



TECHNICAL PAPER 15

Example Of Optional CSK Code Parameter Selection To Obtain RX Throughputs of over 4 Gbps

Previously introduced CSK code parameter examples were given for using a half-code symbol to represent the full symbol to double the network throughput with MIMO receive configurations. It was demonstrated that any further reduction in the symbol fraction beyond 1/2 CSK full symbol length that corresponded to a 2 Gbps receive throughput. The 100 MHz allocation bandwidth contained 128 frequency carriers with many carriers containing 4 half-symbol detections per symbol pair in a QPSK modulation configuration. The case structured every full-code length to be divisible by 4 to accommodate the quarter symbol analysis series. This paper performs the same structure within each 100 MHz allocation bandwidth, but with every CSK code divisible by 2 instead of 4. On the surface this doubles the throughput. However, a specific analysis run shown to the right verifies a throughput value of 4+ GigaBPS throughput is possible.

The 2-column new network configuration in the figure here defines the larger array of symbol pairs provided by the larger count of multiple CSK code pairs on each carrier. This new configuration summary is shown at the bottom of the second column. The earlier configuration of 128 total frequency carriers is replaced with a frequency carrier count of 253 which is close to a 2 to 1 increase of QPSK carriers within a 100 MHz allocation bandwidth. The unique CSK code count is increased from 29 to 57. There are multiple unique and orthogonal CSK code pair counts as high as 6 on carrier 3168 MHz and 7 on 3162 MHz carriers with many more multiples of 5, 4, 3, and 2 orthogonal CSK code pairs elsewhere. The receive MIMO throughput example is:

- Total Carriers (including duplicates) is 253
- Total CSK code pairs is 253 where each pair supports 2 quadrature transports
- Each quad transport supports 4 transport symbols or 2 X 4 transport symbols
- Total of 8 transport symbols per carrier 8 X 253 = 2024 symbols
- Total transport data = 2024 X 4 bits = 8096 bits per 20 microsecond slot
- Throughput = 8096 bits X 10exp6/ 20 = 4.048 Gbps

This results in a throughput of 4.048 Gbps requiring a frequency allocation of less than 100 MHz.

The Final Parameter Is Reflected In The Ratio Of Actual Symbol Pairs / Total Carriers (Bytes per Carrier Ratio)

- CSK Code-Pairs / Unique Carrier Count = 253 / 92 = 2.75 CSK Code-Pairs/Carrier
- Previous CSK Code Pairs / Unique Carrier Count = 128 / 76 = 1.6842----- CSK Code-Pairs/Carrier
- Actual Throughput Gain = 2.75 / 1.6824 = 4.048 Gbps / 1.9765 Gbps (abt 2 to 1) in throughput using the same allocation bandwidth of 100 MHz

CarIdx	CodeLen	ChpRate	Mult	BW	CarIdx	CodeLen	ChpRate	Mult	BW
3161.6	304	15.2	208	10.13	3202.0	308	15.3	175	12.1
3162.0	310	15.5	204	10.33	3202.8	314	15.7	204	10.46
3162.340	17	169	11.23		3202.8	408	20.4	157	12.6
3162.372	16.8	170	12.4		3203.1	308	15.4	208	10.26
3161.6	304	15.2	208	10.13	3203.2	352	17.6	182	11.73
3162.370	15.5	204	10.33		3203.2	364	18.2	176	12.13
3162.340	17	169	11.33		3203.3	354	17.7	181	11.8
3162.372	16.8	170	12.4		3203.7	362	18.1	177	12.08
3162.408	20.4	155	13.6		3203.8	352	18.6	180	11.98
3162.2	328	16.3	194	10.86	3203.8	352	18.6	180	11.98
3162.2	368	18.4	163	12.89	3203.8	352	18.6	180	11.98
3163.5	342	17.1	185	11.4	3203.8	352	18.6	180	11.98
3163.5	370	18.5	171	12.33	3203.8	352	18.6	180	11.98
3164.1	318	15.8	199	10.6	3204.0	360	18	178	12
3164.1	336	16.8	189	11.26	3204.0	360	18	178	12
3164.8	344	17.2	184	11.46	3204.0	360	18	178	12
3164.8	368	18.4	172	12.26	3204.4	354	18.7	182	11.83
3165.0	300	15	211	10	3204.4	354	18.7	182	11.83
3165.2	328	16.4	193	10.93	3204.4	354	18.7	182	11.83
3165.2	368	18.2	164	12.86	3207.4	316	15.6	203	10.53
3165.9	346	17.3	183	11.53	3207.4	408	20.3	158	13.53
3165.9	368	18.3	173	12.2	3207.4	324	16.2	188	11.8
3166.8	312	15.6	203	10.4	3207.6	360	18	182	12.13
3166.8	346	17.4	182	11.6	3208.8	310	15.5	207	10.33
3166.8	364	18.2	174	12.13	3208.8	310	15.5	207	10.33
3166.8	408	20.2	156	13.53	3208.8	360	18	182	12.13
3167.1	308	15.3	207	10.2	3211	338	16.9	190	11.28
3167.5	350	17.5	181	11.66	3211	360	18	182	12.06
3167.5	362	18.1	175	12.06	3211.1	338	16.9	190	11.28
3168	320	16	198	10.66	3211.1	364	18.7	183	11.13
3168	330	16.5	192	11.1	3211.6	352	18	182	11.98
3168	352	17.6	180	11.73	3211.8	404	20.2	159	13.46
3168	360	18	176	12	3212	360	18	182	12.06
3168	364	18.2	176	12.06	3212	360	18	182	12.06
3168	368	18.4	174	12.13	3212	360	18	182	12.06
3168.3	354	17.7	179	11.8	3212	360	18	182	12.06
3168.3	358	17.8	177	11.9	3212.4	354	18.1	178	11.98
3168.4	358	17.8	178	11.86	3214.4	338	16.4	196	10.93
3170.8	322	16.8	191	11.06	3214.4	338	16.4	196	10.93
3170.8	332	18.1	186	11.23	3214.4	338	16.4	196	10.93
3171	302	15.1	210	10.06	3214.8	376	18.8	171	12.53
3171.1	314	15.7	202	10.46	3216	320	16	201	10.66
3171.4	404	20.2	157	13.46	3216	344	17.2	187	11.46
3171.7	322	16.1	197	10.73	3216.3	352	18.1	173	11.98
3171.7	344	16.7	181	11.13	3216.4	344	17.2	187	11.46
3172.4	308	15.4	206	10.28	3216.4	344	17.2	187	11.46
3172.4	412	20.8	154	13.73	3217.5	330	16.5	195	11
3173	344	17.3	187	11.13	3217.5	330	16.5	195	11
3173	360	18	187	12.06	3217.5	330	16.5	195	11
3173.2	324	16.2	196	10.8	3217.5	330	16.5	195	11
3173.2	336	16.8	189	11.2	3217.5	330	16.5	195	11
3173.2	378	18.8	169	12.6	3217.5	330	16.5	195	11
3173.2	392	19.6	162	13.06	3218.1	314	15.7	205	10.46
3173.8	316	15.8	201	10.53	3218.1	314	15.7	205	10.46
3173.8	402	20.1	158	13.4	3218.1	314	15.7	205	10.46
3176.6	344	17.2	209	10.13	3218.1	314	15.7	205	10.46
3177.2	338	16.9	189	11.26	3220	322	16.1	200	10.73
3177.2	378	18.8	169	12.53	3220	360	17.5	194	11.66
3177.5	310	15.5	205	10.33	3220	360	17.5	194	11.66
3177.5	410	20.5	155	13.66	3220	400	20	161	13.33
3178.5	328	16.3	195	10.88	3220.4	352	18.6	184	11.98
3178.5	338	16.8	188	11.2	3220.4	352	18.6	184	11.98
3179	340	17	187	11.33	3220.8	352	18.6	183	11.73
3179	374	18.7	170	12.46	3220.8	352	18.6	183	11.73
3180	300	15	212	9	3221	368	19.3	176	12.2
3180	318	15.9	200	10.6	3221.4	364	18.2	177	12.13
3180	400	20	159	13.33	3221.6	368	19.3	176	12.2
3180.6	342	17.1	186	11.4	3221.6	368	19.3	176	12.2
3180.6	372	18.6	171	12.4	3222	338	17.9	180	11.93
3181.6	328	16.4	194	10.93	3222	360	18	178	12
3181.6	388	19.4	164	12.93	3222.4	364	18.2	178	12.06
3182	344	17.2	185	11.46	3222.4	364	18.2	178	12.06
3182.4	408	20.4	156	13.6	3222.4	364	18.2	178	12.06
3183.2	346	17.3	184	11.53	3222.4	408	20.4	158	13.6
3183.2	368	18.4	173	12.26	3222.4	408	20.4	158	13.6
3184	320	16	199	10.66	3222.4	408	20.4	158	13.6
3184	368	18.8	169	13.26	3222.4	408	20.4	158	13.6
3184.2	348	17.4	183	11.6	3222.4	408	20.4	158	13.6
3184.2	368	18.3	174	12.2	3222.4	408	20.4	158	13.6
3184.5	330	16.5	193	11	3222.4	408	20.4	158	13.6
3184.5	368	18.3	174	12.2	3222.4	408	20.4	158	13.6
3185	350	17.5	182	11.66	3222.4	408	20.4	158	13.6
3185	364	18.2	175	12.13	3222.4	408	20.4	158	13.6
3185.6	352	17.8	181	11.73	3222.4	408	20.4	158	13.6
3185.6	362	18.1	176	12.06	3222.4	408	20.4	158	13.6
3186	354	17.7	180	11.8	3222.4	408	20.4	158	13.6
3186	360	18	177	12	3222.4	408	20.4	158	13.6
3186.1	302	15.1	211	10.06	3222.4	408	20.4	158	13.6
3186.2	308	15.8	204	10.26	3222.4	408	20.4	158	13.6
3186.2	358	17.8	178	11.93	3222.4	408	20.4	158	13.6
3187.1	314	15.7	203	10.46	3222.4	408	20.4	158	13.6
3187.1	408	20.2	157	13.53	3222.4	408	20.4	158	13.6
3187.2	332	16.8	192	11.06	3222.4	408	20.4	158	13.6
3187.2	384	19.2	166	12.8	3222.4	408	20.4	158	13.6
3187.8	308	15.4	207	10.26	3222.4	408	20.4	158	13.6
3187.8	322	16.1	198	10.73	3222.4	408	20.4	158	13.6
3187.8	368	18.8	161	13.2	3222.4	408	20.4	158	13.6
3187.7	334	16.7	191	11.13	3222.4	408	20.4	158	13.6
3187.7	382	19.1	167	12.73	3222.4	408	20.4	158	13.6
3181.4	324	16.2	197	10.8	3222.4	408	20.4	158	13.6
3181.4	368	18.7	162	13.53	3222.4	408	20.4	158	13.6
3181.6	316	15.8	202	10.53	3222.4	408	20.4	158	13.6
3181.6	404	20.2	158	13.46	3222.4	408	20.4	158	13.6
3182	304	15.2	210	10.23	3222.4	408	20.4	158	13.6
3182	338	16.8	180	11.2	3222.4	408	20.4	158	13.6
3182	360	18	180	12.06	3222.4	408	20.4	158	13.6
3183	310	15.5	206	10.33	3222.4	408	20.4	158	13.6
3183	412	20.8	155	13.73	3222.4	408	20.4	158	13.6
3184.1	338	16.8	189	11.26	3222.4	408	20.4	158	13.6
3184.1	378	18.9	169	12.6	3222.4	408	20.4	158	13.6
3184.8	328	16.3	196	10.86	3222.4	408	20.4	158	13.6
3184.8	362	18	183	11.96	3222.4	408	20.4	158	13.6
3185	300	15	213	10	3222.4	408	20.4	158	13.6
3185.9	318	15.3	201	10.6	3222.4	408	20.4	158	13.6
3185.9	402	20.1	159	13.4	3222.4	408	20.4	158	13.6
3186	340	17	188	11.33	3222.4	408	20.4	158	13.6
3186	378	18.8	170	12.53	3222.4	408	20.4	158	13.6
3187.7	306	15.3	209	10.2	3222.4	408	20.4	158	13.6
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