Layering of Point to Point Emulation

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Motivation

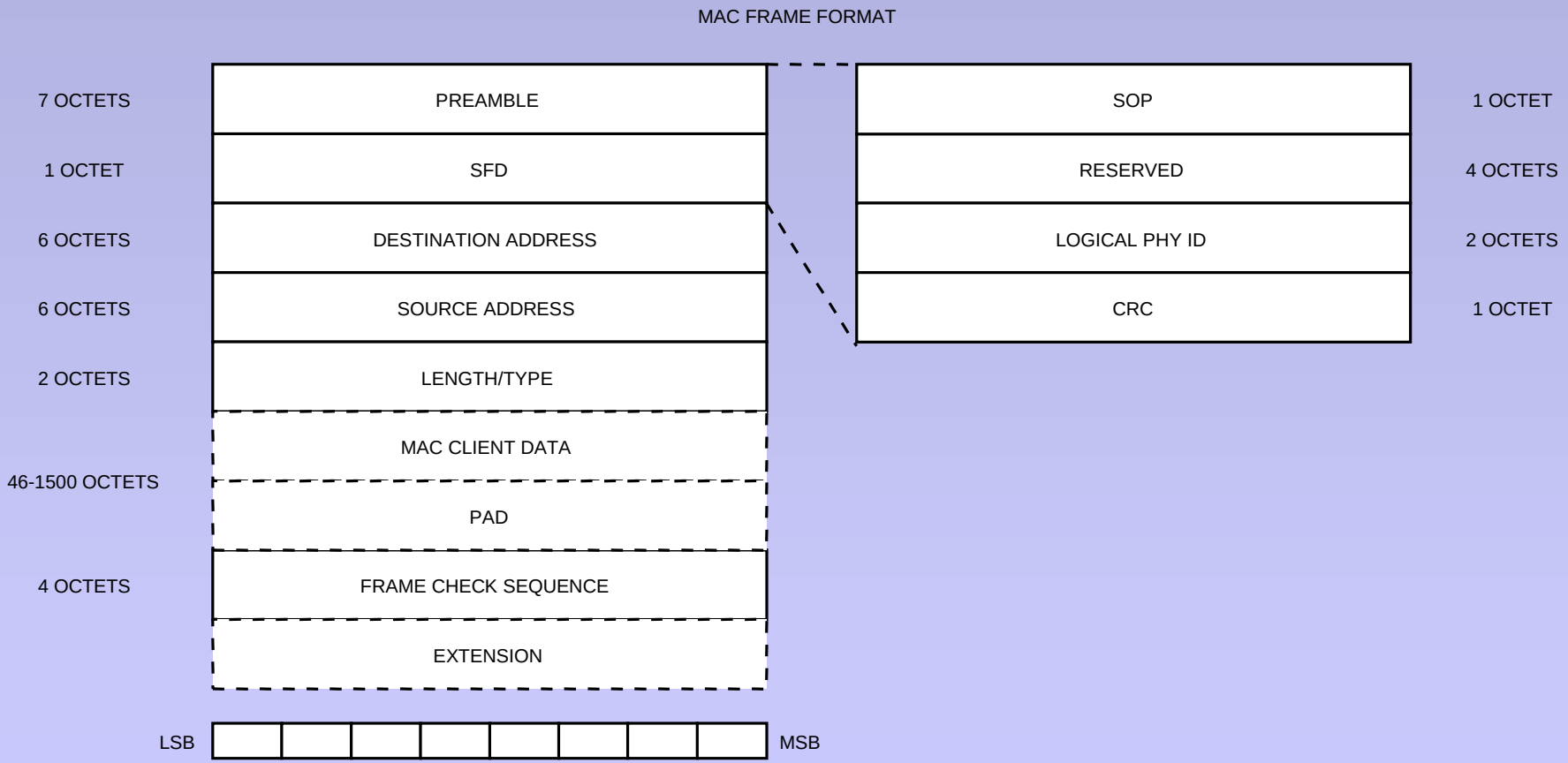
- Solve 802.1D compliance issue in EPONs
- Allow implementation of 802.3x Pause per ONU in EPONs
- Remain backwards compatible

- Link entity may be associated with device
- Link entity may be associated with port or service

Method

- **A layer is defined to multiplex multiple MAC entities into a single PHY**
  - Possibly sitting in RS below MAC
- **Key processes are defined for**
  - Multiplexing
  - Demultiplexing
  - Management

Tagged MAC Frame Format

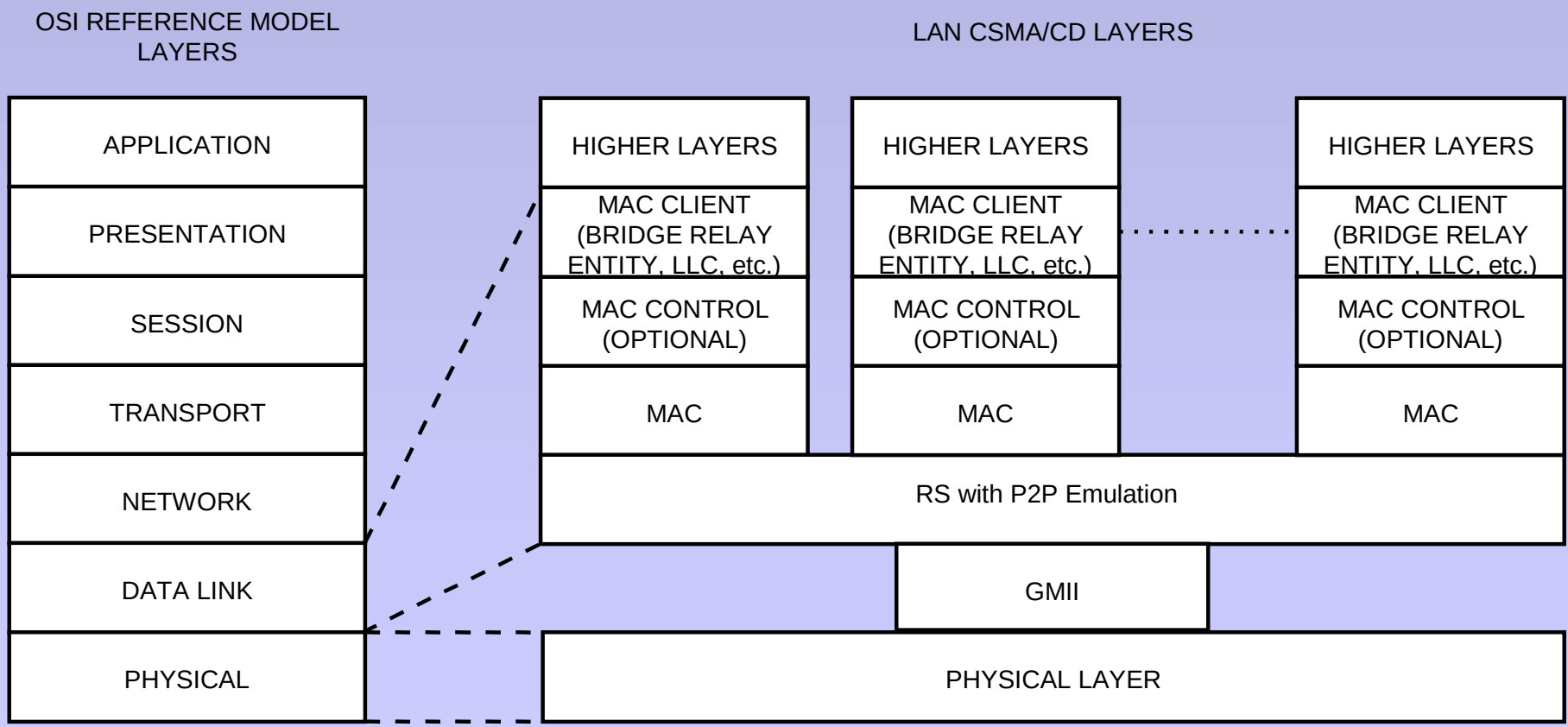


- **Bandwidth is preserved through reuse of existing preamble**

CRC

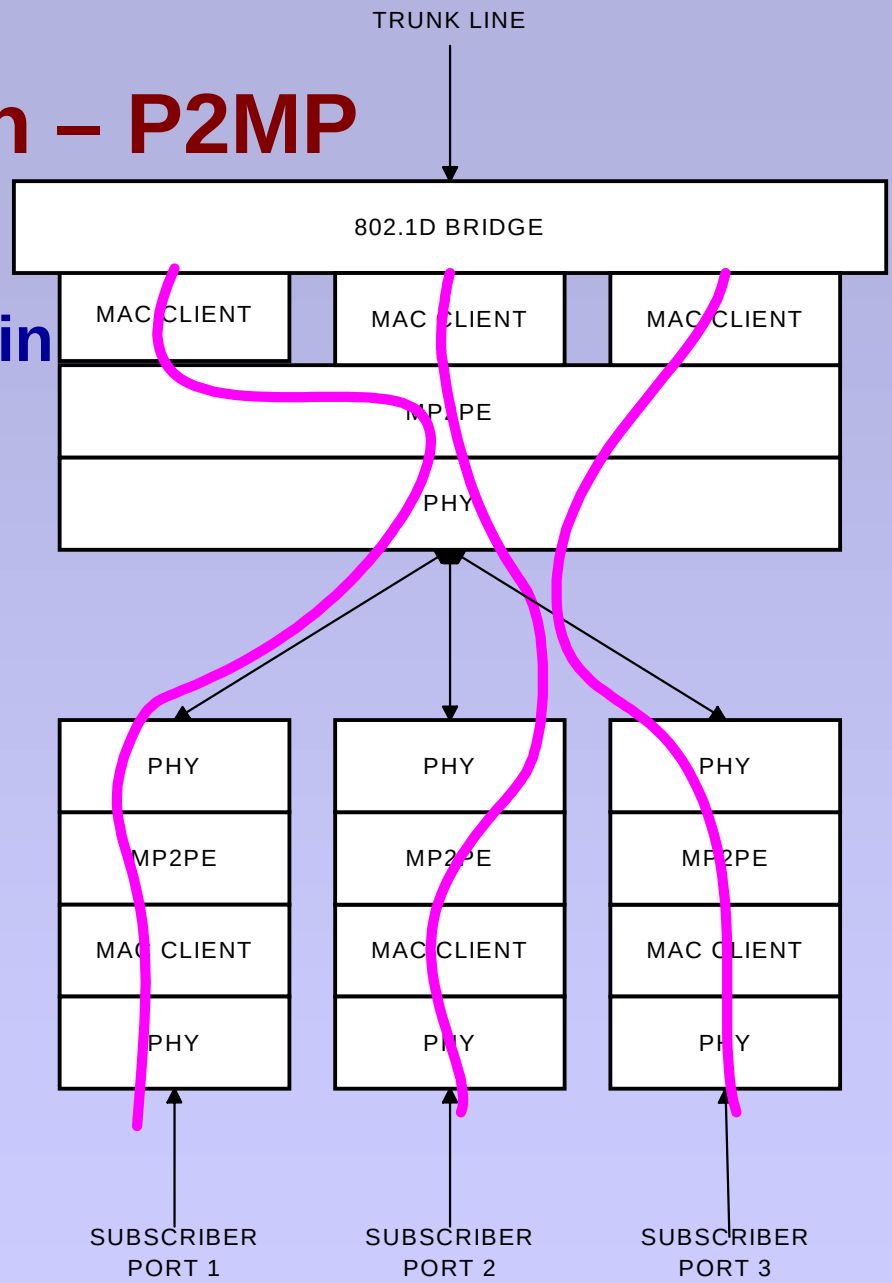
- Motivation: The preamble is not protected by the existing FCS
- Protection is required when demultiplexing in order to avoid collapsing the higher layers
- The generator polynomial x^8 + x^2 + x + 1 is proposed
- Calculated on 6 payload octets

Architectural Position of P2P Emulation Layer



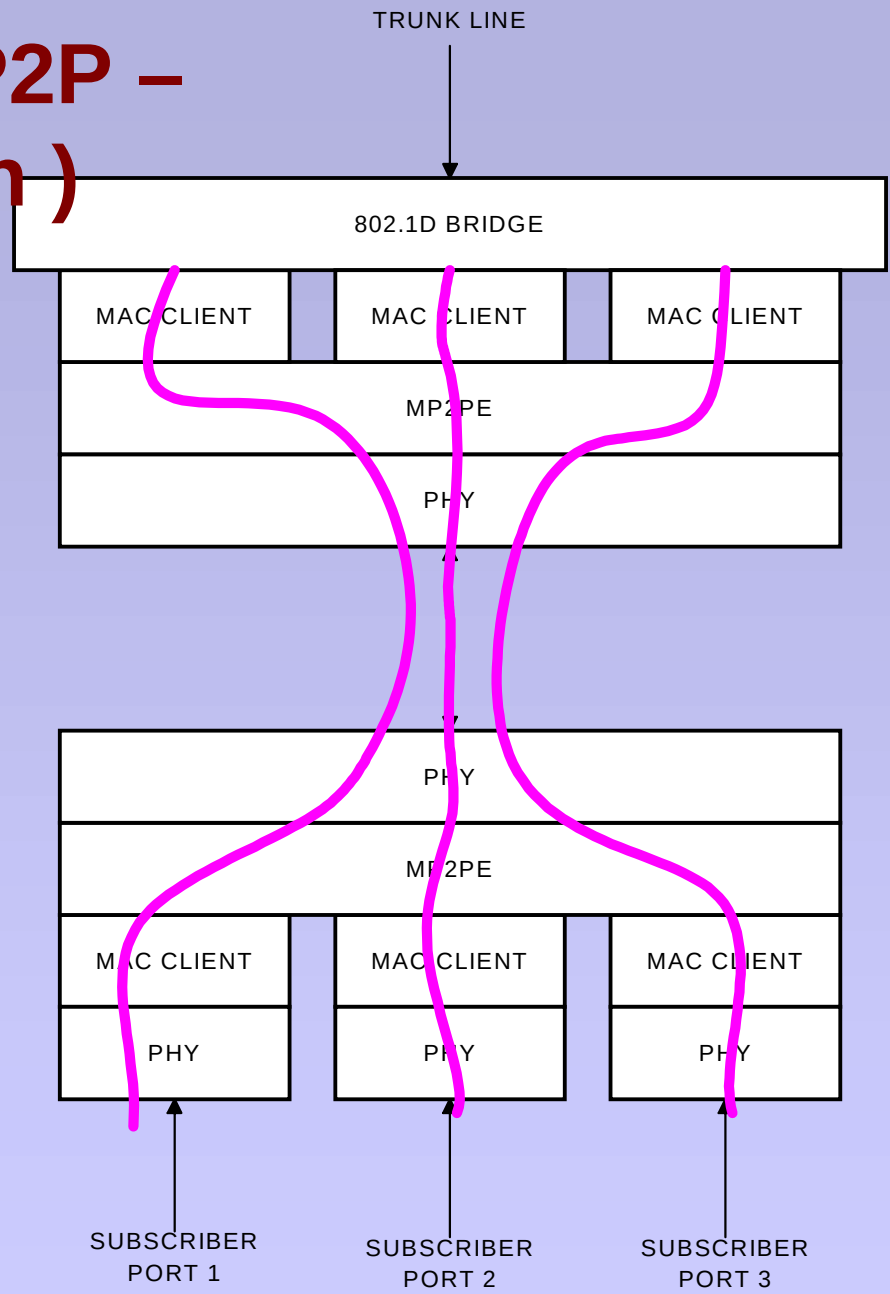
Asymmetrical Operation – P2MP

- Multiple links are created in a distribution network
- Ports are created dynamically, through arbitration

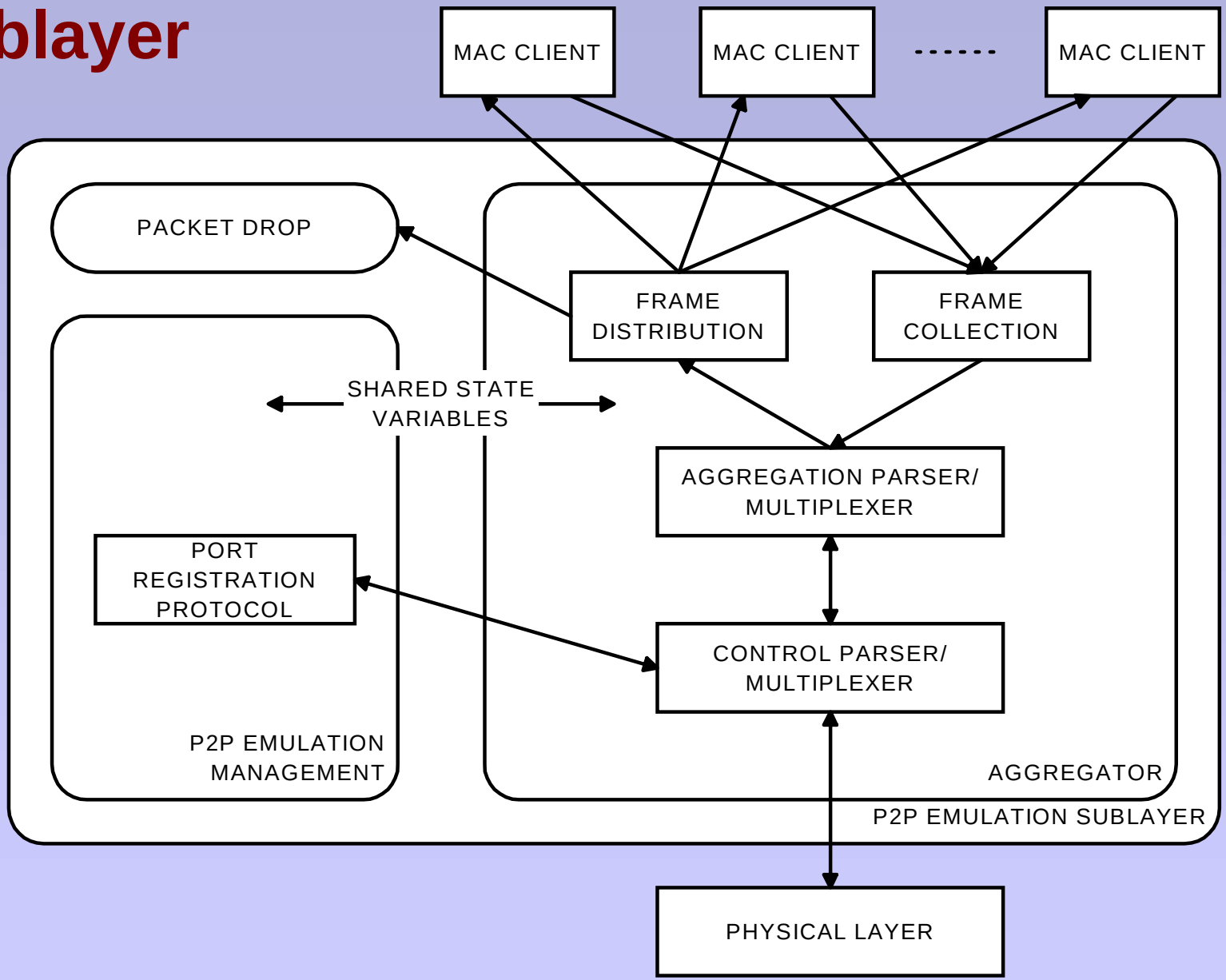


Possible Extension to P2P – (Symmetrical Operation)

- Multiple links are created between two devices
- Ports are created dynamically, through arbitration



Sublayer


MAC CLIENT
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PACKET DROP
FRAME DISTRIBUTION
FRAME COLLECTION
SHARED STATE VARIABLES
AGGREGATION PARSER/ MULTIPLEXER
PORT REGISTRATION PROTOCOL
CONTROL PARSER/ MULTIPLEXER
P2P EMULATION MANAGEMENT
AGGREGATOR
P2P EMULATION SUBLAYER
PHYSICAL LAYER

Frame Distribution

- **Drop any incoming frame that is not:**
  - Registered Logical PHY ID
  - Broadcast Logical PHY ID
- **Select MAC clients based on client ID**
  - MAC client is associated with link at link creation
  - All clients are associated with a broadcast link

Frame Collection

- **Unicast Logical PHY ID is preppended to frame**
- **Broadcast and multicast frames are duplicated across ports due to bridge behavior**
  - Optimizing mechanisms might transform duplicated packets into broadcast tagged packets
  - Optimization mechanism unspecified
- **Frame is forwarded to MAC for transmission**

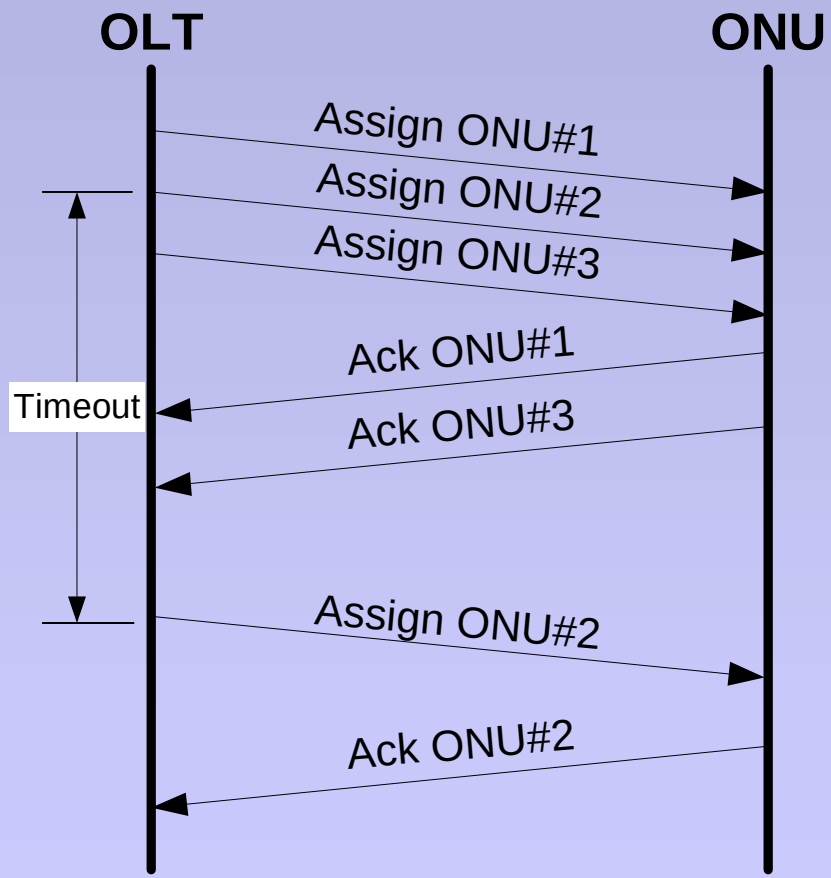
Port Registration Protocol

- In an access environment Uplinks are distinguishable from Downlinks
- Device transmitting downlink is designated as the OLT
- Device receiving downlink is designated as an ONU
- MAC addresses are used to distinguish between end stations
- Protocol is defined similarly to LACP using Slow Protocol

MP2PE Layer Control

- **3 control messages:**
  - Assign Logical PHY ID (OLT → ONU)
  - Release Logical PHY ID (OLT → ONU)
  - Logical PHY ID Acknowledge (ONU → OLT)
- **A message is sent to a specific ONU**

Example Sequence



Pause Operation

- P2PE defines a MAC entity per ONU/subscriber
- Pause can be performed per Logical PHY ID
- Buffering at the 802.1D bridge ensures no frames are lost

Optional / Mandatory

- P2PE Layer is optional
- Implementation allows for grater capability in P2P networks
- SFD is preserved, allowing reception of tagged frames using untagged receivers
- Broadcast tag is set to legacy preamble

Backwards Compatibility

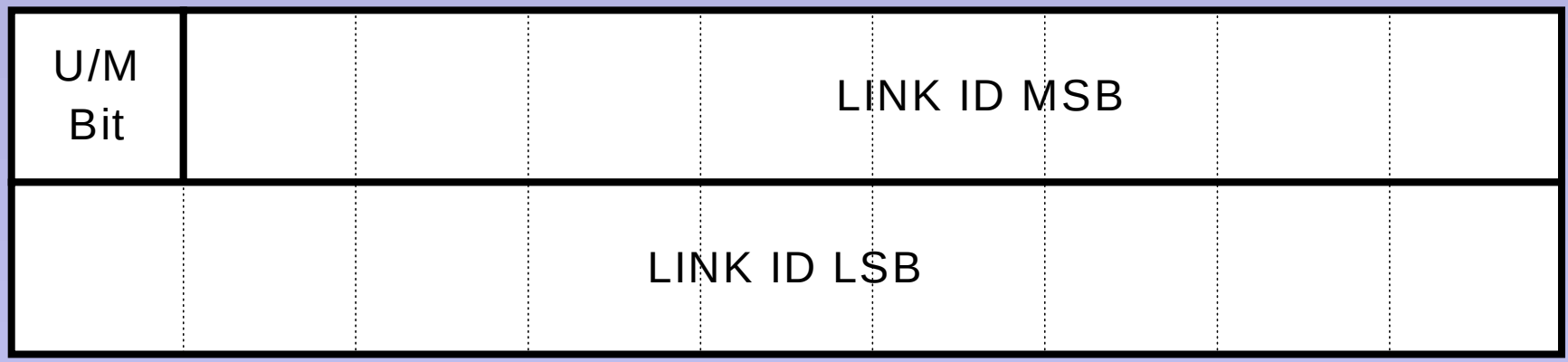
- **Logical PHY tag containing:**
  - 10101010 10101010 10101010 10101010 10101010 10101010 10101010 10101010
- Equivalent to broadcast tag with valid CRC
- Unimplemented P2P Emulation layer will collapse to a single link

Summary

- Layering of P2P Emulation shown
- Support of 802.1D bridging is possible in PONs
- Enhanced functionality in P2P Ethernet
- Slow Protocol used for Port Registration Protocol
- Layering supports per ONU Pause in PONs
- Backward compatibility available for incremental deployment

Backup Slides

Address Space



- **U/M bit specifies unicast vs. multicast address**
- **Default broadcast tag defined as “10101010 10101010”**
- Multicast tags allow single transmission for media broadcast

Assign Logical PHY ID Message

- **OLT sends "Assign Logical PHY ID" when registering a new ONU or port**
- **Sent using broadcast PHY ID**
- **MAC address of ONU learned through auto-discovery process**
- **Message is acknowledged**
- **Message includes one parameter:**
  - Logical PHY ID value [2 bytes] – new Logical PHY ID value

Release Logical PHY ID Message

- **OLT sends “Release PHY ID” when deregistering an ONU or port**
- **Sent using Logical PHY ID**
- **Message is acknowledged**
- **Message includes one parameter:**
  - Logical PHY ID value [2 bytes] – Deregistered Logical PHY ID value

Logical PHY ID Acknowledge Message

- **ONU sends “Logical PHY ID Acknowledge” after receiving either “Assign Logical PHY ID” or “Release Logical PHY ID”**
- **Sent using Logical PHY ID**
- **Message includes two parameter:**
  - Logical PHY ID value [2 bytes] – Logical PHY ID field in acknowledged message