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Shortened test time for Block-Error RX Sensitivity (Comment #593)

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Overview

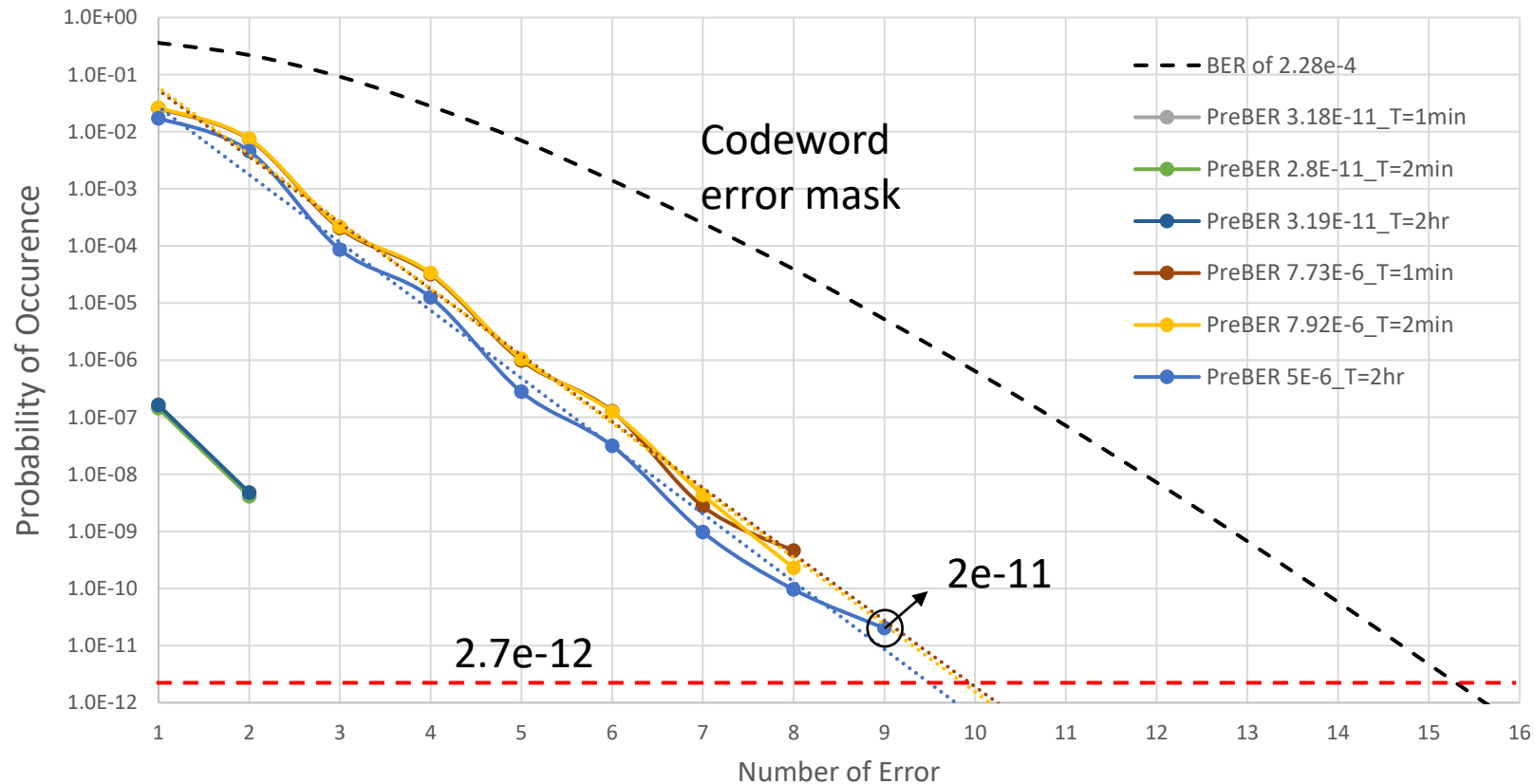
- Contribution by Matt Brown, Alphawave 'oif2025.192.00'

Test time

- The 802.3dj methodology using histograms and block error ratios requires significantly long test times to conclusively determine compliance.
 - The same was the case for stringent BER requirements.
 - As an example, to confirm a codeword error ratio less than $1.45\text{E-}11$ (effective BER of $1\text{E-}13$) with 99% confidence we would need to observe no uncorrectable codewords in $3.7\text{E}11$ codewords.
 - Test time 2.63 hours 200GE and 0.33 hours for 1.6TE
 - For a target of $1.45\text{E-}16$ (effective BER $1\text{E-}18$), as required in many systems, test time increases by $1\text{E}5$ times.
 - Test time 1370 days for 1.6TE
- Regarding to $2.7\text{E-}12$ probability of occurrence
- Completely impractical Test Time

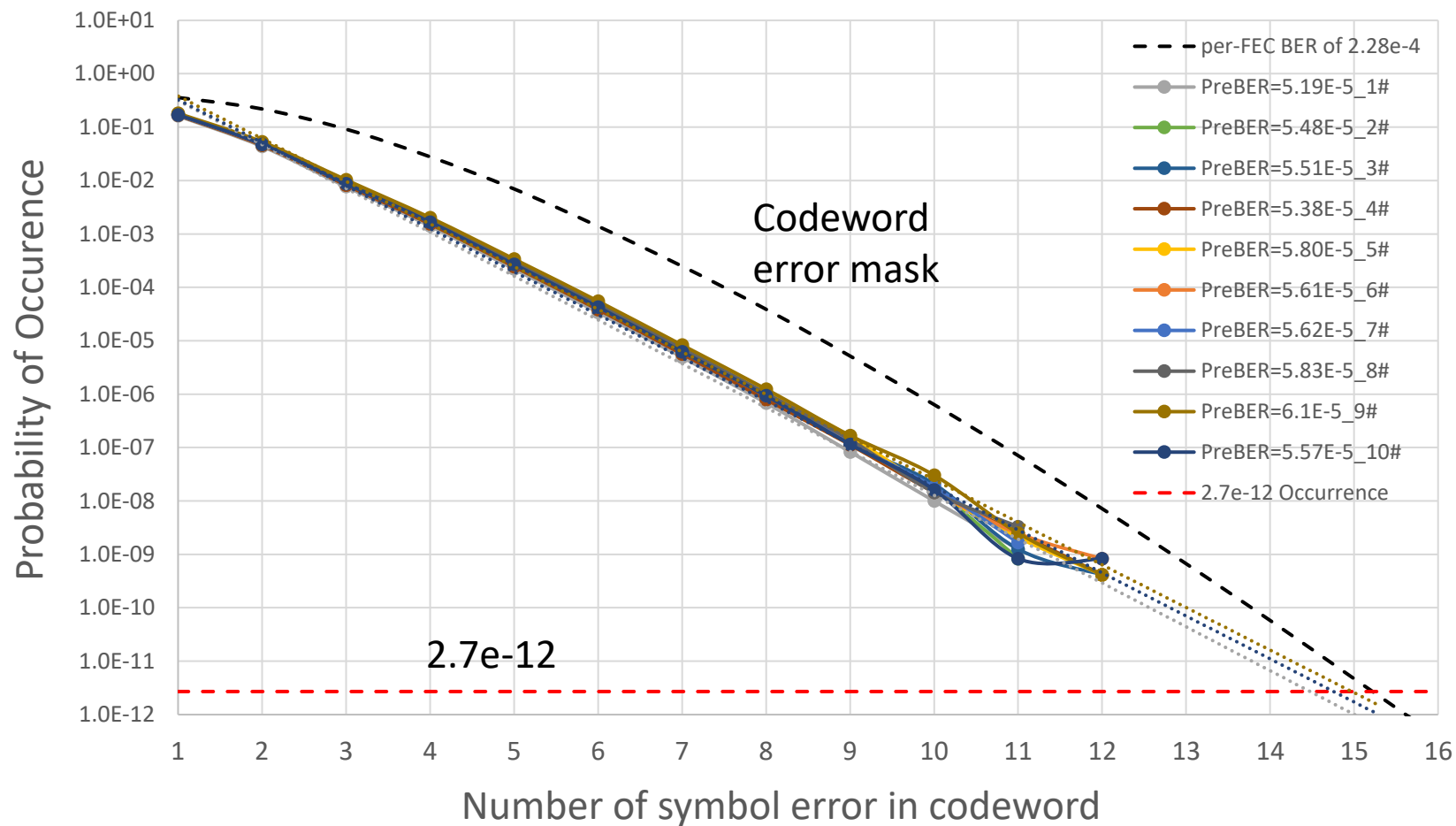
Comparison for test time of mins vs hours

- At same/similar high Pre-FEC BER levels (lower input power), FEC tail grows longer at lower probability with longer test time
 - At Low Pre-FEC/high input power level, FEC tail changes very little
- FEC-tail slope follows extrapolation curve well over short and long test time



Test repeatability of FEC tail curves

- Test repeatability is quite good over 10 x tests

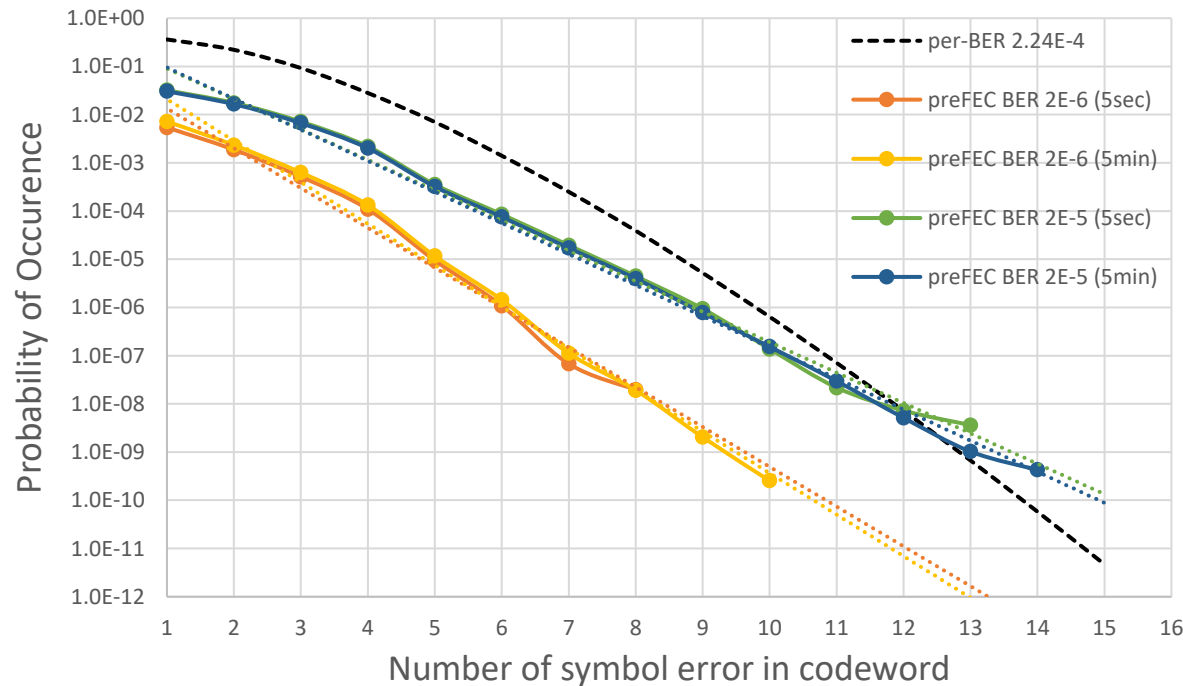


Errored Symbol	Errored Symbol	Errored Symbol
10	11	12
24	3	0
39	2	0
50	3	1
35	6	1
37	5	1
37	6	2
44	4	0
35	8	0
73	6	1
39	2	2

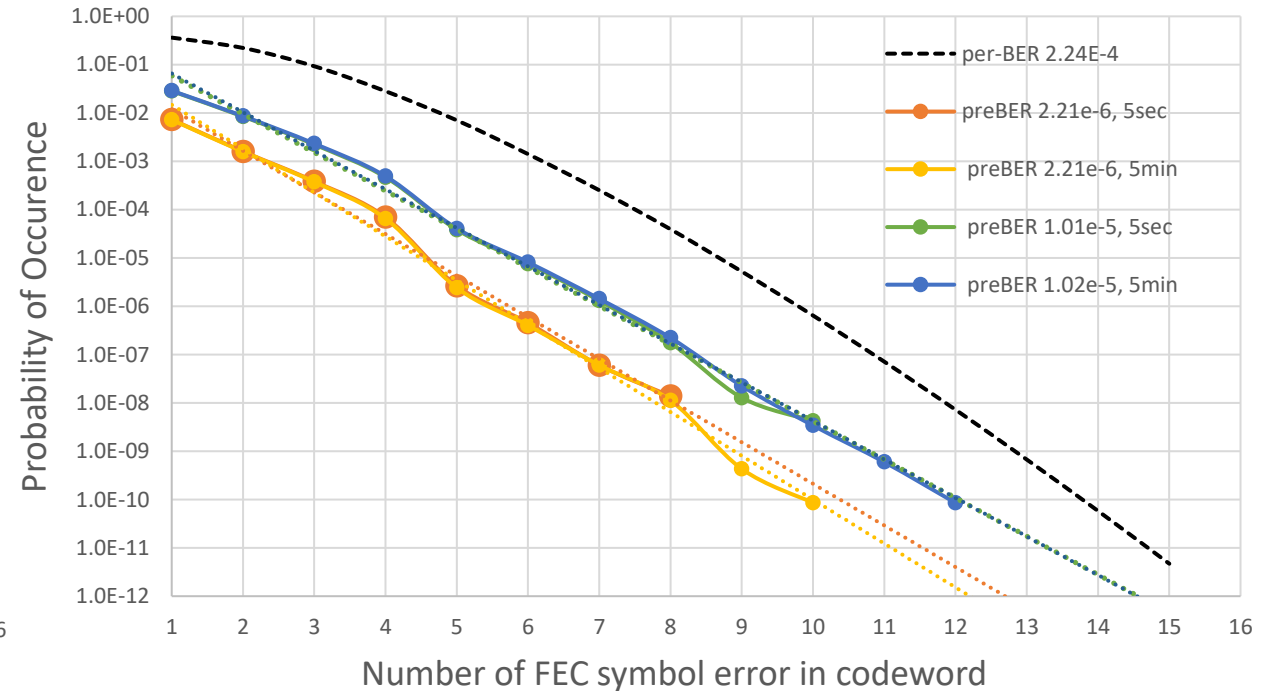
Recommendation for Shortening the Test Time

- FEC tail curve for test time of 5 sec. and 5 min. overlaps well
 - The exponential fitting lines for FEC tail also overlaps well for 5 sec. and 5 min. test time
 - 2 representative DSPs are tested for comparison, and conclusions are similar
- Recommendation:
 - At pre-set input power to receiver, collect FEC Tail data with 5 seconds of test time
 - Extrapolate to $2.7\text{E-}12$ with exponential fit
 - Receiver sensitivity determined by minimum input power achievable to **NOT** violate codeword mask

DSP Type1



DSP Type2



FEC tail curves with fiber transmission

Table 183–9—Optical channel characteristics

Description	800GBASE-FR4	800GBASE-LR4	Unit
Operating distance (max)	2	10	km
Channel insertion loss ^{a, b} (max)	4	6.3	dB
Channel insertion loss (min)	0		dB
Positive dispersion ^b (max)	6.02	2.8	ps/nm
Negative dispersion ^b (min)	-11.26	-24.6	ps/nm
DGD_max ^c	2.3	4	ps
Optical return loss (min)	25	22	dB

^a These channel insertion loss values include cable, connectors, and splices.

^b Over the wavelength range 1264.5 nm to 1337.5 nm for 800GBASE-FR4, and 1294.53 nm to 1310.19 nm for 800GBASE-LR4. The dispersion specifications are based on the statistical link design methodology documented in ITU-T REC G.652, Appendix I.

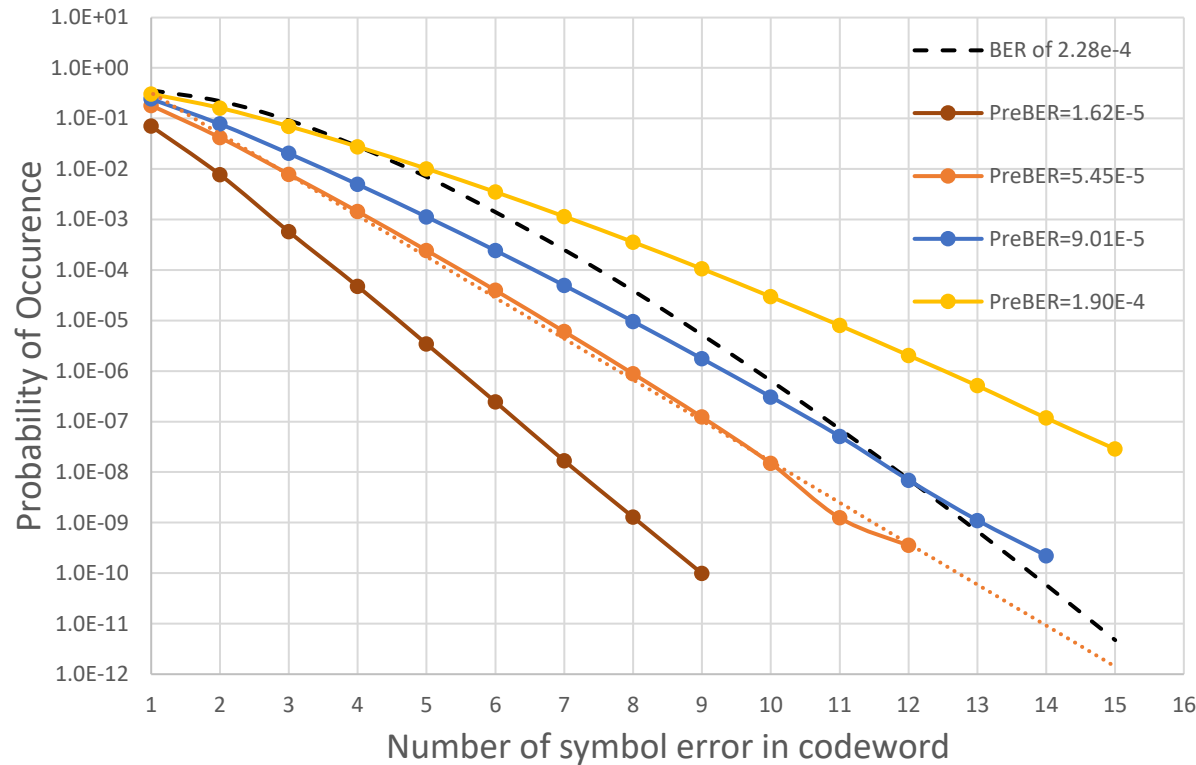
^c Differential Group Delay (DGD) is the time difference at reception between the fractions of a pulse that were transmitted in the two principal states of polarization of an optical signal. DGD_max is the maximum differential group delay that the system is required to tolerate.

	@1331nm	@1271nm
Positive DC fiber (3km)	+8.2 ps/nm	-
Negative CD fiber (5km)	-	-26 ps/nm

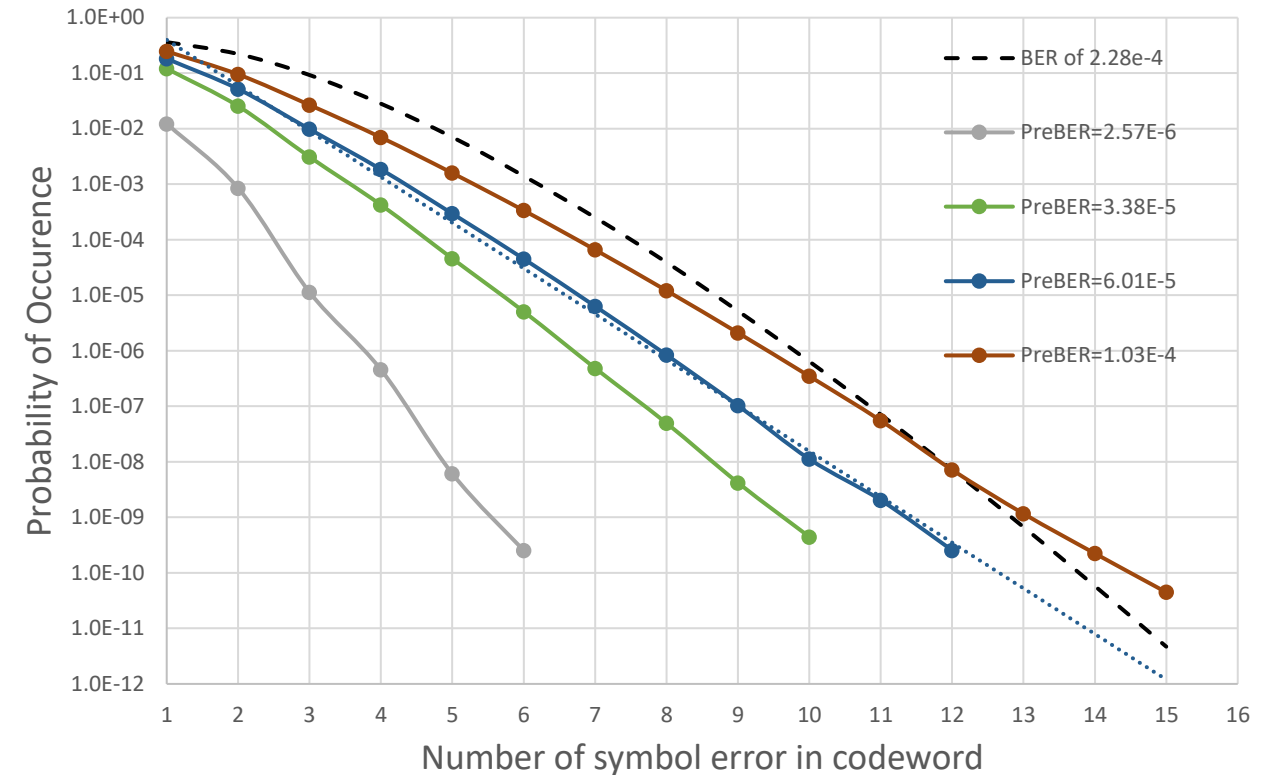
FEC tail curves with fiber transmission

- No distortion or bending occur for the BLER curves with (negative dispersion) fiber transmission

1271 B2B (5min)



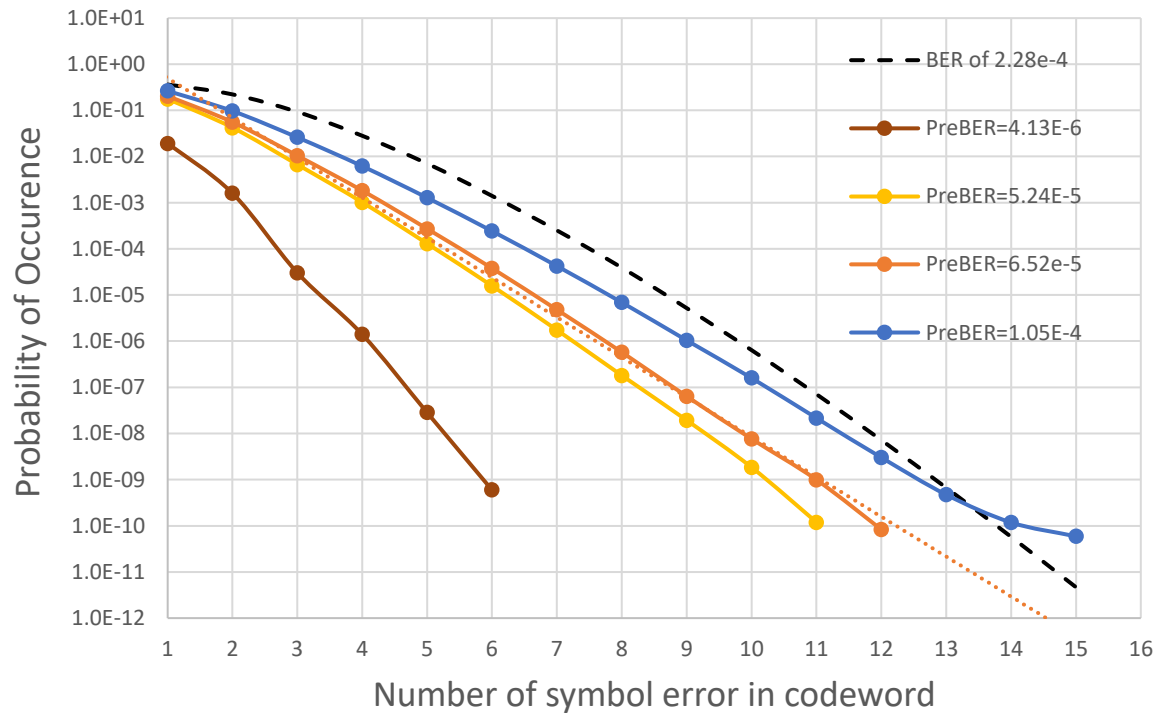
1271 -5km (5min)



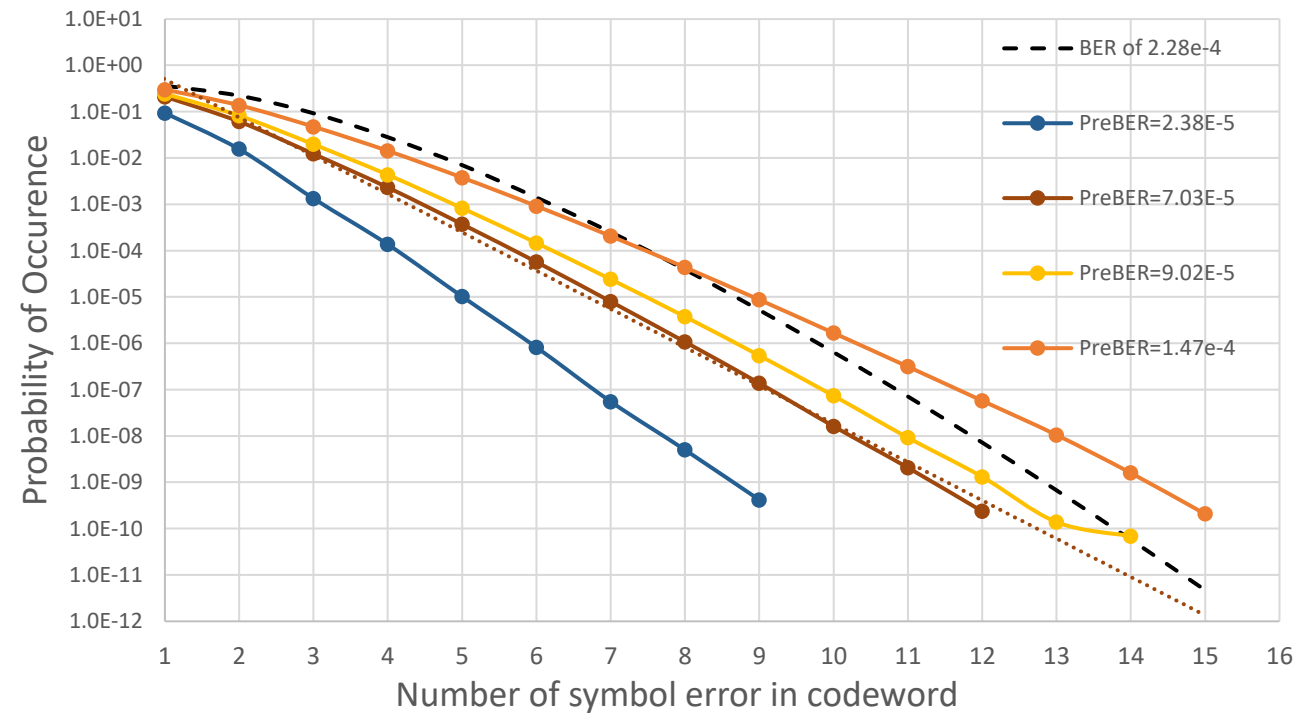
FEC tail curves with fiber transmission

- No distortion or bending occur for the BLER curves with (positive dispersion) fiber transmission

1331 B2B (5min)



1331 +3km (5min)



I Summary

- Test data show consistent FEC tail results with different test time with a given pre-FEC BER (or receiver input power)
 - Over 5 seconds, 5 minutes, to 2 hours
 - Over repeated tests
 - Over 2 different DSPs
 - BTB and over fiber dispersion max/min.
- Recommendation: Short test time (5 seconds) data with exponential fit for FEC tail can be used as good representation to determine receiver sensitivity or pass/fail

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THANK YOU