Reassembly Buffer and Working Mechanism

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Background

- kramer_3ca_1_0117_sar_01.pdf discusses dimensioning of reassembly buffers at the OLT, points out the reassembly buffer problem and presents several methods.
  - How to support a large number of ULIDs/PLIDs while keeping memory requirements reasonable?
  - What is the reasonable reassembly buffer size?
- Other ideas are called for.

Problem Statement

- 100G-EPON supports up to 56K ULIDs and 4K PLIDs (see kramer_3ca_1b_0916.pdf)
- 100G-EPON needs to support jumbo frames (10KBytes)
- Static memory allocation is not feasible
  - 60K x 10KB = 600 MBytes
- **How to support a large number of ULIDs/PLIDs while keeping memory requirements reasonable?**
- **What is the reasonable reassembly buffer size?**
  - 2MB, 4MB?
  - Examples in this presentation will assume 4MB reassembly buffer per PON port

Summary

- Method #1 – Static Flow Limit
- Method #1a – Static Flow+Frame Limit
- Method #2 – Dynamic Slot Reservation
- Method #2a – Dynamic Allocation
- Method #3 – Static Frame/Dynamic Slot
- Method #4 – Token Granting

- Any other ideas?

- Straw Polls

Concept of fragmentable flow

- kramer_3ca_1_0117_sar_01 introduces the concept of fragmentable flow.

- A fragmentable flow
  - may generate fragments on ONU side and need reassembly buffer on OLT side.
  - means a ULID which is allowed to send fragments.

- The number of fragmentable flows
  - equals the number of ULIDs supporting fragment.
  - decides the size of needed reassembly buffer.
  - should not overload the maximum reassembly buffer.

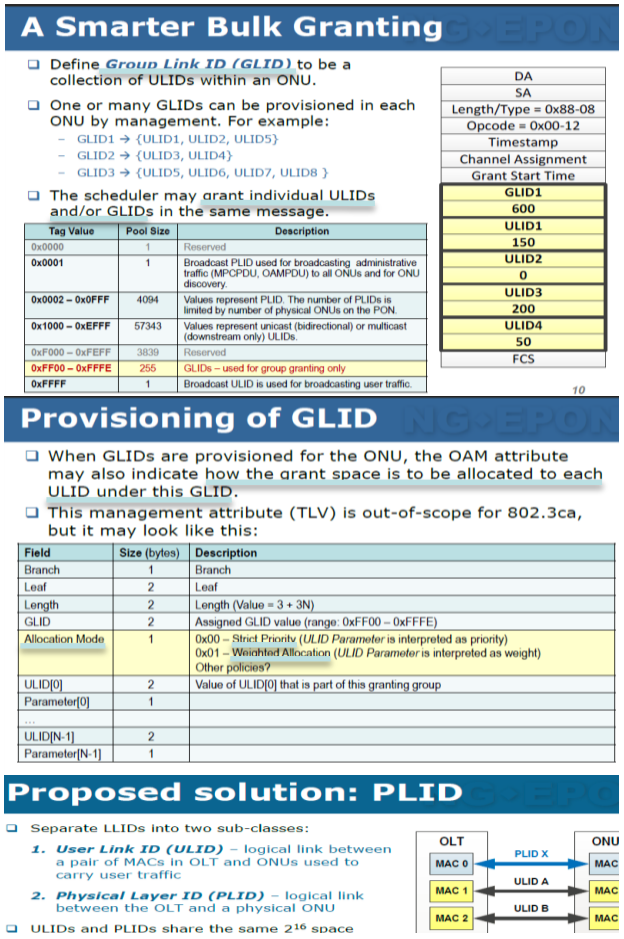
- How to support a large number of ULIDs/PLIDs while keeping memory requirements reasonable?
  - To limit the number of fragmentable flows. HOW?

Method #1 – Static Flow Limit

- Limit the number of fragmentable flows
- Add a field to the ULID assignment attribute to indicate whether that ULID is allowed to send fragments or not.
- Each fragmentable ULID gets a 10K reassembly slot permanently assigned to it.
  - With 4MB buffer and 10KB max frame size, we can have 400 fragmentable ULIDs per PON.
- 400 ULIDs out of 56K is just 0.7%.
- Unfragmentable ULIDs constitute the majority and will cause transmission inefficiency because OLT does not know the frame boundaries
- Hooks required from 802.3ca: a flag (boolean field) in the ULID assignment attribute

Concept of Group Link ID (GLID)

- kramer_3ca_1a_0916_PLID_ULID shows the concept of Group Link ID (GLID).
  - A GLID is a collection of ULIDs within an ONU.
  - OLT may grant individual ULIDs and/or GLIDs.
  - The grant for a GLID is further allocated to member ULIDs according to the configured allocation mode.
  - A member ULID still represents an individual fragmentable flow.
- Is it possible that member ULIDs are not granted?
  - Member ULIDs share the grant for their GLID.
  - A member ULID does not represent an individual fragmentable flow any more.
- Note: PLIDs and ULIDs are both LLIDs, so a PLID could be independent or merged into a GLID.



A Smarter Bulk Granting

- Define *Group Link ID (GLID)* to be a collection of ULIDs within an ONU.
- One or many GLIDs can be provisioned in each ONU by management. For example:
  - GLID1 → {ULID1, ULID2, ULID5}
  - GLID2 → {ULID3, ULID4}
  - GLID3 → {ULID5, ULID6, ULID7, ULID8 }
- The scheduler may grant individual ULIDs and/or GLIDs in the same message.

Tag Value	Pool Size	Description
0x0000	1	Reserved
0x0001	1	Broadcast PLID used for broadcasting administrative traffic (MPCPDU, OAMPDU) to all ONUs and for ONU discovery.
0x0002 – 0x0FFF	4094	Values represent PLID. The number of PLIDs is limited by number of physical ONUs on the PON.
0x1000 – 0xEFFF	57343	Values represent unicast (bidirectional) or multicast (downstream only) ULIDs.
0xF000 – 0xFEFF	3839	Reserved
0xFF00 – 0xFFFE	255	GLIDs – used for group granting only
0xFFFF	1	Broadcast ULID is used for broadcasting user traffic.

DA
SA
Length/Type = 0x88-08
Opcode = 0x00-12
Timestamp
Channel Assignment
Grant Start Time
GLID1
600
ULID1
150
ULID2
0
ULID3
200
ULID4
50
FCS

10

Provisioning of GLID

- When GLIDs are provisioned for the ONU, the OAM attribute may also indicate how the grant space is to be allocated to each ULID under this GLID.
- This management attribute (TLV) is out-of-scope for 802.3ca, but it may look like this:

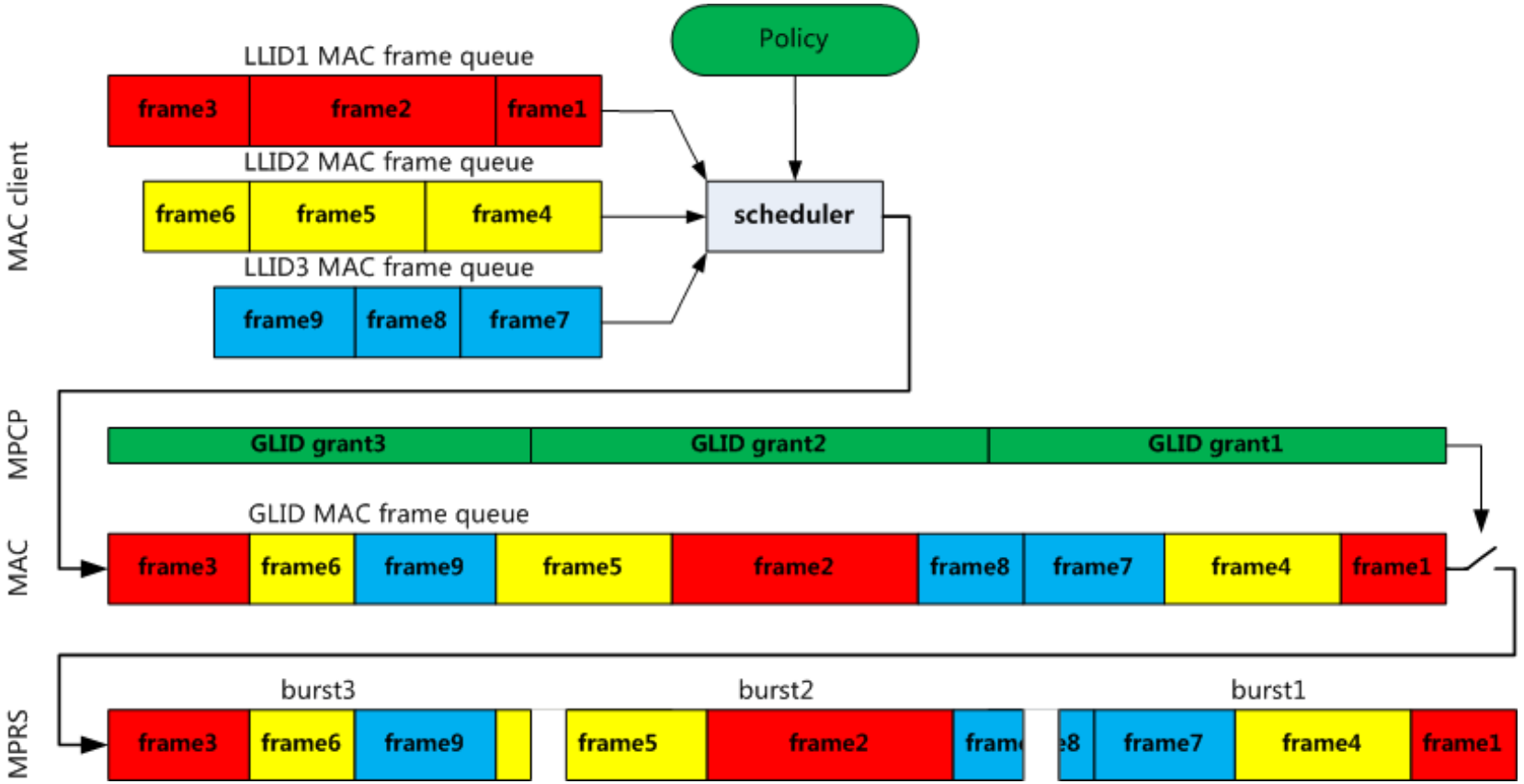
Field	Size (bytes)	Description
Branch	1	Branch
Leaf	2	Leaf
Length	2	Length (Value = 3 + 3N)
GLID	2	Assigned GLID value (range: 0xFF00 – 0xFFFE)
Allocation Mode	1	0x00 – Strict Priority (*ULID Parameter* is interpreted as priority) 0x01 – Weighted Allocation (*ULID Parameter* is interpreted as weight) Other policies?
ULID[0]	2	Value of ULID[0] that is part of this granting group
Parameter[0]	1	
…		
ULID[N-1]	2	
Parameter[N-1]	1	

Proposed solution: PLID

- Separate LLIDs into two sub-classes:
  1. ***User Link ID (ULID)*** – logical link between a pair of MACs in OLT and ONUs used to carry user traffic
  2. ***Physical Layer ID (PLID)*** – logical link between the OLT and a physical ONU
- ULIDs and PLIDs share the same 2^{16} space

Member ULIDs of one GLID share grants

- Member ULIDs of one GLID share grants.
  - MAC frames from member ULIDs are scheduled into a queue of GLID MAC frames, based on scheduling policies (e.g., strict priority or weight of each member ULID).
  - ONU sends frames and/or fragments from GLID MAC frame queue to OLT.
  - GLID is granted but its member ULIDs share the grant.



Member ULIDs of one GLID share grants (continued)

- Fragment is potentially generated at the end of a GLID grant, and the remaining fragment is sent at the beginning of the next GLID grant.
  - Member ULIDs potentially support fragment.
  - Any member ULID does not represent an individual fragmentable flow.
  - A GLID represents an individual fragmentable flow which needs reassembly buffer on OLT side.
- Only independent ULIDs and GLIDs represent individual fragmentable flows.
- By grouping ULIDs into a GLID, the number of fragmentable flows can be reduced.
- At minimal, the number of fragmentable flows equals the number of ONUs, because an ONU supports at least one fragmentable flow.

Reasonable reassembly buffer size / fragmentable flows

- The reassembly buffer size is designed by OLT vendors, based on operators' requirements.
  - Operators are encouraged to provide the requirements of reassembly buffer.
- When the configured ULIDs do not overload the reassembly buffer, they are individually granted, otherwise, some of them should be grouped into one or more GLID(s), based on operators' policy.
- The reassembly buffer should at least support one fragmentable flow per ONU.

Summary and proposals

The size of reassembly buffer is designed by OLT vendors. We propose:

1. The reassembly buffer should support at least one fragmentable flow per ONU.

2. Multiple ULIDs can be grouped into one GLID, to reduce the number of fragmentable flows.

   - OLT grants GLIDs instead of its member ULIDs.

   - MAC frames of member ULIDs are scheduled into one queue of MAC frames, to share the GLID grant.

Thank You