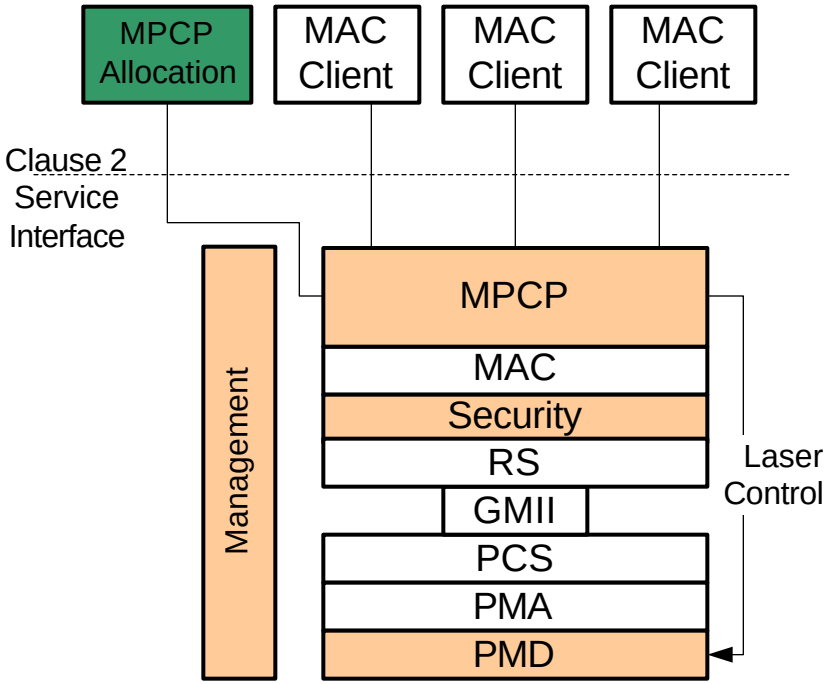
EPON Layering

Layering Requirements

- Architecture should guarantee zero jitter below MPCP
- Support of multiple LLIDs per ONU
- Ability to grant per ONU
- Ability of multiple LLIDs transmitting in the same grant
- Counters per LLID
- Need to decide if Pause as defined in clause 31 is a requirement

Layering Architecture



- **Use of standard interfaces**
- **MPCP as a single control layer with global view of the system**
- **MAC with no modifications**
- **New layers use standard interfaces**
- **Security below MAC to include in the encryption MAC addresses and FCS**
- **Define the new management entities for the added functionality**

MPCP needs additions in shaded areas

OLT Upstream View

- **Link Management**
  - OLT MAC counters are udpated for global state
  - Independent LLID counters can be supported if desired
  - For some counters, the sum of LLID counters does not equate to OLT counter
    - If error in the tag, LLID is not known
- **Demultiplexing**
  - Since there is only one MAC, frame goes up the stack
  - The tag is stripped and information is stored in a variable (similar to the laser control signal)
- **MPCP flow**
  - The MAC passes up to MPCP
  - MPCP processes REPORT frames
  - MPCP passes the frames to the appropriate LLID interface

OLT Downstream View

- **Link Management**
  - OLT MAC counters are udpated for global state
  - Independent LLID counters can be supported if desired
  - In this case, the sum of LLID counters does equate to OLT counter
- **Arbitration**
  - At a given time only one entity of MAC control is enabled transmission. Since there is only one MAC control, only one frame is delivered.
  - Tag is added based on MAC client entity
- **MPCP flow**
  - MPCP adds time stamp when frame is passed to MAC
  - MPCP generates GATEs with the appropriate tag information (LLID, mode bit)

ONU Upstream View

- **Link Management**
  - ONU MAC counters are udpated for global state
  - Independent LLID counters can be supported if desired
  - In this case, the sum of LLID counters does equate to ONU counter
- **Demultiplexing**
  - At a given moment only one ONU is enabled, within the ONU the MAC control enables only one MAC client for transmission.
  - Tag is added based on MAC client entity
- **MPCP flow**
  - MPCP adds time stamp when frame is passed to MAC
  - MPCP generates REPORTs with the appropriate tag information (LLID, mode bit)

ONU Downstream View

- **Link Management**
  - ONU MAC counters are udpated for global state
  - Independent LLID counters can be supported if desired
  - For some counters, the sum of LLID counters does not equate to ONU counter
    - A broadcast frame can be sent once but is received by all LLIDs
- **Demultiplexing**
  - Frame is dropped if LLID does not exist in ONU
  - Tag is stripped
  - Frame is forwarded to the appropriate client based on LLID
- **MPCP flow**
  - The MAC passes up the frame to MPCP
  - MPCP processes GATE frames
  - MPCP passes the frames to the appropriate LLID interface

Summary

- **An architecture design that offers a global view for the MPCP to control the PON**
- **It can be specified with no changes in service interface**
- **It supports**
  - A single MAC control layer to collect and distribute information from/to the entire PON
  - ONU granting with multiple LLIDs sharing the same burst
  - Management of ONU and OLT as global entities
  - Management of LLIDs as individual entities
  - Accurate management counters

Decisions

- **Decide Functionality**
- **Decide multiplexing Layering**
- **Decide Tagging operation**

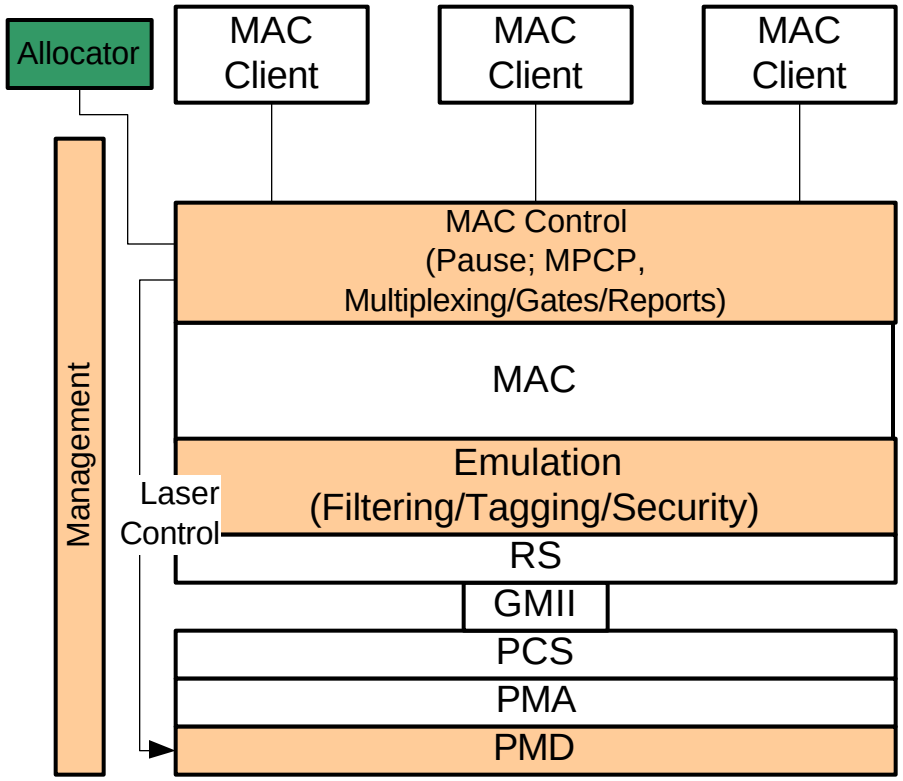
Functionality

- **Support of granting per ONU**
- **Support of counters per LLID**
- **Support of counters per ONU**
- **Support of pause per LLID**
- **Support of pause per ONU**

Multiplexing Layering

- **Above MAC-control**
  - A problem if MAC-control is extended to generate frames without MAC-client intervention
- **Below MAC-control**
  - Guarantees that no frames are generated below
- **Inside MAC-control**
  - Arbitrates MAC-clients and order of execution of MAC-control functions

Proposed Multiplexing Layering



- **All MPCP functions (including multiplexing) defined as new MAC control functions**

Clause 30: Current Specification

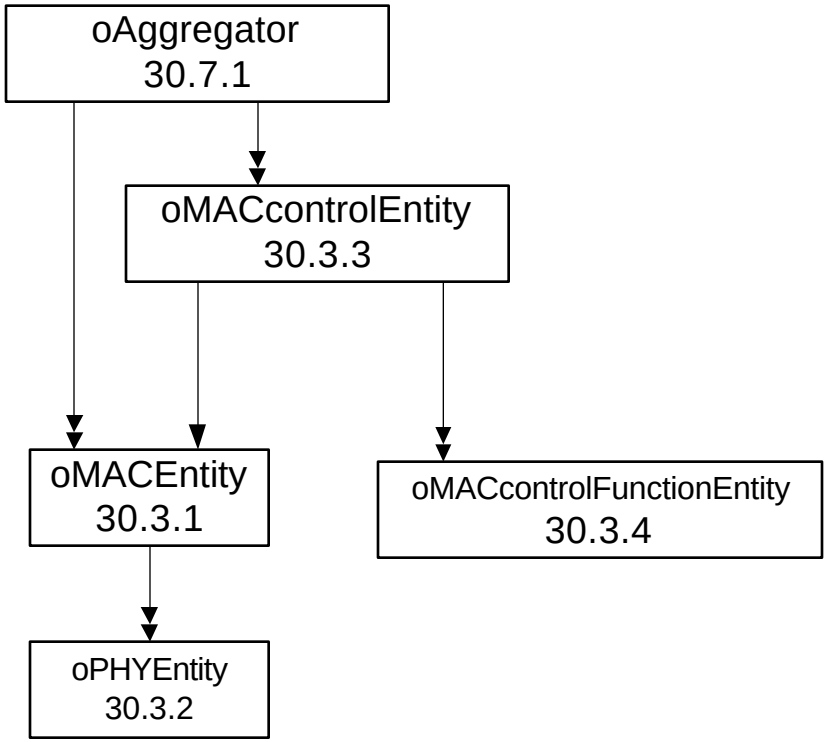
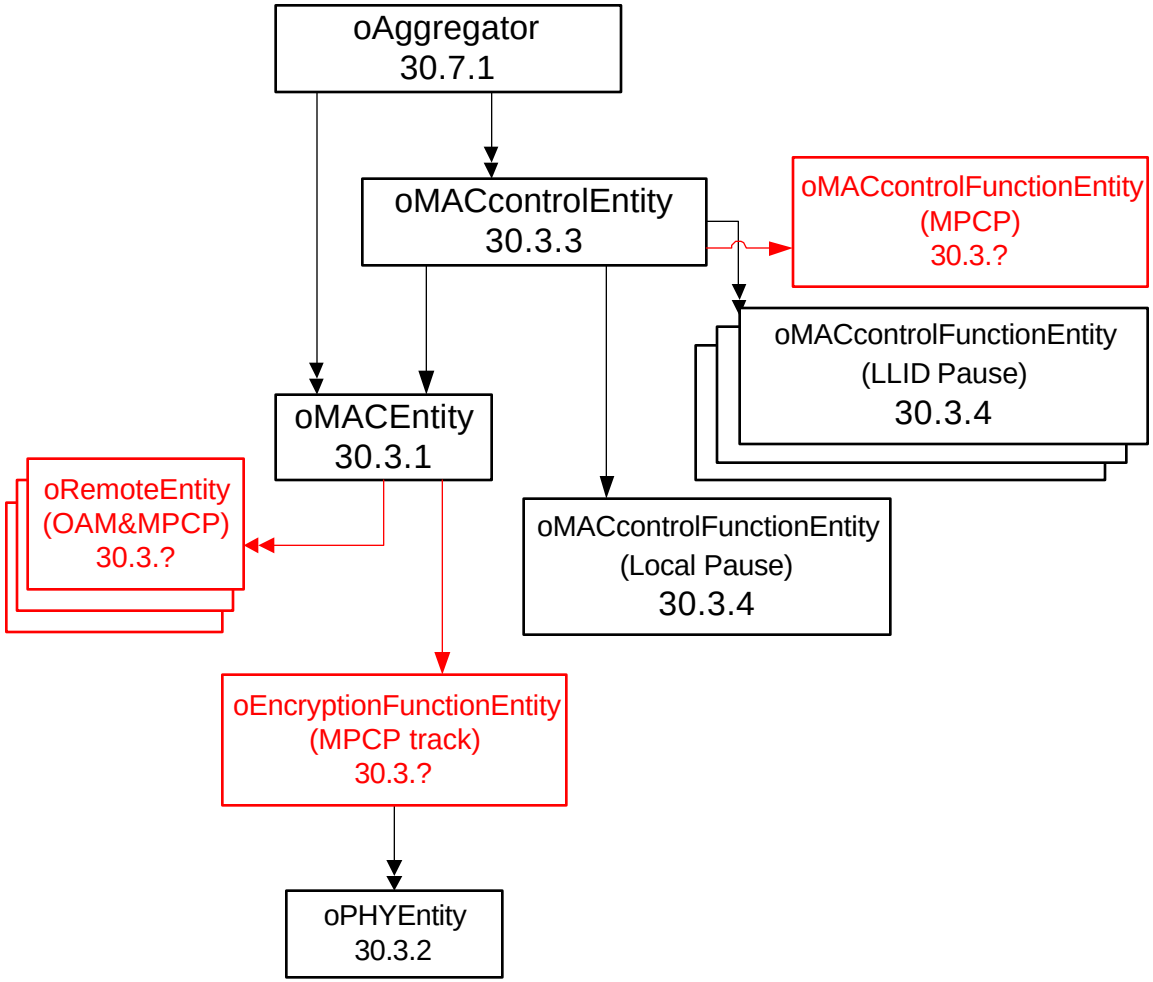


Fig. 30-3 Ethernet Spec 2000

Clause 30: Additions



Added objects shown in red. At least an entity of each object is needed in both layering approaches

Tagging Operation (1)

- **The baseline attaches a tag to a frame in the preamble. Several mechanisms to internally pass tag information across layers within a device:**

- **Option 1: Similar to Laser control signal**
  - Define registers and decide who writes and reads them
    - TxLLID, TxEncOn, TxEncIndex, written by MAC-control and seen by all lower layers
    - RcvLLID, RcvEncOn, RcvEncIndex written by RS layer and seen by all upper layers

- **Option 2: Let information travel with frame across layers using existing interface**
  - The first few bytes of the msdu can be fields used for the tag
  - CRC is computed including this tag in the middle of the frame
  - CRC is recompute and replaced at the RS without considering the tag information

- **Option 3: Let information travel with frame across layers by extending existing interface**
  - Add a tag field to TransmitFrame, ReceiveFrame to pass information from MAC control to RS
  - MAC only needs to transparently pass this information

Tagging Operation (2)

- **Option 4: Use of multiple MACs**
  - Valid as long as we can have a MAC for each different tag value: LLID, bit mode, encryption fields
- **Option 5: Pass tag with a new Ethertype**
  - Implies an Increase of MaxFrameSize
- **Option 6: Combinations**
  - Maintain LLID and bit mode in preamble with one option 1-4 and additional fields such as encryption in an EtherType
  - Still requires increase of MaxFrameSize but keeps flexibility

Recommendations

- **Functionality**
  - Support granting per ONU
  - Support counters per LLID
  - Support counters per ONU
  - Support pause per LLID
  - Support pause per ONU
- **Multiplexing layer**
  - A function within MAC-control
- **Tagging mechanism**
  - Depends on other decisions and functionality
  - Recommend: Use Option 1 for information in preamble and define a PON-tag EtherType for additional functionality

Motion: Multiplexing Layer

- **Adopt sala_general_1_0702.pdf slides 2-8 as the baseline for MPCP multiplexing layering**