LDPC FEC gain, downstream

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LDPC FEC for downstream

LDPC(18493,15677) adopted for downstream, per Motion #6, minutes_unapproved_3ca_1117.pdf

Motion #6

Adopt for the LDPC FEC for the downstream channels:

- LDPC(18493,15677) 0.848 rate parity code matrix presented in laubach_3ca_1a_1117.pdf page 3, and
- the Omega256 structured interleaver presented in laubach_3ca_1_0517.pdf pages 10 and 11 with seed code as in laubach_3ca_2_0517.txt.

Moved: Mark Laubach Second: Duane Remein

For: 23 Against: 2 Abstain: 4

Technical (≥ 75%) Motion Passed

LDPC downstream FEC improvement, without and with precoding

Updated

laubach_3ca_1b_0118

	Length	Rate	Non-Zero Blocks	NECG [1] (dB) (optical gain) AWGN	NECG [1] (dB) (optical gain) 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)
			286	2.63 (1.84 - 2.37)	IL: 1.87 [3] (1.31 – 1.68) 2.12 [4] (1.48 – 1.91)
					no IL: 1.85 [5] (1.3 – 1.67) 2.11 [6] (1.48 – 1.9)

Previous parity matrix

New parity matrix

[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

- Updated FEC gain simulation values from laubach_3ca_1b_0118, p.8
- (optical FEC gain) based on range of APD curves w/varying Shot/Thermal noise (dBo/dBe: 0.7-0.9)
- Minimum optical gain - 1.48 dB relative to RS(255,223) under worst case conditions (G-E noise, precoding), with or w/o Interleaver

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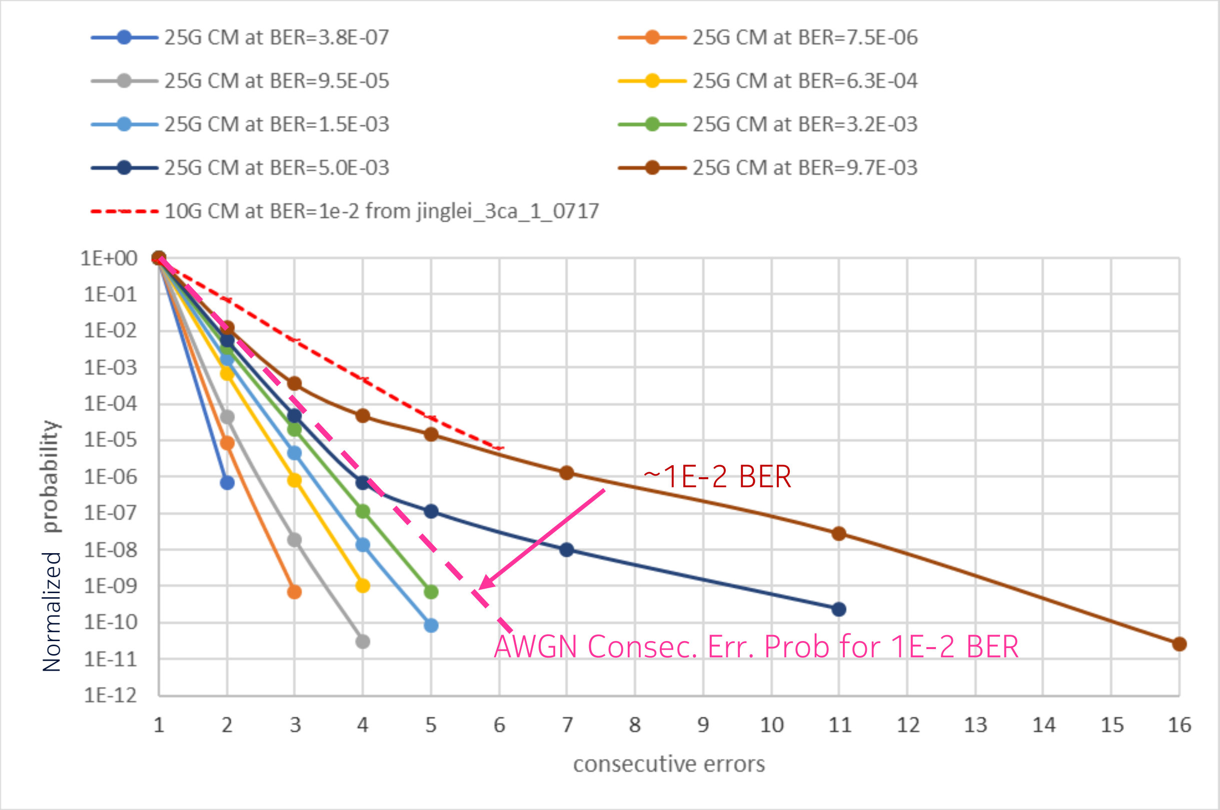
Burst errors in continuous mode transmission-- experimental

Updated

Error statistics for 10G CM and 25G CM transmission



- In houtsma_3ca_2_1117 we showed the occurence of bursty errors for 25G CM transmission at high BER
- Earlier, in jinglei_3ca_1_0717 it was found that errors in a 10G CM transmission experiment at BER=1e-2 are also bursty (>16% of errors are burst errors)

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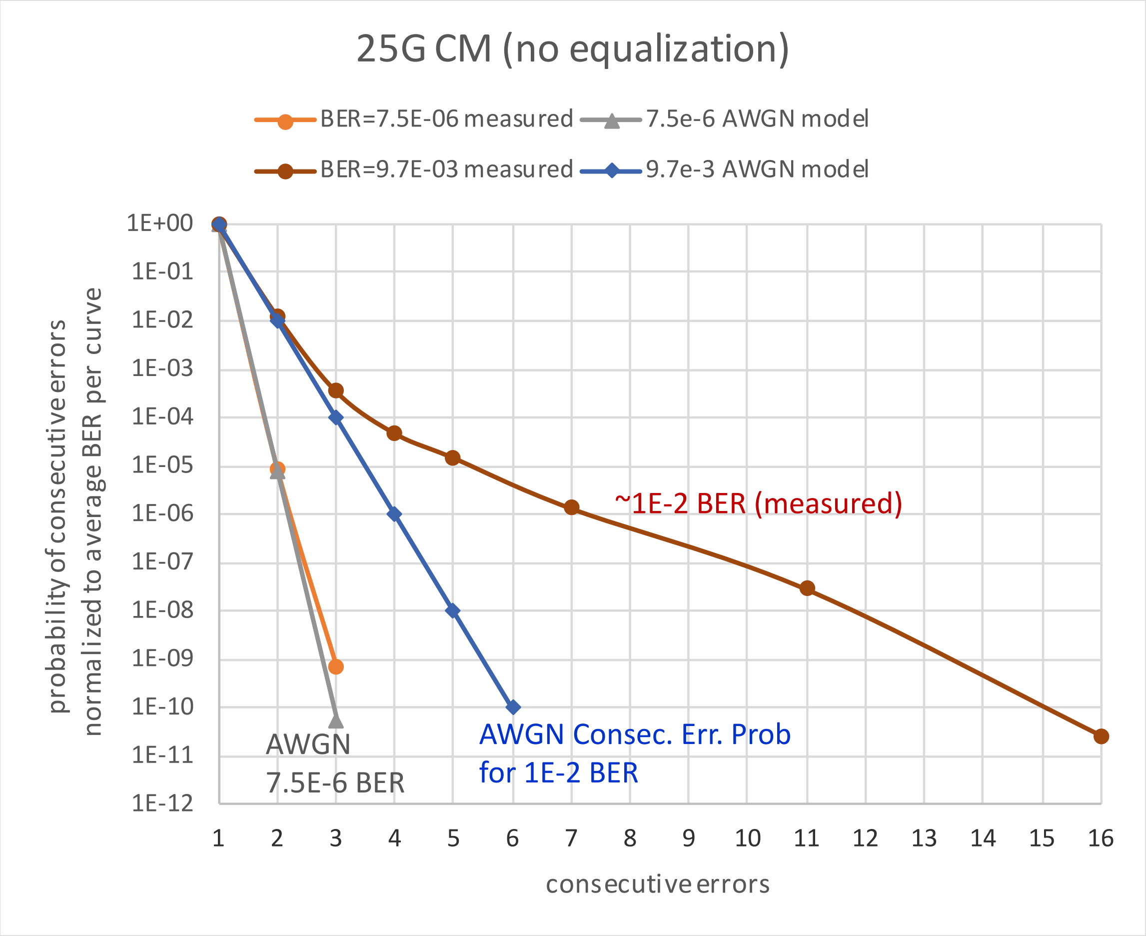
Uncluttered view of measured 9.7E-3 and 7.5E-7 BER curves + AWGN mult. Error probability

New Slide



- We transmitted 1.96E+14 bits
- Triple errors at 7.5e-6 was just a single case (so accuracy is not so good)

Huawei data from jinglei_1_0717 + AWGN multiple error probability

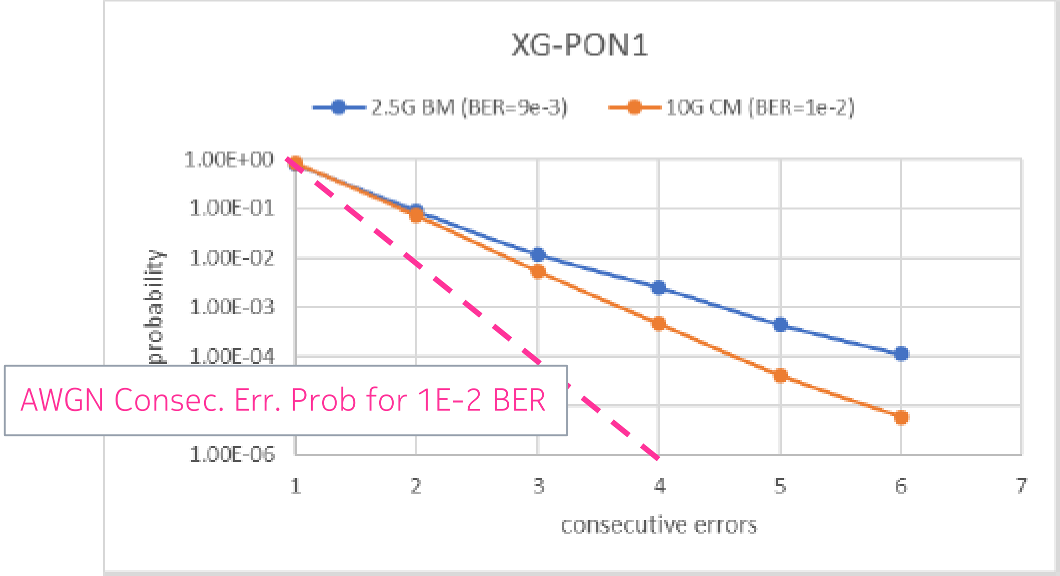
New Slide

Plot from houtsma_3ca_1_1117

Data from table in jinglei_3ca_0717

Experimental data XG-PON1
Probability burst errors

Data from: jinglei_3ca_1_0717



- Probability of burst errors is higher for burst mode transmission

Choosing a FEC improvement for 25G ONU receiver sensitivity

- The impact is on **ONUs**, therefore due to all the uncertainties it is best to be conservative
  - choose the FEC gain corresponding to the Gilbert-Eliot burst model. Burst errors can be caused by
    - ISI
    - CDRs operating at high 1e-2 BER
  - choose the value at the low end of the dBo range
- If using the Gilbert-Eliot burst model, should take advantage of the precoding improvement

- **Therefore we propose to select 1.48 dBo => ~1.5 dBo as the downstream FEC gain compared to 10G EPON RS(255,223).**
- This value will be used to adjust the ONU receiver sensitivity specification based on 1e-3 input BER

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Backup