EPON
P2P Emulation and Downstream BroadCast

Baseline Proposal

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Requirements

- **Compliant to EPON 802.1D Bridging**
- **Support of Single Packet Downstream Broadcast**

EPON
Compliance and Downstream Bcast

Solution

Logical PHY Tag in Preamble to enable

- **1) P2P Emulation mode**

  For 802.1D Bridges compliance

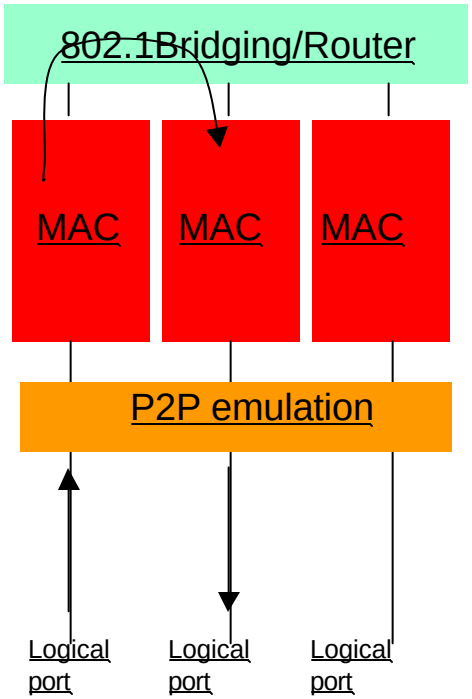
- **2) Downstream Broadcast mode**

  w/ the condition that no bridge attached to EPON

- **3) Both**

“802.1’s view of 802.3 Ethernet: P2P or Shared Media”

EPON as Multiple P2P Links



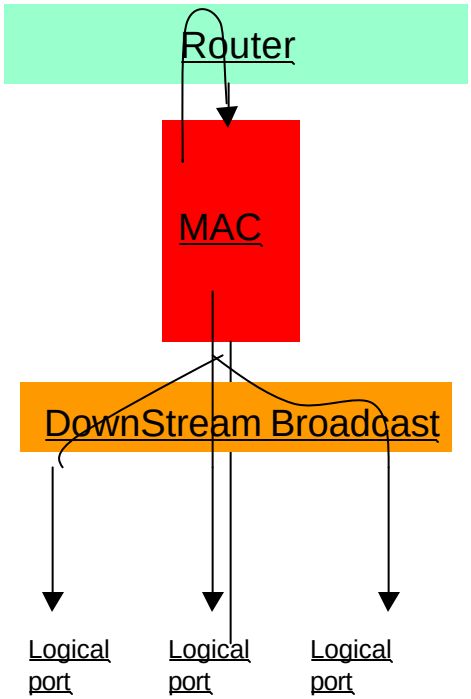
“P2P Emulation”

1) Downstream Frame is received only by ONE ONU

2) All Up stream frame is forwarded to higher layer

3) ONU-ONU Forwarding is done by Higher Layer (Bridge or Router)

Downstream Broadcast Mode



1) Downstream Frame is received only by ALL ONUs

2) All Up stream frame is forwarded to Router

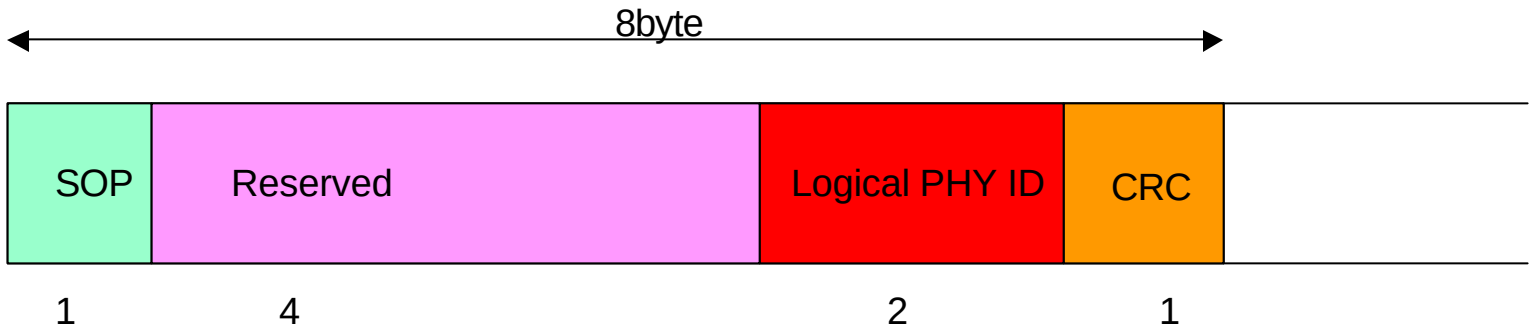
3) ONU-ONU Forwarding is done by Router

4) No Bridge attached to EPON, since Bridge does not support P2MP link

Downstream Broadcast

Logical PHY ID on Preamble

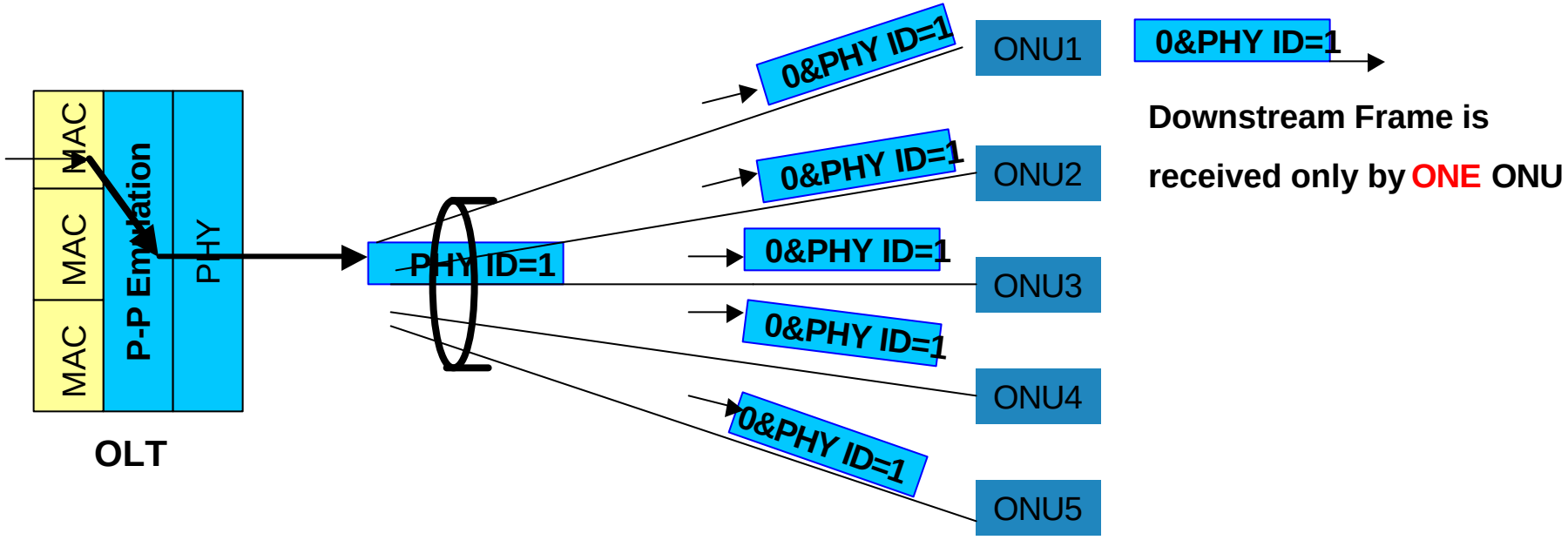
- **8 byte Preamble to carry:**
  - **2byte : Logical PHY ID**
  - **4byte : Reserved**
  - **1byte : CRC**
- **2 byte Logical PHY ID = 1bit mode indicator + 15 Bit PHY Ids**
- **Mode indicator: P2P(0) / BroadCast(1)**
- **CRC8 protected (after SOP byte)**



When passing a frame to MAC, convert back to the normal preamble.

How Point to Point Emulation works:1

Many “Point to Point Link” Emulation over EPON

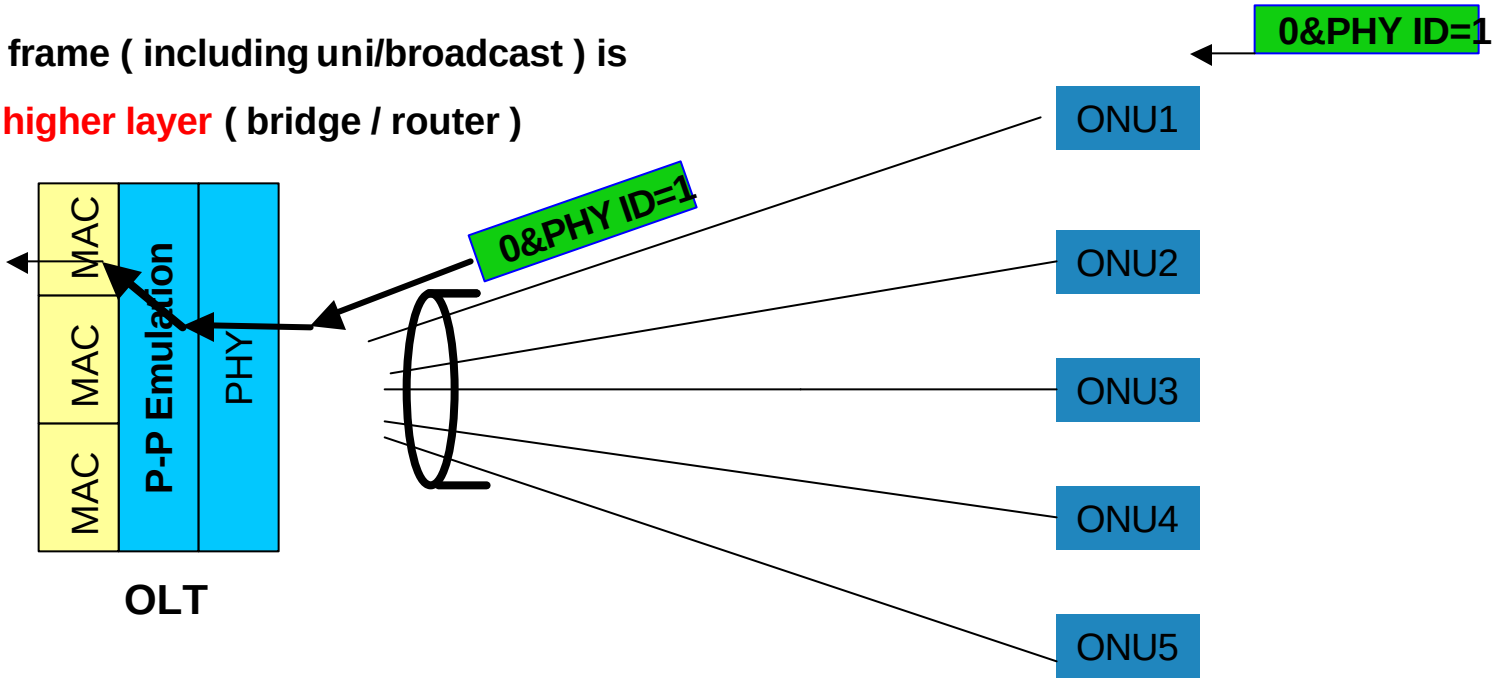


-ONU to Transmit Frames with own Logical PHY ID as Source ID with Mode==0
-ONU to Receive Frame with Mode==0 &Logical PHY ID matching with owns
-OLT to Transmit and demux frames to each MAC
corresponding Logical PHY ID (as Destination ID) with Mode==0

How Point to Point Emulation works:2

Many “Point to Point Link” Emulation over EPON

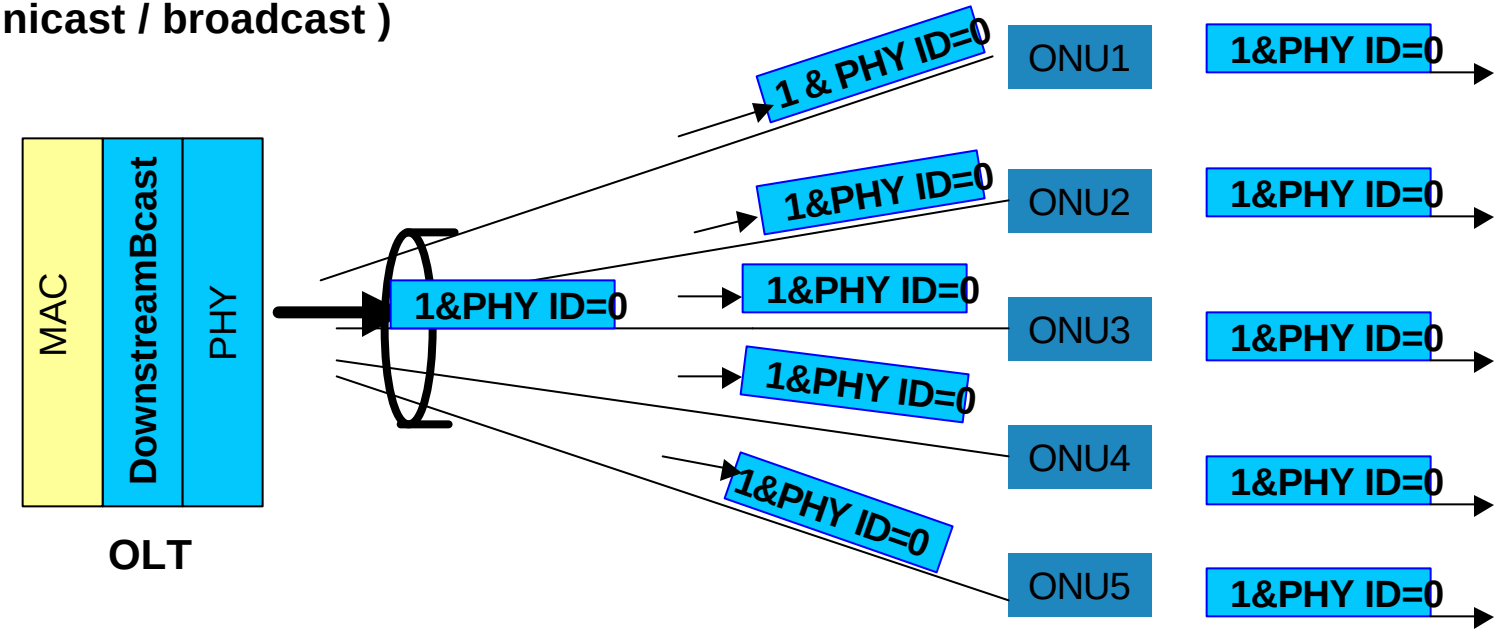
All Upstream frame (including uni/broadcast) is forwarded to higher layer (bridge / router)



-ONU to Transmit Frames with own Logical PHY ID as Source ID with Mode==0
-ONU to Receive Frame with Mode==0 &Logical PHY ID matching with owns
-OLT to Transmit and demux frames to each MAC corresponding Logical PHY ID (as Destination ID) with Mode==0

How Downstream Broadcast mode works: 1

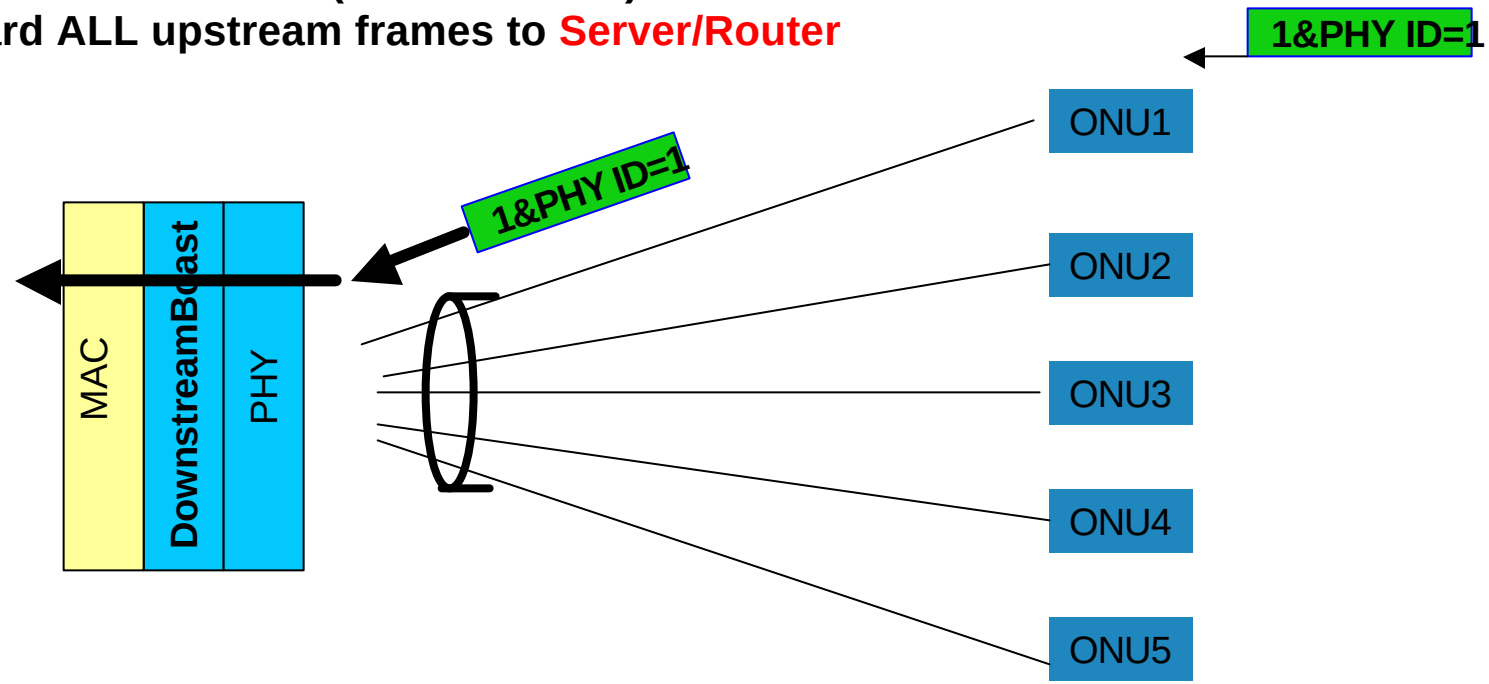
This is Native P2MP mode
All ONU receive ALL downstream Frames
(including unicast / broadcast)



-Transmit Frames with own Logical PHY ID as Source ID with Mode==1
(Both Upstream and Downstream)
-ONU receives ALL frames with Logical PHY ID =OLT/Default with Mode==1
-OLT receive & forward ALL frames with Mode==1 to Router/Server

How Downstream Broadcast mode works:2

This is Native P2MP mode (no reflection)
OLT forward ALL upstream frames to Server/Router



-Transmit Frames with own Logical PHY ID as Source ID with Mode==1
(Both Upstream and Downstream)
-ONU receives ALL frames with Logical PHY ID =OLT/Default with Mode==1
-OLT receive & forward ALL frames with Mode==1 to Router/Server

Logical Phy ID Semantics

- **Logical Phy ID { Mode, PHY Tag }**
  - **-P2P and Broadcast mode has to be recognized by Logical Phy ID**
    - **-Mode Bit: P2P Emulation (0) or Broadcast (1)**
  - **-P2P**
    - **Downstream: ONU need to identify Destination = its own**
    - **Upstream: OLT needs to identify Source**
    - **-P2P Downstream PHY Tag: Destination ID**
    - **-P2P UpStream PHY Tag: Source ID**
  - **-Downstream Broadcast**
    - **Downstream: ALL ONU receive all frames with Default PHY ID**
    - **Upstream: OLT needs to identify each source ONU**
    - **-Broadcast Mode PHY Tag: Source ID**
  - **-PHY Tag : allocated for each "PON entity" (Logical MAC & port instance)**

Bridging Rules

- **If any bridge is attached to EPON, use P2P Emulation ports**
- **Only Router/Server/PC terminals (no bridge) can be attached to Downstream Broadcast Mode ports (P2MP native mode)**

  -Only ONE of ONU can be attached to a bridge, but it may cause broadcast storm if another it is bridge to other ONUs.
- **ALL ONU-ONU forwarding (both unicast / multicast) is performed by Higher layer at OLT**

  -P2P : by Bridge / Router

  -Downstream Bcast: by Router

Why P2P Emulation "below MAC" ?

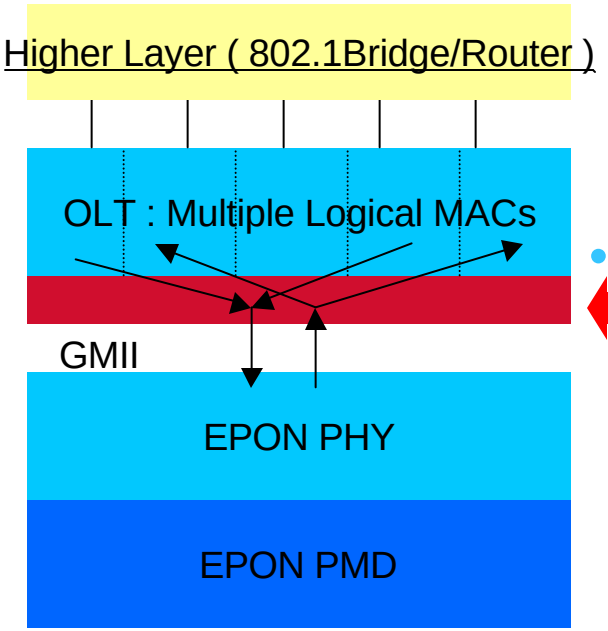
- For 802.1D bridging among EPON ONUs, ONU MUST filter out downstream frames without MAC address table which might be "obsolete".
- A solution : P2P emulation (or shared media emulation) below MAC.
- Reconciliation Sublayer (RS) in MAC

  RS is the best place for multiple logical MAC mux/demux implementation
- This also enables Pause Frame and Link Aggregation possible through P2P emulation.
- If EPON Control/Data frame indication needed for downstream transmit, how about to add 1 bit indicator (Control / Data bit) from MAC Control to RS ?

  TransmitFrame(DA,SA,Length,PDU, C/D bit)
- RS returns back pressure indication using PLS_carrier.indication

  Packets are leaving MAC control only when carrier is available since no buffering exists

P2P Emulation
OLT view

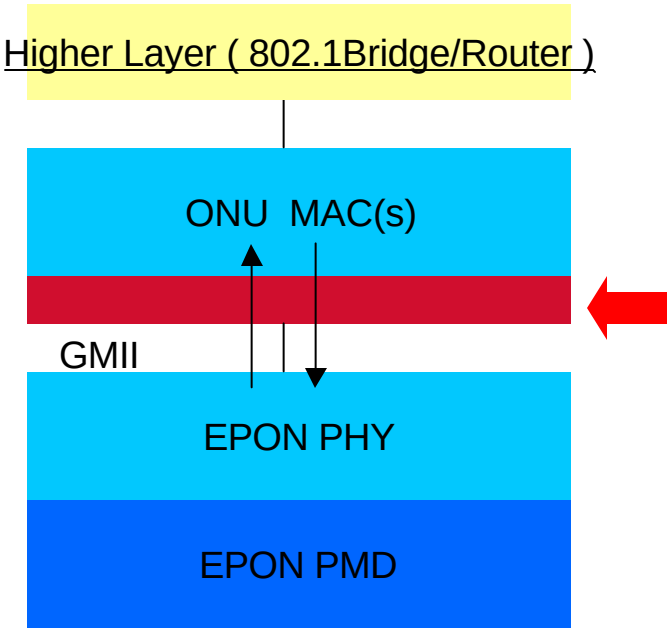


- **P2P Emulation on RS layer**
  - **Mux/Demux Frames by Logical PHY ID**
  - **Downstream TX control among multiple MAC**

OLT Must support Multiple Logical MACs corresponding to individual Logical PHY ID / ONUs P2P at RS layer to multiplex and demultiplex frames from/to individual Logical MAC.

Forwarding among ONU happens at Higher Layer ONLY
Multicast to ONUs happens at Higher Layer ONLY and needs multiple transmission to ONUs

P2P Emulation
ONU View

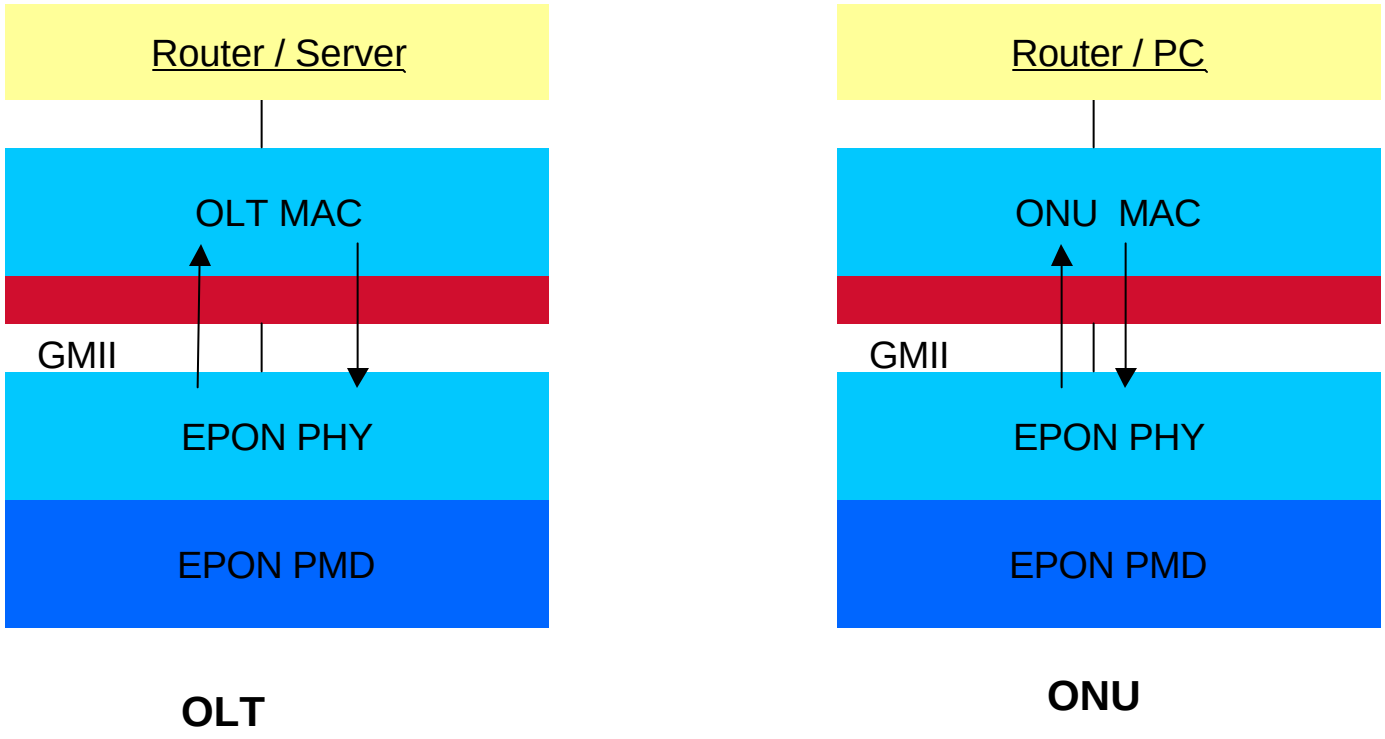


- **P2P Emulation on RS layer**

ONU may support multiple PON entities (logical MACs) with corresponding Logical PHY Ids

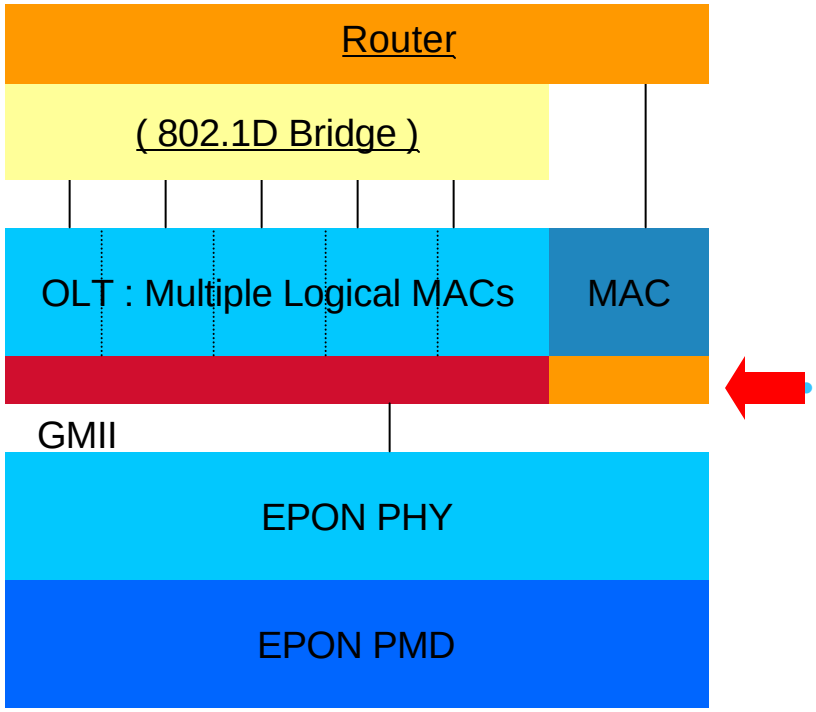
When ONU have multiple PON entities, Mux/Demux behavior needed at ONU as well.

Downstream Broadcast
OLT / ONU View



OLT / ONU needs only one MAC instance to support Downstream Broadcast mode.

P2P Emulation & Downstream Broadcast OLT view

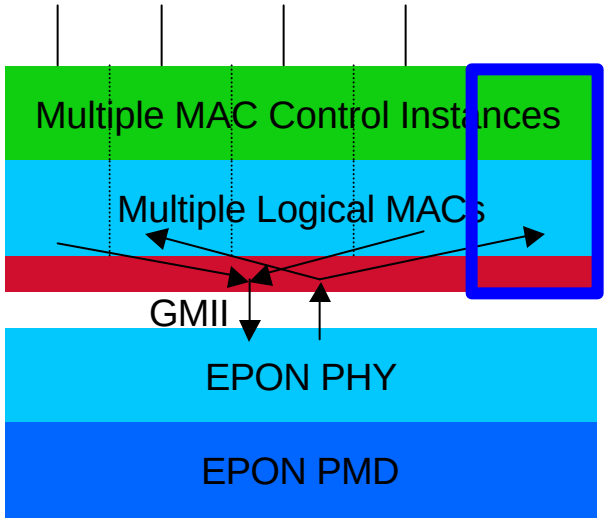


P2P Emulation & Downstream Bcast At RS layer

-OLT supports N+1 Logical MACs (N-P2P port MACs & 1-Broadcast port MAC)
-P2P MAC ports can be bridged.
-Broadcast MAC port (P-MP) is operated only for routers / servers.

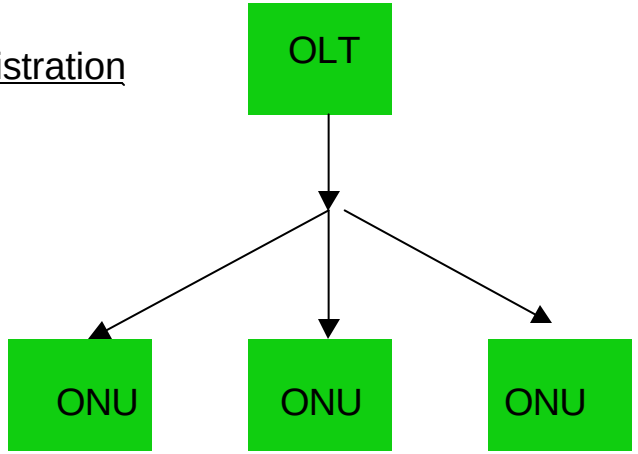
Logical PHY ID Registration

- **Registration uses a special logical port with "Default Logical PHY ID"**
  - **This is a configuration / registration mode BEFORE forming P2P or DownstremBcst and BEFORE timeslot allocation for each ONU**
  - **Frames with Default Logical PHY ID on preamble**
    - **-Downstream (OLT to ONU) frame to be received by ALL ONUs.**
    - **-Upstream (ONU to OLT) "request" needs Response from OLT & Timeout & Retry**



MAC Control Instance for Registration

Default PHY ID



Summary

- **P2P emulation mode for 802.1D compliance**
- **Downstream Broadcast mode also supported with a certain condition.**
- **Logical PHY Tag on Preamble enables both modes in EPON**

Motion: P2PE

- Adopt page 1-12 of suzuki_1_0302.pdf
  as P2MP baseline document for 802.1D compliance and downstream broadcast
- with the replacement of line 5 (P2P) of page11 with
  - Downstream: ONU receive frames with PHY tag = its own
- with the replacement of line 10 (Broadcast) page 11 with
  - Downstream: ONU receive frames with PHY tag != its own
- With deletion of page 4 & 5
- Moved: Hiroshi Suzuki
- Second: Dolors Sala