13

ANALYSIS OF RESULTS OBTAINED BASED ON ALL ALGORITHMS

13.1 INTRODUCTION

In this chapter the Bit Error Rate (BER) (dB) performance verses Eb/No (Signal to noise ratio in dB) of the system for various Algorithms such MIMO V-BLAST (Based on OFDM and CDMA), Genetic Algorithm and PDA Algorithm with various parameters as mentioned below. The transmitted signal is subjected to different condition like fading and multi-path propagation under the influence of various other types of noises such as white noise.

13.2 BACKGROUND

The BER performance of the system is obtained using powerful MATLAB 7.0 platform with PC configuration of

- 512 MB of RAM,
- Speed of 3.2 GHz and
- 80 GB Hard drive space.

PROFILE REPORT generates a profile report in HTML format, saves it to a temporary file, and displays it in your web browser. PROFILE REPORT BASENAME uses the specified base filename to save the report. Note that the HTML report consists of several different files. Because of this, BASENAME should not have an extension. PROFILE REPORT suspends the profiler. PROFILE PLOT displays a bar graph of the functions with the most execution time.

In this study, the actual operation counts are not reported as there is no reliable known way (in MATLAB or in any tool) to count the number of operations. So the time they take is compared to show the merit of the decoding methods. The time required by a method is called the execution time.

However, it is assumed that each execution time has two components (1) the CPU time (the time required for core operations) and (2) the memory access time plus the time

required for other operations. Running the same simulation but turning the decoding module of measure the time required for other operations. The CPU time then represents the real time spent by a decoding method and can be found by subtracting the time required for other operations from the execution time.

- The conditions under which this OFDM MIMO V-BLAST model is presented are
  - All modulation techniques are used for the information signal.
  - Each information/data bit has a period of T and each chip has a period of T_C.
  - IFFT, FFT Size is 512-point.
  - No of Carrier Used 512.
  - The pulse shape is rectangular and has amplitude of 0 and 1 for the information signal.
  - All the users are transmitting at the same bit rate.
  - The system operates in single cell environment.
- The conditions under which this CDMA MIMO V-BLAST model is presented are
  - All modulation techniques are used for the information signal.
  - The length of the spreading code is 8.
  - Each information/data bit has a period of T and each chip has a period of T_C.
  - The pulse shape is rectangular and has amplitude of ± 1 for the information signal. The pulse shape for each chip of the spreading code is also rectangular, having amplitude of ± 1.
  - All the users are transmitting at the same bit rate.
  - The system operates in single cell environment.
- The conditions under which this Genetic Algorithm model is presented are
  - All modulation techniques are used for the information signal.
  - The length of the spreading code is 17.

- Each information/data bit has a period of T and each chip has a period of T_C.
- The pulse shape is rectangular and has amplitude of ± 1 for the information signal. The pulse shape for each chip of the spreading code is also rectangular, having amplitude of ± 1.
- All the users are transmitting at the same bit rate.
- The system operates in single cell environment

❖ The conditions under which this PDA Algorithm model is presented are

- All modulation techniques are used for the information signal.
- The length of the spreading code is 16.
- Each information/data bit has a period of T and each chip has a period of T_C.
- The pulse shape is rectangular and has amplitude of ± 1 for the information signal. The pulse shape for each chip of the spreading code is also rectangular, having amplitude of ± 1.
- All the users are transmitting at the same bit rate.
- The system operates in single cell environment

❖ The parameters are

➢ Modulation Techniques

- QPSK
- 16-QAM
- 64-QAM
- GMSK (Except V-BLAST)

➢ Number of Users

- 2-Users
- 4-Users
- 8-Users
- 16-Users
- 64-Users (Except V-BLAST)

➢ Types of Pseudo-Random Codes

- Walsh codes

- Gold codes
- PN codes

➢ Types of Channels

- AWGN Channel
- MIMO Rayleigh fading channel(For MIMO-V-BLAST)
- Rayleigh fading channel\

13.2.1 System Performance

Here we present a few plots of the bit error rate (BER) versus signal to noise ratio for different parameters mentioned above. The profile plots shown provide the timing information about the simulation and the important functions which consumes larger time to run. Profile plot provide important data to analyze the system in the execution point of view which is important aspect of system design.

The system performance has been observed for different parameters mentioned above and the BER performance and profile plots obtained are shown in this chapter.

13.3 SIMULATION RESULTS FOR V-BLAST ALGORITHM

13.3.1 Plots for OFDM MIMO V-BLAST

13.3.1.1 Using Zero Forcing

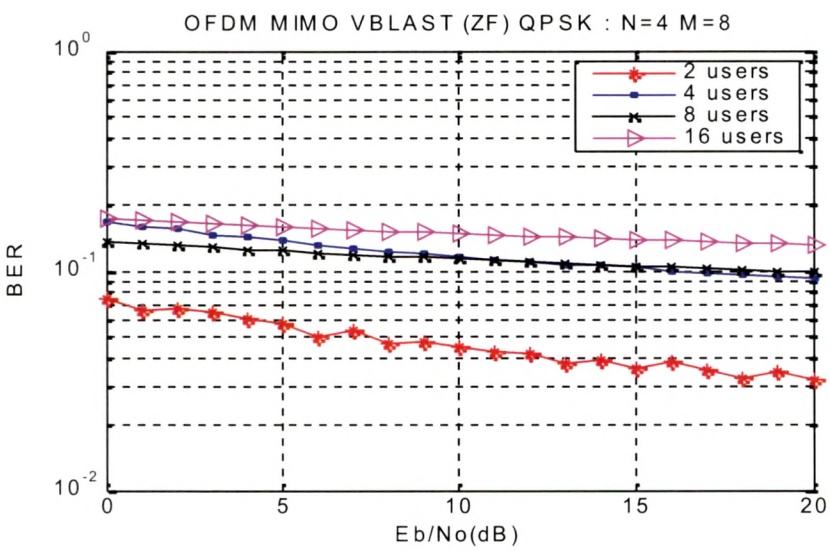


Figure 13.1(a) BER for OFDM_MIMO_V-BLAST (ZF) _QPSK

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
modu_qpsk	3150	364.578 s	1.375 s	
demodu_qpsk	2520	15.922 s	5.109 s	
ddemodce	2520	10.813 s	1.094 s	
awgn	630	5.313 s	0.750 s	
ademodce	2520	3.313 s	3.313 s	
pinv	2520	0.828 s	0.828 s	

Figure 13.1(b) Profile Summary Generated on 16-Jun-2007 05:31:47

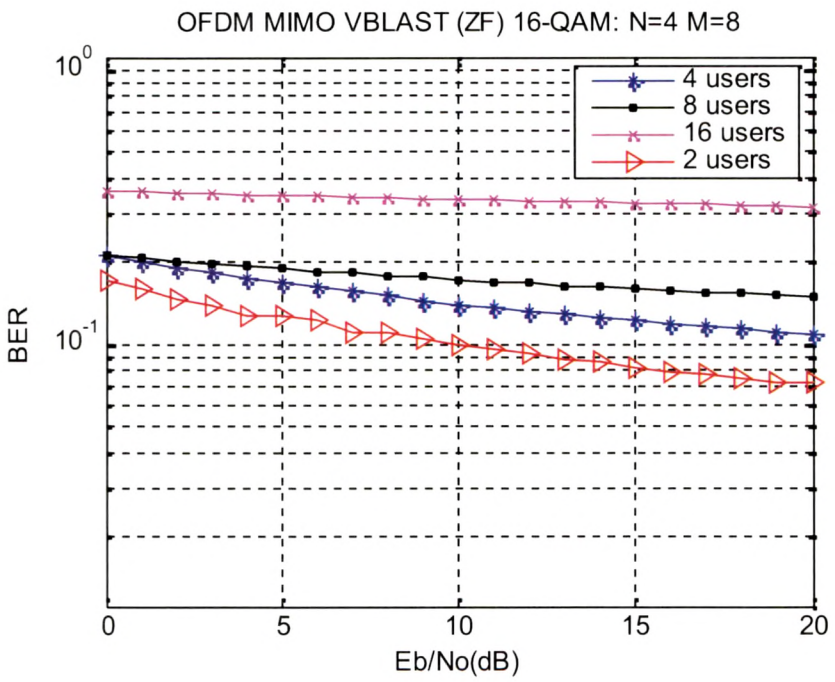


Figure 13.2(a) BER for OFDM_MIMO_V-BLAST (ZF) _16QAM

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
modu_16	3150	248.156 s	0.984 s	
dmodce	3150	247.172 s	239.594 s	
demodu_16	2520	30.188 s	4.813 s	
ddemodce	2520	25.375 s	1.188 s	
de2bi	22680	7.125 s	6.703 s	
awgn	630	5.609 s	0.734 s	
pinv	2520	0.984 s	0.984 s	
fliplr	56704	0.938 s	0.938 s	

Figure 13.2(b) Profile Summary Generated on 16-Jun-2007 06:45:16

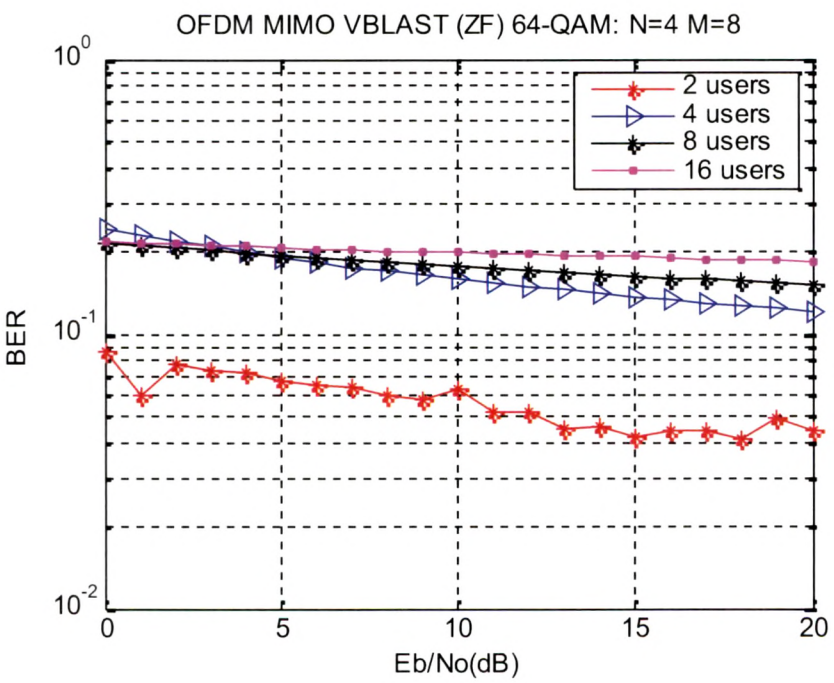


Figure 13.3(a) BER for OFDM_MIMO_V-BLAST (ZF) _64QAM

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
modu_64	3150	258.469 s	1.297 s	
dmodce	3150	257.172 s	244.266 s	
demodu_64	2520	114.313 s	5.141 s	
awgn	630	5.875 s	0.578 s	
fliplr	113404	1.875 s	1.875 s	
pinv	2520	1.094 s	1.094 s	

Figure 13.3(b) Profile Summary Generated 16-Jun-2007 07:20:36

13.3.1.2 Using Minimum Mean Square Error

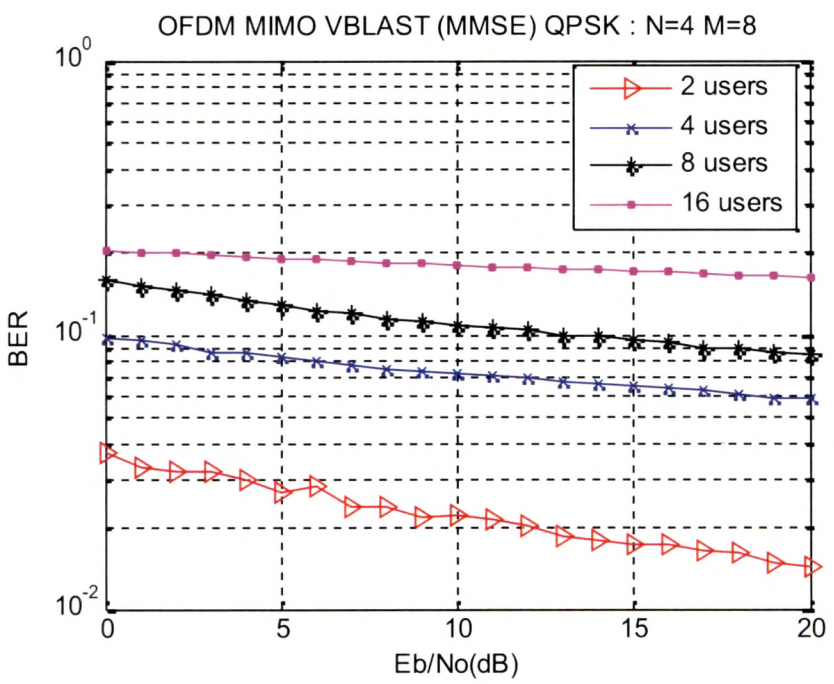


Figure 13.4(a) BER for OFDM_MIMO_V-BLAST (MMSE) _QPSK

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
modu_qpsk	3150	332.859 s	1.422 s	
demodu_qpsk	2520	24.063 s	8.953 s	
ddemodce	2520	15.109 s	1.781 s	
awgn	630	10.688 s	1.266 s	
ademodce	2520	5.813 s	5.813 s	
demodmap	2520	5.531 s	5.531 s	
pinv	2520	0.859 s	0.859 s	

Figure 13.4(b) Profile Summary Generated 16-Jun-2007

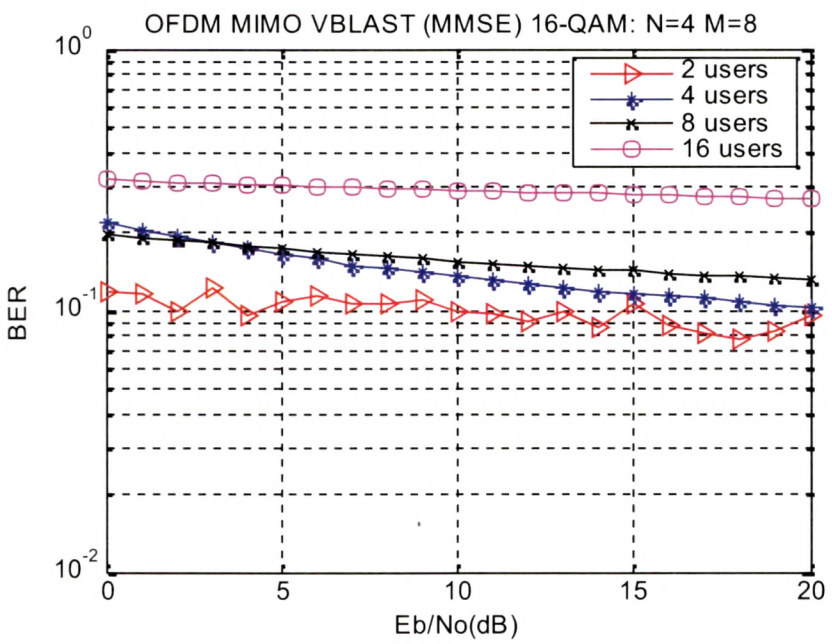


Figure 13.5(a) BER for OFDM_MIMO_V-BLAST (MMSE) _16QAM

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
modu_16	1280	94.031 s	0.469 s	
demodu_16	1024	10.953 s	1.391 s	
qaskenco>QASKConstlation	2304	5.188 s	0.297 s	
awgn	256	1.984 s	0.234 s	
wgn	256	1.750 s	1.750 s	
pinv	1024	0.438 s	0.438 s	
fliplr	23041	0.422 s	0.422 s	
mean	1025	0.125 s	0.125 s	
flipud	4609	0.031 s	0.031 s	

Figure 13.5(b) Profile Summary Generated 15-May-2007 05:08:13

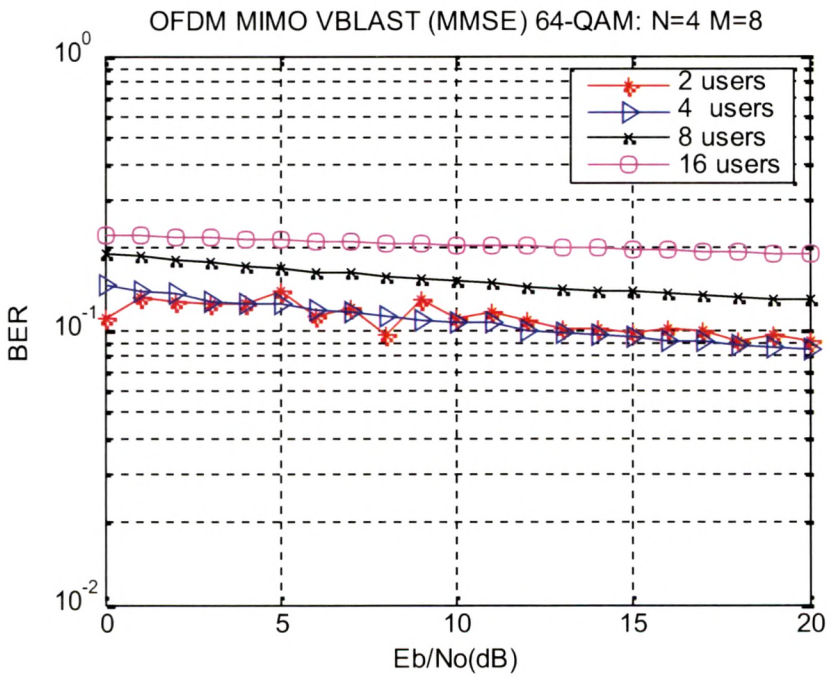


Figure 13.6(a) BER for OFDM_MIMO_V-BLAST_64QAM

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
modu_64	3150	309.953 s	1.422 s	
demodu_64	2520	125.641 s	5.422 s	
awgn	630	10.234 s	1.328 s	
ademodce	2520	4.313 s	4.313 s	
fliplr	113404	2.719 s	2.719 s	
randint	630	1.688 s	1.688 s	
legend	4	1.141 s	0.063 s	
pinv	2520	1.125 s	1.125 s	
flipud	22684	0.453 s	0.453 s	

Figure 13.6(b) Profile Summary Generated on 22-Jun-2007

13.3.2 Plots for CDMA MIMO V-BLAST Using Walsh Code

13.3.2.1 Using Zero Forcing Cancellation

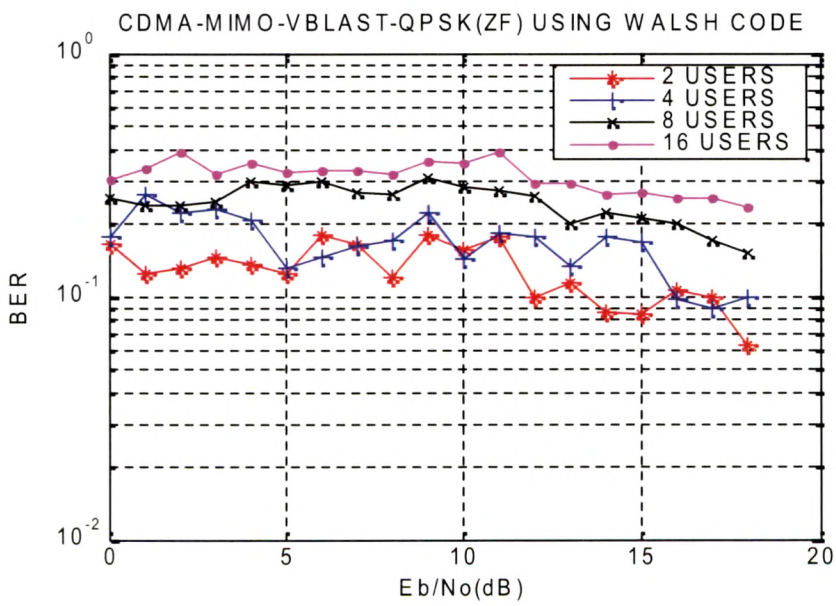


Figure 13.7(a) BER for CDMA_MIMO_V-BLAST (ZF) _QPSK_WALSHCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	1216	5.578 s	0.078 s	
genqamdemod	1216	5.422 s	5.422 s	
pskmod	2736	0.563 s	0.563 s	
awgn	304	0.469 s	0.172 s	
wgn	304	0.297 s	0.297 s	
pinv	1216	0.203 s	0.203 s	
randsrc	1	0.016 s	0.016 s	

Figure 13.7(b) Profile Summary Generated 16-Jun-2007 22:10:27

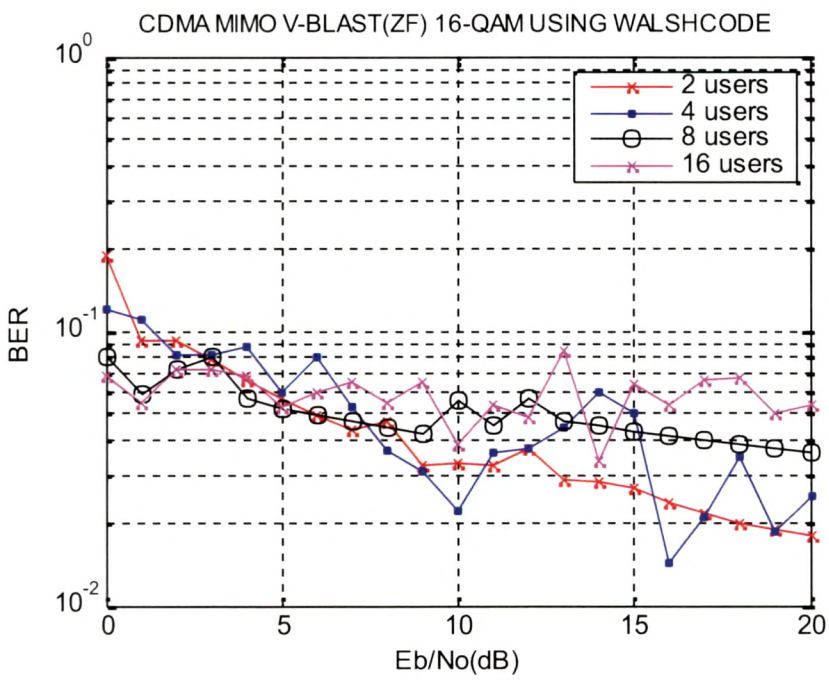


Figure 13.8(a) BER for CDMA_MIMO_V-BLAST (ZF) _16QAM_WALSHCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_16	3150	10.703 s	6.000 s	
qamdemodulation_16	2520	10.219 s	2.828 s	
qamdemod	2520	6.297 s	0.234 s	
qammod	3150	4.000 s	0.281 s	
genqamdemod	2520	3.531 s	3.531 s	
de2bi	2520	1.094 s	1.094 s	
pinv	2520	0.719 s	0.719 s	
bi2de	3150	0.703 s	0.703 s	
awgn	630	0.609 s	0.297 s	

Figure 13.8(b) Profile Summary Generated 17-Jun-2007 06:32:12

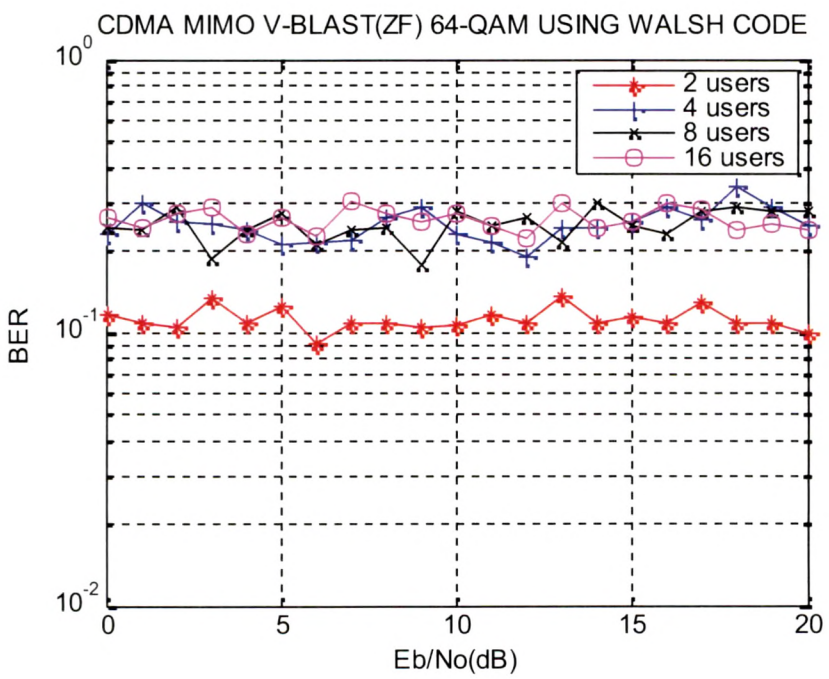


Figure 13.9(a) BER for CDMA_MIMO_V-BLAST (ZF) _ 64QAM_WALSHCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_64	1520	21.813 s	13.828 s	
qamdemodulation_64	1216	13.719 s	5.094 s	
comm\private\squareqamconst	2736	13.078 s	12.656 s	
qamdemod	1216	7.953 s	0.016 s	
qammod	1520	7.422 s	0.141 s	
genqamdemod	1216	2.063 s	2.063 s	
de2bi	1216	0.672 s	0.672 s	
bi2de	1520	0.563 s	0.563 s	

Figure 13.9(b) Profile Summary Generated 17-Jun-2007 10:15:07

13.3.2.2 Using MMSE Cancellation

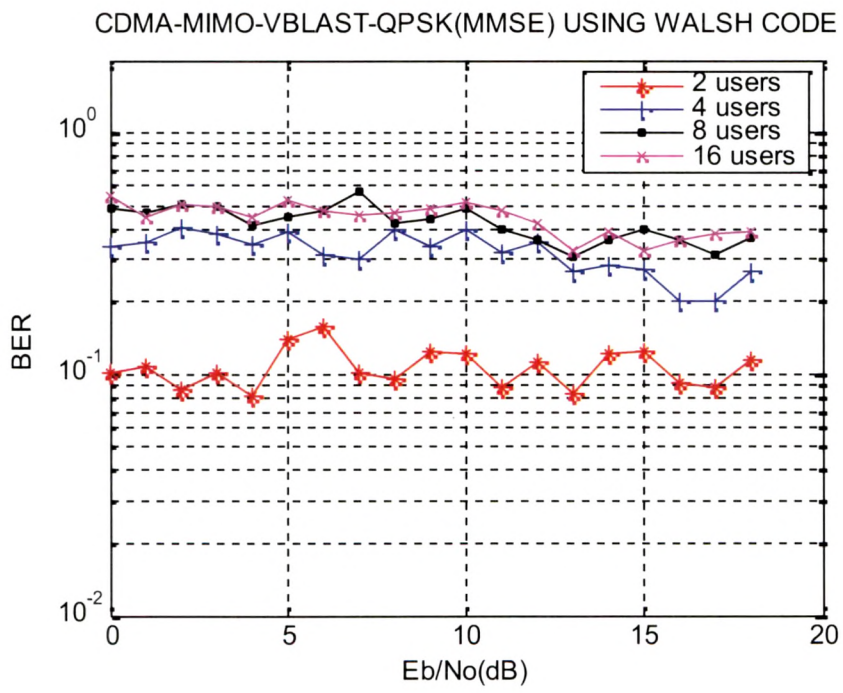


Figure 13.10(a) BER for CDMA_MIMO_V-BLAST (MMSE) _QPSK_WALSHCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	1216	4.719 s	0.078 s	
genqamdemod	1216	4.516 s	4.516 s	
awgn	304	0.609 s	0.156 s	
pskmod	2736	0.484 s	0.484 s	
wgn	304	0.453 s	0.453 s	

Figure 13.10(b) Profile Summary Generated 03-Jun-2007 02:09:25

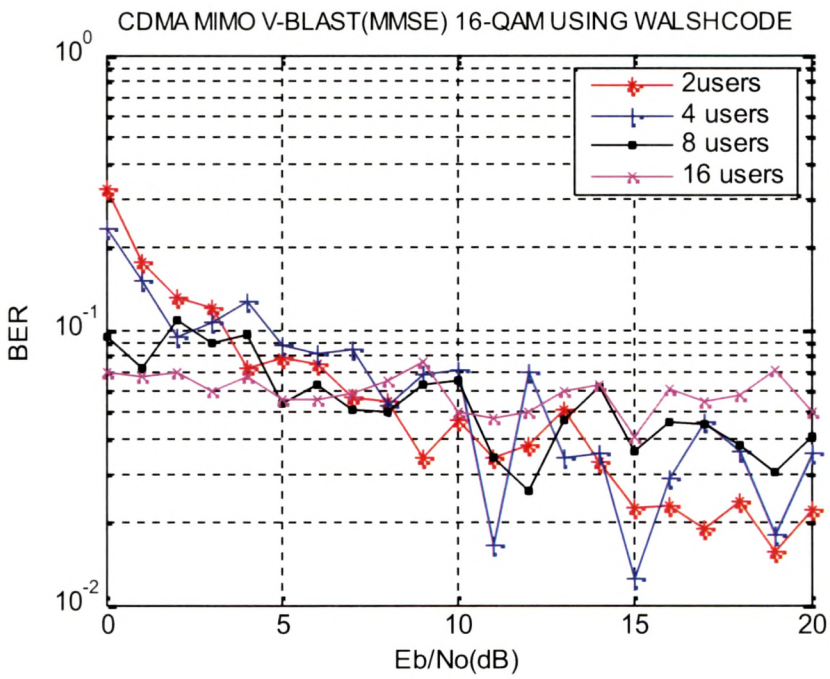


Figure 13.11(a) BER for CDMA_MIMO_V-BLAST (MMSE) _16QAM_WALSHCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_16	3150	13.000 s	7.172 s	
qamdemodulation_16	2520	12.797 s	3.781 s	
bi2de	3150	1.500 s	1.500 s	
de2bi	2520	1.094 s	1.094 s	
awgn	630	0.750 s	0.234 s	
pinv	2520	0.609 s	0.609 s	

Figure 13.11(b) Profile Summary Generated on 17-Jun-2007 08:39:10

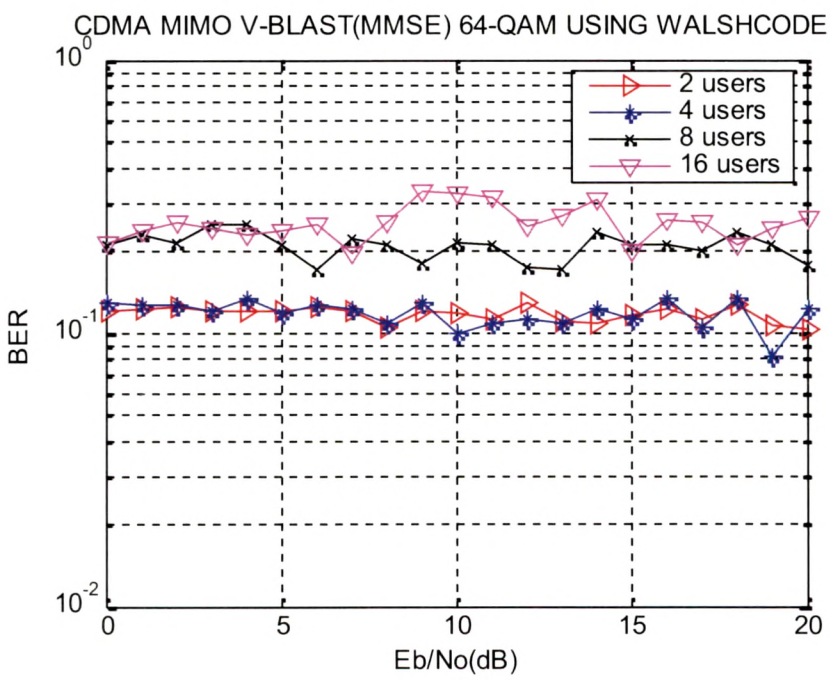


Figure 13.12(a) BER for CDMA_MIMO_V-BLAST (MMSE) _64QAM_WALSHCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_64	1520	26.516 s	17.000 s	
qamdemodulation_64	1216	16.063 s	5.969 s	
comm\private\squareqamconst	2736	15.406 s	14.750 s	
pinv	1216	0.375 s	0.375 s	
scribe.legend (Opaque-function)	82	0.344 s	function is recursive	
awgn	304	0.328 s	0.109 s	

Figure 13.12(b) Profile Summary Generated on 23-Jun-2007 20:34:35

13.3.3 Plots for CDMA MIMO V-BLAST Using Gold Code

13.3.3.1 Using Zero Forcing Cancellation

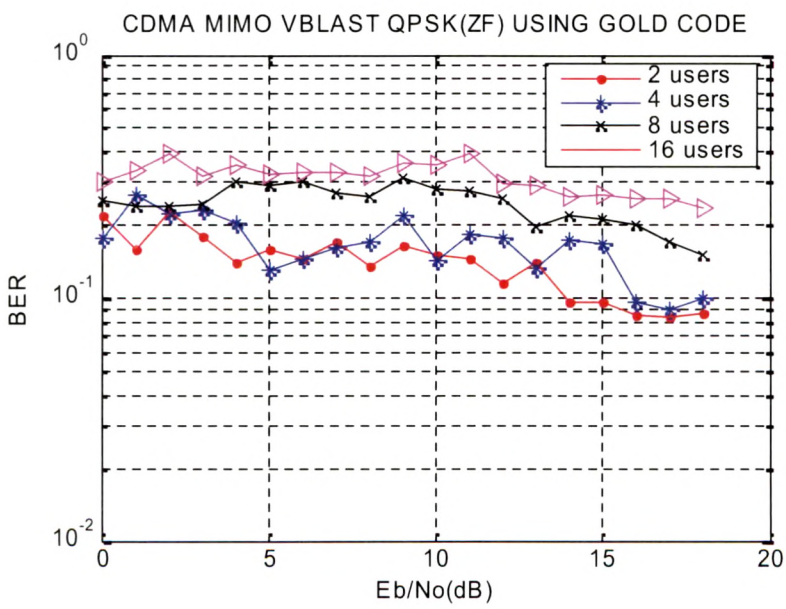


Figure 13.13(a) BER for CDMA_MIMO_V-BLAST (ZF) _QPSK_GOLDCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	1216	10.594 s	0.172 s	
genqamdemod	1216	10.359 s	10.359 s	
pskmod	2736	0.859 s	0.859 s	
awgn	304	0.828 s	0.125 s	
wgn	304	0.703 s	0.703 s	
pinv	1216	0.297 s	0.297 s	

Figure 13.13(b) Profile Summary generated on 17 Jun-2007 22:06:5

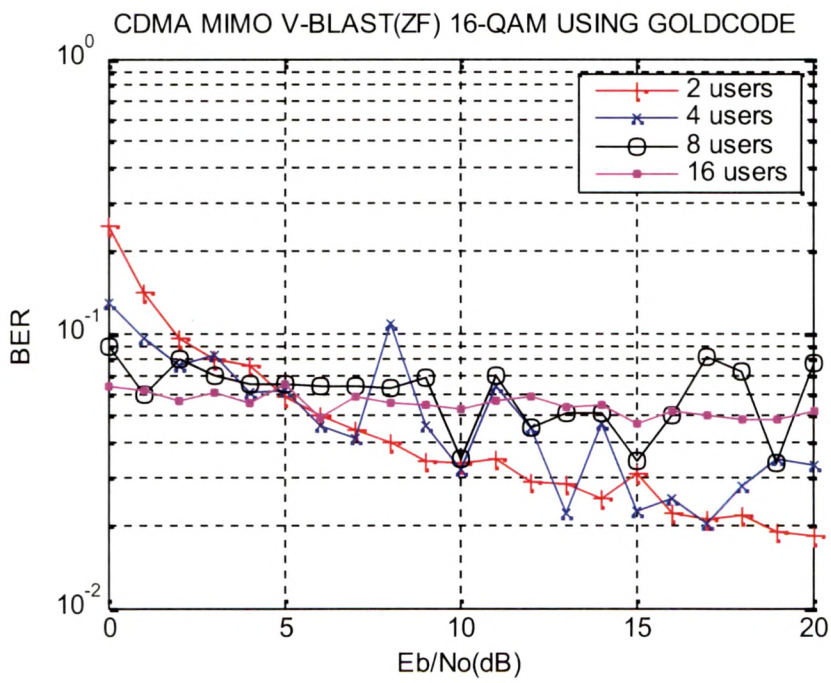


Figure 13.14(a) BER for CDMA_MIMO_V-BLAST (ZF) _16QAM_GOLD CODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_16	3150	13.578 s	7.719 s	
qamdemodulation_16	2520	13.125 s	4.359 s	
qammod	3150	4.531 s	0.219 s	
genqamdemod	2520	4.156 s	4.156 s	
bi2de	3150	1.328 s	1.328 s	
de2bi	2520	1.250 s	1.250 s	
awgn	630	0.703 s	0.172 s	

Figure 13.14(b) Profile Summary

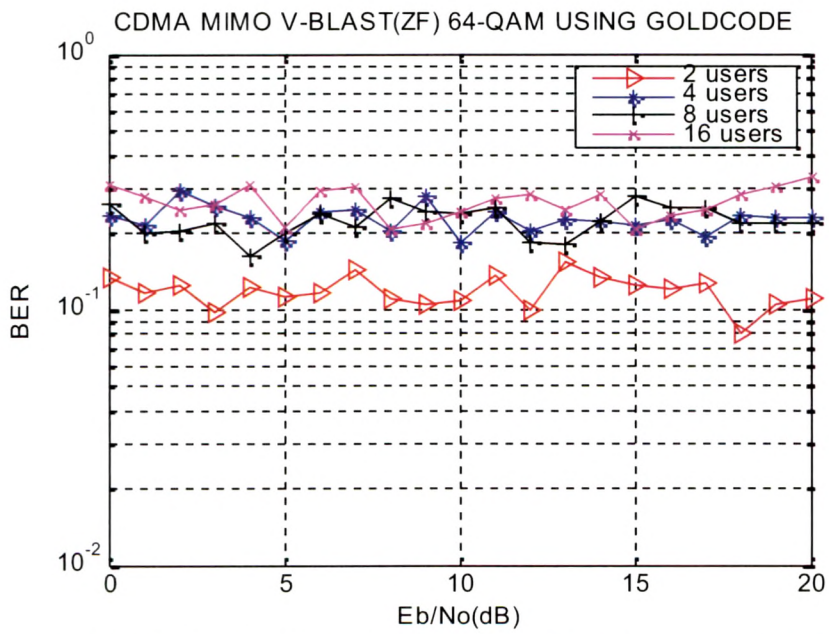


Figure 13.15(a) BER for CDMA_MIMO_V-BLAST (ZF) _16QAM_GOLDCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_64	1680	24.203 s	15.531 s	
qamdemodulation_64	1344	15.766 s	5.781 s	
comm\private\squareqamconst	3024	14.109 s	13.688 s	
qamdemod	1344	9.266 s	0.047 s	
qammod	1680	7.953 s	0.203 s	
genqamdemod	1344	2.781 s	2.781 s	

Figure 13.15(b) Profile Summary Generated on 17-Jun-2007 10:11:01

13.3.3.2 Using MMSE Cancellation

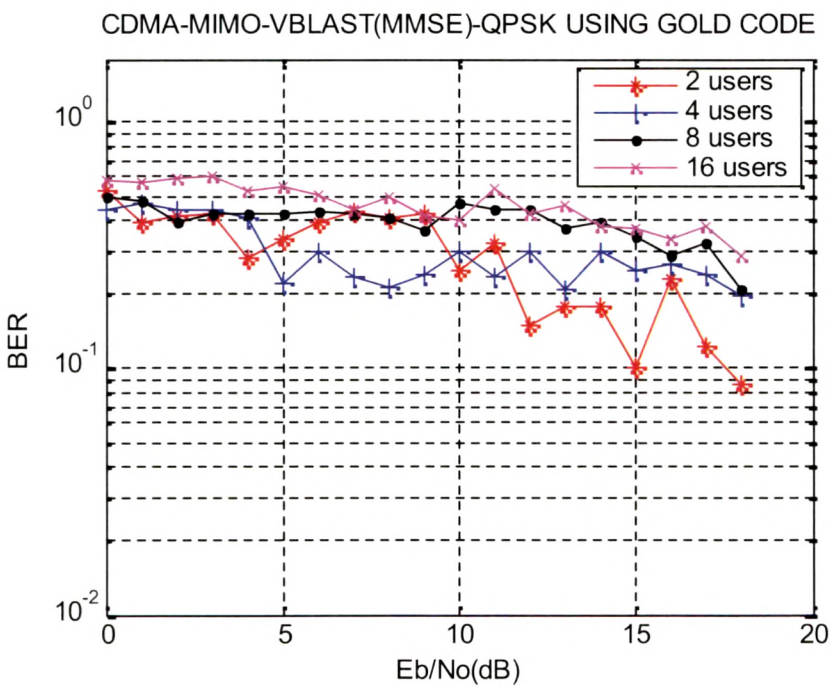


Figure 13.16(a) BER for CDMA_MIMO_V-BLAST (MMSE) _16QAM_GOLDCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	1216	8.891 s	0.063 s	
genqamdemod	1216	8.734 s	8.734 s	
pskmod	2736	0.797 s	0.797 s	
awgn	304	0.641 s	0.109 s	
gold_code	1	0.406 s	0.359 s	
m_seq	1	0.047 s	0.016 s	
rshift	31	0 s	0.000 s	

Figure 13.16(b) Profile Summary Generated on 03-Jun-2007 02:22:58

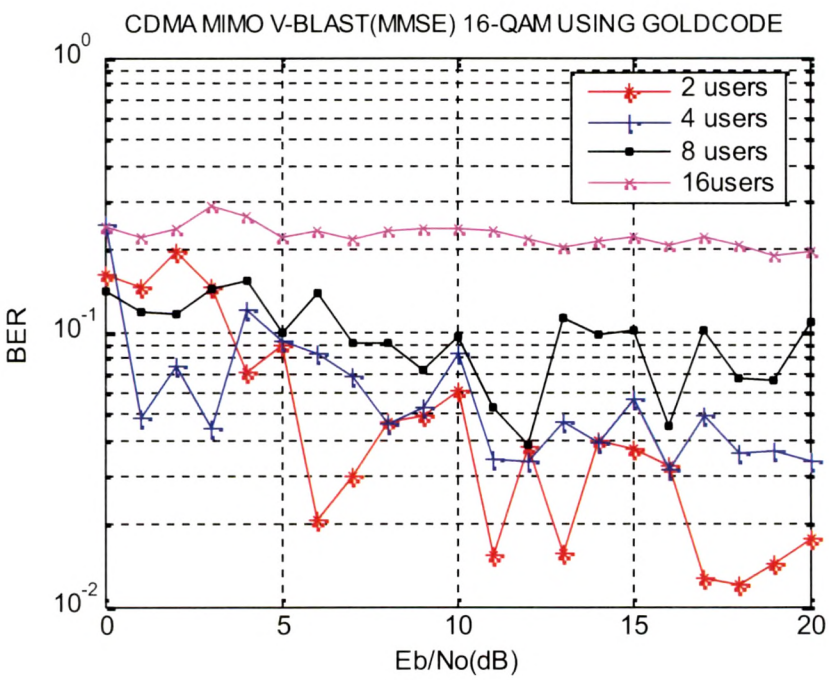


Figure 13.17(a) BER for CDMA_MIMO_V-BLAST (MMSE) _16QAM_GOLDCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qamdemodulation_16	2520	12.609 s	3.906 s	
qammodulation_16	3150	12.594 s	7.625 s	
qammod	3150	3.953 s	0.266 s	
de2bi	2520	1.109 s	1.109 s	
bi2de	3150	1.016 s	1.016 s	
pinv	2520	0.813 s	0.813 s	
legend	4	0.750 s	0.031 s	
awgn	630	0.734 s	0.141 s	

Figure 13.17(b) Profile Summary Generated on 17-Jun-2007 08:27:11

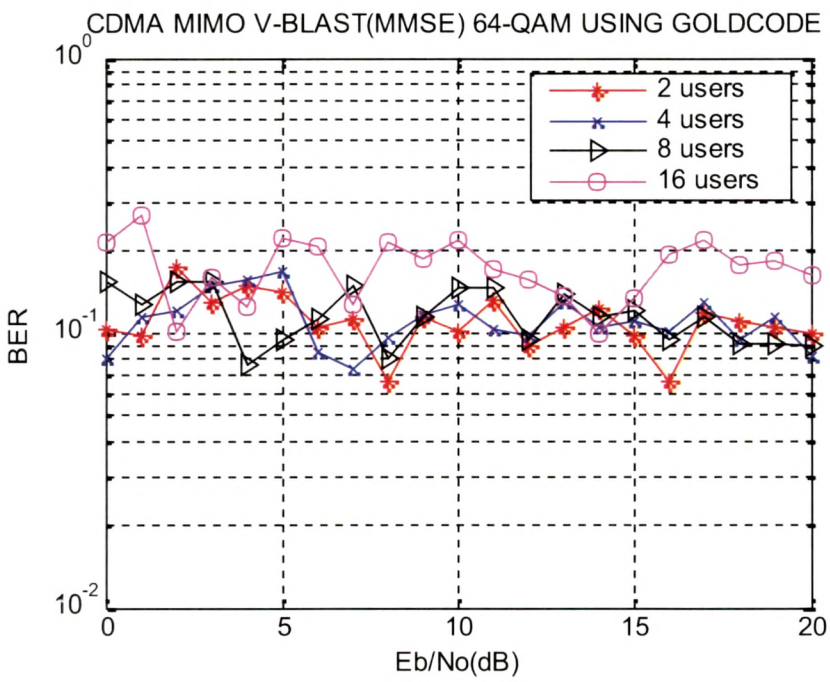


Figure 13.18(a) BER for CDMA_MIMO_V-BLAST (MMSE) _64QAM_GOLDCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_64	3150	52.797 s	33.172 s	
qamdemodulation_64	2520	32.828 s	12.188 s	
comm\private\squareqamconst	5670	30.438 s	29.313 s	
pinv	2520	0.797 s	0.797 s	
awgn	630	0.766 s	0.266 s	
wgn	630	0.500 s	0.500 s	
gold_code	1	0.078 s	0.016 s	
m_seq	1	0.063 s	0.047 s	

Figure 13.18(b) Profile Summary generated on 23-Jun-2007 20:47:31

13.3.4 Plots for CDMA MIMO V-BLAST Using PN Code

13.3.4.1 Using Zero Forcing Cancellation

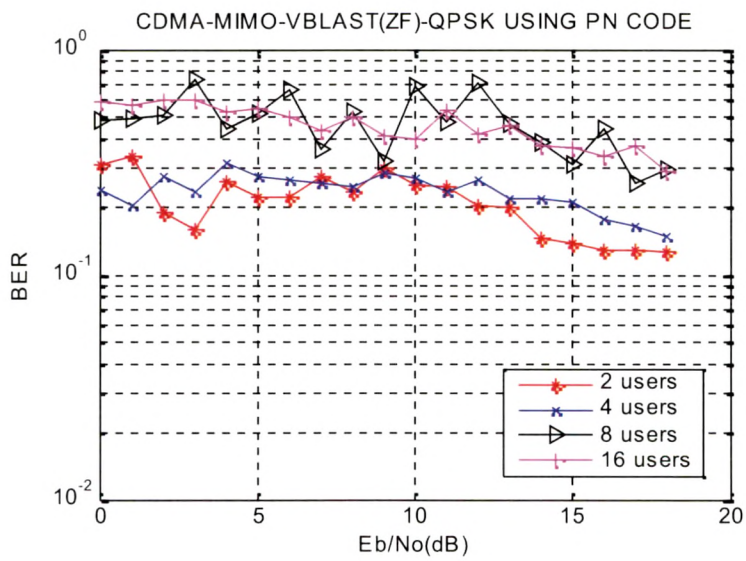


Figure 13.19(a) BER for CDMA_MIMO_V-BLAST (ZF) _QPSK_PNCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	1216	0.906 s	0.047 s	
genqamdemod	1216	0.766 s	0.766 s	
awgn	304	0.516 s	0.094 s	
wgn	304	0.422 s	0.422 s	
pinv	1216	0.219 s	0.219 s	
pskmod	2736	0.219 s	0.219 s	

Figure 13.19(b) Profile Summary Generated on 16-Jun-2007 22:23:18

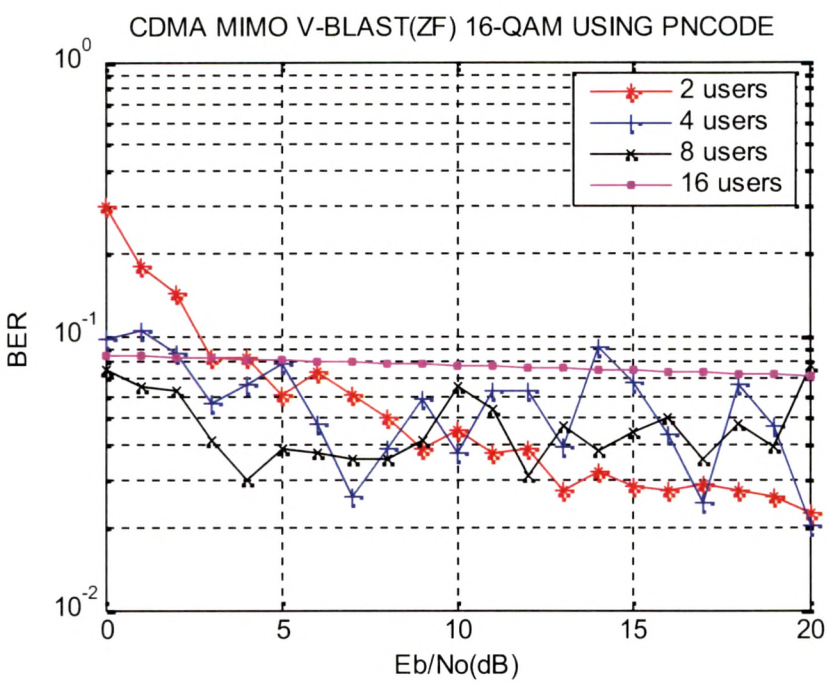


Figure 13.20(a) BER for CDMA_MIMO_V-BLAST (ZF) _16QAM_PNCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_16	3150	11.766 s	6.672 s	
qamdemodulation_16	2520	10.813 s	3.453 s	
qamdemod	2520	6.500 s	0.156 s	
comm\private\squareqamconst	5670	5.891 s	5.500 s	
genqamdemod	2520	3.828 s	3.828 s	
qammod	3150	3.828 s	0.359 s	
awgn	630	0.672 s	0.172 s	
pinv	2520	0.422 s	0.422 s	

Figure 13.20(b) Profile Summary Generated on 27-Jun-2007 09:05:37

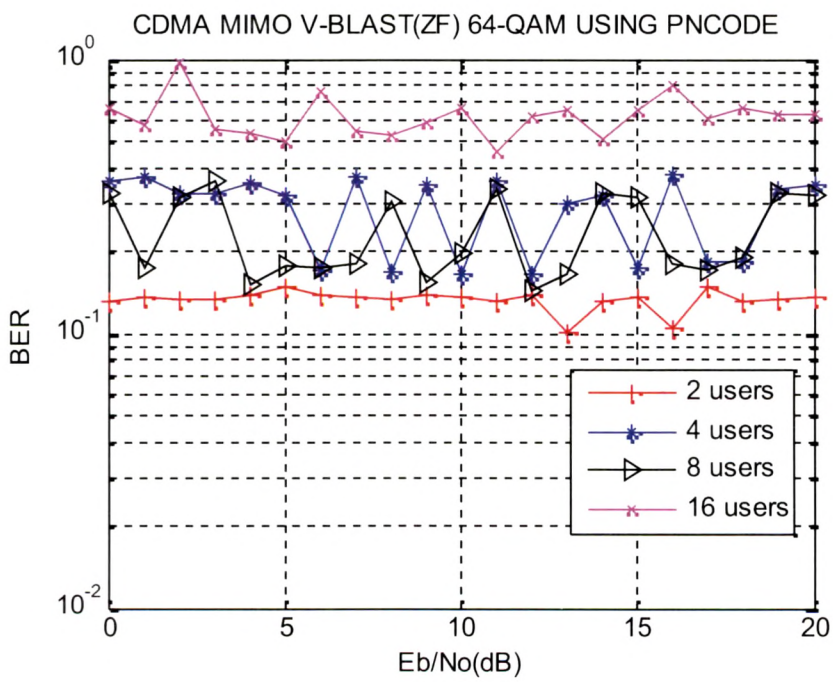


Figure 13.21(a) BER for CDMA_MIMO_V-BLAST (ZF) _64QAM_PNCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_64	2870	43.078 s	27.328 s	
qamdemodulation_64	2296	29.828 s	11.625 s	
comm\private\squareqamconst	5166	25.234 s	24.547 s	
qamdemod	2296	16.891 s	0.125 s	
comm\private\idealQAMConst	5166	0.688 s	0.688 s	
awgn	574	0.672 s	0.141 s	

Figure 13.21(b) Profile Summary Generated on 26-Jun-2007 07:43:07

13.3.4.2 Using MMSE Cancellation

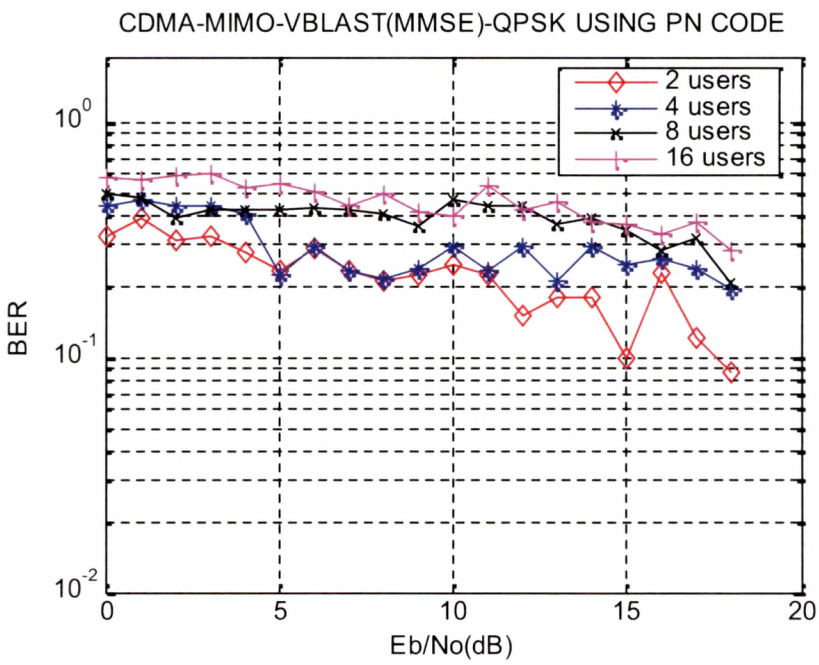


Figure 13.22(a) BER for CDMA_MIMO_V-BLAST (MMSE) _QPSK_PNCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	1216	8.688 s	0.141 s	
genqamdemod	1216	8.438 s	8.438 s	
pskmod	2736	0.672 s	0.672 s	
awgn	304	0.594 s	0.141 s	
wgn	304	0.453 s	0.453 s	
pinv	1216	0.203 s	0.203 s	
oct2gen	1	0.031 s	0.031 s	
m_seq	1	0.031 s	0.000 s	

Figure 13.22(b) Profile Summary Generated 26-Jun-2007 06:22:43

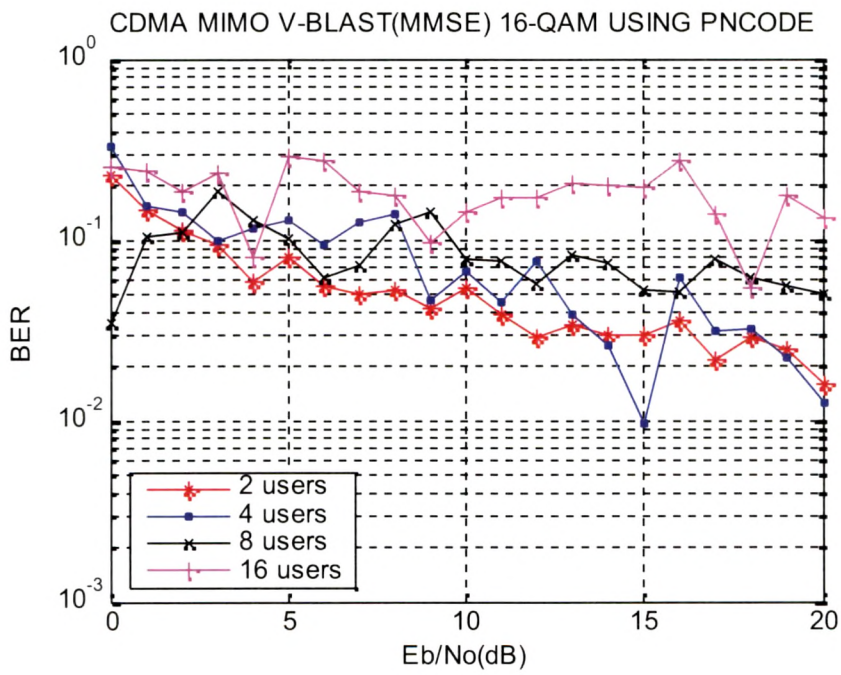


Figure 13.23(a) BER for CDMA_MIMO_V-BLAST (MMSE) _16QAM_PNCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_16	3150	13.578 s	7.719 s	
qamdemodulation_16	2520	13.125 s	4.359 s	
qamdemod	2520	7.516 s	0.203 s	
comm\private\squareqamconst	5670	7.172 s	6.594 s	
qammod	3150	4.531 s	0.219 s	
awgn	630	0.703 s	0.172 s	
comm\private\idealQAMConst	5670	0.578 s	0.578 s	
scribe.legend.legend	4	0.547 s	function is recursive	
pinv	2520	0.547 s	0.547 s	
wgn	630	0.531 s	0.531 s	

Figure 13.23(b) Profile Summary Generated 26-Jun-2007 06:22:43

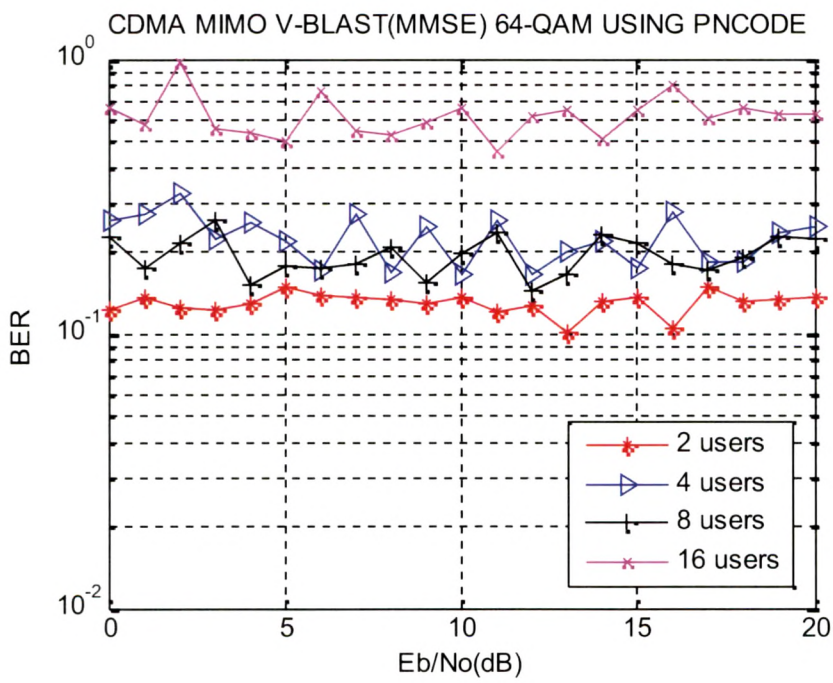


Figure 13.24(a) BER for CDMA_MIMO_V-BLAST (MMSE) _64QAM_PNCODE

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qammodulation_64	3150	44.875 s	28.594 s	
qamdemodulation_64	2520	29.688 s	10.969 s	
comm\private\squareqamconst	5670	25.797 s	24.875 s	
comm\private\idealQAMConst	5670	0.922 s	0.922 s	
pinv	2520	0.734 s	0.734 s	
awgn	630	0.734 s	0.219 s	
wgn	630	0.516 s	0.516 s	

Figure 13.24(b) Profile Summary Generated 23-Jun-2007 20:55:34

13.4 SIMULATION RESULTS FOR GENETIC ALGORITHM

13.4.1 Plots for QPSK

13.4.1.1 AWGN Channel

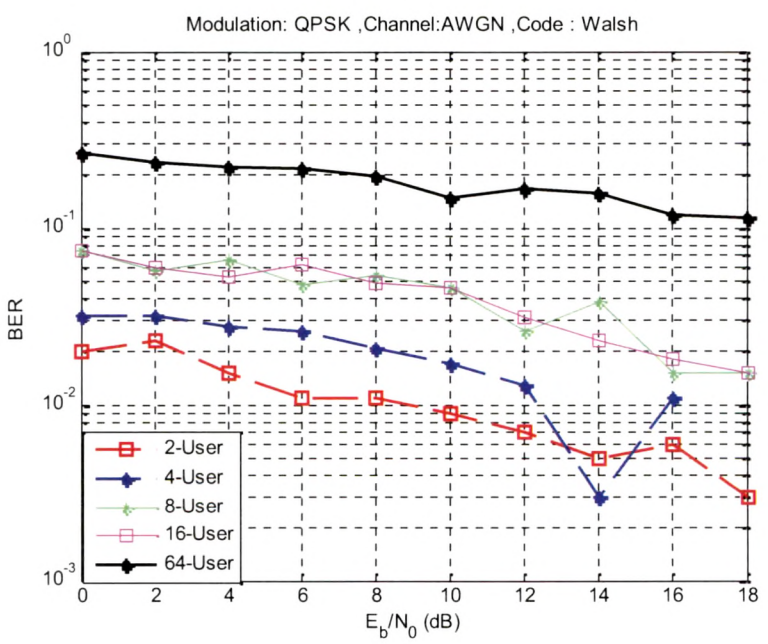


Figure 13.25(a): BER for Walsh Code AWGN : QPSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	0.328 s	0.094 s	
wgn	320	0.234 s	0.234 s	
dfilt.dtffir.quantizecoeffs	60	0.031 s	0.031 s	
gcf	1	0.016 s	0.016 s	
dfilt.dffir.thissetstates	36	0.016 s	0.016 s	
sigdatatypes.schema>check_vector	28	0.016 s	0.016 s	
isfield	1	0 s	0.000 s	

Figure 13.25(b): Profile Summary Generated 23-May-2007 09:42:29

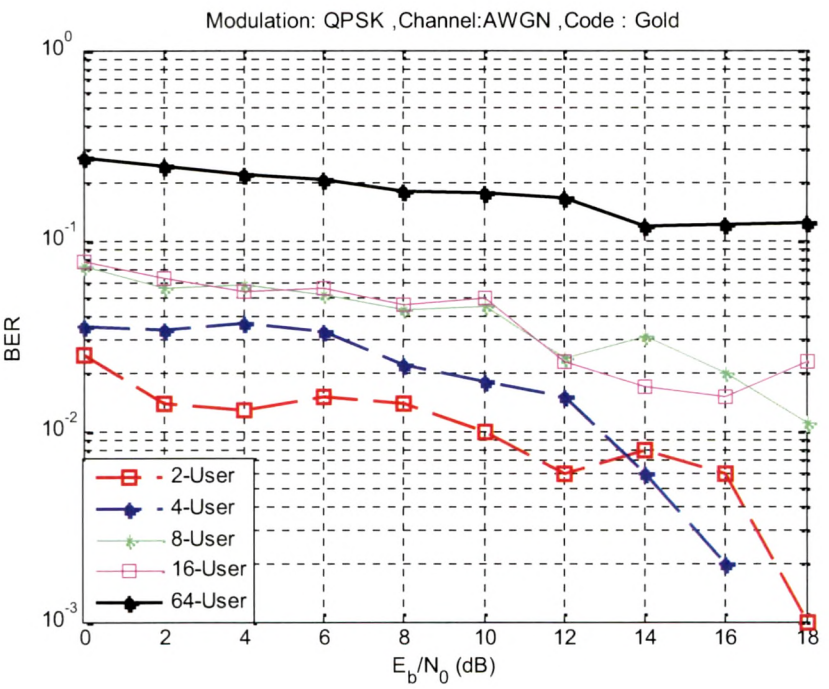
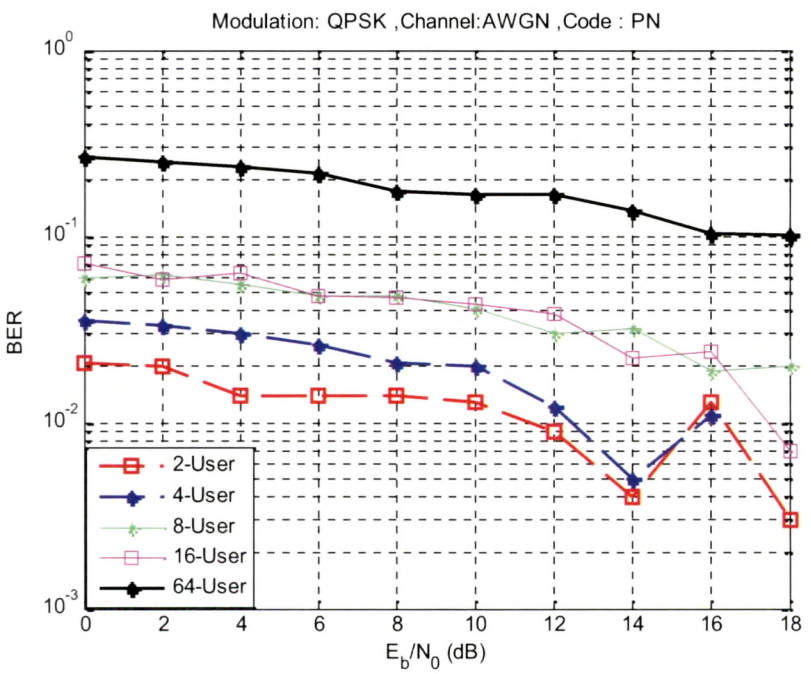


Figure 13.26(a): BER for Gold Code AWGN : QPSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	0.391 s	0.031 s	
wgn	320	0.359 s	0.359 s	
grid	1	0.016 s	0.000 s	
dfilt.dffir.secfilter	16	0.016 s	0.016 s	
shiftdim	32	0.016 s	0.016 s	
shiftdata	16	0.016 s	0.000 s	
dfilt.basefilter.schema>setrate	28	0.016 s	0.016 s	

Figure 13.26(b): Profile Summary Generated 23-May-2007 09:40:48



. Figure 13.27(a): BER for PN Code AWGN : QPSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	0.406 s	0.047 s	
wgn	320	0.359 s	0.359 s	
grid	1	0.031 s	0.016 s	
dfilt.schema>checkCoefficientVector	80	0.031 s	0.016 s	
dfilt.dtffir.quantizecoeffs	60	0.031 s	0.016 s	
timezparse	4	0.016 s	0.016 s	
signalpolyutils>isfir	16	0.016 s	0.016 s	

Figure 13.27(b): Profile Summary Generated 23-May-2007 09:44:06

13.4.1.2 Rayleigh Fading Channel

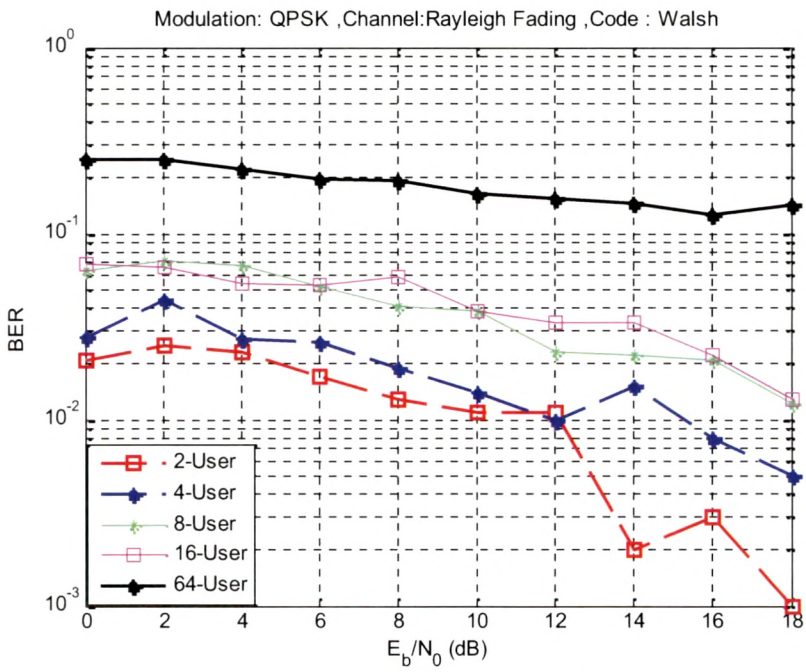


Figure 13.28(a): BER for Walsh Code Rayleigh : QPSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	49.672 s	function is recursive	
channel.multipath.filter	320	48.047 s	function is recursive	
channel.multipath.filterblock	680	45.984 s	0.578 s	
channel.channelfilter.filter	680	40.859 s	40.813 s	
channel.interpfilter.filter	680	4.313 s	0.016 s	
...l.interpfilter.filter>polyphaseFilter	680	4.297 s	3.391 s	
rayleighchan	40	1.594 s	0.016 s	

Figure 13.28(b): Profile Summary Generated 23-May-2007 09:50:16

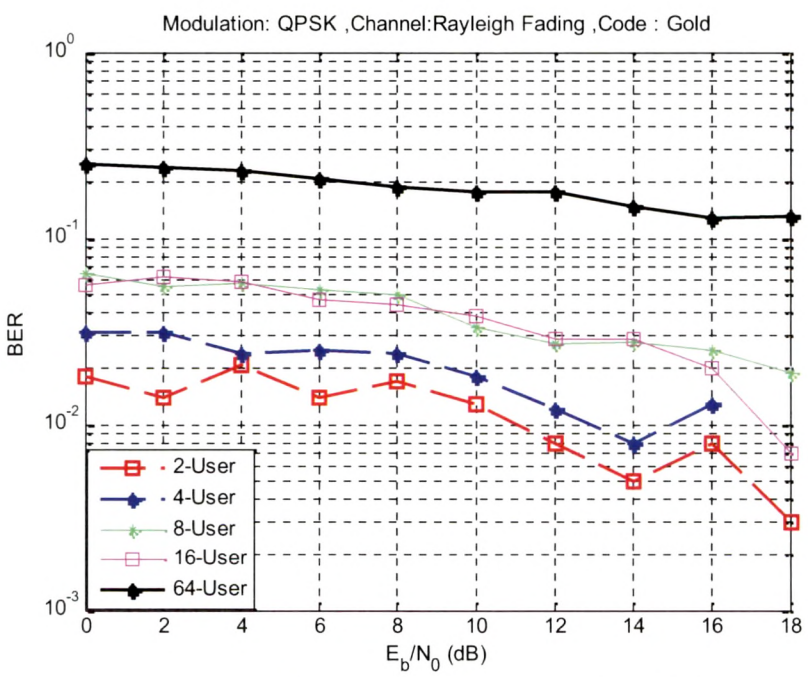


Figure 13.29(a): BER for Gold Code Rayleigh : QPSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	45.219 s	Function is recursive	
channel.multipath.filter	320	43.828 s	Function is recursive	
channel.multipath.filterblock	680	41.953 s	0.469 s	
channel.channelfilter.filter	680	37.547 s	37.438 s	
channel.interpfilter.filter	680	3.688 s	0.078 s	
...l.interpfilter.filter>polyphaseFilter	680	3.594 s	2.797 s	
channel.dopplerfilter.generateoutput	680	1.031 s	0.141 s	
...el.multipath.filter>ComputeStatistics	320	0.703 s	0.203 s	

Figure 13.29(b): Profile Summary Generated 23-May-2007 09:54:41

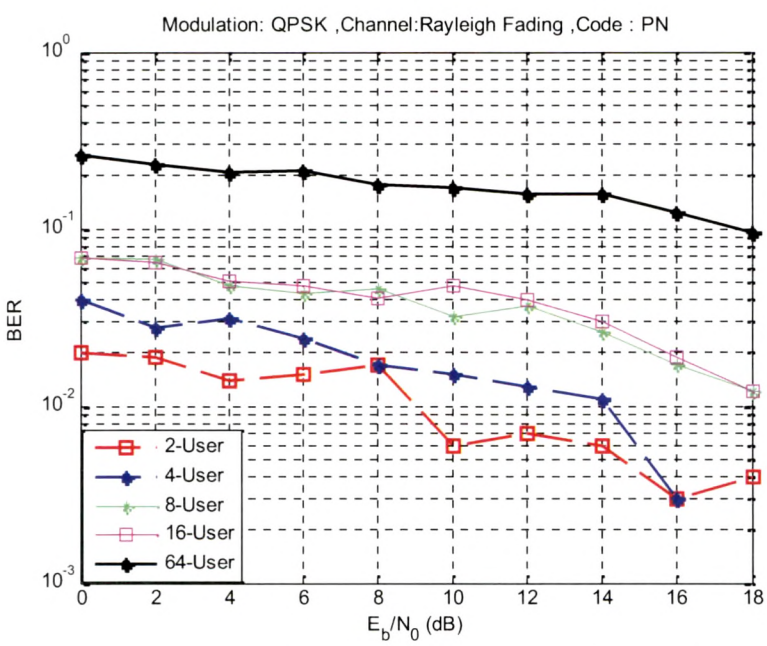


Figure 13.30(a): BER for PN Code Rayleigh : QPSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	51.734 s	function is recursive	
channel.multipath.filter	320	49.922 s	function is recursive	
channel.multipath.filterblock	680	47.500 s	0.484 s	
channel.channelfilter.filter	680	42.047 s	41.969 s	
channel.interpfilter.filter	680	4.578 s	0.078 s	
...l.interpfilter.filter>polyphaseFilter	680	4.438 s	3.391 s	
channel.dopplerfilter.generateoutput	680	1.438 s	0.297 s	
...el.multipath.filter>ComputeStatistics	320	1.125 s	0.203 s	

Figure 13.30(b): Profile Summary Generated 23-May-2007 09:47:01

13.4.2 Plots for 16-QAM

13.4.2.1 AWGN Channel

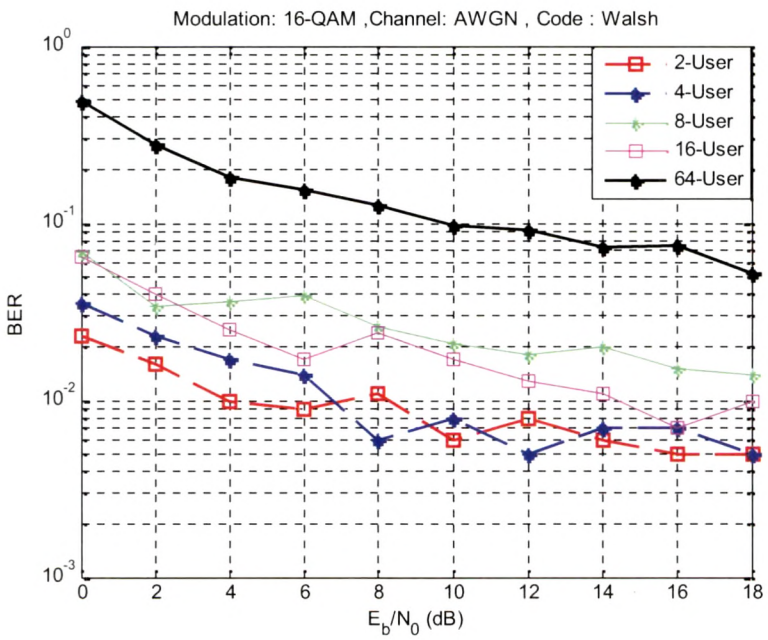


Figure 13.31(a): BER for Walsh Code AWGN : 16 QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	7.359 s	1.094 s	
wgn	320	6.266 s	6.266 s	
legend	1	0.844 s	0.016 s	
legend>make_legend	1	0.828 s	0.000 s	
newplot>ObserveAxesNextPlot	5	0.219 s	0.016 s	
graphics\private\clo	1	0.172 s	0.016 s	
gcf	19	0.063 s	0.063 s	

Figure 13.31(b): Profile Summary Generated 03-May-2007 14:57:53

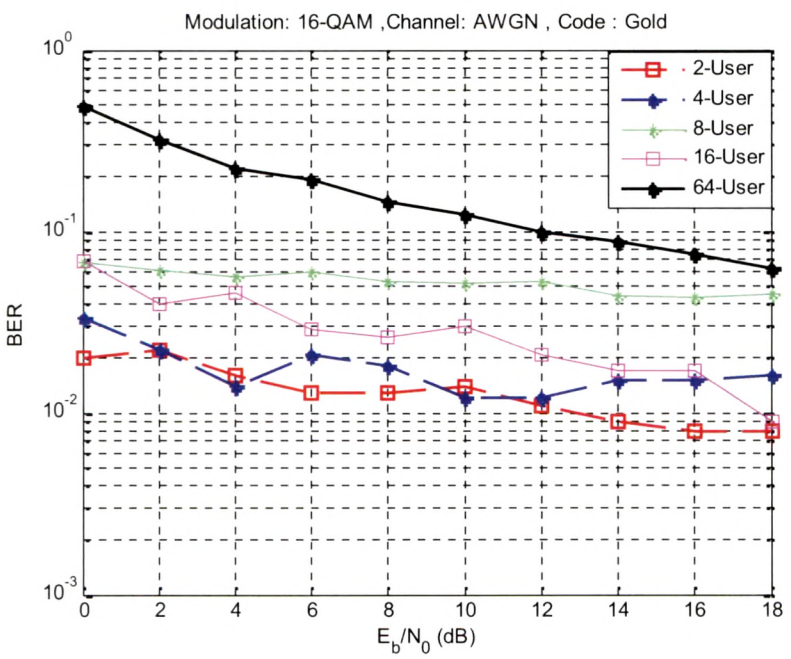


Figure 13.32(a): BER for Gold Code AWGN : 16 QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	6.859 s	1.031 s	
wgn	320	5.828 s	5.828 s	
legend	1	0.813 s	0.047 s	
legend>make_legend	1	0.766 s	0.016 s	
newplot	5	0.500 s	0.078 s	
newplot>ObserveAxesNextPlot	5	0.313 s	0.016 s	
graphics\private\clo	1	0.250 s	0.125 s	
setdiff	2	0.109 s	0.094 s	

Figure 13.32(b): Profile Summary Generated 03-May-2007 16:04:50

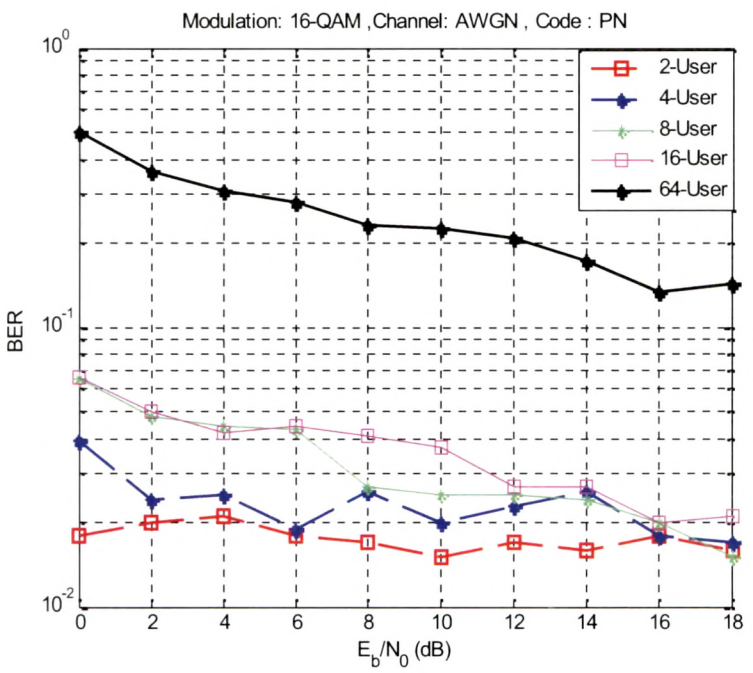


Figure 13.33(a): BER for PN Code AWGN : 16 QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	6.672 s	1.016 s	
wgn	320	5.656 s	5.656 s	
legend	1	0.328 s	0.016 s	
legend>make_legend	1	0.313 s	0.000 s	
newplot	5	0.109 s	0.000 s	
graphics\private\clo	1	0.094 s	0.016 s	
newplot>ObserveAxesNextPlot	5	0.094 s	0.000 s	

Figure 13.33(b): Profile Summary Generated 04-May-2007 12:05:19

13.4.2.2 Rayleigh Fading Channel

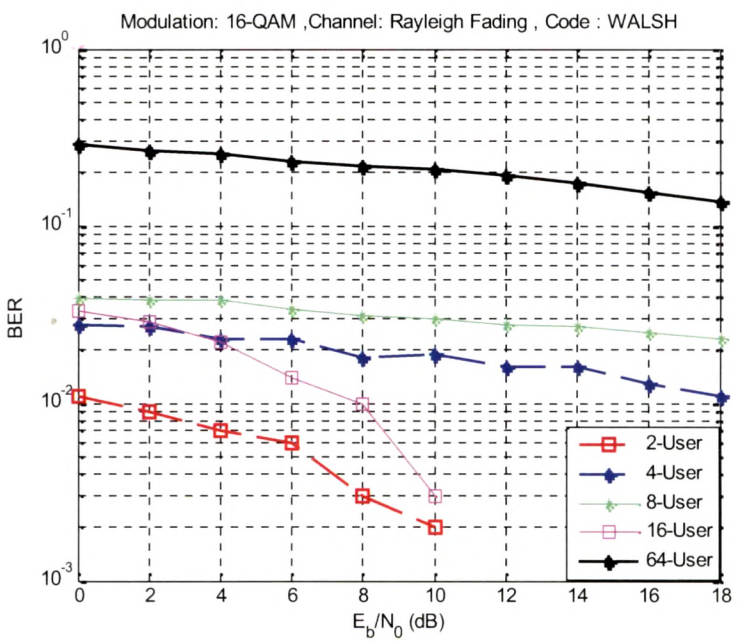


Figure 13.34(a): BER for Walsh Code Reyleigh : 16 QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	1099.016s	function is recursive	
channel.multipath.filter	320	1097.21 s	function is recursive	
channel.multipath.filterblock	680	1071.734 s	8.469 s	
channel.channelfilter.filter	680	975.484 s	975.359 s	
channel.interpfilter.filter	680	86.625 s	0.109 s	
...l.interpfilter.filter>polyphaseFilter	680	86.484 s	73.109 s	
...el.multipath.filter>ComputeStatistics	320	15.297 s	2.938 s	

Figure 13.34(b): Profile Summary Generated 11-May-2007 16:16:16

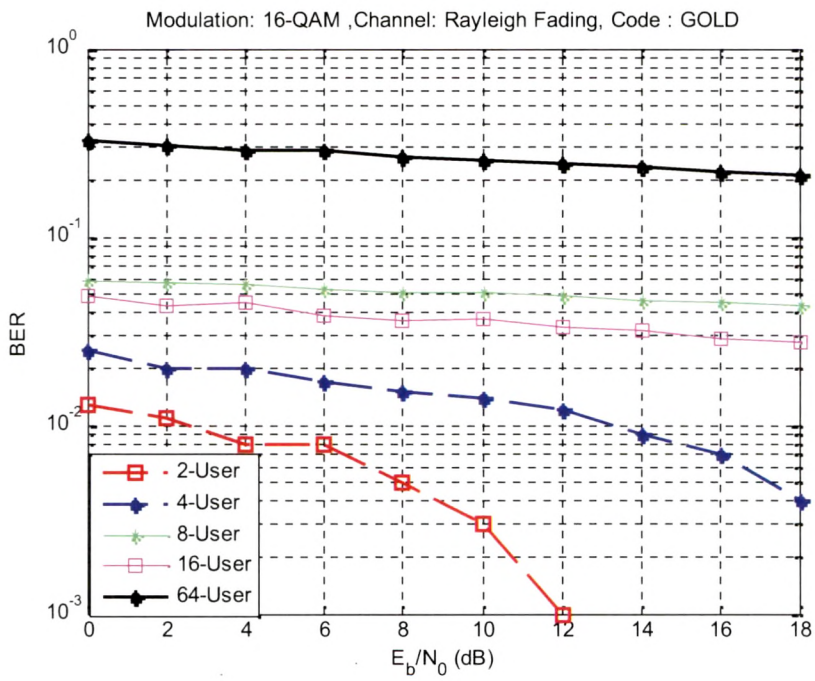


Figure 13.35(a): BER for Gold Code Reyleigh : 16 QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	1049.625 s	function is recursive	
channel.multipath.filter	320	1047.922s	function is recursive	
channel.multipath.filterblock	680	1024.75 s	7.734 s	
channel.channelfilter.filter	680	934.063 s	933.984 s	
channel.interpfilter.filter	680	81.703 s	0.078 s	
...l.interpfilter.filter>polyphaseFilter	680	81.609 s	69.844 s	
...el.multipath.filter>ComputeStatistics	320	13.516 s	2.453 s	

Figure 13.35(b): Profile Summary Generated 17-May-2007 15:45:40

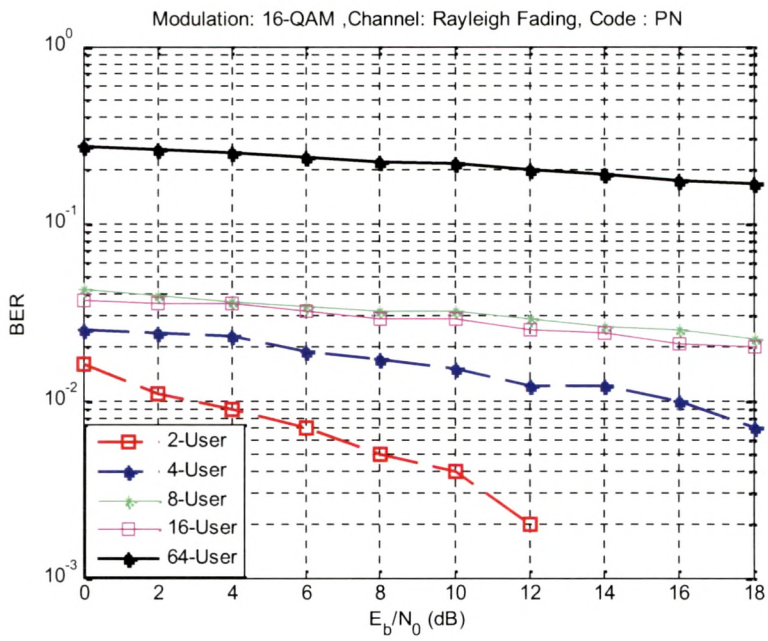


Figure 13.36(a): BER for PN Code Reyleigh : 16 QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	1063.172s	function is recursive	
channel.multipath.filter	320	1061.28 s	function is recursive	
channel.multipath.filterblock	680	1037.23 s	7.938 s	
channel.channelfilter.filter	680	945.547 s	945.516 s	
channel.interpfilter.filter	680	82.656 s	0.047 s	
...l.interpfilter.filter>polyphaseFilter	680	82.609 s	70.141 s	
...el.multipath.filter>ComputeStatistics	320	13.797 s	2.266 s	

Figure 13.36(b): Profile Summary Generated 17-May-2007 14:14:44

13.4.3 Plots for 64-QAM

13.4.3.1 AWGN Channel

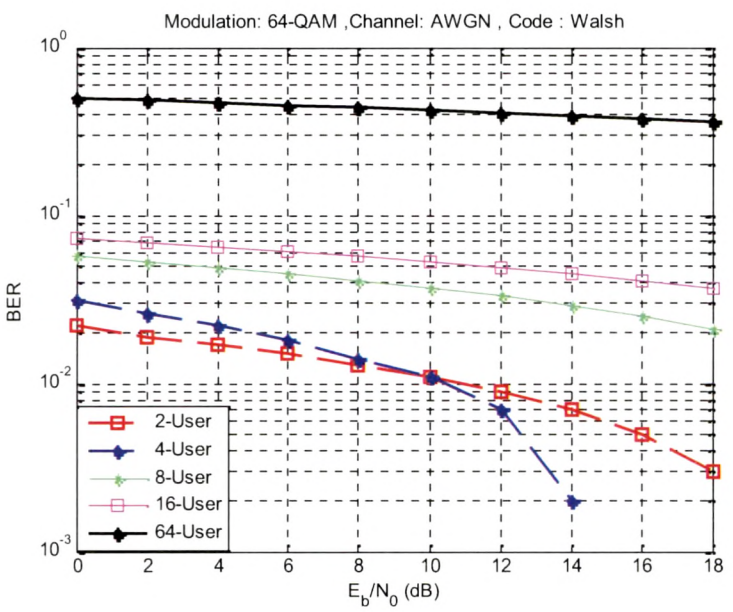


Figure 13.37(a): BER for Walsh Code AWGN : 64-QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	5.047 s	0.828 s	
wgn	320	4.219 s	4.219 s	
legend	1	1.172 s	0.063 s	
legend>make_legend	1	1.109 s	0.016 s	
scribe\private\islegendable	9	0.078 s	0.078 s	
findall	11	0.031 s	0.031 s	
newplot	8	0.031 s	0.016 s	

Figure 13.37(b): Profile Summary Generated 04-May-2007 12:46:54

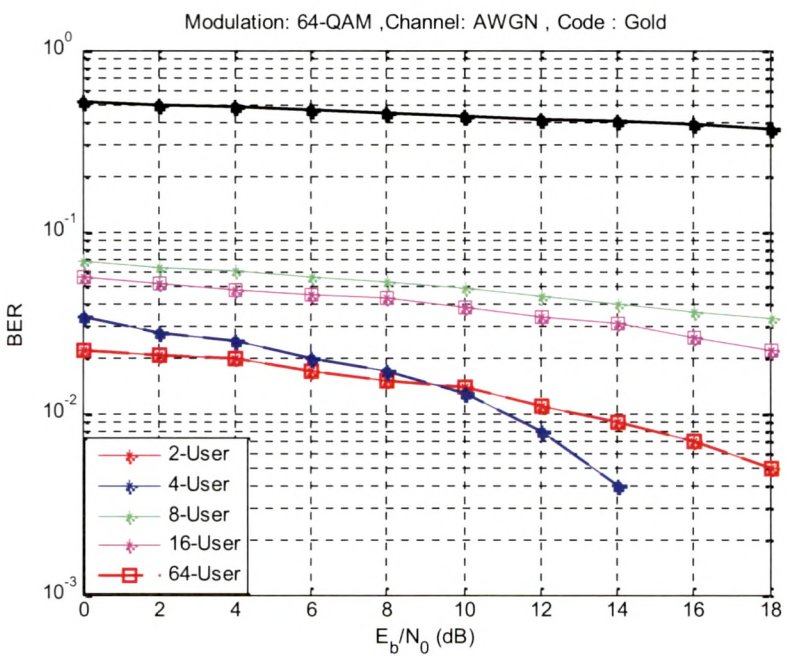


Figure 13.38(a): BER for Gold Code AWGN : 64-QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	4.516 s	0.547 s	
wgn	320	3.969 s	3.969 s	
legend	1	0.938 s	0.047 s	
legend>make_legend	1	0.891 s	0.000 s	
scribe\private\islegendable	9	0.047 s	0.031 s	
findall	11	0.031 s	0.031 s	
hold	8	0.031 s	0.031 s	
allchild	4	0.016 s	0.016 s	

Figure 13.38(b): Profile Summary Generated 04-May-2007 13:22:33

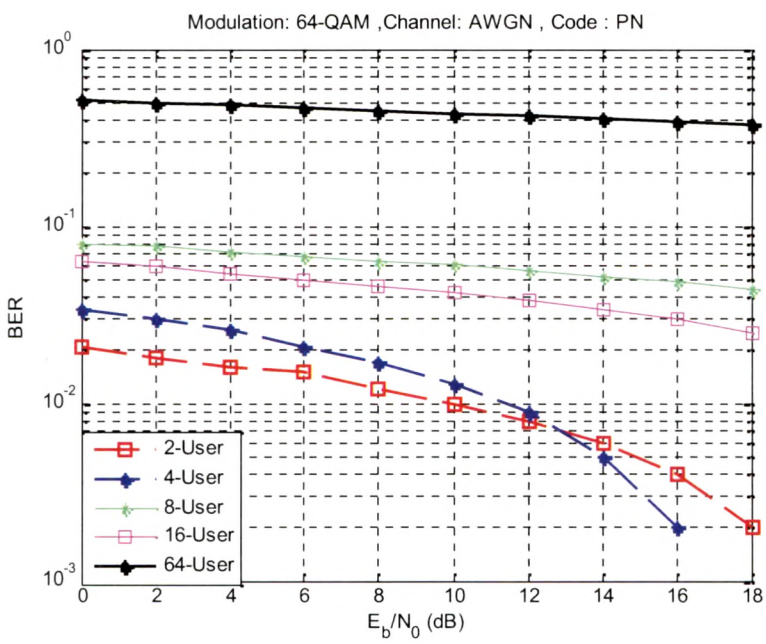


Figure 13.39(a): BER for PN Code AWGN : 64-QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	4.922 s	0.969 s	
wgn	320	3.953 s	3.953 s	
legend	1	1.094 s	0.063 s	
legend>make_legend	1	1.031 s	0.063 s	
uigettoolbar	1	0.016 s	0.016 s	
plotedit>create_enumstrprop_menu	3	0.016 s	0.016 s	
plotedit>add_general_action_menu	3	0.016 s	0.016 s	

Figure 13.39(b): Profile Summary Generated 04-May-2007 14:08:34

13.4.3.2 Rayleigh Fading Channel

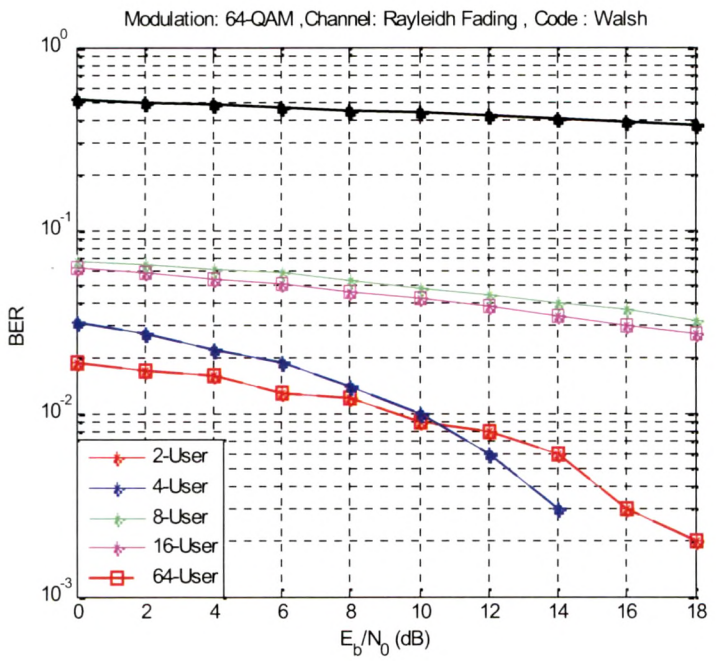


Figure 13.40(a): BER for Walsh Code Reyleigh : 64-QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1170	220.188 s	function is recursive	
channel.multipath.filter	240	219.078 s	function is recursive	
channel.multipath.filterblock	510	213.609 s	1.609 s	
channel.channelfilter.filter	510	194.406 s	194.375 s	
channel.interpfilter.filter	510	17.250 s	0.031 s	
awgn	320	5.000 s	0.750 s	
wgn	320	4.250 s	4.250 s	

Figure 13.40(b): Profile Summary Generated 21-May-2007 22:11:31

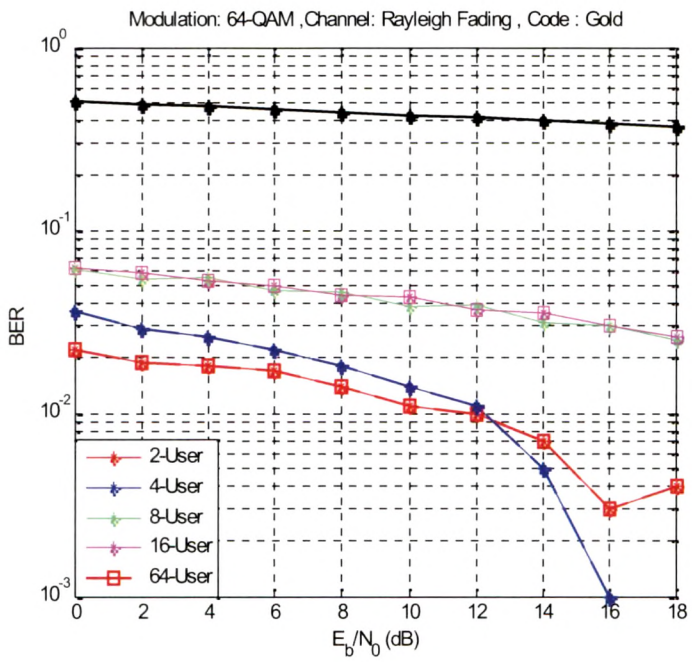


Figure 13.41(a): BER for Gold Code Reyleigh : 64-QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1170	223.141 s	function is recursive	
channel.multipath.filter	240	221.781 s	function is recursive	
channel.multipath.filterblock	510	216.250 s	1.531 s	
channel.channelfilter.filter	510	196.688 s	196.641 s	
channel.interpfilter.filter	510	17.609 s	0.094 s	
...l.interpfilter.filter>polyphaseFilter	510	17.516 s	14.594 s	
awgn	320	5.219 s	0.797 s	
wgn	320	4.422 s	4.422 s	

Figure 13.41(b): Profile Summary Generated 22-May-2007 07:44:55

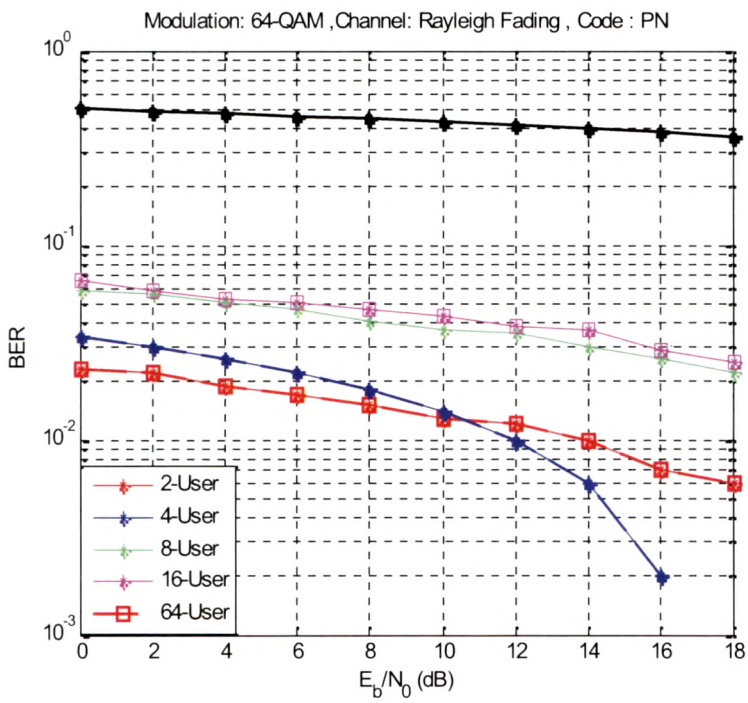


Figure 13.42(a): BER for PN Code Reyleigh : 64-QAM_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1170	224.078 s	function is recursive	
channel.multipath.filter	240	222.703 s	function is recursive	
channel.multipath.filterblock	510	217.391 s	1.625 s	
channel.channelfilter.filter	510	197.719 s	197.703 s	
channel.interpfilter.filter	510	17.656 s	0.078 s	
...l.interpfilter.filter>polyphaseFilter	510	17.578 s	14.875 s	
awgn	320	5.344 s	0.953 s	
wgn	320	4.391 s	4.391 s	

Figure 13.42(b): Profile Summary Generated 22-May-2007 13:53:39

13.4.4 Plots for GMSK

13.4.4.1 AWGN Channel

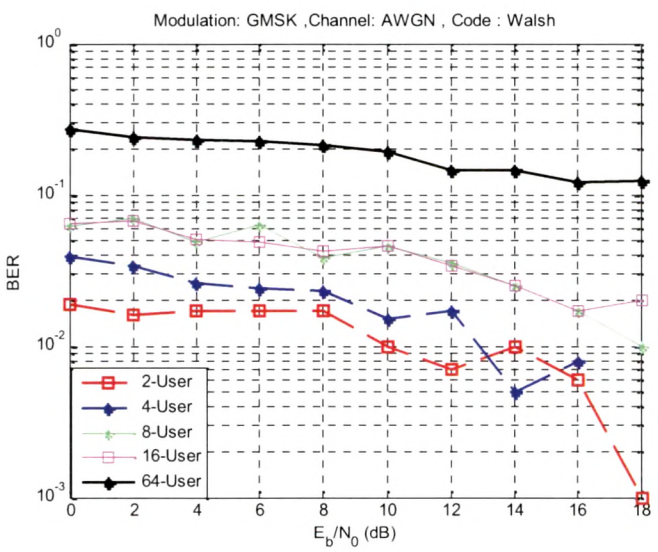


Figure 13.43(a): BER for Walsh Code AWGN : GMSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	0.313 s	0.078 s	
wgn	320	0.234 s	0.234 s	
firgauss	4	0.156 s	0.000 s	
gcf	1	0.016 s	0.016 s	
signalpolyutils>isfir	16	0.016 s	0.016 s	
dfilt.dtfwnum.getnumerator	72	0.016 s	0.016 s	
dfilt.dtffir.quantizecoeffs	60	0.016 s	0.000 s	

Figure 13.43(b): Profile Summary Generated 03-May-2007 12:28:54

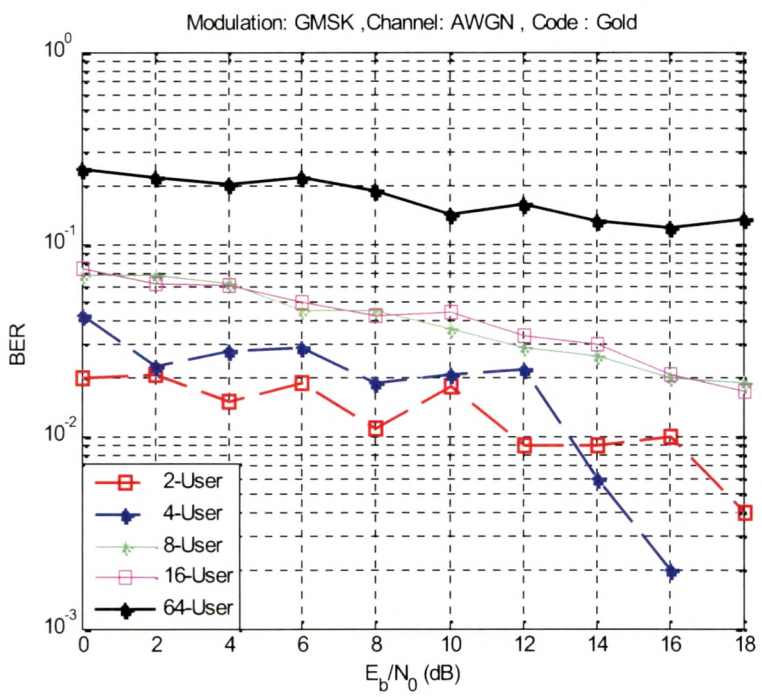


Figure 13.44(a): BER for Gold Code AWGN : GMSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	0.375 s	0.094 s	
wgn	320	0.281 s	0.281 s	
firgauss	4	0.156 s	0.000 s	
grid	1	0.031 s	0.016 s	
gcf	1	0.016 s	0.016 s	
signalpolyutils>isvector	32	0.016 s	0.016 s	
dfilt.dtfwnum.getnumerator	72	0.016 s	0.016 s	

Figure 13.44(b): Profile Summary Generated 03-May-2007 12:32:33

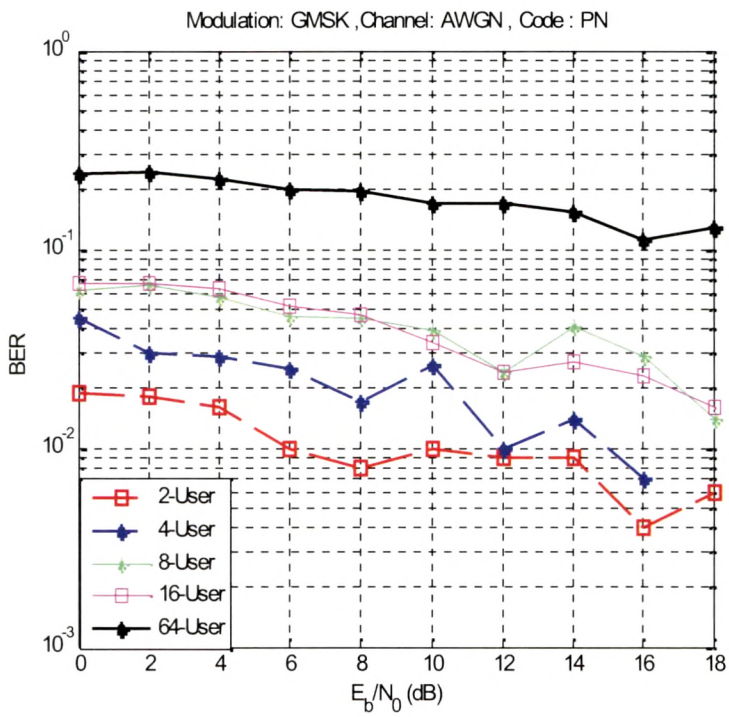


Figure 13.45(a): BER for PN Code AWGN : GMSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
awgn	320	0.375 s	0.047 s	
wgn	320	0.328 s	0.328 s	
firgauss	4	0.172 s	0.016 s	
grid	1	0.031 s	0.016 s	
dfilt.dffir.thissetstates	36	0.031 s	0.016 s	
gcf	1	0.016 s	0.016 s	
shiftdim	32	0.016 s	0.016 s	
shiftdata	16	0.016 s	0.000 s	

Figure 13.45(b): Profile Summary Generated 03-May-2007 12:34:45

13.4.4.2 Rayleigh Fading Channel

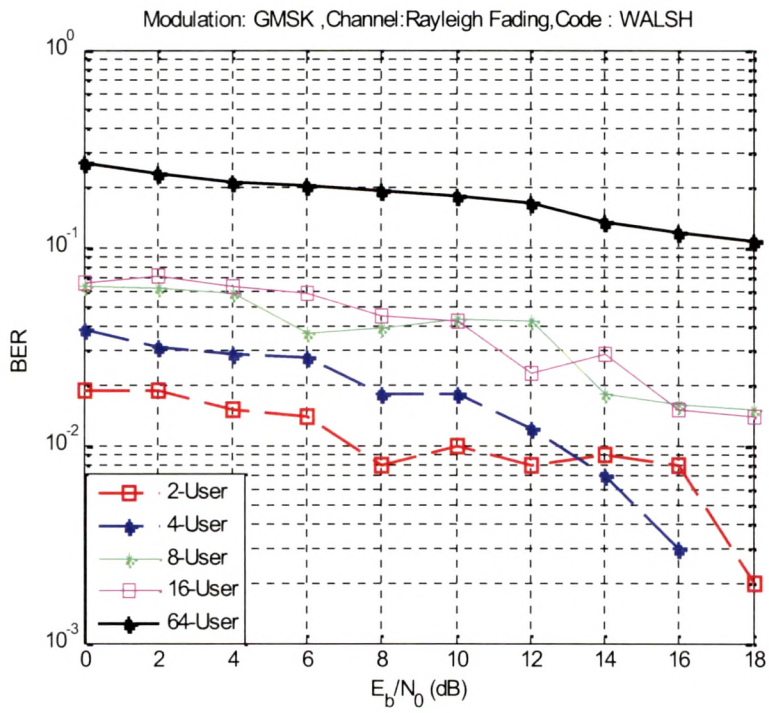


Figure 13.46(a): BER for Walsh Code Reyleigh : GMSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	46.563 s	function is recursive	
channel.multipath.filter	320	45.031 s	function is recursive	
channel.multipath.filterblock	680	43.156 s	0.484 s	
channel.channelfilter.filter	680	38.266 s	38.203 s	
channel.interpfilter.filter	680	4.094 s	0.078 s	
...l.interpfilter.filter>polyphaseFilter	680	4.016 s	3.000 s	
conv	680	0.844 s	0.844 s	

Figure 13.46(b): Profile Summary Generated 07-May-2007 22:00:14

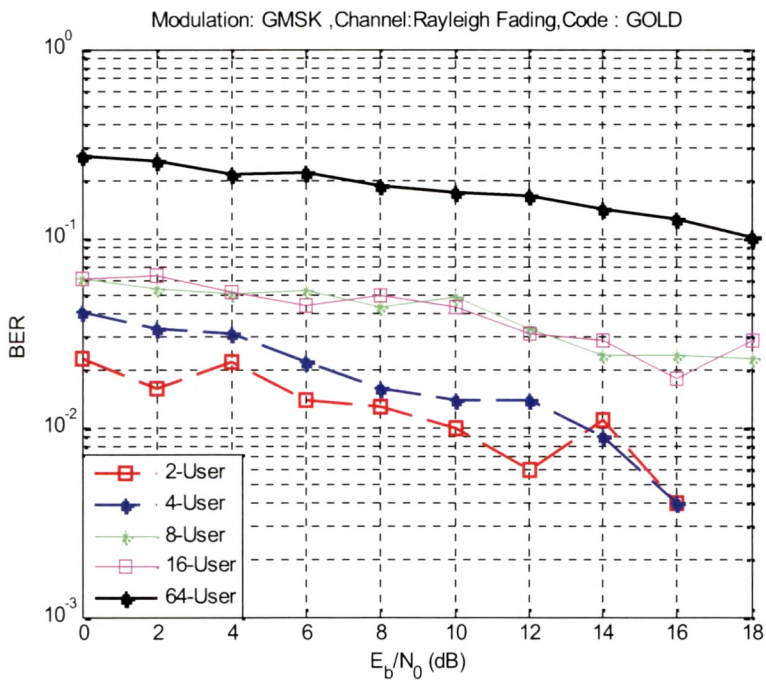


Figure 13.47(a): BER for Gold Code Reyleigh : GMSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	46.438 s	function is recursive	
channel.multipath.filter	320	44.938 s	function is recursive	
channel.multipath.filterblock	680	43.047 s	0.391 s	
channel.channelfilter.filter	680	38.375 s	38.328 s	
channel.interpfilter.filter	680	4.078 s	0.141 s	
conv	680	0.875 s	0.875 s	
firls	40	0.672 s	0.094 s	

Figure 13.47(b): Profile Summary Generated 07-May-2007 22:04:17

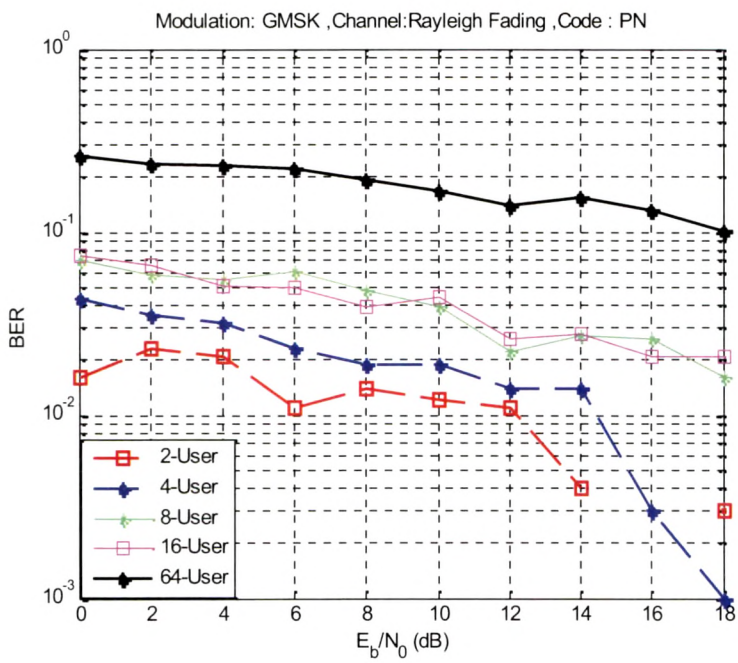


Figure 13.48(a): BER for PN Code Reyleigh : GMSK_GA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	1560	44.922 s	function is recursive	
channel.multipath.filter	320	43.516 s	function is recursive	
channel.multipath.filterblock	680	41.813 s	0.406 s	
channel.channelfilter.filter	680	37.125 s	37.094 s	
channel.interpfilter.filter	680	4.063 s	0.047 s	
...l.interpfilter.filter>polyphaseFilter	680	4.000 s	2.953 s	
channel.dopplerfilter.generateoutput	680	1.391 s	0.313 s	
conv	680	1.047 s	1.047 s	

Figure 13.48(b): Profile Summary Generated 07-May-2007 22:08:42

13.5 SIMULATION RESULTS FOR PDA ALGORITHM

13.5.1 Plots for AWGN Channel

13.5.1.1 QPSK

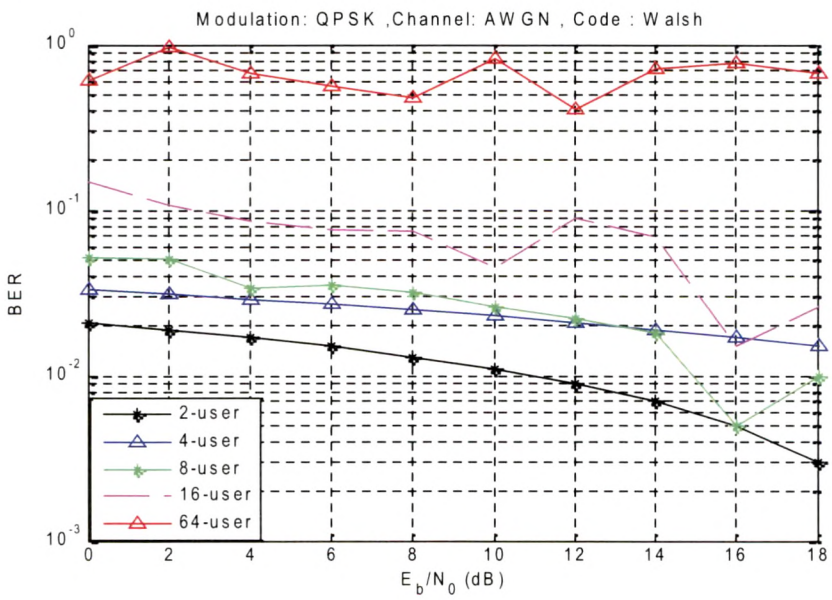


Figure 13.49(a) BER versus Eb/E0 (dB) for Walsh Code AWGN : QPSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	940	26.219 s	0.000 s	
genqamdemod	940	26.078 s	26.078 s	
pskmod	1880	1.672 s	1.672 s	
awgn	940	1.578 s	0.344 s	
wgn	940	1.234 s	1.234 s	
legend	1	0.813 s	0.047 s	
legend>make_legend	1	0.766 s	0.063 s	

Figure 13.49(b) Profile Plot for QPSK_PDA

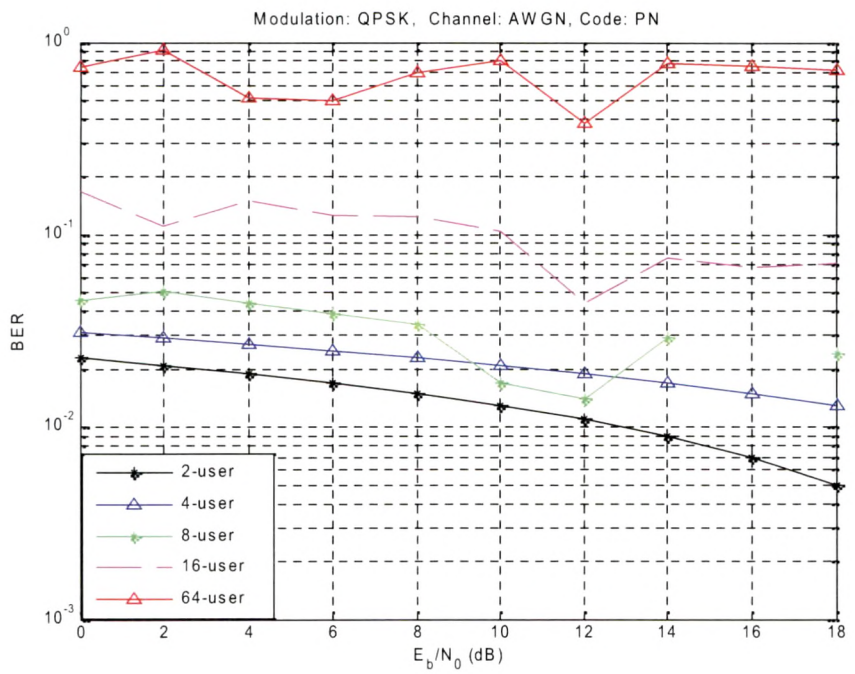


Figure 13.50(a) BER versus Eb/E0 (dB) for PN Code AWGN : QPSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	940	23.750 s	0.094 s	
genqamdemod	940	23.578 s	23.578 s	
pskmod	1880	1.563 s	1.563 s	
awgn	940	1.328 s	0.250 s	
wgn	940	1.078 s	1.078 s	
legend	1	0.563 s	0.047 s	
legend>make_legend	1	0.500 s	0.016 s	

Figure 13.50(b) Profile Plot for QPSK

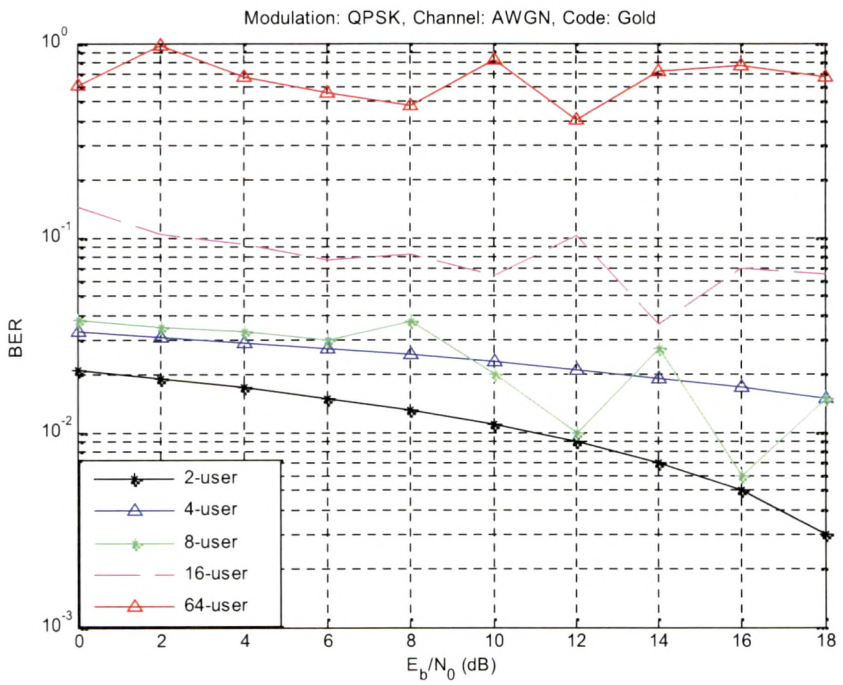


Figure 13.51(a) BER versus Eb/E0 (dB) for Gold Code AWGN : QPSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
pskdemod	940	23.531 s	0.078 s	
genqamdemod	940	23.344 s	23.344 s	
pskmod	1880	1.484 s	1.484 s	
awgn	940	1.406 s	0.219 s	
wgn	940	1.188 s	1.188 s	
legend	1	0.953 s	0.078 s	
legend>make_legend	1	0.813 s	0.047 s	

Figure 13.51(b) Profile Plot for QPSK

13.5.1.2 16-QAM

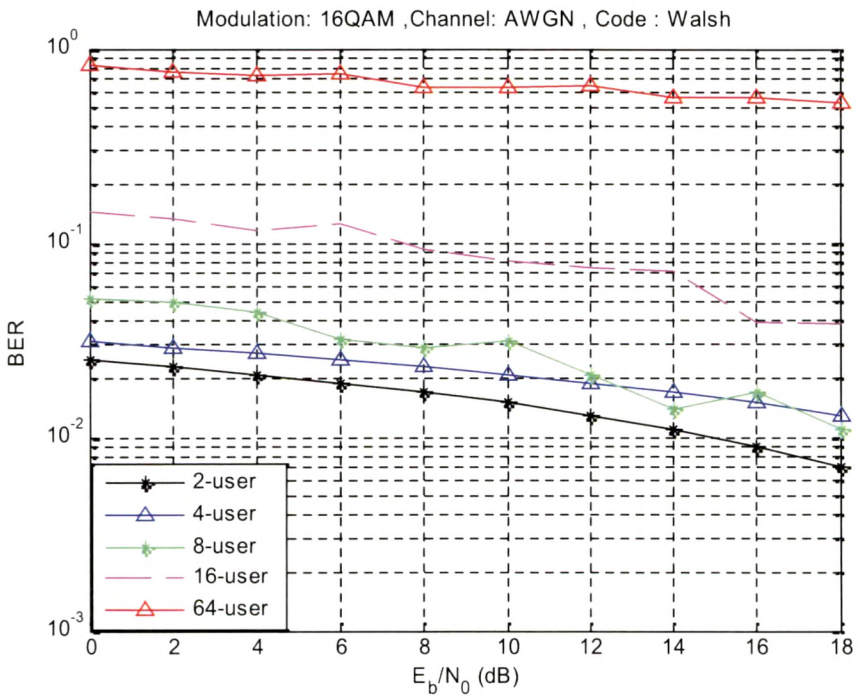


Fig13.52(a) BER versus Eb/E0 (dB) for Walsh Code AWGN : 16 QAM_PDA

Function name	Calls	Total Time	Self Time*	Total Time Plot (dark band = self time)
qamdemod	940	22.469 s	0.078 s	
genqamdemod	940	21.297 s	21.297 s	
de2bi	940	2.313 s	2.313 s	
comm\private\squareqamconst	1880	2.219 s	2.047 s	
awgn	940	1.594 s	0.328 s	
qammod	940	1.578 s	0.250 s	
wgn	940	1.266 s	1.266 s	

Figure 13.52(b) Profile Plot for 16-QAM

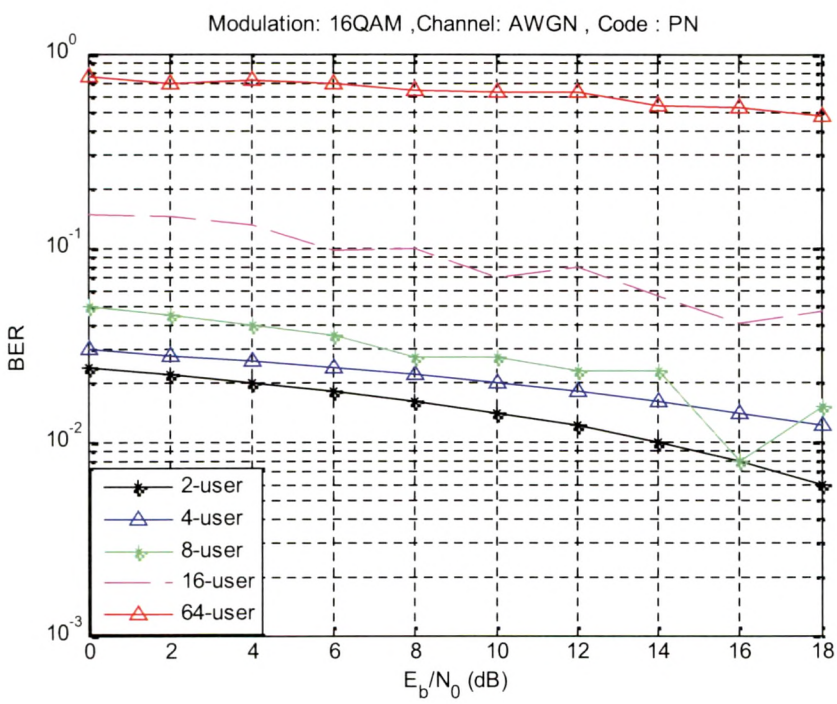


Figure 13.53(a) BER versus Eb/E0 (dB) for PN Code AWGN : 16 QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qamdemod	940	20.688 s	0.047 s	
genqamdemod	940	19.188 s	19.188 s	
comm\private\squareqamconst	1880	2.578 s	2.297 s	
de2bi	940	1.891 s	1.891 s	
qammod	940	1.844 s	0.375 s	
awgn	940	1.625 s	0.344 s	
bi2de	940	1.500 s	1.500 s	
wgn	940	1.281 s	1.281 s	

Figure 13.53(b) Profile Plot for 16-QAM

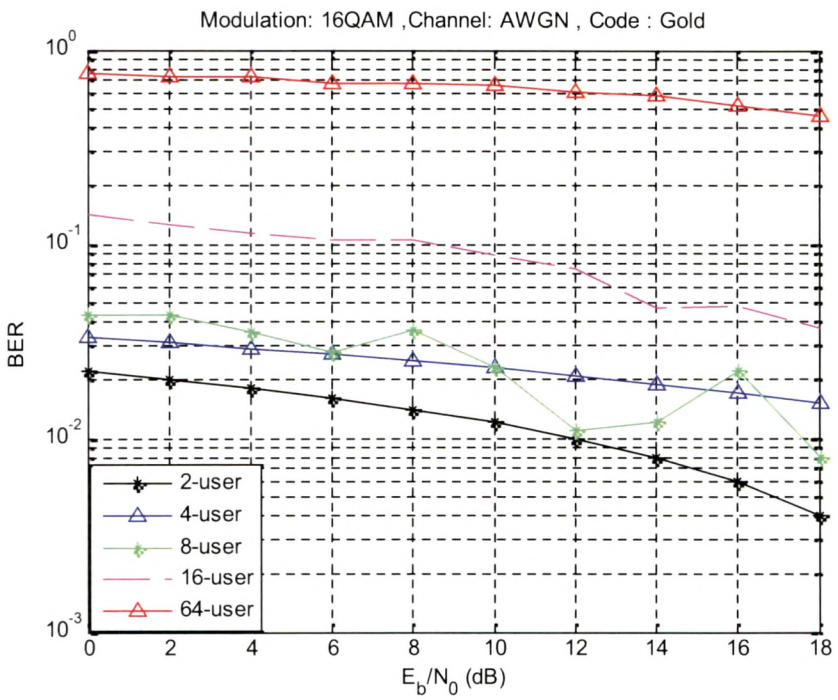


Figure 13.54(a) BER versus Eb/E0 (dB) for Gold Code AWGN : 16 QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qamdemod	940	20.422 s	0.125 s	
genqamdemod	940	19.188 s	19.188 s	
comm\private\squareqamconst	1880	2.438 s	2.250 s	
qammod	940	2.125 s	0.406 s	
de2bi	940	2.078 s	2.078 s	
awgn	940	1.703 s	0.359 s	
bi2de	940	1.391 s	1.391 s	
wgn	940	1.344 s	1.344 s	

Figure 13.54(b) Profile Plot for 16-QAM

13.5.1.3 64-QAM

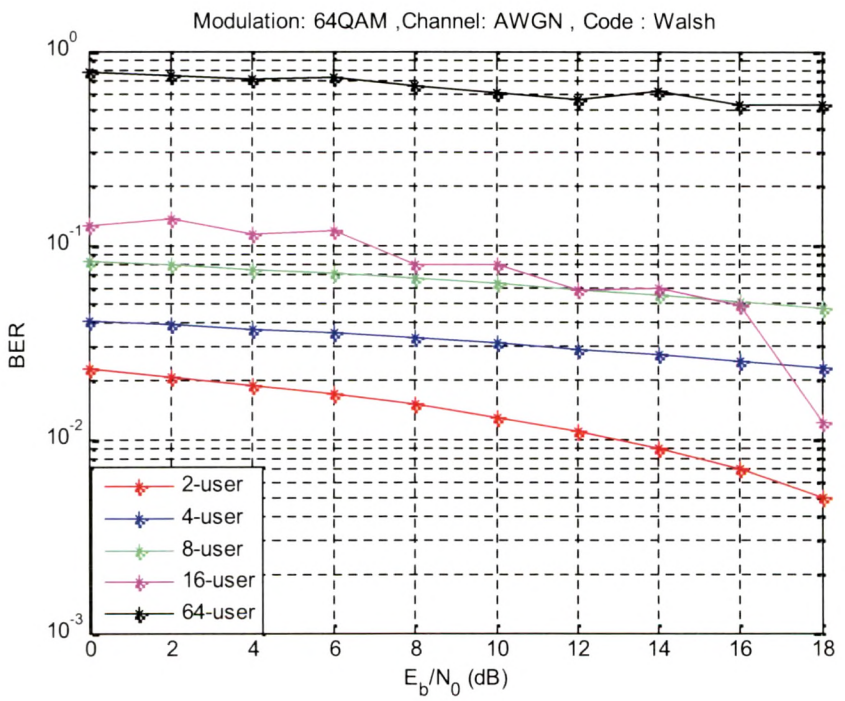


Figure 13.55(a) BER versus Eb/E0 (dB) for Walsh Code AWGN : 64 QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qamdemod	940	28.641 s	0.109 s	
genqamdemod	940	22.672 s	22.672 s	
comm\private\squareqamconst	1880	11.875 s	11.484 s	
qammod	940	6.406 s	0.203 s	
de2bi	940	2.109 s	2.109 s	
awgn	940	1.453 s	0.359 s	
bi2de	940	1.438 s	1.438 s	
wgn	940	1.094 s	1.094 s	

Figure 13.55(b) Profile Plot for 64-QAM

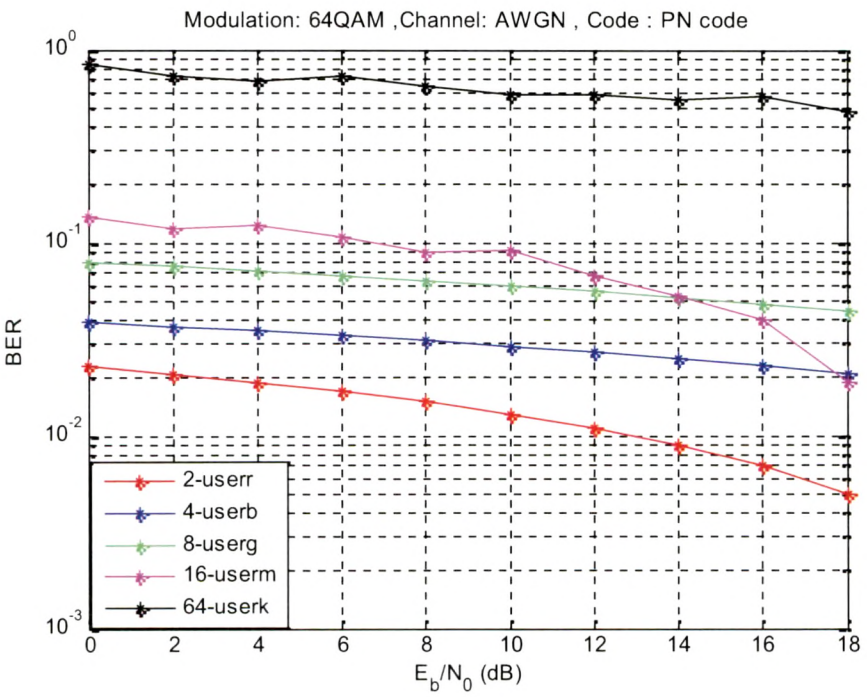


Figure13.56(a) BER versus Eb/E0 (dB) for PN Code AWGN : 64 QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
qamdemod	940	38.813 s	0.094 s	
genqamdemod	940	32.516 s	32.516 s	
comm\private\squareqamconst	1880	12.172 s	11.641 s	
qammod	940	6.438 s	0.328 s	
de2bi	940	2.078 s	2.078 s	
awgn	940	1.719 s	0.453 s	
bi2de	940	1.500 s	1.500 s	

Figure 13.56(b) Profile Plot for 64-QAM

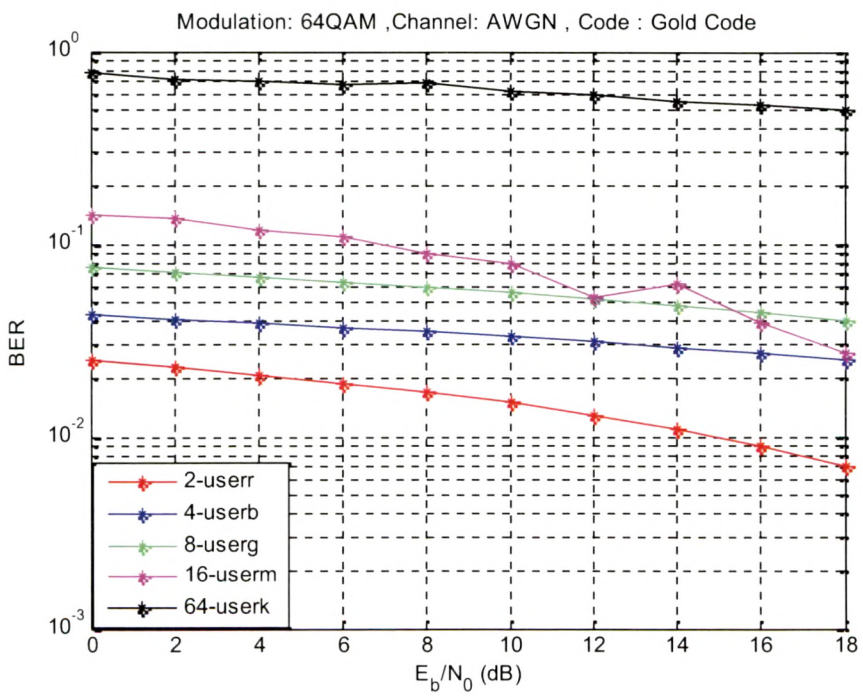


Figure13.57(a) BER versus Eb/E0 (dB) for Gold Code AWGN : 64 QAM_PDA

Function name	Calls	Total Time	Self Time*	Total Time Plot (dark band = self time)
qamdemod	940	38.719 s	0.078 s	
genqamdemod	940	32.516 s	32.516 s	
comm\private\squareqamconst	1880	11.844 s	11.375 s	
qammod	940	6.234 s	0.250 s	
de2bi	940	1.813 s	1.813 s	
awgn	940	1.750 s	0.578 s	
bi2de	940	1.328 s	1.328 s	

Figure 13.57(b) Profile Plot for 64-QAM

13.5.1.4 GMSK

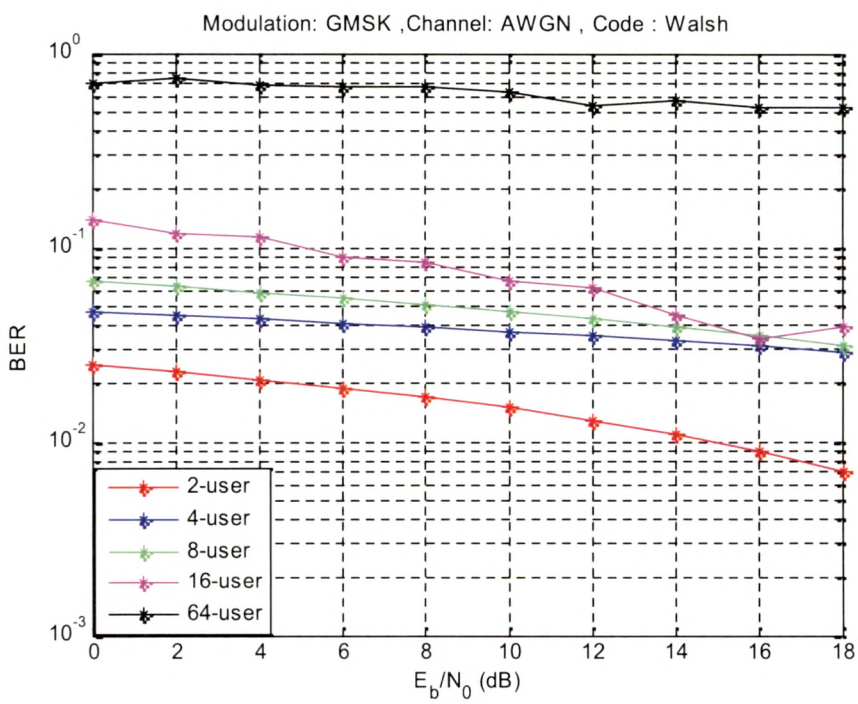


Figure 13.58(a) BER versus Eb/E0 (dB) for Walsh Code AWGN : GMSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
firgauss	940	68.594 s	0.422 s	
dfilt.cascade (Opaque-fun)	38540	59.422 s	function is recursive	
dfilt.dfilt.ziscalarexpand	8460	2.969 s	function is recursive	
dfilt.dtfwnum.getnumerator	16920	2.547 s	1.328 s	
awgn	940	2.078 s	0.688 s	
dfilt.dffir.secfilter	3760	2.031 s	0.688 s	
dfilt.dtfwnum.setrefnum	9400	1.672 s	0.734 s	

Figure 13.58(b) Profile Plot for GMSK

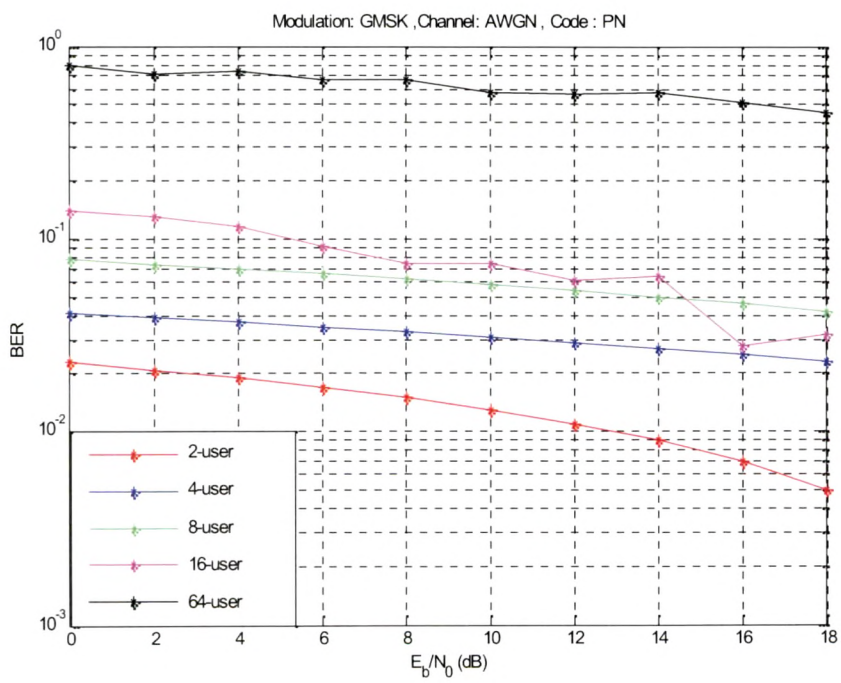


Figure13.59(a) BER versus Eb/E0 (dB) for PN Code AWGN : GMSK_PDA

Function name	Calls	Total Time	Self Time*	Total Time Plot (dark band = self time)
awgn	940	1.328 s	0.250 s	
wgn	940	1.078 s	1.078 s	
legend	1	0.563 s	0.047 s	
legend>make_legend	1	0.500 s	0.016 s	
graphics\private\clo	1	0.078 s	0.016 s	
gcf	19	0.078 s	0.078 s	
setdiff	2	0.063 s	0.063 s	

Figure 13.59(b) Profile Plot for GMSK

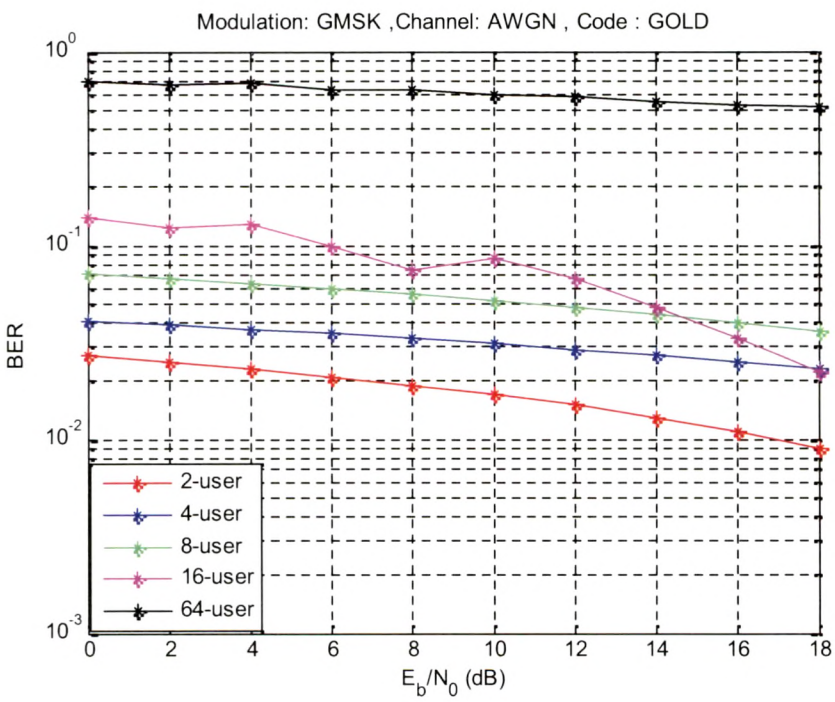


Figure13.60(a) BER versus Eb/E0 (dB) for Gold Code AWGN : GMSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time
dfilt.dtfwnum.getnumerator	16920		2.703 s	1.328 s
awgn	940		2.453 s	0.578 s
dfilt.dffir.secfilter	3760		2.125 s	0.750 s
wgn	940		1.875 s	1.875 s
dfilt.basefilter.tf	3760		1.719 s	function is recursive
dfilt.dtfwnum.setrefnum	9400		1.516 s	0.547 s

Figure 13.60(b) Profile Plot for GMSK

13.5.2 Plots for Rayleigh Fading Channel.

13.5.2.1 QPSK

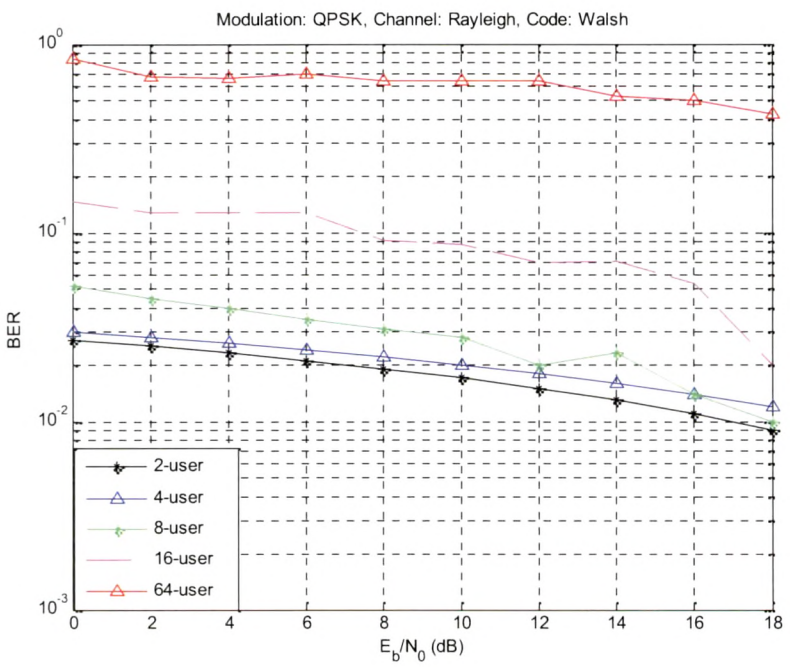


Figure 13.61(a) BER versus Eb/E0 (dB) for Walsh Code Reyleigh : QPSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	216.641 s	function is recursive	
channel.multipath.filter	940	176.469 s	function is recursive	
channel.multipath.filterblock	2820	156.031 s	2.875 s	
channel.channelfilter (Opaque-function)	5640	125.656 s	function is recursive	
channel.channelfilter.filter	2820	123.156 s	122.813 s	
pskdemod	940	55.250 s	0.156 s	
genqamdemod	940	54.969 s	54.969 s	

Figure 13.61(b) Profile Plot for QPSK

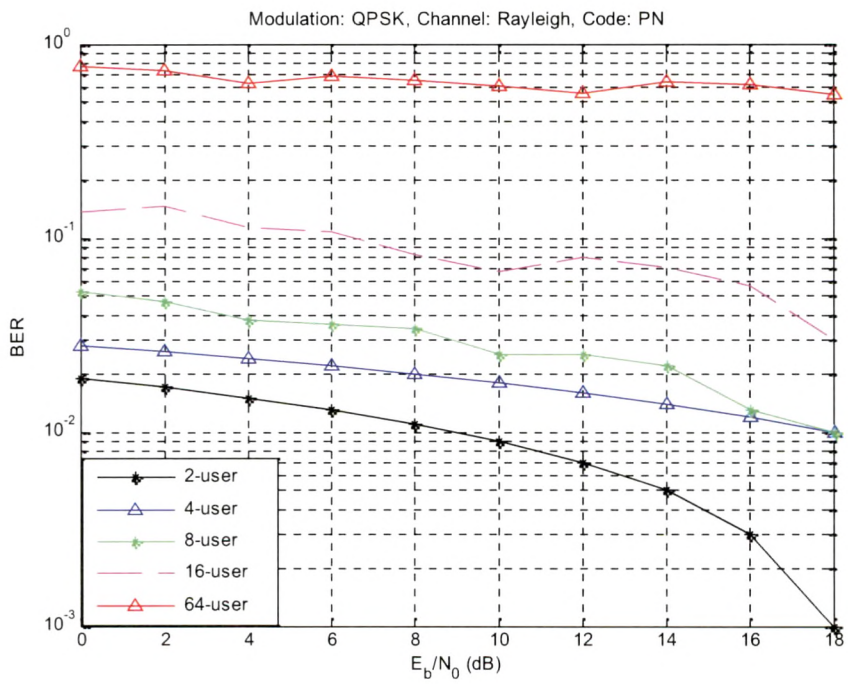


Figure 13.62(a) BER versus Eb/E0 (dB) for PN Code Reyleigh : QPSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	96.781 s	function is recursive	
channel.multipath.filter	940	77.922 s	function is recursive	
channel.multipath.filterblock	2820	68.688 s	1.516 s	
channel.channelfilter (Opaque-function)	5640	55.203 s	function is recursive	
channel.channelfilter.filter	2820	53.656 s	53.422 s	
pskdemod	940	23.906 s	0.047 s	
genqamdemod	940	23.766 s	23.766 s	

Figure 13.62(b) Profile Plot for QPSK

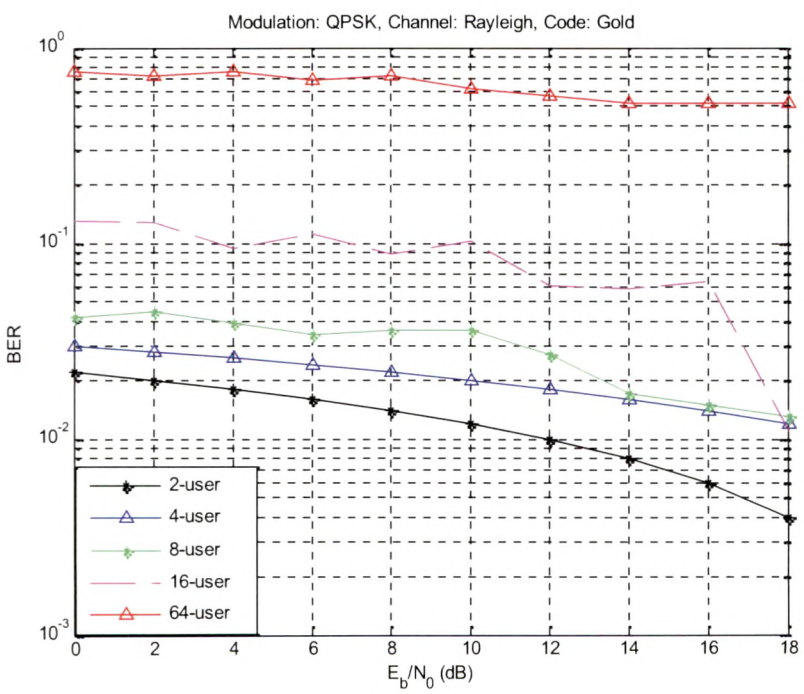


Figure 13.63(a) BER versus Eb/E0 (dB) for Gold Code Reyleigh : QPSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	98.859 s	function is recursive	
channel.multipath_filter	940	80.250 s	function is recursive	
channel.multipath_filterblock	2820	70.234 s	1.656 s	
channel.channelfilter (Opaque-function)	5640	56.594 s	function is recursive	
channel.channelfilter.filter	2820	55.234 s	55.000 s	
pskdemod	940	25.031 s	0.047 s	
genqamdemod	940	24.891 s	24.891 s	

Figure 13.63(b) Profile Plot for QPSK

13.5.2.2 16-QAM

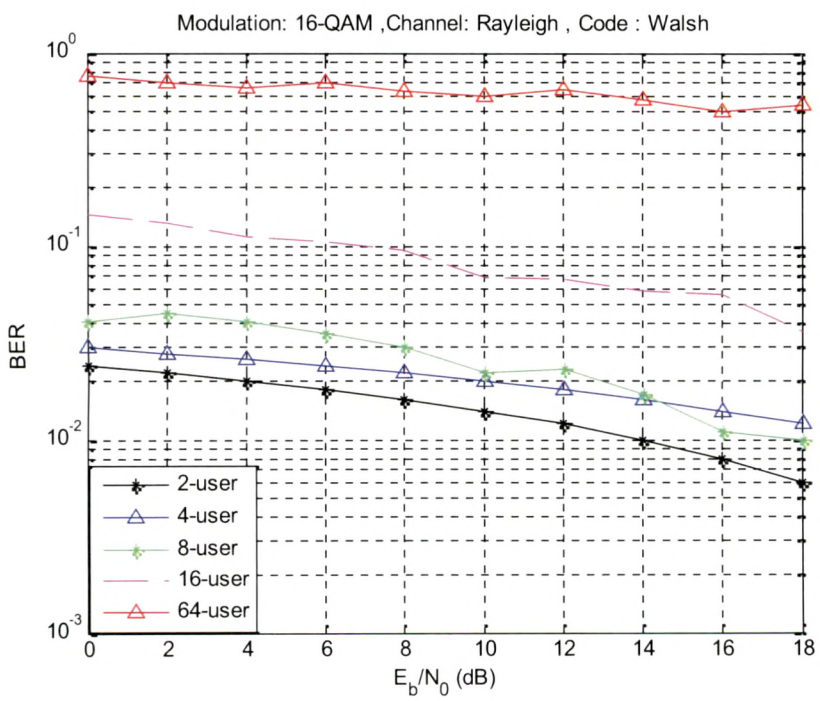


Figure 13.64(a) BER versus Eb/E0 (dB) for Walsh Code Reyleigh : 16 QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	41.875 s	function is recursive	
channel.multipath.filter	940	23.172 s	function is recursive	
channel.multipath.filterblock	2820	22.328 s	0.734 s	
rayleighchan	940	18.688 s	0.047 s	
channel.channelfilter.filter	2820	14.063 s	13.906 s	
qamdemod	940	10.766 s	0.047 s	
channel.multipath.reset	1880	10.109 s	function is recursive	

Figure 13.64(b) Profile Plot for 16-QAM

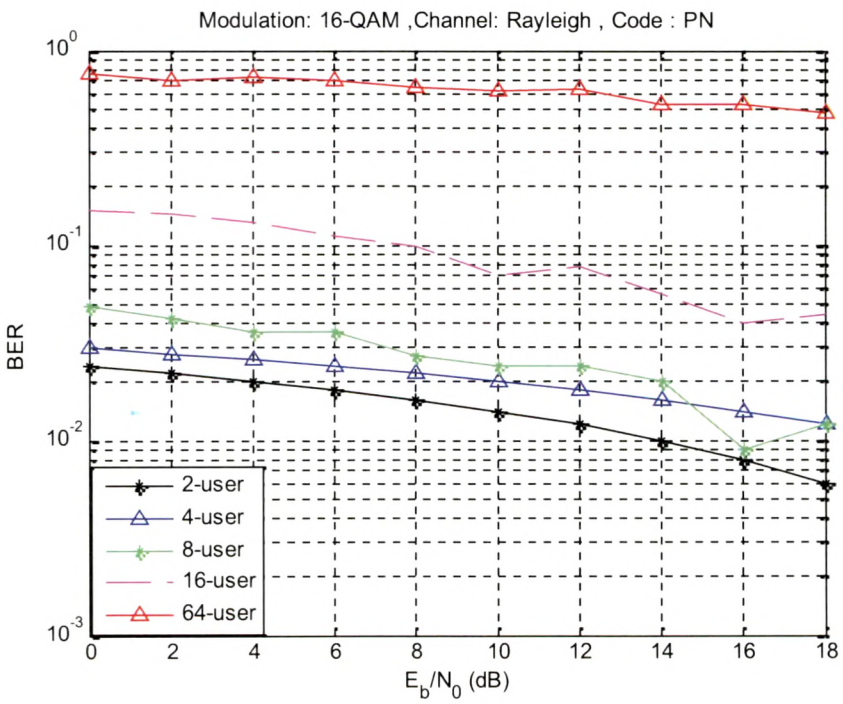


Figure 13.65(a) BER versus Eb/E0 (dB) for PN Code Reyleigh : 16-QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	41.953 s	function is recursive	
channel.multipath.filter	940	23.172 s	function is recursive	
channel.multipath.filterblock	2820	22.391 s	1.094 s	
rayleighchan	940	18.734 s	0.016 s	
channel.channelfilter.filter	2820	13.813 s	13.688 s	
qamdemod	940	10.844 s	0.063 s	
channel.multipath.reset	1880	10.031 s	function is recursive	

Figure 13.65(b) Profile Plot for 16-QAM

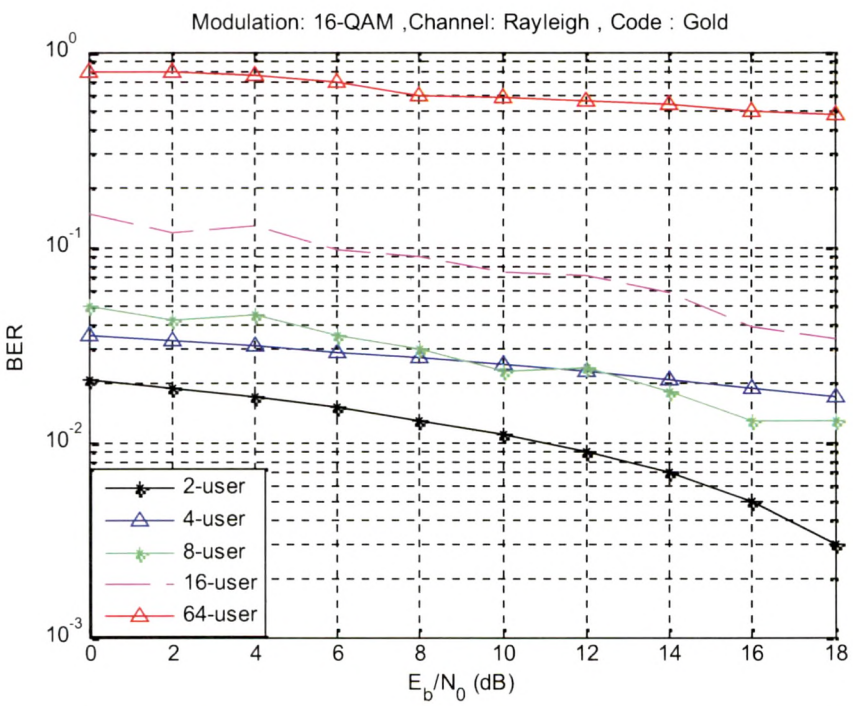


Figure 13.66(a) BER versus Eb/E0 (dB) for Gold Code Reyleigh : 16-QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	42.469 s	function is recursive	
channel.multipath.filter	940	23.359 s	function is recursive	
channel.multipath.filterblock	2820	22.453 s	1.172 s	
channel.channelfilter.filter	2820	13.984 s	13.813 s	
qamdemod	940	10.656 s	0.016 s	
channel.multipath.reset	1880	10.234 s	function is recursive	
genqamdemod	940	9.969 s	9.969 s	

Figure 13.66(b) Profile Plot for 16-QAM

13.5.2.3 64-QAM

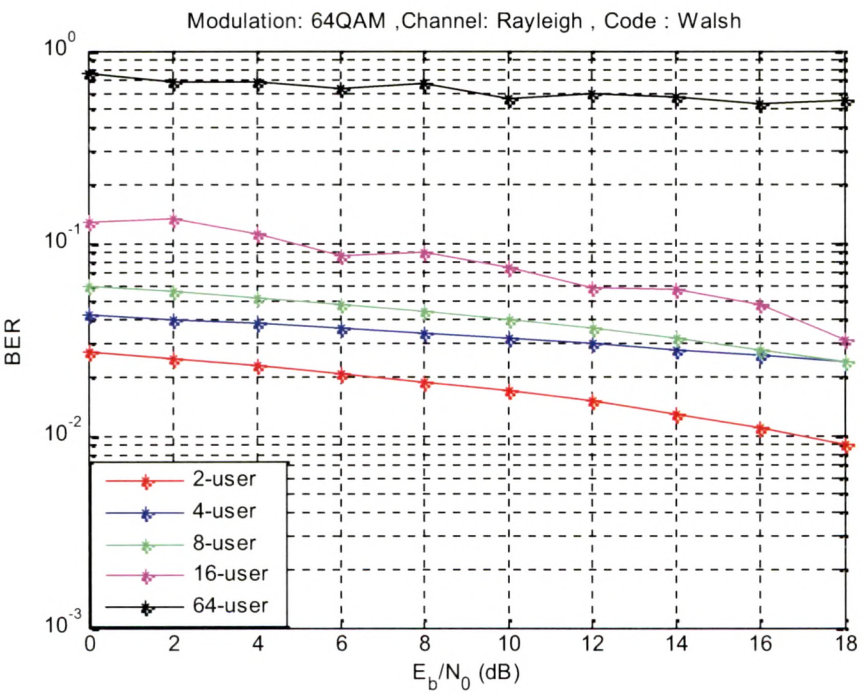


Figure 13.67(a) BER versus Eb/E0 (dB) for Walsh Code Reyleigh : 64-QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	36.563 s	function is recursive	
channel.multipath.filter	940	18.281 s	function is recursive	
rayleighchan	940	18.234 s	0.000 s	
channel.rayleigh.rayleigh	940	18.156 s	function is recursive	
qamdemod	940	17.734 s	0.047 s	
channel.multipath.filterblock	2820	16.969 s	1.016 s	
channel.multipath.initialize	2820	16.594 s	function is recursive	

Figure 13.67(b) Profile Plot for 64-QAM

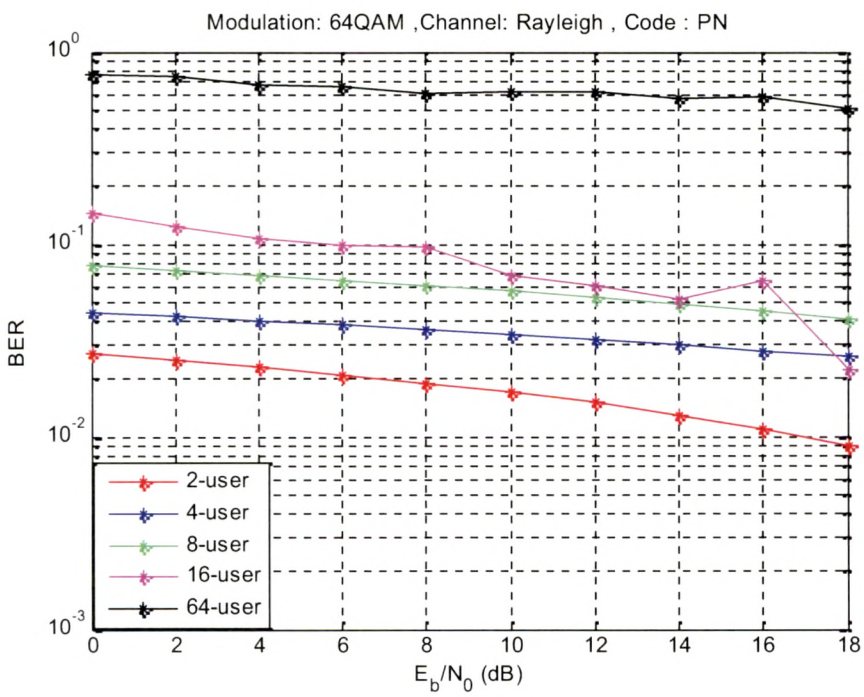


Figure 13.68(a) BER versus Eb/E0 (dB) for PN Code Reyleigh : 64-QAM_PDA

Function name	Calls	Total Time	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	37.297 s	function is recursive	
rayleighchan	940	18.984 s	0.016 s	
qamdemod	940	17.891 s	0.109 s	
channel.multipath.filterblock	2820	17.672 s	0.922 s	
genqamdemod	940	14.750 s	14.750 s	
channel.channelfilter (Opaque-function)	5640	11.172 s	function is recursive	
channel.multipath.reset	1880	10.328 s	function is recursive	

Figure 13.68(b) Profile Plot for 64-QAM

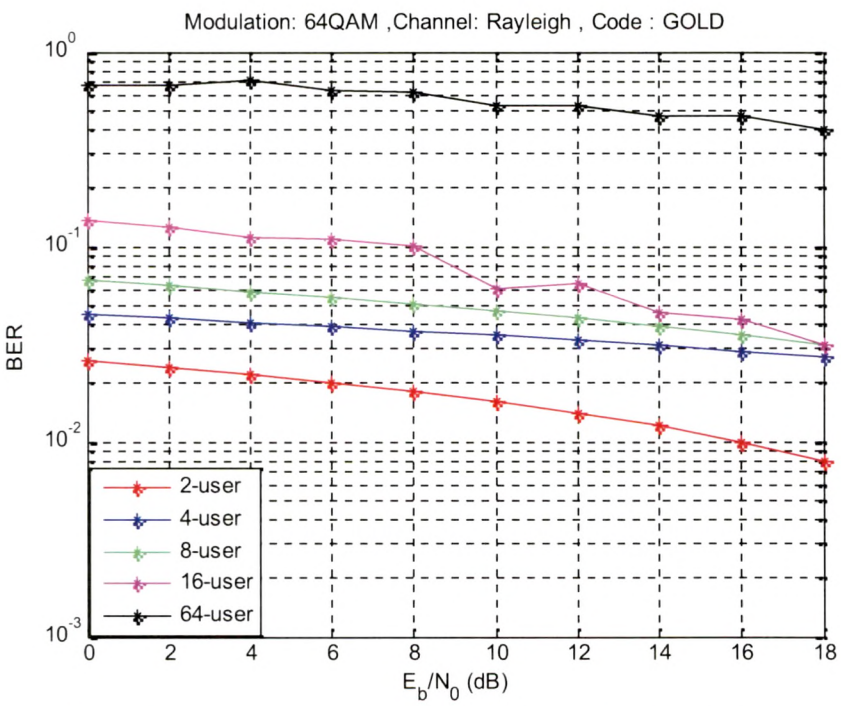


Figure 13.69(a) BER versus Eb/E0 (dB) for Gold Code Reyleigh : 64-QAM_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	35.484 s	function is recursive	
rayleighchan	940	18.000 s	0.016 s	
channel.rayleigh.rayleigh	940	17.734 s	function is recursive	
channel.multipath.filter	940	17.531 s	function is recursive	
qamdemod	940	17.016 s	0.063 s	
channel.multipath.filterblock	2820	16.656 s	0.844 s	
channel.multipath.initialize	2820	16.094 s	function is recursive	

Figure 13.69(b) Profile Plot for 64-QAM

13.5.2.4 GMSK

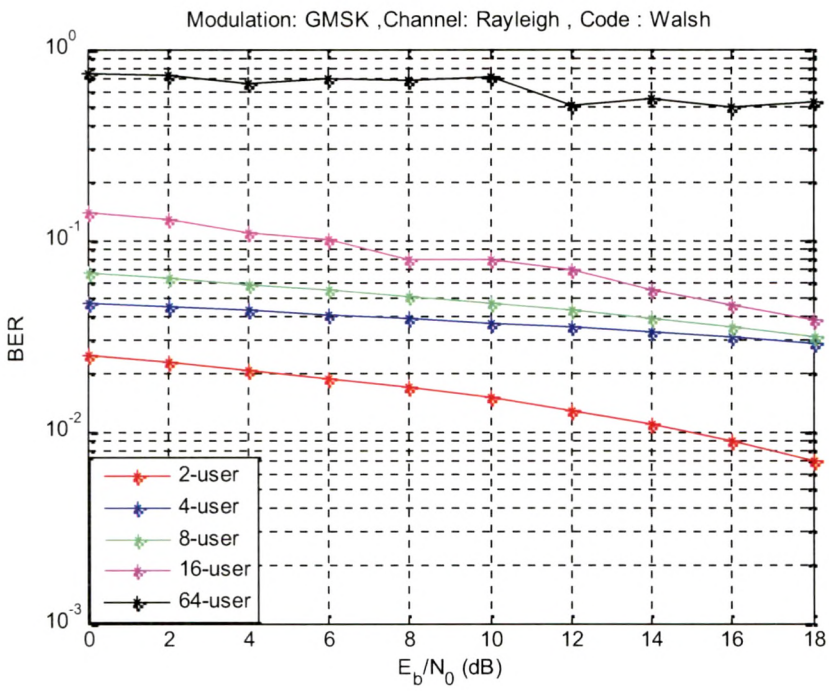


Figure 13.70(a) BER versus Eb/E0 (dB) for Walsh Code Reyleigh : GMSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	212.484 s	function is recursive	
channel.multipath.filter	940	172.672 s	function is recursive	
channel.multipath.filterblock	2820	152.578 s	3.203 s	
channel.channelfilter.filter	2820	120.078 s	119.672 s	
firgauss	940	66.078 s	0.281 s	
rayleighchan	940	40.000 s	0.109 s	
channel.rayleigh.rayleigh	940	39.297 s	function is recursive	

Figure 13.70(b) Profile Plot for GMSK

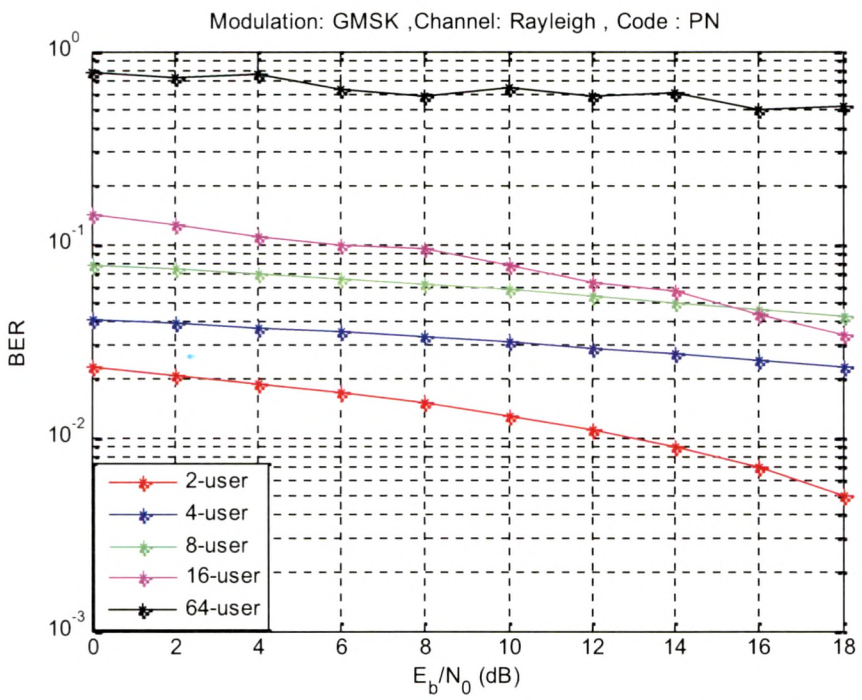


Figure 13.71(a) BER versus Eb/E0 (dB) for PN Code Reyleigh : GMSK_PDA

Function name	Calls	Total Time	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	214.016 s	function is recursive	
channel.multipath.filter	940	174.688 s	function is recursive	
channel.multipath.filterblock	2820	154.688 s	3.219 s	
channel.channelfilter (Opaque-function)	5640	124.016 s	function is recursive	
channel.channelfilter.filter	2820	121.203 s	120.828 s	
firgauss	940	64.359 s	0.109 s	
rayleighchan	940	39.359 s	0.109 s	

Figure 13.71(b) Profile Plot for GMSK

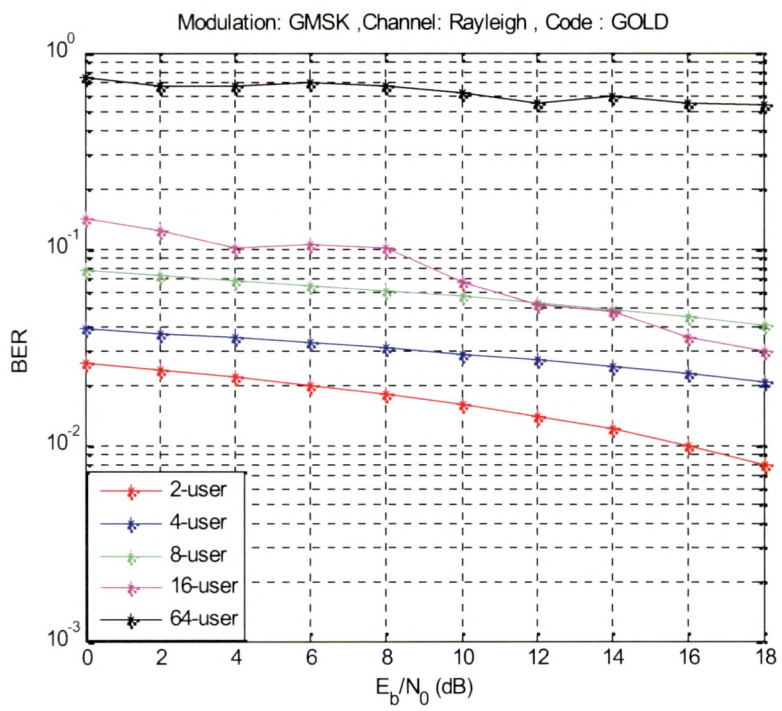


Figure 13.72(a) BER versus Eb/E0 (dB) for Gold Code Reyleigh : GMSK_PDA

Function name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
channel.rayleigh (Opaque-function)	10340	218.328 s	function is recursive	
channel.multipath.filterblock	2820	159.547 s	3.203 s	
channel.channelfilter (Opaque-function)	5640	125.422 s	function is recursive	
channel.channelfilter.filter	2820	122.547 s	122.219 s	
firgauss	940	65.953 s	0.156 s	
channel.dopplerfilter.generateoutput	4700	33.797 s	5.672 s	
channel.interpfilter.filter	2820	31.984 s	0.688 s	

Figure 13.72(b) Profile Plot for GMSK

13.6 SUMMARY

In this chapter we have shown an analysis of Results which have been obtained by implementing various multi user detection techniques based on V-BLAST, GA, PDA for OFDM and CDMA based systems considering various parameters like modulation scheme, BER, no. of users, spreading codes and channels.