

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

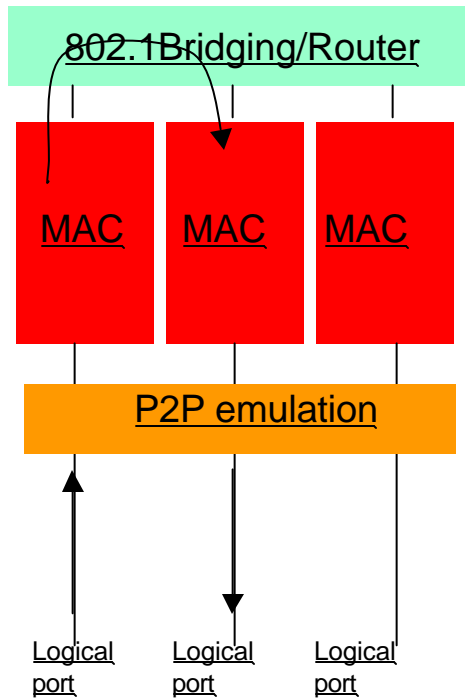
Compliance and Downstream Bcast

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



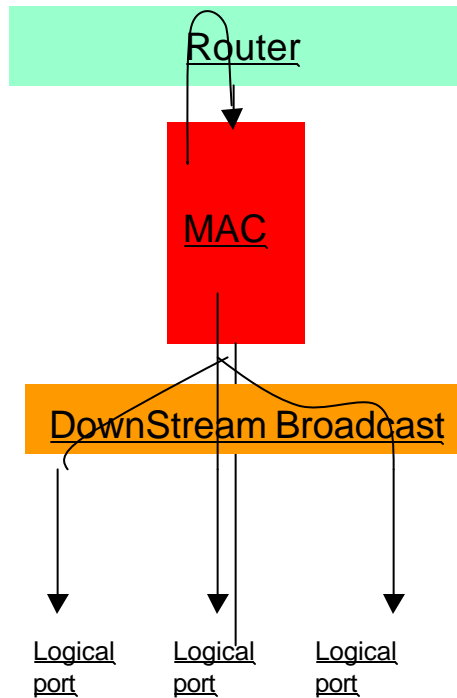
1) Downstream Frame is received only by **ONE** ONU

2) All Up stream frame is forwarded to higher layer

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

“P2P Emulation”

Downstream Broadcast Mode

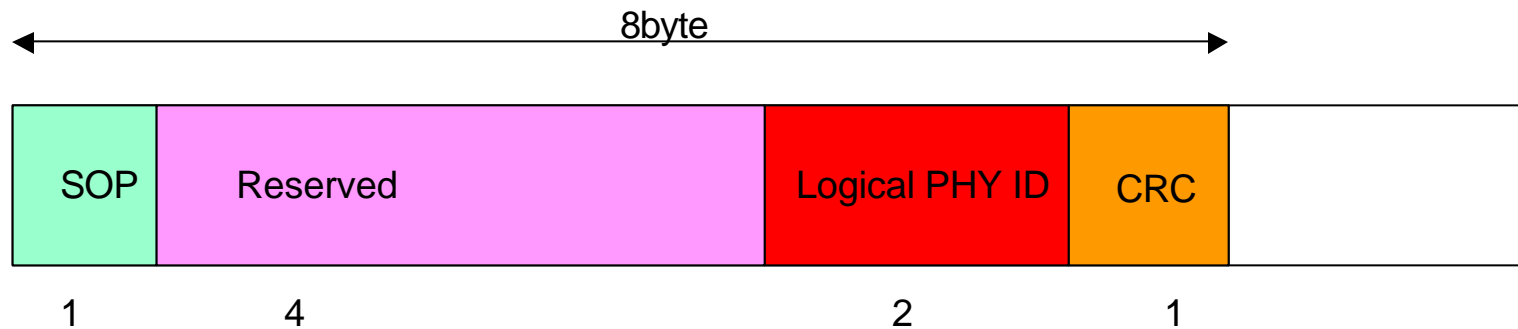


- 1) Downstream Frame is received only by **ALL** ONUs
- 2) All Up stream frame is forwarded to Router
- 3) ONU-ONU Forwarding is done by Router
- 4) **No Bridge attached to EPON**, since Bridge does not support P2MP link

Downstream Broadcast

Logical PHY ID on Preamble

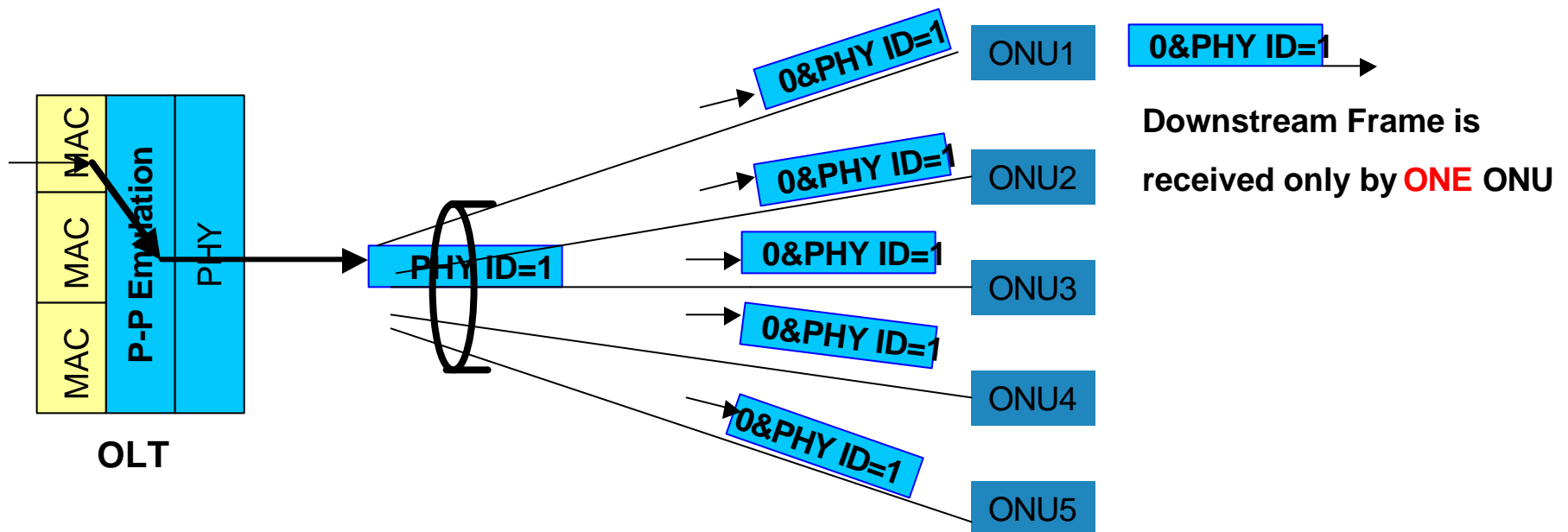
- 8 byte Preamble to carry:
 - 2byte : Logical PHY ID
 - 4byte : Reserved
 - 1byte : CRC
- 2 byte Logical PHY ID = 1bit mode indicator + 15 Bit PHY Ids
- Mode indicator: P2P(0) / BroadCast(1)
- CRC8 protected (after SOP byte)



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

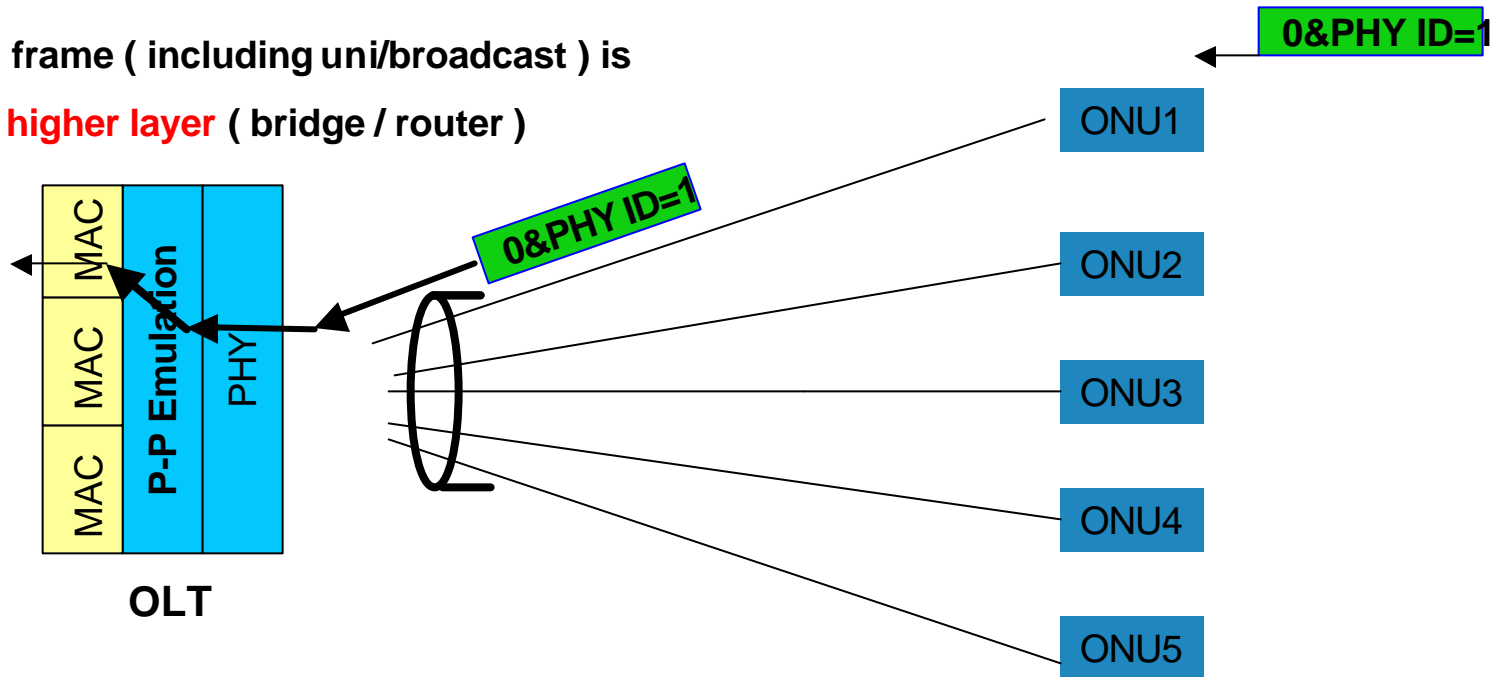


- ONU to Transmit Frames with own **Logical PHY ID as Source ID with Mode==0**
- ONU to Receive Frame with Mode==0 & Logical PHY ID matching with owns
- OLT to Transmit and demux frames to each MAC corresponding Logical PHY ID (as Destination ID) with Mode==0

How Point to Point Emulation works:2

Many “Point to Point Link” Emulation over EPON

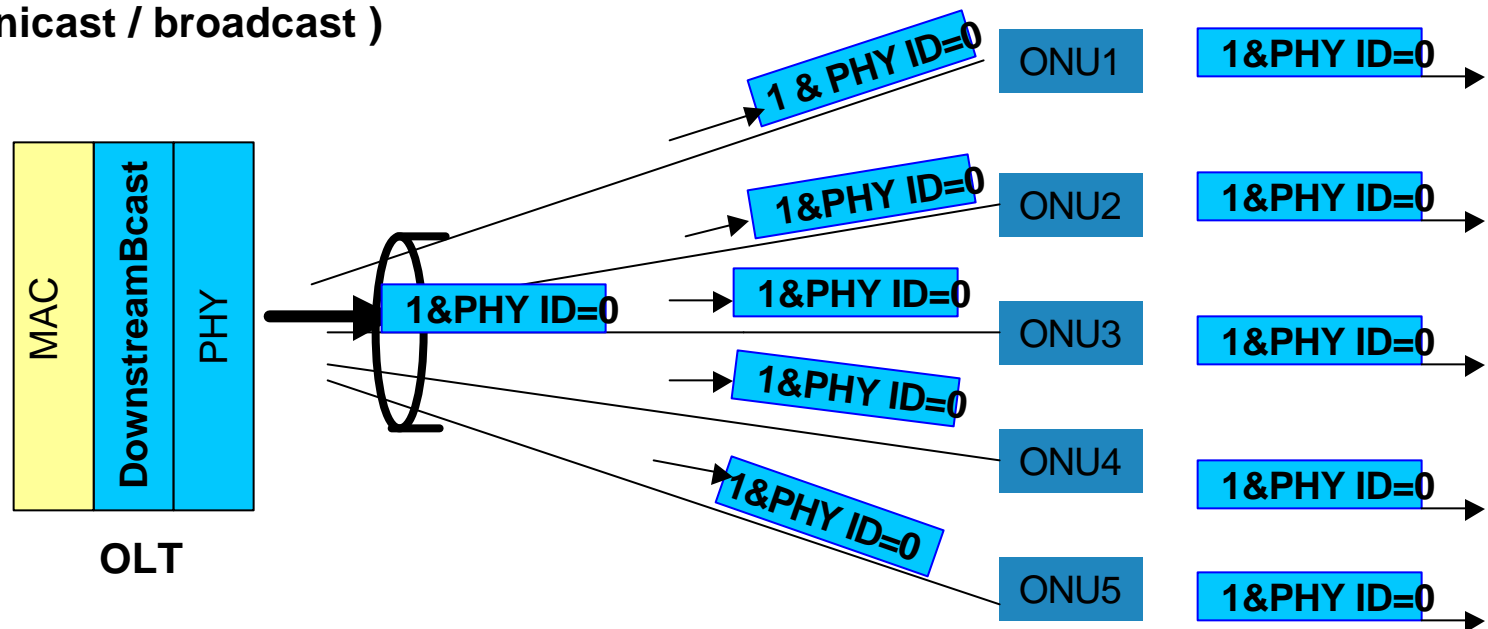
All Upstream frame (including uni/broadcast) is forwarded to **higher layer** (bridge / router)



- 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

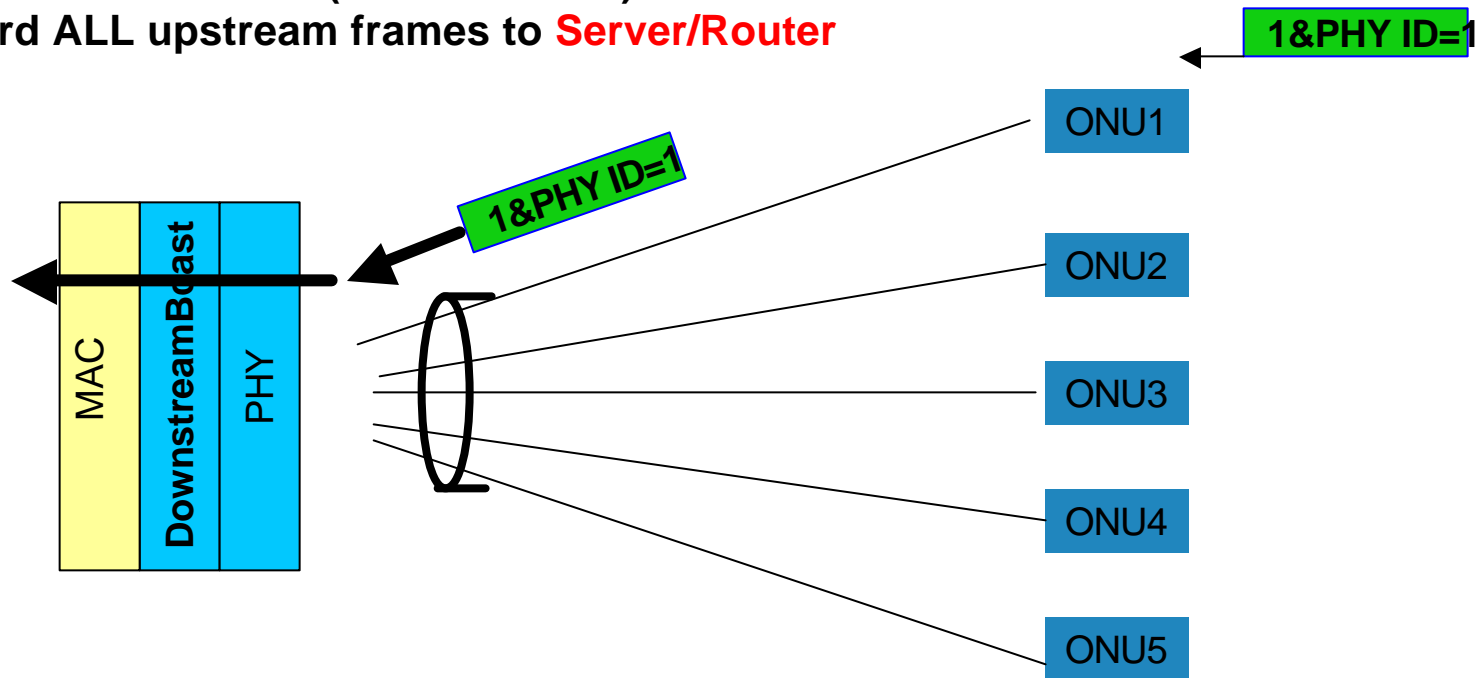
This is Native P2MP mode
All ONU receive ALL downstream Frames
(including unicast / broadcast)



- 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)

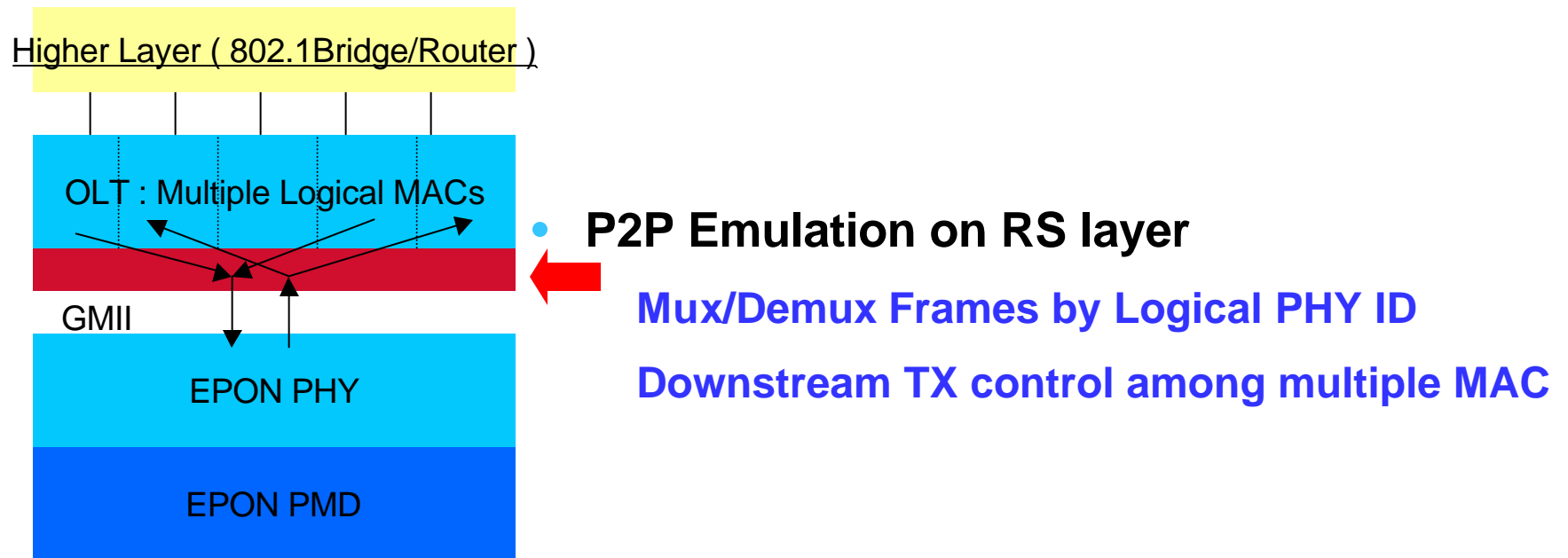
Bridging Rules

- 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

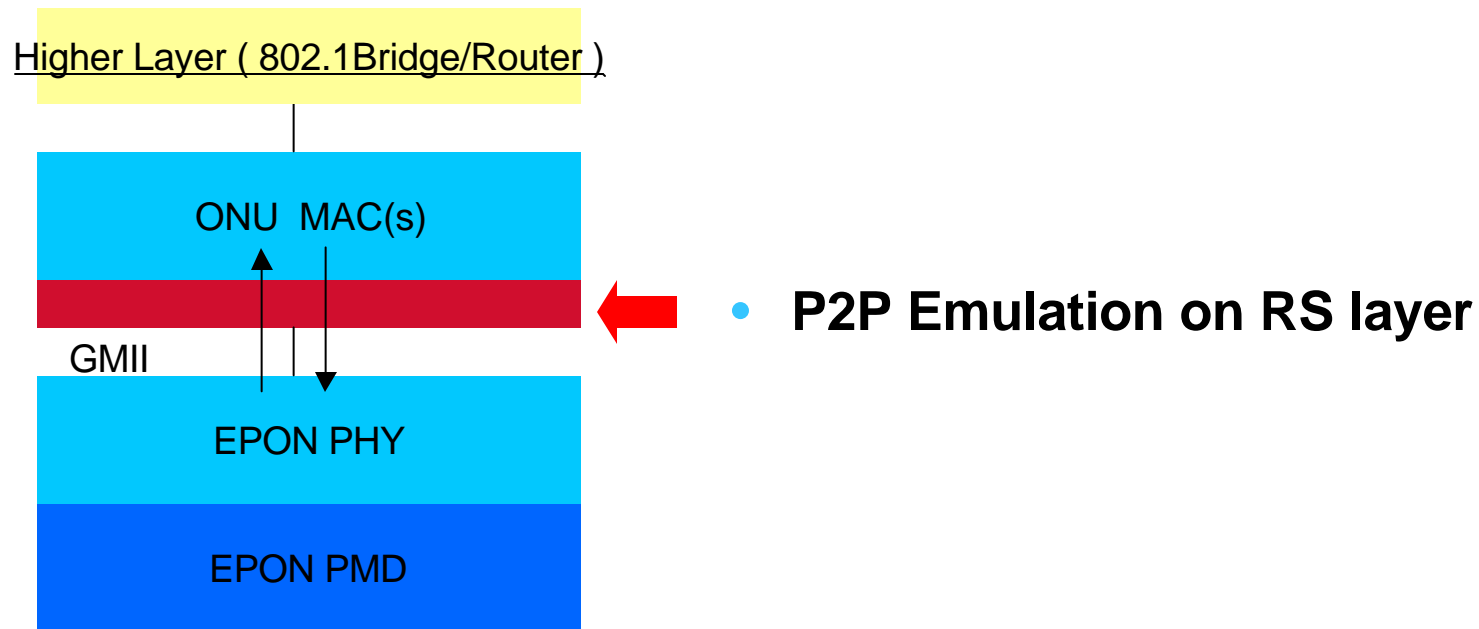


OLT Must support Multiple Logical MACs corresponding to individual Logical PHY ID / ONUs
P2P at RS layer to multiplex and demultiplex frames from/to individual Logical MAC.

Forwarding among ONU happens at Higher Layer ONLY

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

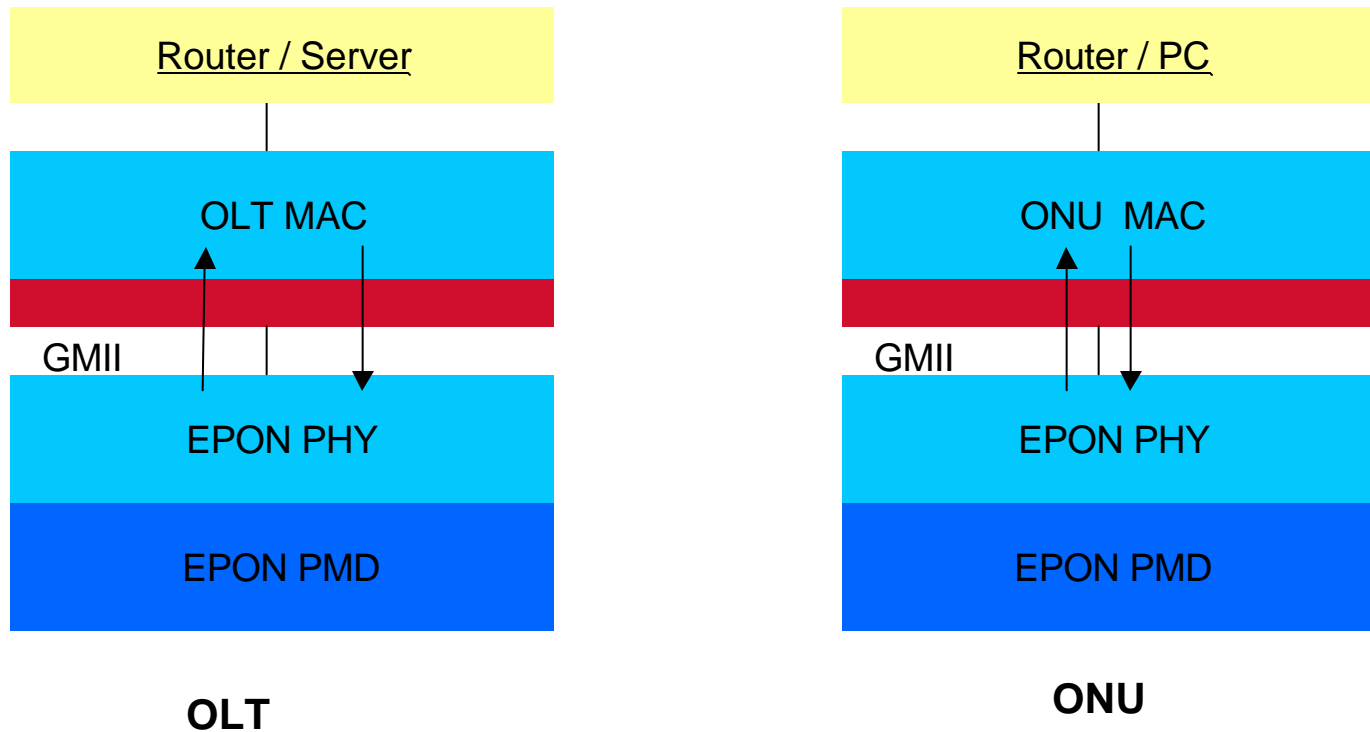
P2P Emulation ONU View



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

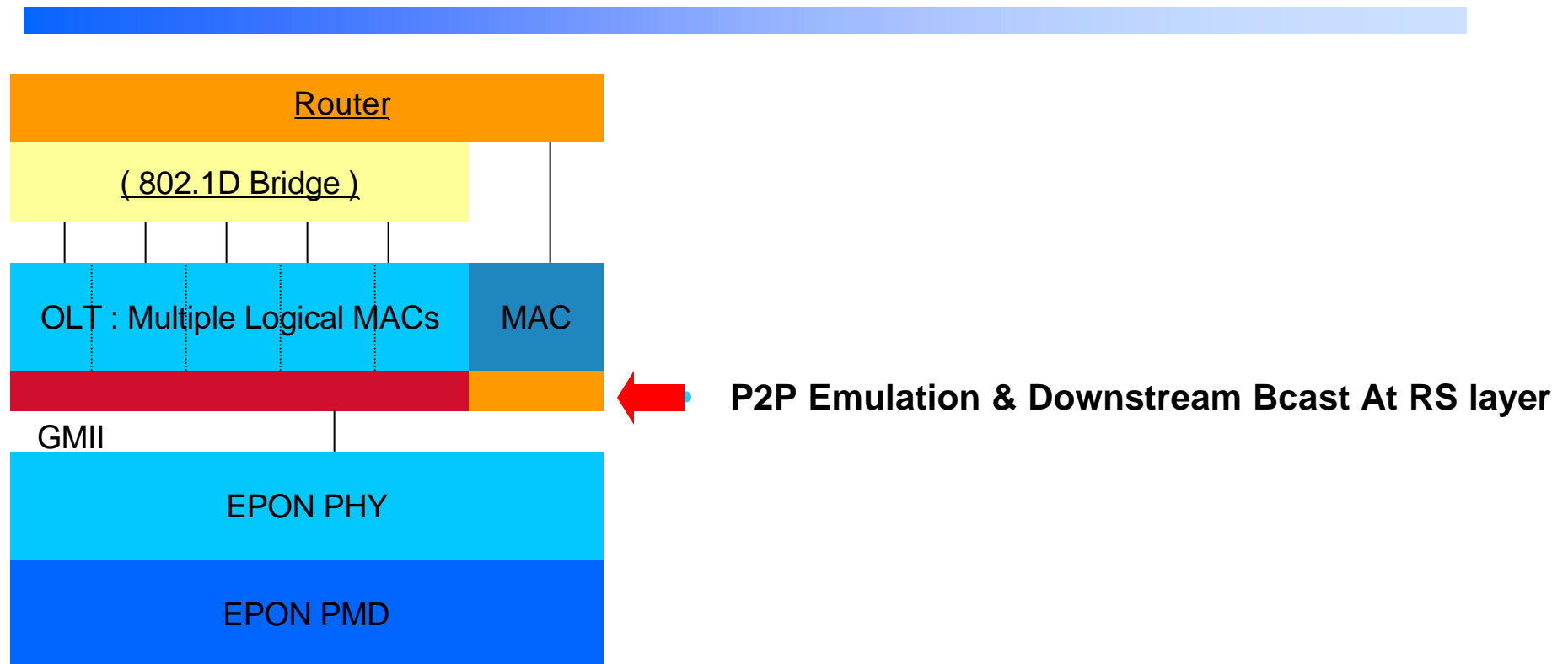
When ONU have multiple PON entities, Mux/Demux behavior needed at ONU as well.

Downstream Broadcast OLT / ONU View



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

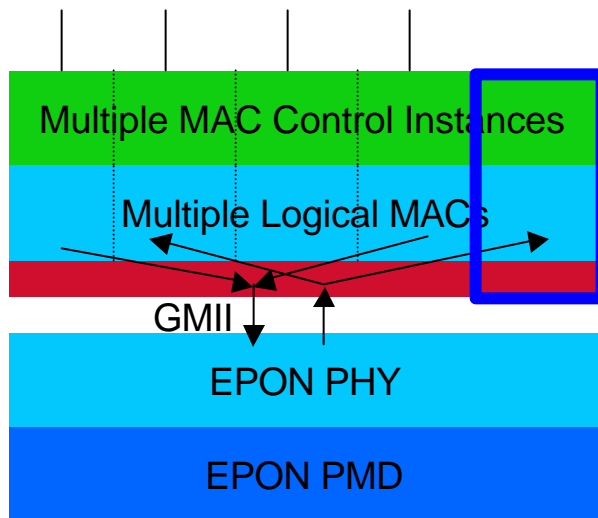
P2P Emulation & Downstream Broadcast OLT view



- 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.

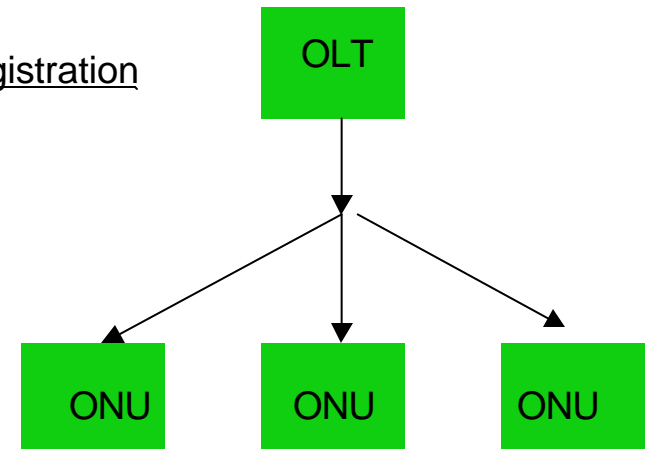
Logical PHY ID Registration

- Registration uses a special logical port with **“Default Logical PHY ID”**
 - This is a configuration / registration mode BEFORE forming P2P or DownstreamBcst 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**