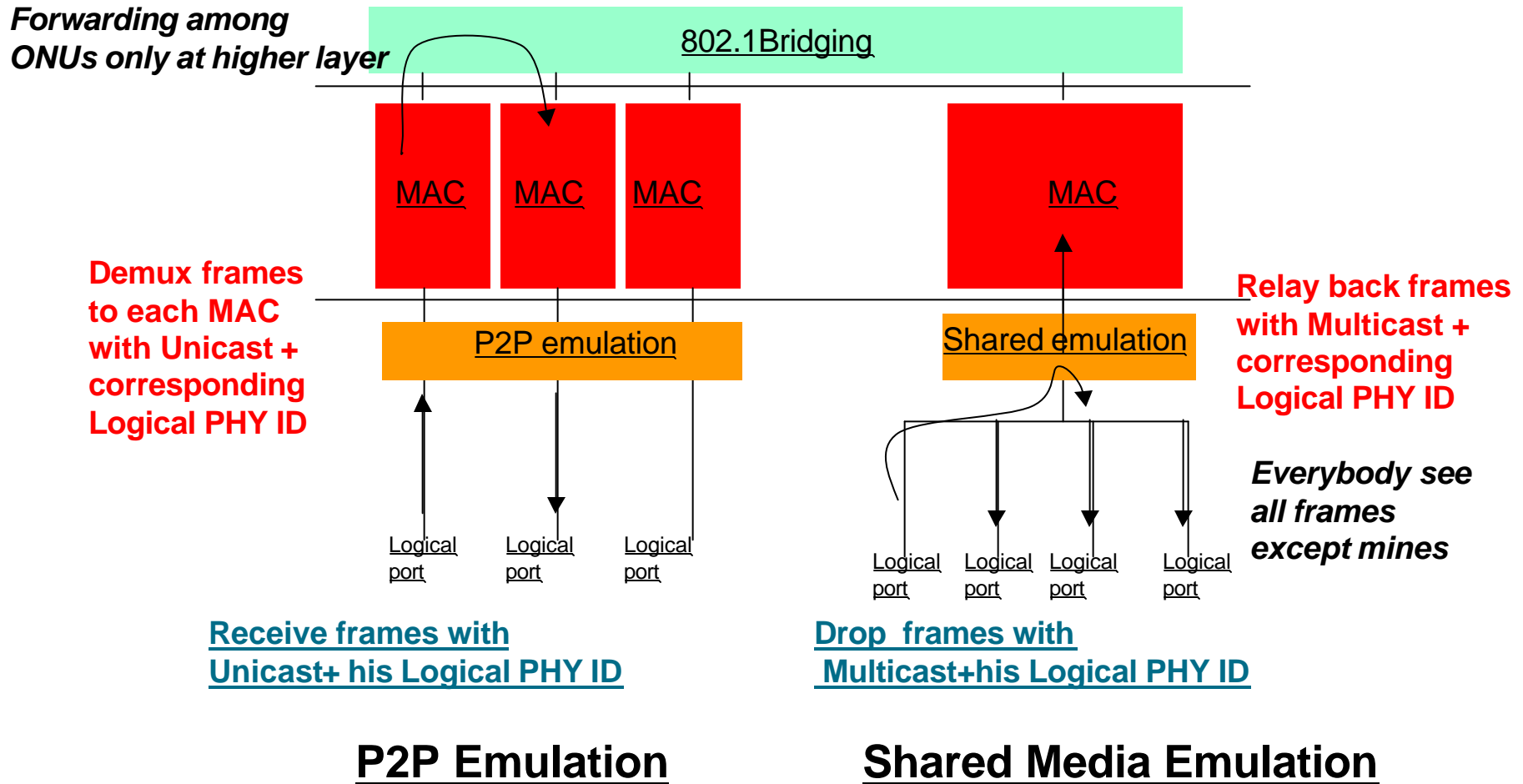

EPON

P2P Emulation Detail Behaviors

- Basis for EPON protocol –

Hiroshi Suzuki, Norm Finn, Cisco Systems
Jian Song, Salira Systems
Onn Haran, Passave
Glen Kramer, JC Kuo, Alloptic

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

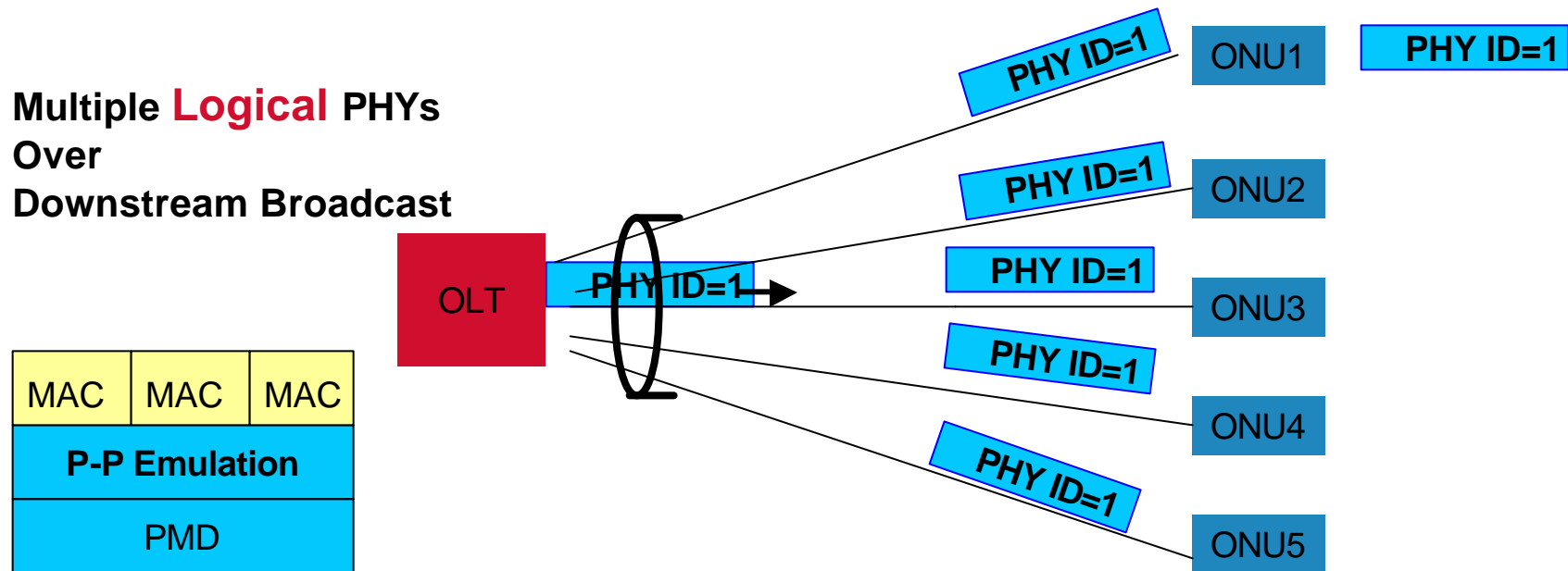


Why P2P emulation shall be “below MAC” ?

- For 802.1D bridging among EPON ONUs, ONU MUST filter out downstream frames without MAC address table which might be “obsolete”.
 - The Same MAC address may be stored in the MAC address tables in multiple ONUs when end stations move from one ONU to other ONU.
 - The same MAC address may validly come from two different directions on two different VLANs (in 802.1Q, more common in 802.1S)
- 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 may NOT need a MAC address table. Thus Low cost media converter implementation possible.

What Point to Point Emulation does

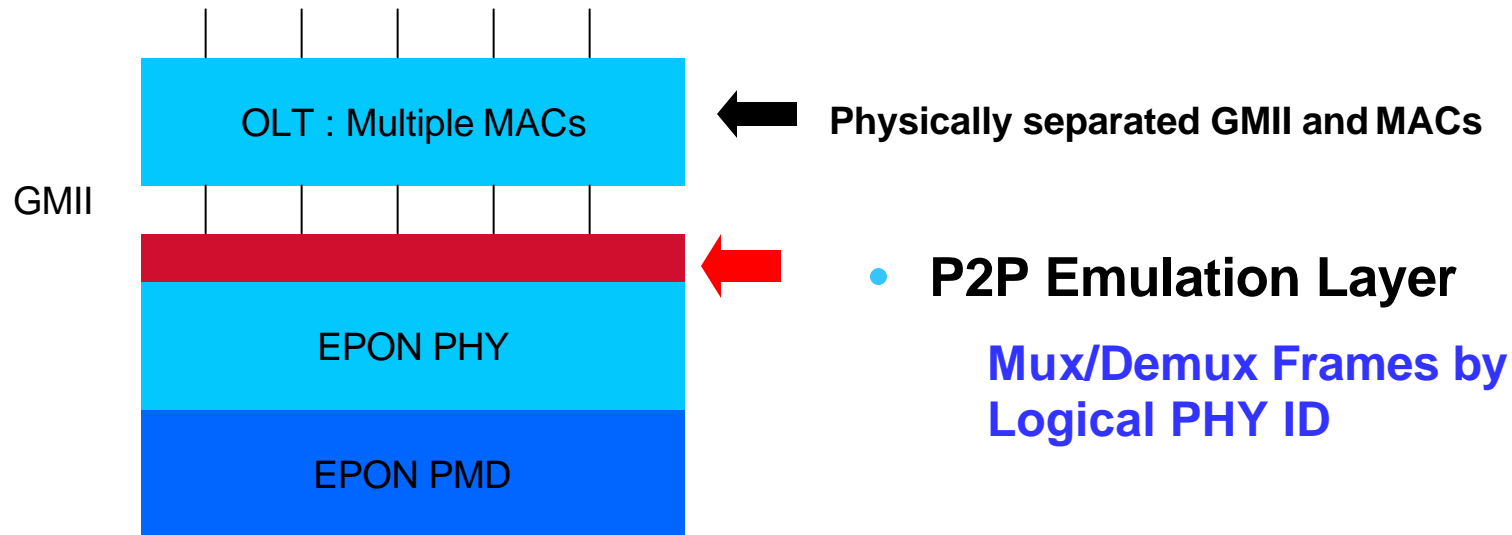
Many “Point to Point Link” Emulation over EPON



- 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

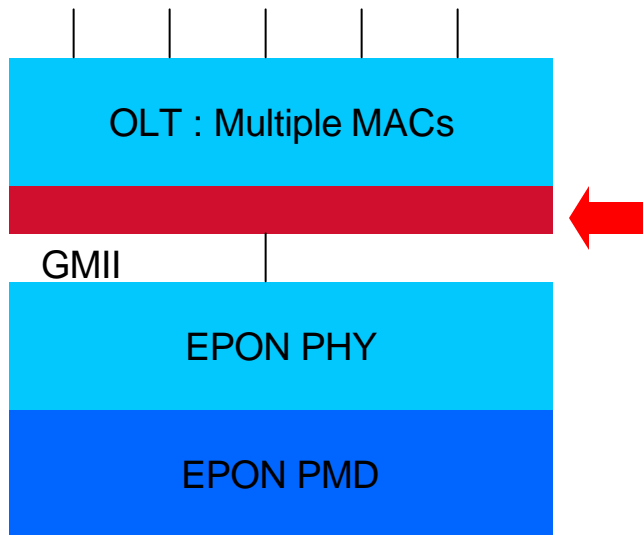
OLT view-1

PHY Sub-layer ?



Seems like very un-scalable and expensive implementation ??

OLT view-2 MAC Sub-layer



- P2P Emulation on RS layer

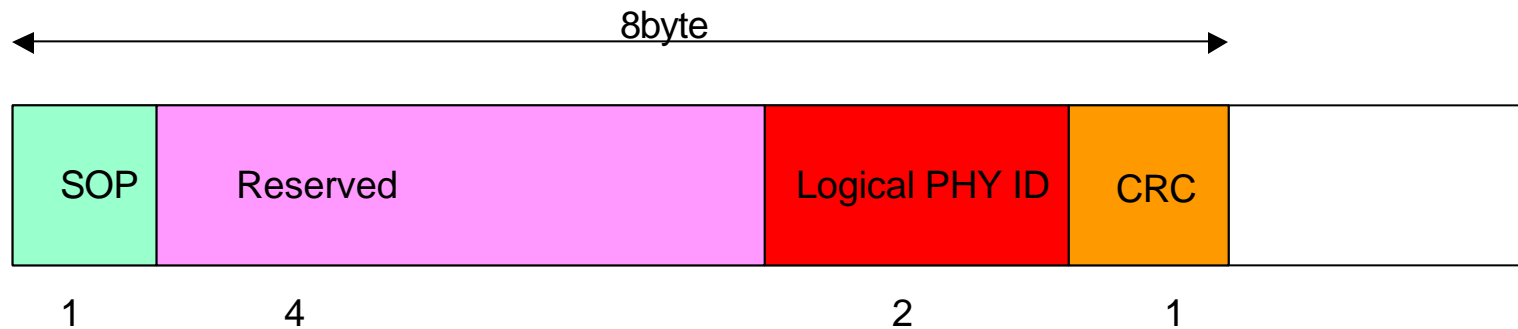
Mux/Demux Frames by Logical PHY ID

(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.

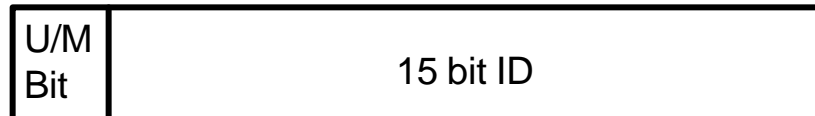
Logical PHY ID Format

- 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.

2 bytes Logical PHY ID



- 1 bit of Unicast / Multicast Bit
0: Unicast, 1: Multicast
- 15 bit Multicast ID
- 15 bit Unicast ID (32K ports)
Upstream : Source Logical PHY ID
Downstream : Destination Logical PHY ID

Unicast / multicast bit may be removed....

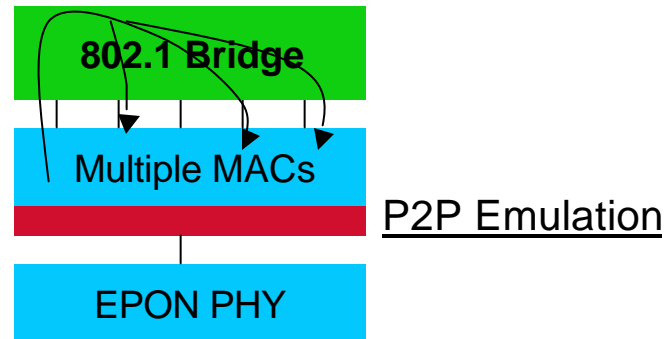
Proposed CRC Scheme

- The preamble CRC is needed to avoid misbehavior of frame filtering / demux.
- Proposed scheme is re-using CRC-8 [ITU-T432].
- It is an 8-bit sequence and is the remainder of the modulo-2 division by the generator polynomial $x^8 + x^2 + x + 1$ of the product x^8 multiplied by the content of the preamble field excluding the SOP symbol and the preamble CRC.
- SFD is overwritten by CRC at PHY layer. But when passing up the preamble to individual MAC, it will be converted back to the “standard” preamble with SFD.

Registration of Logical PHY ID

- Using EPON Signaling protocol (eg MAC Control Frame / Dedicated Control Slot)
- When ONU becomes ACTIVE, register his MAC address to OLT
- Response from OLT to ONU includes PHY ID
- Periodic (long term) Registration
- When it goes power-off, send dying gasp, which releases PHY ID and Timeslots immediately

OLT Bridging Behaviors with P2P Emulation



- Bridging at OLT to be performed by standard 802.1 (above MAC) as if multiple P2P links.
- Always use Unicast PHY ID and multiple transmit of a frame to each ONU

Broadcast Behavior

- **Default : Broadcast ID downstream control message / initialization phase. (eg. Logical PHY ID = all zero)**
- **If we really need high-speed downstream broadcast, use “shared media emulation” with Logical PHY ID.**
 - All Upstream frames relayed back to downstream with source PHY/ONU ID (to be filtered out by the source PHY/ONU)
 - Do we really need it ?

ONU

P-P Emulation Layer behavior

- **ONU obtains & registers Logical PHY ID allocated by MAC Control Frame**
 - ONU's P2P Emulation Layer stores allocated Logical PHY ID in the register in PHY
 - Periodically ONU obtains a new Logical PHY ID allocated by OLT.
- **Upstream Tagging:**
 - When ONU sends frame to OLT, put registered Logical PHY ID on the preamble and calculate CRC to replace SFD.
- **Downstream Filtering :**
 - When receiving the frame, it examine Preamble CRC. If error, it discards the frame. If no error then examine Logical PHY ID.
 - If the received Logical PHY ID matches with registered Logical PHY ID, the frame will be passed to MAC layer. If it does not match, it discards the frame.
 - When passing to MAC layer, it will write over the normal preamble to MAC.

OLT

P-P Emulation Layer behavior

- **OLT allocate & registers Logical PHY ID for each active ONU by MAC Control Frame**
 - When OLT recognize active ONU, OLT allocate individual Logical PHY ID through MAC Control
 - P2P Emulation Layer stores allocated Logical PHY ID in mapping table which MAC / GMII instance this ONU be correspond to.
 - Periodically (Long term) OLT re-allocate a new Logical PHY ID to each ONU.
- **Downstream Muxing and Tagging :**
 - When OLT sends a frame from corresponding MAC / GMII instance to a particular ONU, it look up the mapping table to decide the corresponding Logical PHY ID.
 - Looked up Logical PHY ID be put on the Preamble and calculate CRC to replace SFD.
- **Upstream Demultiplexing:**
 - When receiving a frame, it examine Preamble CRC. If error, it discards the frame. If no error then examine Logical PHY ID.
 - If the received Logical PHY ID matches with registered Logical PHY ID in the mapping table, the frame will be passed to corresponding MAC/GMII. If it does not match, it discards the frame.
 - When passing to MAC layer, it will write over the normal preamble to MAC.