Gain Control of SOA Preamplifier

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Supporters

- Glen Kramer, Broadcom

Motivation

- At the last meeting in Chicago, Motion #9 on the extension of the discovery message was passed.

> ## Motion #9
>
> In order to extend OLT burst receiver dynamic range, move to extend the discovery message shown in umeda_3ca_1b_0318.pdf pages 7 and 8 to support ONUs with different RX_RSSI to be registered in different time slots. Align the table with new bit positions in draft as amended in this meeting.
>
> Moved: Daisuke Umeda   Second: Dekun Liu
>
> For: 19   Against: 0   Abstain: 3
>
> Technical (≥ 75%)   Motion Passed

- In order to use Rx_RSSI indication, we need to announce many information to determine ONU Rx thresholds (th0,th1 and th2). We propose to announce ONU RSSI thresholds (ONU_RSSI_Min and ONU_RSSI_Max) instead of Rx_RSSI indication and the information to determine th0, th1 and th2.

Table 144-6 Discovery Information Fields

GATE MPCPDU discovery information fields		
Bit	Flag field	Values
0	Reserved	Ignored on Reception
1	OLT is 10G upstream capable	0 – OLT does not support 10 Gb/s reception 1 – OLT supports 10 Gb/s reception
2	OLT is 25G upstream capable	0 – OLT does not support 25 Gb/s reception 1 – OLT supports 25 GB/s reception
3-4	Reserved	Ignored on reception
5	OLT is opening 10G discovery window	0 – OLT cannot receive 10 Gb/s data in this window 1 – OLT can receive 10 Gb/s data in this window
6	OLT is opening 25G discovery window	0 – OLT cannot receive 25 Gb/s data in this window 1 – OLT can receive 25 Gb/s data in this window
7-9	ONU Rx_SSI indication	000 : registration for all ONUs 001 : registration for ONUs Rx_RSSI < th1 010 : registration for ONUs Rx_RSSI $\geq$ th1 100 : registration for ONUs Rx_RSSI < th0 101 : registration for ONUs Rx_RSSI $\geq$ th0 & Rx_RSSI < th1 110 : registration for Rx_RSSI $\geq$ th1 & Rx_RSSI < th2 111 : registration for ONUs Rx_RSSI $\geq$ th2
10-15	Reserved	Ignored on reception

- In order to use ONU RSSI indication, ONUs need RSSI thresholds th0-2 information.

  $th_X = TH_X + OLT\_Tx - ONU\_Tx$ (dBm)

  TH_X: OLT Rx threshold (dBm), OLT_Tx: OLT Tx power (dBm), ONU_Tx: ONU Tx power (dBm)

- There are some types of ONU (10G US ONU, 25G US ONU and 50G US ONU). As their transmitter powers are different, ONU RSSI thresholds are different. OLT needs to announce a lot of information for all ONU types.

Announcement ONU RSSI Threshold (Min/Max) by DISCOVERY GATE message

Use 4 Octets on DISCOVERY GATE MPCPDU to announce ONU RSSI Thresholds "ONU_RSSI_Min" and "ONU_RSSI_Max". **Different RSSI thresholds are set for each ONU type and RSSI class.**

- ONU_RSSI_Min/Max : RSSI thresholds are 16-bit unsigned integer, with the LSB equal to 0.1 uW, covering the range of 0 to 6.5535 mW (~ -40 to +8.2 dBm)

ONU RSSI threshold information fields

Octet	Field	Value	Unit
0-1	ONU_RSSI_Min	0 to 6.5535 mW (~ -40 to 8.2 dBm)	0.1 uW
2-3	ONU_RSSI_Max		

Comparison to ONU_RSSI_Indication case

ONU_RSSI_Indication	ONU_RSSI_Min	ONU_RSSI_Max
000	0	0xffff
001	0	th1
010	th1	0xffff
100	0	th0
101	th0	th1
110	th1	th2
111	th2	0xffff

10G US ONU: $th_X\_10G = TH_X * OLT\_Tx / ONU\_Tx10G$ (mW)

25G US ONU: $th_X\_25G = TH_X * OLT\_Tx / ONU\_Tx25G$ (mW)

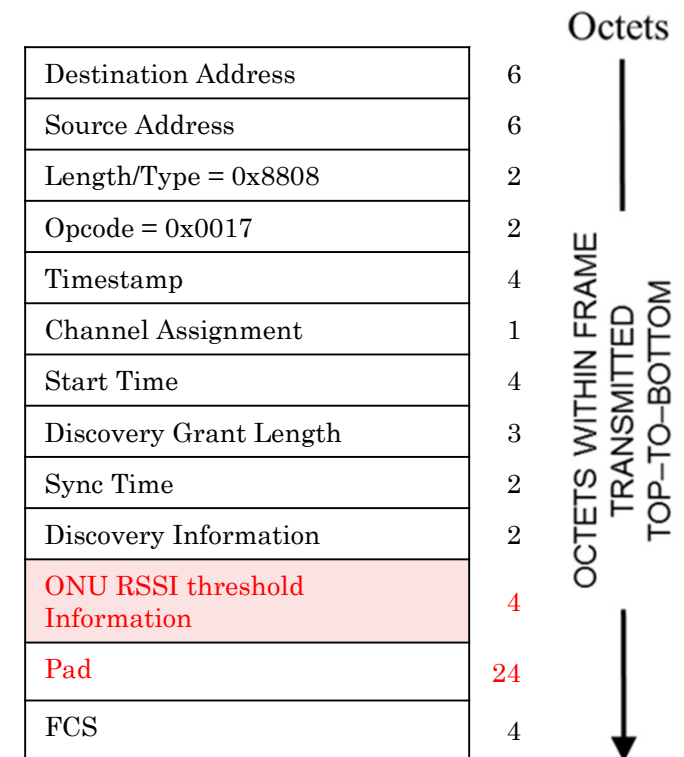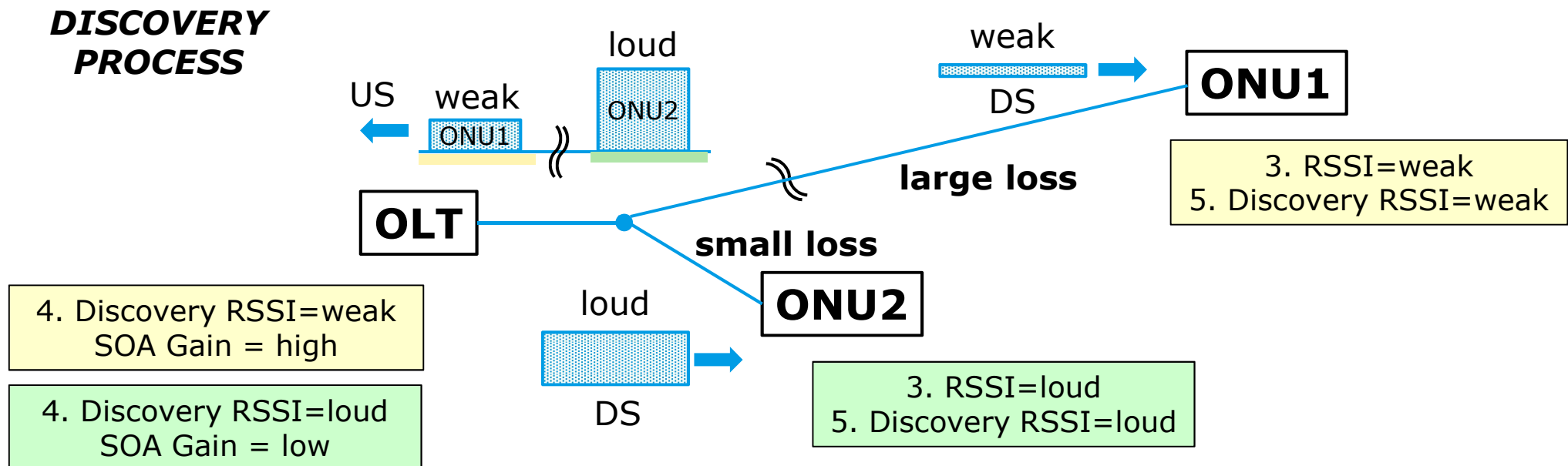| Field	Octets
Destination Address	6
Source Address	6
Length/Type = 0x8808	2
Opcode = 0x0017	2
Timestamp	4
Channel Assignment	1
Start Time	4
Discovery Grant Length	3
Sync Time	2
Discovery Information	2
ONU RSSI threshold Information	4
Pad	24
FCS	4

OCTETS WITHIN FRAME TRANSMITTED TOP–TO–BOTTOM

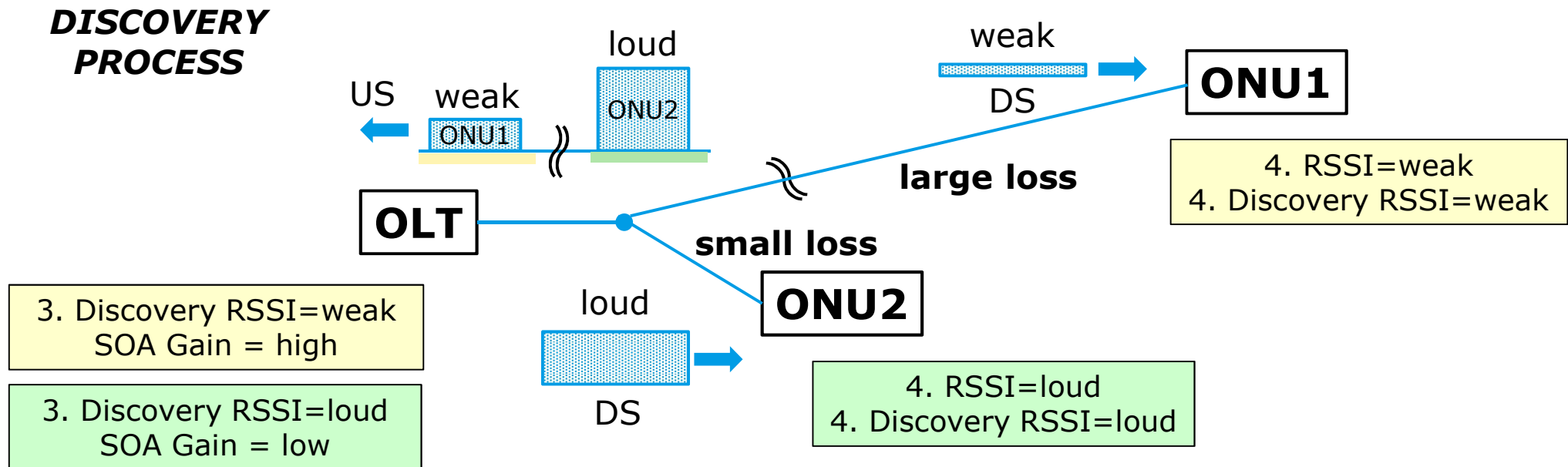**Figure 144-23 – DISCOVERY GATE MPCPDU**

Old Discovery with ONU RSSI Indication

1. OLT announces parameters for ONU to calculate ONU RSSI thresholds by DISCOVERY GATE message or a new MPCPDU.
2. ONU receives the parameters and calculates ONU RSSI thresholds.
3. ONU monitors RSSI, compares the RSSI value with ONU Rx thresholds. ONU determines the RSSI class.
4. OLT executes dedicated discovery by DISCOVERY GATE message with ONU RSSI Indication.
5. ONU responds to the DISCOVERY GATE with matched RSSI Indication.

DISCOVERY PROCESS

loud

weak

US   weak   ONU2

ONU1

DS

ONU1

3. RSSI=weak
5. Discovery RSSI=weak

large loss

OLT

small loss

ONU2

loud

4. Discovery RSSI=weak
   SOA Gain = high

DS

3. RSSI=loud
5. Discovery RSSI=loud

4. Discovery RSSI=loud
   SOA Gain = low

New Discovery with ONU_RSSI_Min/Max

1. OLT calculates all sets of ONU_RSSI_Max/Min for all ONU types and RSSI classes.
2. ONU monitors RSSI. ONU hasn't known its RSSI class yet.
3. OLT executes dedicated discovery by DISCOVERY GATE message with ONU_RSSI_Min/Max.
4. ONU compares the RSSI and ONU_RSSI_Min/Max and responds to the DISCOVERY GATE if ONU_RSSI_Min <= RSSI < ONU_RSSI_Max. ONU knows the RSSI class at this point.

DISCOVERY PROCESS

weak

loud

US   weak   ONU2

ONU1

DS

ONU1

large loss

4. RSSI=weak
4. Discovery RSSI=weak

OLT

small loss

ONU2

3. Discovery RSSI=weak
   SOA Gain = high

loud

3. Discovery RSSI=loud
   SOA Gain = low

DS

4. RSSI=loud
4. Discovery RSSI=loud

Summary

- Proposed to replace "ONU Rx_RSSI Indication" with "ONU_RSSI_Min" and "ONU_RSSI_Max" parameters that are announced by ONU RSSI threshold information on DISCOVERY GATE message.

Thank you !

Motion

Move to delete "ONU RSSI Indication" and define "ONU RSSI Min" and "ONU RSSI Max" on DISCOVERY GATE message on slide 5 in umeda_3ca_1_0158 to announce ONU RSSI thresholds and indicate RSSI class.

Moved:

Second:

For:

Against:

Abstain:

Backup

Announcement of TH_X and OLT/ONU_Tx Parameters for ONU Rx_RSSI Indication method

OLT announces the following parameters to all ONUs.

Parameter	Description	Example
TH0 [1]	OLT Rx threshold 0 (Low)	-15 dBm
TH1 [1]	OLT Rx threshold 1 (Middle)	-12 dBm
TH2 [1]	OLT Rx threshold 2 (High)	-9 dBm
OLT_Tx [2]	OLT transmitter power	6 dBm
ONU_Tx10G [3]	ONU 10G transmitter power	6 dBm
ONU_Tx25G [3]	ONU 25G transmitter power	6 dBm
(ONU_Tx50G) [3]	Reserved (ONU 50G transmitter power)	

(Note)

(1) OLT announces "OLT Rx thresholds" TH_X and ONUs calculate "ONU RSSI tresholds" th_X .

th_X for 10G US ONU: $th_{X\_10G} = TH_X + OLT\_Tx - ONU\_Tx10G$ (dBm)   X=0,1,2

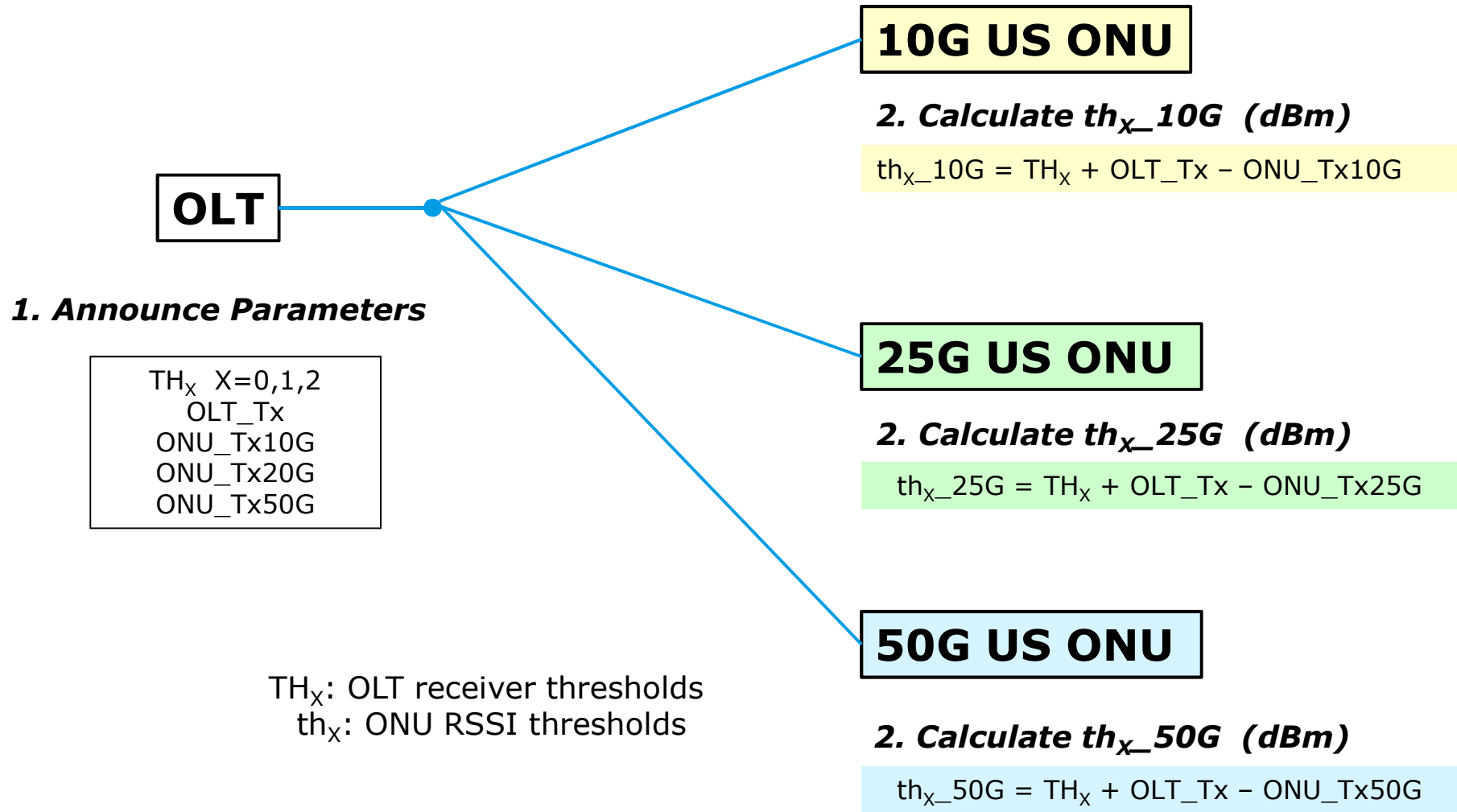th_X for 25G US ONU: $th_{X\_25G} = TH_X + OLT\_Tx - ONU\_Tx25G$ (dBm)   X=0,1,2

th_X for 50G US ONU: $th_{X\_50G} = TH_X + OLT\_Tx - ONU\_Tx50G$ (dBm)   X=0,1,2

(2) A typical, calibrated or TSSI value can be announced as OLT transmitter power.

(3) Typical values are announced as ONU transmitter powers. ONU Tx power range is about 3dB and typical value is accurate enough.
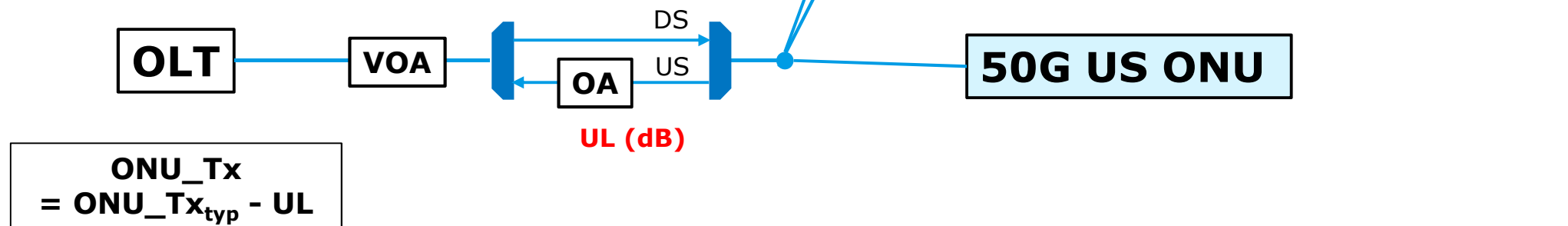
Calculation of ONU RSSI thresholds

OLT

1. Announce Parameters

TH_X X=0,1,2
OLT_Tx
ONU_Tx10G
ONU_Tx20G
ONU_Tx50G

TH_X: OLT receiver thresholds
th_X: ONU RSSI thresholds

10G US ONU

2. Calculate th_X_10G (dBm)

$th_X\_10G = TH_X + OLT\_Tx − ONU\_Tx10G$

25G US ONU

2. Calculate th_X_25G (dBm)

$th_X\_25G = TH_X + OLT\_Tx − ONU\_Tx25G$

50G US ONU

2. Calculate th_X_50G (dBm)

$th_X\_50G = TH_X + OLT\_Tx − ONU\_Tx50G$

Consideration on Asymmetric Channel Insertion Loss

In some system tests, asymmetric C.I.L. configurations are needed.

**Ex1. OLT sensitivity tests
        US loss > DS loss**

Ex2. ONU sensitivity tests
        DS loss > US loss

OLT announces OLT_Tx or ONU_Tx considering the loss difference between US and DS paths.

10G US ONU

25G US ONU

2. Calculate th_X_25G (dBm)

$$th_X\_25G = TH_x + OLT\_Tx - ONU\_Tx25G$$

$$=$$

$$th_X\_25G = TH_X + OLT\_Tx - (ONU\_Tx25G_{typ} - UL)$$

DS

US

OLT — **VOA** — **OA** — **50G US ONU**

UL (dB)

**ONU_Tx
= ONU_Tx$_{typ}$ - UL**
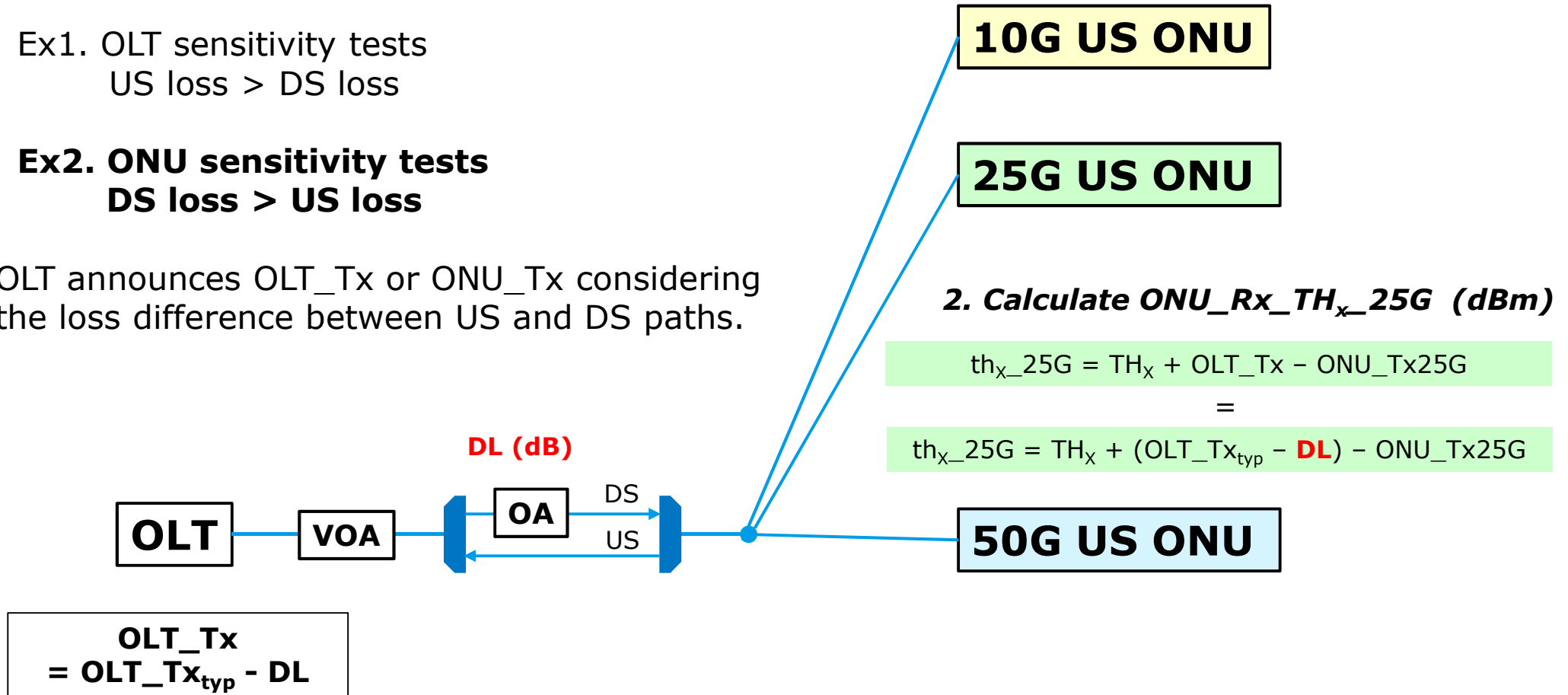
Ex.1 OLT sensitivity test

Consideration on Asymmetric Channel Insertion Loss

In some system tests, asymmetric C.I.L. configurations are needed.

Ex1. OLT sensitivity tests
     US loss > DS loss

Ex2. ONU sensitivity tests
    DS loss > US loss

OLT announces OLT_Tx or ONU_Tx considering the loss difference between US and DS paths.

10G US ONU

25G US ONU

2. Calculate $ONU\_Rx\_TH_x\_25G$ (dBm)

$$th_X\_25G = TH_X + OLT\_Tx - ONU\_Tx25G$$
$$=$$
$$th_X\_25G = TH_X + (OLT\_Tx_{typ} - DL) - ONU\_Tx25G$$

50G US ONU

DL (dB)

OLT — VOA — OA — DS →
   ← US

OLT_Tx = OLT_Tx$_{typ}$ - DL

Ex.2 ONU sensitivity test