

Performance Improvements due to FEC Interleaving

IEEE P802.3ck

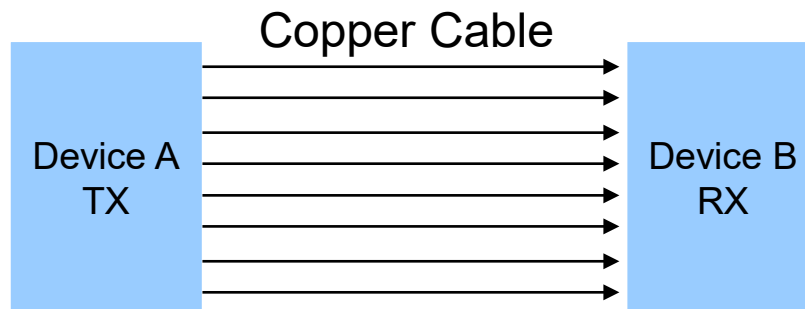
Hawaii

November 2019

Mark Gustlin – Cisco
Upen Reddy Kareti – Cisco
IL-Young Park - Cisco

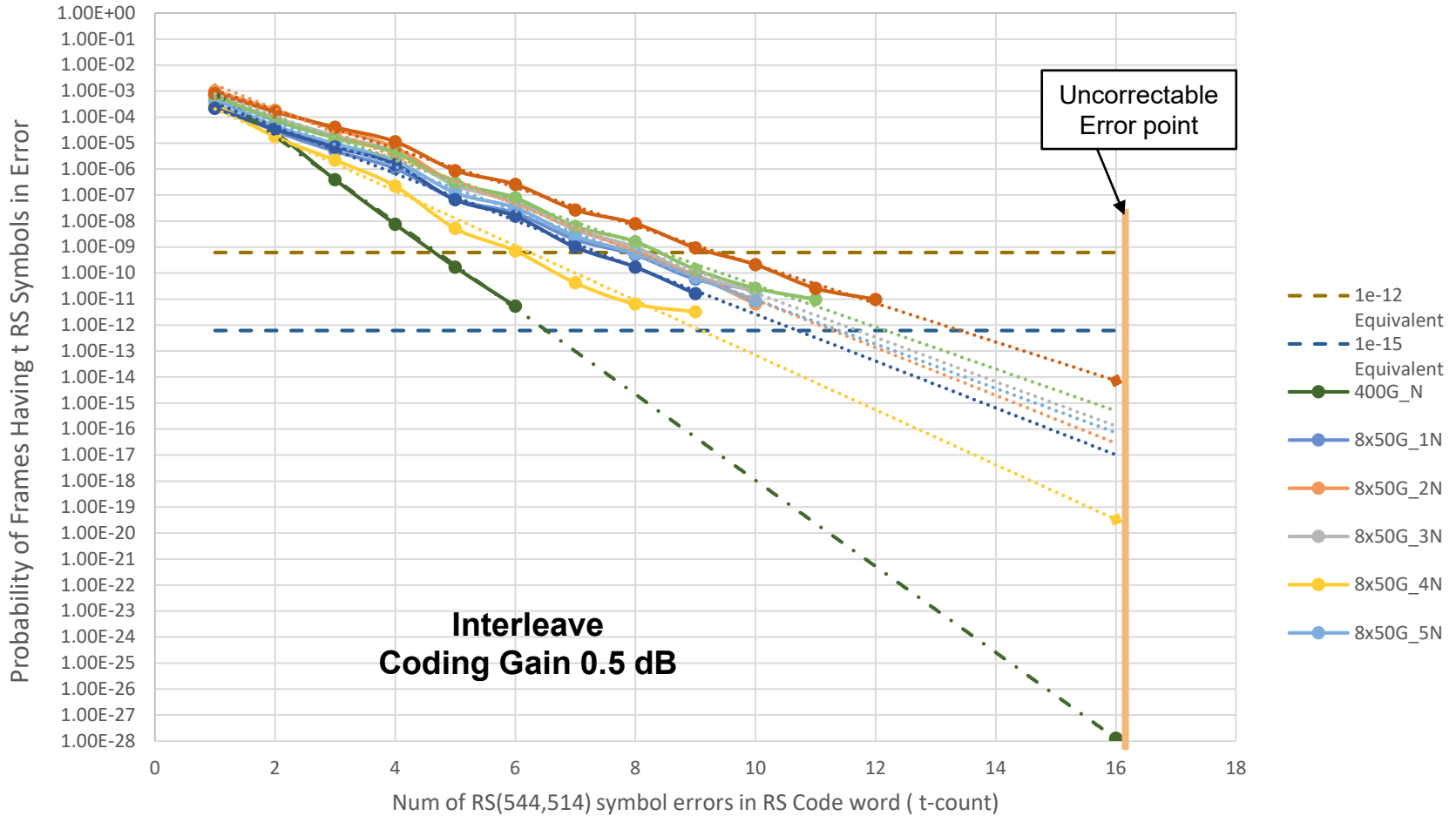
Introduction

- We present data from a single 8 lane 25GBaud PAM4 channel
 - Configured as 1x400GbE and then 8x50GbE
- Relatively long channel (~36dB bump to bump)
- We ran this port four ways, standard non-interleaved FEC (8x50GbE mode) and standard interleaved FEC (1x400GbE mode); and then with and without precoding
 - 2:1 bit mux for 400GbE (802.3ck will do 4:1 bit mux)



Performance Comparison – No Precoding

Impact of Interleave
- 400G No Precoding vs 8x50G No Precoding



FEC Histograms – No Precoding

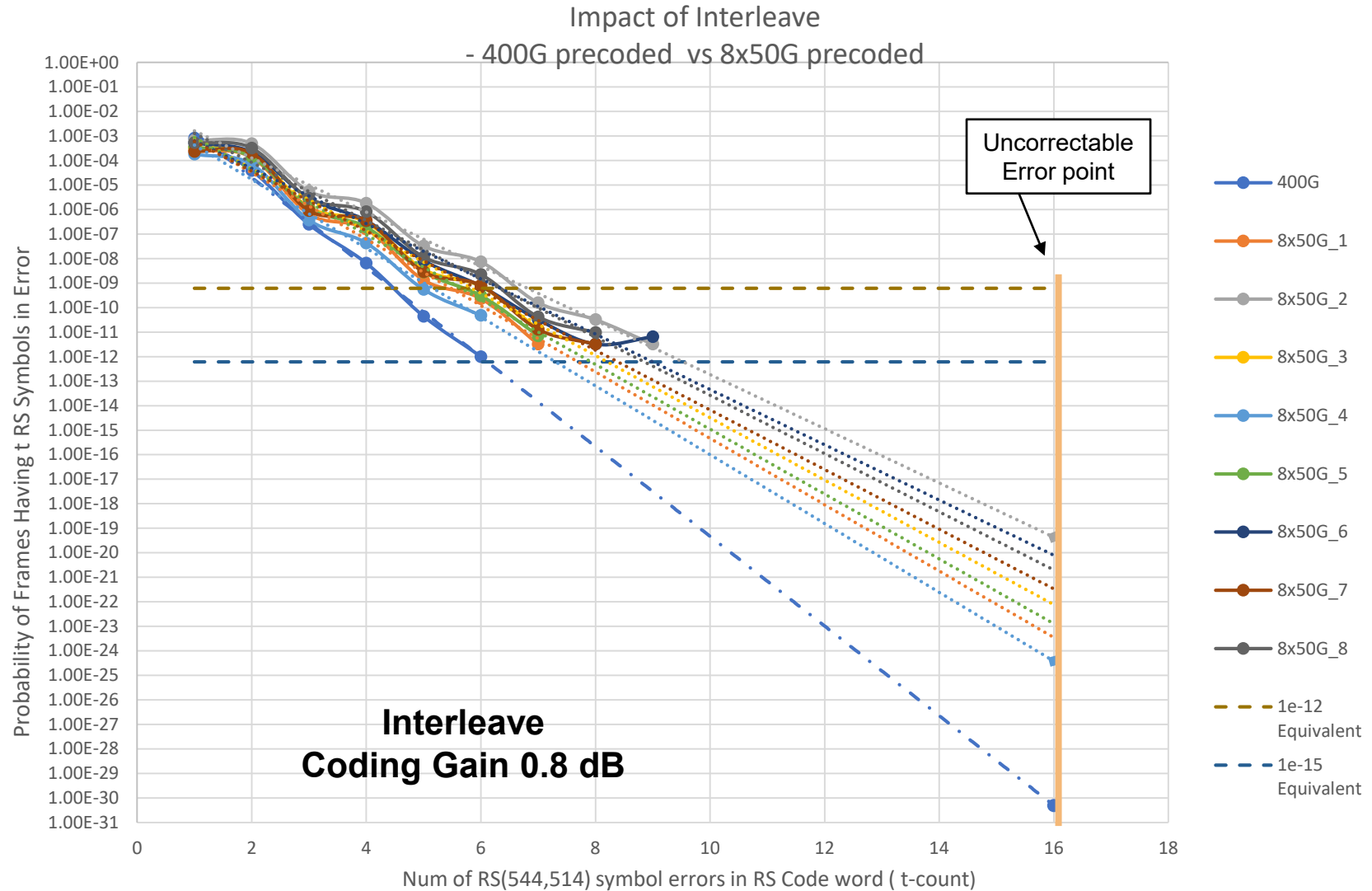
	SymErr0	SymErr1	SymErr2	SymErr3	SymErr4	SymErr5	SymErr6	SymErr7	SymErr8	SymErr9	SymErr10	SymErr11	SymErr12	SymErr13	SymErr14	SymErr15	SymErr16
400G	3.4E+11	2.2E+09	76144847	1171053	22700	511	16	0	0	0	0	0	0	0	0	0	0
8x50G_1	3.52E+10	97448171	9167185	1516972	326427	21547	6268	604	154	18	7	0	0	0	0	0	0
8x50G_2	3.49E+10	3.12E+08	57359368	10588950	2045070	83793	16101	1484	243	25	2	0	0	0	0	0	0
8x50G_3	3.51E+10	1.74E+08	28896199	5933635	1403609	72183	19433	1412	301	25	6	0	0	0	0	0	0
8x50G_4	3.52E+10	96413517	5384566	683564	68905	1610	220	13	2	1	0	0	0	0	0	0	0
8x50G_5	2.63E+10	1.1E+08	10538189	2198290	485761	28200	7504	606	134	16	2	0	0	0	0	0	0
8x50G_6	3.5E+10	2.12E+08	22563823	4902822	1289234	90175	24220	1923	497	42	8	3	0	0	0	0	0
8x50G_7	3.52E+10	67142448	10540091	2196946	472989	20523	4780	307	53	5	0	0	0	0	0	0	0
8x50G_8	3.5E+10	2.51E+08	49162192	12496536	3489138	270678	79065	8273	2471	286	65	8	3	0	0	0	0

SymErr buckets are mutually exclusive

	2 ConsBrst	3 ConsBrst	4 ConsBrst	5 ConsBrst	6 ConsBrst
400G	26183	0	0	0	0
8x50G_1	6866111	472046	108988	11172	5155
8x50G_2	47280116	574227	533291	20302	7104
8x50G_3	23245579	578814	542987	37510	15760
8x50G_4	3461129	487131	61376	402	76
8x50G_5	7637784	494953	327478	16859	6515
8x50G_6	16335908	615299	545983	50097	20051
8x50G_7	8318016	531021	455632	12338	4111
8x50G_8	40011216	666838	616852	147506	62941

2ConstBrst = 2 consecutive symbols with errors

Performance Comparison – With Precoding



FEC Histograms – with Precoding

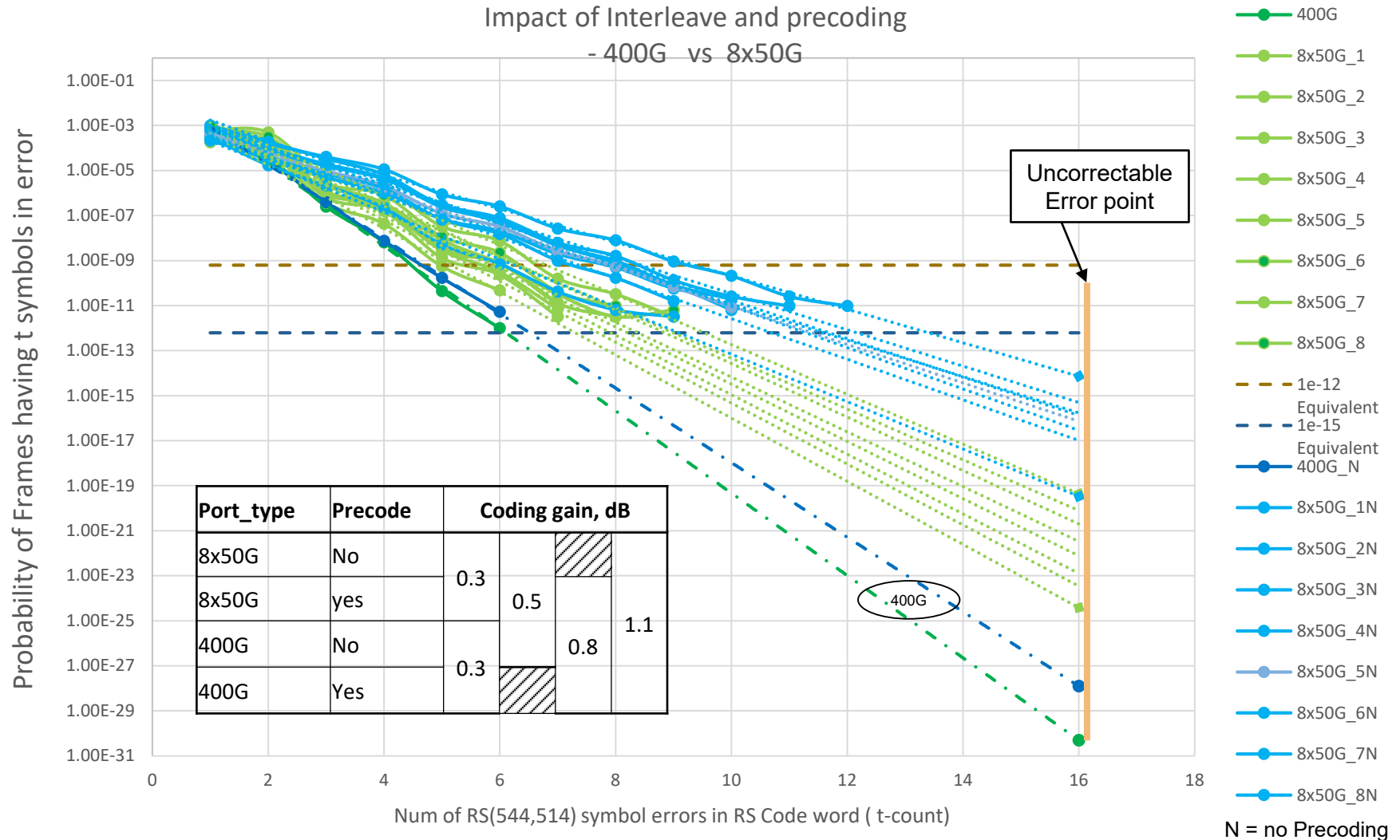
	SymErr0	SymErr1	SymErr2	SymErr3	SymErr4	SymErr5	SymErr6	SymErr7	SymErr8	SymErr9	SymErr10	SymErr11	SymErr12	SymErr13	SymErr14	SymErr15	SymErr16
400G	3.4E+11	2.48E+09	1.19E+08	745322	19478	132	3	0	0	0	0	0	0	0	0	0	0
8x50G_1	3.52E+10	79133200	41646040	199141	49874	405	72	1	0	0	0	0	0	0	0	0	0
8x50G_2	3.49E+10	2.07E+08	1.53E+08	1713550	567719	10097	2312	49	10	1	0	0	0	0	0	0	0
8x50G_3	3.51E+10	1.03E+08	57321134	377438	95157	1111	228	4	0	0	0	0	0	0	0	0	0
8x50G_4	3.52E+10	56062319	21874849	114805	13365	171	15	0	0	0	0	0	0	0	0	0	0
8x50G_5	3.22E+10	1.01E+08	40055126	311056	54438	804	87	2	0	0	0	0	0	0	0	0	0
8x50G_6	3.51E+10	1.6E+08	66788235	875534	109316	2562	235	10	1	2	0	0	0	0	0	0	0
8x50G_7	3.51E+10	72902281	62680781	277581	109321	891	252	4	1	0	0	0	0	0	0	0	0
8x50G_8	3.5E+10	1.66E+08	99011206	875450	251386	3575	701	13	3	0	0	0	0	0	0	0	0

SymErr buckets are mutually exclusive

	2 ConsBrst	3 ConsBrst	4 ConsBrst	5 ConsBrst	6 ConsBrst
400G	22321	1	0	0	0
8x50G_1	27563323	11407	1579	2	0
8x50G_2	90024346	138482	11989	30	1
8x50G_3	38177440	37349	2435	11	0
8x50G_4	13302400	31890	879	7	1
8x50G_5	23174952	41532	1855	3	0
8x50G_6	34746342	243039	3157	88	5
8x50G_7	40758161	21609	2237	2	0
8x50G_8	62026247	36561	5127	6	0

2ConstBrst = 2 consecutive symbols with errors

Performance Comparison – with/without Precoding



Summary

- At least for this channel and setup, interleaved FEC can improve the FLR significantly
- This data is for 50Gb/s/lane with 2:1 bit muxing, 100Gb/s/lane with 4:1 bit muxing will be significantly more difficult

Thanks!