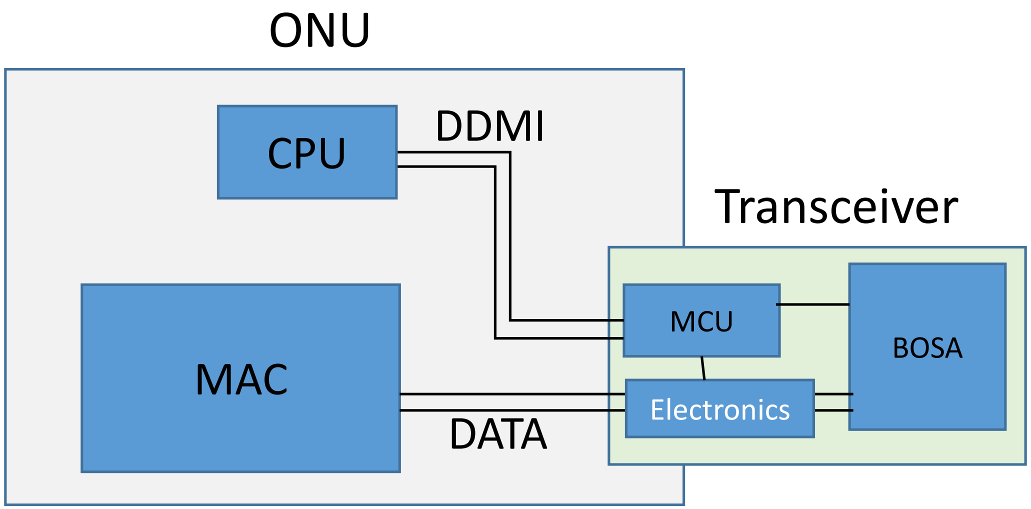
1. MAC-driven method



- The common way to handle it is by turning off all the ONUs, and then turning them back on one-by-one until the faulty one is found.
- This process requires disconnection of traffic to every one of the customers on the PON.
- ITU-T G.sup 49 introduces the rogue ONU detection method by monitoring ONU behavior.

2. ONU-driven method



[Procedure]

① Insert a transceiver
② Turn on the transceiver (Laser off)
① Read information to check
② Confirm the valid transceiver
③ Turn on the transceiver
④ Receive a downstream signal

- One common method is to check the transceiver information when the transceiver is inserted in the ONU
- First, the ONU access a internal memory of the transceiver to confirm the information of transceiver by using I^2C interface before turning on the transceiver.
- Second, ONU checks that the information of transceiver is valid or invalid.
- If the information is invalid then ONU makes the transceiver shutdown.
- This method requires a predetermined commitment between a system vender and a transceiver vender .

PHY-driven silence start

- The key idea of this method is to ensure that the 802.3cp transceiver doesn't inherently receive downstream signals from PONs when the transceiver is connected to PON ONUs.
  - Design 802.3cp DN wavelength plan to avoid overlapping current PON downstream wavelength bands. (1490 nm, 1577 nm, 1355 nm etc.)
- 802.3cp transceiver will not receive current PON downstream signals even the transceiver connects 1G, 10G, 25G or 50G EPON ONU.
  - ONU doesn't work without receiving downstream signals.
- This scheme doesn't need to define a new MAC protocol and does not require modification of existing SFP transceivers.

Proposed wavelength plan

- We propose a wavelength plan of 25GBASE NGBIDI to avoid overlap 50G EPON downstream wavelength .
  - ➢ Downstream option A
    - ✓ Same with the wavelength of commercial 10G bidirectional SFP+ transceiver.
    - ✓ The wavelength range is modified to consider EML source.
  - ➢ ~~Downstream option B~~
    - ✓ ~~Same with 50G EPON wavelength plan in order to share optics and electronics of 50G EPON~~

	Upstream	Downstream (Option A)	Downstream (Option B)
Center wavelength	1271 nm	1331 nm	1358 nm
Wavelength range	20 nm	+/- 2 nm	+/- 2 nm
Gap btw Up and Dn		48 nm	76 nm
Note	• DML+ APD • Same as a UW0 wavelength of 50G-EPON	• EML + APD	• EML + APD • Same as a DN0 wavelength of 50G-EPON

http://www.ieee802.org/3/NGBIDI/public/1809/180911%20O-band%20Wavelegnth%20plan_hhlee_R1.pdf

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Supplements

PIN map of SFP OTRx

Commercial SFP Ethernet transceiver

Pin Num.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	
2	TX Fault	Transmitter Fault Indication	3	Note 1
3	TX Disable	Transmitter Disable	3	Note 2 Module disables on high or open
4	MOD-DEF2	Module Definition 2	3	Note 3, 2 wire serial ID interface
5	MOD-DEF1	Module Definition 1	3	Note 3, 2 wire serial ID interface
6	MOD-DEF0	Module Definition 0	3	Note 3, Grounded in Module

Commercial SFP PON ONU transceiver

VI. Pin Descriptions

Pin	Symbol	Name/Description	Notes
1	VeeT	Transmitter Ground (Common with Receiver Ground)	
2	TX Fault	Transmitter Fault.	PIN Note 1
3	TX Disable	Transmitter Disable. **Burst enable**	PIN Note 2, Module disables on high or open
4	MOD-DEF2	Module Definition 2.	PIN Note 3, 2 wire serial ID interface

- Since Ethernet SFP and PON SFP transceiver has a same pin map the Ethernet transceiver will operate when it is inserted to PON ONU equipment.

Problem

- Ethernet transceiver has no burst mode transmitter which doesn't ensure faster laser turn-on and off time.
- The slow response would be effect to next burst signals
- OLT upstream receiver will be lost and as a result whole communication over that port will reach to a halt. In case OLT and all ONU can become nonoperational.