FEC_Overhead considerations

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Current situation in D1.1

- FEC_Overhead equation
  - It does not properly account for overhead (bad).
  - Count in units of time_quanta (inefficient).
  - Choice needs to be made between trading off bandwidth and timestamp jitter.

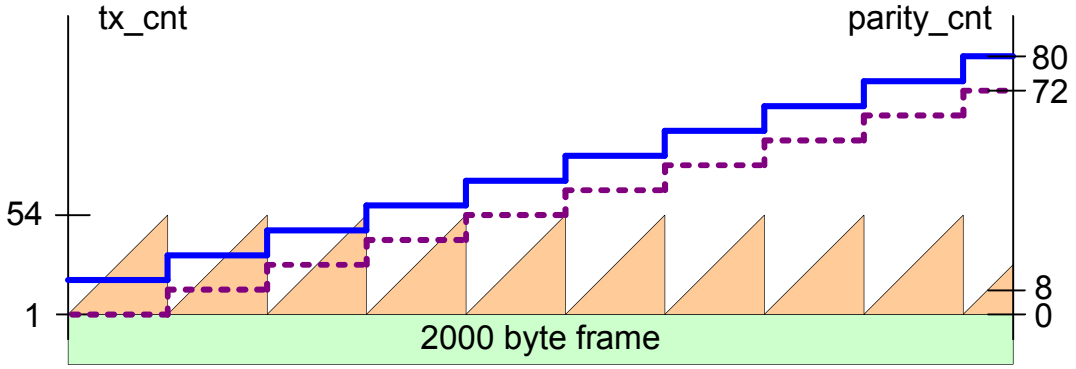
- Determination if last frame fits in burst
  - MPCP has no knowledge of delay MAC may add.
  - Need to know if last frame will fit in burst.
  - Possibility of frame extending beyond grant slot.
  - Equations performing this check need to be fixed.

RS calculation of parity_cnt

- Initial parity_cnt prior to frame will either be 0 or 8.
- For a given frame size, parity_cnt can be calculated as

$$parity\_cnt = \left\lfloor \frac{Length}{4} \times \frac{1}{54} \right\rfloor \times 8 = \left\lfloor \frac{Length}{216} \right\rfloor \times 8$$

- This value will either have 0 or 8 added to it:
  - parity_cnt for 64-byte frame is 0 or 8 columns
  - parity_cnt for 2000-byte frame is 72 or 80 columns
- RS will delay MAC correct number of columns.



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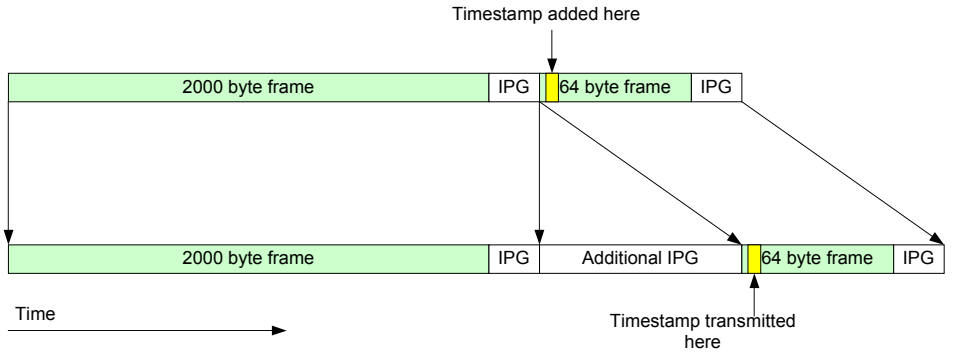
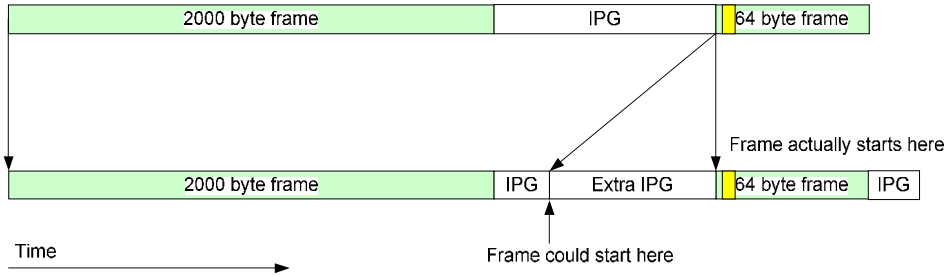
MPCP calculation of FEC_Overhead

- MPCP is not aware of CARRIER_STATUS signal, and does not know how long a frame will be delayed in MAC. The calculated delay can be exact, too little, or too much.

- If the delay is too little, new frame will have timestamp inserted and will be delayed in the MAC while the RS continues to defer the MAC.



- If the delay is too much, there will be wasted bandwidth as MPCP delays a new frame even though the MAC is capable of transmitting one.



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Other issues

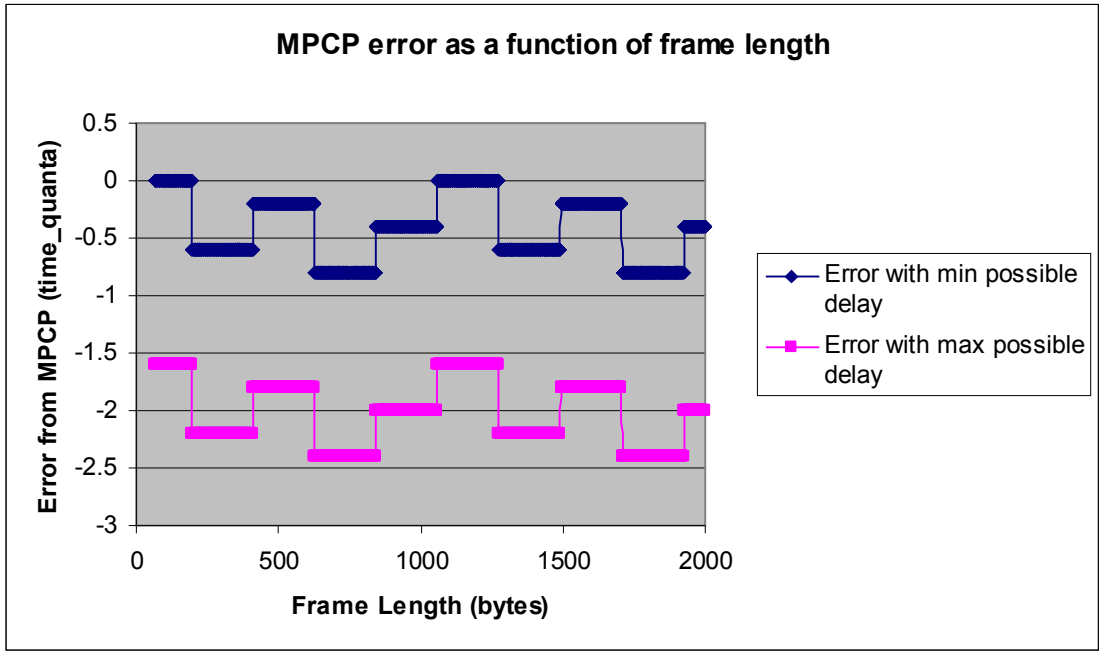
- MPCP layer can only count in terms of full time_quanta, but actual delay added by RS could be a fraction of a time_quanta.
- MPCP layer does not know actual IPG due to addition or removal of IPG from deficit idle count.
- MPCP layer does not know if initial parity_cnt value of previous frame was 0 or 8.

Available options for FEC_Overhead

- Option 1:
  - Round down in all cases.
  - For certain frame lengths MPCP will wait right amount.
  - For certain frame lengths MPCP will not wait long enough.
- Option 2:
  - Round up in all cases and add delay for worst case.
  - For all frame lengths MPCP will wait too long.
- Option 3:
  - Remove FEC_Overhead function.
  - For all frame lengths, MPCP will not wait long enough.
  - Possibly up to 16 time_quanta delay in MAC

Option 1

- No delay in MPCP (no wasted bandwidth)
- Max MAC delay is 2.4 time_quanta



Positive delay means frame is delayed by MPCP (extra bandwidth).
Negative delay means frame is delayed by MAC (timestamp jitter)

Proposal for Comment XXX

- Option 1 is the best solution.
- FEC_Overhead equation for 10G-EPON becomes:

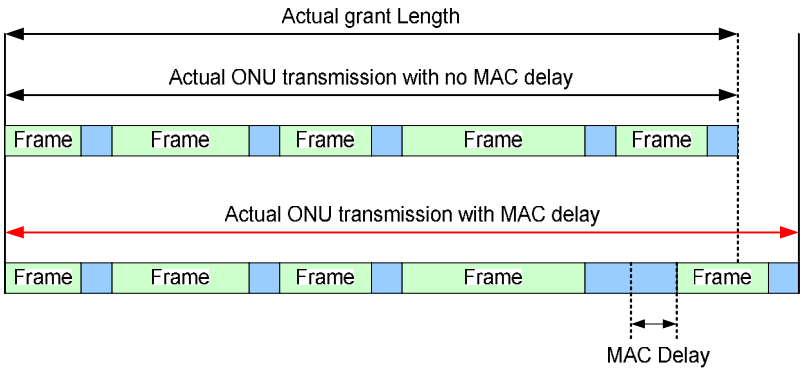
$$FEC\_Overhead = \left\lfloor \left\lfloor \frac{Length}{216} \right\rfloor \times \frac{32}{20} \right\rfloor$$

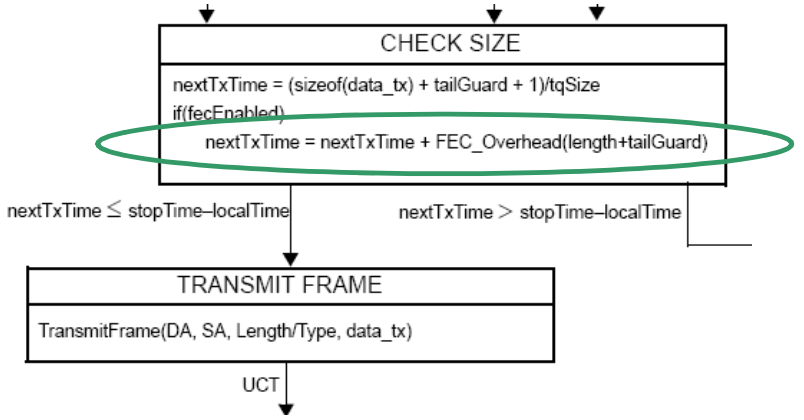
Length = Frame Length + Preamble + Minimum IPG

Frame Length		
Min	**Max**	**Overhead**
64	195	0
196	411	1
412	627	3
628	843	4
844	1059	6
1060	1275	8
1276	1491	9
1492	1707	11
1708	1923	12
1924	2000	14

MPCP allows transmission outside of slot

- After MPCP sends frame to MAC, the frame can still be delayed prior to transmission.
- MPCP has no way of knowing whether or not frame will be delayed and by how much.
- If last frame just fits in grant length, then it will extend outside of the grant slot if delayed by MAC.
- With new FEC_Overhead function, MAC can delay frame by ~3 time_quanta. ONU will overrun grant slot by 384 bit times.
- MAC delay needs to be accounted for
  - Option 1: ONU solves problem
  - Option 2: OLT solves problem





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Proposal for Comment XXX

- Option 1 – ONU solves problem
  - Fix equation that decides if next frame fits in burst
  - Changes to state diagram, different behavior for 1G and 10G ONUs
  - Since ONU must assume worst case, it is possible for frame that otherwise would have fit in burst to be pushed off until next burst.
- Option 2 – OLT solves problem
  - OLT can increase guard band between bursts to account for anticipated delay in MAC
  - State diagrams for ONU stay the same
  - ONU is allowed to send extra frame
  - No changes needed to draft except possibly informative note.

Propose that Option 2 is used