Start-of-Frame Alignment Within 66-bit Block

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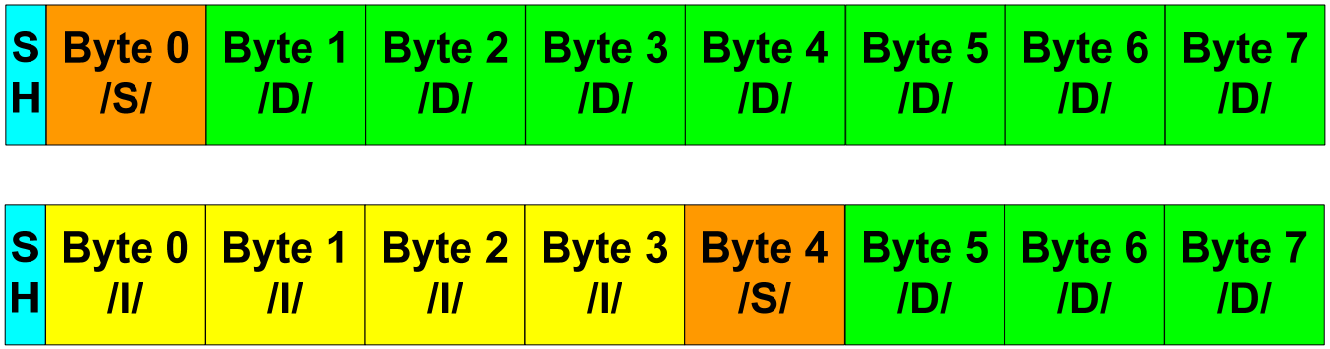
Overview and Definitions

- In PCS, two 36-bit XGMII words are combined into one 72-bit vector (tx_raw<71:0>).
- tx_raw<71:0> is then encoded into 66-bit block
- In XGMII word, /S/ is always aligned to lane 0.
- Within 66-bit block, /S/ may appear in byte 0 or byte 4.

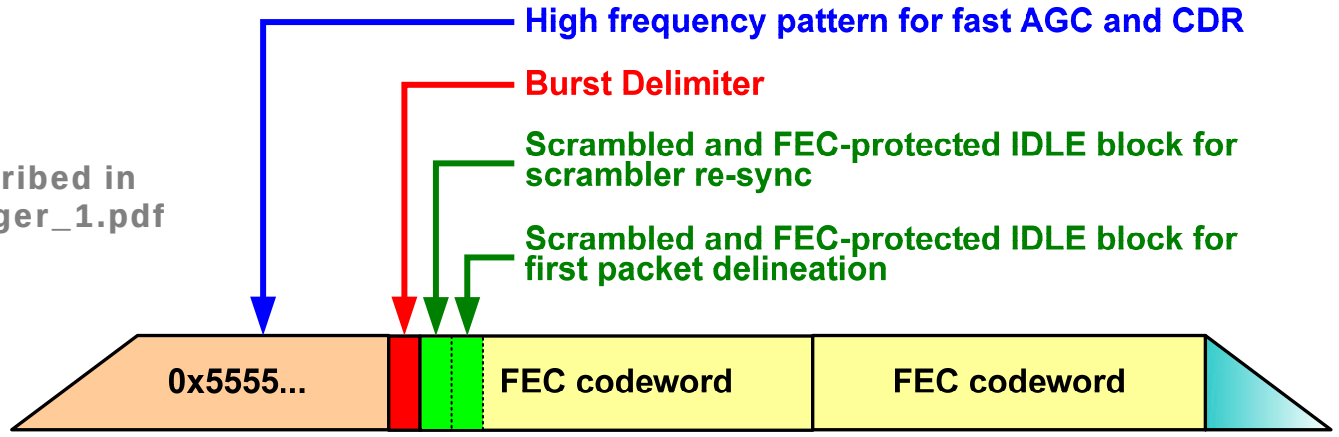
66-bit block



Position of /S/ Affects Grant Size

- FEC coverage starts two 66-bit clocks ahead of the block containing /S/
  - First block of IDLEs is to synchronize the scrambler
  - Second block IDLEs is required for proper SOP detection

Burst format is described in 3av_0701_effenberger_1.pdf



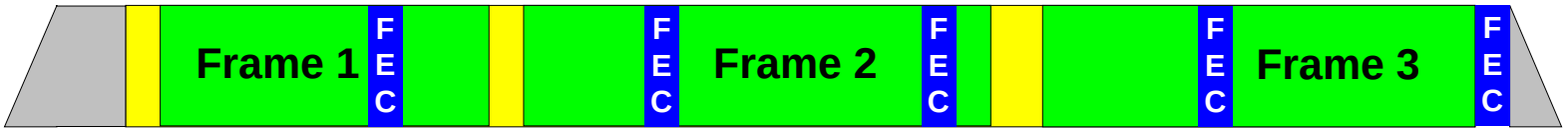
- When /S/ is located in position 4, the transmission length increases by 4 bytes
- MPCP does not know if /S/ will happen to be in position 0 or in position 4 when it is time to transmit, so MPCP must always report 4 extra bytes

Effect of Reporting Extra Bytes (1)

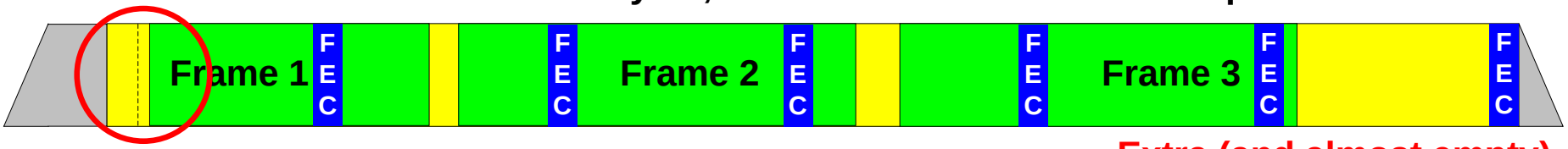
- If queued frames fit in ***N*** FEC codewords with less then 4 spare bytes left, then adding 4 extra bytes would require the OLT to additionally allocate full FEC codeword

- In reality, the first /S/ may end up in byte 0, and the ONU would still only send ***N*** codewords, however the OLT would allocate ***N+1*** codewords according to previous REPORT

3 frames fit in N FEC codewords with less then 4 bytes to spare



But with 4 additional bytes, an additional codeword is required

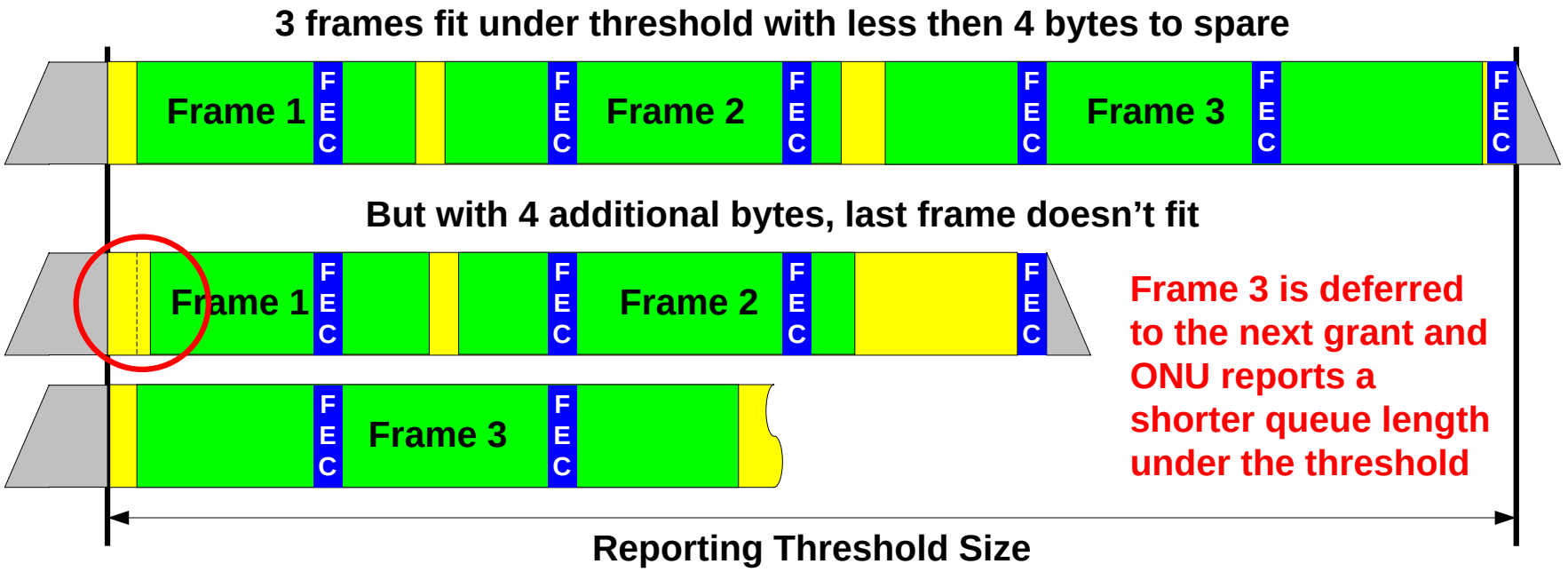


Extra (and almost empty) codeword is transmitted

Effect of Reporting Extra Bytes (2)

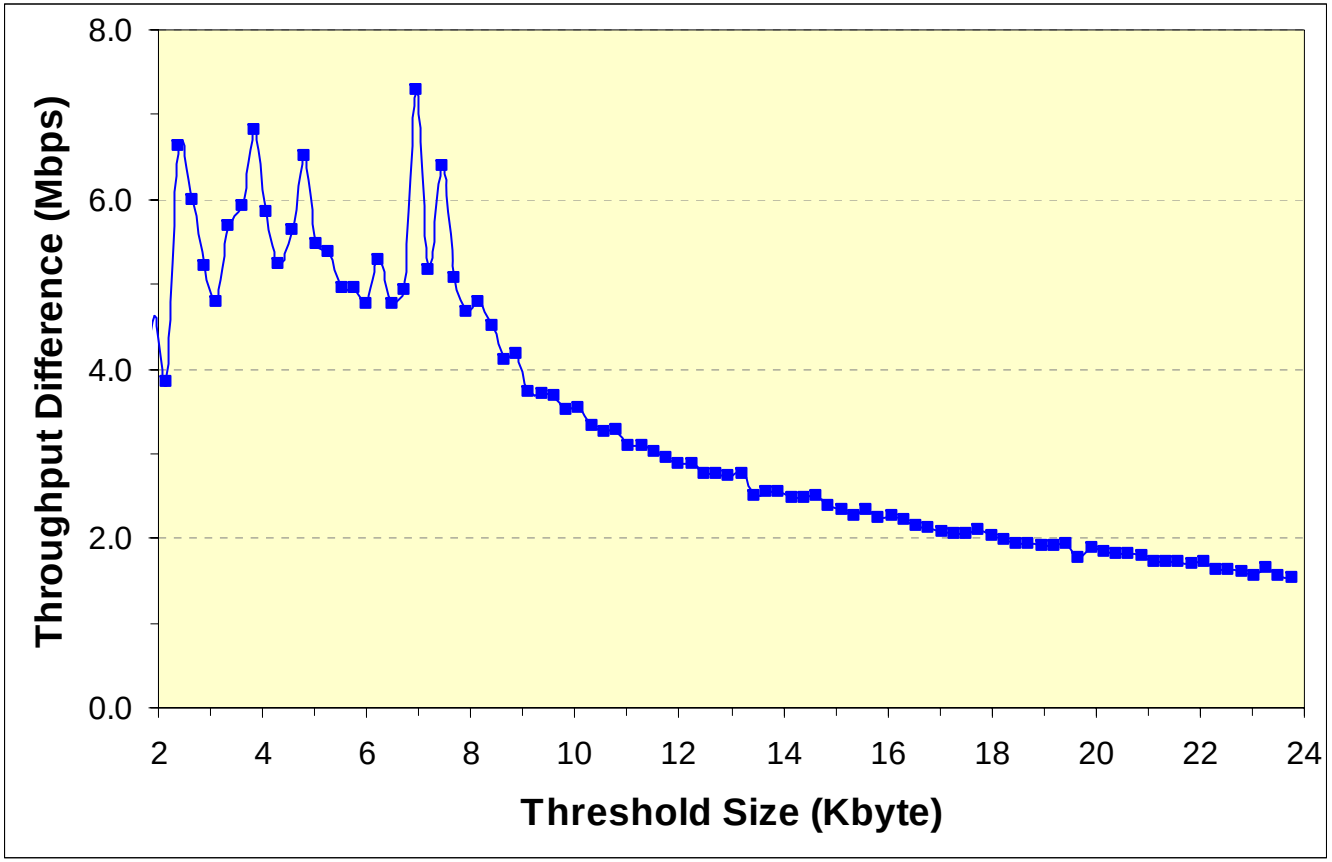
- If queued frames fit in ***N*** FEC codewords with less then 4 spare bytes left, and these ***N*** codewords add up exactly to the reporting threshold, then adding 4 extra bytes would make the last frame not fit in the current grant

- The ONU will not include the last frame in its REPORT and the OLT will grant a smaller slot. The last frame will wait for the next grant.



Simulation Results

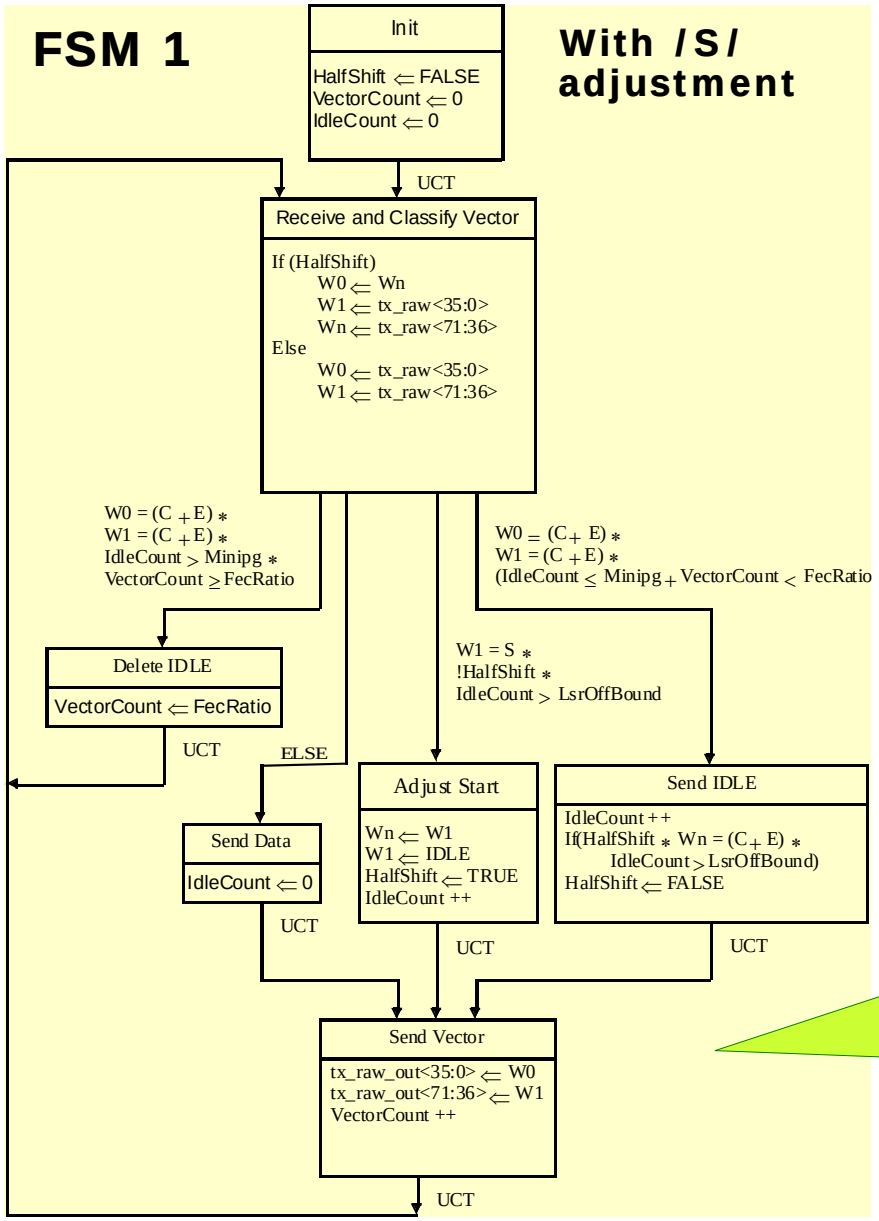
- The graph shows throughput gain due to alignment of the /S/ character

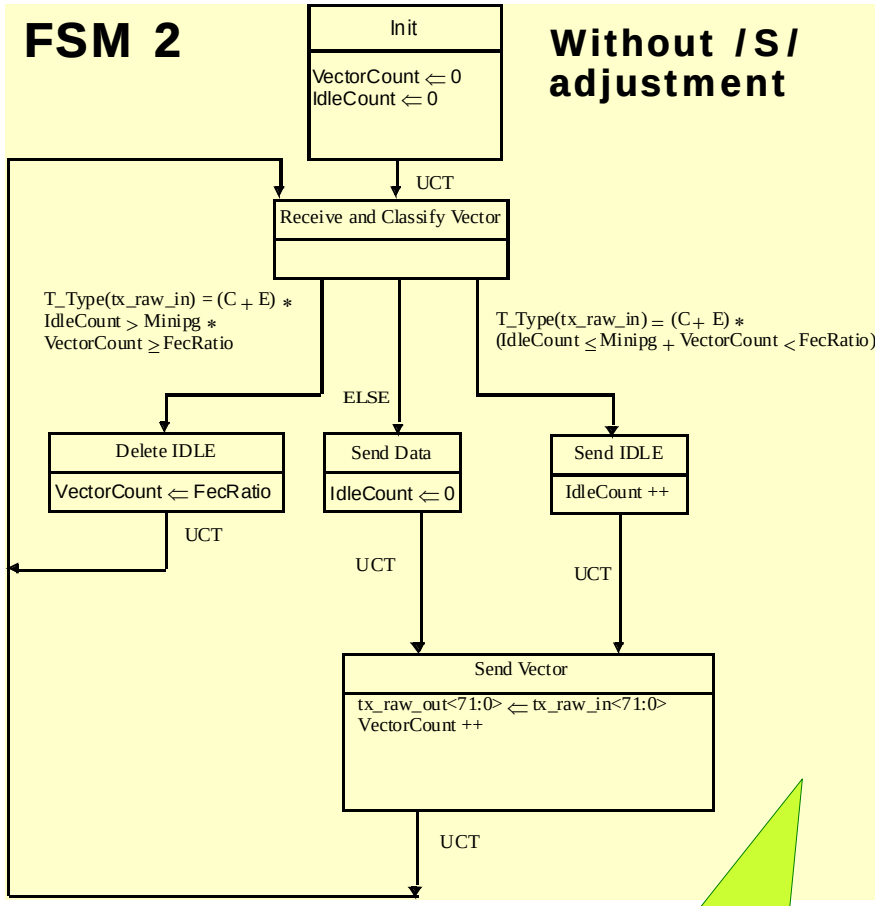


Simulation parameters

- Threshold sizes varied from 7 to 100 FEC codewords (from 1.68 to 24 Kbytes).
- 10 million packets were transmitted for each threshold size.
- System was under heavy load, i.e., there was unlimited supply of packets in each queue.
- Packets followed empirical tri-modal distribution as shown in http://www.ieee802.org/3/efm/public/jul01/presentations/sala_1_0701.pdf.

Comparing State Machines





- More complicated FSM
- Need to break vector into XGMII words and then reassemble

- Simpler FSM
- Fewer states
- Works with 72-bit complete vectors

Opinion Poll

- Aligning the /S/ character saves up to 8 Mbit/s of bandwidth, but requires a more complicated state machine to re-package tx_raw<71:0> vectors.

- No aligning /S/ characters results in a loss of up to 8 Mbit/s, but allows a simpler state machine

I prefer to align /S/ _____

I prefer to not align /S/ _____

Motion

- Idle Deletion state machine should align /S/ character of the first frame in the burst to the byte-0 position as shown in FSM1 on slide 7 in 3av_0707_kramer_1.pdf

- Idle Deletion state machine should not align /S/ character of the first frame in the burst to the byte-0 position as shown in FSM2 on slide 7 in 3av_0707_kramer_1.pdf

(Technical >= 75%)

- Y:
- N:
- A: