

# FINAL YEAR PROJECT PRESENTATION

## BIT ERROR RATE (BER) PERFORMANCE ANALYSIS OF DS-CDMA AND MC/CDMA OVER FADING CHANNELS

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# PRESENTATION OUTLINE

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# INTRODUCTION

- ❖ Multiple access schemes allow multiple users to share the radio spectrum in the most efficient way.
- ❖ Digital Multiple Access (CDMA) is a predominant multiple access technique for the 3G wireless services worldwide.
- ❖ The maturing of 3G mobile communication technologies from concepts to commercially deliverable systems motivates the design of possible architectures for future generations of mobile wireless system.
- ❖ Future wireless communication systems must be able to accommodate a large number of users and should provide high data rates at the required quality of service.
- ❖ What types of air link architecture are qualified to deliver such high-data-rate services?
- ❖ The DS-CDMA and MC-CDMA architecture that has a great potential for future mobile communications tackles this issue comprehensively.
- ❖ The inherent multipath propagation in mobile radio channels, however, constitutes a limiting factor in achieving satisfactory level of performance in these access schemes.



# PROBLEM STATEMENTS

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- ❖ Problem of multipath fading which results in severe signal degradation.
- ❖ Elimination of costs of outages of wireless communications systems.
- ❖ Problem of reaching the required data rate at the acceptable BER and complexity for the defined number of active users.

# AIMS AND OBJECTIVES

## •AIM

- ❖ To carry out the Bit Error Rate (BER) performance analysis of CDMA and MC-CDMA under fading channel condition using different modulation schemes

## •OBJECTIVES

- ❖ To carry out performance evaluation of the BPSK and QPSK modulation techniques.
- ❖ To simulate the BER performance of CDMA and MC-CDMA using a suitable software.
- ❖ To perform a performance comparison of CDMA and MC-CDMA systems in terms of BER performance.
- ❖ Based on the results, to propose a scheme that meets the modern-day requirements of wireless communications.

# SCOPE OF PROJECT

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- ❖ Bit Error Rate (BER) was used as the performance metric to assess the BER performance capability of CDMA and MC-CDMA systems.
- ❖ Additive White Gaussian Noise (AWGN) channel and Rayleigh fading channels are the mobile channels used in the simulation .
- ❖ Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK) are the modulation techniques considered.



# LITERATURE REVIEW

## CODE DIVISION MULTIPLE ACCESS (CDMA)

- ❖ A digital method for simultaneously transmitting signals over a shared portion of the spectrum by coding each distinct signal with a unique code.
- ❖ CDMA is a wireless communication technology that uses the principle of spread spectrum communication.
- ❖ Its advantages includes multiple access capability, interference rejection, protection against multipath interference, privacy etc.
- ❖ DS-CDMA is the most commonly used technology for CDMA.
- ❖ It is the basic technology for 3G systems.
- ❖ In DS-CDMA system transmission, the user data signal is multiplied by a pseudo random code sequence.
- ❖ DS-CDMA systems are considered to be single carrier CDMA systems.



# LITERATURE REVIEW (cont.)

## MULTI-CARRIER CDMA (MC/CDMA)

- ❖ MC-CDMA techniques were born from a fusion of the OFDM technology and the CDMA technique to provide multi-user capability.
- ❖ MC-CDMA spreads the original data stream into the frequency domain by initially converting the input data stream from serial to parallel, then multiplying this stream by the spreading chips in different OFDM subcarriers.
- ❖ All users use all subcarriers simultaneously.
- ❖ MC-CDMA combines the advantage offered by OFDM and CDMA.
- ❖ OFDM is well suited for high data rate applications in frequency selective fading channels, while CDMA is a multiplexing technique where number of users is simultaneously available to access a channel.
- ❖ MC-CDMA receiver processes signal in the frequency domain which is preferable than processing in the time domain for multipath channels.



# LITERATURE REVIEW (cont.)

## BER Measurement in a Fading Channel

- ❖ The bit error rate (BER) is a performance measurement for telecommunication systems.
- ❖ It represents the percentage of bits that have errors relative to the total number of bits received in a transmission.
- ❖ A small BER indicates that the system has a small probability of receiving bits in error.
- ❖ On the contrary, a large BER indicates a large probability of receiving error bits.
- ❖ The BER, or quality of the digital link, is calculated from the number of bits received in error divided by the number of bits transmitted during a particular time interval.
- ❖ Fading means rapid fluctuations (or distortions) of the amplitudes, phases, or multipath delays that a carrier-modulated signal experiences over certain propagation media.
- ❖ Multipath propagation results in a number of bits of the received signal being corrupted.



# METHODOLOGY

- ❖ The mathematical modelling carried out will be used to compare the theoretical values of BER performance of both systems.
- ❖ The two modulation techniques employed will be simulated to compare their BER performance over AWGN and Rayleigh fading channel.
- ❖ The simulation of the bit error rate (BER) of the DS-CDMA and MC/CDMA will be carried out using MATLAB programming language.
- ❖ The results obtained from the simulation will be used to compare with the theoretical results.



# METHODOLOGY (CONT.)

## DS-CDMA Spread spectrum system

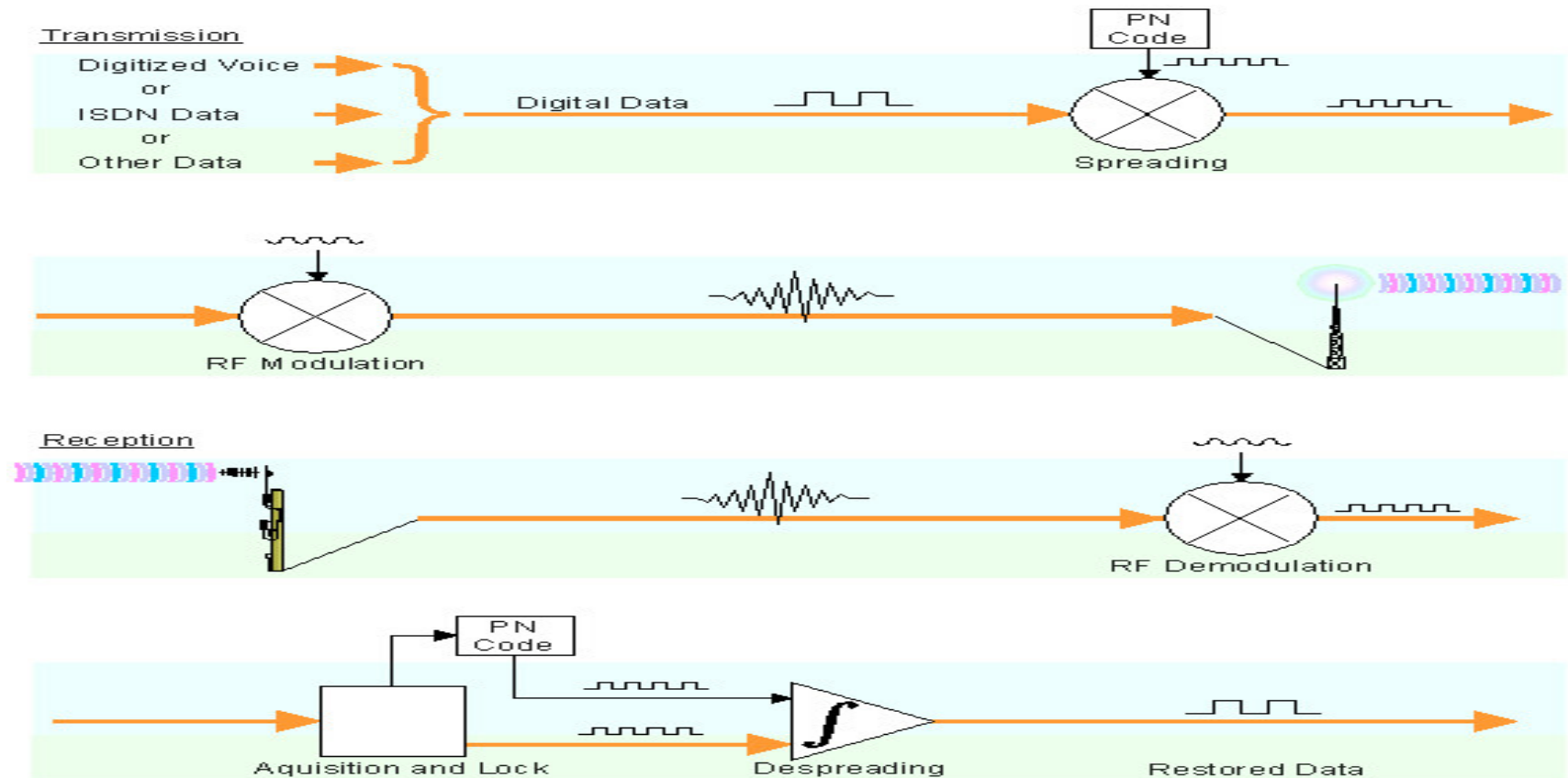


FIGURE 1

# METHODOLOGY (CONT.)

## BLOCK DIAGRAM FOR MC-CDMA IMPLEMENTATION

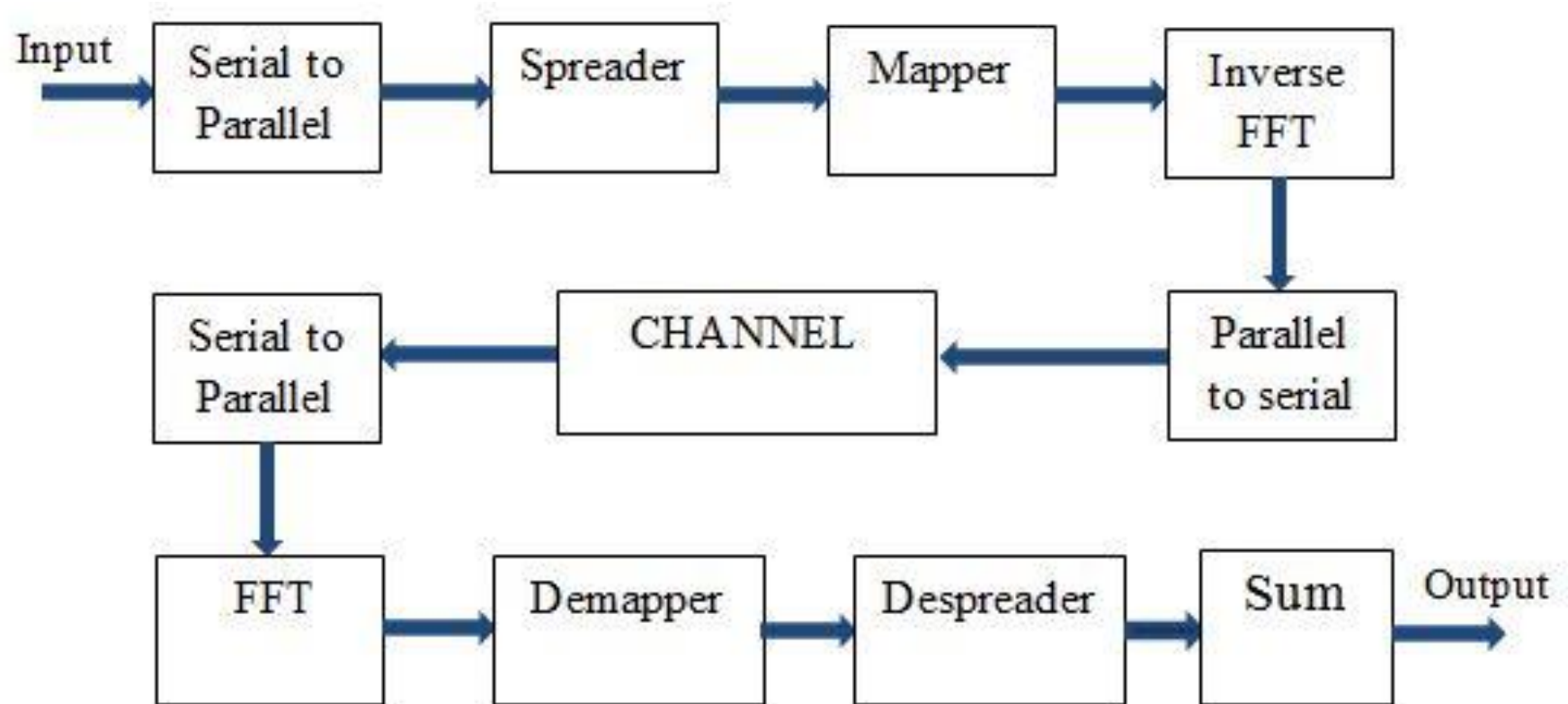


FIGURE 2

# SIMULATED RESULTS

## BER Comparison of BPSK and QPSK in Rayleigh with AWGN

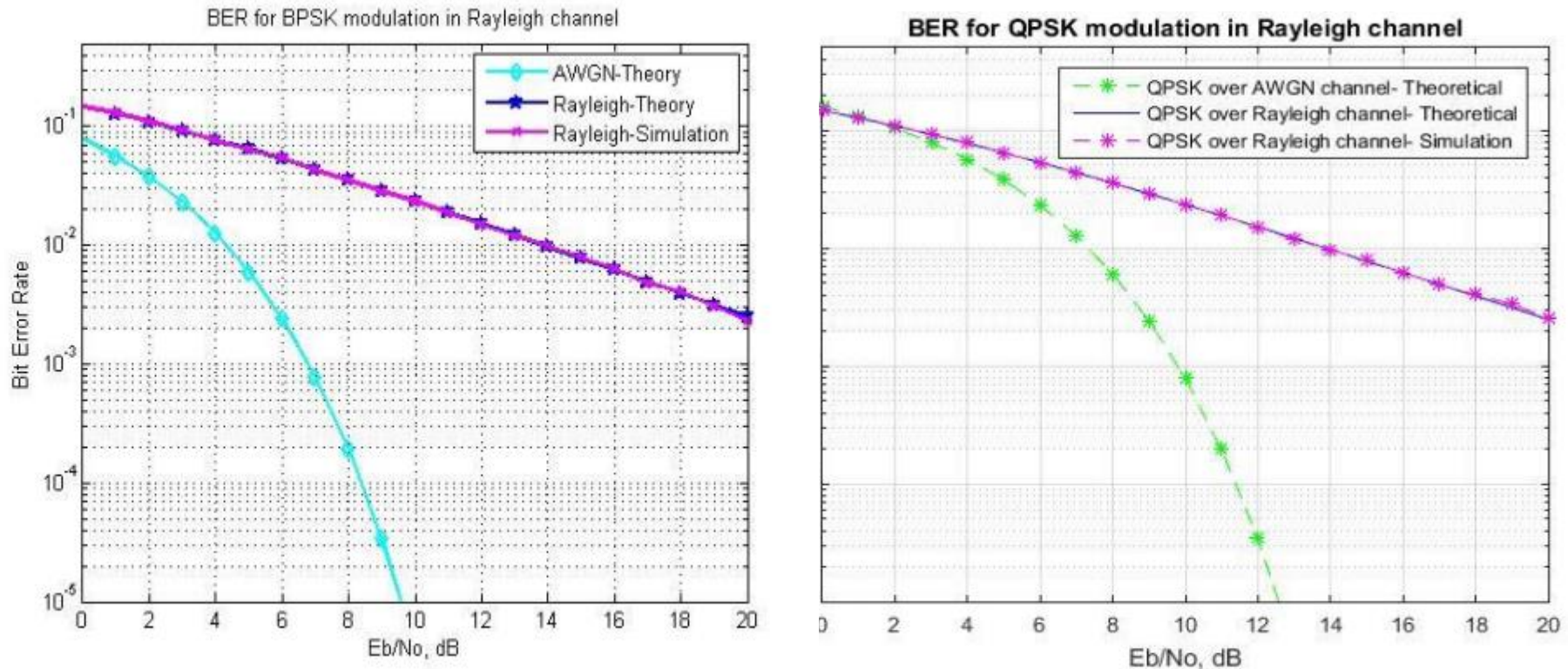


FIGURE 3

- ❖ Both modulation techniques have almost identical BER performance
- ❖ This result validates the BER theoretical results of both techniques



# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of DS-CDMA in AWGN Channel

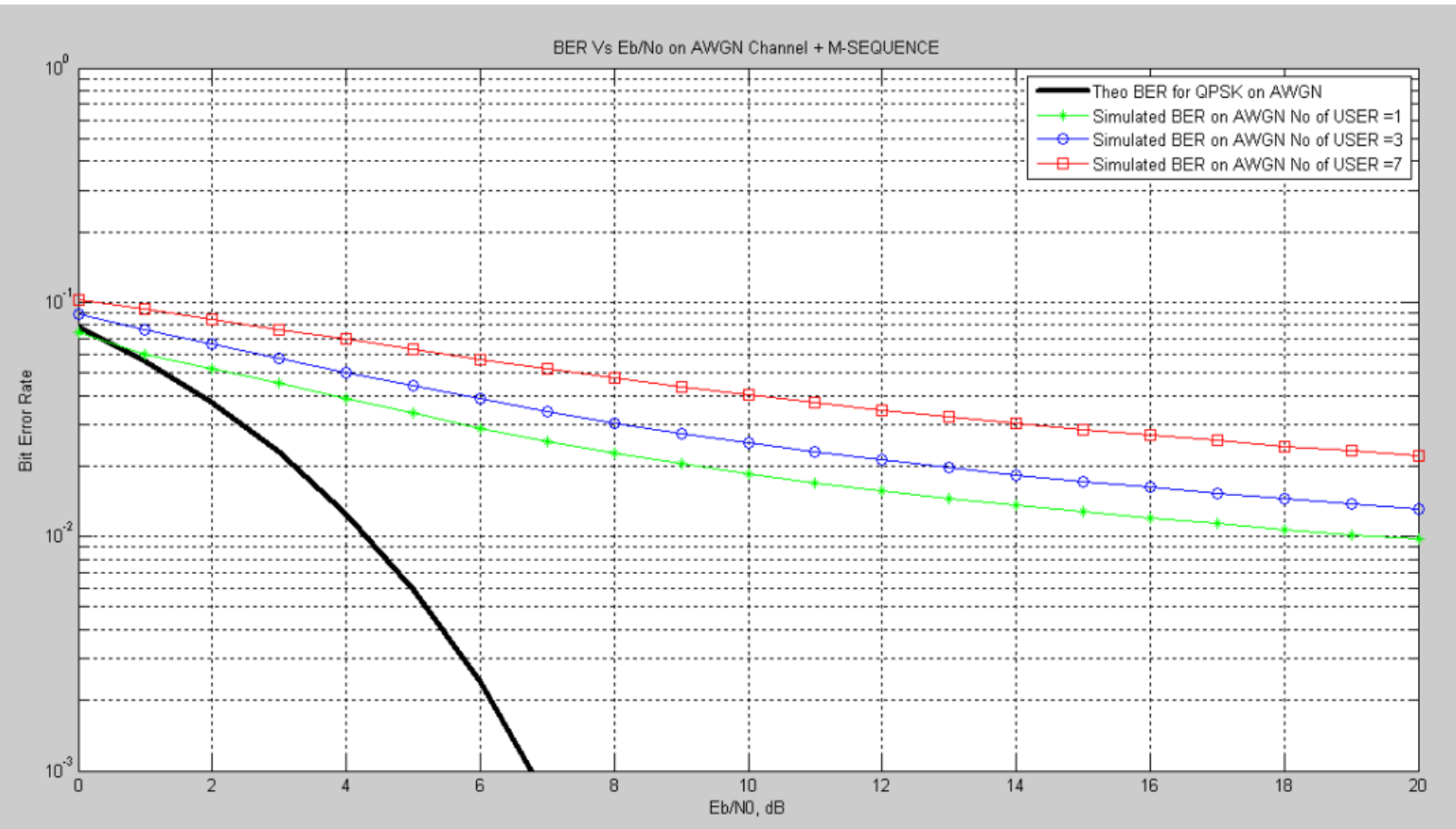


FIGURE 4

- ❖ BER performance of synchronous DS-CDMA in AWGN using M-sequence.
- ❖ This result shows as number of users increases, the BER increases.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of DS-CDMA in AWGN Channel (cont.)

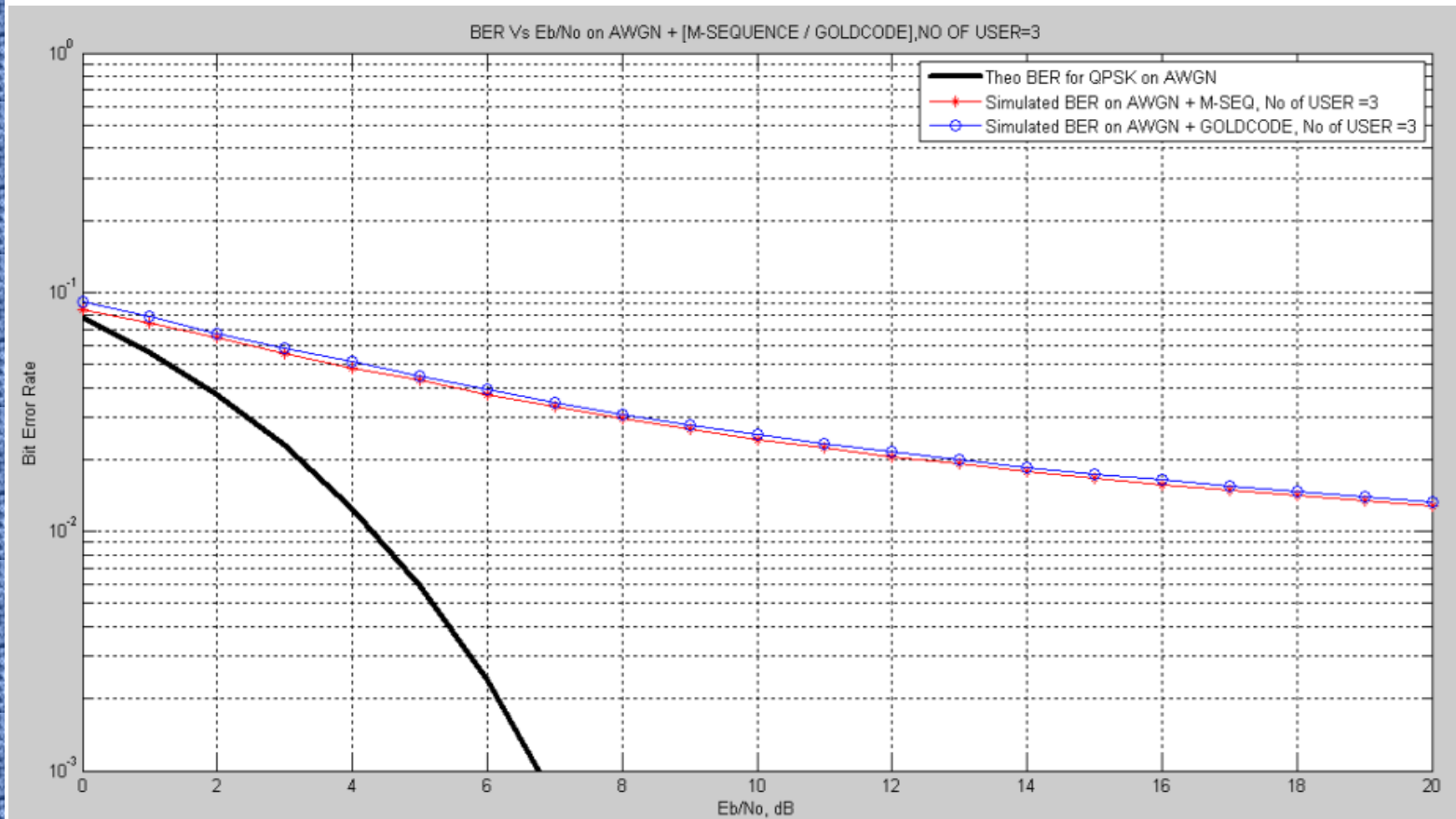


FIGURE 5

- ❖ The BER curve of Gold coded DS-CDMA has relatively higher BER than the M-sequence coded DS-CDMA for same number of users.
- ❖ This demonstrates the importance of code selection in DS-CDMA system.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of DS-CDMA in Rayleigh fading Channel

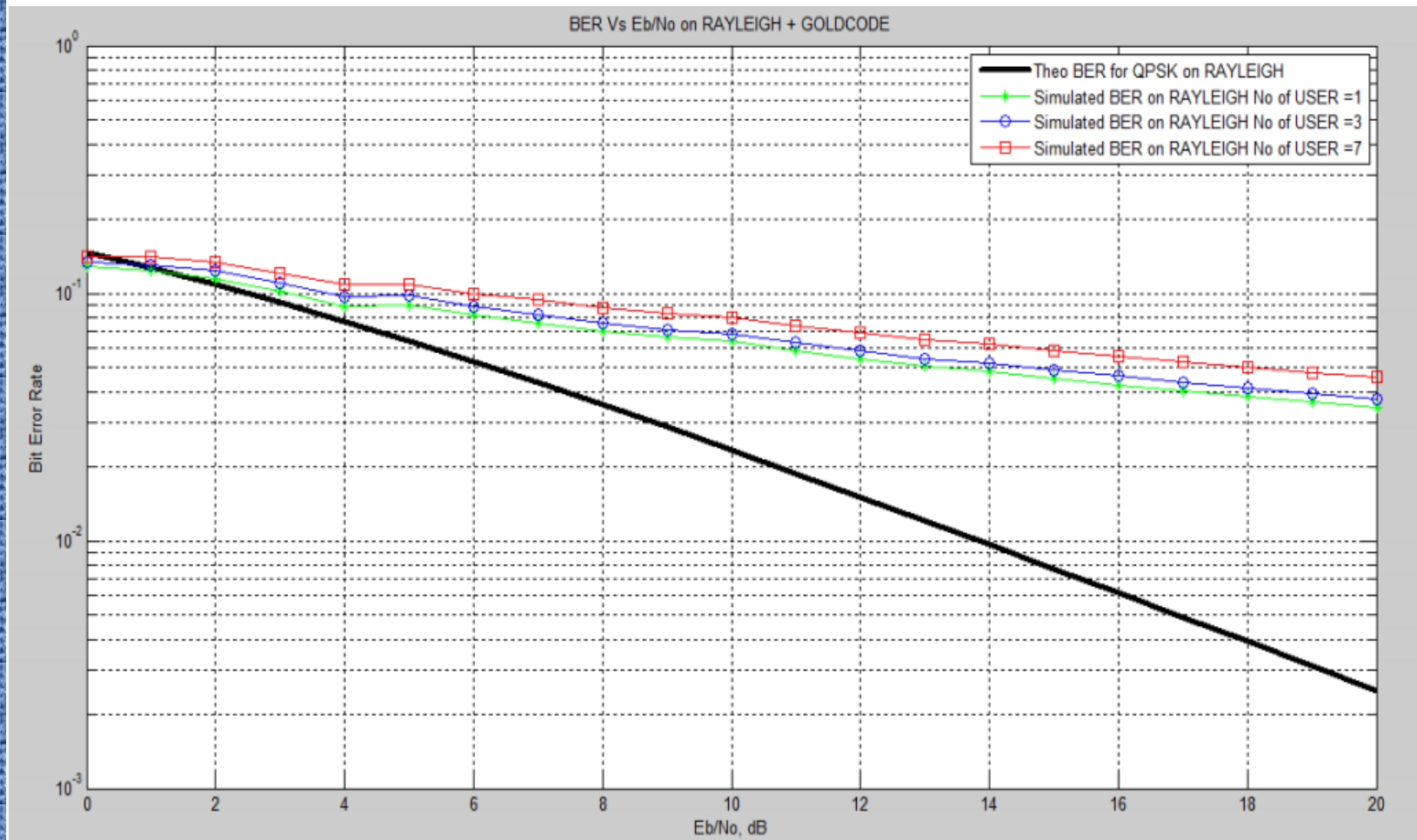


FIGURE 6

- ❖ BER performance of synchronous Gold-coded DS-CDMA in Rayleigh fading channel.
- ❖ This result shows as number of users increases, the BER increases.



# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of DS-CDMA in Rayleigh fading Channel (cont.)

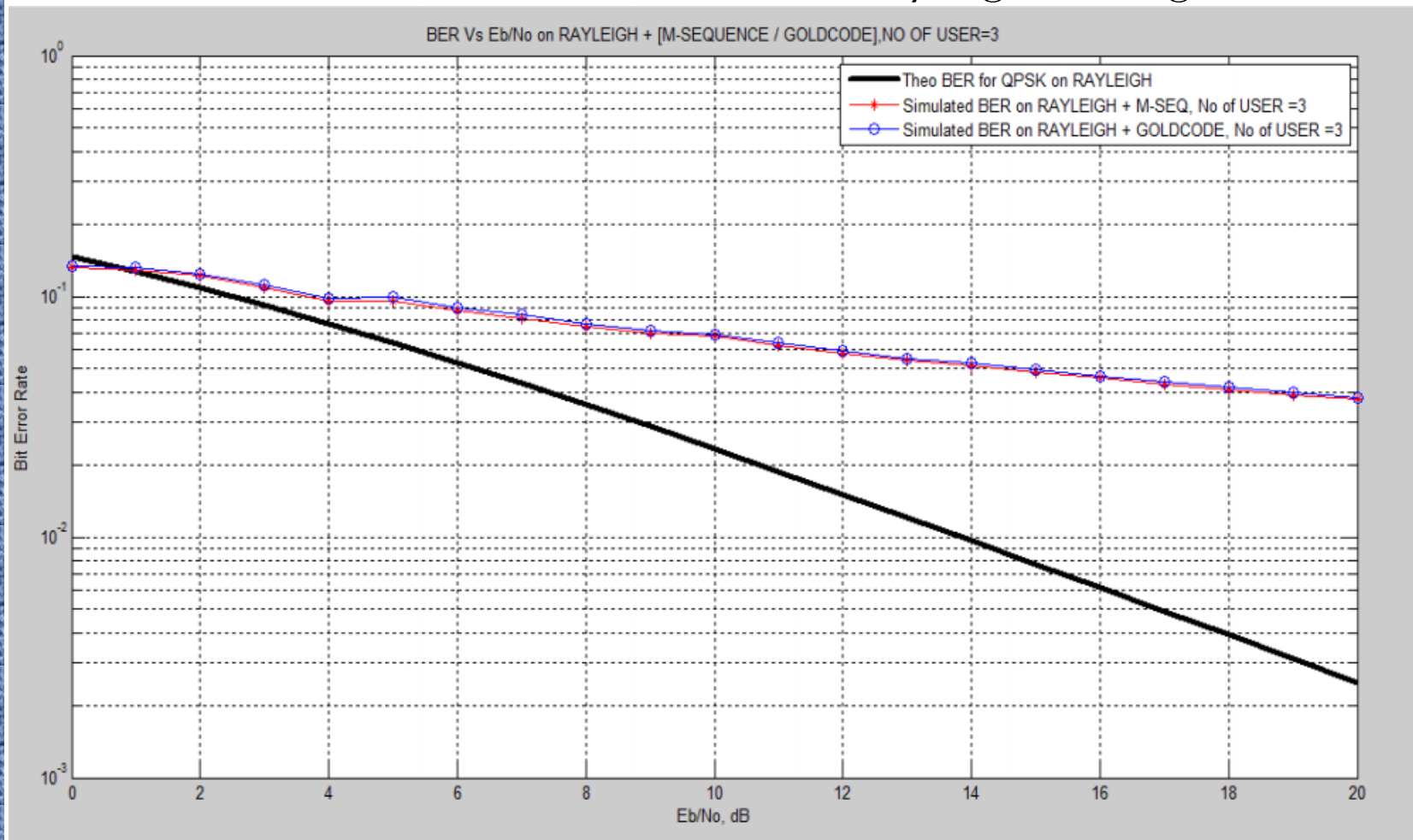


FIGURE 7

- ❖ In Rayleigh, the BER performance of DS-CDMA using Gold code and M-sequence have almost identical curve for same number of users.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Comparison of DS-CDMA in AWGN and Rayleigh fading channel

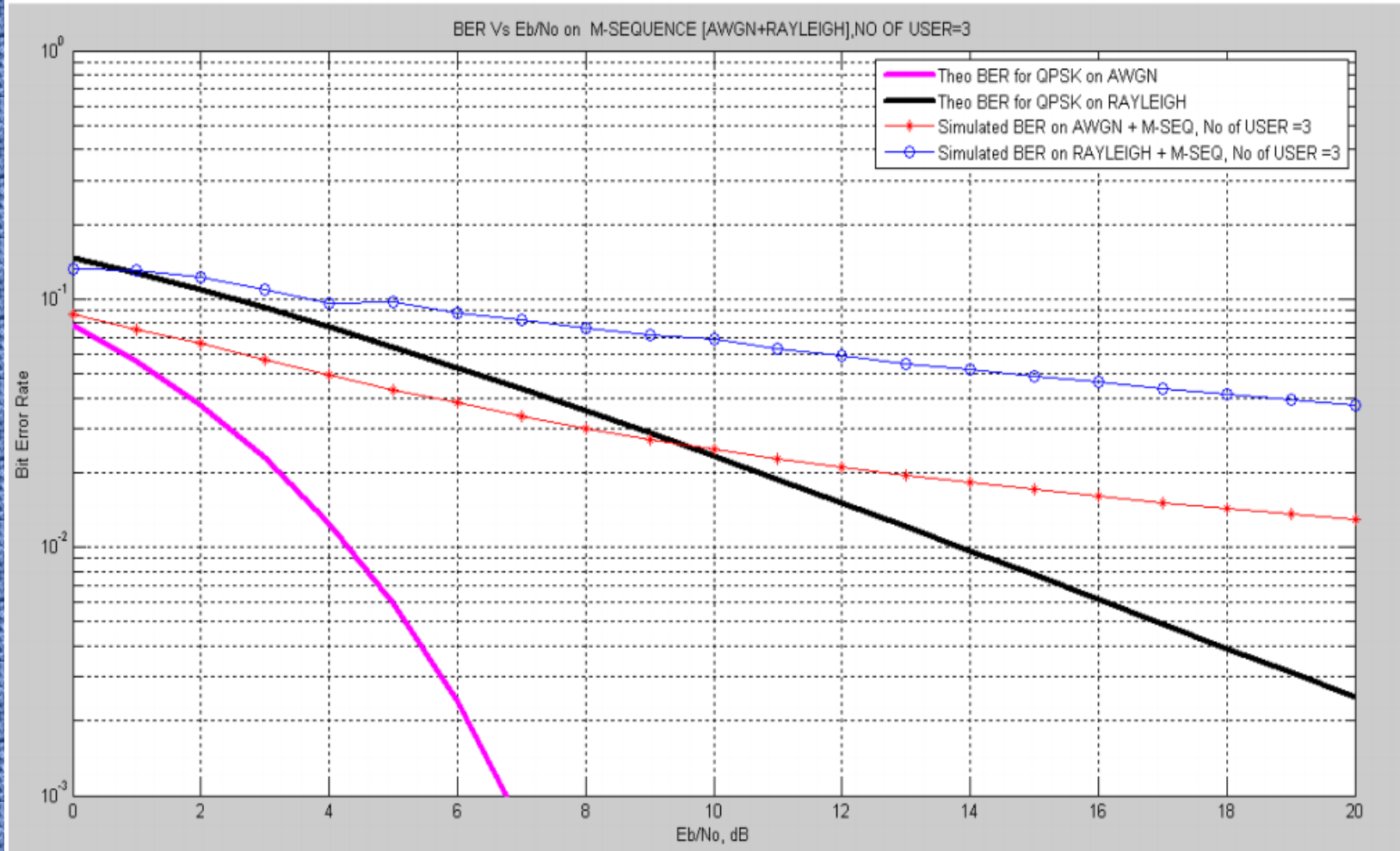


FIGURE 8

- ❖ The BER performance of DS-CDMA using M-sequence in AWGN is significantly lower than in Rayleigh fading channel for the same number of users.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Comparison of DS-CDMA in AWGN and Rayleigh (cont.)

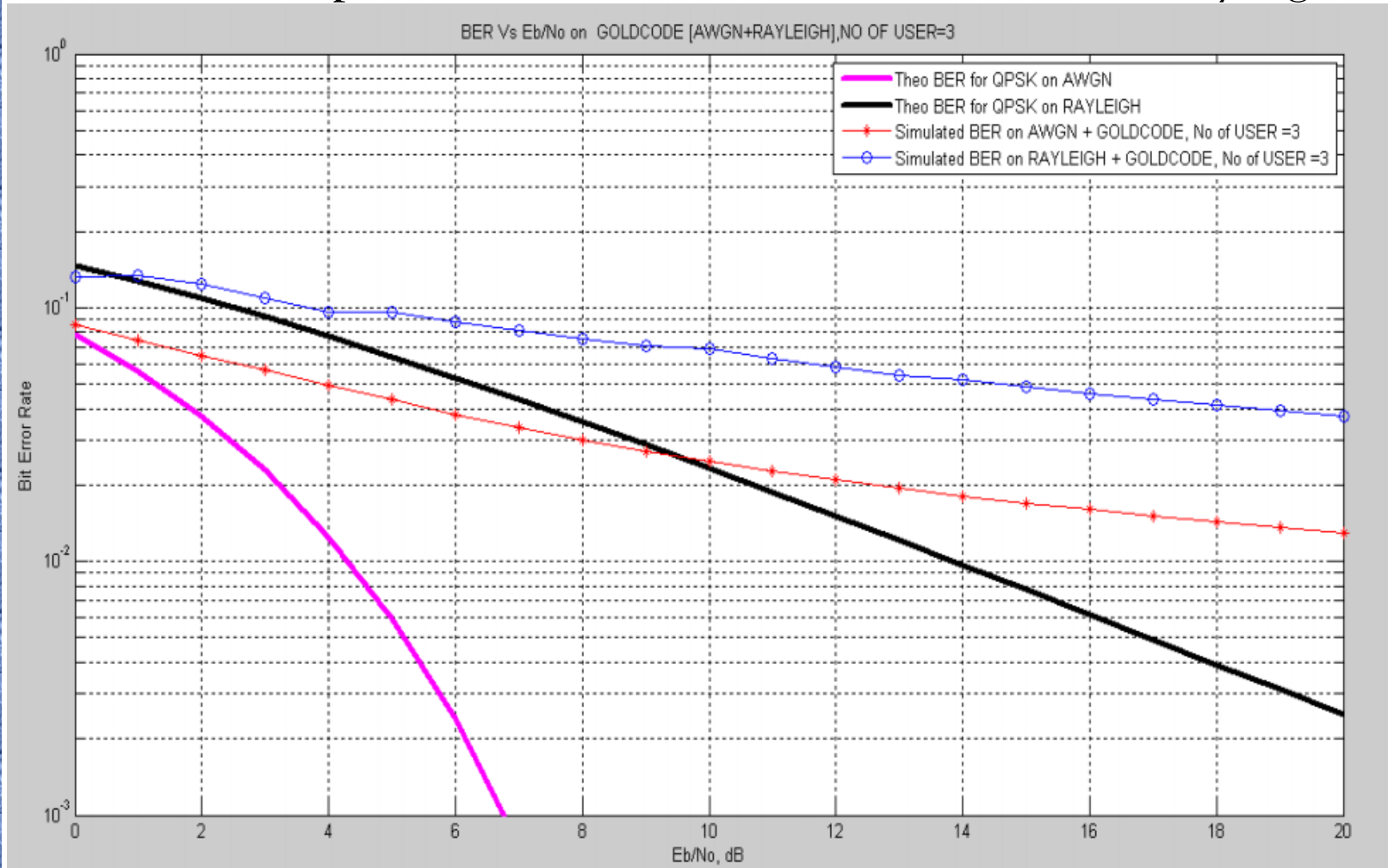


FIGURE 9

- ❖ The BER performance of Gold-coded DS-CDMA in AWGN is significantly lower than in Rayleigh fading channel for the same number of users.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of MC/CDMA in AWGN Channel

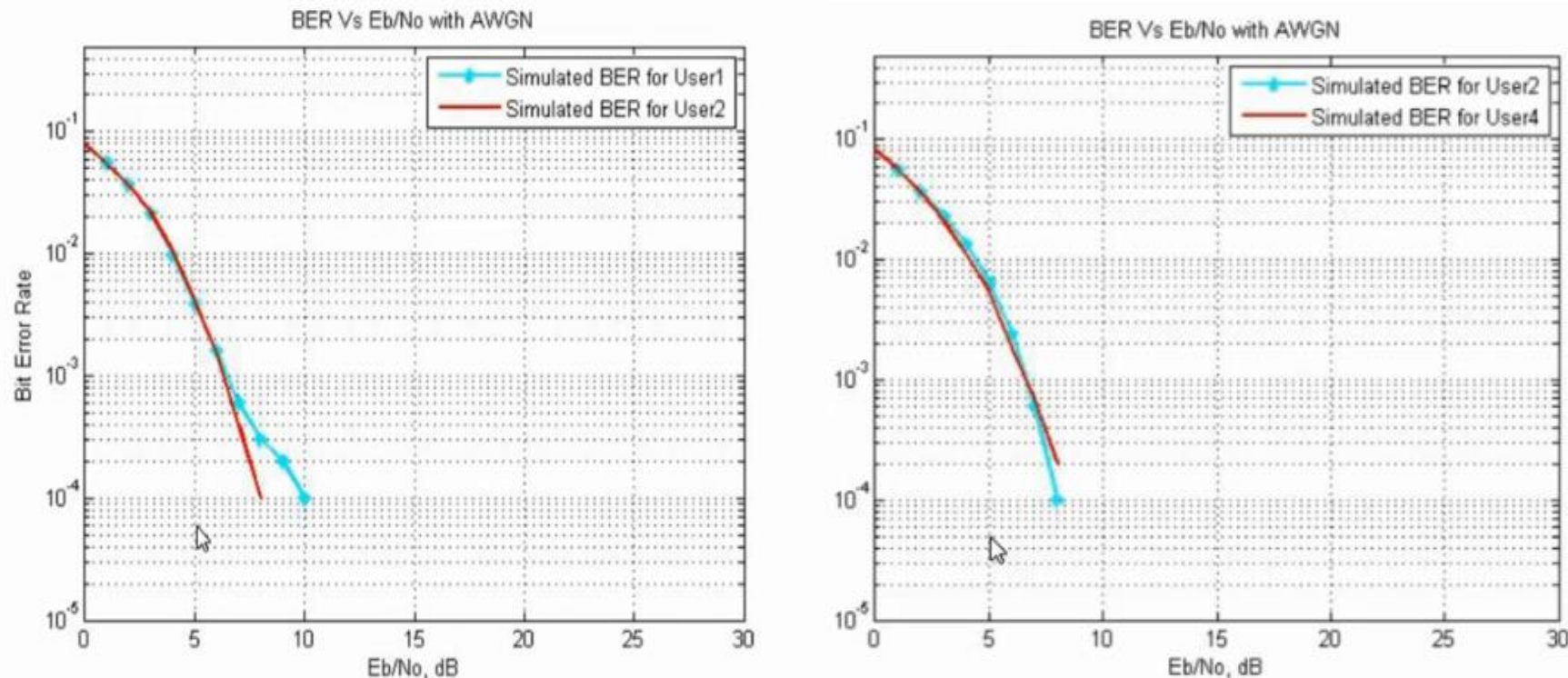


FIGURE 10

- ❖ The result of BER performance of MC-CDMA in AWGN shows that as the number of users increases, the BER remains fairly constant.



# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of MC/CDMA in AWGN Channel

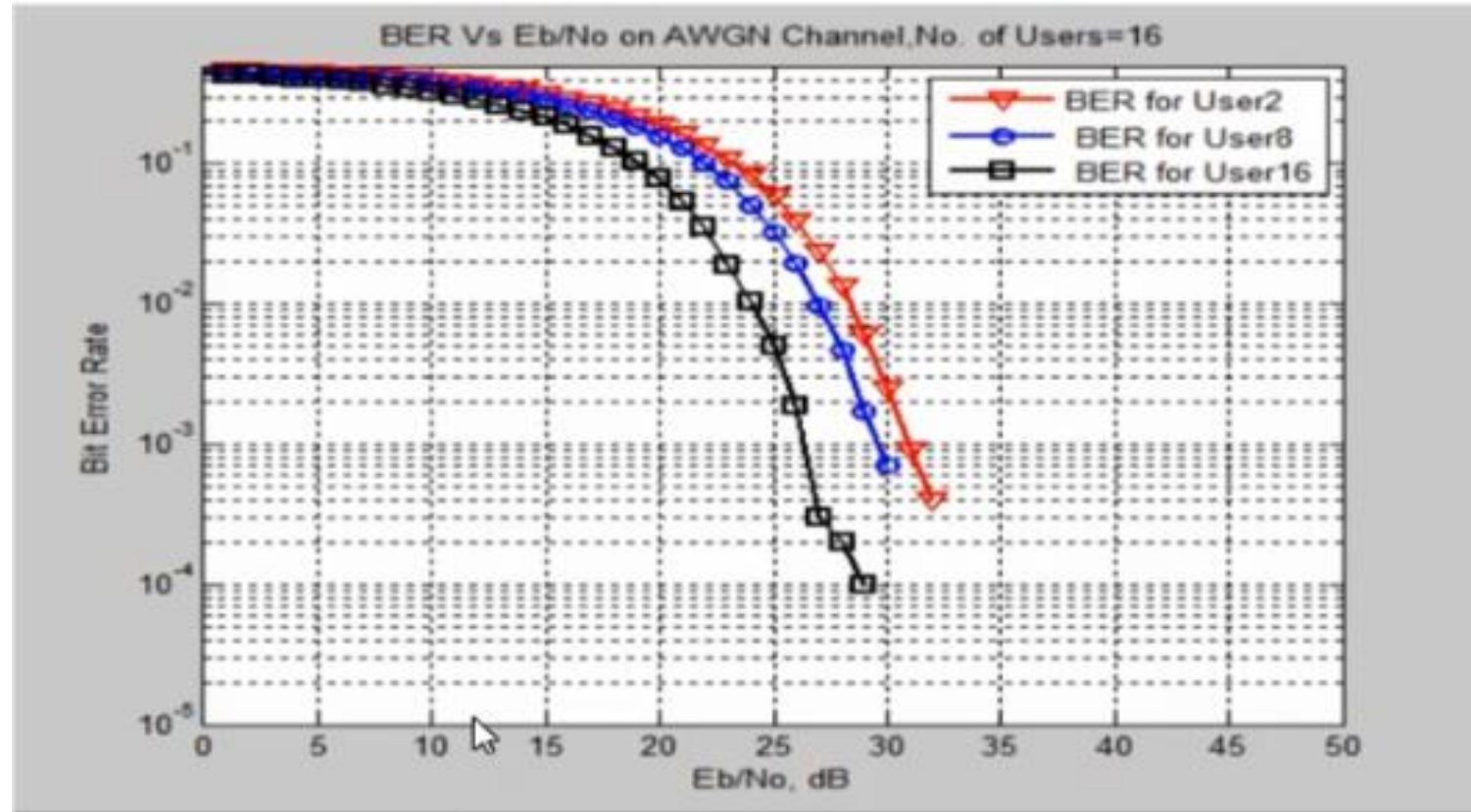


FIGURE 11

- ❖ The result of BER performance of MC-CDMA in AWGN shows that the BER decreases with the number of users.
- ❖ As the number of users increases, the BER decreases.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## BER Performance of MC/CDMA in Rayleigh fading Channel

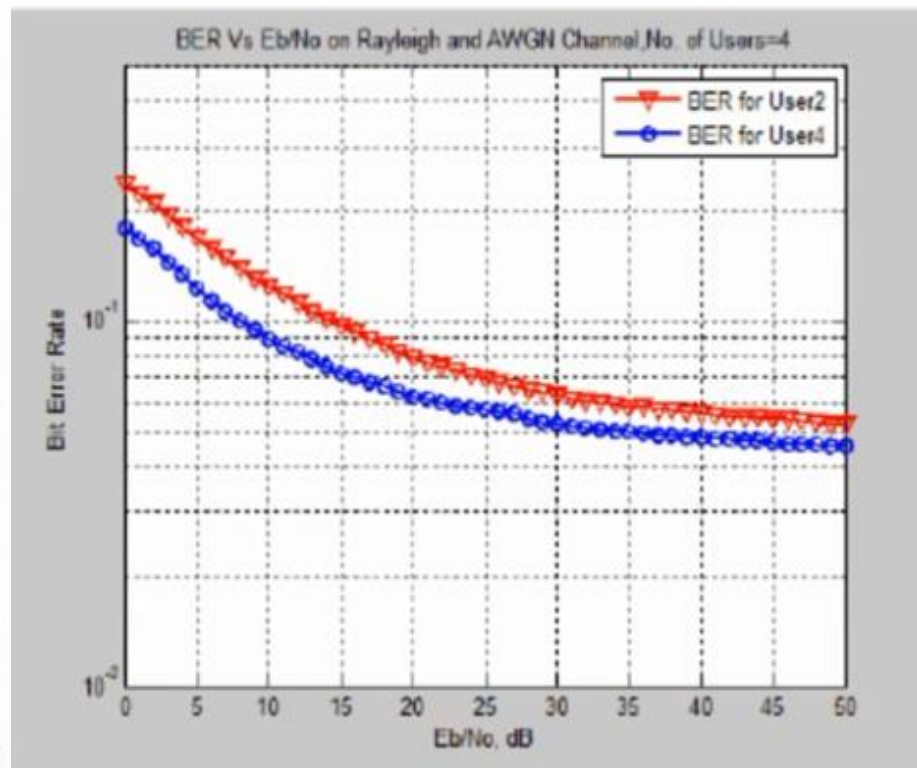
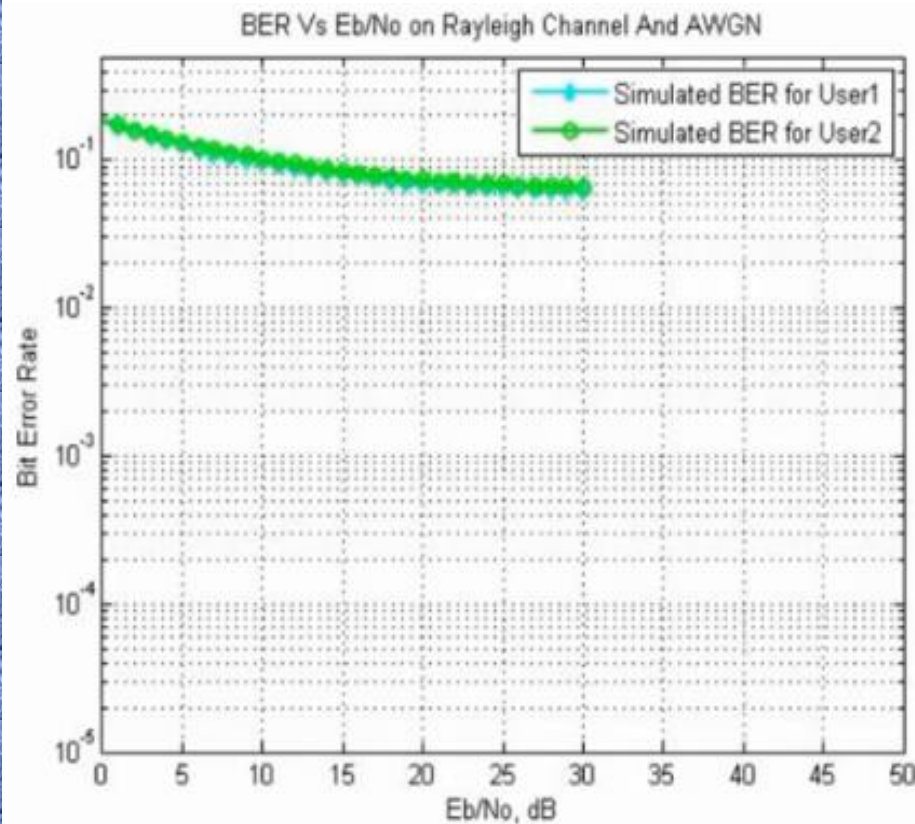


FIGURE 12

- ❖ In the presence of Rayleigh fading channel, BER performance of MC-CDMA still continues to decrease with increasing number of users.

# SIMULATED RESULTS AND DISCUSSION (CONT.)

## DS-CDMA and MC/CDMA BER Performance Comparison Summary

- ❖ In AWGN channel, DS-CDMA and MC/CDMA have almost the same BER performance regardless of the code sequence employed.
- ❖ However, under Rayleigh fading channel, MC/CDMA have better BER performance.
- ❖ As the numbers of users increase, the BER of DS-CDMA increases.
- ❖ In contrast, the BER of MC/CDMA decreases with increase in the number of users.
- ❖ M-sequence DS-CDMA synchronous system have lower BER performance compared to gold-coded DS-CDMA.

# CONCLUSION

- ❖ The DS-CDMA and MC-CDMA access scheme can be seen as an important technique needed for global actualization of high-data rate wireless communications at the acceptable quality of service.
- ❖ The MC/CDMA has been validated as the best for delivering quality wireless services at the acceptable bit error rate.
- ❖ The simulated BER results has validated the theoretical results.
- ❖ The importance of code selection has been confirmed in achieving acceptable BER in DS-CDMA.
- ❖ This project has laid a model for which future research works can be carried out on wireless communications technologies.





# REFERENCES

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