RS-FEC EEE Fast Lock Using Rapid Codeword Markers

IEEE P802.3by 25Gb/s Ethernet Task Force Ad Hoc

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RS-FEC EEE Rapid Lock Issues

- Unscrambled IDLEs/LPIs are not DC balanced and don't have enough transition density, which is unsuitable for the electrical signaling.
  - See ran_042915_25GE_adhoc and #38,#179

- Sending unscrambled IDLEs/LPIs enables the peer port to detect transcoding block boundaries. However it does not provide an efficient way to detect the FEC codeword boundaries.
  - Comment #179

- Sending unscrambled data at the start of TX_WAKE (TX_MODE transition from ALERT to DATA), does not allow the peer PMA/PMD to refresh. As a result the peer RS-FEC may not detect the pattern and lock.
 - Comment #75

RS-FEC EEE Rapid Lock Issues

- **First CWM transmission (comment #180)**
  - The transmitter sends unscrambled data for 0.9us - 1.1us.
  - The transmitter inserts the first codeword marker at the beginning of the second codeword - 0.2usec - 0.4usec after the scrambler bypass.
  - The receiver may not succeed to identify the codeword boundaries in time and miss the codeword marker.

- **The rapid codeword lock does not describe how to lock on the codeword marker position.**
  - Comment #178

Suggested Remedy

- Send Rapid Codeword Markers (RCWMs) to enable the peer port to rapidly achieve codeword marker lock.

- Use RS-FEC EEE fast lock as defined in D1.0, with the following changes:
  - TX: Instead of bypassing the scrambler, set down_count = 16 and insert a RCWM in the beginning of each of the following 16 FEC codewords.
  - RX: Instead of performing rapid lock based on a known pattern, lock on the codeword marker position based on RCWMs.

- The conditions for sending / searching for RCWMs are the same as defined in D1.0 for the rapid lock:
  - Tx: TX_MODE Send RCWMs on the transition from ALERT => DATA
  - Rx: RX_MODE (RX_TX_MODE) search for RCWMs on the transition from QUIET=> DATA

- RCWM are identical to regular CWMs with the down_count value set in offsets: 24:31 and the bit-wise inversion of the down_count in offsets 56:63.

Transition from RCWM to CWM
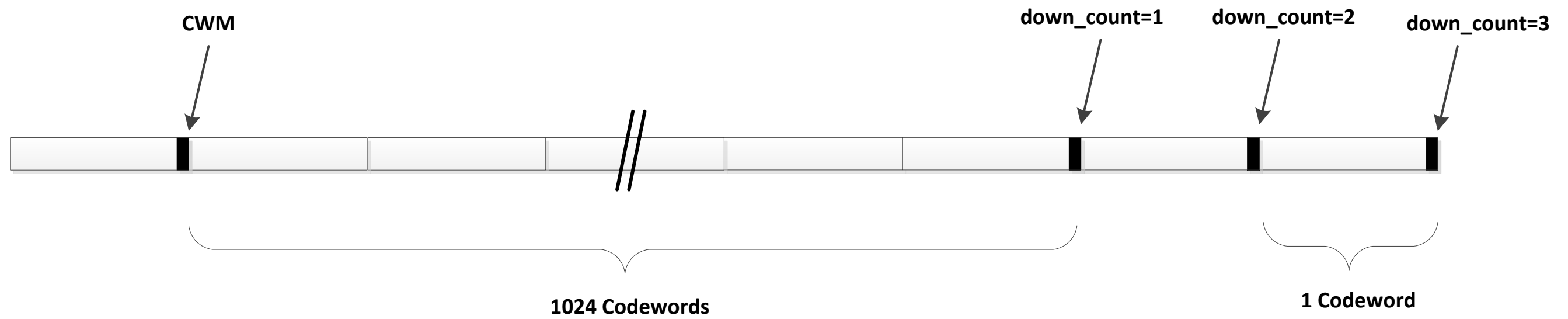
Suggested Remedy – Proposed Changes to the Draft

1. Modify 108.5.2.7 RS-FEC encoding for rapid codeword lock (EEE deep sleep) (page 105)

   - **Replace a), b) (lines 5-9) with:**

     a) Set down_count to 16 and send 16 rapid codeword markers (RCWMs). This causes the Codeword marker insertion function (108.5.2.4) to insert a RCWM in the beginning of each of the following 16 FEC codewords.

     b) The first regular codeword marker is inserted at the beginning of the 1024th RS-FEC codeword after the RCWM with down_count = 1.

   - **Remove lines 14-17 "As a result … by the remote PCS"**

2. Rapid Codeword marker insertion:

   - **Add at the bottom of 108.5.2.4 Codeword marker insertion: (page 105, line 37)**

     For the optional EEE capability, a rapid method of FEC alignment is used when operating in the deep sleep low power state using Rapid Codeword Markers (RCWMs). RCWMs are inserted at the beginning of 16 codewords following the transmitter tx_mode transition from ALERT to DATA.

     RCWMs are identical to regular CWMs with the exception that the constant value of 0x33 in offsets 24:31 is replaced with a down_count value, and the constant value of 0xCC in offsets 56:63 is replaced with the bit-wise inversion of the down_count. The down_count is decremented each time a RCWM is sent.

Suggested Remedy – Proposed Changes to the Draft

3. In 108.5.3.6 Rate compensation for codeword markers in the receive direction, (page 109, line 9)

   Replace: "Insert idle characters, according to the rules in 49.2.4.7, to fill in as necessary for any deleted codeword markers." **With:** "Insert idle or low power idle (LPI) characters, according to the rules in 49.2.4.7, to fill in as necessary for any deleted codeword markers or rapid codeword markers."

4. In 108.5.3.7 Rapid codeword lock for EEE deep sleep: (page 109)

   • **Remove a) in line 29.**

   • **Replace c) in line 33 with:**

   c) Enable the RS-FEC rapid codeword lock mechanism, which attempts to detect rapid codeword markers sent by the remote RS-FEC transmit function (see 108.5.2.7). When two sequential rapid codeword markers are detected, the start location of the RS-FEC codeword is set to the start location of the rapid codeword markers. The next codeword marker position is set to 1024 codewords following the rapid codeword marker with down_count = 1.

   • **Remove the sentence in line 44: "When the decoding .. Set to false"**

   • **Replace 1) in line 50 "Two 64B/66B .. true to false" with:**

   1) The RS-FEC codeword monitor state diagram (Figure 108-6) reaches the CW_GOOD state.

Suggested Remedy – Proposed Changes to the Draft

5. In 108.5.4.2 State variables:

    - **Remove page 110, lines 35-40: descrambler_bypass**
    - **Remove page 110, lines 52-54: scrambler_bypass**
    - **Remove page 112, lines 1-3: "optional EEE … always false."**

    - **Add a new variable to page 100, lines 35-40:**

      down_count

      A counter that is used in rapid codeword markers and is decremented each time a RAM is sent. The counter initial value is set by the RS-FEC transmit function when the tx_mode parameter of the FEC:IS_TX_MODE.request primitive from ALERT to DATA.