Upstream FEC Selection (rev 3a)

Mark Laubach, Yang Han, Shaohua Yang, Ryan Hyrth , Glen Kramer

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Introduction

- The LDPC(18493,15677) [13x75x256] 0.848 FEC code was adopted for the downstream at the last meeting in Orlando. See motion #6 from unapproved minutes.
  - This included a parity code matrix and interleaver as presented in laubach_3ca_1a_1117.

- Selection of an upstream FEC method remains.

LDPC Performance Review

	Length	Rate	Non-Zero Blocks	NECG [1] (dB) (optical gain)		M Gates Encoder + Decoder (approximately)	Latency [2] (µsec) (includes single buffer)	Reference
				AWGN	Gilbert Burst			
LDPC	(18493,15677) [13x75x256]	0.848	290	2.6 (1.82-2.34)	1.76 [3] (1.23 - 1.58) 2.03 [4 7] (1.41 – 1.82)	1.65 to 1.8	E 2.77 + D 2.95 = 5.72	laubach_3ca_1a_1117
			286	2.63 (1.84 - 2.37)	1.87 [3] (1.31 – 1.68) 2.12 [4] (1.48 – 1.91)		E 2.61 + D 2.92 = 5.53	laubach_3ca_1_0118
					1.85 [5] (1.3 – 1.67) 2.11 [6] (1.48 – 1.9)			

[1] Electrical gain over RS(255,223) of 7.1 dB. Optical gain is 0.7 to 0.9 * NECG.

[2] Capped at 15 iterations

[3] With interleaver, precoder off

[4] With interleaver, precoder on

[5] No interleaver, precoder off

[6] No interleaver, precoder on

[7] Omitted from laubach_3ca_1a_1117

Rev 3a updated values.

Where are we to date?

- LDPC FEC has demonstrated the highest optical gain
  - RS configurations presented fall short by > 1 dB compared to LDPC.
- In laubach_3ca_1_0317, "20 Gb/s Aggregate Throughput", Glen Kramer's analysis showed with a single codeword size of ~2K bytes and shortened last codeword (information "user" word) that 20 Gb/s is attainable.
  - Concluded ~2KB codeword size with 84.77% rate works.
  - No presentation to date has provided alternative detailed analysis for shortened last codeword.
    - bonk_3ca_1_1118 did look at shortening vs. code rate, but shortened both LDPC user and parity.
- Several presentations have examined CDR/SERDES locking at 25 Gb/s
  - Some have stated locking not to be an issue. Others state more analysis is needed.
  - No studies to date use EPON sync header + burst delimiter format(s) adapted for 25 Gb/s.
  - Any FEC would be impacted if CDR/SERDES isn't sufficiently settled by end of the burst delimiter.

Downstream for Upstream

- The adopted downstream LDPC code is very suitable for use in the upstream:
  - Provides the highest net effective coding gain.
  - Meets the 2KB size and rate examined for upstream.
  - Has been studied for AWGN and Gilbert Burst (with and without precoding) and includes a hardware friendly structured Omega256 interleaver.
  - Having the same LDPC code retains the 10G-EPON property of local loopback.
    - Accelerates separate OLT and ONU development, debugging, etc.
  - Facilitates using the same PCS and line coding for downstream and upstream.
  - One-way latency same as downstream.
  - Consistent with 256b/257b line coding proposal in kramer_3ca_1_0118 (if adopted by TF).
  - Consistent with 257-bit burst delimiter study presented in kramer_3ca_2_0118.

Proposed Motion

- The upstream shall use the same LDPC method, parity code matrix, and interleaver as adopted for the downstream.

Thank you


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