EPoC FEC for Passive Coax Plants

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Introduction and Scope

- During the Victoria meeting it was agreed to specify two sets of LDPC codes (prodan_3bn_01_0513.pdf):
  - One code set for passive plants
  - One code set for active plants
- This presentation specifies the LDPC codes for passive plants.

Codes Parameters and Deployment Scenarios

CODES	Rate	Length
A	$R_A = 8/9$	16200
B	$R_B = 8/9$	16200
C	$R_C = 0.848$	5940
D	$R_D = 3/4$	1120
E	$R_E = 41/46$	16560
F	$R_F = 26/30$	10800
G	$R_G = 13/15$	5400
H	$R_H = 3/4$	960

DEPLOYMENT	Passive plant	Active plant
US, low band	F, G, H	B, C, D
DS, low band	E, F, G, H	---
US, high band	E, F, G, H	---
DS, high band	E, F, G, H	A

Code Description

- All LDPC codes for passive plants are quasi-cyclic and binary
- The matrix M to calculate the parity bits has nearly upper diagonal form for all codes
  - Only the first sub-diagonal of the matrix M is non-zero
  - The parity matrices H are constructed so that encoding can be realized with low complexity
- In the following slides the parity check matrices H of the LDPC codes are given
- Description
  - In all tables the top row indexes columns of the parity check matrix
  - The second row of the tables indicates information (1) and parity (0) columns
  - The third row of the tables indicates transmitted columns (1) and punctured columns (0)

Parity Matrices for Codes E and F

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
0	-	203	-	-	188	278	-	-	313	-	-	-	-	56	308	248	206	142	25	309	-	355	257	-	-	-	-	99	-	42	-	303	-	-	-	-	197	126	359	308	257	342	113	-	318	109
0	61	-	-	-	-	-	-	319	106	-	250	153	-	-	283	32	-	-	-	-	225	-	284	-	132	71	113	-	-	130	173	194	287	129	19	294	307	-	-	265	233	-	274	-	-	318
-	61	113	-	-	-	268	330	-	-	142	-	-	-	-	-	-	-	202	-	279	282	-	132	99	-	203	129	26	347	-	74	181	352	84	-	293	353	212	309	-	199	-	-	303	-	210
-	-	113	183	-	302	-	-	221	153	349	5	334	256	269	-	-	208	61	240	-	40	-	-	194	-	-	-	-	123	-	-	-	-	1	147	288	-	109	-	122	333	152	-	275	42	142
-	-	-	183	244	-	-	89	-	-	105	-	301	331	-	-	-	194	-	237	155	-	36	-	-	142	248	-	182	51	51	-	-	191	-	107	54	91	-	18	254	-	75	225	111	200	116
-	-	-	-	244	189	45	352	118	-	-	59	-	340	99	267	122	-	-	-	-	-	213	-	159	86	-	352	-	-	-	163	151	339	225	326	-	-	147	170	-	-	7	198	110	300	35

Figure 8: Base code information bits: 41; (max) block length: 46. Lifting: ROTATION SPACE:NESTED CYCLIC:1: 360

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
183	90	·	·	160	295	·	·	268	240	182	127	·	187	·	·	179	288	·	167	14	327	96	·	215	359	·	·	273	344	261
183	0	·	·	·	276	291	·	·	58	308	348	286	·	4	93	·	·	171	·	·	·	207	54	190	352	309	34	223	84	62
·	0	61	·	·	·	184	160	212	235	·	·	·	256	·	39	191	236	303	324	·	·	·	292	·	83	132	189	224	251	142
·	·	61	122	351	·	344	51	·	·	·	267	122	·	284	341	94	335	·	·	256	194	270	·	240	127	351	234	·	202	228
·	·	·	122	175	104	·	206	42	·	91	·	198	329	266	·	·	·	284	269	73	192	·	93	1	·	220	197	44	·	266

Figure 4: Base code information bits: 26; (max) block length: 30. Lifting: ROTATION SPACE:NESTED CYCLIC:1: 360

Parity Matrices for Codes G and H

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
0	·	·	45	·	92	28	·	137	111	344	2	338	190	258	328	13
0	241	·	·	284	·	·	186	·	198	185	334	76	148	236	93	190
·	241	122	119	171	17	244	303	218	356	258	53	181	330	271	279	150
·	·	122	0	287	36	135	84	72	245	208	303	239	124	176	284	121

Figure 2: Base code information bits: 13; (max) block length: 15. Lifting: ROTATION SPACE:NESTED CYCLIC:1: 360

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
0	16	·	·	21	9	·	·	33	44	·	·	15	40	4	56	47
0	1	·	·	·	·	·	12	39	42	40	2	·	54	33	32	12
·	1	32	·	·	4	46	50	·	·	44	7	43	47	23	·	48
·	·	32	3	34	·	44	58	8	·	·	54	14	4	·	43	26
·	·	·	3	27	43	41	·	·	38	56	20	20	·	13	16	10

Figure 1: Base code information bits: 12; (max) block length: 16. Lifting: ROTATION SPACE:NESTED CYCLIC:1: 60

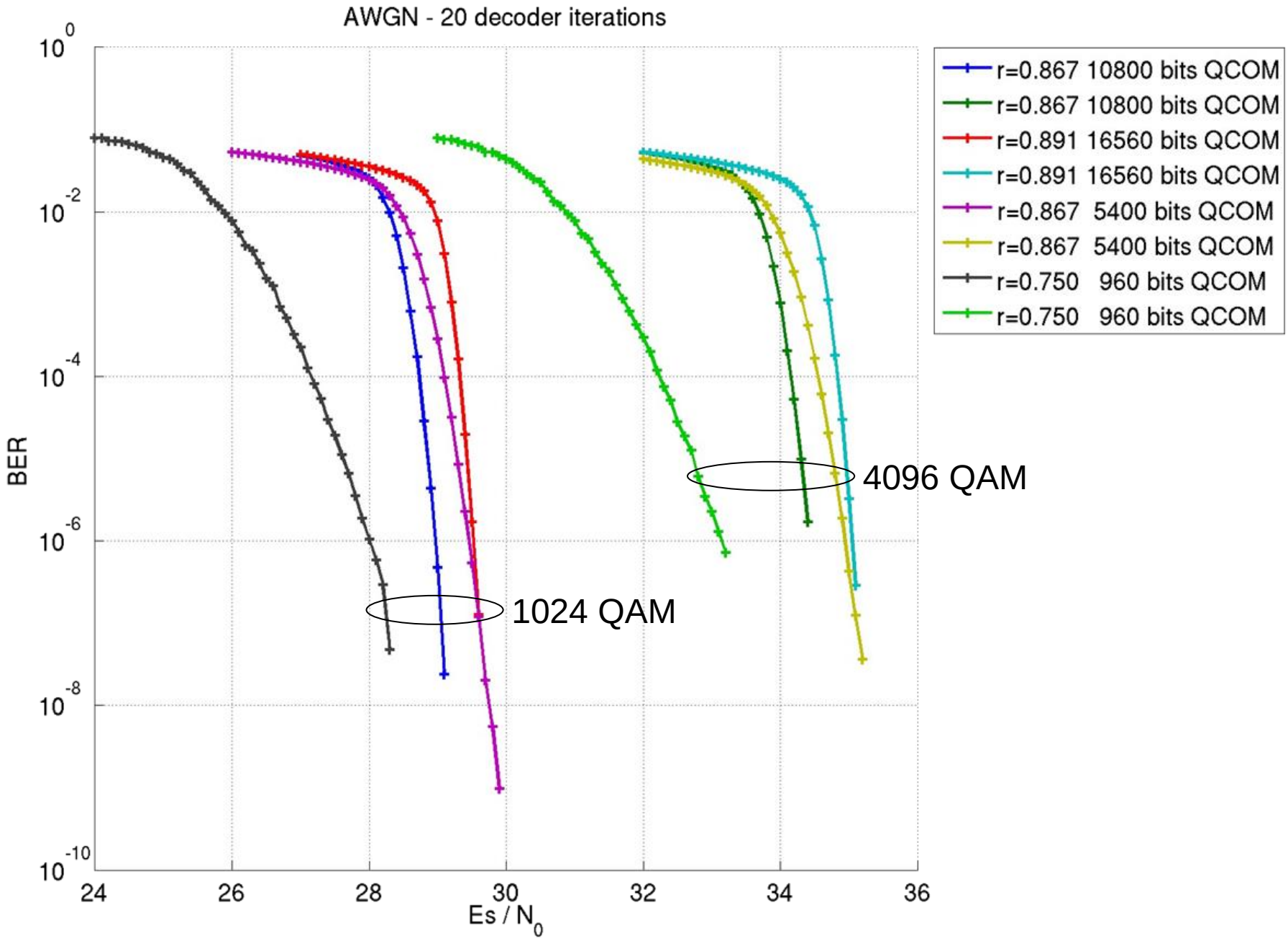
Edge Density, Parity Checks and Lifting Size

Base n	Base k	Rate	Lifting Z	Information Bits	Code word length	Parity checks	Based edges	Edge density
46	41	0.8913	**360**	14760	16560	**2160**	154	**3.348**
30	26	0.8667	**360**	9360	10800	**1800**	98	**3.267**
15	13	0.8667	**360**	4680	5400	**1080 (1440)**	54 (56)	**3.6 (3.73)**
16	12	0.75	**60**	720	960	**300**	53	**3.3125**

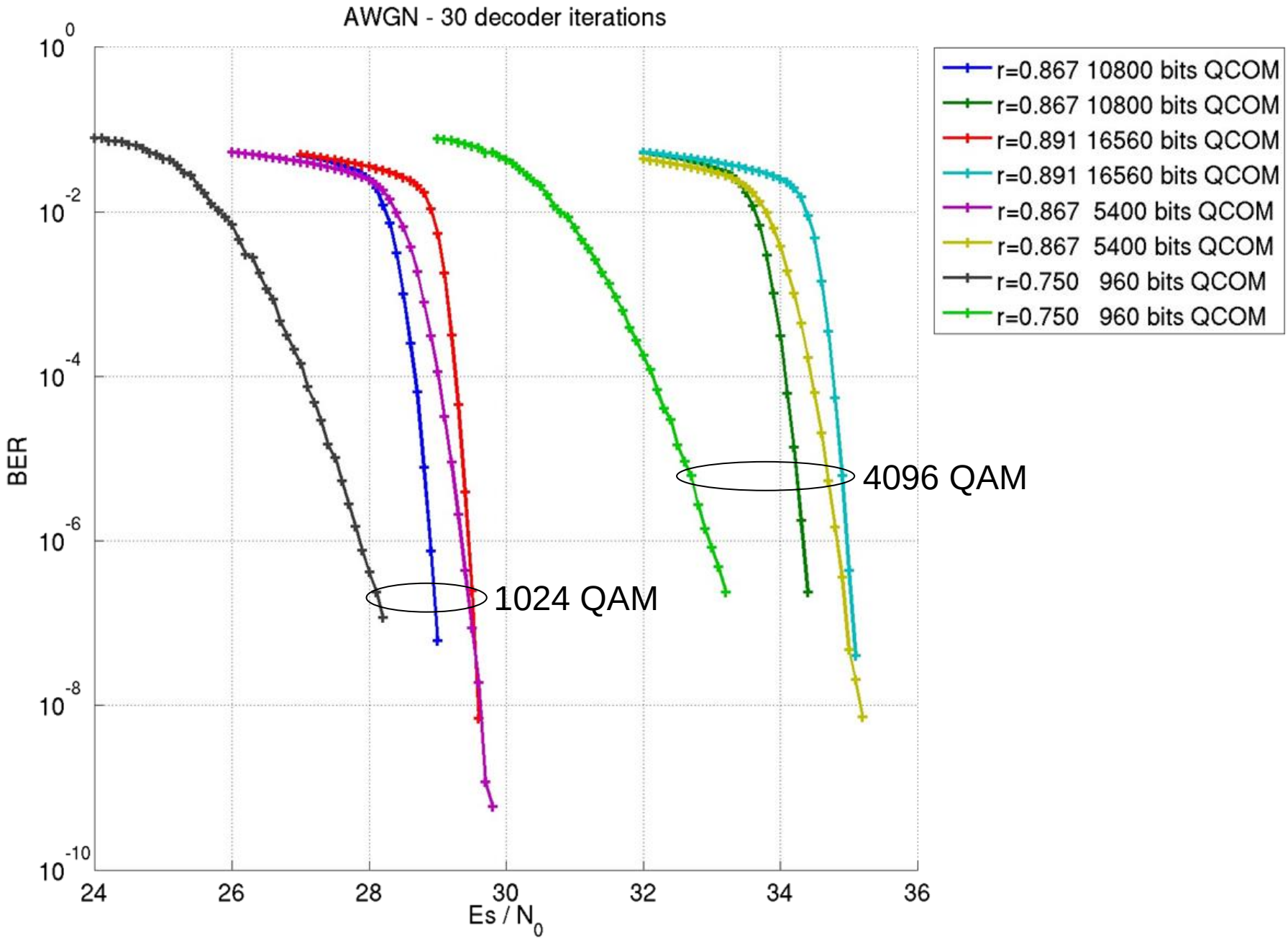
LDPC Decoder Assumptions

- Sum product decoder
- Flooding schedule
  - No layered iterations are applied
- The maximal number of iterations is set to 20 or 30, respectively
  - In the hardware implementation, layered iterations would be applied
    - This allows reducing the number of iterations roughly by 50%
    - Since the implementation and performance of a layered schedule is LDPC code specific, it is not used for code comparison
- Simulation methodology according to prodan_3bn_02_0313.pdf

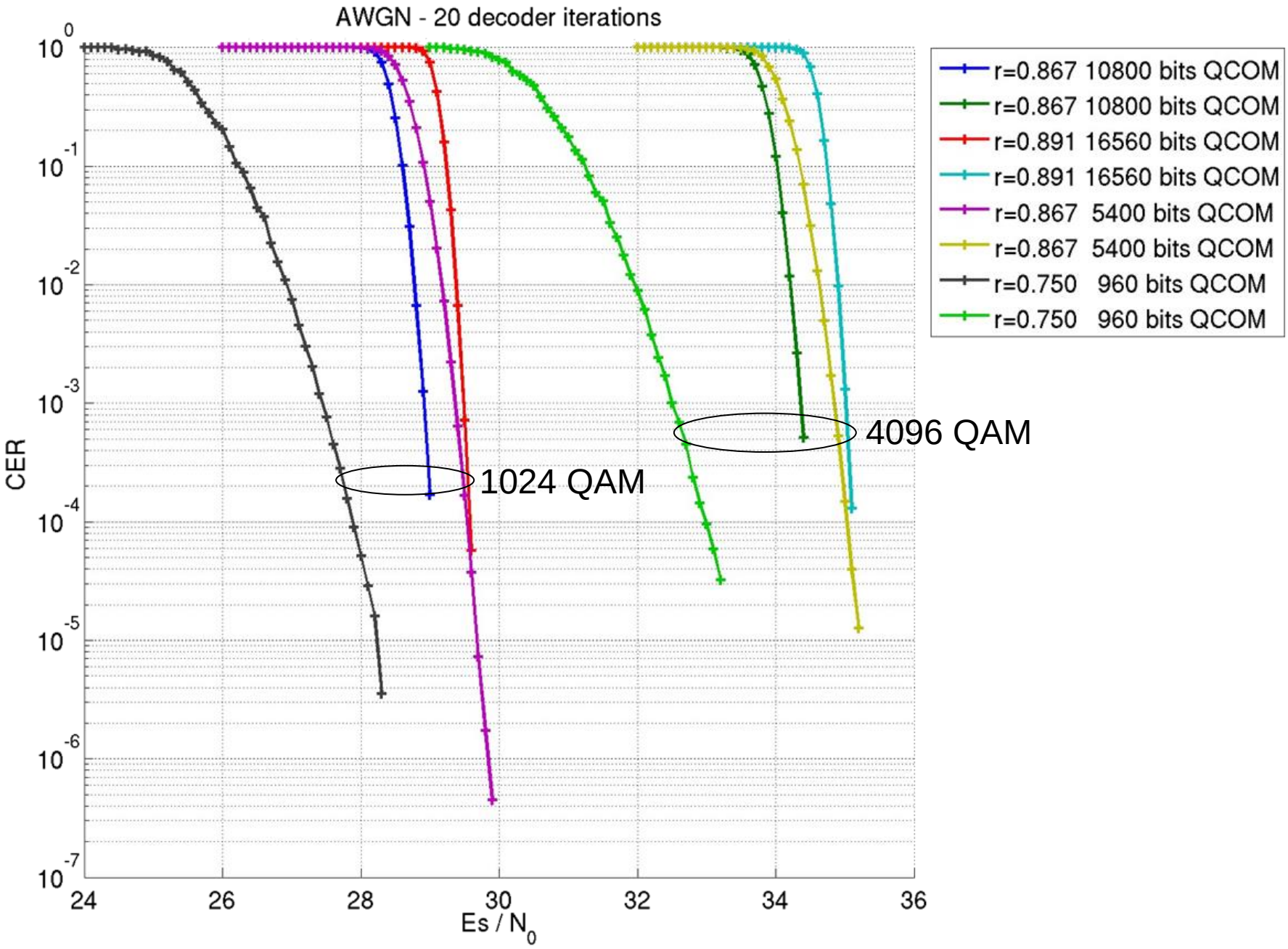
Performance Result: AWGN – 20 Decoder Iterations – BER



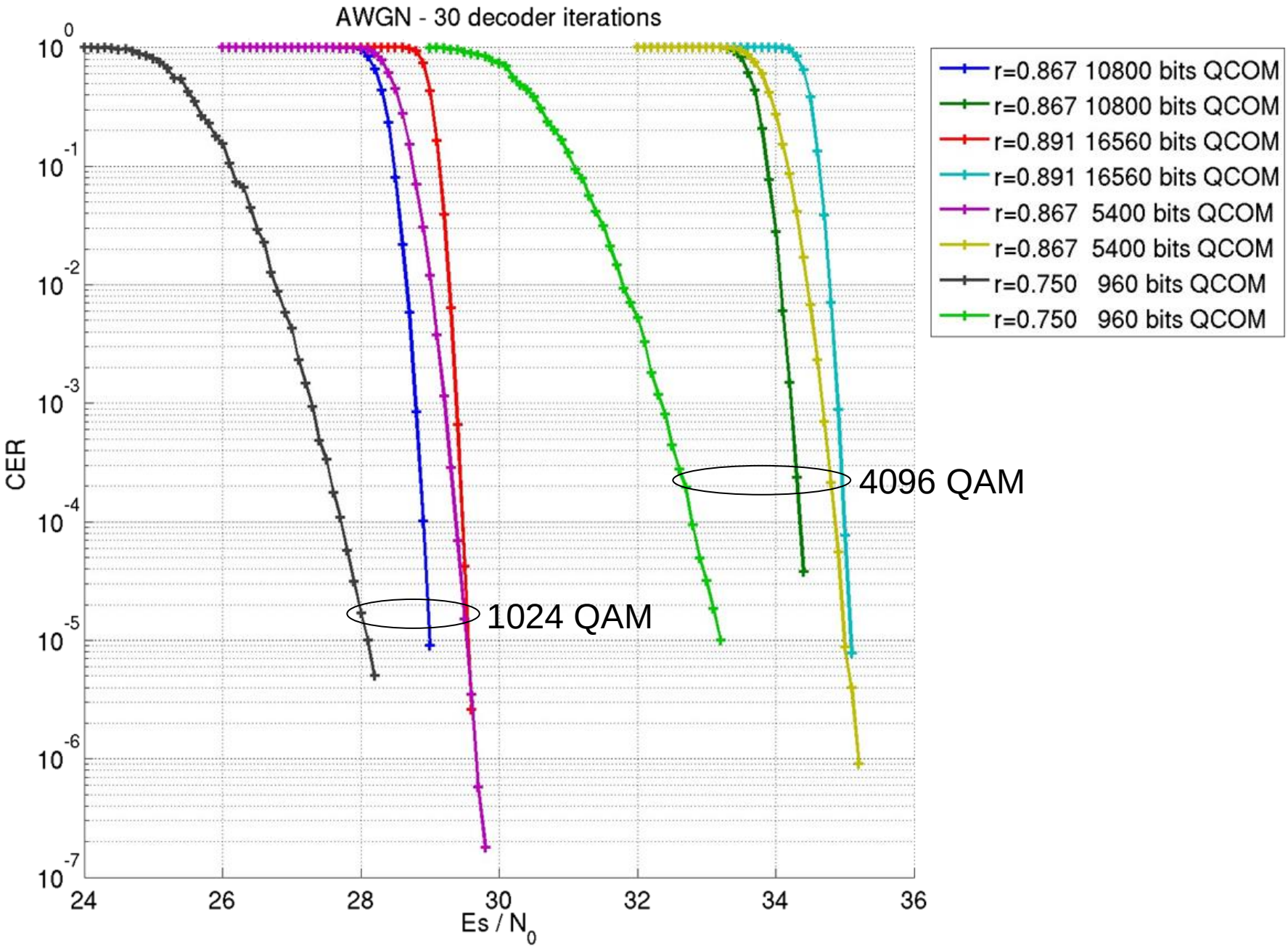
Performance Result: AWGN – 30 Decoder Iterations – BER



Performance Result: AWGN – 20 Decoder Iterations – FER



Performance Result: AWGN – 30 Decoder Iterations – FER



thank you