EPON
P2P Emulation and Shared Media Emulation For 802.1 compatibility

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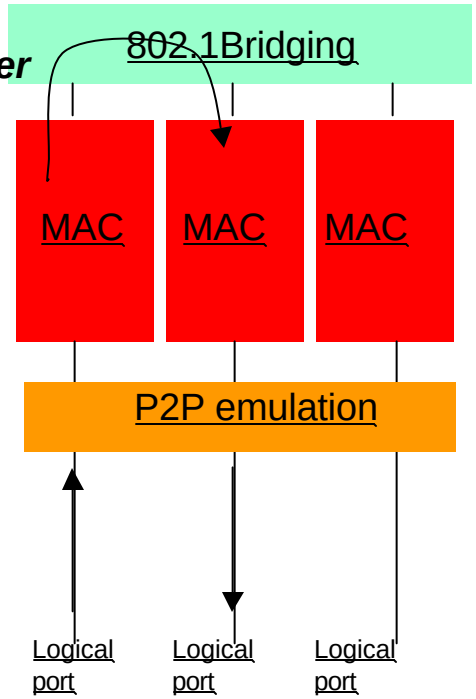
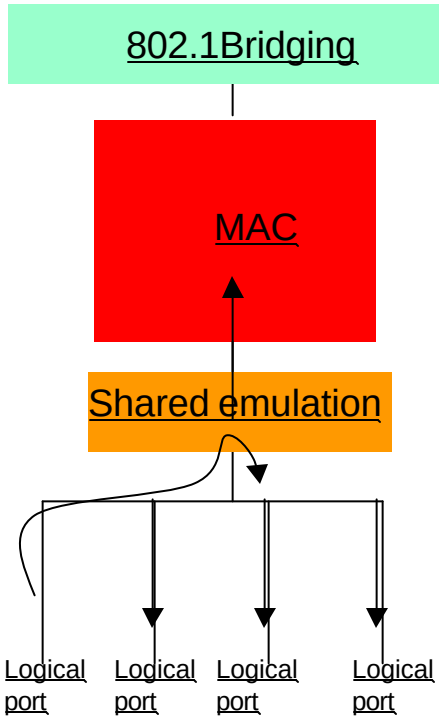
802.1's view of 802.3 Ethernet: P2P or Shared Media – Not Half & Half!

Forwarding among ONUs only at higher layer



Transmit and demux frames to each MAC corresponding Logical PHY ID

Transmit own Logical PHY ID, receive only matching ID



Transmit OLT PHY ID, reflect and receive all frames

Everybody sees all frames except own

Transmit own Logical PHY ID, drop frames with own Logical PHY ID

P2P Emulation

Shared Media Emulation

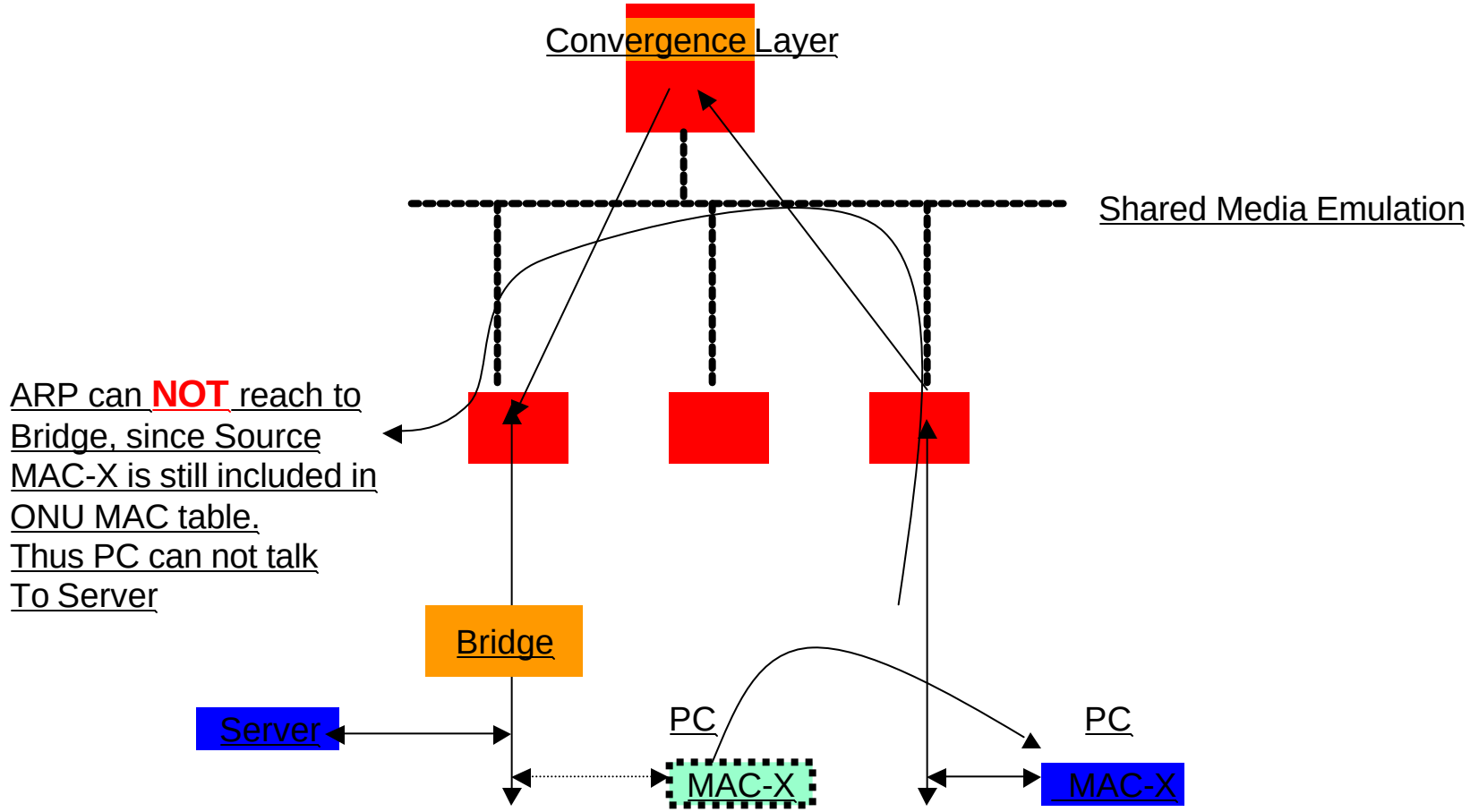
Why P2P emulation shall be "below MAC" ?

- **For 802.1D bridging among EPON ONUs, ONU MUST filter out downstream frames without MAC address table which might be "obsolete".**
  - **-A bridge port LEARNS from source MAC addresses and FILTERS on destination MAC addresses; it DOES NOT filter on source MAC addresses !**
  - **-Example: I walk my hand-held computer from building to building using 802.11**
- **Ask changes for 802.1D to compliant to EPON is not the way of EPON to be compliant to 802.1D !!**
- **Only solution : P2P emulation (or shared media emulation) below MAC.**
  - **-With Logical PHY ID scheme, ONU filtering behavior is deterministic based on allocated Logical PHY ID to ONU, rather than learned MAC address table.**
  - **-Actually, ONU does NOT need a MAC address table. Thus Low cost media converter implementation possible.**

Issues on Forwarding at MAC layer

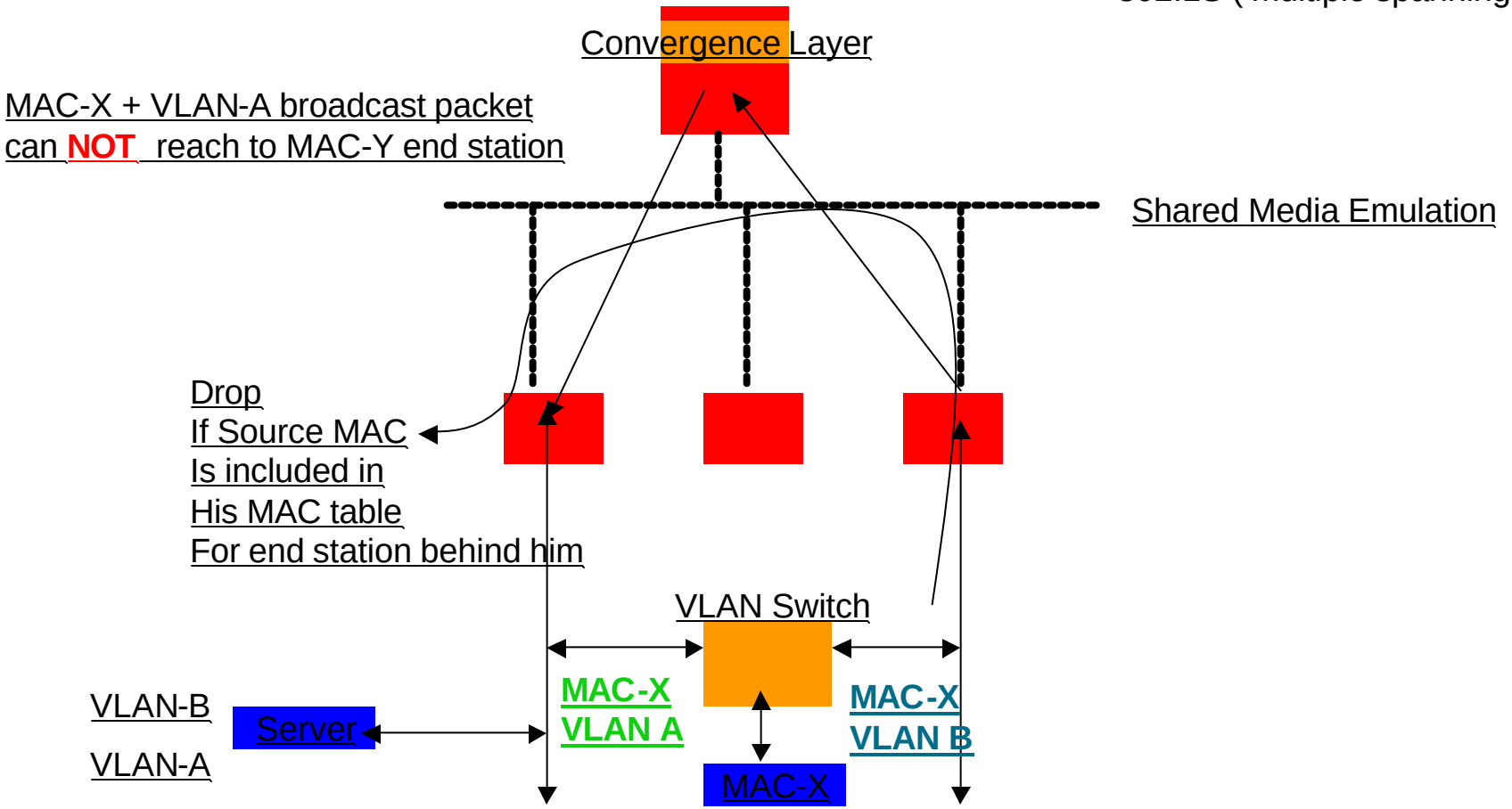
- **Multiple ONU can have the same MAC address**
  - **-End station moves one ONU to another**
  - **-End station has the same MAC address with different VLAN Ids attached to multiple ONUs**
- **Behavior of "ONU to filter frame with source MAC address" defeats MAC address learning capability of 802.1 Bridging**

Moving end-stations



Multiple VLANs with the same MAC

This will happen for
802.1S (multiple spanning tree)

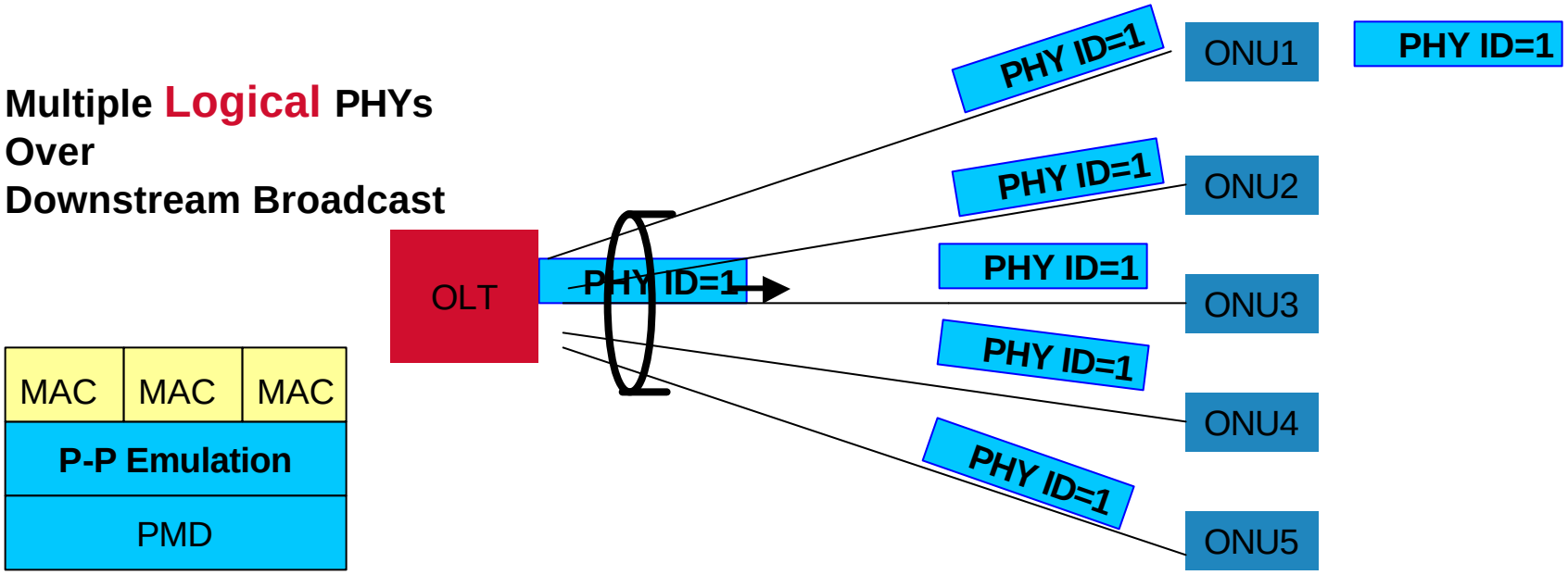


Which mode to be used ?

- **P2P Emulation : If most of traffic is P2P mode**
- **Shared Emulation : If most of traffic is down-steam broadcast**

What Point to Point Emulation does

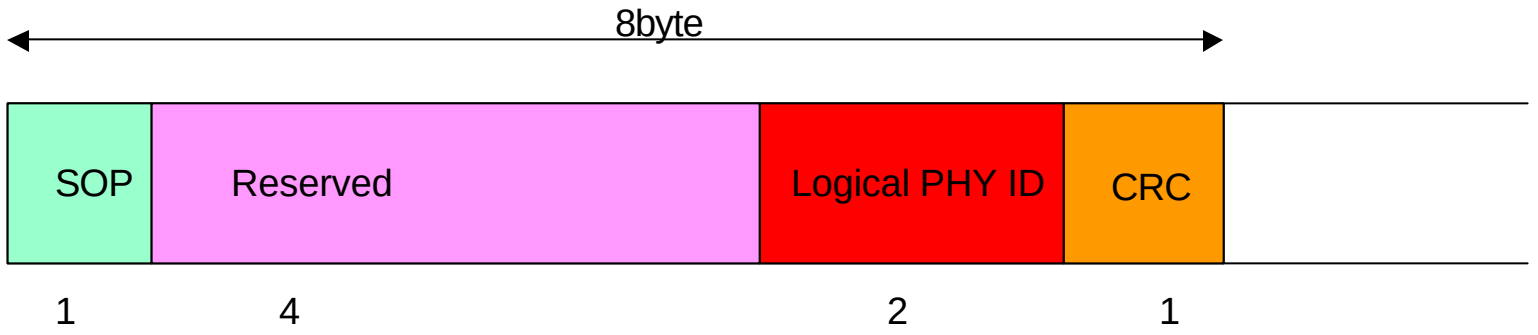
Many “Point to Point Link” Emulation over EPON



-To meet Peer-Peer, 802.1D etc compatibility requirements
-Frames to carry Logical PHY/ (Virtual Port / Virtual Link) ID
-Downstream frames to be filtered out by Logical PHY ID

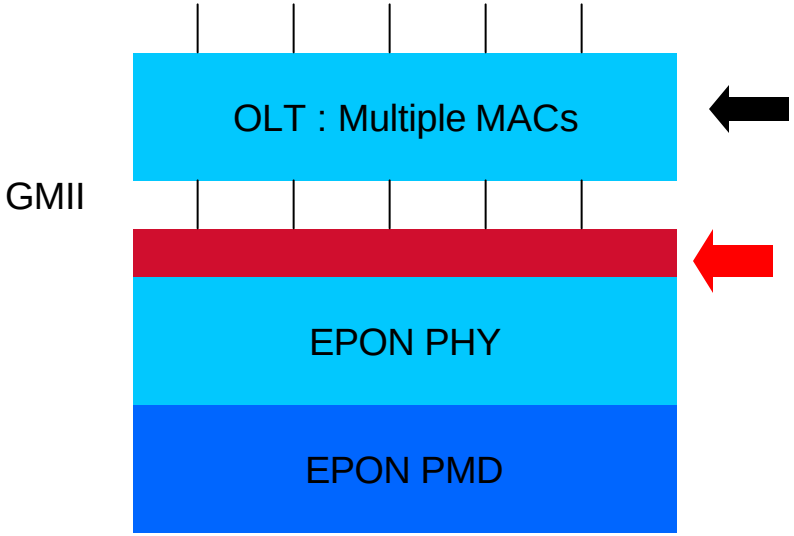
Logical PHY ID Format

- **8 byte Preamble to carry:**
  - **2byte : Logical PHY ID**
  - **2-4byte : Reserved**
  - **1byte : CRC**



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

OLT view-1
PHY Sub-layer ?



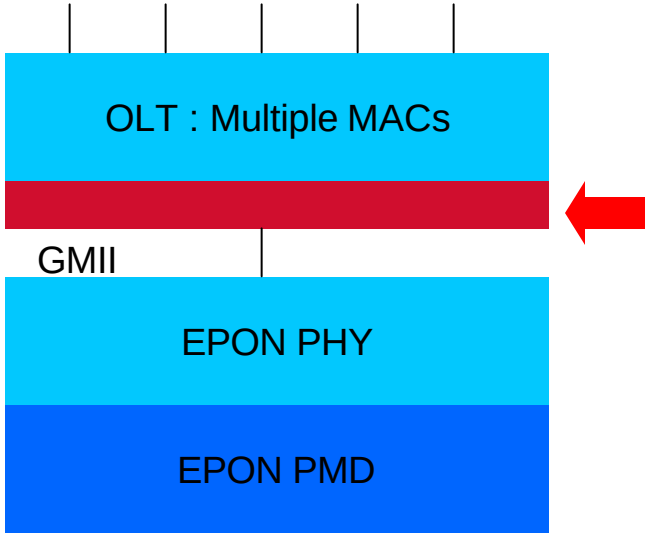
Physically separated GMII and MACs

- **P2P Emulation Layer**

  Mux/Demux Frames by Logical PHY ID

Seems like very un-scalable and expensive implementation ??

OLT view-2
MAC Sub-layer



- **P2P Emulation on RS layer**

  Mux/Demux Frames by Logical PHY ID

(Optimization)
Multiple (Virtual) MACs over "**single:** GMII is possible by having a MAC Sub-Layer=RS between Multiple MACs and GMII
which multiplex and demultiplex frames from/to individual MACs.

Can Shared Media Emulation co-exist with P2P Emulation ?

- **Broadcast Efficiency Issue in P2P Emulation :**

  Downstream Multicast : Multiple consecutive Unicast Frame transmits

  Can we optimize this, especially for high-speed downstream broadcast ?

- **[Solution]**

  -Allocating 2 Logical PHY IDs for each ONU

  -One for P2P link, Another for Shared Emulation link

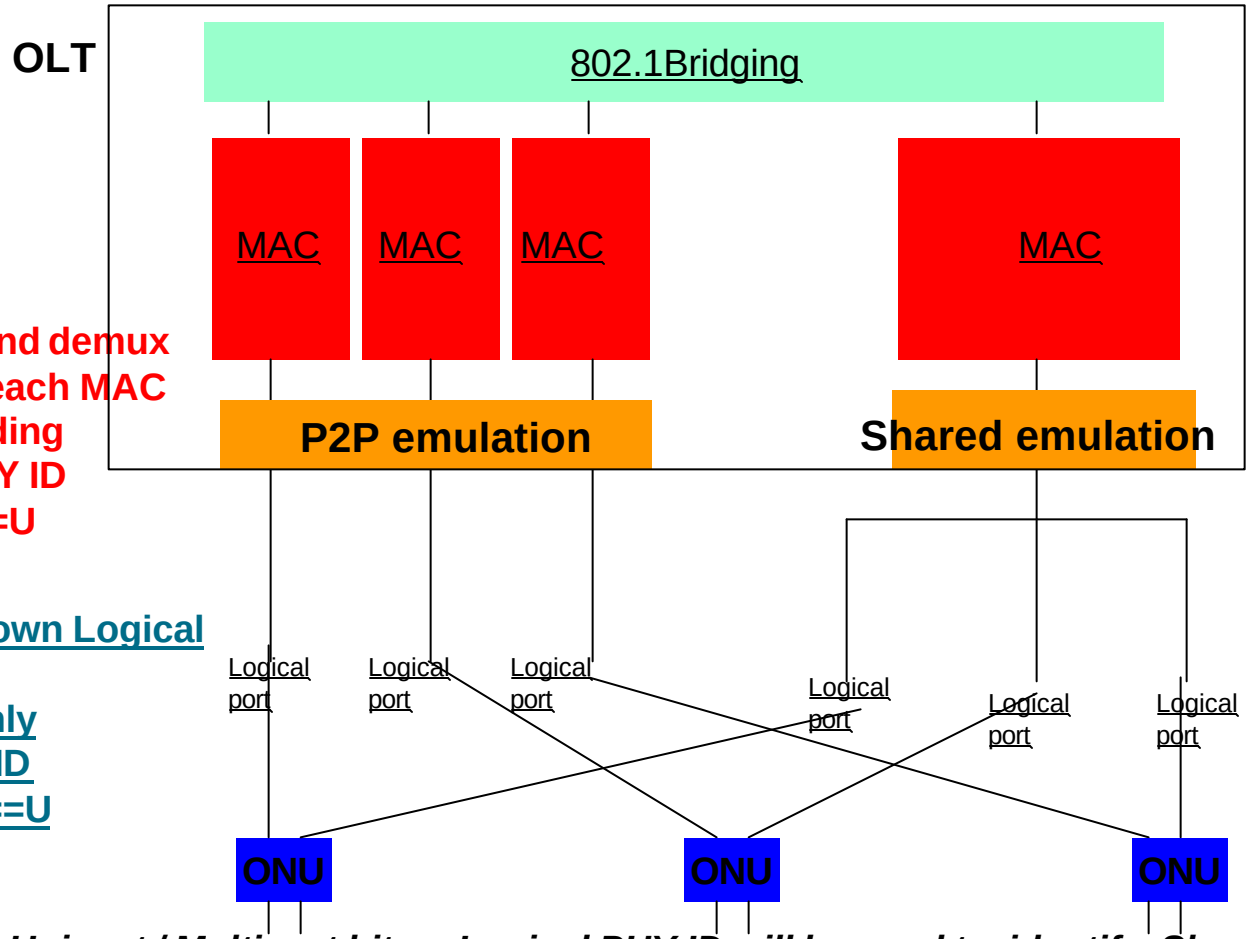
  -Each ONU has 2 MAC and separated Logical PHY IDs

  -OLT will have N+1 logical ports (MAC & Logical PHY IDs)

  -Unicast/Multicast Bit on Logical PHY ID for selection of the modes

  -ONU can configure to operate one of the operation.

P2P and Shared Media Combined Mode



Transmit and demux frames to each MAC corresponding Logical PHY ID With U/M==U

Transmit OLT PHY ID, reflect and receive all frames with U/M==M

Transmit own Logical PHY ID, receive only matching ID With U/M==U

Transmit own Logical PHY ID, drop frames with own Logical PHY ID With U/M==M

-Unicast / Multicast bit on Logical PHY ID will be used to identify Shared / P2P Emulation

-Each ONU configures to operate one of the modes of operation.

Summary

- **P2P emulation, Shared emulation options**
- **P2P Emulation and Shared Emulation meet 95% of the requirements**
- **Do we really need to meet 5% requirements to fully optimize the link utilization of EPON by making it very complicated system ?**
- **Look at Ethernet 802.3 History to win the market.**