GPON Knowledge Introduce

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2019/8/5

Creating smarter living through a seamlessly connected world.

Outline

- GPON Introduction
- GTC frame
  - Downstream frame
  - Upstream frame
- DBA(Dynamic bandwidth assignment)
- PLOAM Message
- GPON LOID Register

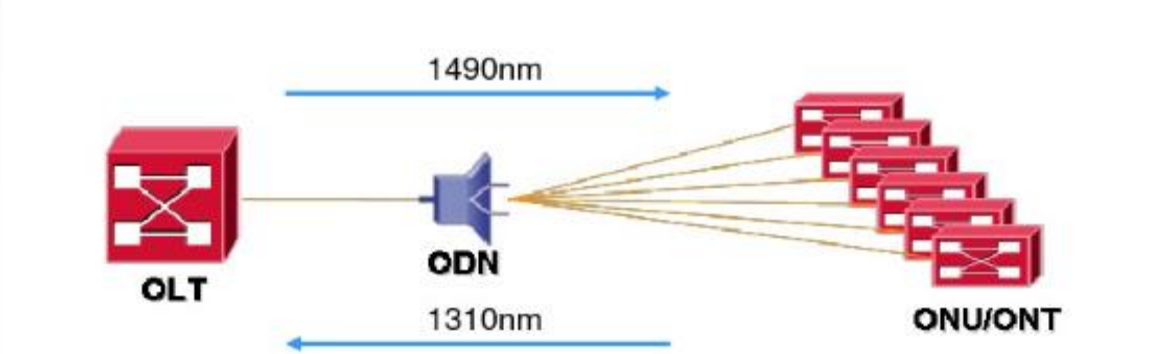
Different type of PON

	A/B-PON	G-PON	EPON
Standard	FSAN/ITU-T(G.983 series)	FSAN/ITU-T(G.984 series)	IEEE 802.3ah (1000 Base-PX)
Transmission Rate	Up: 155Mbps Down: 622Mbps	Up: 155M/622M/1.24G/2.48 Gbps Down: 1.24/2.48Gbps	Up:1.25Gbps Down:1.25Gbps
Splitting Branches	32 Max.	64 Max.	32 Max.
Transmission length	20km Max.	20km Max.	10/20km (1000Base-PX-10/1000Base-PX-20)
Frame type	ATM cell	GEM frame, GTC frame	Ethernet frame
Compatible Service	Full service (Ethernet, TDM, POTS)	Full service (Ethernet, TDM, POTS)	Ethernet Service
Country/Area	USA/Europe	USA/Europe	Japan
Commercial Service	Jun.1999 start	Not yet	The end of 2004 start

Introduction -- GPON

- GPON --- Gigabit PON
  - A passive optical network (PON)
  - 2.488Gbit/s Downstream, 1.244Gbit/s upstream
  - 1:64 Max split ratio
  - 20km Max Distance
  - Transmit multiple service:Ethernet/IP, Voice,CATV

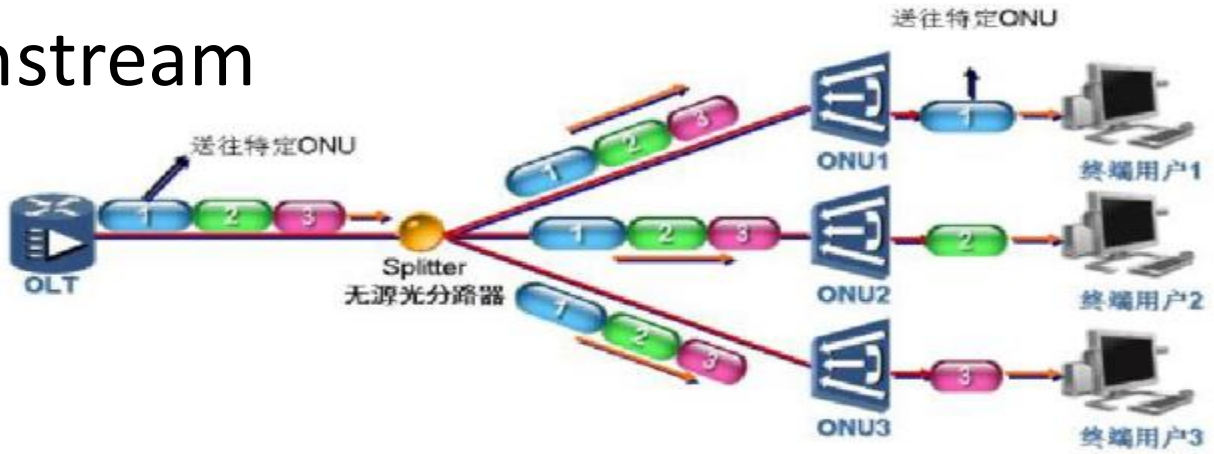
GPON COMMUNICATION



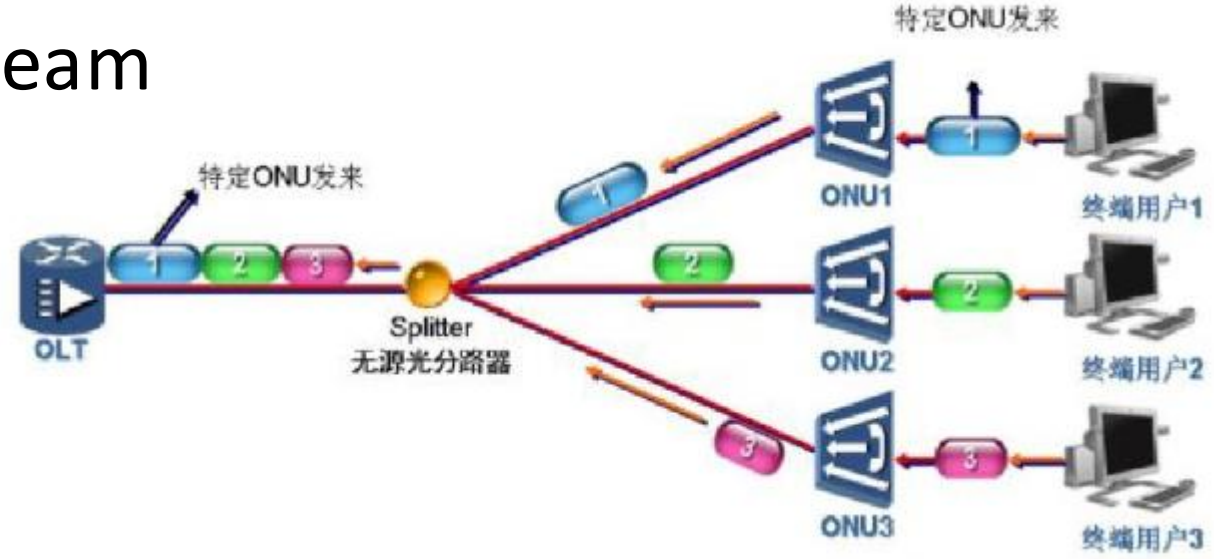
- WDM technology is used to realize upstream and downstream data transmission with different light waves
- The downlink data stream uses broadcast technology
- The upstream data uses TDMA technology

GPON COMMUNICATION

- Downstream

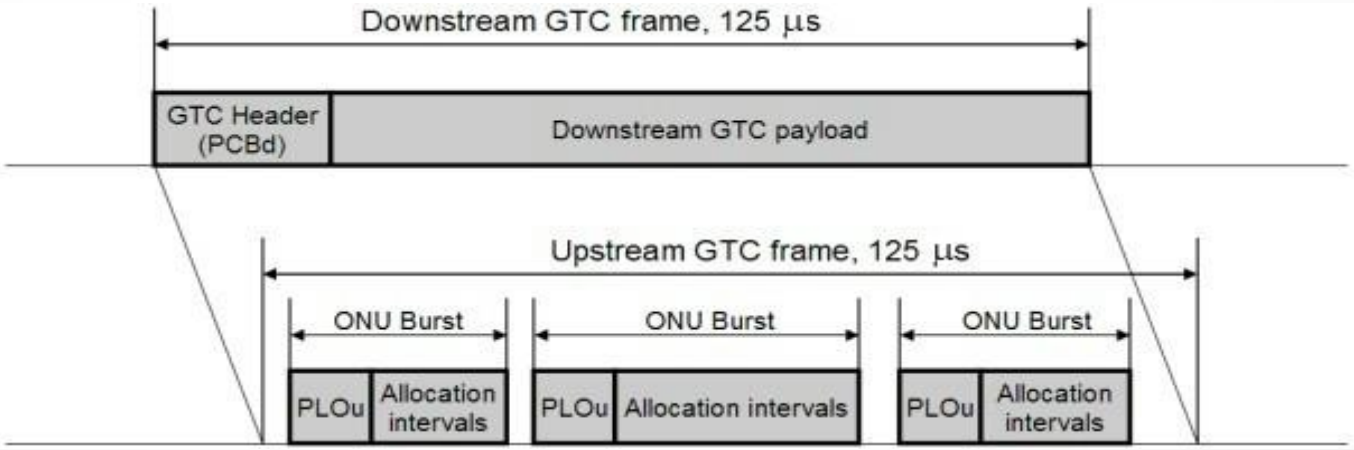


- Upstream



The Length of Frame

- each frame 125 us
- 1.244Gbit/s upstream and 2.488Gbit/s Downstream
- 1.24416xE9 / (1s/125us) / 8 = 19440 bytes
- 2.48832xE9 / (1s/125us) / 8 = 38880 bytes



Introduction -- GPON

- OLT optical module

  Transmitted light power: 1.5 ~ 5dBm

  Received light power : -28 ~ -8dBm

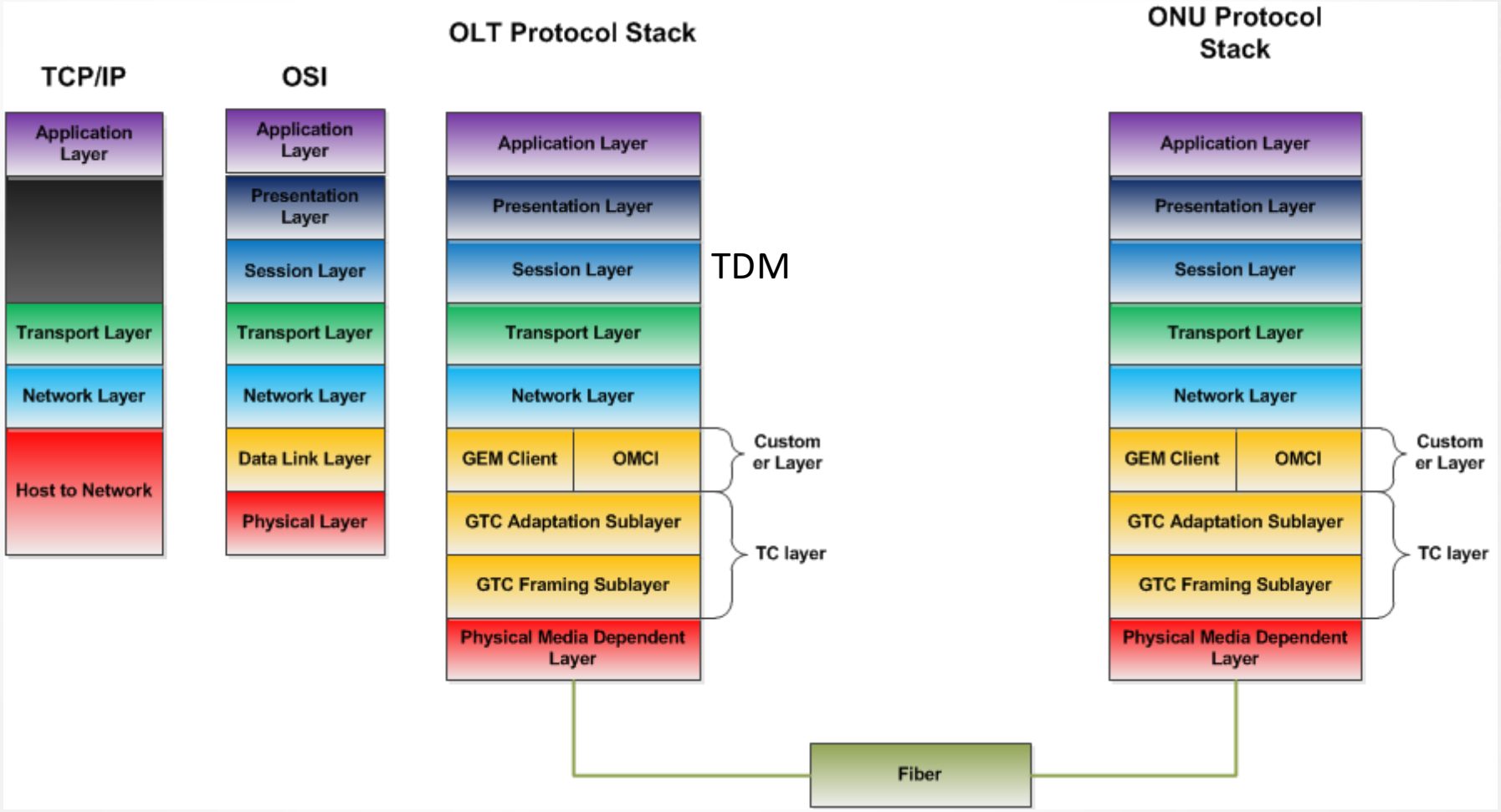
- ONU optical module

  Transmitted light power: 0.5 ~ 5dBm

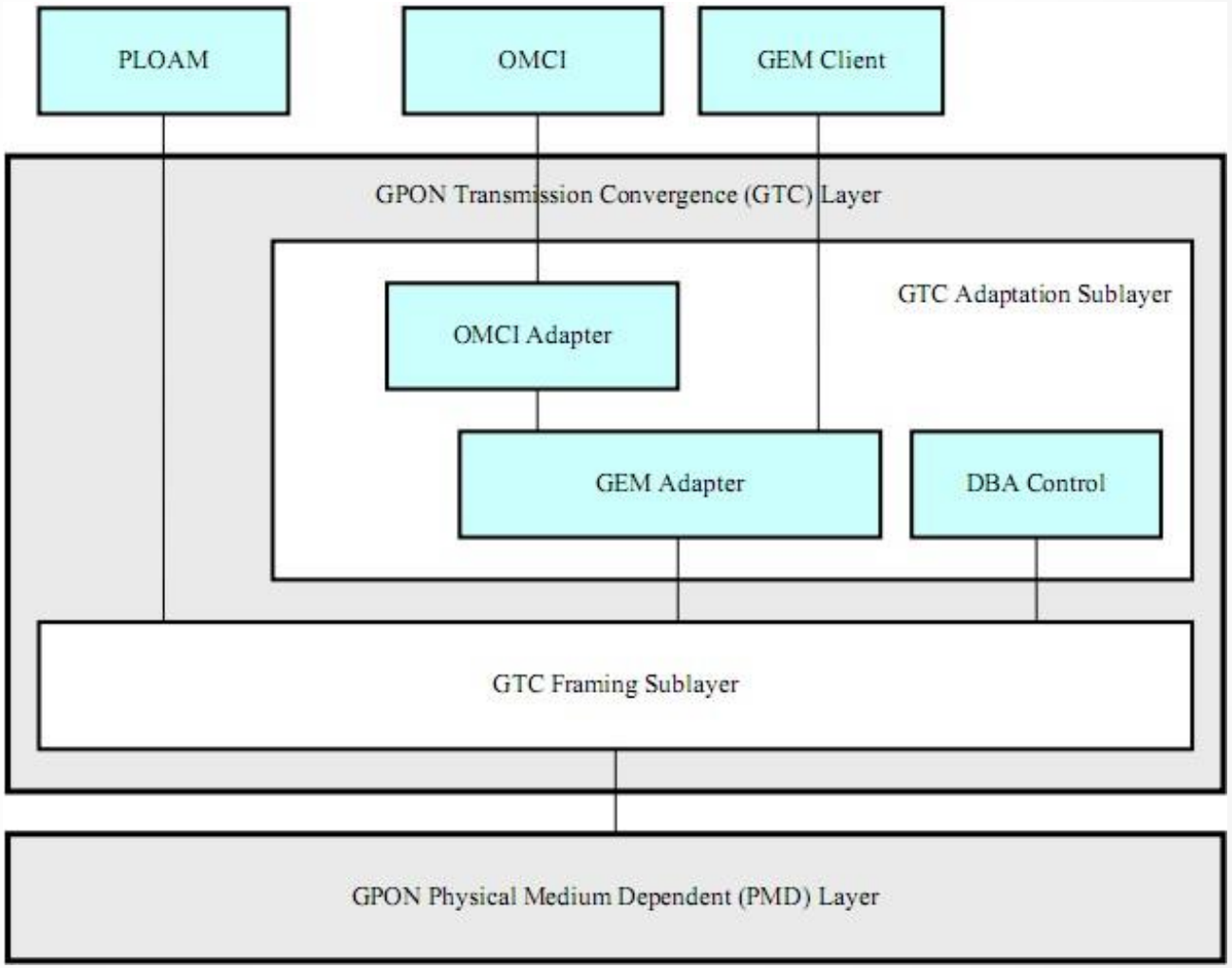
  Received light power : -27 ~ -8dBm

Introduction -- GPON

- Protocol Stack

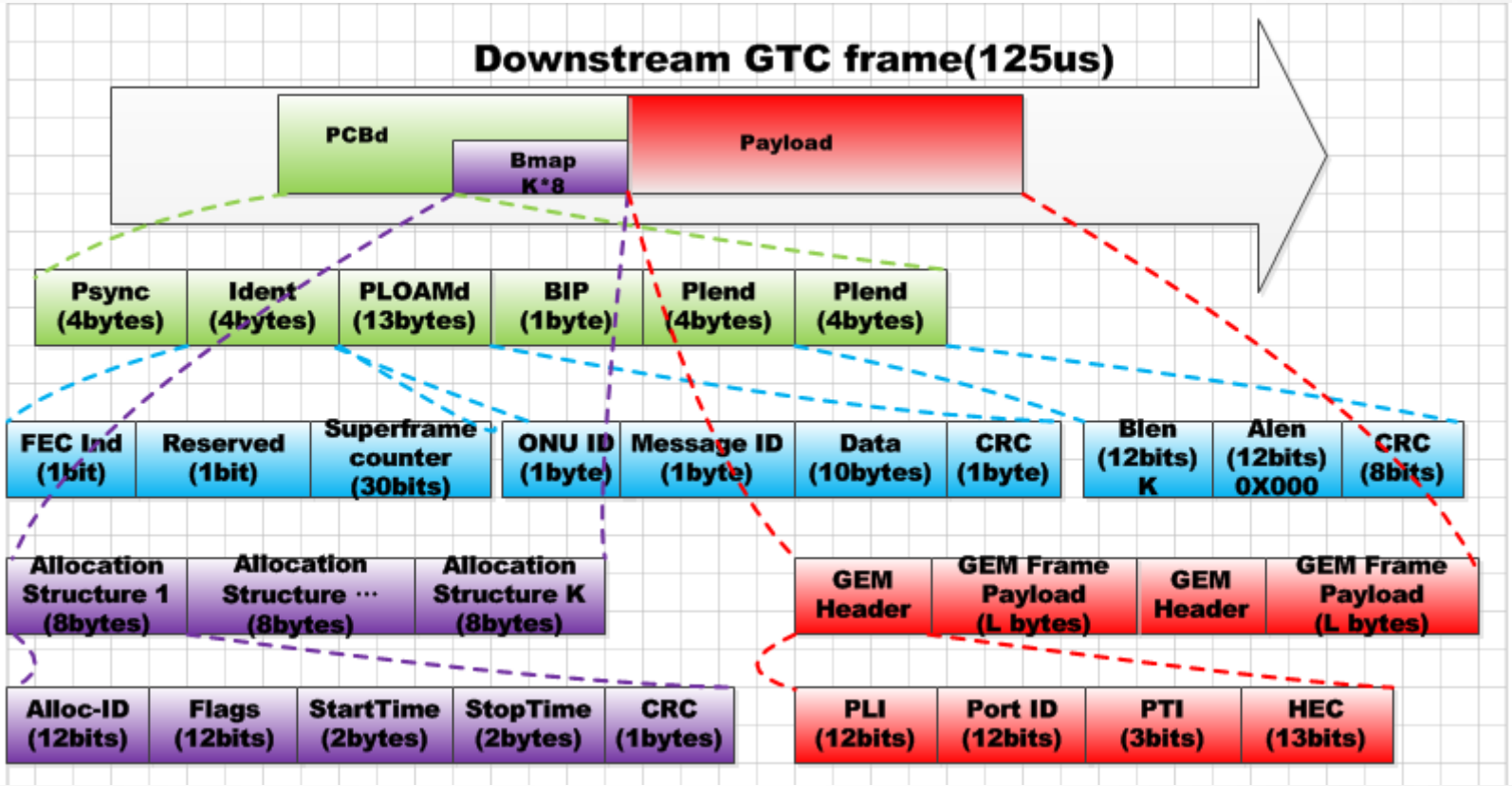


Introduction -- GPON



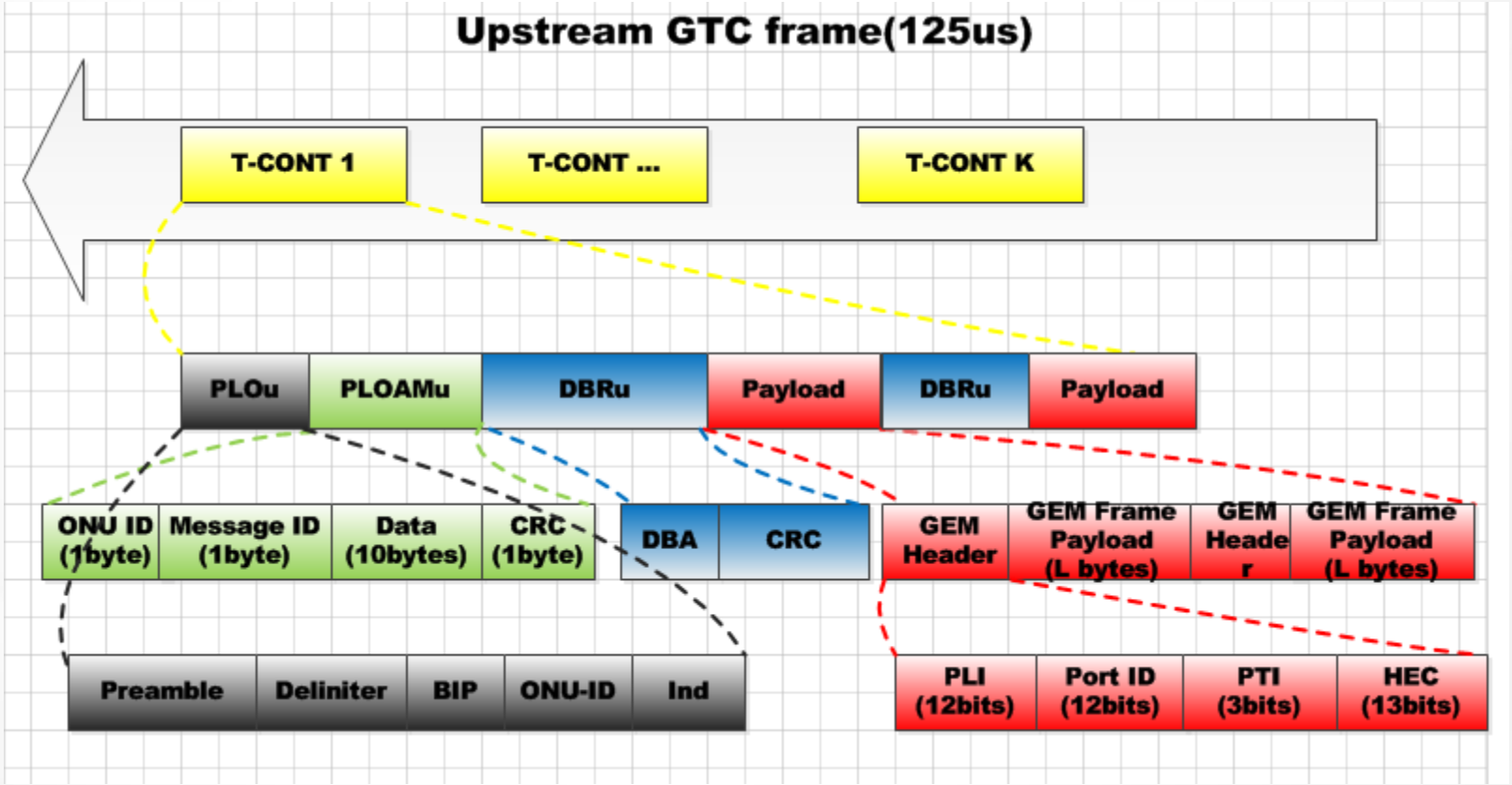
GTC frame -- Downstream frame

- Downstream frame

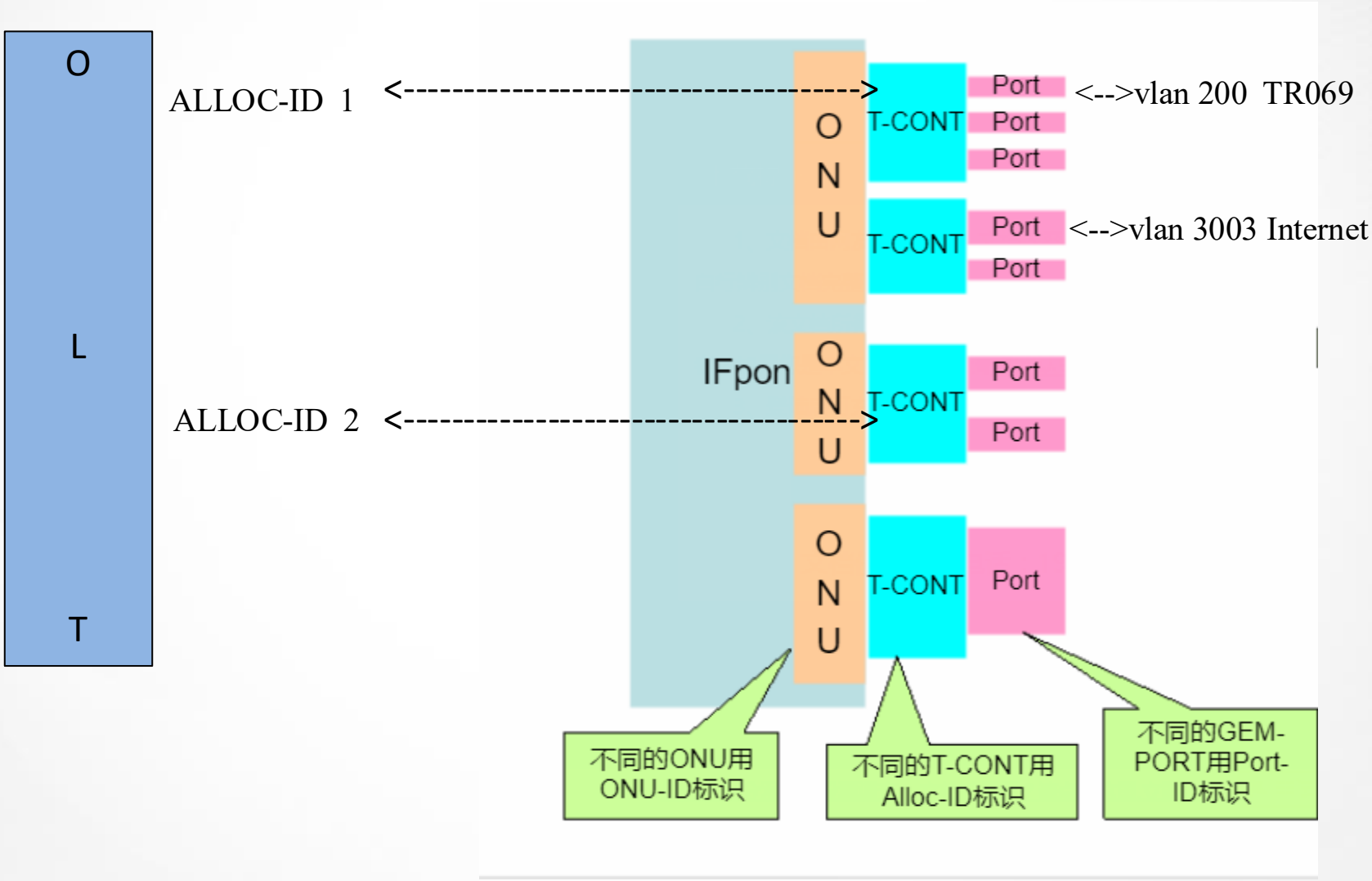


GTC frame -- Upstream frame

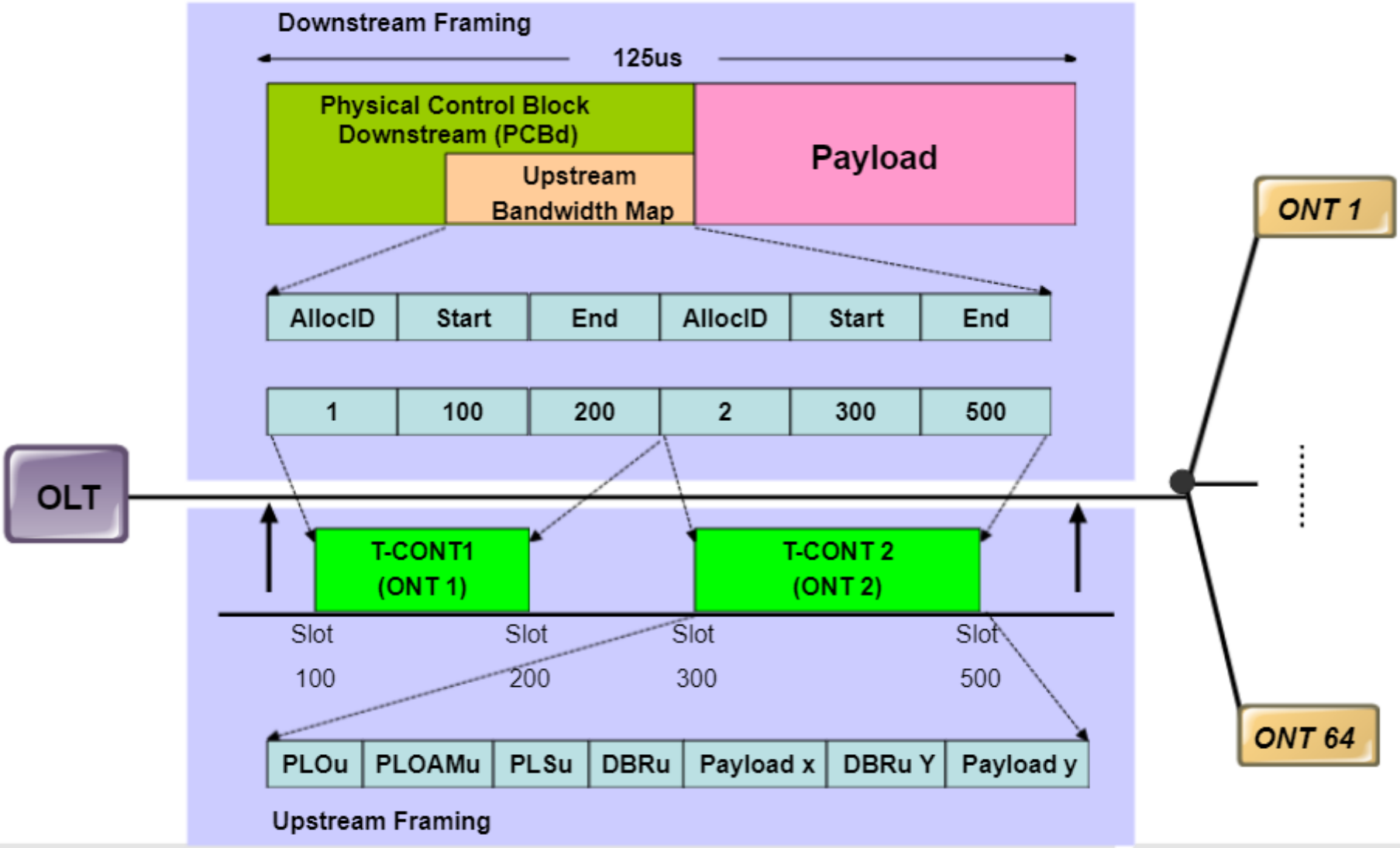
- Upstream frame



GPON bandwidth allocation



GPON bandwidth allocation



T-CONT

- T-CONT have five types

Traffic descriptor component	Type 1	Type 2	Type 3	Type 4	Type 5
Fixed bandwidth (BW)	R_F				R_F
Assured BW		R_A	R_A		R_A
Maximum BW	$R_M = R_F$	$R_M = R_A$	$R_M > R_A$	R_M	$R_M \geq R_F + R_A$
Additional BW eligibility	None	None	NA	BE	Any

R_F ： Fixed bandwidth

R_A: Assured BW

R_M: Maximum BW

DBA methods

- Status reporting (SR) DBA is based on the explicit buffer occupancy reports that are solicited by the OLT and submitted by the ONUs in response;
- – Traffic monitoring (TM) DBA is based on the OLT's observation of the idle GEM frame pattern and its comparison with the corresponding bandwidth maps.

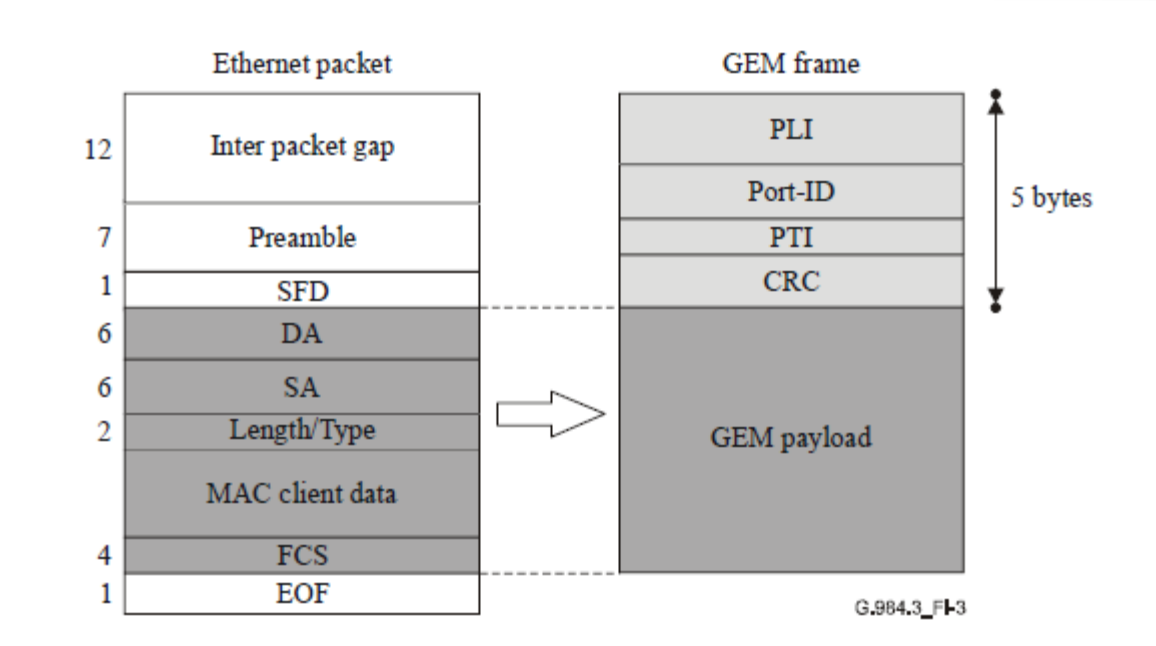
Mapping Date into the GTC payload

- **Ethernet over GEM**

B6 AB 31 E0	00 05 12 76	12 13 21 01 05 00 00 00 00 00 00 00 CA	55	00 20 00 AE 00 20 00 AE	01 00 00 10 00 15 00 AE	15 04 00 16 00 17 00 F2
Psync	Ident	PLOAM	BIP	Plend	Access 1	Access 2

B2 AA 31 CD 74	FF FF FF FF FF FF 00 0E 7F 5F F1 DF 08 06 00 01 08 00 06 04 00 01 00 0E 7F 5F F1 DF C0 A8 01 84 00 00 00 00 00 00 C0 A8 01
GEM Header	DA / SA / Ethernet Packet

41 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 F9 A6 DF 13	B7 8A 12 CD 2D	76 12 05 72 08 11 77 06 08 74 10 20 73 03 14 81 01 21
Ethernet Packet / FCS	GEM Header	Data



PLOAM Message

- 13 bytes including CRC
- 18 types of message at downstream and 9 types of message at upstream

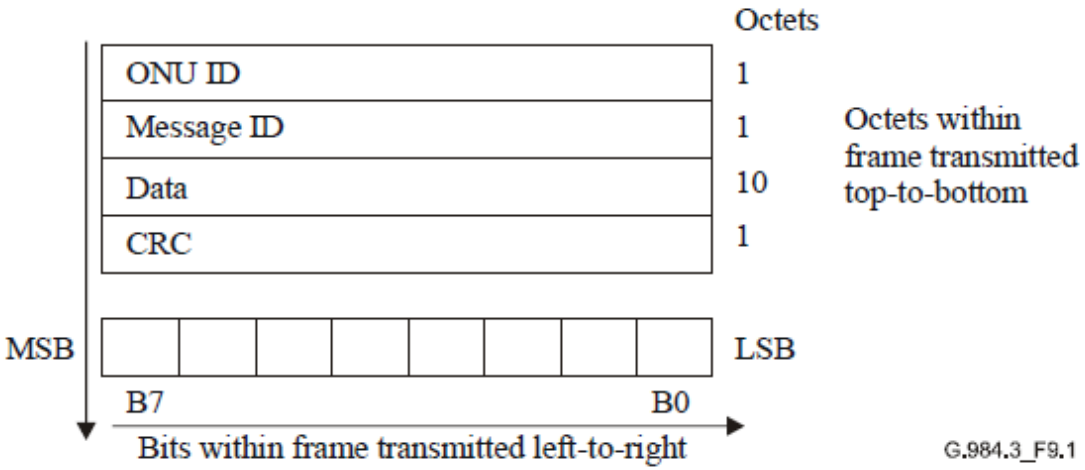
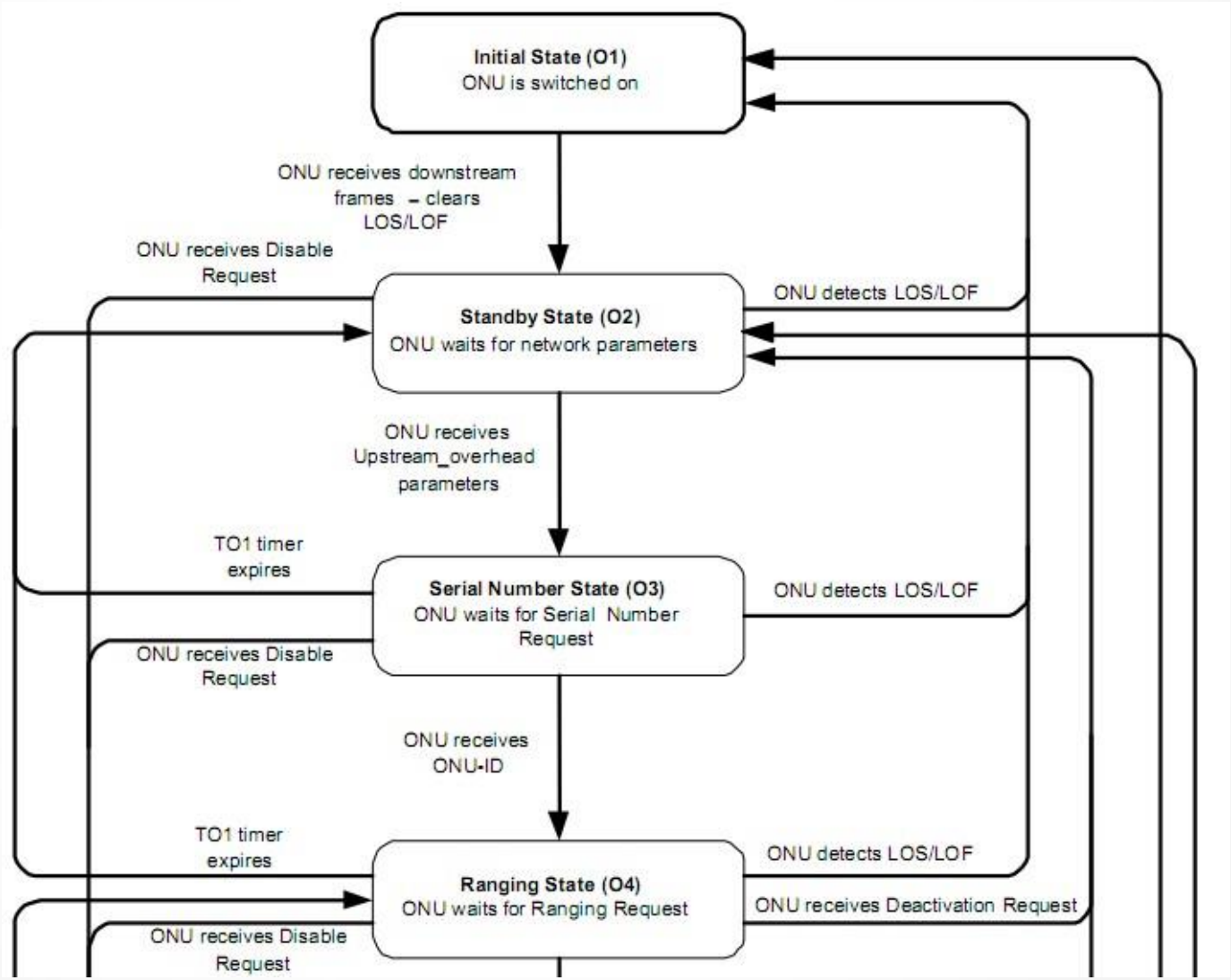


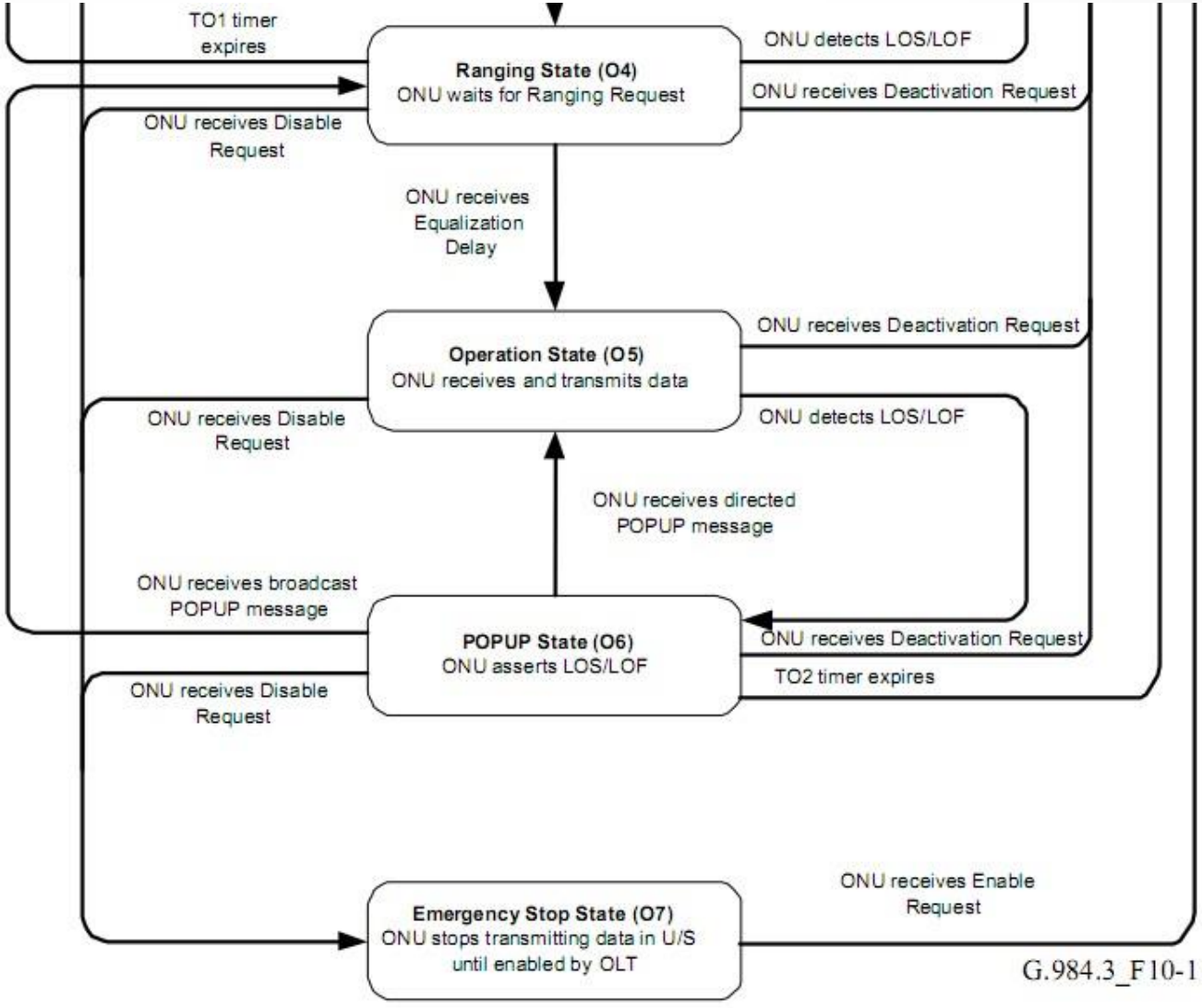
Figure 9-1 – Generic message structure

- ONU_ID
  - This ONU-ID can be from 0 to 253. For broadcast to all ONUs, this field is set to 0xFF
- Message_ID : the type of the message

GPON Register -- State change



GPON Register – State change



SN authentication

GPON Register – Initial State<o1> → Standby State <o2>

- Initial State<o1> → Standby State<o2>
  - receive two continuous downstream Message;
- PLOAM Message:
  - Activation state machine: Invoke: state=INIT (O1), event=CLEAR_DS_LOS_O
- Standby State<o2> → Serial Number State<o3>

  receive Upstream_overhead PLOAM Message;

GPON Register – State <o2> → State <o3>

- US_OVERHEAD : ff 01 20 00 00 aa ab 59 83 20 00 00

```
[1062760ms]PLOAM: Rx Upstream_Overhead.(FF012000 00AAAB59 83200000),state O2
PLOAM: State change O2 --->  O3
```

Upstream_Overhead message		
Octet	**Content**	**Description**
1	11111111	Broadcast message to all ONUs.
2	00000001	Message identification "Upstream_Overhead".
3	gggggggg	gggggggg = Number of guard bits.
4	xxxxxxxx	xxxxxxxx = Number of type 1 preamble bits. Type 1 preamble bits contain the 'all-ones' pattern. This may be set to zero.
5	yyyyyyyy	yyyyyyyy = Number of type 2 preamble bits. Type 2 preamble bits contain the 'all-zeroes' pattern. This may be set to zero.
6	cccccccc	cccccccc = Pattern to be used for type 3 preamble bits (Note 1).
7	bbbbbbbb	Data to be programmed in delimiter byte 1 (Notes 2 and 3).
8	bbbbbbbb	Data to be programmed in delimiter byte 2.

GPON Register
State <o2> → State <o3>

9	bbbbbbbb	Data to be programmed in delimiter byte 3.
10	xxemsspp	xx = Reserved: e = Status of delay pre-equalization mechanism: "0" = No pre-assigned delay, "1" = Use pre-assigned delay given below. m = Status of SN_Mask mechanism: "0" = SN_Mask disabled, "1" = SN_Mask enabled (Note 5). ss = Max number of **extra** SN-transmissions sent in response to a single SN-request. For example, ss = 10 means an ONU will send 3 SN-transmissions when responding to a SN-request (Note 6). Default ONU transmit power level mode: pp = "00" – Mode 0: Normal. pp = "01" – Mode 1: Normal – 3 dB. pp = "10" – Mode 2: Normal – 6 dB. pp = "11" – Reserved. (Note 4)

Octet	Content	Description
11	dddddddd	MSB of pre-assigned delay (32 byte units).
12	dddddddd	LSB of pre-assigned delay (32 byte units).

GPON Register
Serial Number State <o3>

- Serial Number State<o3>
  - receive SN_Request(BWmap with Alloc-ID=254, PLOAMu=1, StartTime = xx, StopTime = xx + 12)[Alloc-ID=254 is broadcast]
  - send Serial_Number_ONU PLOAM Message to OLT[including SN Message]

GPON Register – Serial Number State <o3>

- SN Ploam: ff 01 4D 53 54 43 0A000056 05 d6 ef
- Sn :MSTC0A000056

Serial_Number_ONU		
Octet	**Content**	**Description**
1	11111111 ONU-ID	No ONU-ID was assigned yet. If the ONU-ID was assigned to this ONU.
2	00000001	Message identification "Serial_Number_ONU".
3	VID1	Vendor_ID byte 1.
4	VID2	Vendor_ID byte 2.
5	VID3	Vendor_ID byte 3.
6	VID4	Vendor_ID byte 4 (Note 1).
7	VSSN1	Vendor-specific serial number byte 1.
8	VSSN2	Vendor-specific serial number byte 2.
9	VSSN3	Vendor-specific serial number byte 3.
10	VSSN4	Vendor-specific serial number byte 4.
11	RRRRRRRR	The random delay (MSB) (In 32-byte units) used by the ONU when sending this message.
12	RRRRAGTT	RRRR = random delay (LSB) (in 32-byte units) used by the ONU when sending this message. A = 0; this bit shall not be evaluated by the OLT. G = GEM transport is supported by this ONU (G = 1: supported). TT = ONU TX Power Level Mode used by the ONU. TT = 00: Low power. TT = 01: Medium power. TT = 10: High power. TT = 11: Reserved.

GPON Register – State <o3> → State <o4>

- Serial Number State<o3> → Ranging State<o4>
  - receive Assign_ONU_ID PLOAM Message

```
[6727830ms]Receive the PLOAM message same:FF142912
[6728560ms]PLOAM: Receive Assign_ONU_ID message.(FF03384D 5354430A 00005600)
```

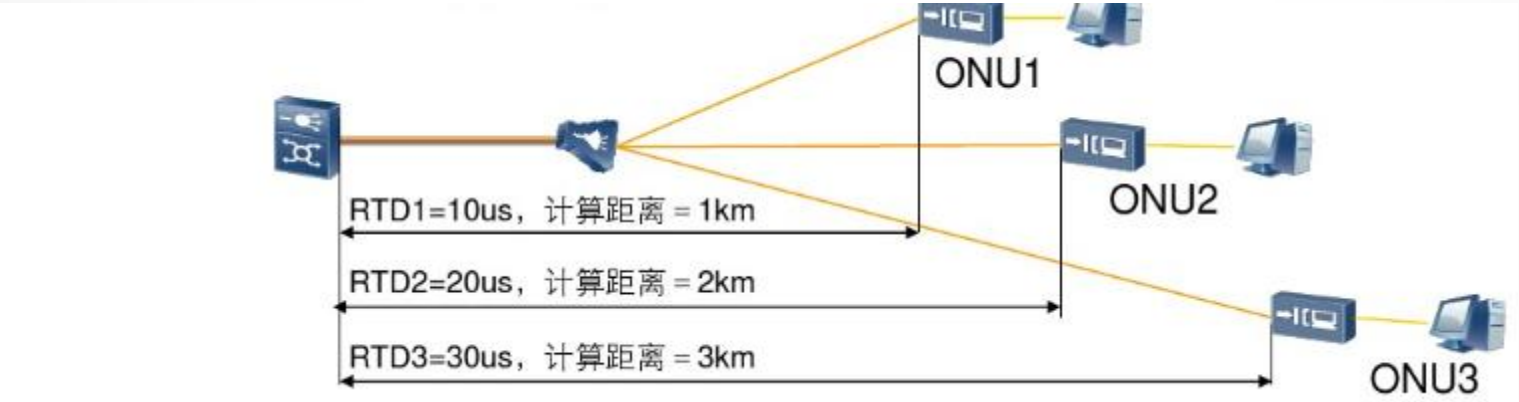
GPON Register – State <o3> → State <o4>

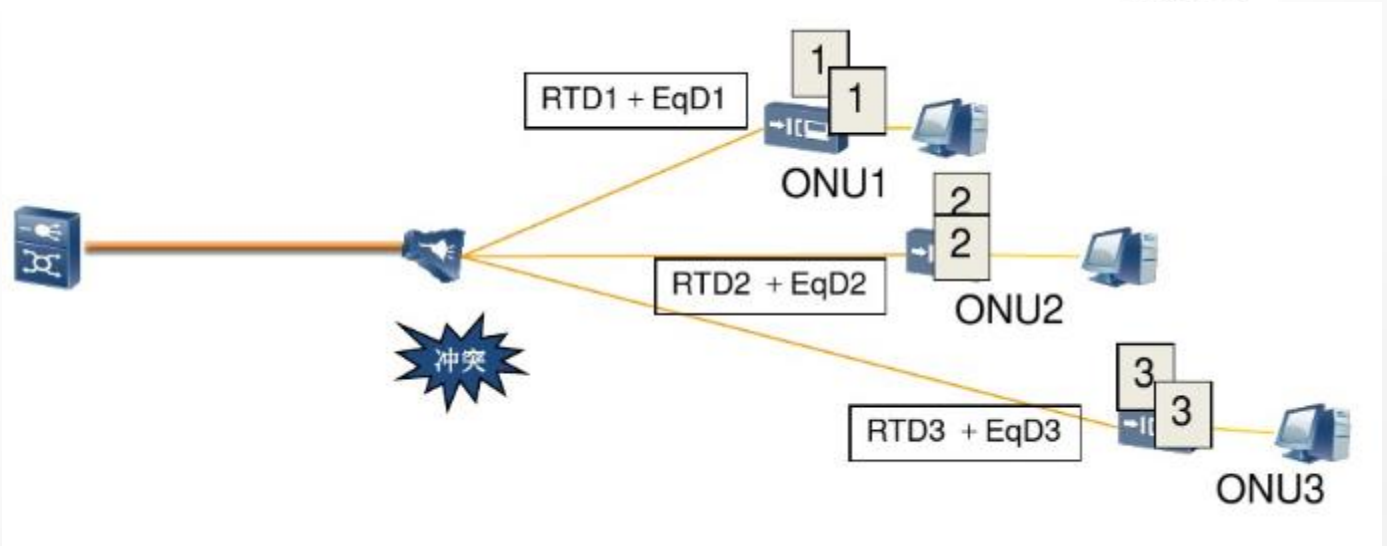
- ASSIGN_ONU_ID : FF 03 38 4D 5354430A 000056 00

Assign_ONU-ID message		
Octet	**Content**	**Description**
1	11111111	Broadcast message to all ONUs.
2	00000011	Message identification "Assign_ONU-ID".
3	pppppppp	ONU-ID.
4	abcdefgh	Serial number byte 1.
5-10	.....	
11	stuvwxyz	Serial number byte 8.
12	Unspecified	
NOTE – This message is used to assign an ONU-ID to a physical ONU. Later, Alloc-IDs are assigned to each T-CONT of the specific ONU according to its ONU-ID.		

GPON Register – State <o4>

- Ranging State<o4> Recv Ranging_Time message





GPON Register – State <o5>

- Operation State<o5>
  - receive CONFIGURE_PORT_ID PLOAM Message
  - send Acknowledge PLOAM Message
- PLOAM Message:
  - Received Ploam: 38 0E 0103 80000000 00000000

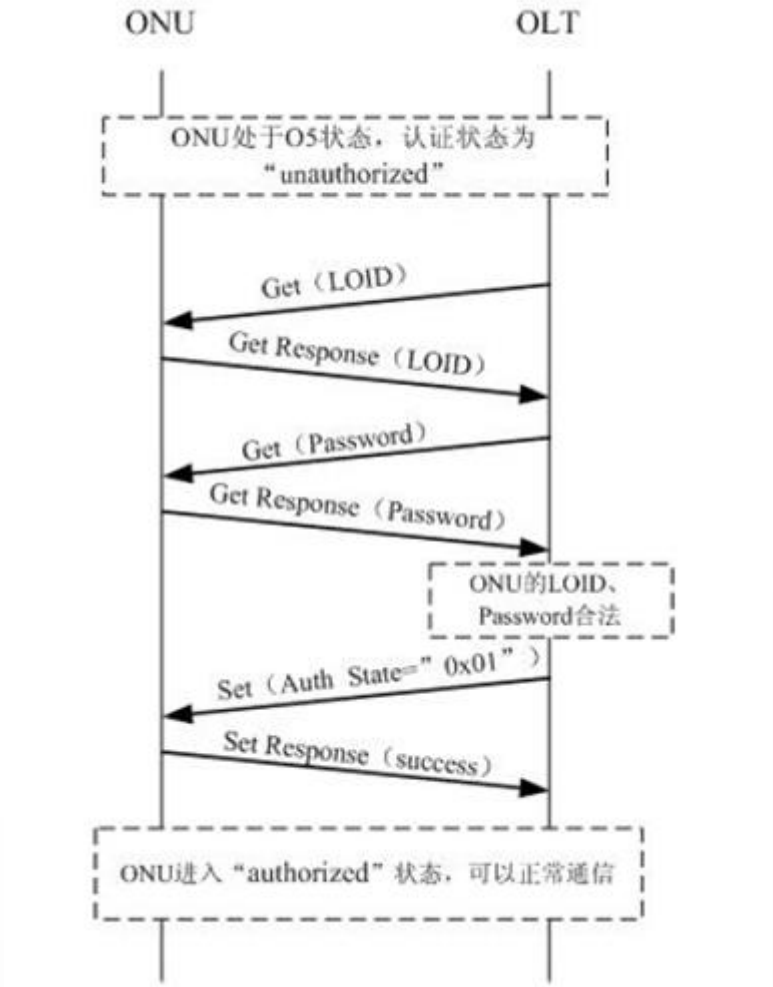
```
[6728820ms]PLOAM: Receive Configure_PortID message.(380E0103 80000000 00000000)
[6728820ms]PLOAM: Send acknowledge PLOAM message.
```

GPON Register – State <o5>

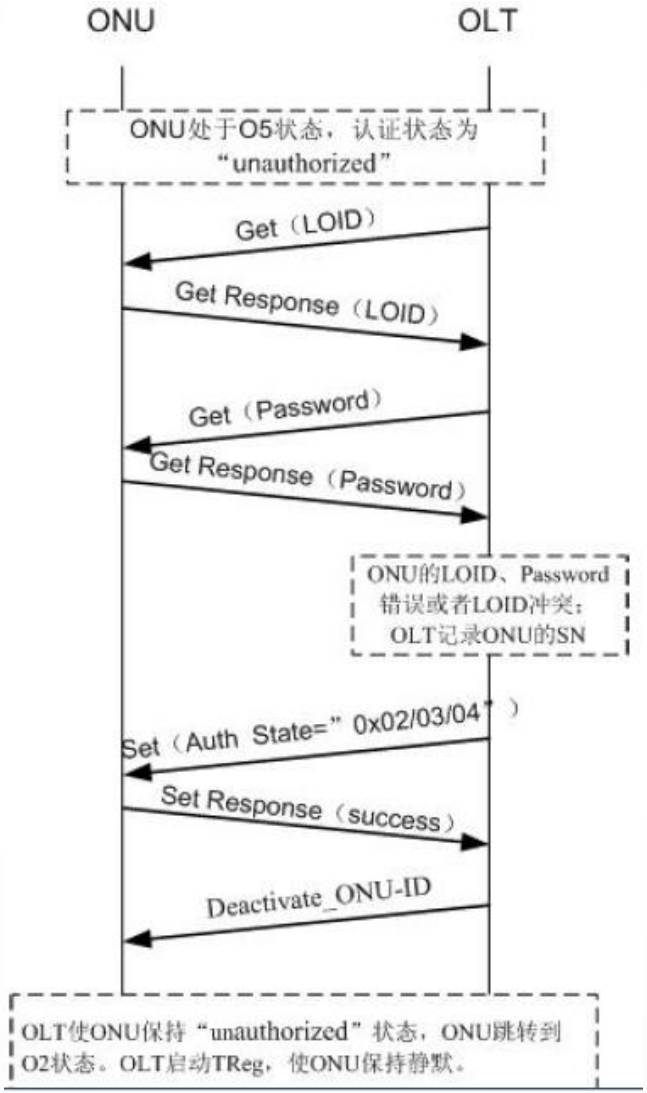
- Configure port id : 38 0E 01 03 80000000 00000000

Configure Port-ID message		
Octet	**Content**	**Description**
1	ONU-ID	Directed message to one ONU.
2	00001110	Message identification "Configure_Port-ID".
3	0000000a	Byte 4-5 define downstream and upstream Port-ID: a: 1 activates this Port-ID. a: 0 deactivates this Port-ID.
4	abcdefgh	abcdefgh = Port-ID[11..4].
5	ijkl0000	ijkl = Port-ID[3..0].
6-12	Unspecified	

GPON LOID Register -- success



GPON LOID Register --failed



GPON LOID Register – LOID authentication

- New ME : LOID authentication
  - Attributes:
    - Authentication status，标识ONU 的认证的状态，ONU 缺省值为0x00。ONU 重启后该属性应恢复成0x00 （W，R） （1bytes）(mandatory)
      - 0x00： 初始状态
      - 0x01： 认证成功
      - 0x02： LOID 不存在
      - 0x03： LOID 存在，但是password 错误
      - 0x04： LOID 冲突，即已有该LOID 的ONU 认证成功。
      - 0x05-0xff：Reserved

GPON loid register error

- Loid error :AuthenticationStatus => 0x02

```
#mosapp:RS**************************************************
#mosapp:RSTime: 2856.923
#mosapp:RSTransaction ID: 0x89cd
#mosapp:RSDevice ID: 0x0a
#mosapp:RSME class ID: 65530 -> LoidAuthentication
#mosapp:RSME instance ID: 0x0000
#mosapp:RSMessage type: Request
#mosapp:RSAction: Set
#mosapp:RSAttr: Mask => 0x1000
#mosapp:RSAttr: AuthenticationStatus => 0x02
#mosapp:RS**************************************************
```

- Loid conflict： AuthenticationStatus => 0x04

```
#mosapp:RS**************************************************
#mosapp:RSTime: 3600.390
#mosapp:RSTransaction ID: 0x96fc
#mosapp:RSDevice ID: 0x0a
#mosapp:RSME class ID: 65530 -> LoidAuthentication
#mosapp:RSME instance ID: 0x0000
#mosapp:RSMessage type: Request
#mosapp:RSAction: Set
#mosapp:RSAttr: Mask => 0x1000
#mosapp:RSAttr: AuthenticationStatus => 0x04
#mosapp:RS**************************************************
```

GPON DEACTIVATE_ONU_ID

- DEACTIVATE_ONU_ID : 32 05 00 00 00 00 00 00 00 00 00 00

Deactivate_ONU-ID message		
Octet	**Content**	**Description**
1	ONU-ID or 11111111	Directed message to one ONU or all ONUs. As a broadcast to all ONUs, ONU-ID = 0xFF.
2	00000101	Message identification "Deactivate_ONU-ID"
3-12	Unspecified	

- To instruct an ONU with this ONU-ID to stop sending upstream traffic and reset itself.

It can also be a broadcast message.

Which conditions will trigger DEACTIVATE ONU ID message

	Message name	Function	Trigger	Times sent	Effect of receipt
4	Deactivate_ONU-ID	To instruct an ONU with this ONU-ID to stop sending upstream traffic and reset itself. It can also be a broadcast message.	When any of the following alarm conditions are raised at the OLT: LOSi (unless cleared by A POPUP message or suppressed by prior receipt of a Dying_Gasp), LOFi, LOKi, LOAi, LOAMi, SFi, SUFi.	3	The ONU with this ONU-ID switches off the laser; the ONU-ID, OMCI Port-ID and all Alloc-ID assignments are discarded. ONU moves to the Standby state.

Which conditions will trigger DEACTIVATE ONU ID message

- LOSi: Loss of signal for ONUi, ONU Send No valid optical signal
- LOFi :Loss of frame of ONUi, When olt receive 4 consecutive invalid delimiters from ONUi
- LOKi :Loss of key, synch with ONUi Key transmission from the ONU in response to Request_Key message fails three times.
- LOAi :Loss of acknowledge with ONUi, The OLT does not receive an acknowledgement from ONUi after a set of downstream messages that imply an upstream acknowledge.
- LOAMi : Loss of PLOAM for ONUi , When in response to three consecutive PLOAM allocations, the ONU transmits the PLOAM

field that has incorrect CRC or does not parse into a valid PLOAM message.

Which conditions will trigger DEACTIVATE ONU ID message

- SFi :Signal fail of ONUi , When the upstream BER of ONUi becomes ≥10−y, this state is entered. Y is configurable in the range of 3 to 8.
- SUFi :Start-up failure of ONUi, The ranging of ONUi has failed n times (n = 2).

GPON Register

- How to capture the log and logfile (chips: EN7526F)
  - How to open the ploam message dump

    echo msg oam 1 >/proc/gpon/debug

    echo msg act 1 >/proc/gpon/debug

    echo msg int 1 >/proc/gpon/debug
  - How to open the omci log

    Econet 7526F：moscli omcilog on

GPON Register

- Q&A

THANK YOU!