



NS2000 Nominal Performance

Executive Summary

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1 Definitions

1.1 CNR and SNR

The figure below shows spectral plot of two signals and the noise level. The red signal has 20% Roll-Off Factor (ROF). The green signal has 5% ROF. The blue line represents the noise level.

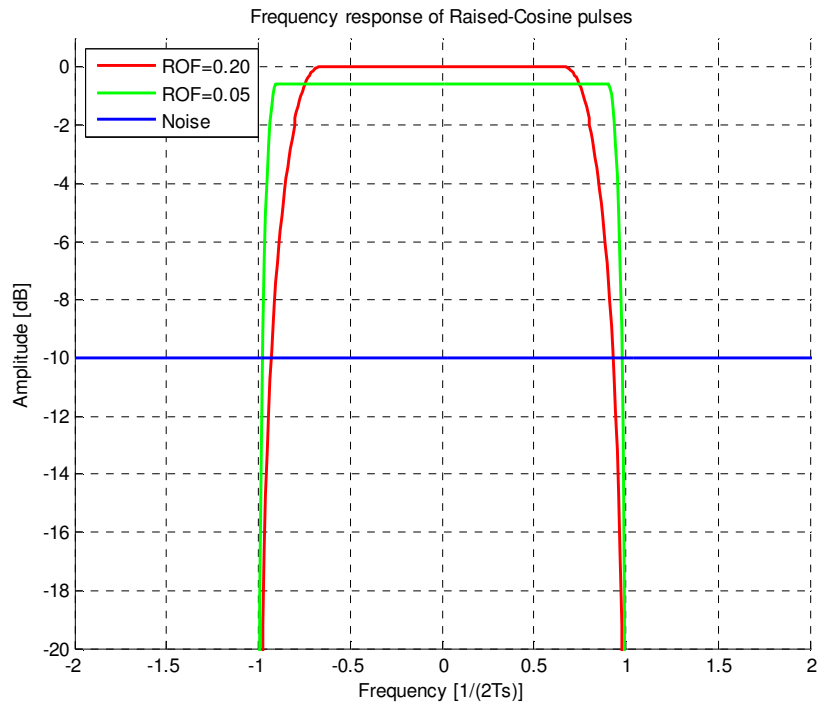


Figure 1: 5% vs. 20% ROF signals

The red area in the figure below represents the signal power with the 20% ROF:

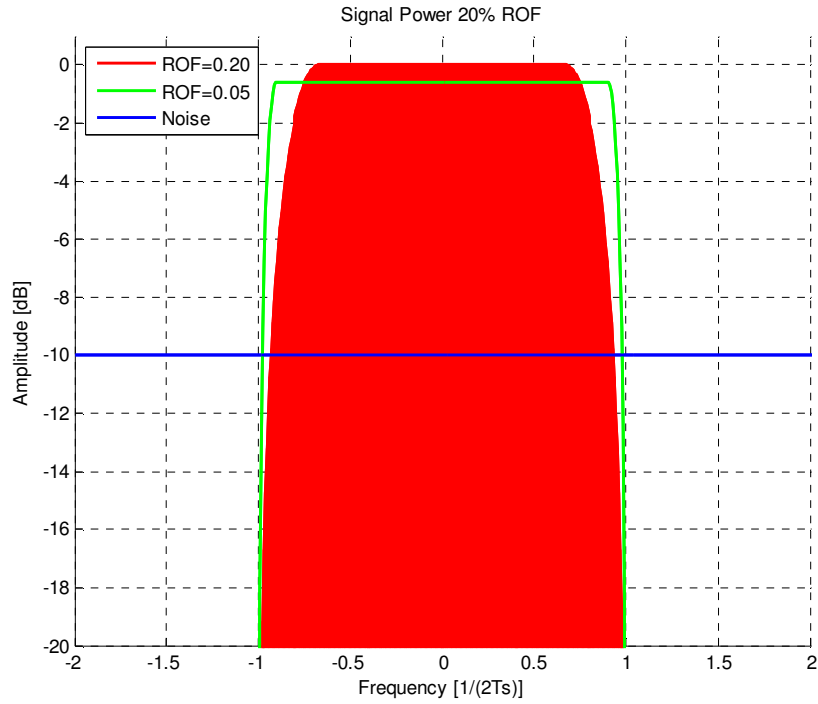


Figure 2: signal power - 20% ROF

The green area in the figure below represents the signal power with the 5% ROF:

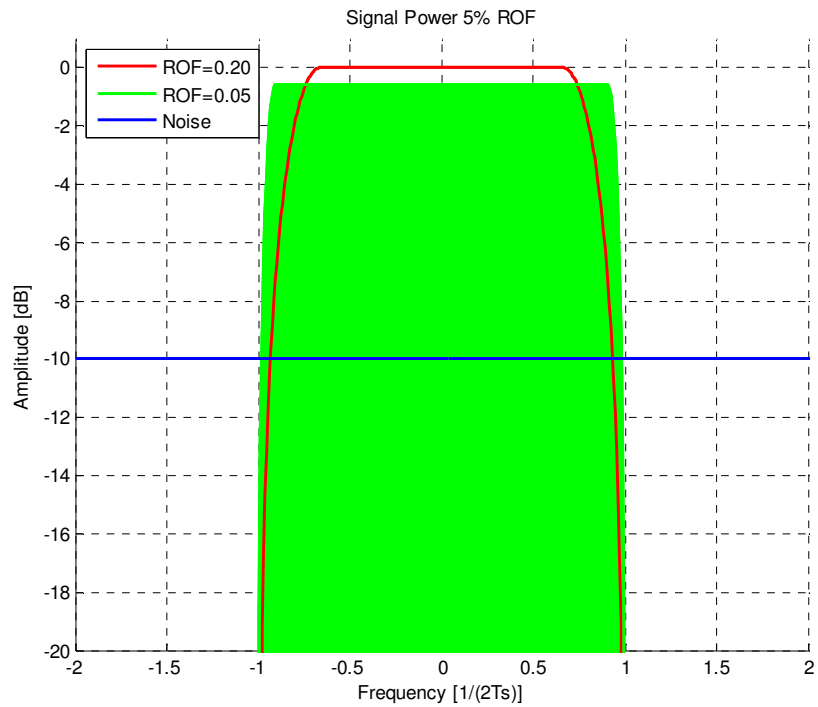


Figure 3: signal power - 5% ROF

Note the power of the red and green signals are kept the same. The blue area in the figure below represents the noise power:

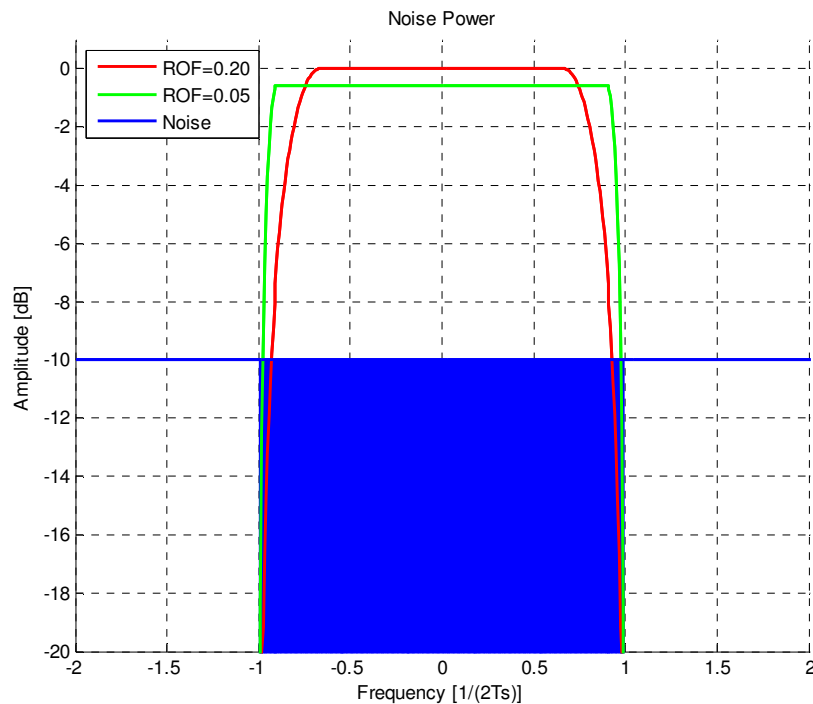


Figure 4: noise power

The CNR is defined as follows:

$$\text{CNR} = 10\log_{10}(10^{(\text{signal power}/10)} - 10^{(\text{noise power}/10)})$$

The SNR is defined as follows:

$$\text{SNR} = \text{CNR} + 10\log_{10}(1 + \text{ROF})$$

Note that the SNR is also equal to the gap between the spectral density of the signal and the spectral density of the AWGN, and that the SNR of the signal with the 5% ROF is therefore 0.58 dB lower than the SNR of the signal with the 20% ROF.

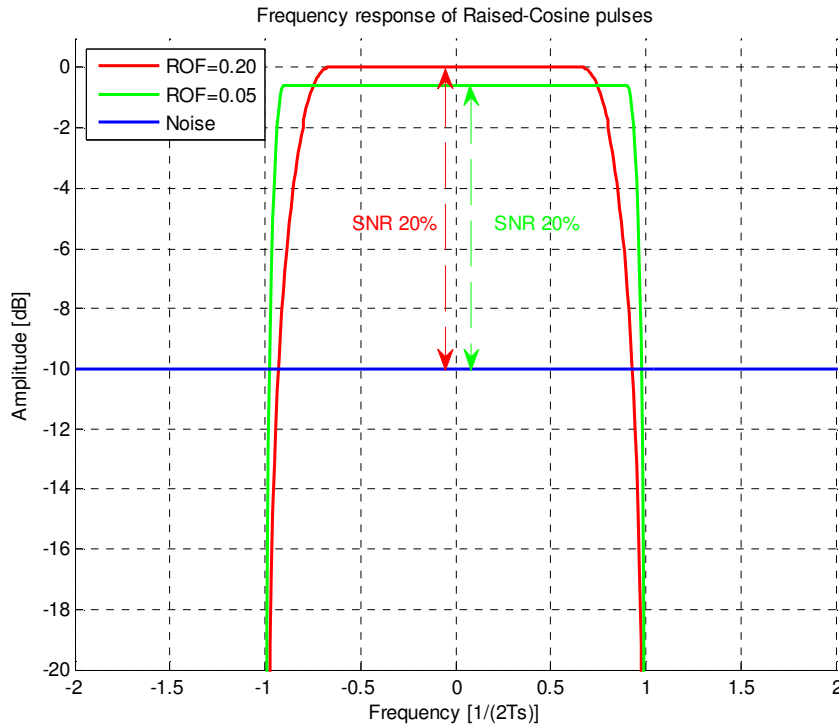


Figure 5: SNR comparison

1.2 Symbol-Rate

Since the occupied bandwidth of both the signals is the same their symbol rate is different. If the carrier bandwidth is normalized to 1Hz the symbol rate of the 20% ROF signal is 0.8333 [sym/sec] while the symbol rate of the 5% ROF signal is 0.9524 [sym/sec].

1.3 Spectral-Efficiency

The spectral efficiency is defined as:

$$\text{Spectral-Efficiency} = \text{Symbol-Rate} \times \log_2(\text{Constellation-Size}) \times \text{FEC-Rate}$$

This simplified formula does not account for framing overhead, such as header and pilots.

1.4 Eb/No

Eb/No is typically used to define the FEC performance. EBNO is calculated as a function of the SNR as follows:

$$\text{EbNo} = \text{SNR [dB]} - 10 \times \log_{10}(\log_2(\text{Constellation-Size}) \times \text{FEC-rate})$$

2 NS2000 Performance Table

64800 (SNR [dB] / CNR @ 20% & 5% ROF [dB]/ Spectral efficiency [bits/sec/Hz])													
QPSK	S2	NS3™	8PSK	S2	NS3™	16APSK	S2	NS3™	32APSK	S2	NS3™	64APSK	NS3™
1/4	-2.30 -3.09 0.40	-2.39 -2.60 0.46											
1/3	-1.16 -1.95 0.53	-1.13 -1.34 0.61											
2/5	-0.13 -0.92 0.64	-0.10 -0.31 0.73	2/5		2.58 2.37 1.10	2/5		4.89 4.68 1.46	2/5		6.43 6.22 1.83		
13/30		0.26 0.05 0.80	13/30		3.02 2.81 1.19	13/30		5.21 5.00 1.59	13/30		6.96 6.75 1.99		
7/15		0.70 0.49 0.86	7/15		3.46 3.25 1.29	7/15		5.66 5.45 1.71	7/15		7.47 7.26 2.14		
1/2	1.20 0.41 0.80	1.13 0.92 0.92	½		4.00 3.79 1.38	1/2		6.25 6.04 1.83	1/2		8.24 8.03 2.29		
8/15		1.53 1.32 0.98	8/15		4.58 4.37 1.47	8/15		6.75 6.54 1.96	8/15		8.71 8.50 2.45		
17/30		1.97 1.76 1.04	17/30		5.01 4.80 1.56	17/30		7.19 6.98 2.08	17/30		9.35 9.14 2.60		
3/5	2.42 1.63 0.97	2.26 2.05 1.10	3/5	5.85 5.06 1.45	5.50 5.29 1.66	3/5		7.81 7.60 2.20	3/5		9.99 9.78 2.76		
19/30		2.70 2.49 1.17	19/30		6.11 5.90 1.75	19/30		8.24 8.03 2.33	19/30		10.57 10.36 2.91	19/30	12.90 12.69 3.48
2/3	3.28 2.49 1.07	3.02 2.81 1.23	2/3	6.90 6.11 1.61	6.54 6.33 1.84	2/3	9.22 8.43 2.14	8.85 8.64 2.45	2/3		11.13 10.92 3.07	2/3	13.52 13.31 3.67
32/45		3.59 3.38 1.31	32/45		7.36 7.15 1.97	32/45		9.55 9.34 2.61	32/45		11.84 11.36 3.27	32/45	14.24 14.03 3.92
3/4	4.27 3.48 1.21	4.14 3.93 1.38	3/4	8.14 7.35 1.81	7.97 8.76 2.07	3/4	10.48 9.69 2.41	10.16 9.95 2.76	3/4	13.11 12.32 3.02	12.64 12.43 3.45	3/4	15.16 14.95 4.13
4/5	4.80 4.01 1.29	4.73 4.52 1.48	4/5		8.86 8.65 2.21	4/5	11.34 10.55 2.58	10.91 10.70 2.94	4/5	14.08 13.29 3.22	13.52 13.31 3.68	4/5	16.24 16.03 4.41
5/6	5.26 4.47 1.35	5.23 5.02 1.54	5/6	9.63 8.84 2.02	9.49 9.28 2.31	5/6	11.90 11.11 2.68	11.57 11.36 3.07	5/6	14.67 13.88 3.36	14.14 13.93 3.84	5/6	17.04 16.83 4.60
8/9	6.39 5.60 1.44	6.15 5.94 1.64	8/9	10.93 10.14 2.15	10.76 10.55 2.46	8/9	13.21 12.42 2.87	12.80 12.59 3.28	8/9	16.02 15.23 3.59	15.42 15.21 4.10	8/9	18.48 18.27 4.91
9/10	6.58 5.79 1.46	6.37 6.16 1.66	9/10	11.30 10.51 2.18	10.95 10.74 2.49	9/10	13.67 12.88 2.90	13.05 12.84 3.32	9/10	16.33 15.54 3.63	15.68 15.47 4.15	9/10	18.81 18.60 4.97

* The spectral efficiency in the above table accounts for the net data-rate taking into consideration all the framing overheads. The above performance has been measured at 30Mbaud.

Table 1: Nominal performance table

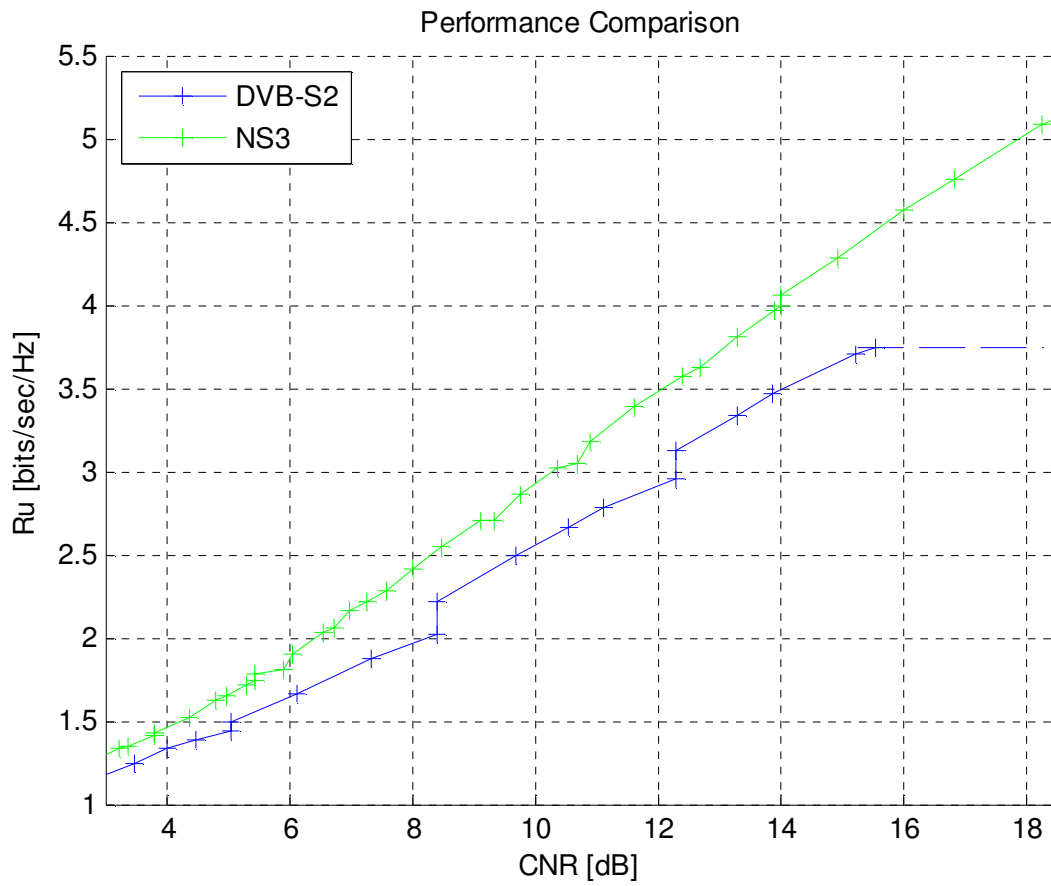


Figure 6: NS3 vs. DVB-S2 spectral efficiency as function of the CNR – NS2000

3 NS2000 FEC Eb/No Table

64800 threshold Eb/No [dB]													
QPSK	S2	NS3™	8PSK	S2	NS3™	16APSK	S2	NS3™	32APSK	S2	NS3™	64APSK	NS3™
1/4	0.71	0.62											
1/3	0.60	0.63											
2/5	0.84	0.87	2/5		1.79	2/5		2.85	2/5		3.42		
13/30		0.88	13/30		1.88	13/30		2.82	13/30		3.60		
7/15		1.00	7/15		2.00	7/15		2.95	7/15		3.79		
1/2	1.2	1.13	½		2.24	1/2		3.24	1/2		4.26		
8/15		1.25	8/15		2.54	8/15		3.46	8/15		4.45		
17/30		1.43	17/30		2.71	17/30		3.64	17/30		4.83		
3/5	1.63	1.47	3/5	3.30	2.95	3/5		4.01	3/5		5.22		
19/30		1.67	19/30		3.32	19/30		4.2	19/30		5.56	19/30	7.10
2/3	2.03	1.77	2/3	3.89	3.53	2/3	4.96	4.59	2/3		5.90	2/3	7.50
32/45		2.06	32/45		4.07	32/45		5.01	32/45		6.33	32/45	7.94
3/4	2.51	2.38	3/4	4.62	4.45	3/4	5.71	5.39	3/4	7.37	6.90	3/4	8.63
4/5	2.76	2.69	4/5		5.06	4/5	6.29	5.86	4/5	8.06	7.50	4/5	9.43
5/6	3.04	3.01	5/6	5.65	5.51	5/6	6.67	6.34	5/6	8.47	7.94	5/6	10.05
8/9	3.89	3.65	8/9	6.67	6.50	8/9	7.70	7.29	8/9	9.54	8.94	8/9	11.21
9/10	4.03	3.82	9/10	6.99	6.64	9/10	8.11	7.49	9/10	9.80	9.15	9/10	11.49

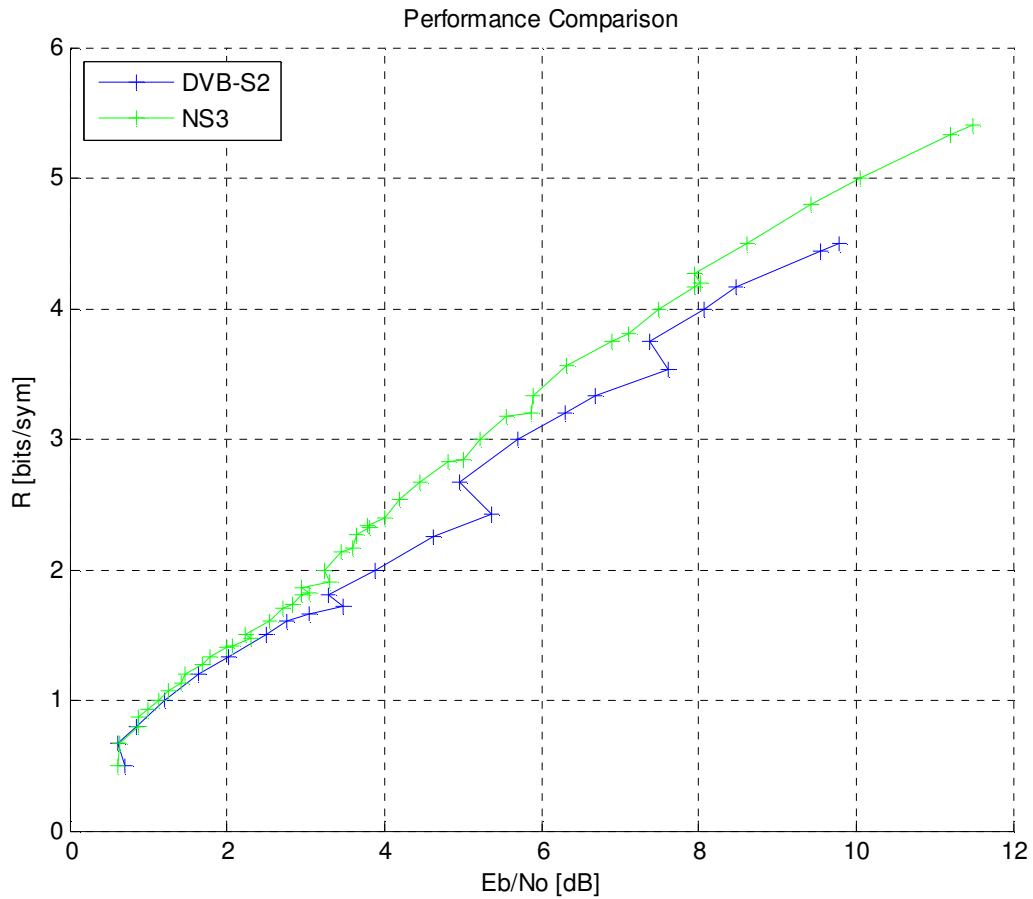


Figure 7: NS3 vs. DVB-S2 FEC spectral efficiency as function of the E_b/N_0 – NS2000

Note: the last graph only demonstrates the advantage of NS3 FEC and does not account for the different NS3 modulation scheme which enables a higher baud rate.