NG-EPON Fragmentation

Open Discussion

- Don't forget our CFI:
  - We Steal
  - We Fight

What is needed to fragment?

- Definition of min fragment size
  - FEC CW has been suggested
  - This might change depending on final FEC decision.
- Control signal from MPCP+ to control:
  - Burst start
    - Frame start
      - Fragment end
      - Fragment start
    - Frame end
  - Burst end
- Indication to receiver of each of the above

Min fragment size

- Things to consider during FEC selection if it is also related to fragmentation
  - How small (granular) is the FEC data size?
  - How well does the FEC data size match the shortened 64B/66B line code size?

Steal from Preemption

- Ctrl Signal: MM_CTL.request
  - Two values
    - Hold
    - Release
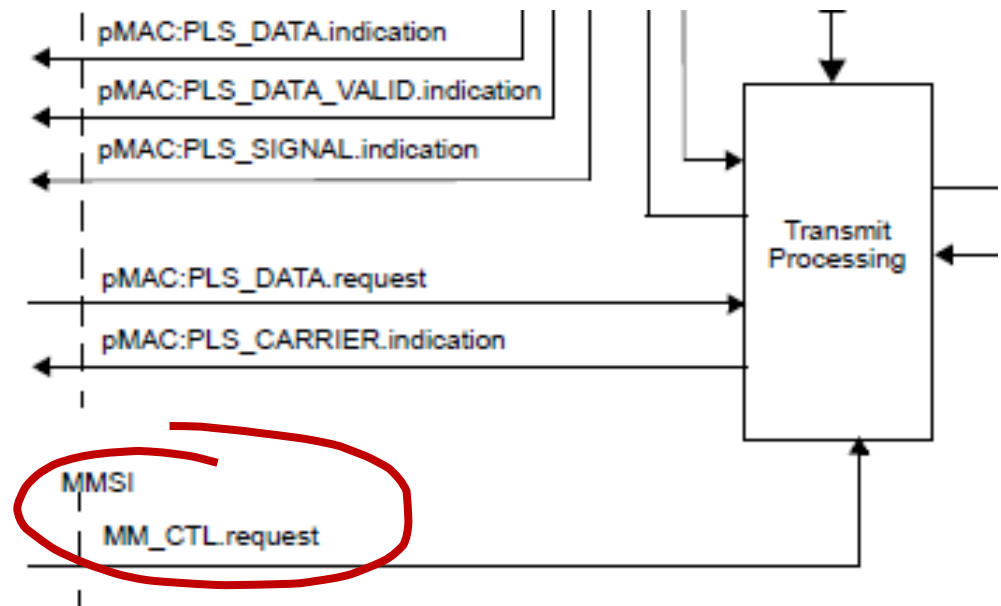
Excerpt from Fig 99-3

Control

- Invent new signal to control fragmentation similar to MM_CTRL.request
- EF_CTRL.request (EPON Fragment)
  - Determines transmit enable/disable
  - Determines Lane use 1, 2, 3, 4
  - Ex. 4b bit mapped signal
    - `0b0000` = tx disable - if transmitting;
      fragment & stop transmission
    - `0bxxx1` = tx enable lane 1
    - `0bxx1x` = tx enable lane 2 ⎫ if DATA.request = 0/1;
    - `0bx1xx` = tx enable lane 3 ⎬ transmit data
    - `0b1xxx` = tx enable lane 4 ⎭

Control

- EF_CTRL.request (EPON Fragment)
  - Determines transmit enable/disable
  - Determines Lane use 1, 2, 3, 4
  - Transition from 0$\Rightarrow$1 "Insert Fragment Start"
  - Transition from 1$\Rightarrow$0 "Insert Fragment Terminate"
  - Change in lane usage always signaled by 0b0000

```
0bxxx1  = Frag enable lane 1
0bxx1x  = Frag enable lane 2
0bx1xx  = Frag enable lane 3
0b1xxx  = Frag enable lane 4
```
if DATA.request = 0/1; transmit fragment

```
0b0000  = Frag disable – if transmitting insert Fragment
          Terminate, cease transmission if duration > 8
          bytes (length of Fragment Terminate marker)
```

What else can we Steal?

- Current Preamble defines
  - Burst start
  - Frame start
  - Can we modify it to also indicate Fragment start?
- Preemption fragments a frame
  - Replaces SFD to indicate:
    - New frame, fragment end, fragment start
- Preemption defines mCRC (see 99.3.6)
  - Marks end of a fragment
  - FCS XORed with 0x0000FFFF
- Frame Check Sequence defines Frame End

☑ Burst start
☑ Frame start
☑ Fragment end
☐ Fragment start
☑ Frame end
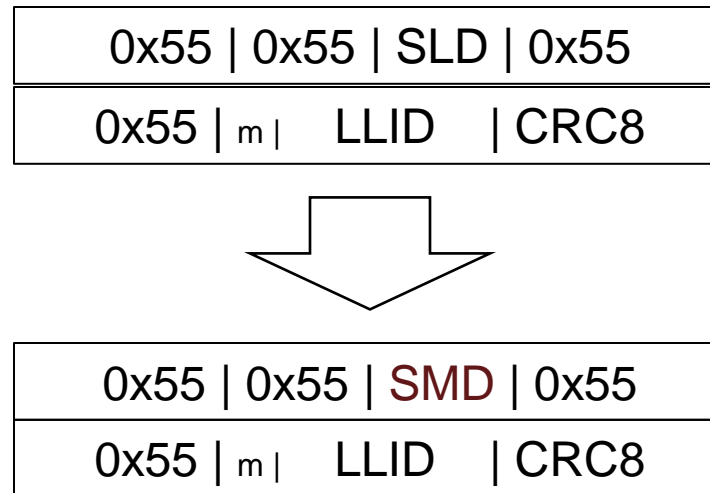☐ Burst end

Steal from Preemption

- SMD (replaces SFD)
  - Frame start
  - Fragment start

☑ Burst start
☑ Frame start
☑ Fragment end
☑ Fragment start
☑ Frame end
☐ Burst end

Table 99–1—SMD values

mPacket type	Notation	Frame count	Value
verify packet	SMD-V	—	0x07
respond packet	SMD-R	—	0x19
express packet	SMD-E	—	0xD5
preemptable packet start	SMD-S0	0	0xE6
	SMD-S1	1	0x4C
	SMD-S2	2	0x7F
	SMD-S3	3	0xB3
continuation fragment	SMD-C0	0	0x61
	SMD-C1	1	0x52
	SMD-C2	2	0x9E
	SMD-C3	3	0x2A

Redefined Preamble

0x55	0x55	SLD	0x55
0x55	m	LLID	CRC8

⬇

0x55	0x55	SMD	0x55
0x55	m	LLID	CRC8

☑ Burst start

☑ Frame start

☑ Fragment end

☑ Fragment start

☑ Frame end

☐ Burst end

- Redefine SLD to include:
  - Frame Start
  - Fragment Start
- Burst always begins with Frame Start or Fragment Start

Alternative

- Rather than try to reuse existing preamble add new one
- Add MII control code to indicate Fragment Start/Terminate
- Include SMD like field to indicate
  - Fragment # (1-4) in N (1-4) Lanes
    - Identifies fragment order for this transmission pattern
    - Any lane can be first, no order or inter lane phase relationship required
- Terminate & Start new fragment whenever a new transmission pattern starts (i.e, add/remove a lane from the burst)

Alternative

- /Fs/ - New control code to signal fragment start/stop over MII
- SFM – Start Fragment Marker
  - Indicates Fragment *f* of transmission in *n* Lanes
  - Ex. for a transmission that occupies all 4 lanes where fragment start order by lane is lane 2, 4, 3, 1

    SFM Lane 1 = 4 of 4
    SFM Lane 2 = 1 or 4
    SFM Lane 3 = 3 of 4 and
    SFM Lane 4 = 2 of 4
  - Need total of 16 values

/Fs/ (tbd)	0x55	SFM (tbd)	0x55
0x55	M | LLID		CRC8

- Use a similar format for fragment Terminate marker

Endings

- Fragments end with mCRC
- Frames end with FCS
- Bursts end with mCRC or FCS

☑ Burst start

☑ Frame start

☑ Fragment end

☑ Fragment start

☑ Frame end

☑ Burst end

We Fight

- Current thinking has been entire frame is sent to a single lane
  - This made sense without fragmentation
  - Aligning bursts was difficult & potentially wasteful of transmission capacity
- Should we reconsider striping frames across lanes?
  - Bursts from all ONUs easily aligned with fragmentation
  - Truly achieves 100Gb/s transmission
  - Eliminates frame reordering issues

Other thoughts?

- In a multi-lane mixed capability network (mix of 25G, 50G & 100G ONUs) how would fragmenting avoid loss of capacity due to gaps between bursts?

- In a multi-lane mixed capability network how could fragmenting allow an ONU that is bursting on x lanes expand its transmission to x+m (ex go from 2 lane transmission to 4 lane transmission) smoothly?

THANKS