MPCP Baseline Proposal Architecture and Layering Model

Glenn Algie

Vicent Bemmel

Richard Brand

Bob Gaglianello

Ajay Gummalla

Onn Haran

Ryan Hirth

David Horne

Lior Khermosh

Hiroshi Suzuki

John Limb

Ariel Maislos

Dolors Sala

Jian Song

Osamu Yoshihara

802.3ah P2MP Track

Overview

☐ **Protocol Overview**

☐ **Layering Model**

– External Interface

– Internal Layering and Interface

- ONU Arbitration

- Laser Control

- Multiplexing Function

☐ **Summary**

☐ **Open Layering Issues**

802.3ah P2MP Track

PON system operation

Gates
Downstream

OLT

ONU1   ONU2   ONUn

Reports
Upstream
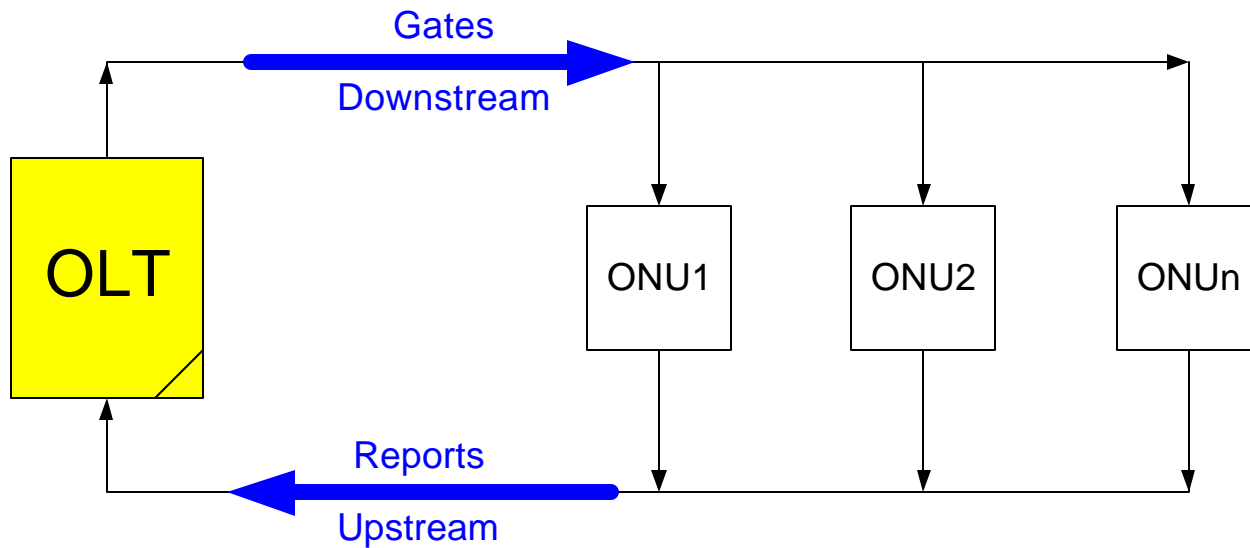
ONU Operation

- **ONU synchronization**
  - ONU synchronizes to OLT timing through timestamps on the downstream MAC-control frames
- **ONU waits for discovery gate**
- **ONU performs discovery process which includes**
  - Ranging
  - Assignment of PHY_IDs
  - Assignment of certain amount of bandwidth
- **ONU waits for its grants**
  - ONU transmits frames in these grants
  - Request for additional bandwidth can be sent in report frames

*Timing and ranging and ONU discovery mechanisms described in separate presentations
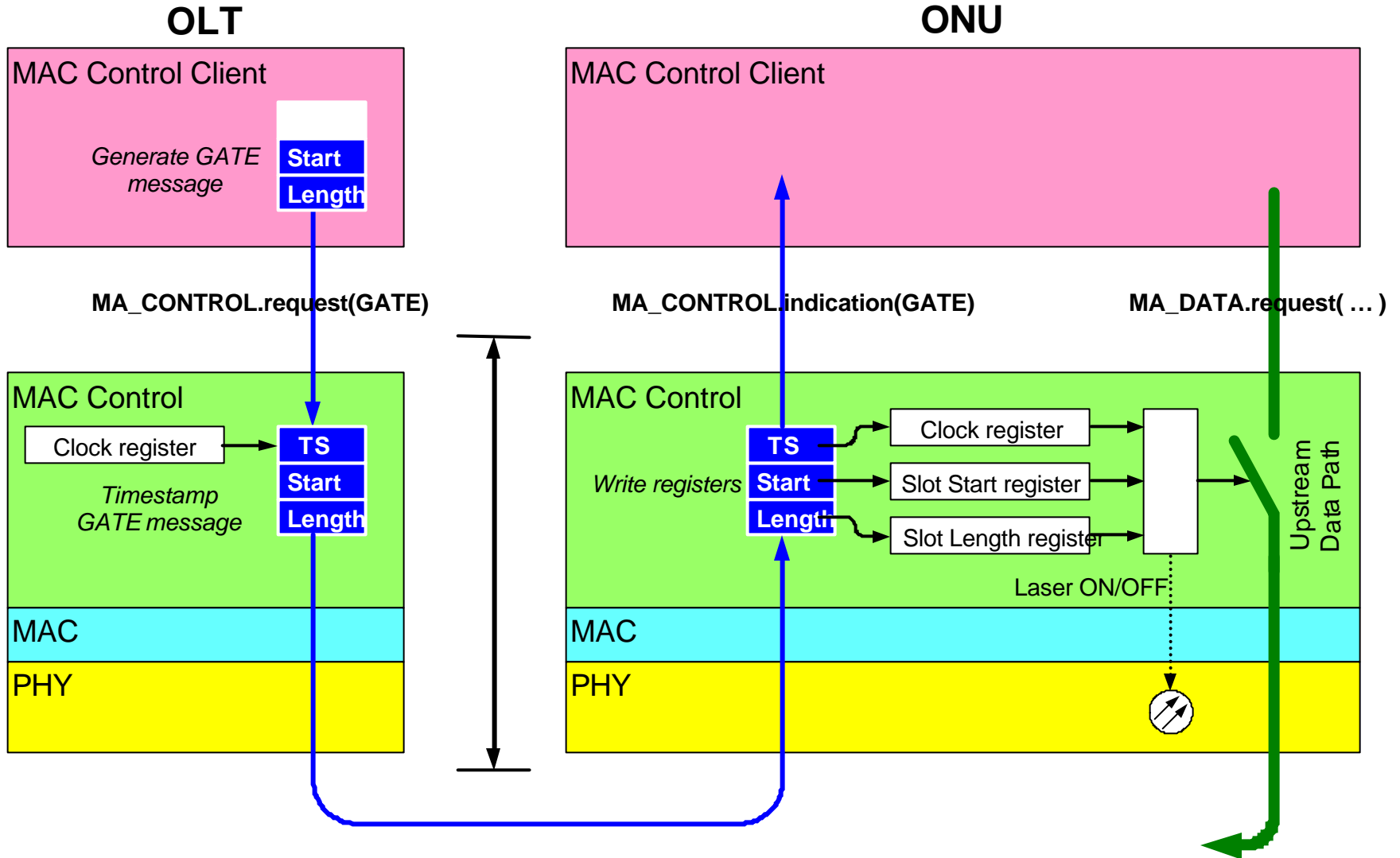
OLT Operation

- **Generates time stamped messages to be used as global time reference**

- **Assigns bandwidth (MPCP allocation)**
  - Generates discovery windows for new ONUs
  - Assigns individual grant windows to registered ONUs

- **Performs ranging operation**

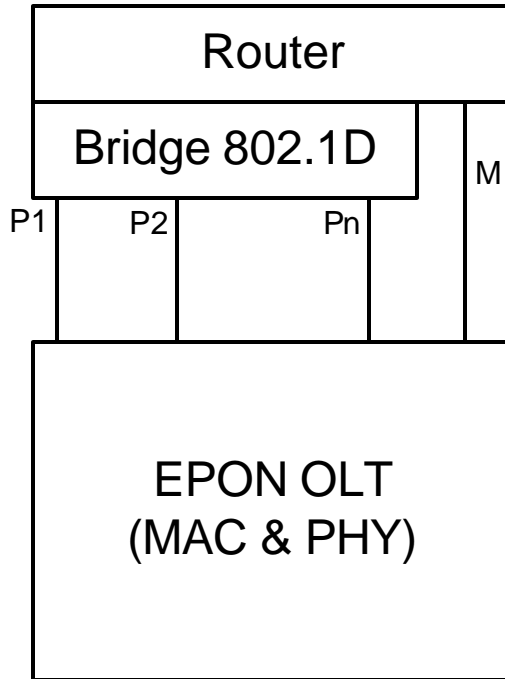- **Controls ONU registration process**

Protocol Highlights

- **Collisions can occur only during discovery**
- **The OLT must guarantee a minimum amount of bandwidth to each registered ONU**
  - This minimum must be large enough at least to be able to manage the ONU, and for the ONU to request more bandwidth when needed
- **Mechanism to support flexible assignment of bandwidth**

802.3ah P2MP Track

General Layering Overview

OLT

ONU

MAC Control Client

Generate GATE message

Start
Length

MAC Control Client

MA_CONTROL.request(GATE)

MA_CONTROL.indication(GATE)

MA_DATA.request(…)

MAC Control

Clock register

TS
Start
Length

Timestamp GATE message

MAC Control

Write registers

TS
Start
Length

Clock register

Slot Start register

Slot Length register

Laser ON/OFF

Upstream Data Path

MAC

PHY

MAC

PHY

802.3ah P2MP Track

External Interface

OLT

Router

Bridge 802.1D

M

P1   P2   Pn

EPON OLT
(MAC & PHY)

Pi: Point-to-point link to ONUi
M: Point-to-multipoint link

ONU

Point-to-point   Point-to-multipoint
Service   Service

Pn   M

EPON ONU
(MAC & PHY)

External Interface: Details

- **Compliance is achieved with P2P emulation**
  - Defines a virtual P2P link between ONU and OLT. Each individual virtual link interfaces separately to the bridge.
- **Single copy broadcast is achieved with a special port**
  - This port supports a "native" mode of operation with a point-to-point upstream and a point-to-multipoint downstream
  - This port cannot be attached to a bridge because it is not compliant with 802.1 (requires special routing capabilities)
- **Shared emulation is not specified**
  - No need to specify how to reflect frames from upstream to downstream
- **Multiplexing function is used to map these interfaces to a single PHY**
- **Clean architecture for start process**
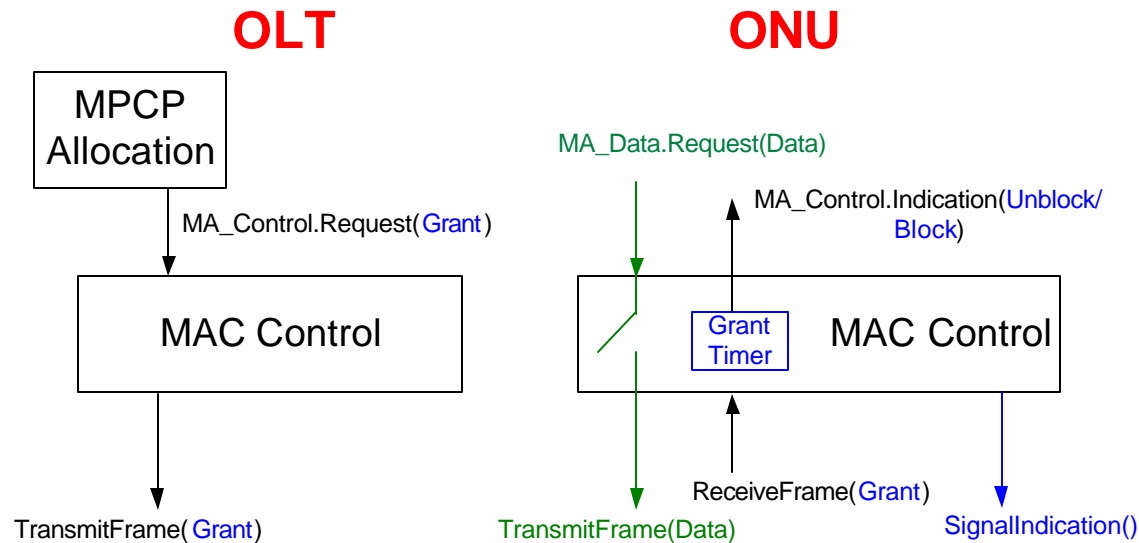 - Autodiscovery can start in "native" mode and establish additional vMACs for P2PE during registration

Internal Layering Specification

- ❒ **ONU Arbitration**

- ❒ **Multiplexing Function**

- ❒ **ONU Laser Control**

ONU Arbitration in MAC-control

□ **Defined in MAC-control layer as it requires real time control**

– Operates with standard MAC-control interface but new messages are required

□ **Control layering assumes traditional Ethernet layering**

– MAC-control entity connects to a single MAC entity

– MAC-control entity can connect to several MAC-clients

□ **MPCP allocation is performed by a centralized scheduler**

– Scheduler transmits and receives control frames using MAC-control primitives

– Scheduler behavior is considered out of scope
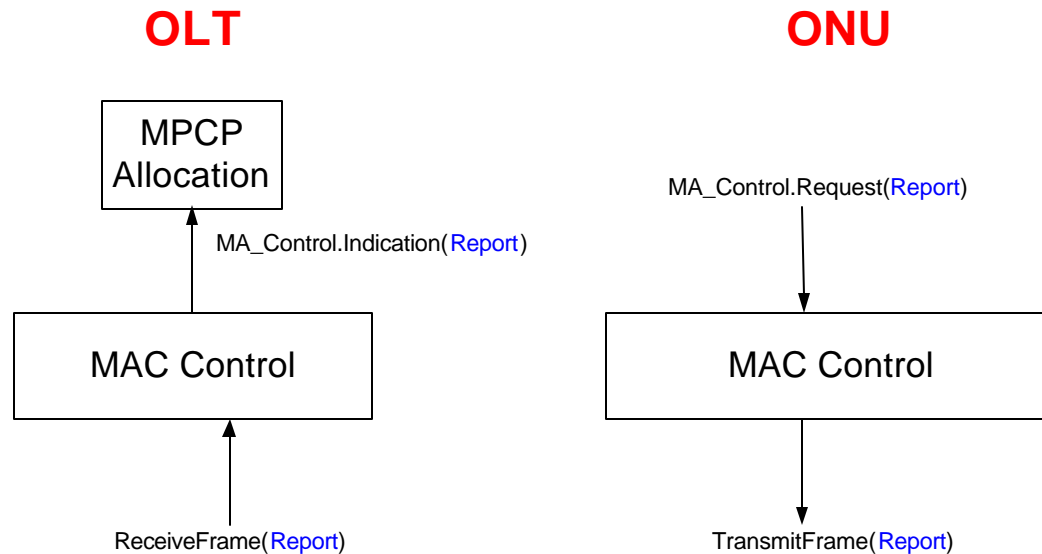
□ **Two messages are defined for arbitration**

Grant Operation

OLT　　　　　　**ONU**

```
┌──────────────┐
│    MPCP      │
│  Allocation  │
└──────────────┘
        │
        │ MA_Control.Request(Grant)
        ▼
┌──────────────┐        ┌────────────────────────────┐
│              │        │  Grant   │  MAC Control     │
│ MAC Control  │        │  Timer   │                  │
│              │        └────────────────────────────┘
└──────────────┘
        │
        ▼
TransmitFrame(Grant)
```

MA_Data.Request(Data)

MA_Control.Indication(Unblock/ Block)

ReceiveFrame(Grant)

TransmitFrame(Data)　　　SignalIndication()

Note: Modifications of existing operation marked in blue
Data path marked in green

- **Grant gates MAC-client delivery of frames.**

- **Grant operates exactly like PAUSE mechanism (generated in client and interpreted in MAC-control with indication of client at timeout time)**

- **ONU transmits only during the time indicated in the grant**

- **ONU MAC-control enables Phy transmission at the start of a grant duration and disables it at the end of the grant duration**

Report Operation

OLT   ONU

MPCP Allocation

MA_Control.Indication(Report)

MA_Control.Request(Report)

MAC Control   MAC Control

ReceiveFrame(Report)   TransmitFrame(Report)

Note: Modifications of existing operation marked in blue

□ **Reports are used to send ONU state to OLT**

– Timestamps for synchronization and ranging

– Requests for additional bandwidth

ONU Synchronization

☐ **Time stamps are added to MAC-control frames**

☐ **Specification must guarantee no jitter across MAC and lower layer**

– Any jitter is accounted for in the guard band

ONU Laser Control

- **MAC-control indicates PHY when to turn on/off laser**
- **Need to provide a real-time unidirectional signal from MAC-control to PHY**
  - It is a simple one-way indication to change state
- **Signal provided through a direct side path from MAC-control to PHY**
  - MAC-control generates (or writes) the signal
  - PHY receives (or reads) the signal
- **Details of signal specification to be worked out**

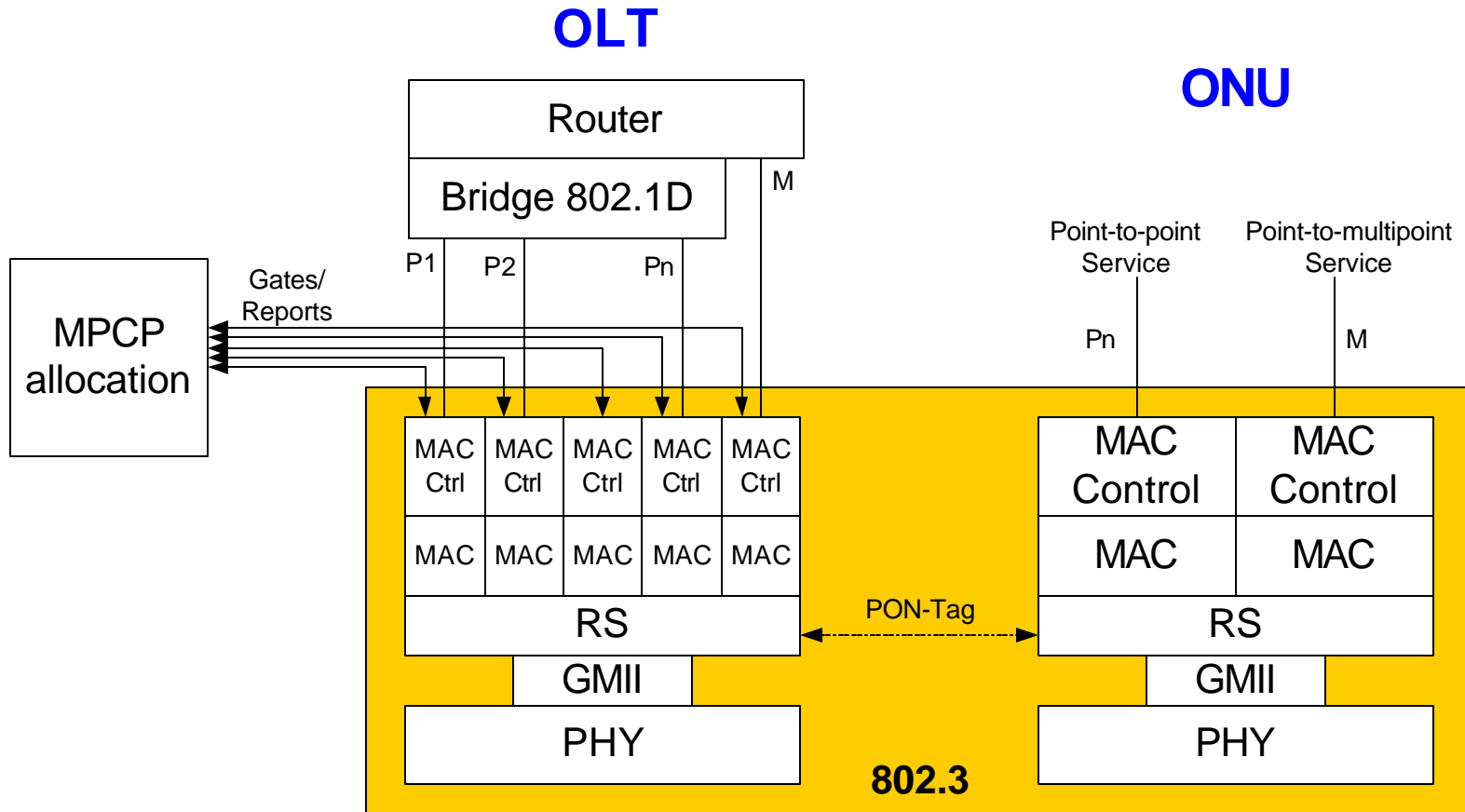**802.3ah P2MP Track**

Multiplexing function

- **Multiplexing function**
  - Multiplexes frames coming from several bridge ports to a single interface to the PHY (and vice versa)

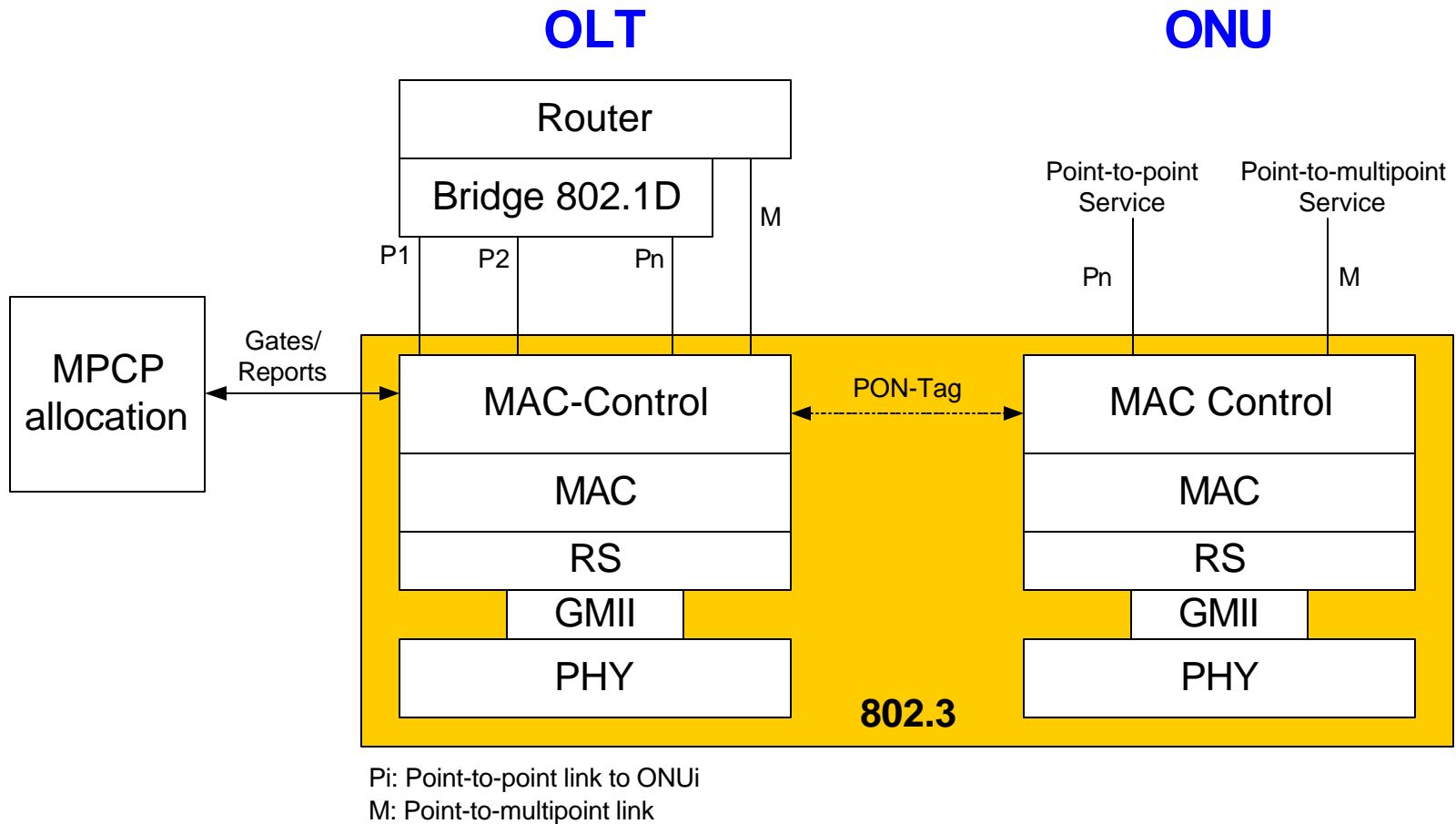- **Two layering architectures are being considered for the multiplexing function:**
  - Reconciliation sublayer multiplexing (RSM)
  - MAC-control multiplexing (MCM)

RS Multiplexing : Architecture

Pi: Point-to-point link to ONUi
M: Point-to-multipoint link

MAC-Control Multiplexing: Architecture

OLT

Router

Bridge 802.1D

P1 P2 Pn M

MPCP allocation

Gates/ Reports

MAC-Control

MAC

RS

GMII

PHY

802.3

PON-Tag

ONU

Point-to-point Service

Point-to-multipoint Service

Pn M

MAC Control

MAC

RS

GMII

PHY

Pi: Point-to-point link to ONUi
M: Point-to-multipoint link

Summary

- **Important layering decisions**
  - "Native" port that cannot be attached to bridge for single-copy broadcast service
  - A requirement of "router" functionality at OLT and ONU for single-copy broadcast service
  - MPCP at MAC-control layer
  - MPCP allocation a separate block with MAC-control interface
  - Protocol timing at MAC-control
  - Laser control signal direct from MAC-control to PHY
- **Need to decide**
  - Layer of Multiplexing function
- **Additional presentations give more details**