Performance Comparison using various LDPC coded and CSK modulated Schemes

Daekyung Kim and Hong-Yeop Song

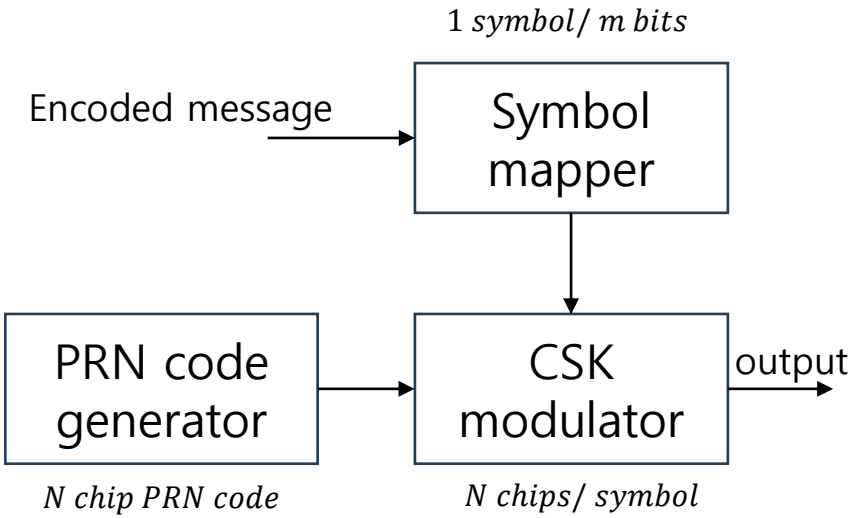
(presenter: Gangsan Kim)

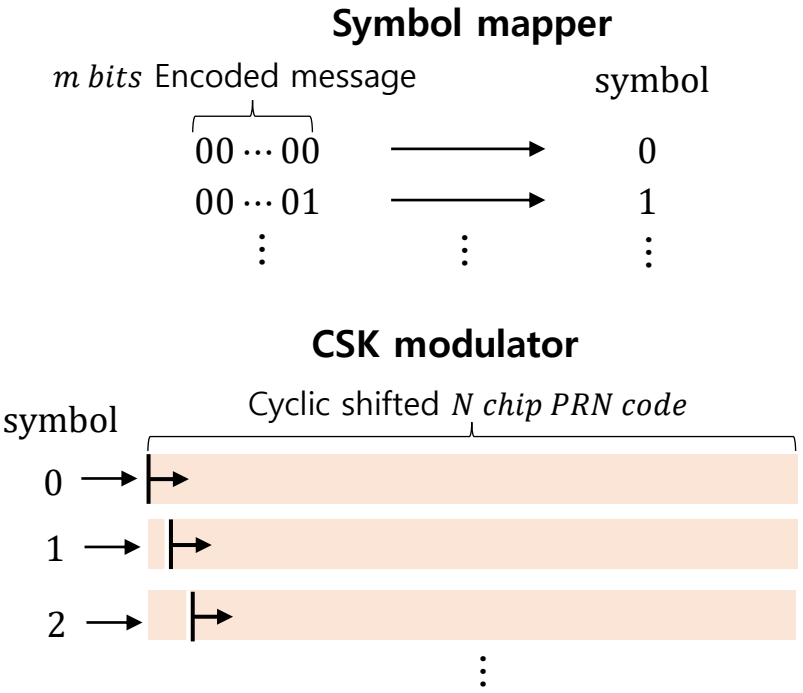
Channel Coding Lab.
Dept. of Electrical and Electronic Engineering, Yonsei Univ.

The 3rd International Conference on $\mathbf{M}^3$ IT Convergence

Introduction

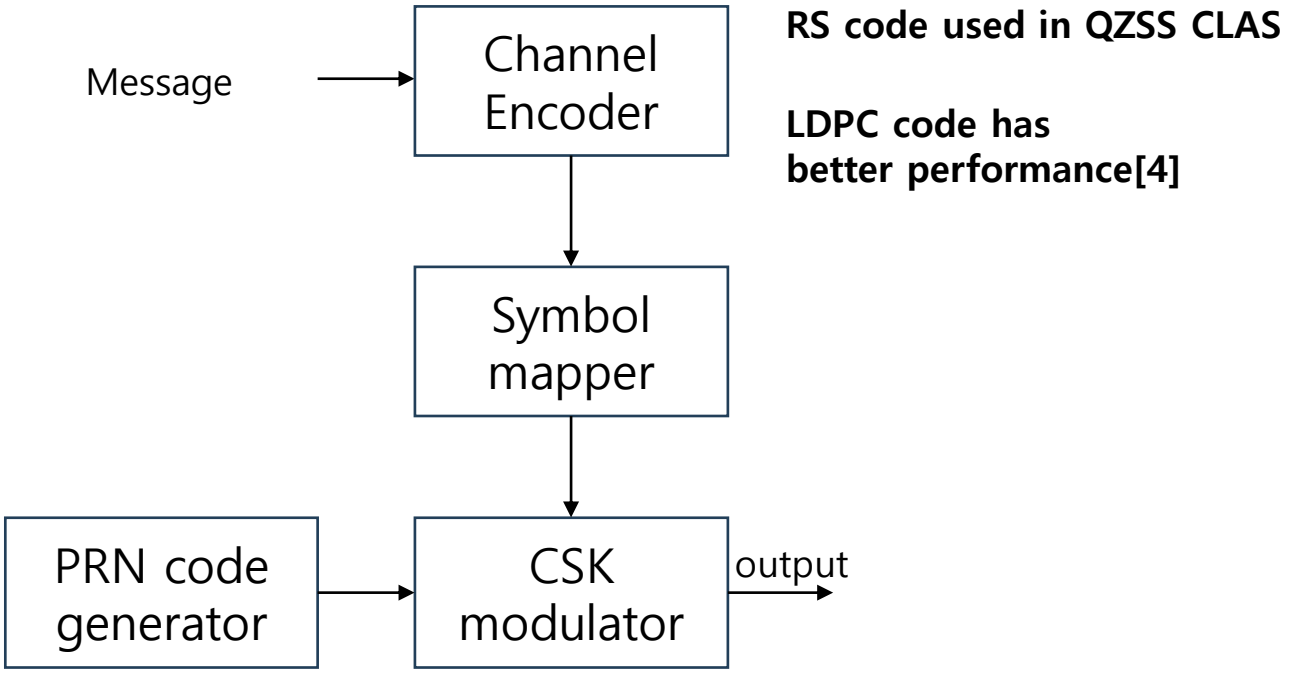
Code shift Keying (CSK) modulation maps several bits to some cyclically shifted version of pseudo-random noise (PRN) code representing one modulation symbol.





Introduction

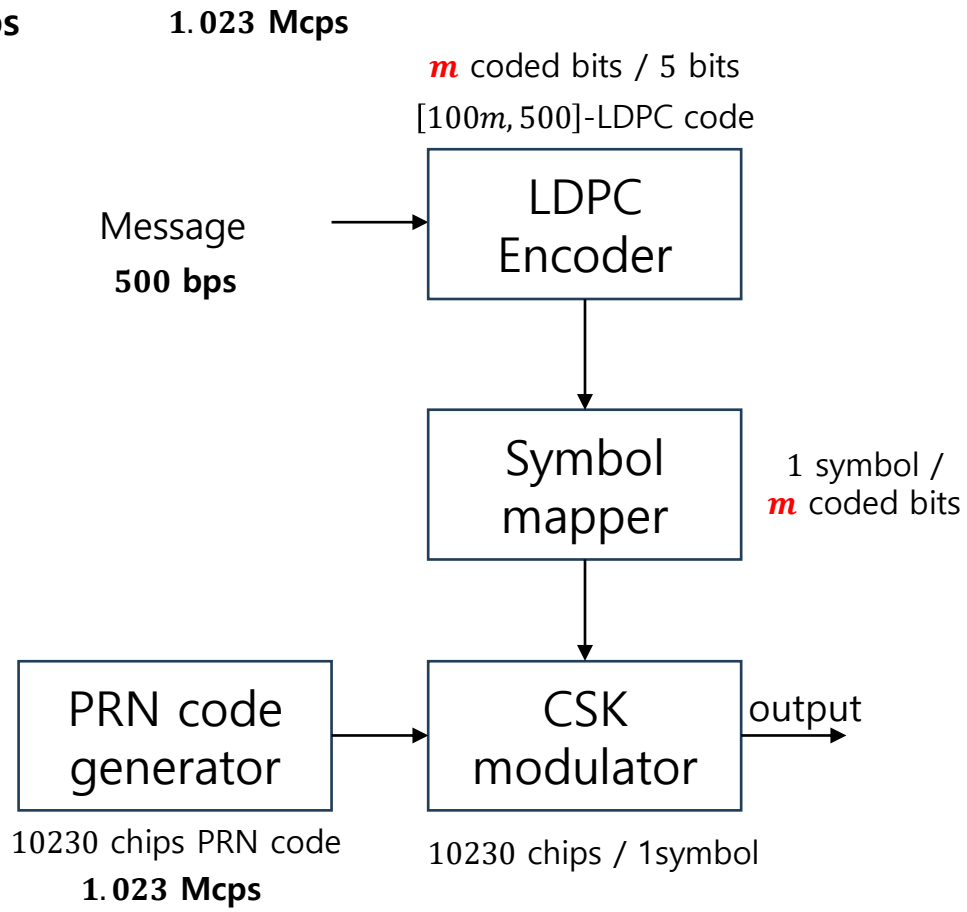
For centimeter-level augmentation services (CLAS) in quasi-zenith satellite sysem (QZSS), RS-CSK is used. Recently, we reveal that LDPC-CSK has better performance[4].



[4] H. Cho, J.M. Ahn, J.H. Noh, H.-Y. Song, “Some new LDPC-coded orthogonal modulation schemes for high data rate transmissions in navigation satellite systems,” ICT Express (2024).

Introduction

This paper finds the optimal combination of (**code rate, symbol mapping order**) for **given data rate and chip rate of PRN code.**



Introduction

We measure C/N_0 vs FER for each scheme.

C/N_0 is commonly used to evaluate performance in satellite navigation system.

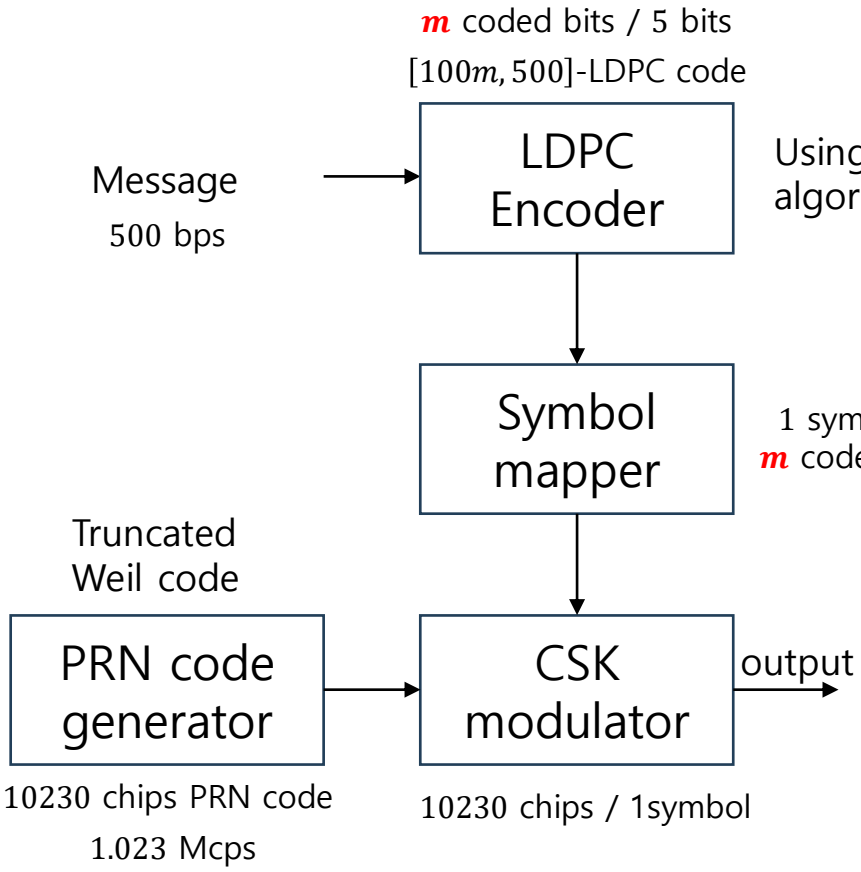
Relationship between E_b/N_0 and $C\ /\ N_0$ can be written as

$$C\ /\ N_0 = E_b/N_0 + 10\log_{10} R_b\ ,$$

where R_b: data rate.

Simulation

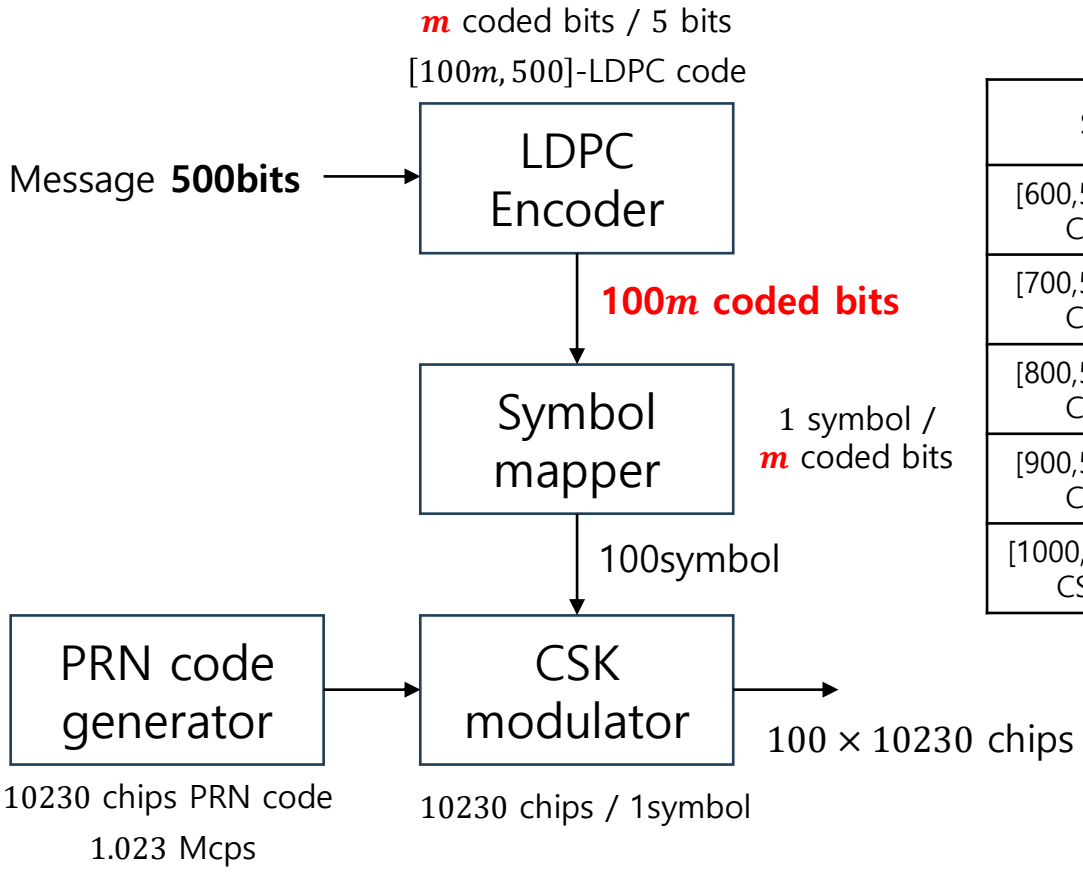
We simulate the following scheme for $m = 6, 7, 8, 9, 10$.



Scheme	message	coded	symbol
[600,500] LDPC & CSK(m=6)	500 bit	600 bit	100 symbol
[700,500] LDPC & CSK(m=7)	500 bit	700 bit	100 symbol
[800,500] LDPC & CSK(m=8)	500 bit	800 bit	100 symbol
[900,500] LDPC & CSK(m=9)	500 bit	900 bit	100 symbol
[1000,500] LDPC & CSK(m=10)	500 bit	1000 bit	100 symbol

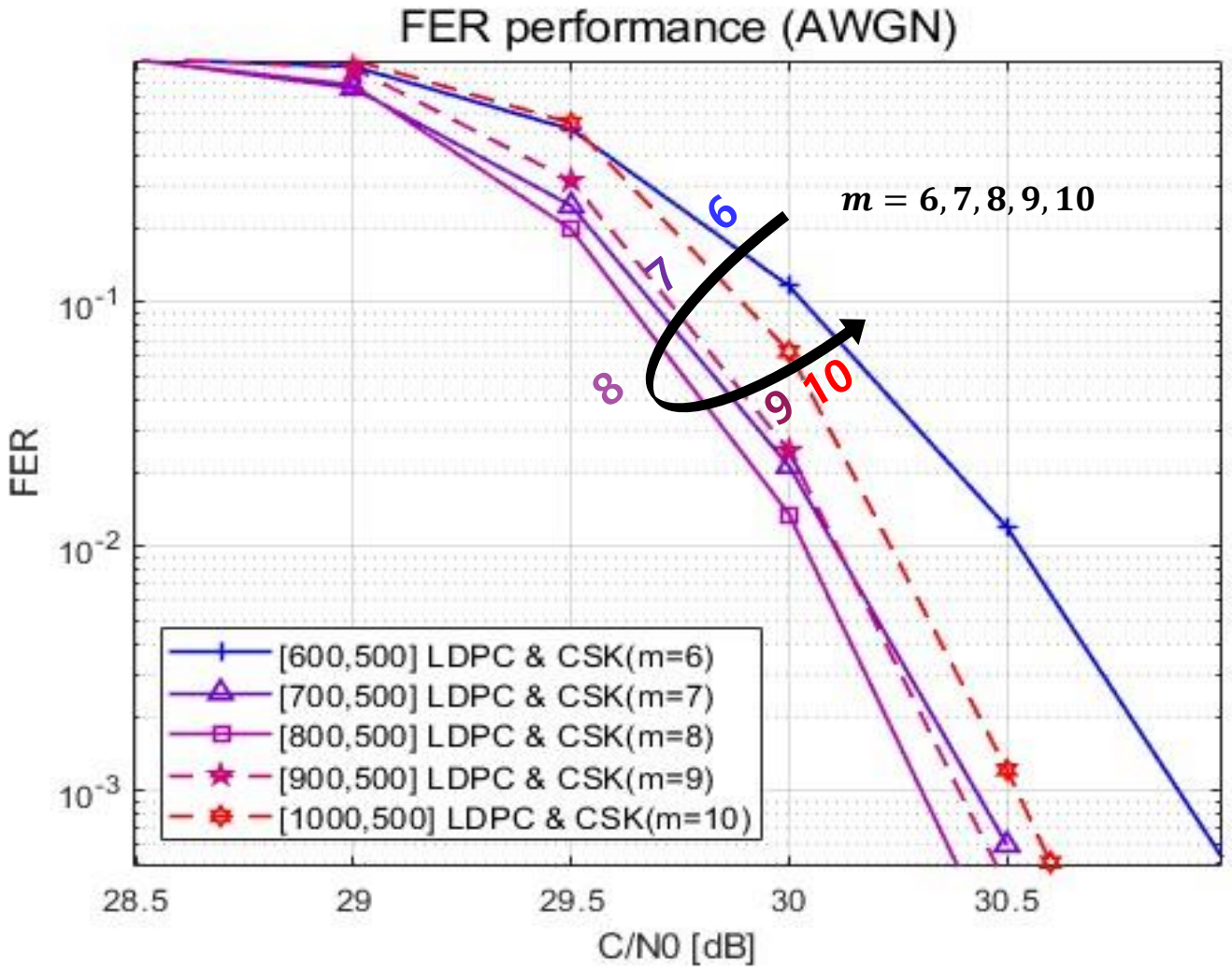
Simulation

We simulate the following scheme for $m = 6, 7, 8, 9, 10$.

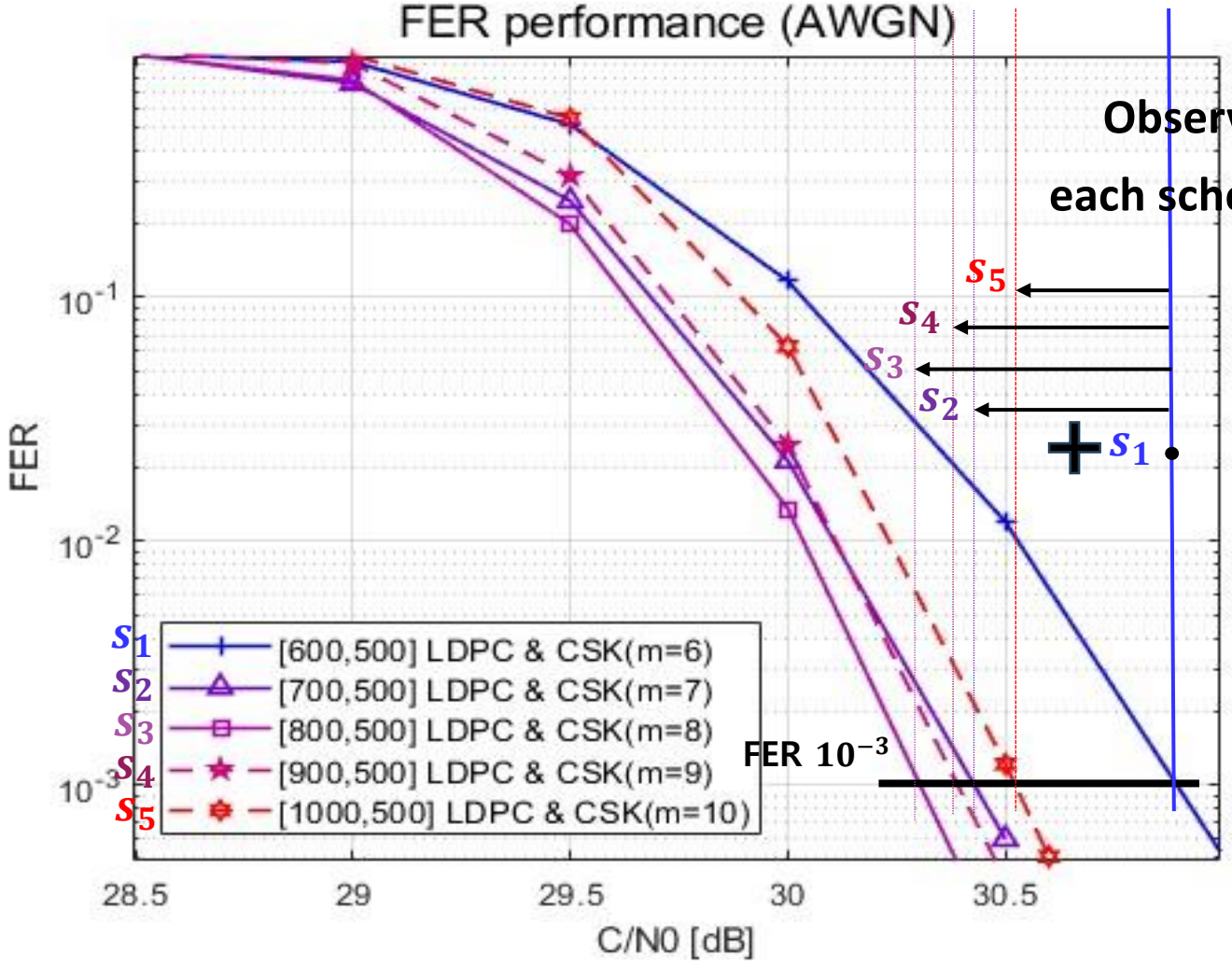


Scheme	message	coded	symbol
[600,500] LDPC & CSK(**m=6**)	**500 bit**	**600 bit**	100 symbol
[700,500] LDPC & CSK(**m=7**)	**500 bit**	**700 bit**	100 symbol
[800,500] LDPC & CSK(**m=8**)	**500 bit**	**800 bit**	100 symbol
[900,500] LDPC & CSK(**m=9**)	**500 bit**	**900 bit**	100 symbol
[1000,500] LDPC & CSK(**m=10**)	**500 bit**	**1000 bit**	100 symbol

Simulation

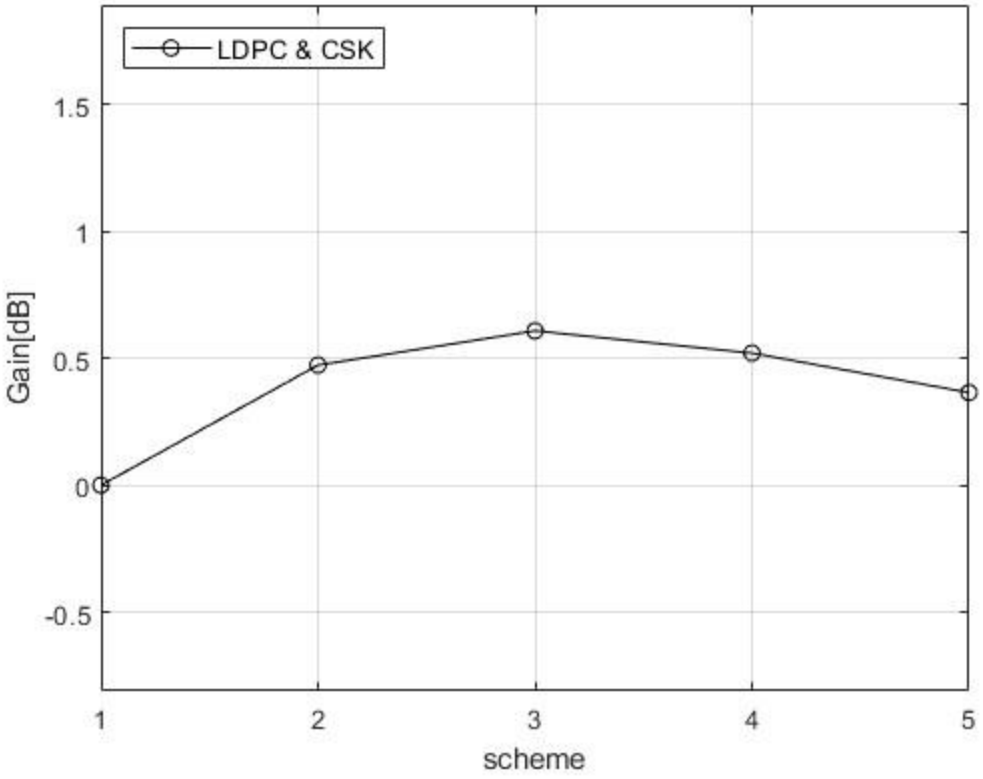

FER performance (AWGN)
$m = 6, 7, 8, 9, 10$
6
7
8
9
10
FER
10^{-1}
10^{-2}
10^{-3}
28.5
29
29.5
30
30.5
C/N0 [dB]
[600,500] LDPC & CSK(m=6)
[700,500] LDPC & CSK(m=7)
[800,500] LDPC & CSK(m=8)
[900,500] LDPC & CSK(m=9)
[1000,500] LDPC & CSK(m=10)

Simulation

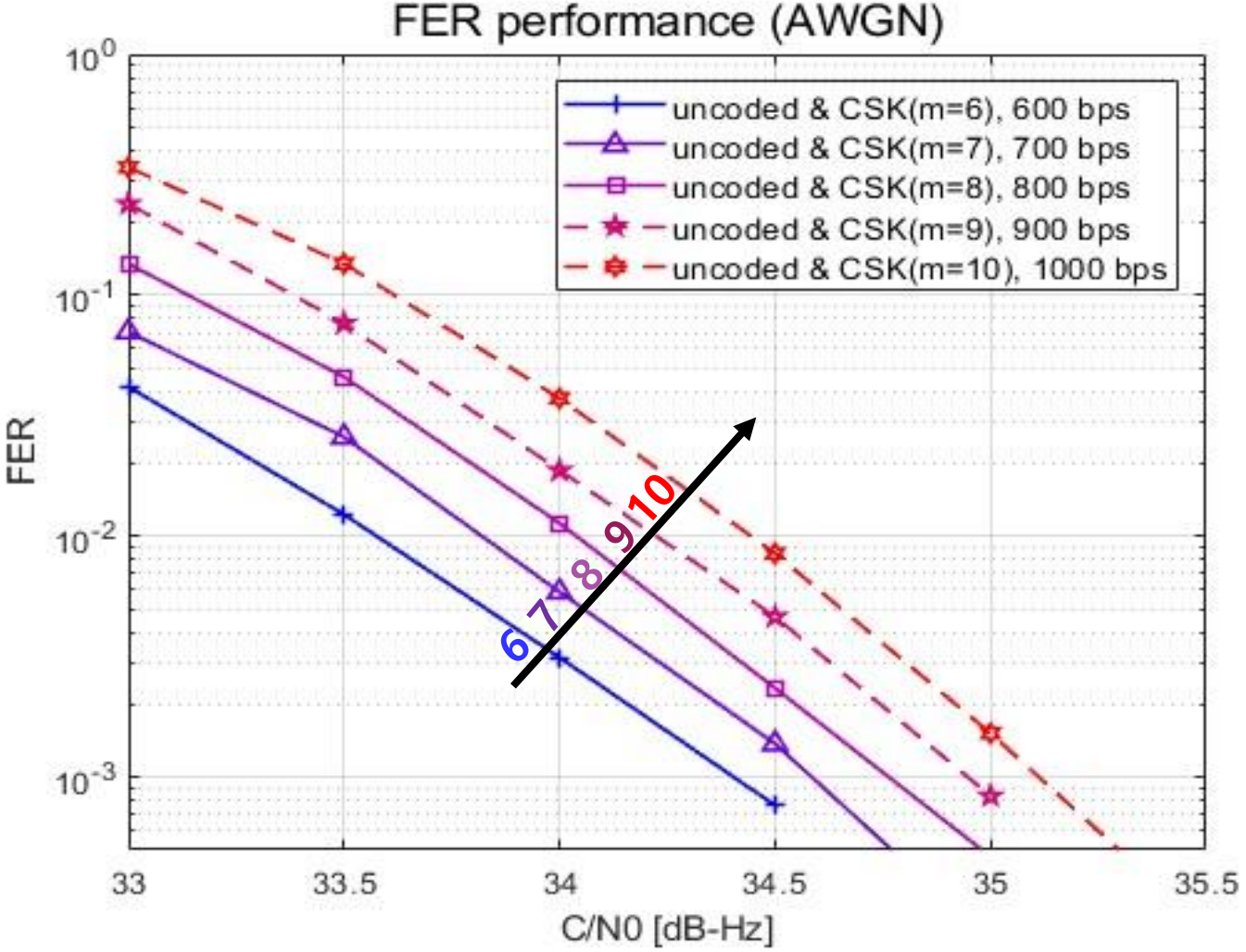

FER performance (AWGN)
FER
C/N0 [dB]
28.5
29
29.5
30
30.5
10^{-1}
10^{-2}
10^{-3}
s_1 [600,500] LDPC & CSK(m=6)
s_2 [700,500] LDPC & CSK(m=7)
s_3 [800,500] LDPC & CSK(m=8)
s_4 [900,500] LDPC & CSK(m=9)
s_5 [1000,500] LDPC & CSK(m=10)
FER 10^{-3}
Observe Gain of
each scheme from s_1
s_5
s_4
s_3
s_2
s_1

Simulation

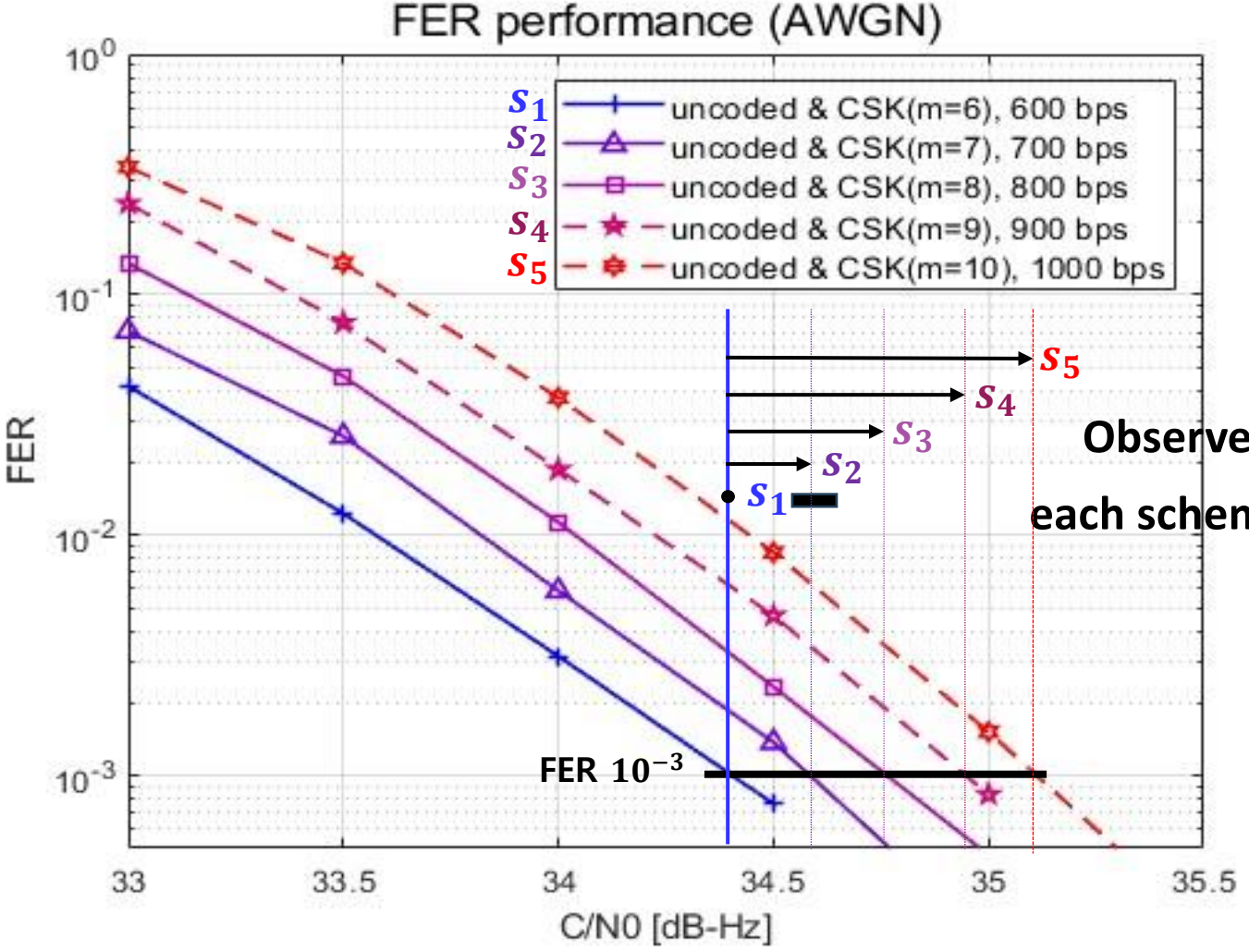
Gain of each scheme from s_1



Simulation (CSK only)



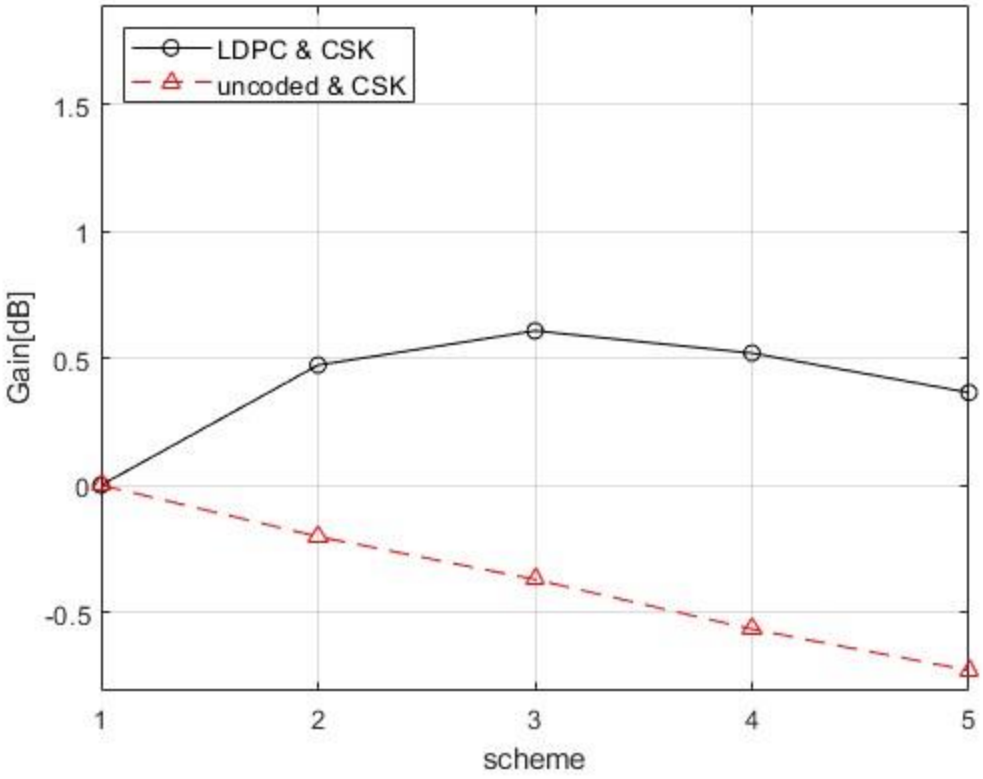
Simulation (CSK only)



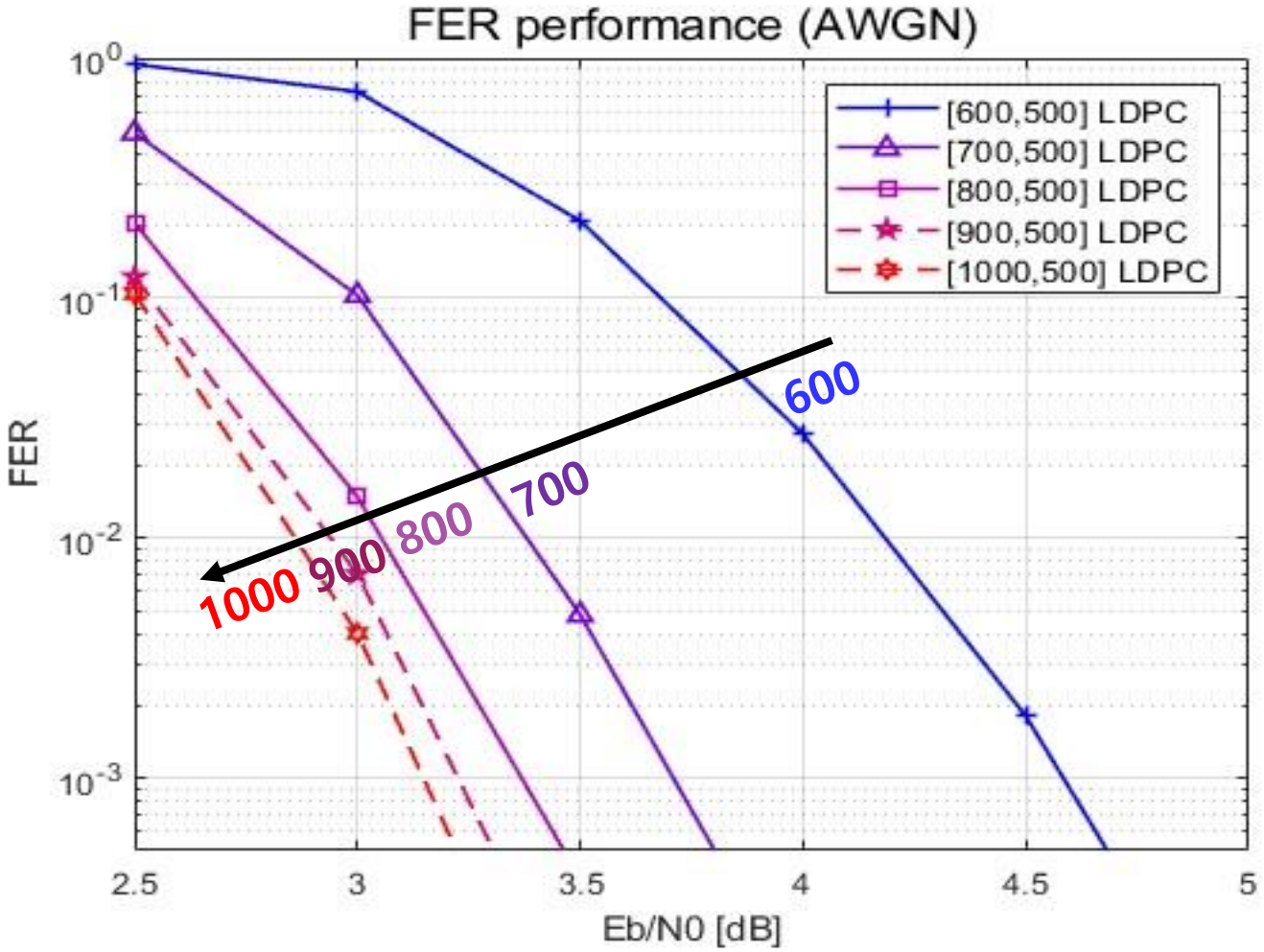
Observe Gain of each scheme from s_1

Simulation

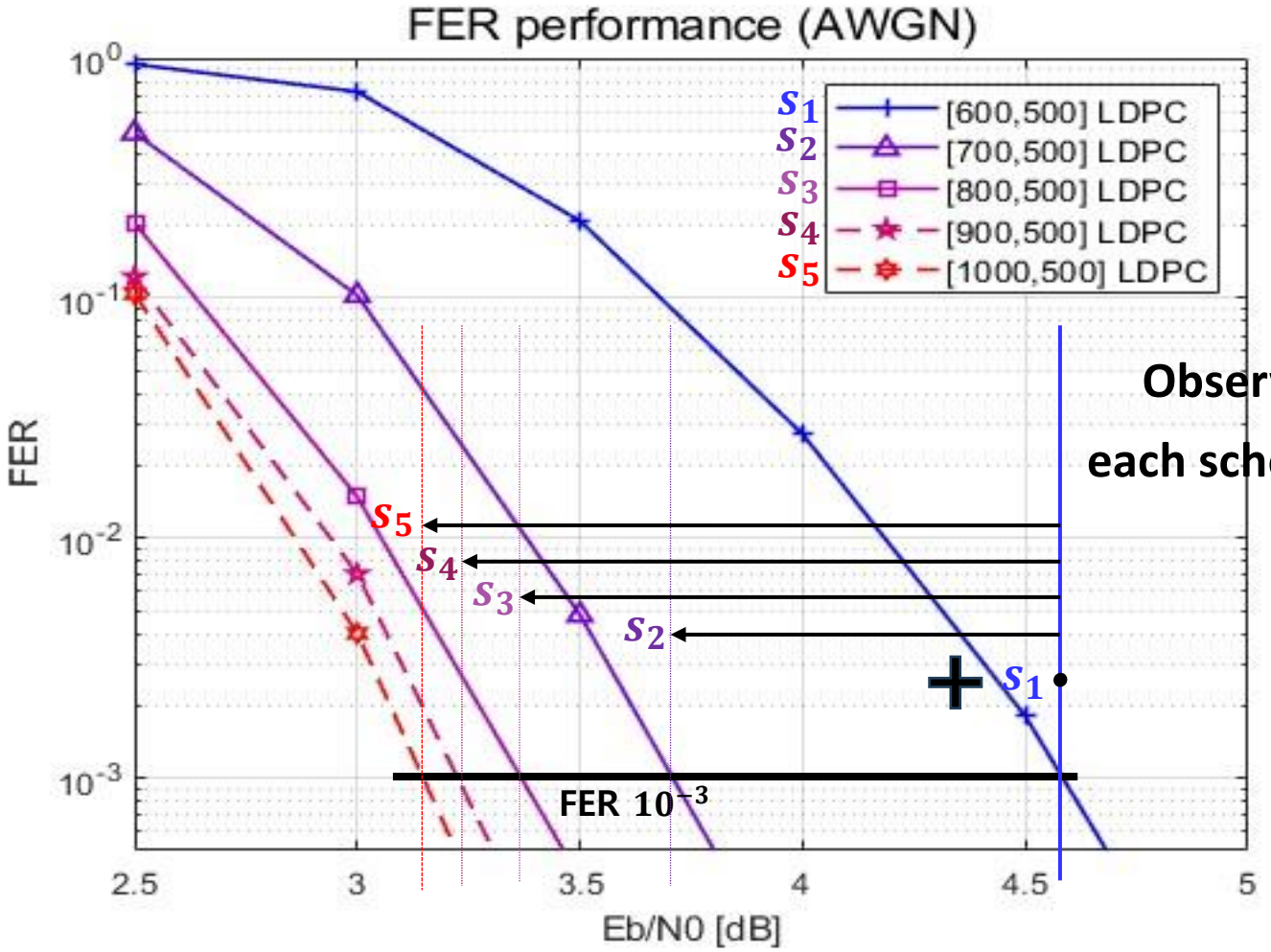
Gain of each scheme from s_1



Simulation (LDPC only)



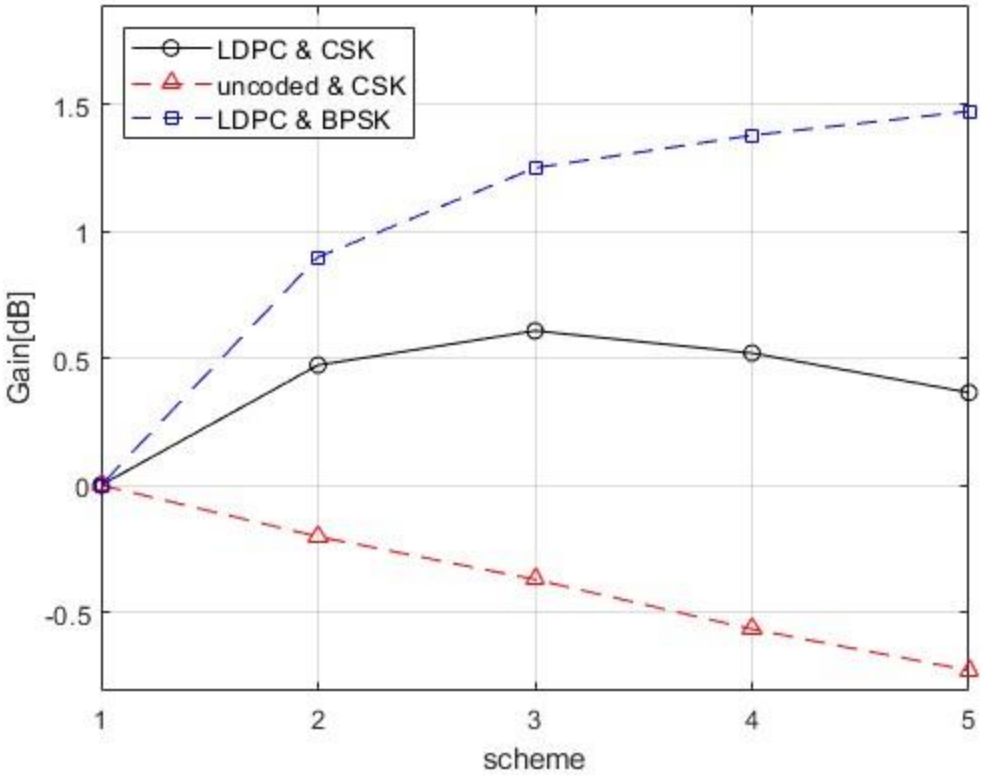
Simulation (LDPC only)



Observe Gain of each scheme from s_1

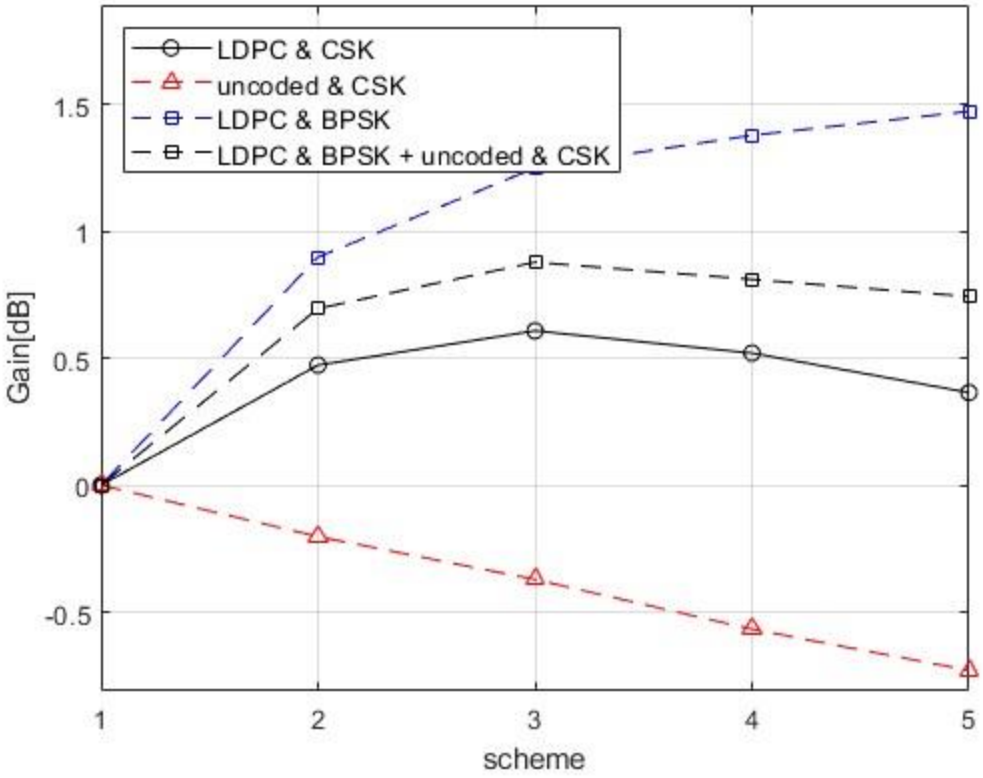
Simulation

Gain of each scheme from s_1



Simulation

Gain of each scheme from s_1



LDPC&CSK gain comes from sum of LDPC gain and CSK gain

Conclusion

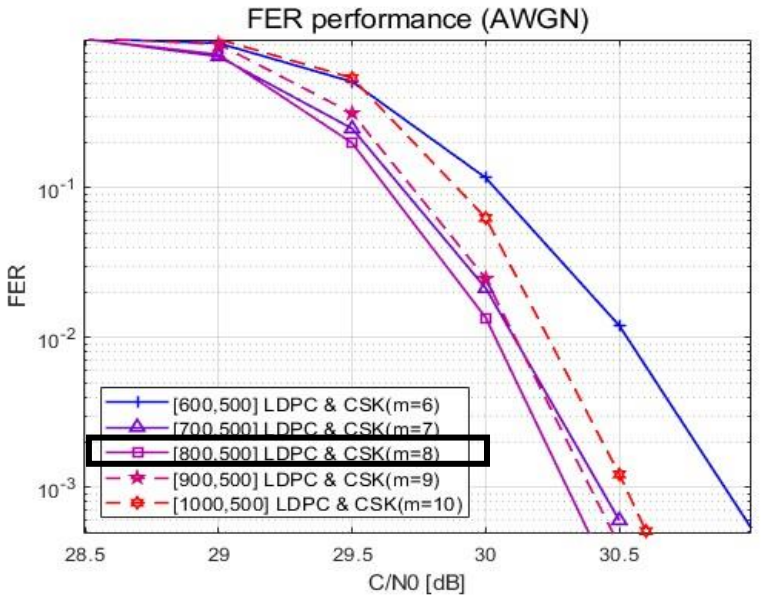
There is some trade-off relation between redundancy of LDPC code and order of CSK modulation.

In our simulation, [800,500] LDPC & CSK($m = 8$) is best.

Further considerations in future work:

- Use state-of-art LDPC code.

- Experiment with various LDPC codes and various PRN codes.



END