FSM for PCS-layer End-of-Burst Detection

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Background

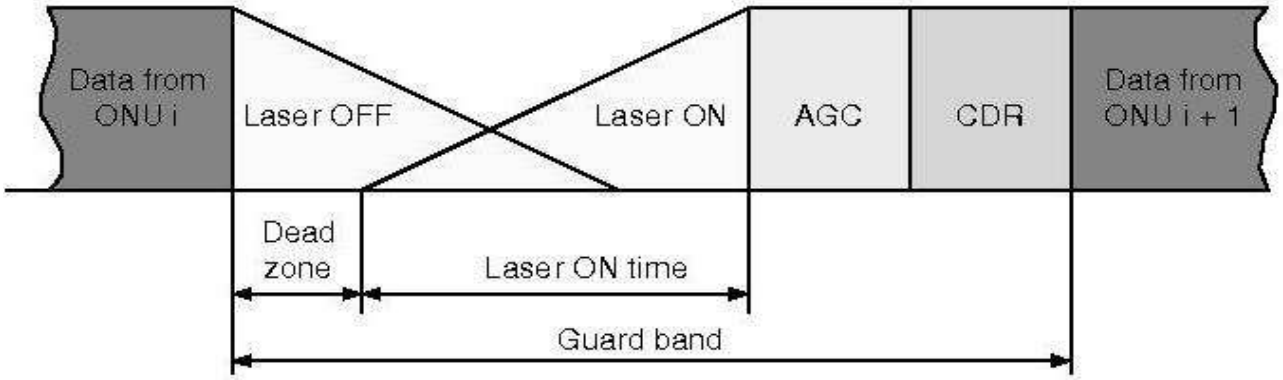
1. The TF has indicated intention to accommodate aggressive burst timing at the 10G optical layer and consequently to support suitably fast end-of-burst detection in the PCS layer.

2. At the Tokyo meeting the TF expressed support for a scheme using an “end-of-burst delimiter” placed by the ONU

   - Upon evaluating this scheme, another approach suggests itself: using a longer start-of-burst delimiter

3. OLT Synchronizer FSMs for these approaches are presented to facilitate selection by the TF.

Background: Interval Between Upstream Bursts



- Guard band scheme assumes T_{off} of ONU#1 overlaps with T_{on} of ONU#2
  - Laser on/off times are variable and overlap is fundamental to burst efficiency
- There's consequently no silent period or obvious data pattern that the OLT's PCS can use to determine that it is between bursts

End-of-burst Delimiter Scheme - considerations

1. In Tokyo the TF discussed the possibility of using a special 66bit control code to signal the end-of-burst:

   - Guarantees that the end-of-burst delimiter will never appear in a data context

   - Still must address the case where the delimiter appears in an uncorrectable FEC codeword however

     - Uncorrectable CW shouldn't cause loss of current or subsequent burst
     - 2 bit errors can change the delimiter to real data and vice-versa
     - Also: cannot make assumptions about randomness of the unscrambled data

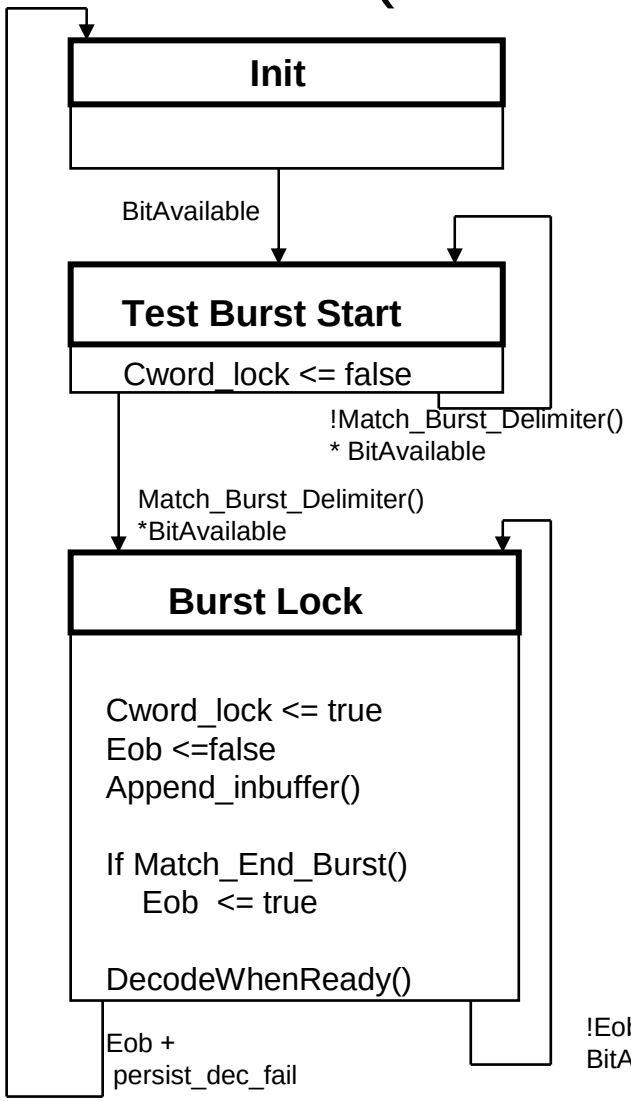
2. Consequently, we define the End-of-Burst Delimiter as a 132-bit binary pattern that is FEC-protected and appears at the end of the final FEC codeword of the burst

   - Rely on statistical improbability of selected delimiter pattern appearing at the indicated data position

End-of-burst Delimiter Scheme - considerations

1. At the ONU:
   - Data detector replaces the final 66b blocks at the end of the burst (containing scrambled IDLEs) with end-of-burst delimiter pattern
     - Precisely as is done with the start-of-burst delimiter
     - FEC parity is calculated on the FEC codeword that contains the delimiter
2. At the OLT:
   - Check for the end-of-burst delimiter at the end of the corrected FEC codeword (before descrambling)
   - In the case of an uncorrectable FEC codeword, it's necessary to check for the delimiter but tolerate a specific number of errors

OLT Synchronization FSM (End-of-burst Delimiter)



- BitAvailable:

  Flag that returns true when and only when there exists an unprocessed bit from the PMA

- Match_Burst_Delimiter():

  returns true when and only when the Hamming Distance between the Start-of-Burst Delimiter and the last 66bits received is 12 or less

- Match_End_Burst():

  returns true if and only if a full FEC codeword has been accumulated and the Hamming Distance between the End-of-Burst Delimiter and the last 2 blocks accumulated is 14 or less

Alternative Scheme: Single delimiter

1. Scheme presented is based on 2 delimiters:

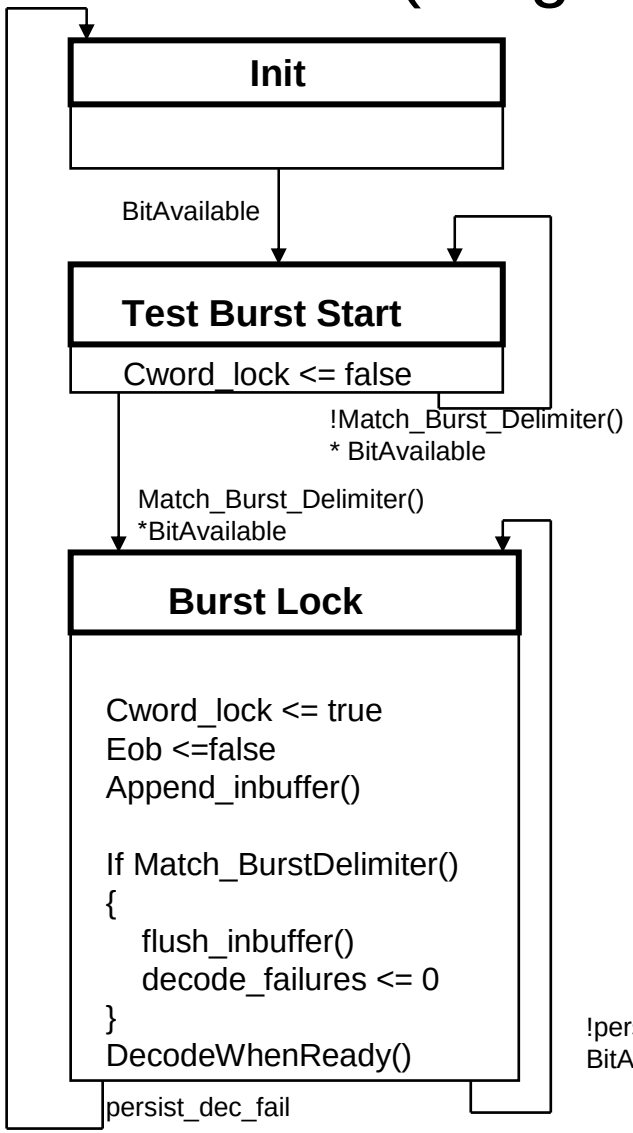
   – Start-of-Burst delimiter is 66b long and detected by OLT at any alignment

   – End-of-burst delimiter is 132 bits long (to reliably distinguish from data) and detected in a particular codeword position

2. Rather than having a distinct end-of-burst delimiter, we can use a single 132 start-of-burst delimiter:

   - In “locked state”, detection of the delimiter will cause a reset to the FEC codeword build

OLT Synchronization FSM (Single long delimiter)



- Match_Burst_Delimiter():

  returns true when and only when the Hamming Distance between the Start-of-Burst Delimiter and the 2 blocks received is 14 or less

Backup