3GPP TSG RAN WG 1 #12
Seoul, Korea, 10th April -13th April, 2000

TSG R1-00-0574

Source: LGIC

Title: Softest Hand over Design Using Iterative Decoding(Turbo Coding)

Document for : Discussion

---

1. Introduction

In WG1 meeting #5, there was a contribution from Nortel Netwoks about a method of radio link performance enhancement when a UE is in soft hand-over mode. There were some discussion about the proposal, and the conclusion was that this item can be studied in release 2000. In this contribution, we introduce a possibility of enhancing the radio link performance when the UE is in soft hand-over. The main idea of this proposal is that when a UE is in soft hand-over mode, we can use a concept of 'coding diversity' and 'packet diversity'. By this concept, we can obtain performance gain in soft hand-over mode, eventuall increase overall system reliability and capacity.

This document proposes a modification of the channel coding, especially for turbo code on the downlink when the UE is in soft hand-over. The current assumption is that the UE receives from the different Node B in its active set the same encoded data bits for each DCH that uses the soft hand-over. The corresponding CCTrCH is though spread and scrambled by different sets of channelisation code and scrambling.

In our proposal we suggest to apply different turbo coded signal per Node B, all the channel coding schemes being obtained by performing some puncturing on the same mother code. This scheme that we call here puncturing diversity is described into more details. In the current presentation, we assume that a half rate turbo code case and 1/3. Although the simulation assumption used in this presentation is not a real case for 3GPP, this idea of coding diversity can be efficiently and easily incorporated into 3GPP spec by introducing different rate matching initial offset value. We will elaborate on incorporating this coding diversity into the rate matching algorithm.

The Softest Hand over Design Using Iterative Decoding (Turbo Coding)

LGIC

3GPP WG1 #12 Seoul, Korea
April, 2000

Presentation Outline

- Introduction and Motivation
- Soft Hand over Scheme
- The Novel Down-Link System Model for the CCPC Hand over Scheme
- Simulation Results Over AWGN and Rayleigh Channels
- Upper Bounding Performances Over AWGN and Rayleigh Channels
- Conclusions

Introduction and Motivation

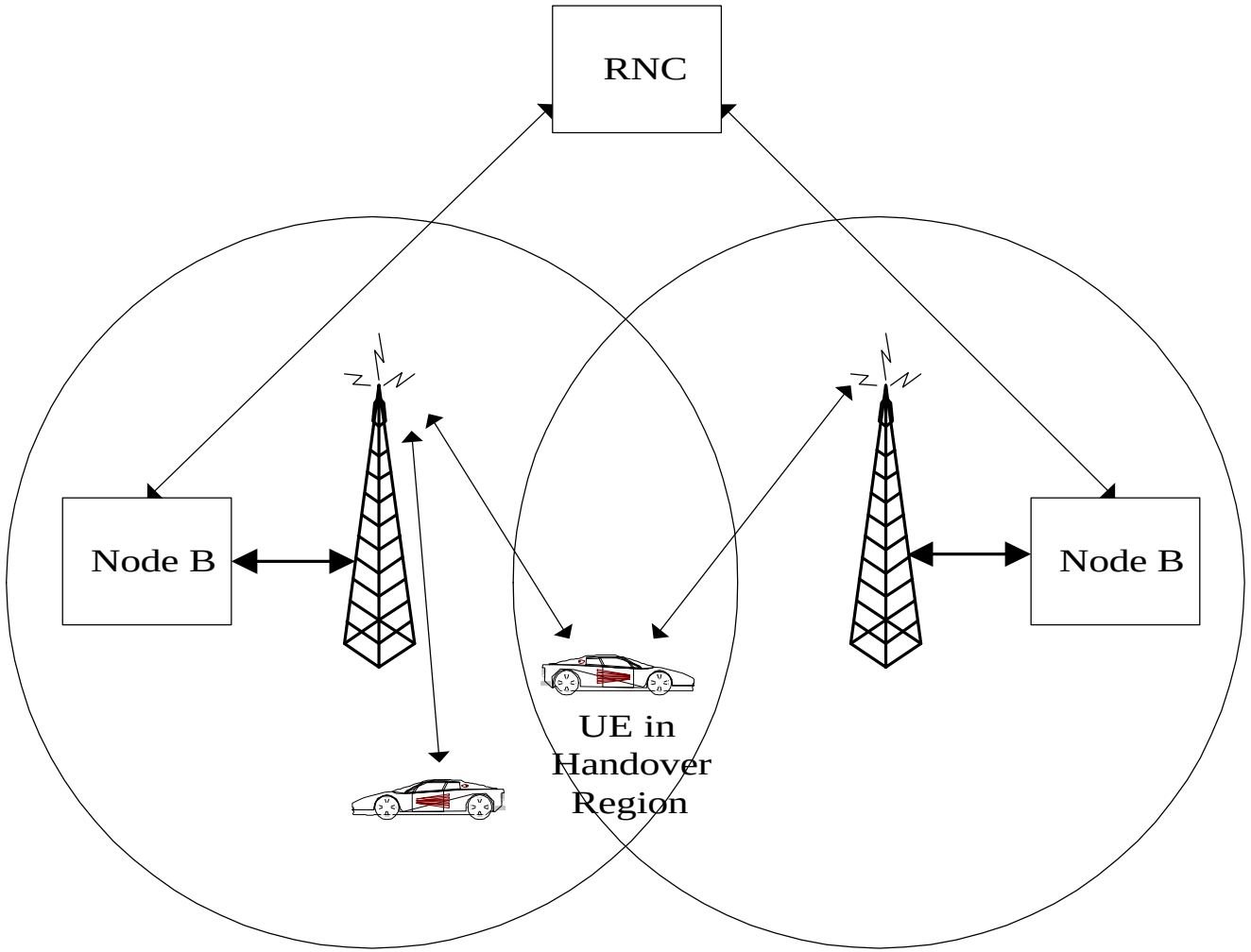
- Recent Measurements of an operating CDMA Cellular System indicate that About 30% to 50% of an average call period Is in soft-hand over process
- System Reliability during hand over becomes one of the major system performance parameters
- Turbo Codes have been adapted
- Are there techniques providing soft hand over without increasing the transmitter power and bandwidth?
- Can we achieve a type of “Soft” Hand over for TDMA, FDMA, CDMA-to-CDMA System, or between various dual mode operations?

Introduction and Motivation (Cont'd)

- Are There Any Inherent benefits using the turbo code for next generation multi-media traffics beyond the Coding Gain?
- Answers Are "YES"
- Code Combining and Packet Combining (CCPC) Scheme in Conjunction With Iterative Turbo Decoding

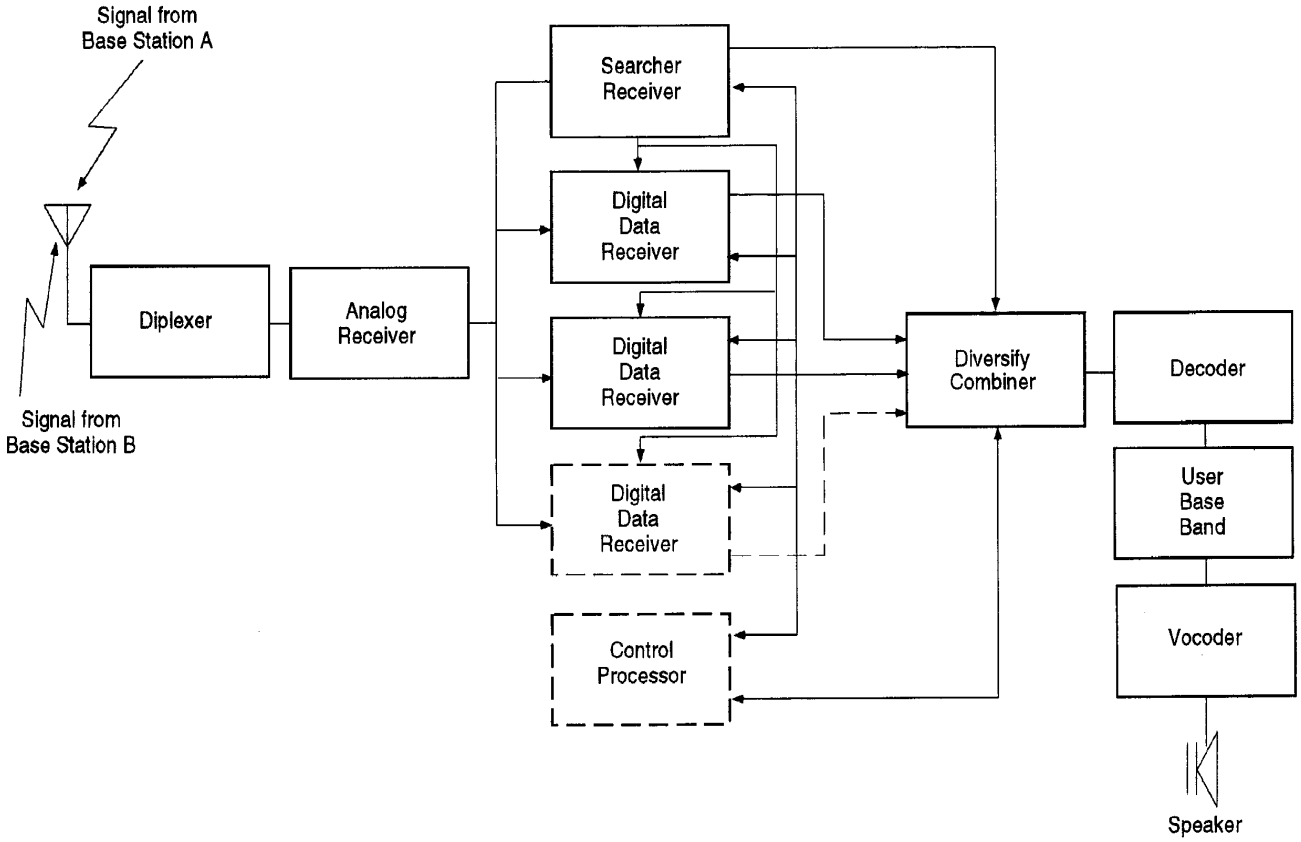
Soft Hand over

System Model for the Cellular Hand over



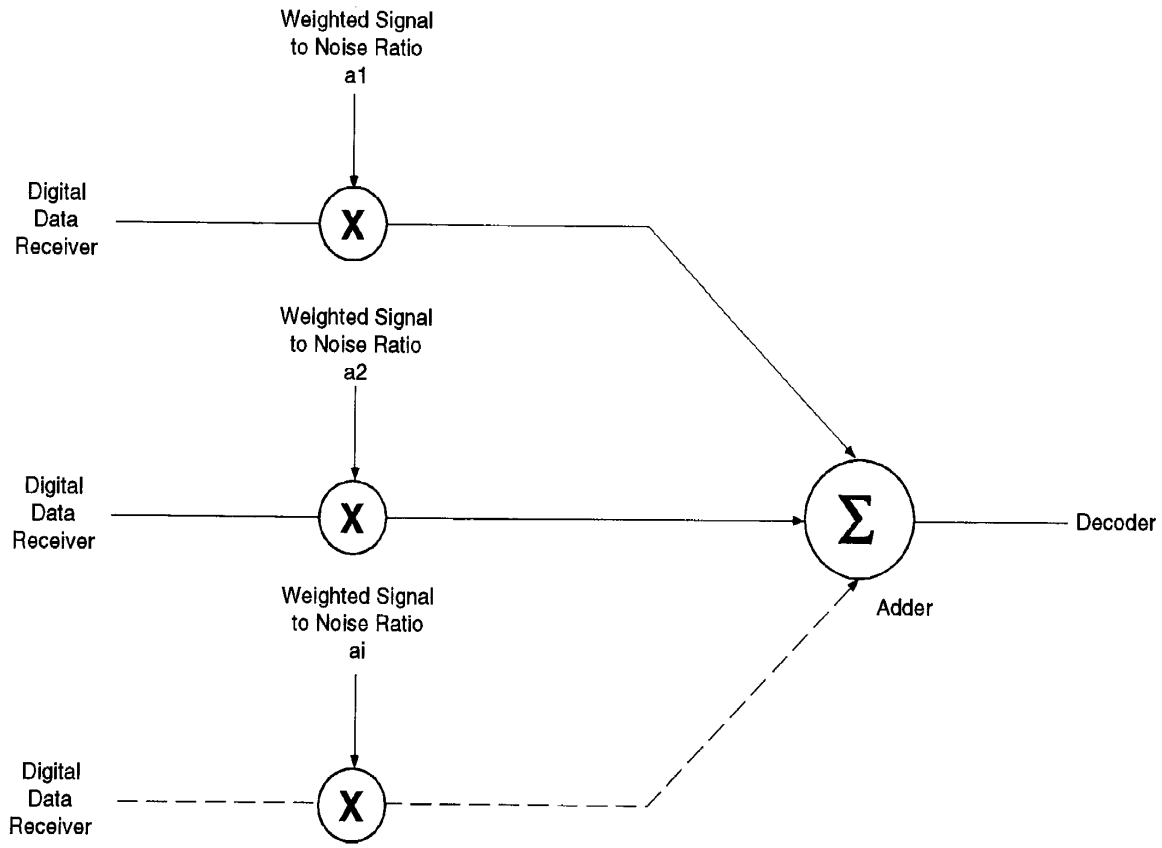
System Models for the Down-Link

Down-Link Receiver



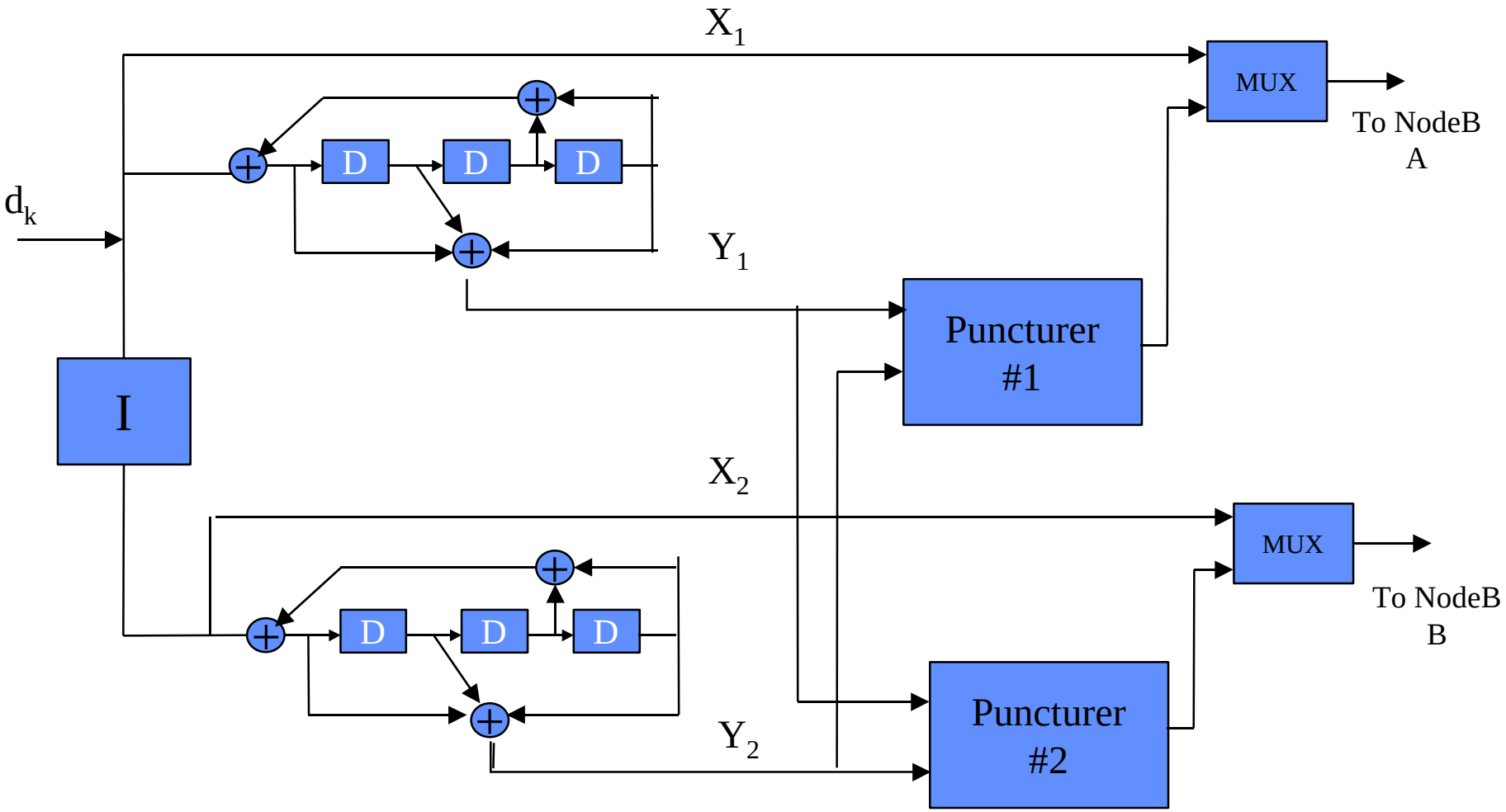
Soft Hand over

Maximal Ratio Combiner of the Down Link



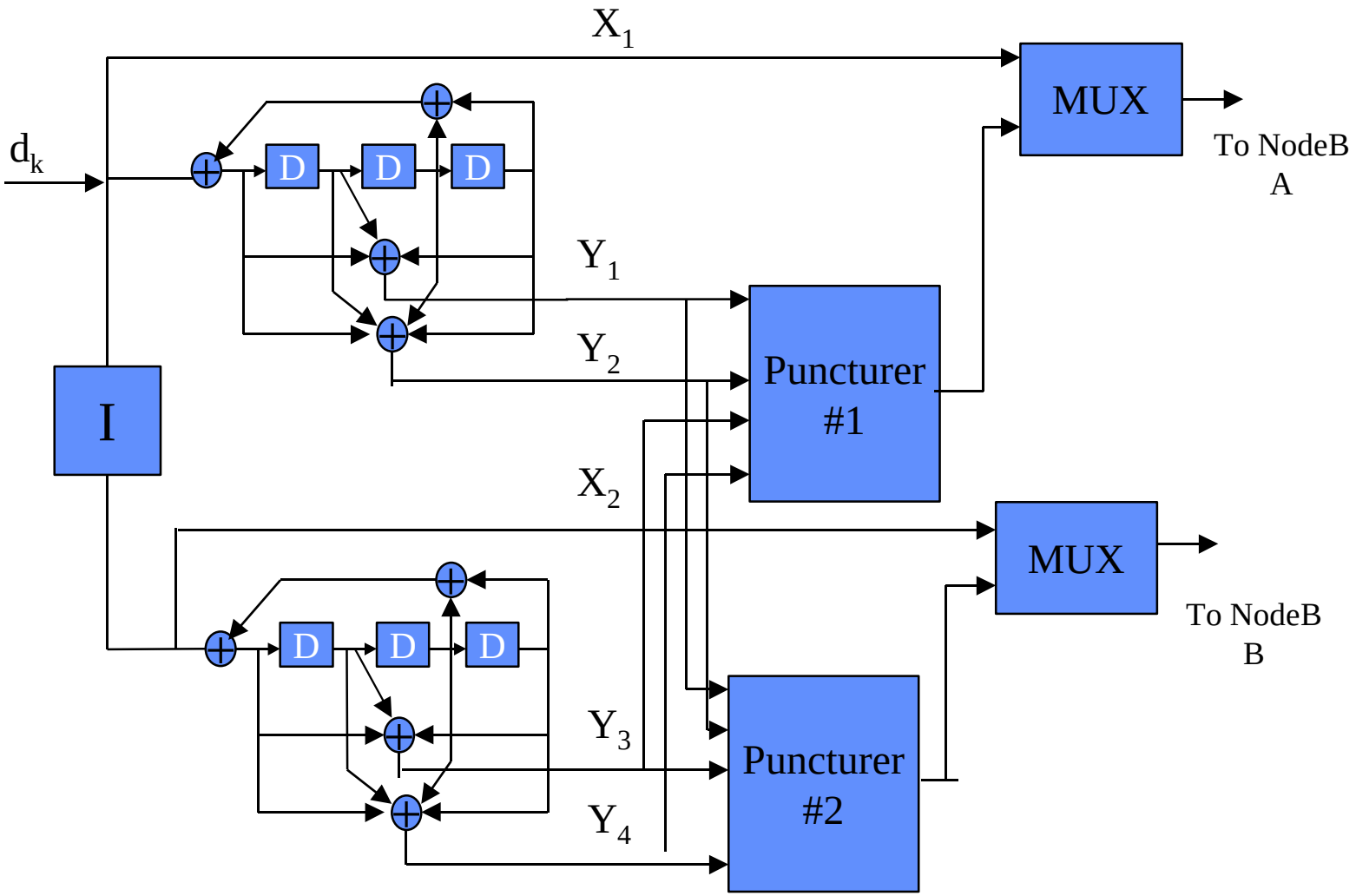
The Novel Softest Hand over System Model for Down Link

Encoder for the CCPC Hand over for Code Rate 1/2



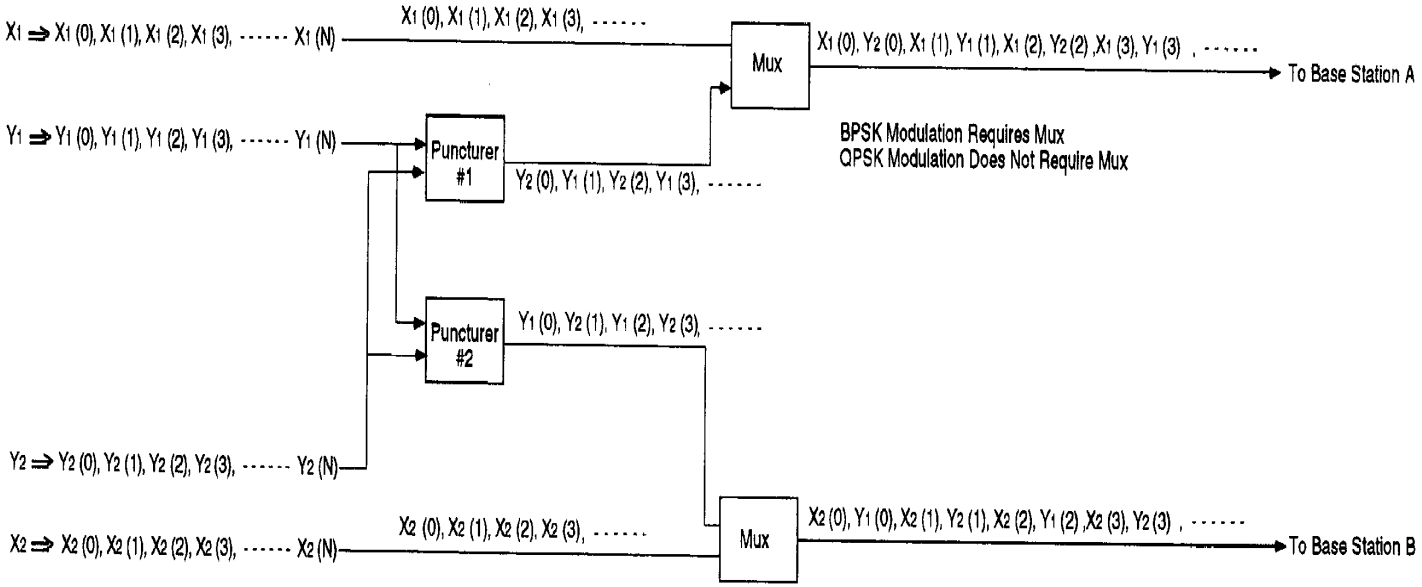
The Novel Softest Hand over System Model for Down Link

Encoder for the CCPC Hand over for Code Rate 1/3



The Novel Softest Hand over System Model for Down Link

Detailed Signal Puncturing for the CCPC Hand over

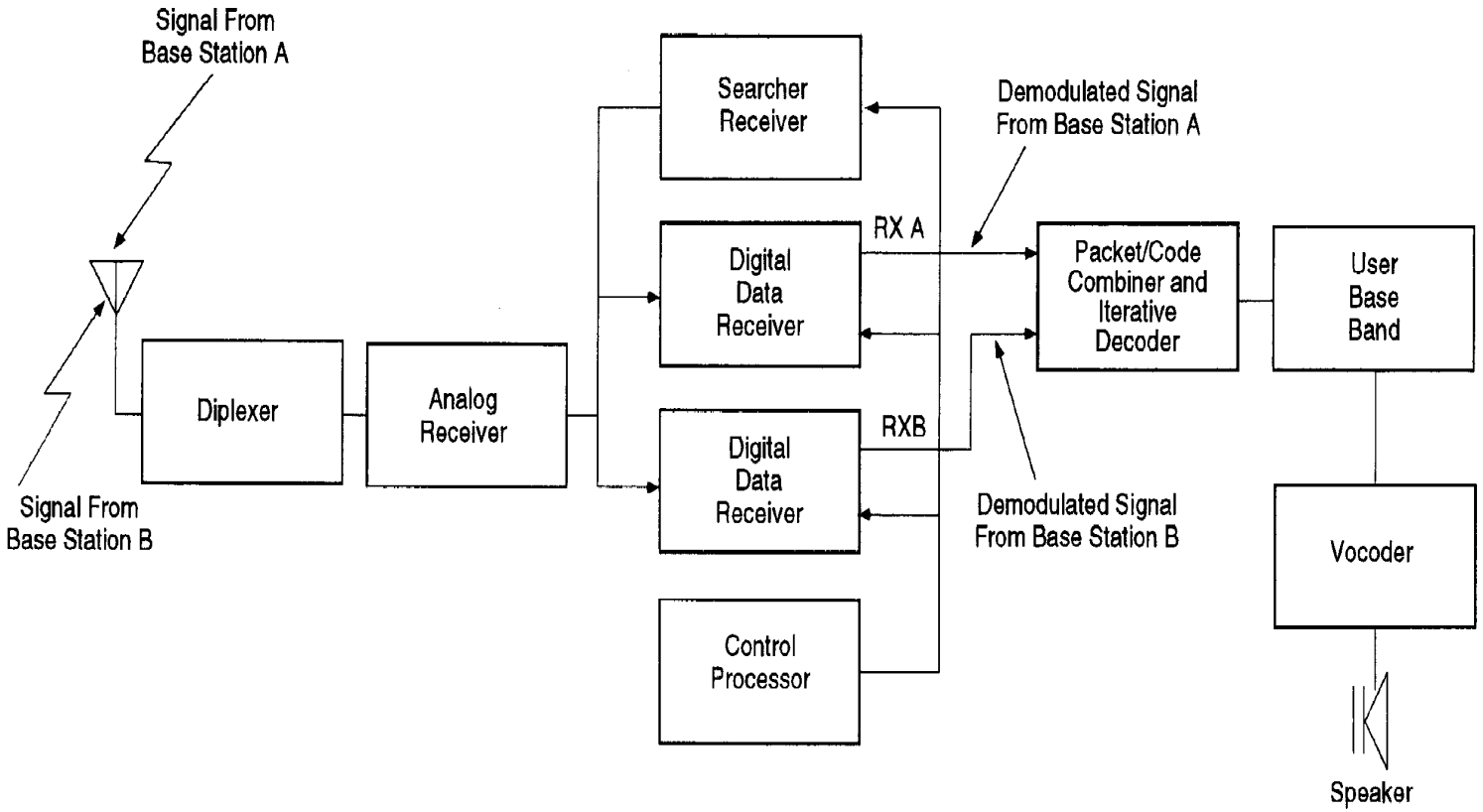


Puncturer #1 with Puncturing Pattern $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

Puncturer #2 with Puncturing Pattern $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

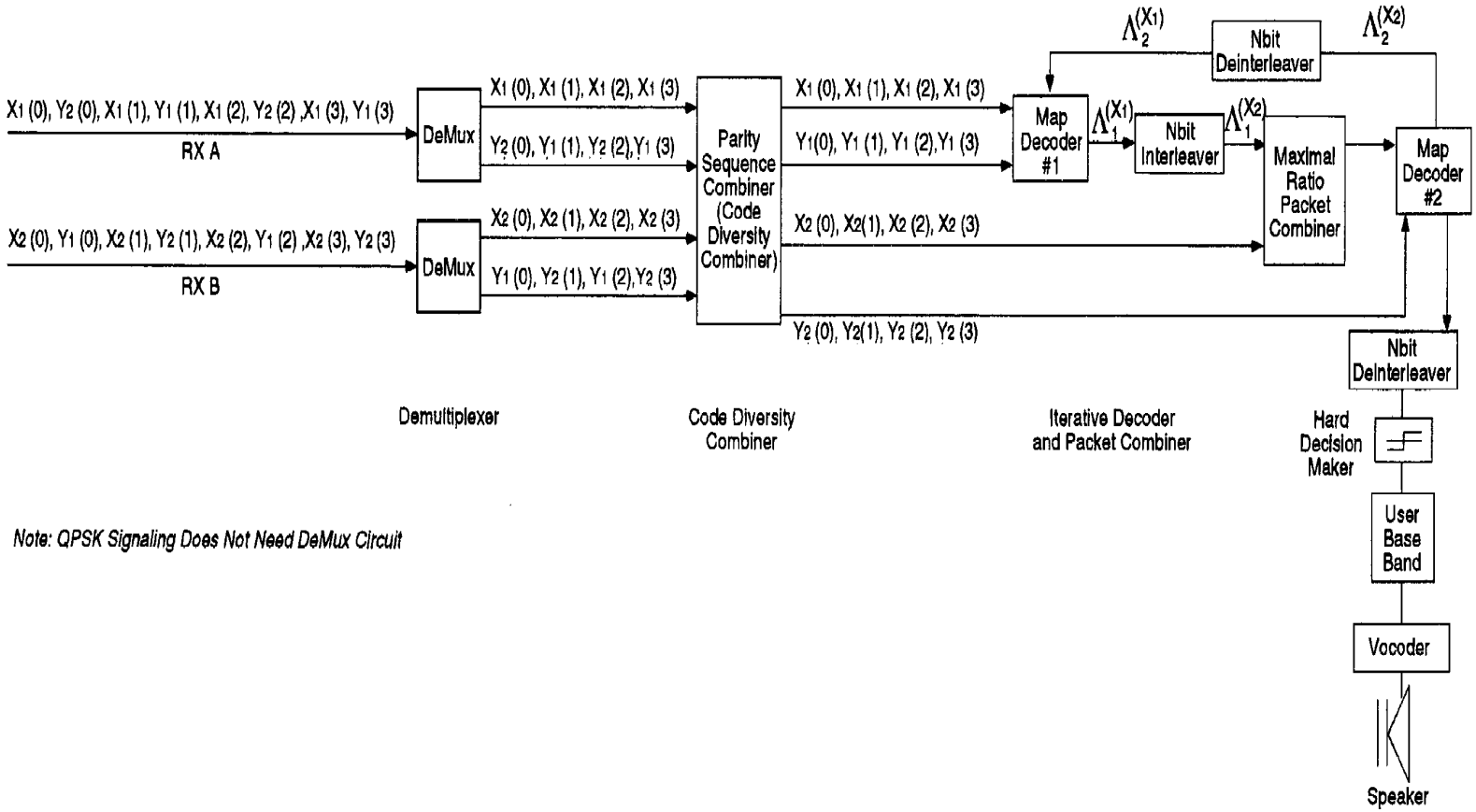
The Novel Softest Hand over System Model for Down Link

Mobile Receiver for the CCPC Hand over



The Novel Softest Hand over System Model for Down Link

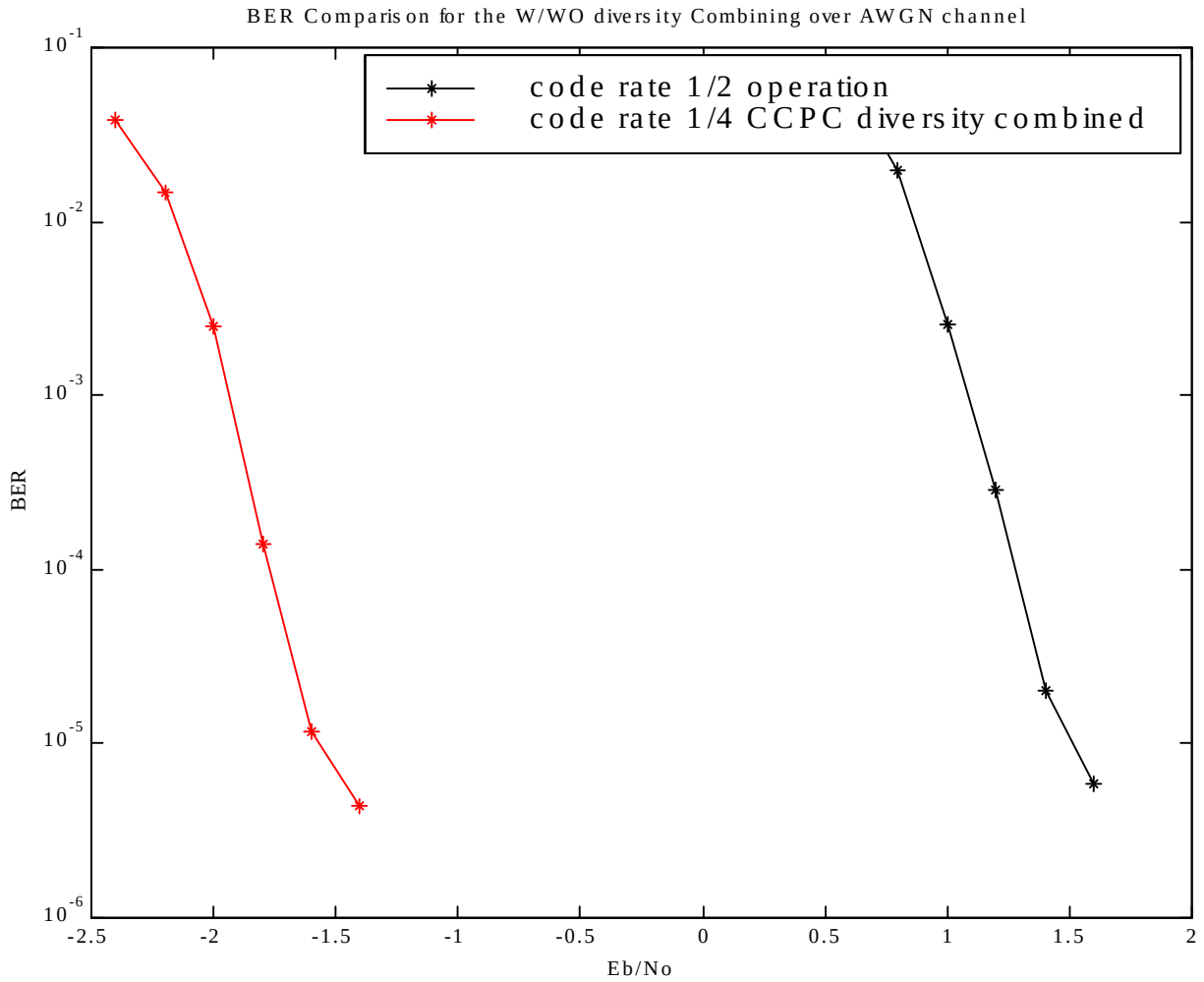
Detailed Decoder for the CCPC Hand over Scheme



Note: QPSK Signaling Does Not Need DeMux Circuit

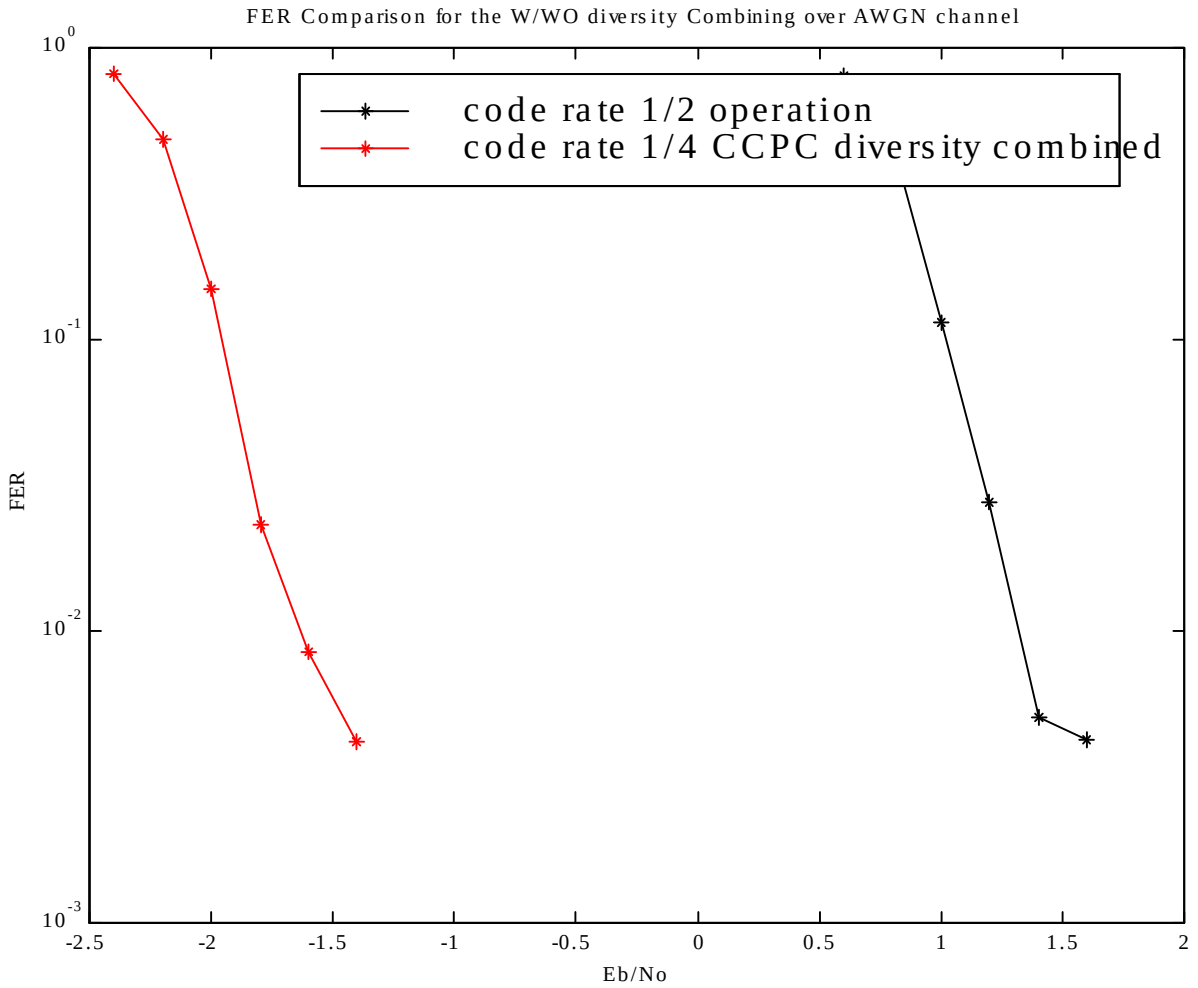
Simulation Results for the Code Rate 1/2

BER over AWGN Channel



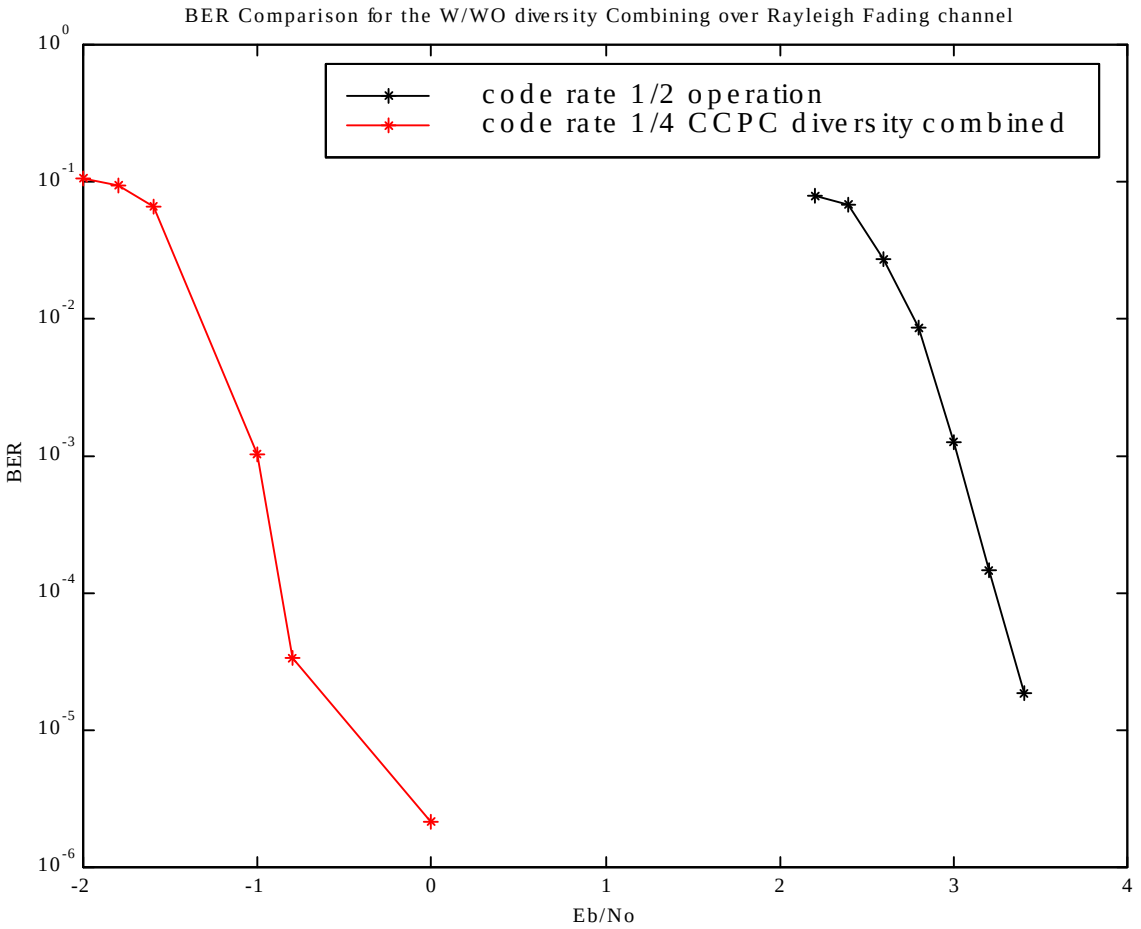
Simulation Results for the Code Rate 1/2

FER over AWGN Channel



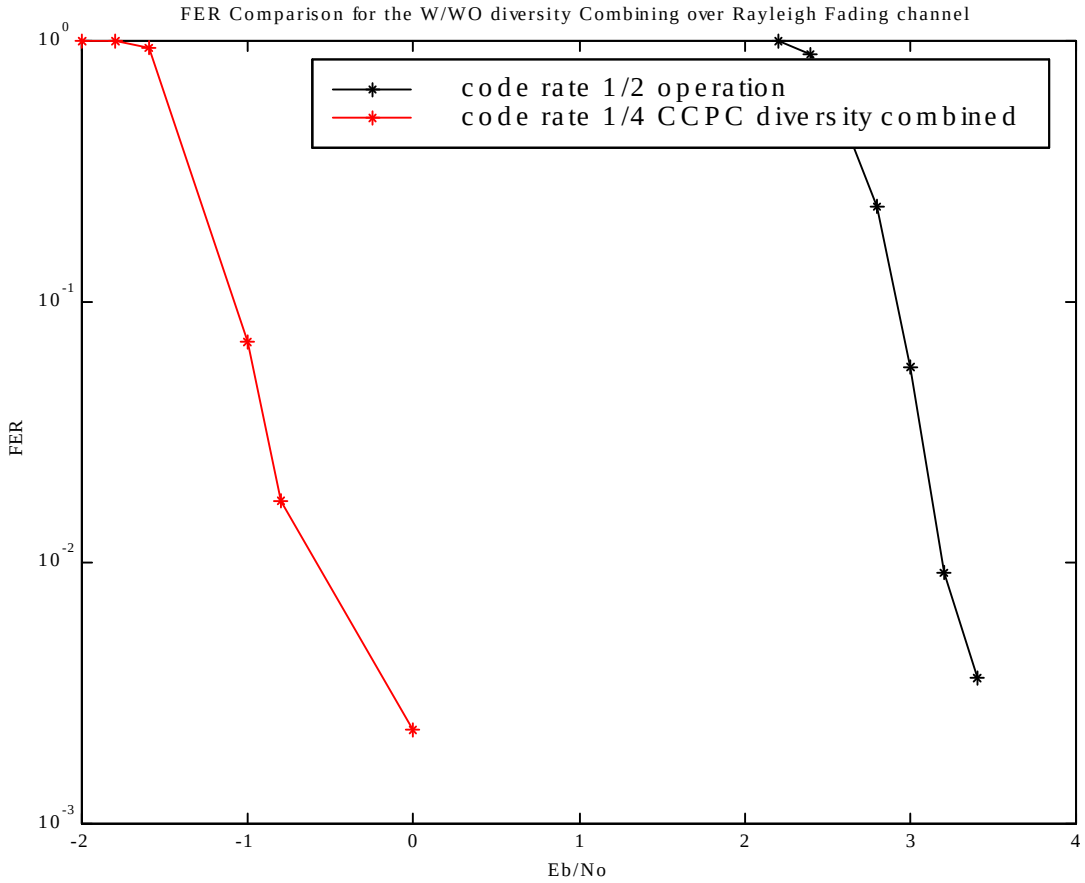
Simulation Results for the Code Rate 1/2

BER over Rayleigh Fading Channel



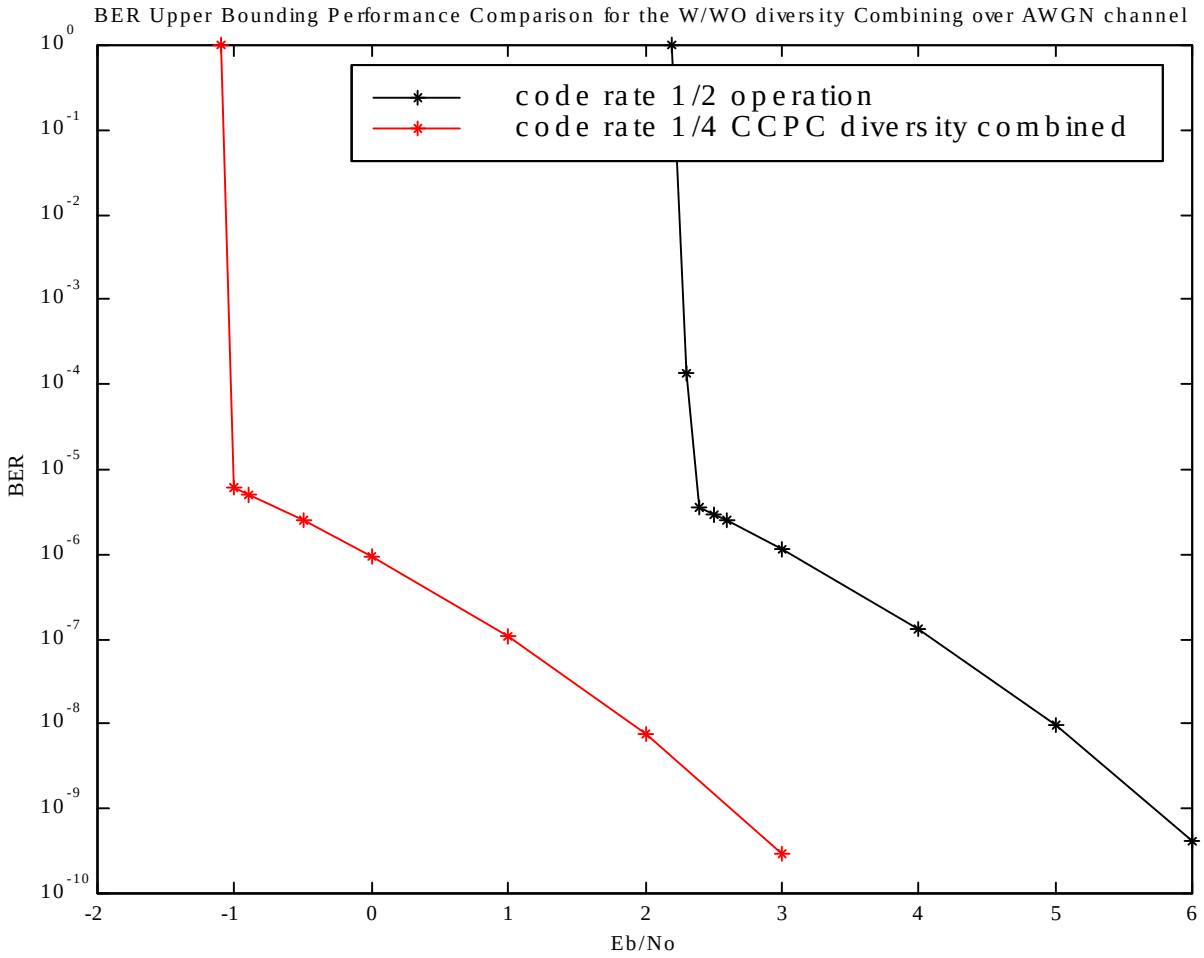
Simulation Results for the Code Rate 1/2

FER over Rayleigh Fading Channel



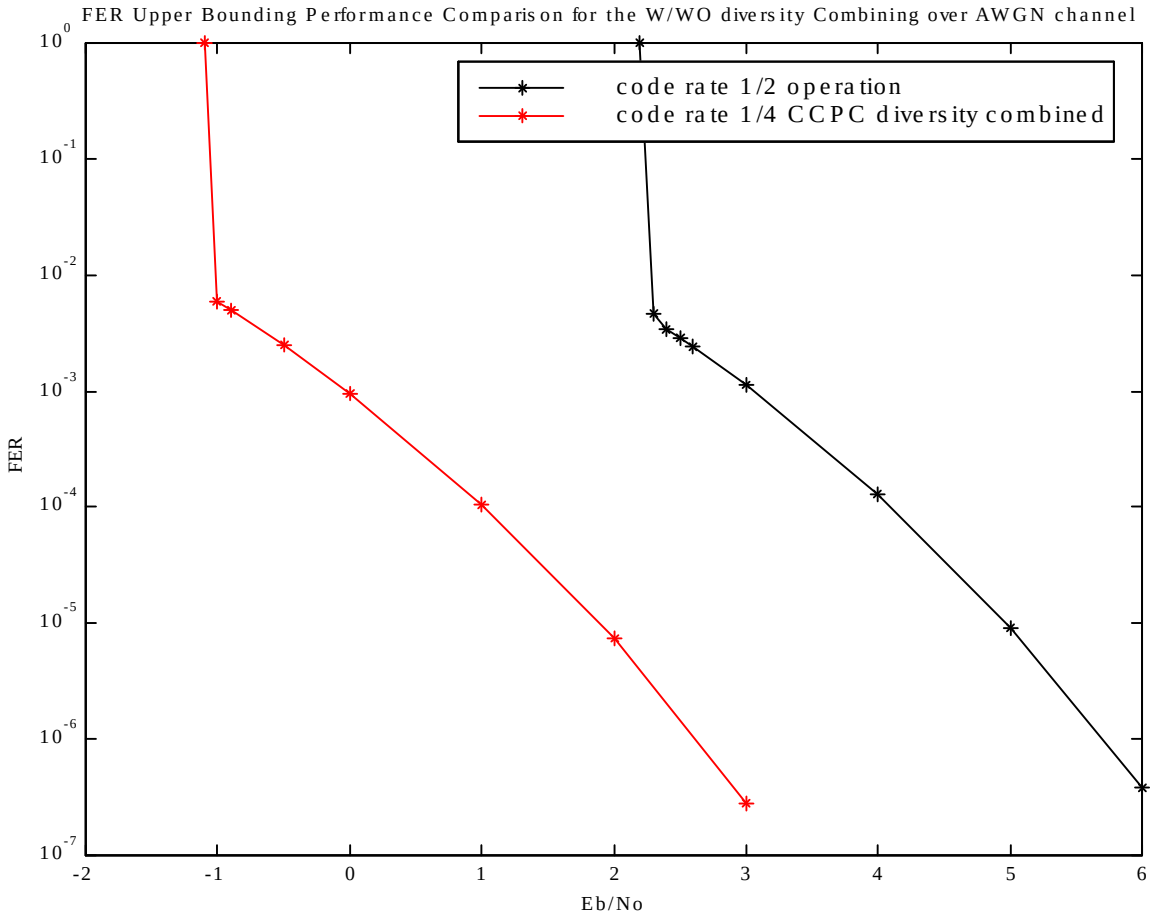
Upper bounding Performance for Code Rate 1/2

BER over AWGN



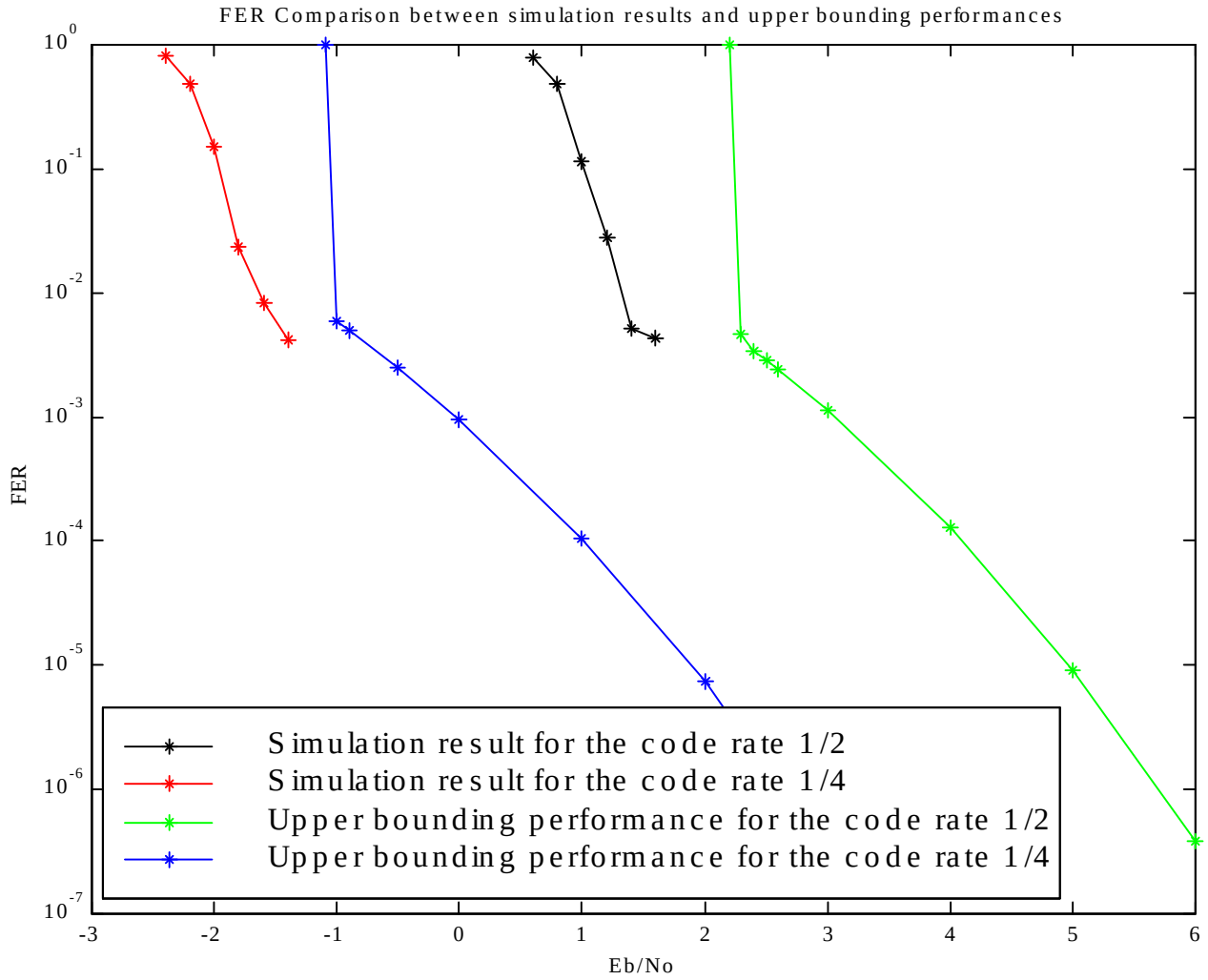
Upper bounding Performance for Code Rate 1/2

FER over AWGN



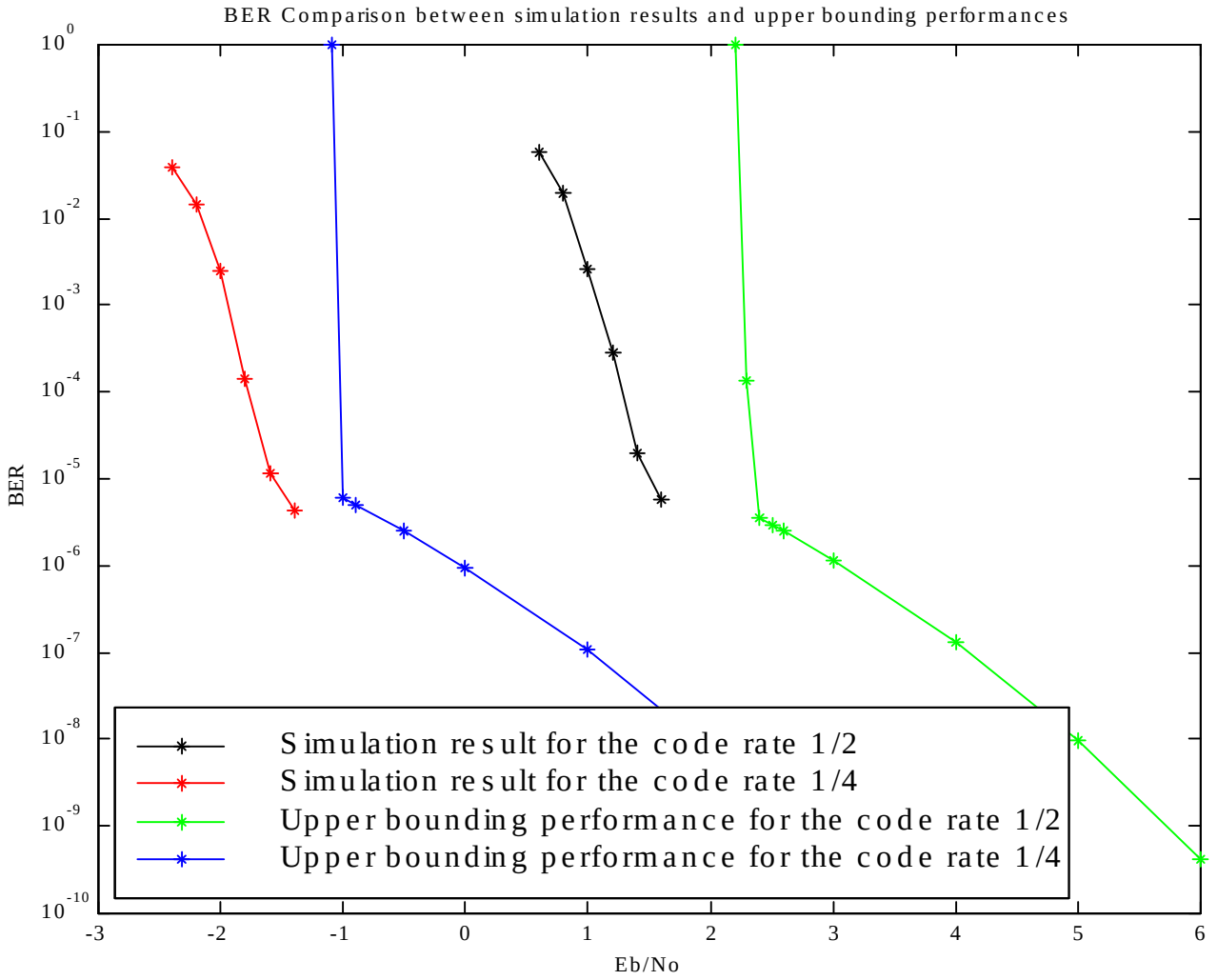
Comparison between Simulations and Upper Bounding Results

Frame Error rates for AWGN Channel



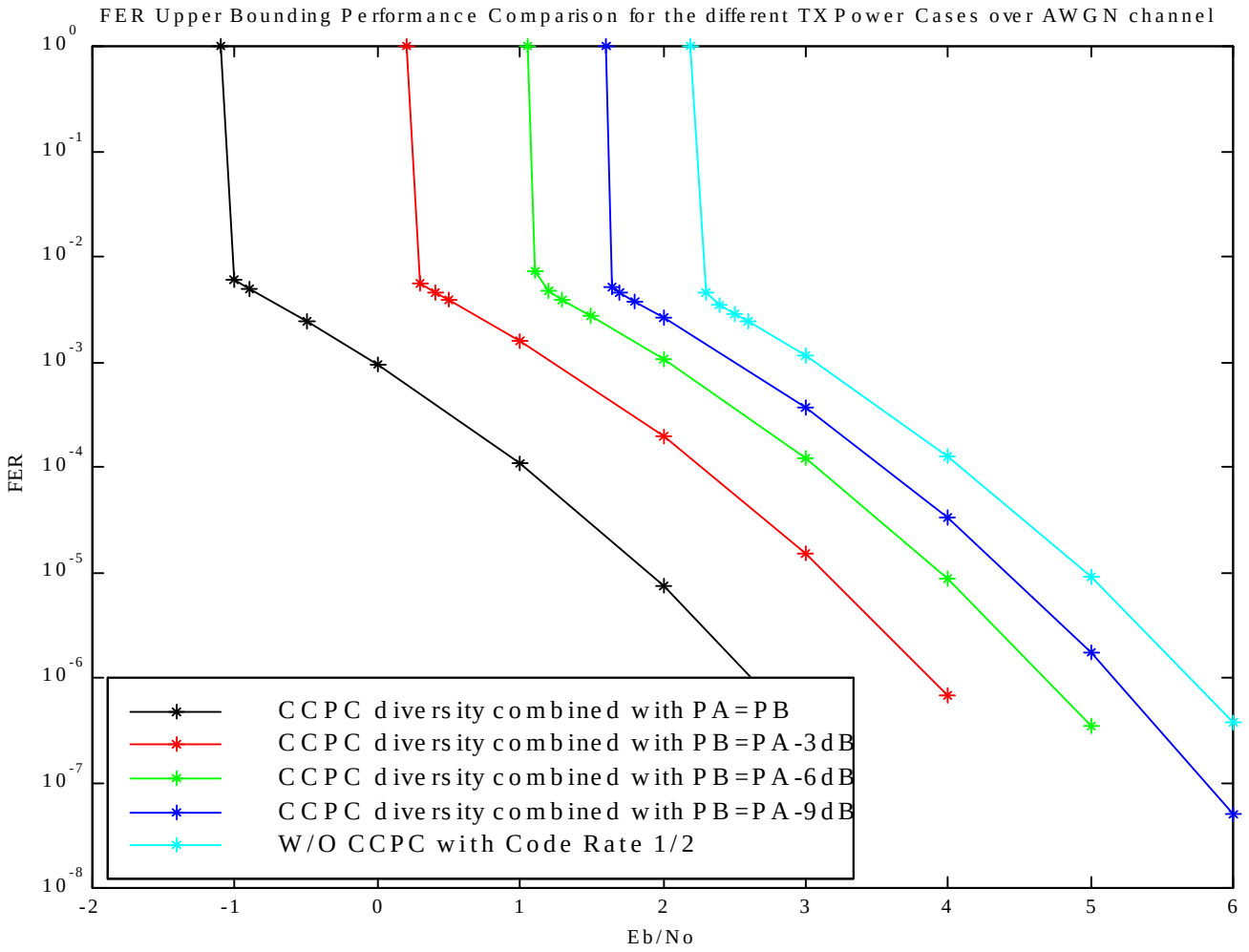
Comparison between Simulations and Upper Bounding Results

Bit Error rates for AWGN Channel



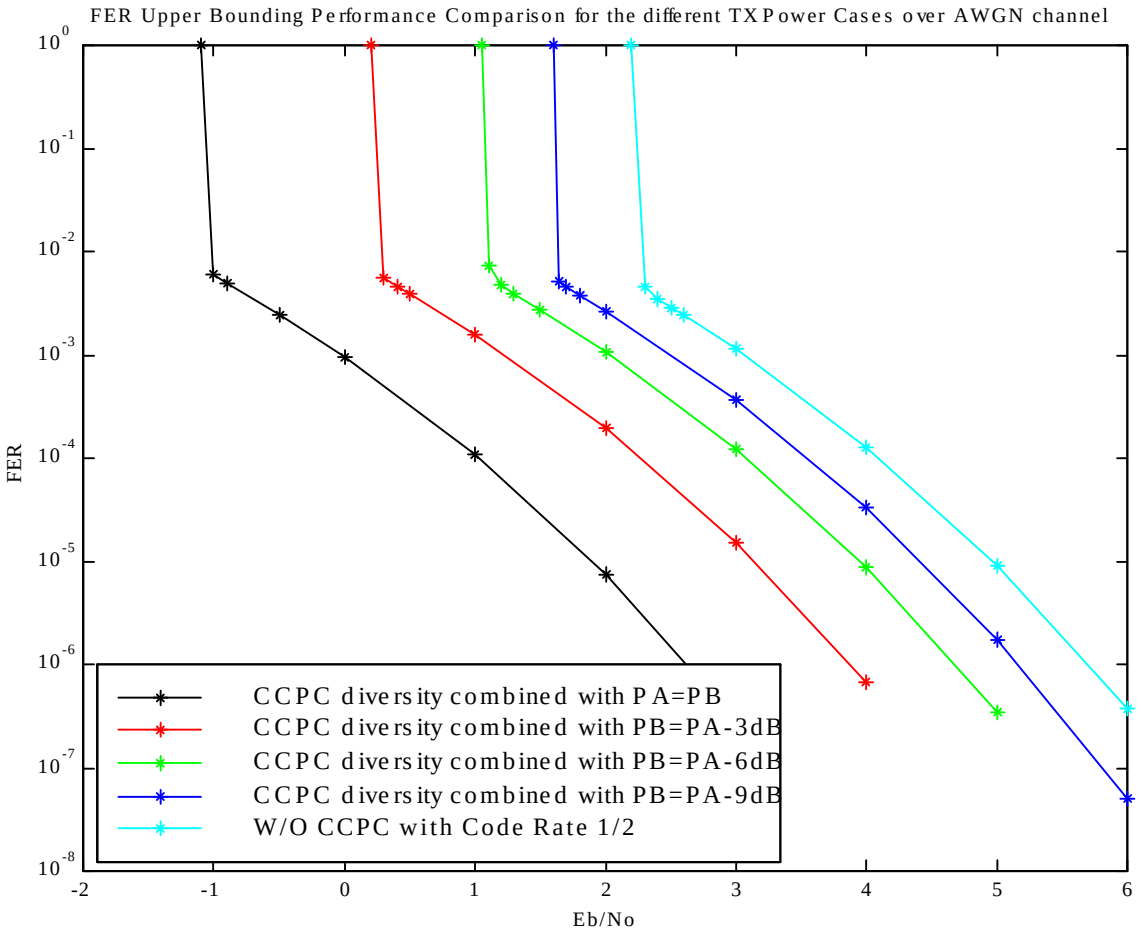
Upper bounding Performance for Code Rate 1/2

FER over AWGN Channel for Different TX Power Cases



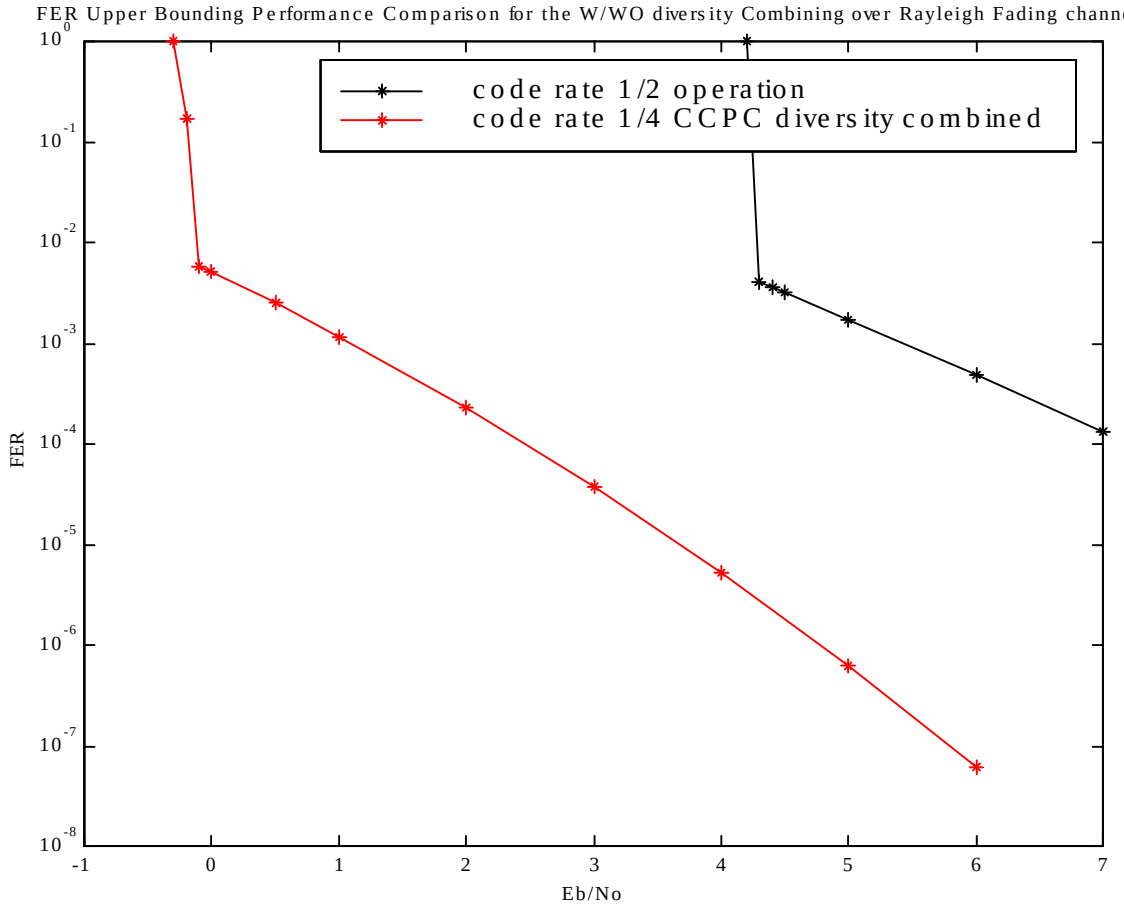
Upper bounding Performance for Code Rate 1/2

BER over AWGN Channel for Different TX Power Cases



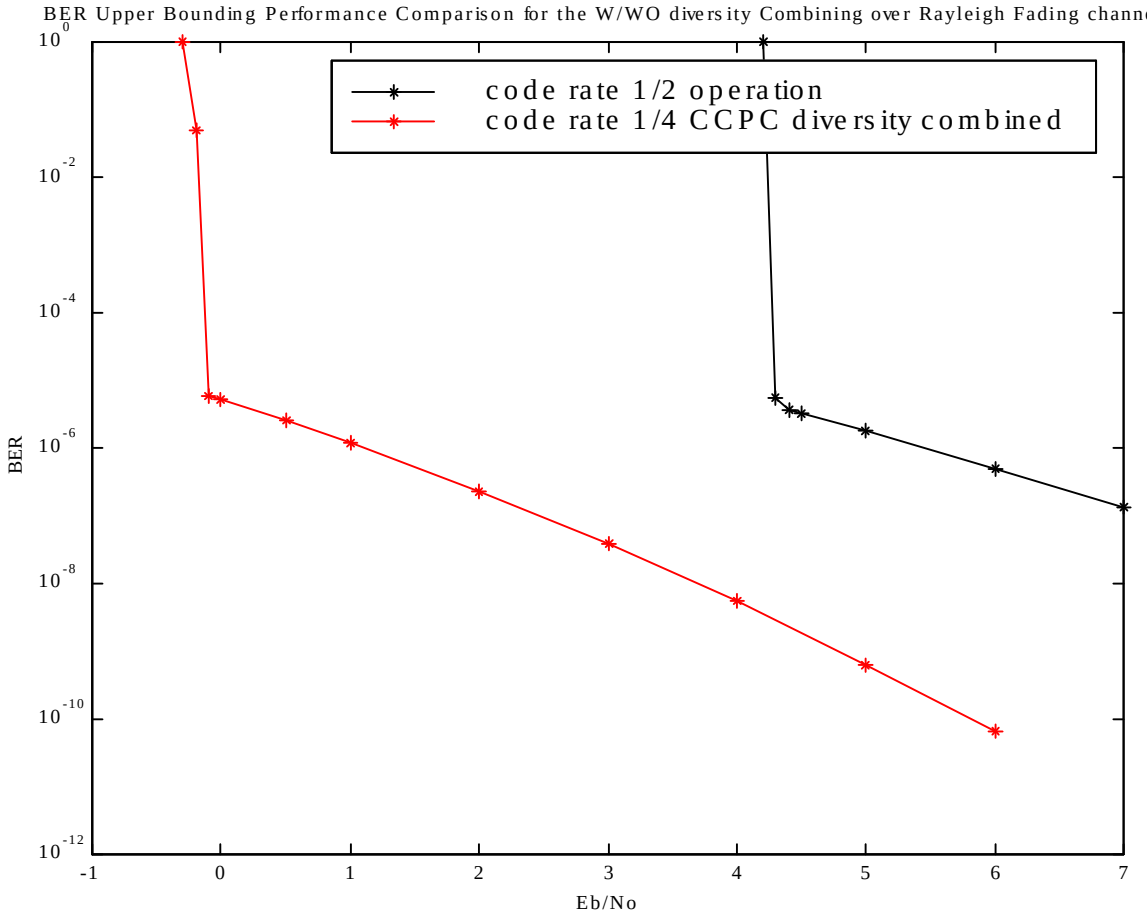
Upper bounding Performance for Code Rate 1/2

FER over Rayleigh Fading Channel for the Same TX Power Case



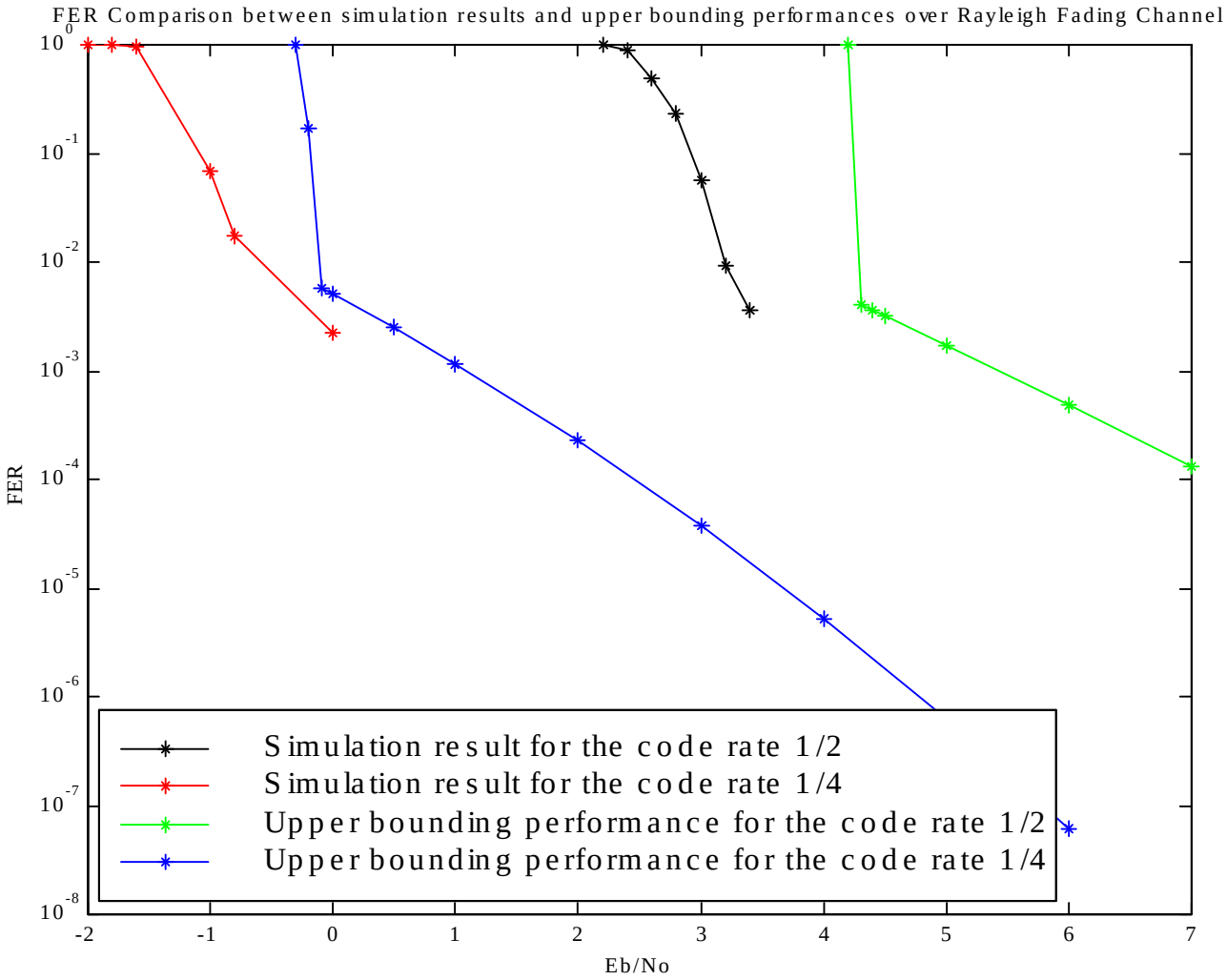
Upper bounding Performance for Code Rate 1/2

BER over Rayleigh Fading Channel for the Same TX Power Case



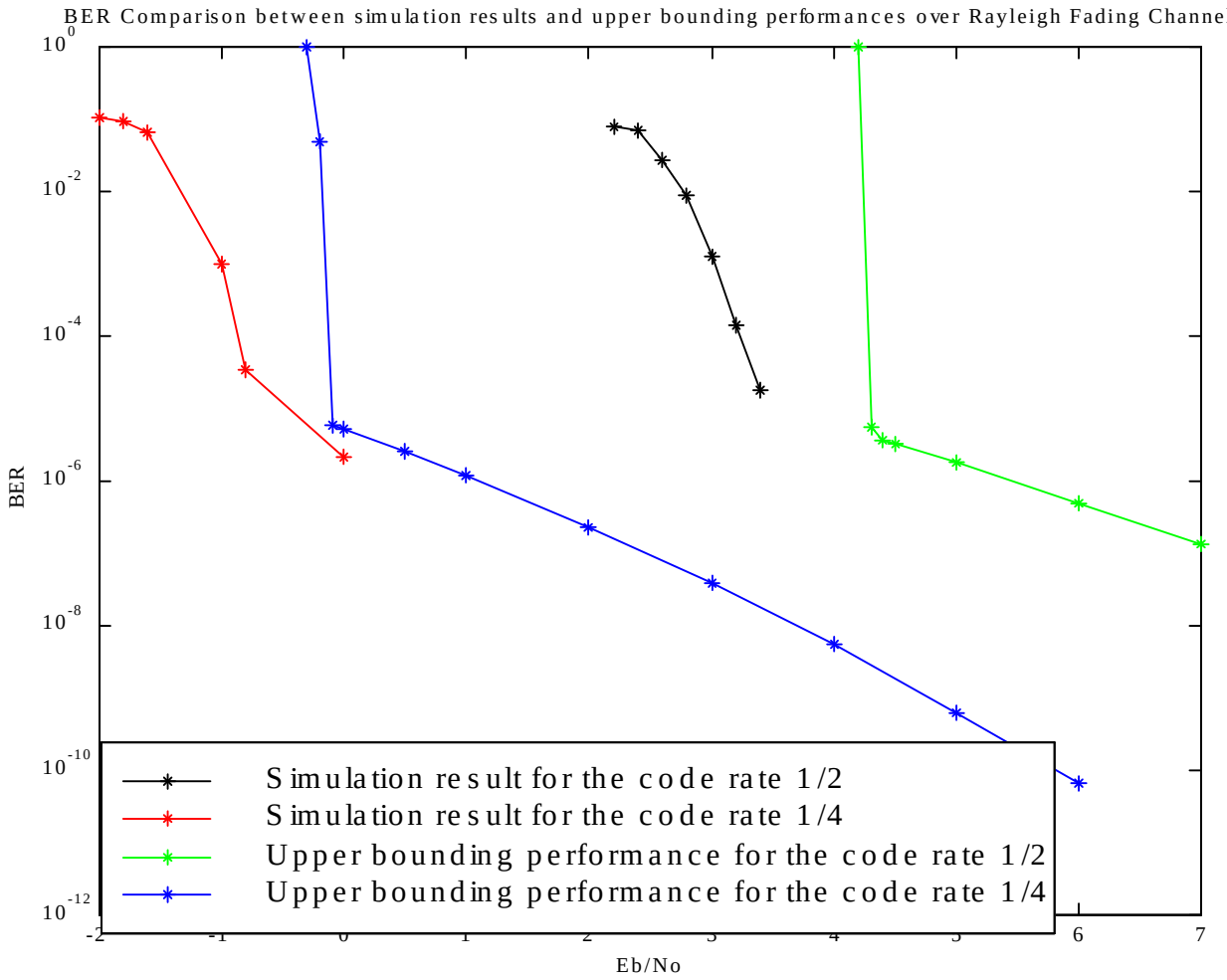
Comparison between Simulations and Upper Bounding Results

Frame Error rates for Rayleigh Fading Channel



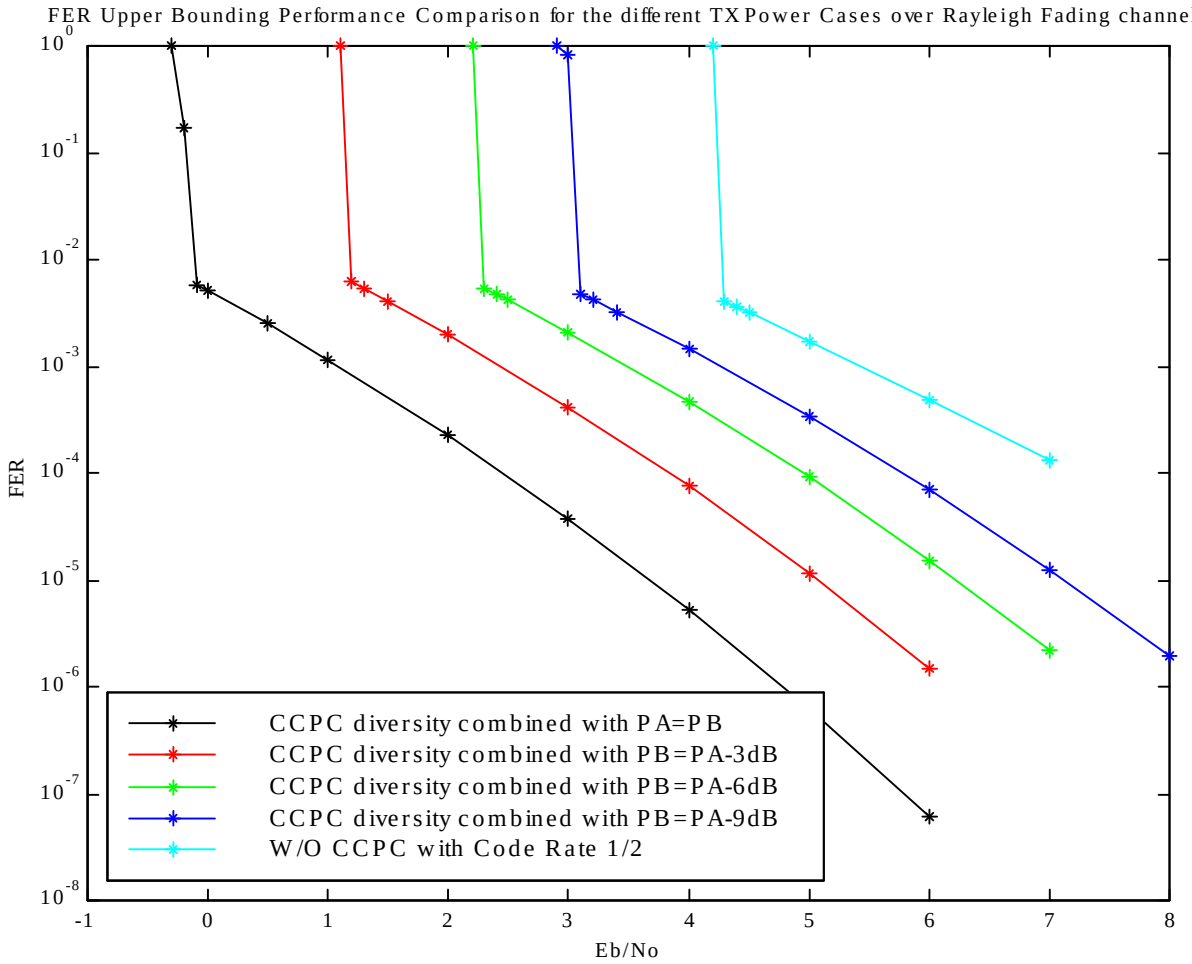
Comparison between Simulations and Upper Bounding Results

Bit Error rates for Rayleigh Fading Channel



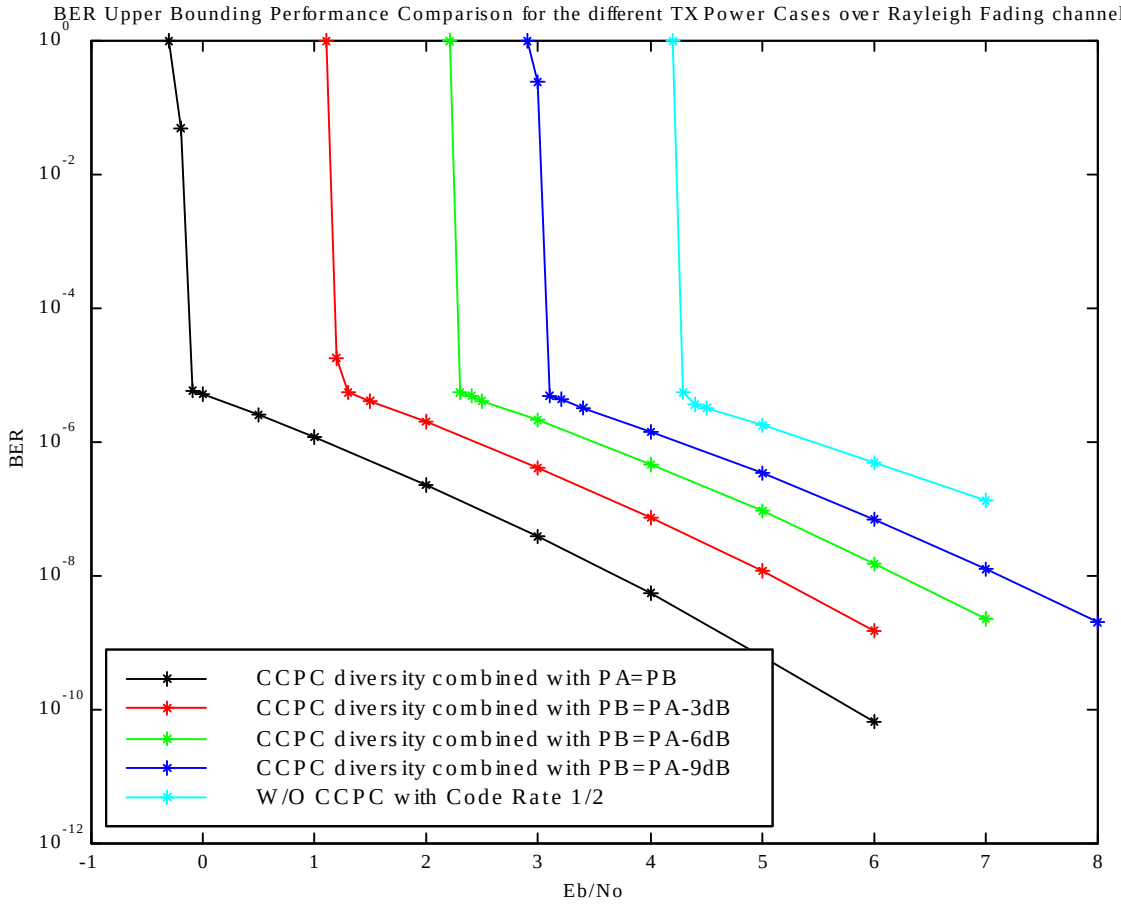
Upper bounding Performance for Code Rate 1/2

FER over Rayleigh Fading Channel for Different TX Power Cases



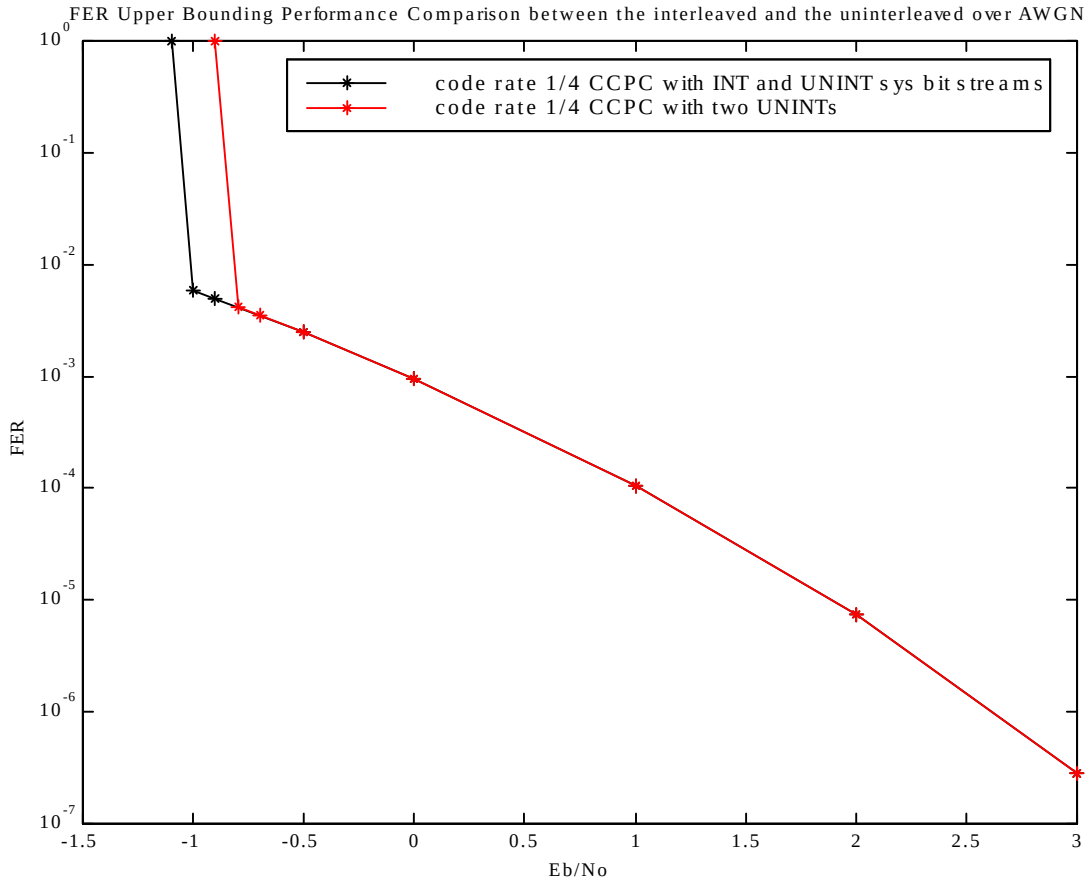
Upper bounding Performance for Code Rate 1/2

BER over Rayleigh Fading Channel for Different TX Power Cases



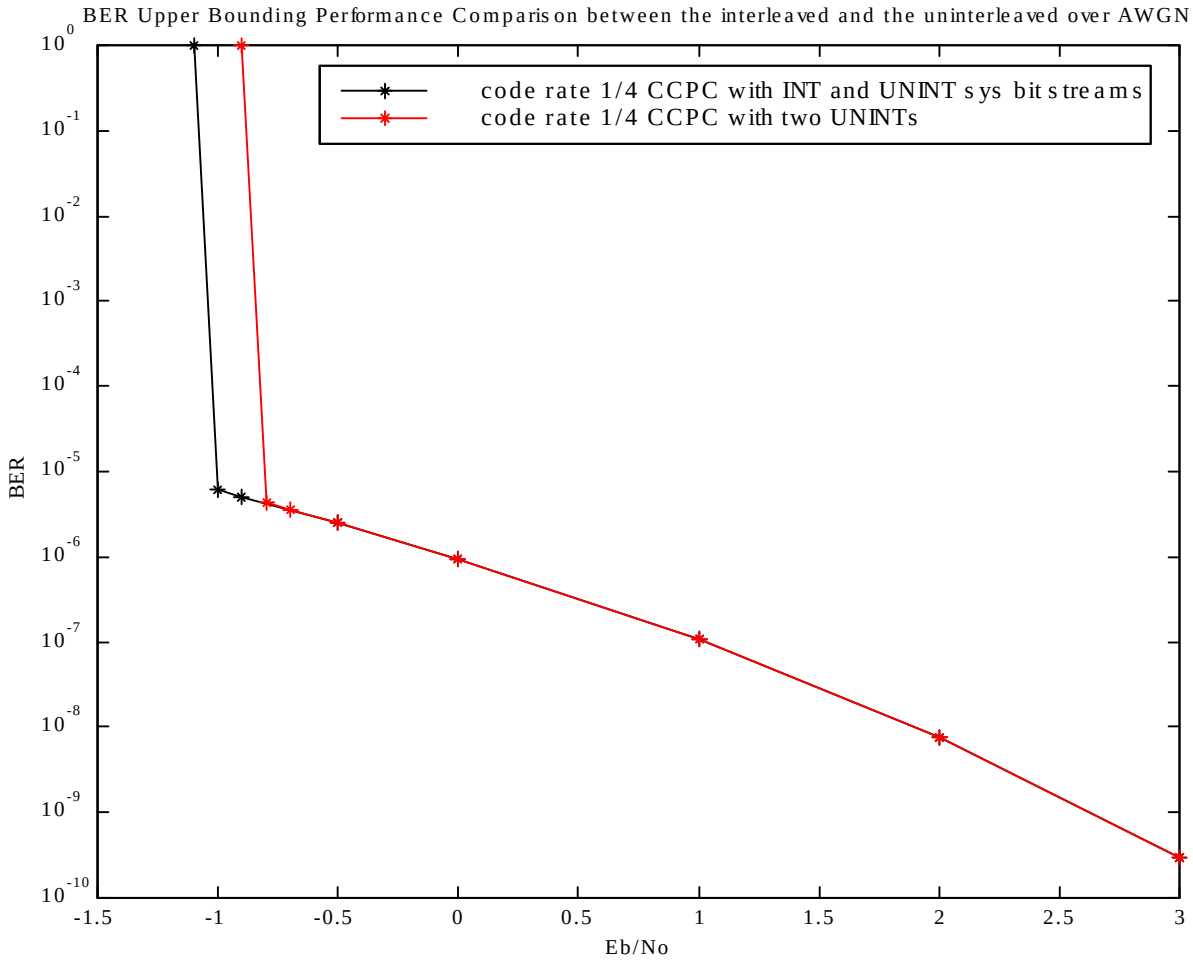
Upper bounding Performance for Code Rate 1/2

FER Performance Comparison between 2-UNINTER and UNINT+INT Over AWGN Channel



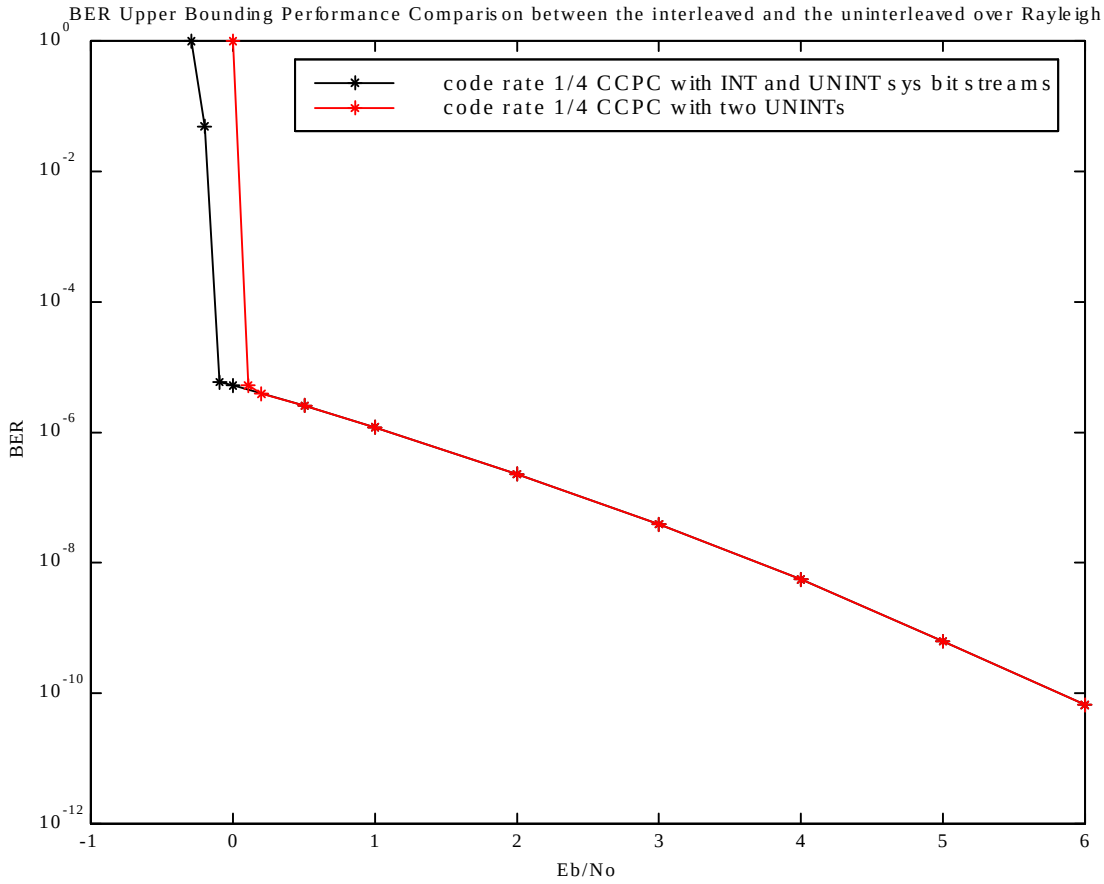
Upper bounding Performance for Code Rate 1/2

BER Performance Comparison between 2-UNINTER and UNINT+INT Over AWGN Channel



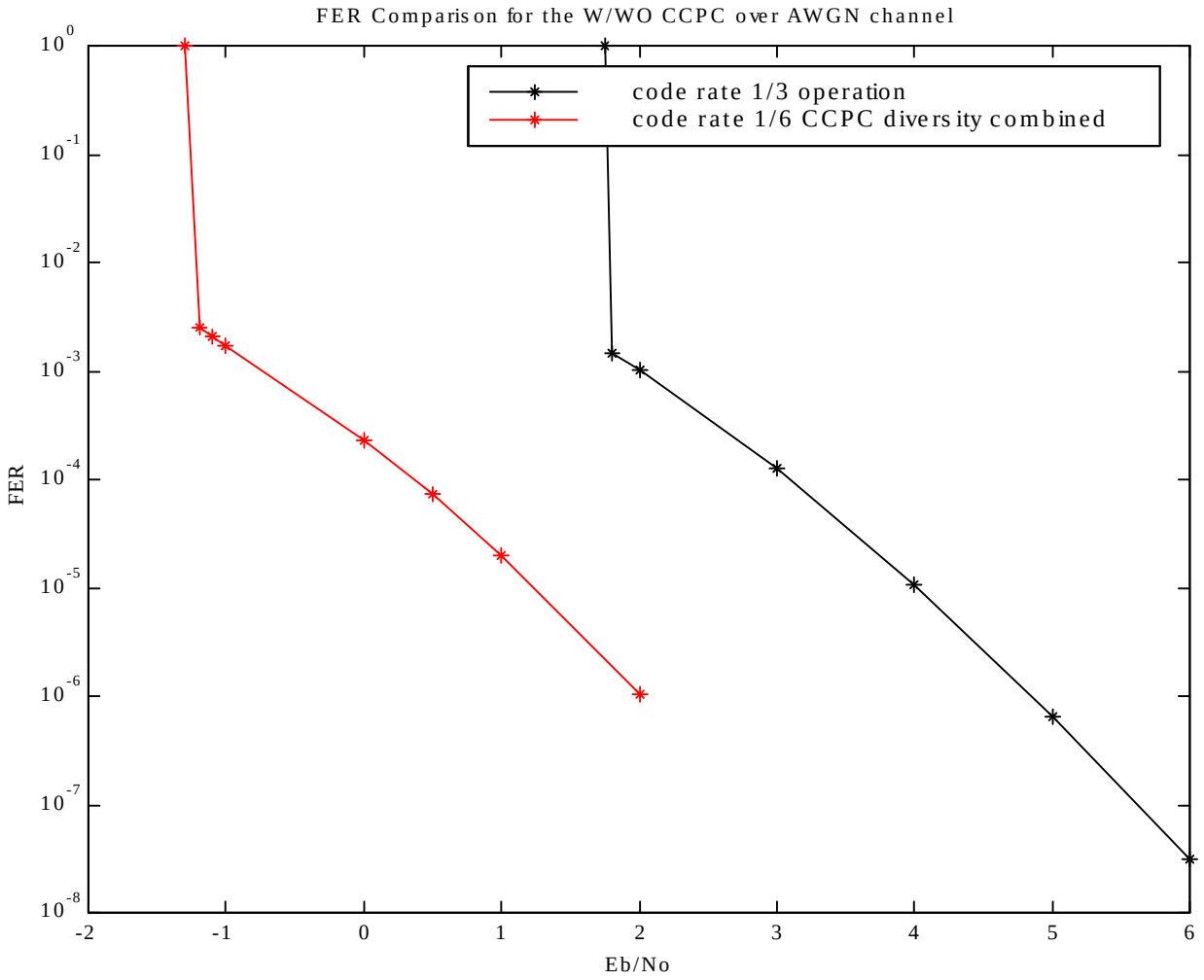
Upper bounding Performance for Code Rate 1/2

BER Performance Comparison between 2-UNINTER and UNINT+INT Over Rayleigh Fading Channel



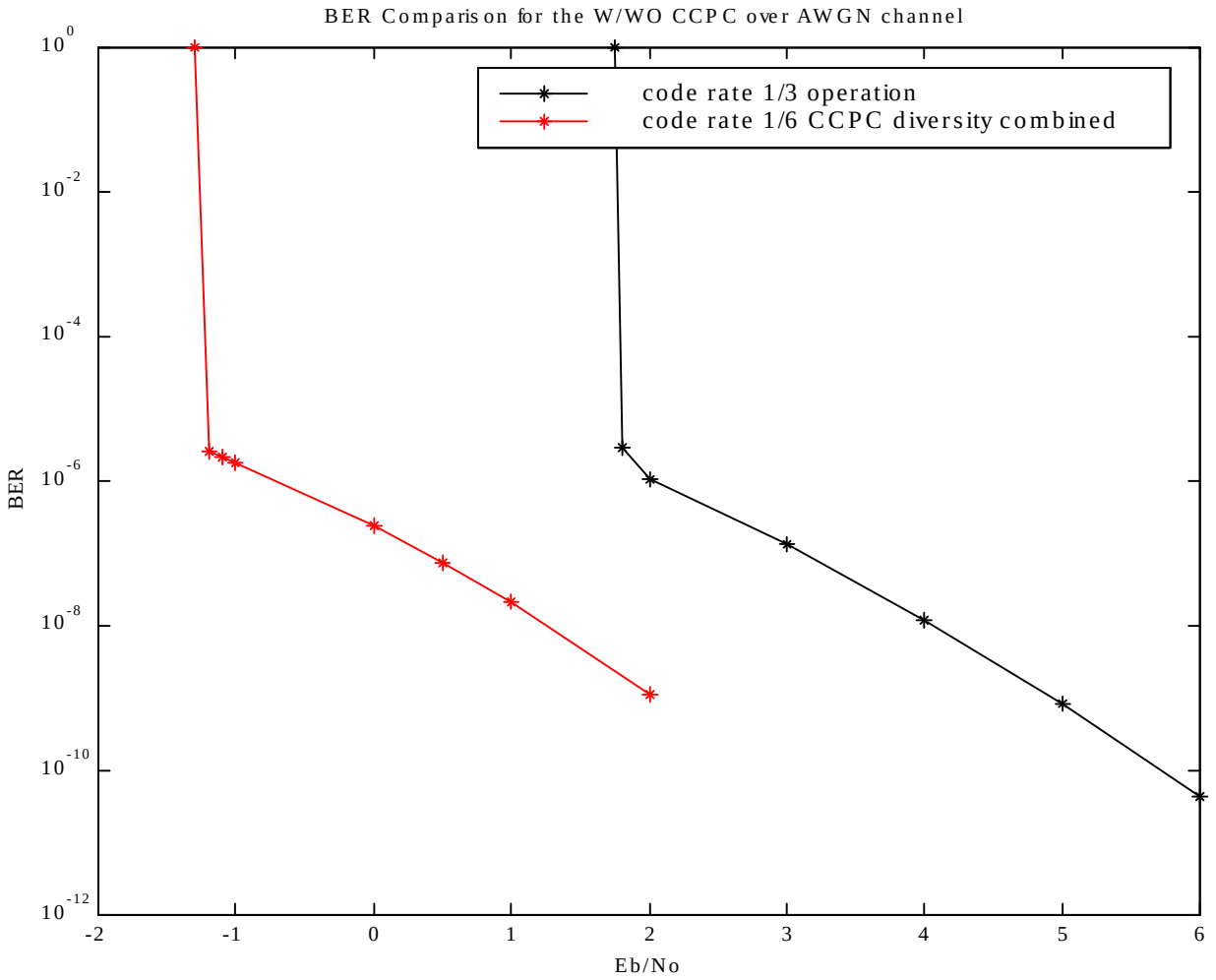
Upper bounding Performance for Code Rate 1/3

FER over AWGN



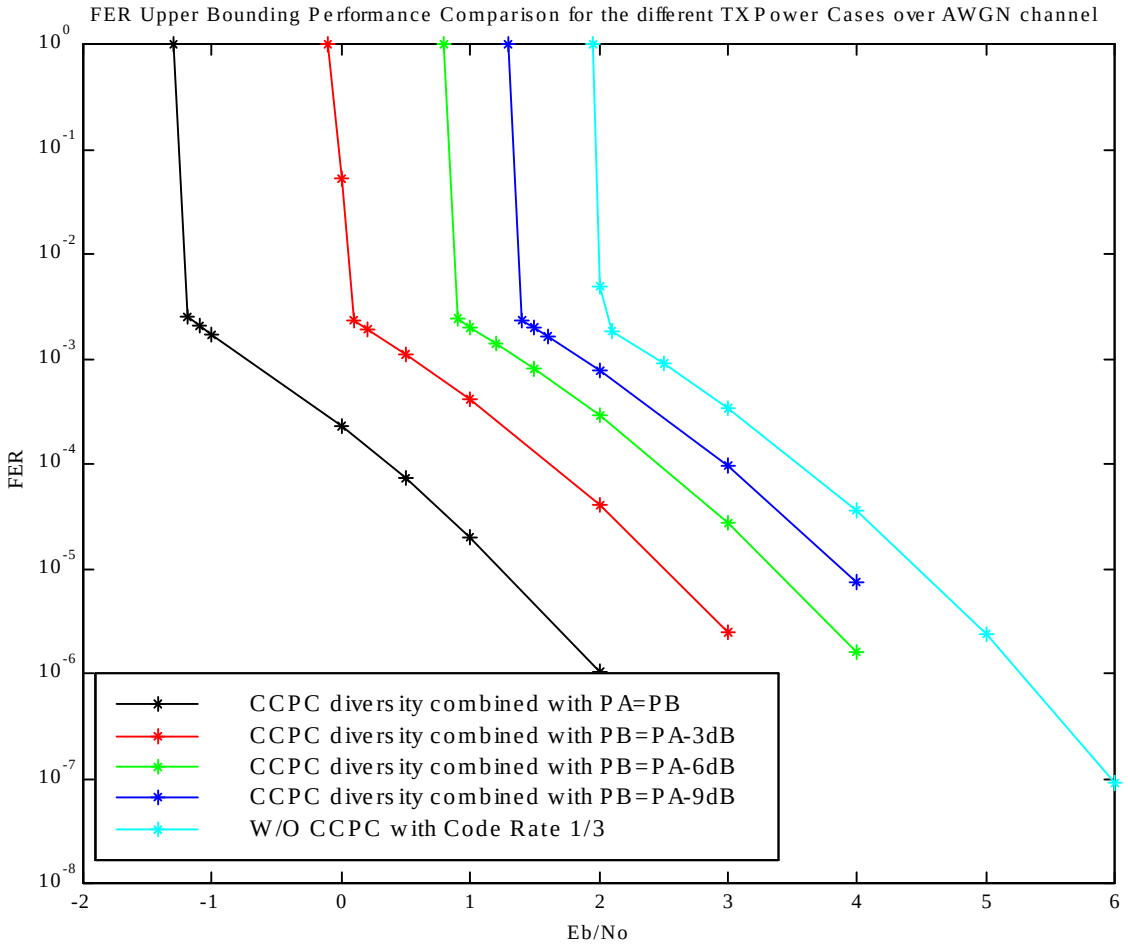
Upper bounding Performance for Code Rate 1/3

BER over AWGN



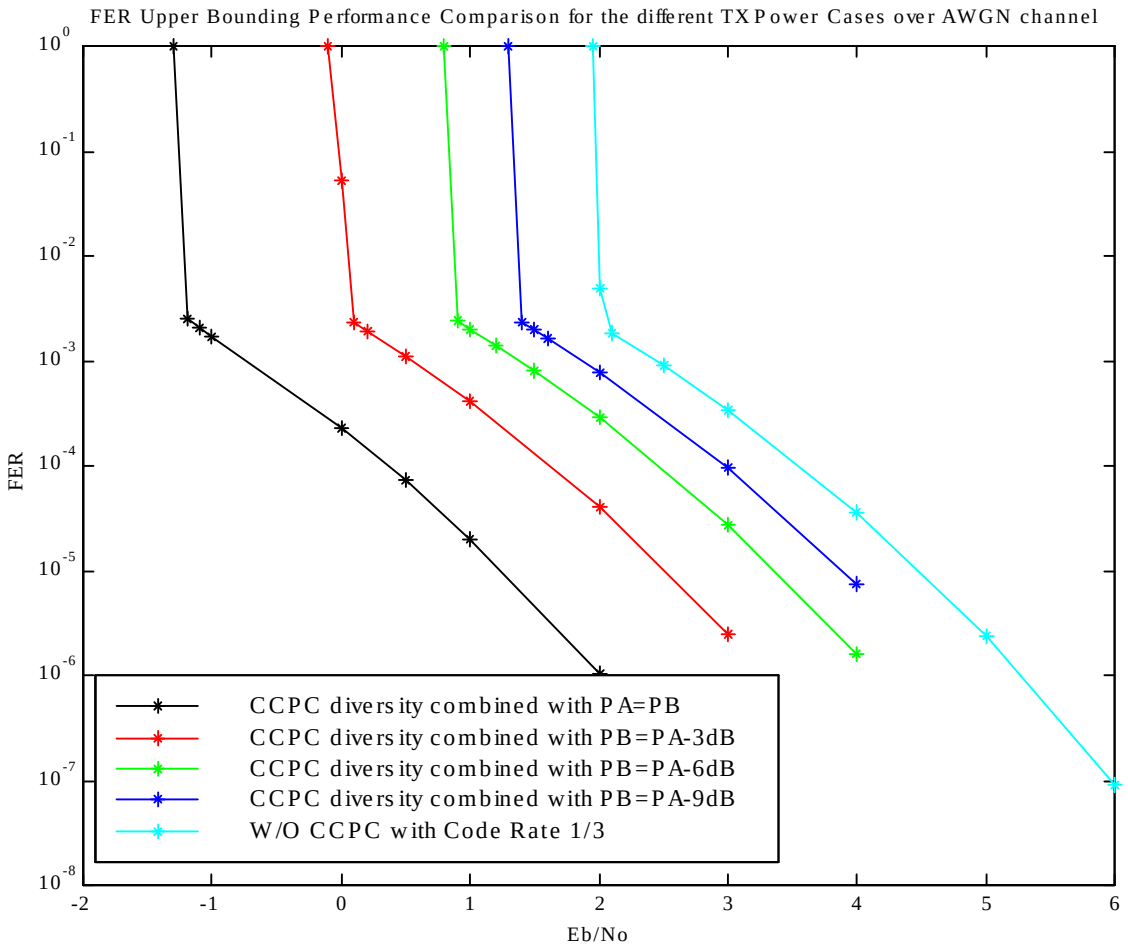
Upper bounding Performance for Code Rate 1/3

BER over AWGN Channel for Different TX Power Cases



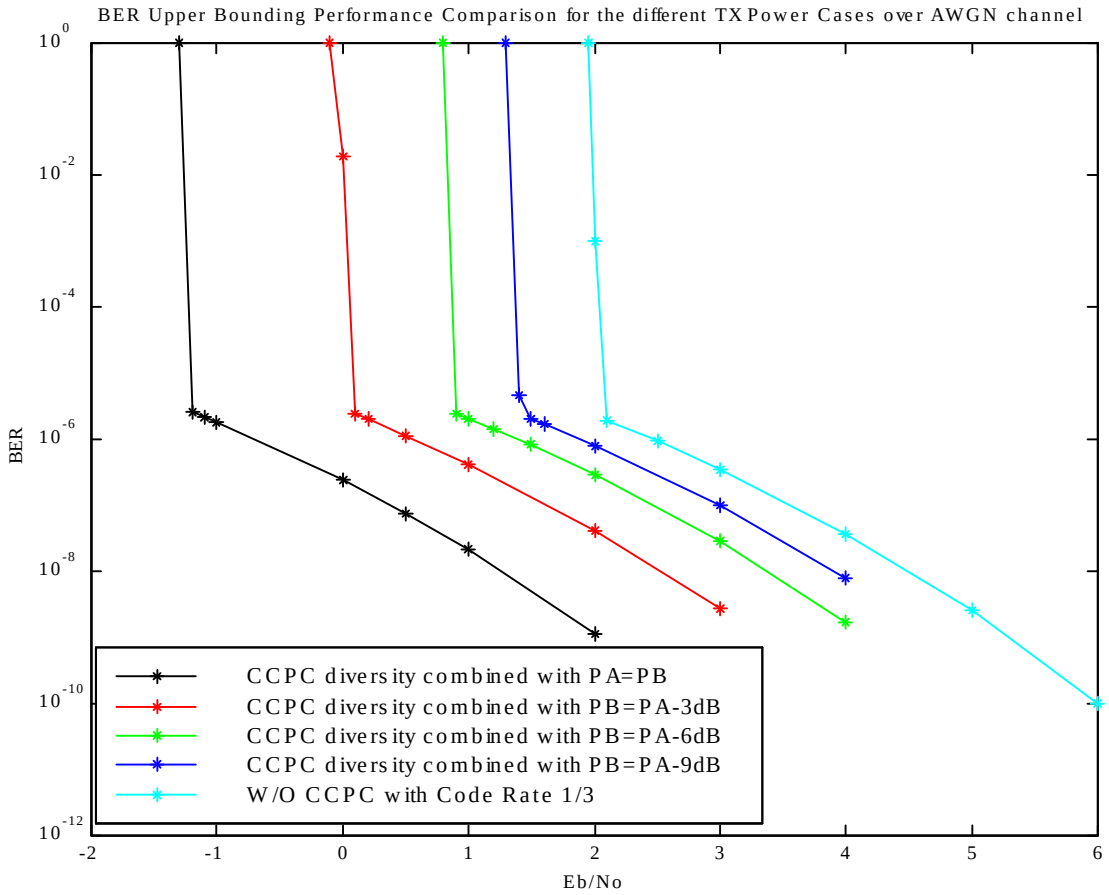
Upper bounding Performance for Code Rate 1/3

FER over AWGN Channel for Different TX Power Cases



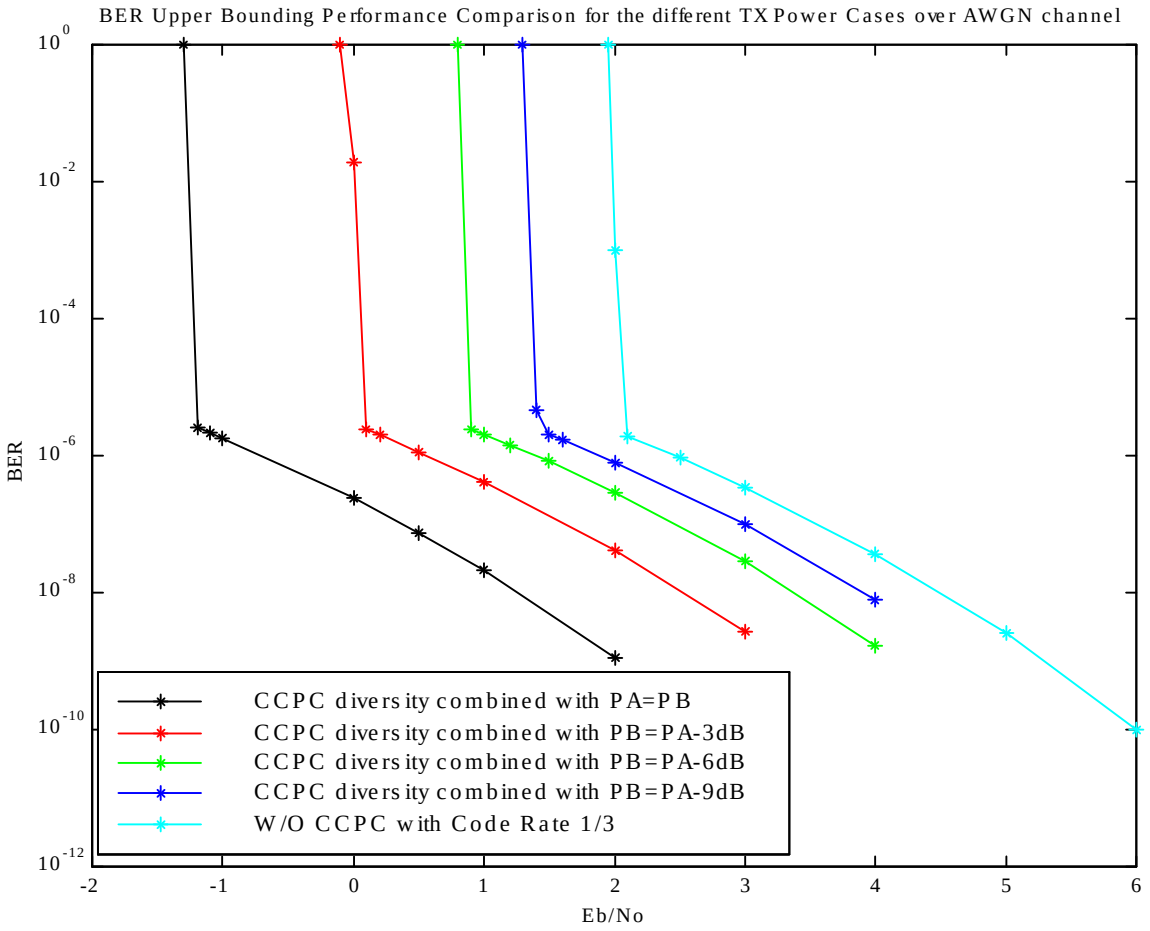
Upper bounding Performance for Code Rate 1/3

BER over AWGN Channel for Different TX Power Cases



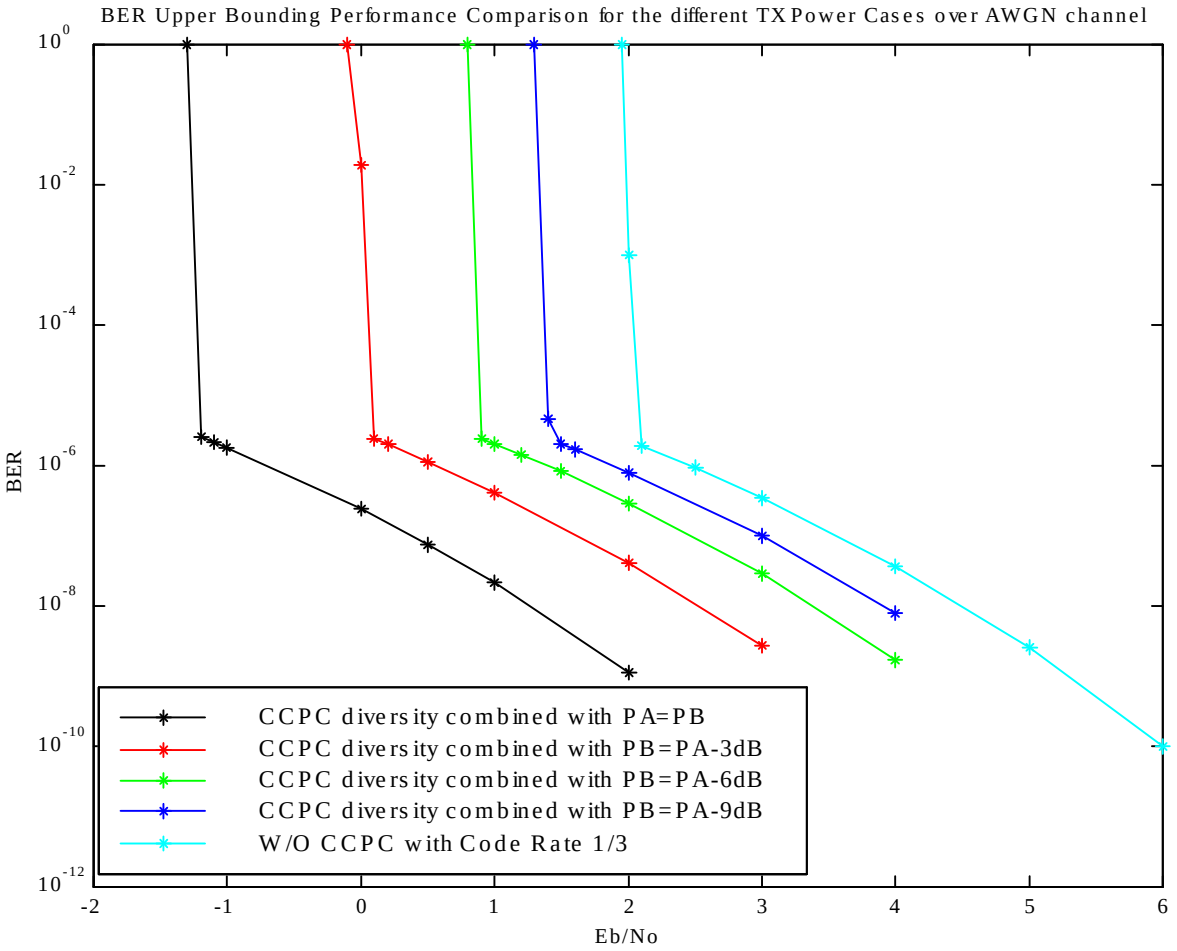
Upper bounding Performance for Code Rate 1/3

FER over Rayleigh Channel for Different TX Power Cases



Upper bounding Performance for Code Rate 1/3

BER over Rayleigh Channel for Different TX Power Cases



Conclusions

- We Proposed a New Soft Hand over Scheme Combining With CCPC Scheme With Iterative Turbo Decoding
- We Demonstrated Not Only an Unprecedented Coding Gain From Iterative Turbo Code, but Also More Than 3.2 dB and 4.0 dB Diversity Gains Due to the CCPC Scheme
- The CCPC Hand over Provides “the Softest” Hand over Mechanism for CDMA Systems
- The CCPC Hand over Can Allow a Type of Soft Hand over for TDMA, FDMA, CDMA-to- CDMA, or Between Dual Mode Operations
- The CCPC Hand over Scheme Provides Seamless and Transparent Hand over to Users