Suggestion for the Layering Architecture

Yoo, Tae-Whan

Han, Kyeong-Soo

Lee, Ho-Sook

ETRI

PON Team

PON-tagging

- ✍ PON-tag
  - ✍ PON-tag {mode, LLID or PHY ID}
    - Identification of many logical links between ONUs and OLT
    - Mode-bit indicates P2P or SCB emulation mode
    - LLID is 1:1 is either 1:1 matching to ONU MACs or logical link between OLT and ONU
    - PHY ID indicates which vMAC receives the frame in OLT

- ✍ Where is the best place for PON-tagging?
  - ✍ PON-tagging in RS layer
    - PON-tag in preamble – PHY ID or LLID of ONUs with mode bit
  - ✍ PON-tagging in MAC control layer
    - PON-tag in Ethernet frame – LLID with mode bit
    - Another field for PON-tag must be defined in Ethernet MAC frame
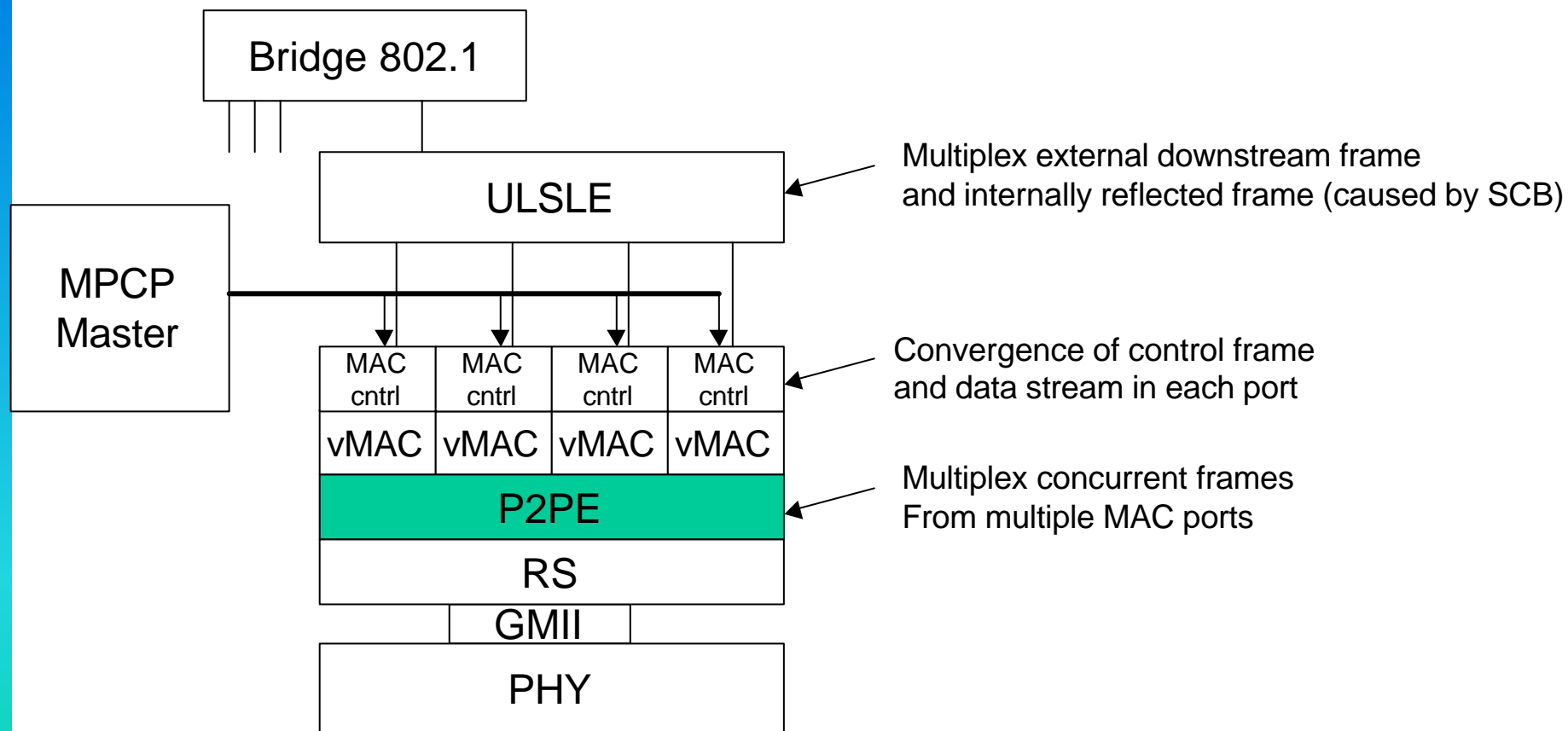
- ✍ Why RS layer?
  - ✍ Preamble tagging requires no frame overhead
  - ✍ ONUs must filter out frames from other P2P link below the MAC
  - ✍ ONUs must filter out its own sourced SCB frame
  - ✍ Do not violate link management

- ✍ Why not RS layer?
  - ✍ 802.1D bridge must covers vMACs
  - ✍ Involving many multiplexing functions in different layers
  - ✍ Frame multiplexing in RS layer
    - invoke unpredictable delay
    - Difficult to estimate correct RTT by time stamp

How it works? – tagging in preamble

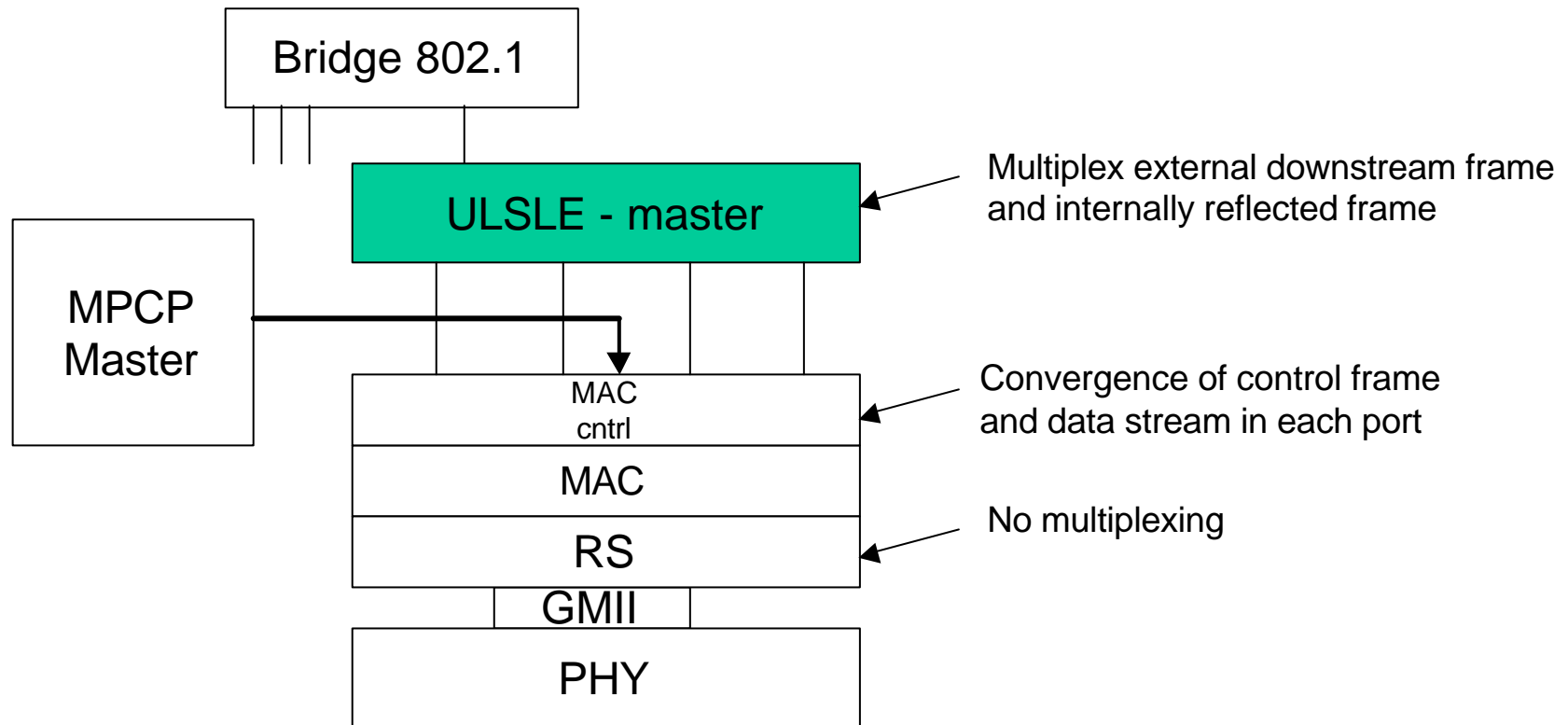- ✍ Layering and required multiplexing function

```
           ┌──────────────────────┐
           │    Bridge 802.1      │
           └──┬──┬──┬──┬──────────┘
              │  │  │  │
           ┌──┴──┴──┴──┴──────────┐        Multiplex external downstream frame
           │        ULSLE         │ ◄────── and internally reflected frame (caused by SCB)
┌──────────┤                      │
│  MPCP    │                      │
│  Master  │                      │
│          │                      │
└──────────┘ ┌────┬────┬────┬────┐
             │MAC │MAC │MAC │MAC │ ◄──────  Convergence of control frame
             │cntrl│cntrl│cntrl│cntrl│       and data stream in each port
             ├────┼────┼────┼────┤
             │vMAC│vMAC│vMAC│vMAC│
             ├────┴────┴────┴────┤
             │       P2PE        │ ◄──────  Multiplex concurrent frames
             ├───────────────────┤          From multiple MAC ports
             │        RS         │
             ├───────────────────┤
             │       GMII        │
             ├───────────────────┤
             │        PHY        │
             └───────────────────┘
```

PON-tagging in MAC Control sublayer

- ? Why PON-tagging in MAC Control sublayer?
  - ? No multiplexing function in RS layer
  - ? No multiple vMACs – just one MAC address for the OLT
    - External bridge sees only one MAC for OLT

- ? Why not PON-tagging in MAC Control sublayer?
  - ? Inevitable modification of Ethernet frame
  - ? Additional frame overhead
  - ? Link management problem in ONU
    - Frames from other P2P links or its own sourced SCB frame must be filtered out below the MAC

How it works? – tagging in MAC control layer

✍ Multiplexing function is more simplified

Bridge 802.1

ULSLE - master

MPCP
Master

MAC
cntrl

MAC

RS

GMII

PHY

Multiplex external downstream frame
and internally reflected frame

Convergence of control frame
and data stream in each port

No multiplexing

What should be avoided for efficient layering?

- Multiple vMACs
  - to simplify interface to 801.2D bridge function
  - one MAC in OLT is much better
- Multiplexing function in each layer
  - Requires many buffering capability across layers
- PON-tag relaying to upper layer of the MAC
  - It may requires Ethernet frame modification – no frame overhead is better
  - Invokes link management problem
- Frame multiplexing below the MAC
  - invokes unpredictable delay - difficult to estimate correct RTT by time stamp

Solution – reflection at FRM & PON-tagging at RS layer

- ✎ PON tagging is terminated in RS layer
  - ✎ ULSLE need to have frame reflection capability without LLID.
 - ✎ How can it possible? – We suggest FRM (Frame reflection and Multiplexing) which is a simplified ULSLE.
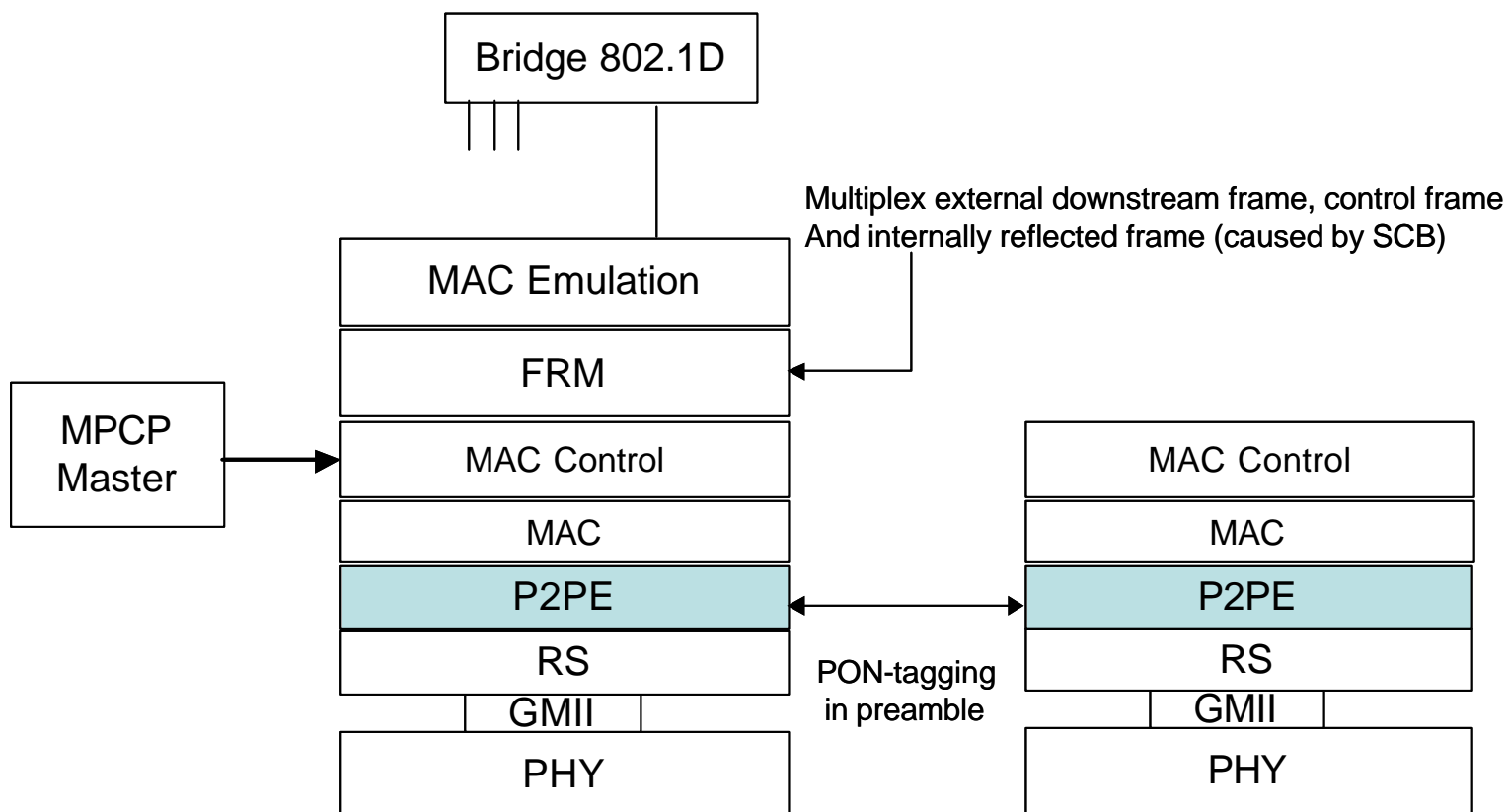
Functions of FRM

- ✍ ONU-to-ONU frame is reflected based on address table without LLID.
- ✍ External downstream frame is forwarded to lower layer.
- ✍ External upstream frame is directly forwarded to bridge.
- ✍ Multiplexing of external downstream data frame and internal reflected frame.
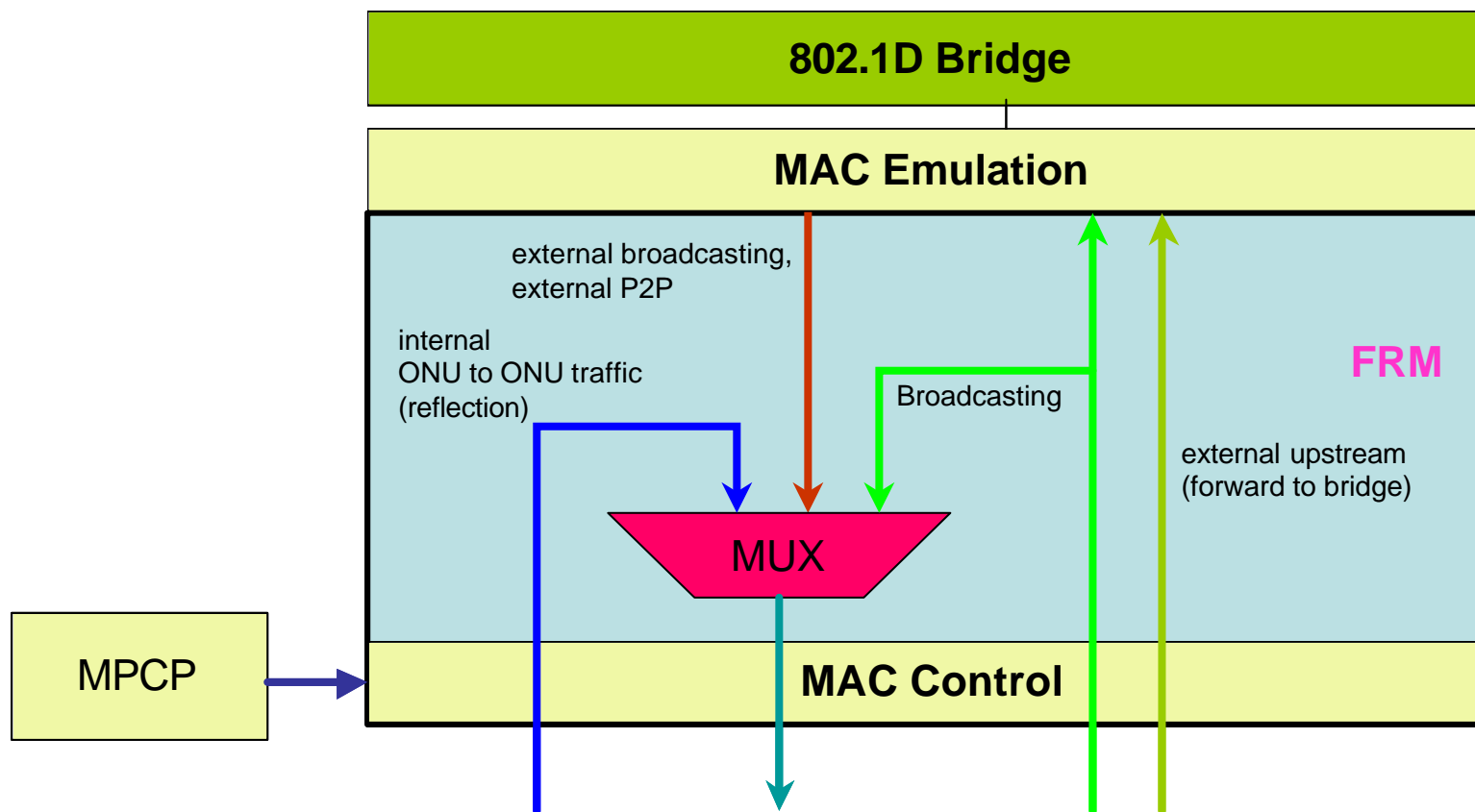
Functions of FRM (cont.)

- ✍ Address learning table for PON I/F is managed by RS layer
- ✍ Mirrored table is referenced by FRM for frame reflection
- ✍ Address table for external device port is managed by FRM
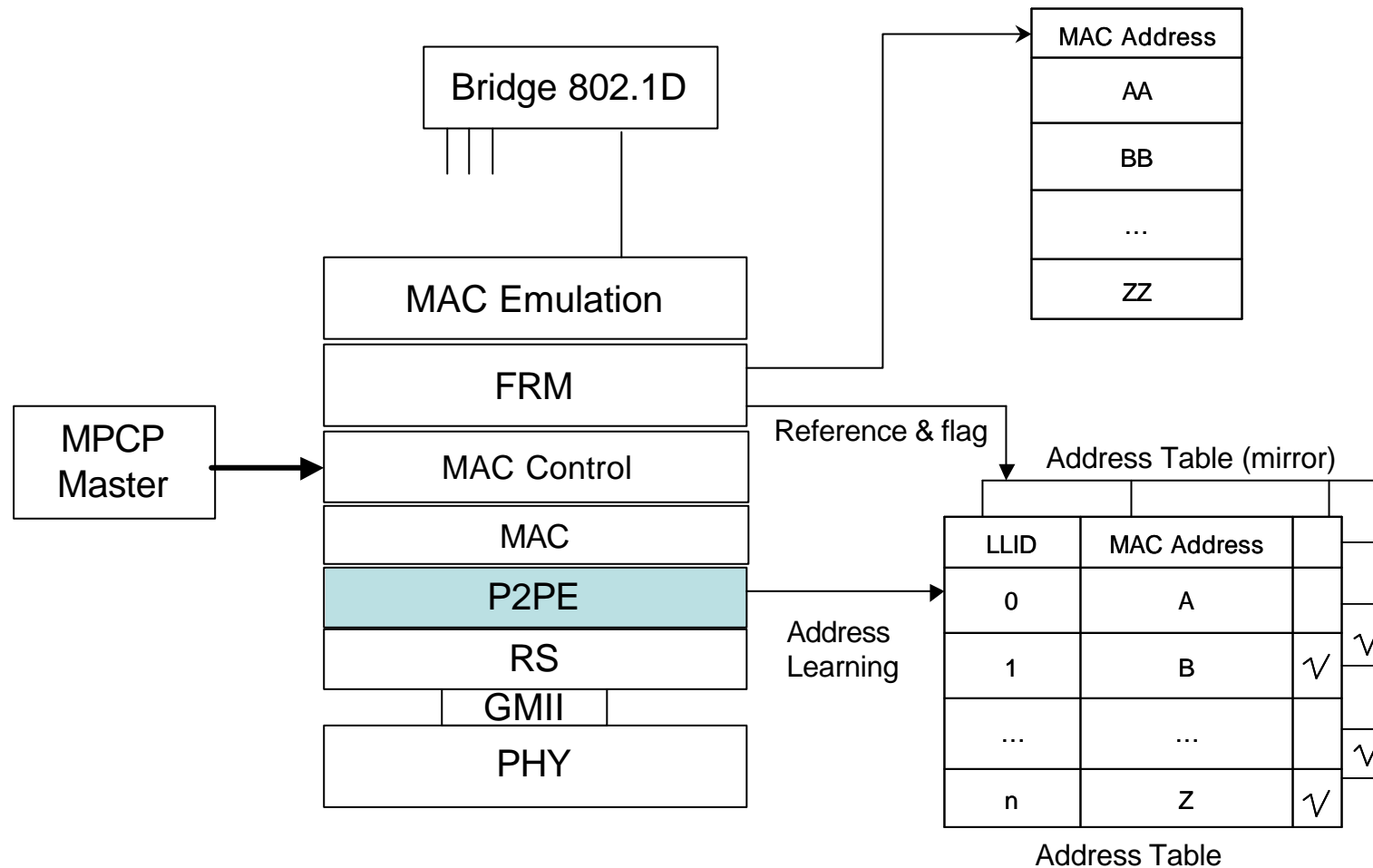
Functions of OLT layers

- ? FRM (frame reflection and multiplexing)
  - ? Frame reflection
  - ? Frame forwarding to 802.1D bridge
  - ? Downstream frame multiplexing
- ? MAC-control layer convergence
  - ? Convergence of control frames and downstream data frames
- ? RS layer
  - ? PON-tagging in preamble to downstream frames
    - DA is broadcast MAC – mapping to ULLID
    - both DA and SA is in address table – LLID of SA with SCB mode bit
    - DA is in address table, but SA is not in – LLID of DA with P2P mode bit
    - DA is not in address table, but SA is not in – LLID of SA with SCB mode bit
    - both DA and SA is not in address table – mapping to ULLID
  - ? LLID mapping
  - ? Address learning
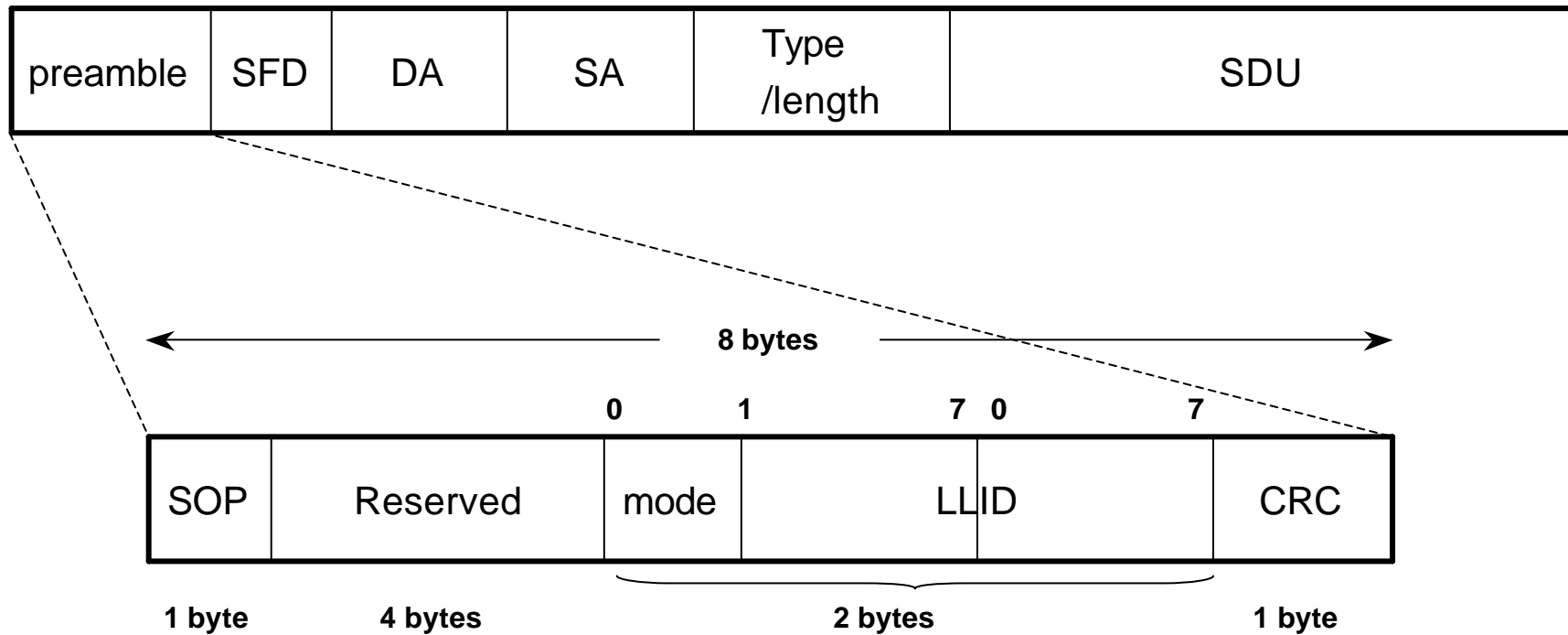 - ? No multiplexing function because OLT has only one MAC

Functions of ONU layers

- ✍ P2PE in RS layer
    - ✍ Insert PON-tag in preamble to upstream frames
    - ✍ Strip the PON-tag of preamble from downstream frame
    - ✍ Filtering the downstream frame by PON-tag

Frame format –proposed by Suzuki

preamble	SFD	DA	SA	Type /length	SDU

← 8 bytes →

		0 1 7	0 7	
SOP	Reserved	mode	LLID	CRC

1 byte **4 bytes** **2 bytes** **1 byte**

Summary

- FRM in upper layer of MAC control layer
  - Frame reflection without LLID
  - Downstream multiplexing
- PON-tagging in RS layer
  - No frame overhead
  - No link management problem(?)
  - Frame filtering by PON-tag
- Simple multiplexing
  - No multiplexing in RS layer

Downstream Convergence & Upstream Convergence

- ? What is multiplexing function in EPON?
    - ? Add/Delete PON-tag (PHY ID or LLID with mode bit)
- ? Downstream multiplexing
    - ? in OLT process
    - ? Multiplex the frames from different bridge ports (virtual MAC port)
    - ? May be a concurrent frames

- ? Downstream frame multiplexing
    - ? Multiplex the frames coming from several bridge ports(vMACs) to a single interface to the PHY (vice versa) – by Sala's presentation material
        - Multiplexing of concurrent frames from multiple MAC ports
        - Required in OLT only

- ? Convergence
    - ? merging control frames to data stream
        - Required in OLT and ONUs