"DESIGN AND SIMULATION OF FREQUENCY DIVISION MULTIPLEXING IN MATLAB"

A Project Report of

Course Wireless Communication (18EC4111)

Submitted in the partial fulfilment of the requirements for the award of the degree of

Bachelor of Technology

in

Department of Electronics and Communication Engineering

By

N. ESWAR -- 180040256

D. SRINIVAS RAO SIR

ERP MAPPED FACULTY FOR LAB NAME

KONERU LAKSHMAIAH EDUCATION FOUNDATION,

Green Fields, Vaddeswaram- 522502, Guntur (Dist.),
Andhra Pradesh, India.
November – 2018

KONERU LAKSHMAIAH EDUCATION FOUNDATION

Department of Electronics and Communication Engineering

Declaration

The Wireless Communication Project Report entitled "DESIGN AND SIMULATION OF FREQUENCY DIVISION MULTIPLEXING IN MATLAB"is a record of bonafide work of **N.Eswar -- 180040256**, submitted in partial fulfilment for the award of Bachelor of Technology in **Electronics And Communication Engineering**

I also declare that this report is of our own effort and it has not been submitted to any other university for the award of any degree.

N. ESWAR -- 180040256

KONERU LAKSHMAIAH EDUCATION FOUNDATION

Department of Electronics and Communication Engineering

CERTIFICATE

The Wireless Communication Project Report entitled "**DESIGN AND SIMULATION OF FREQUENCY DIVISION MULTIPLEXING IN MATLAB**" submit **N. ESWAR -- 180040256** in partial fulfilment for the award of Bachelor of Technology in **Electronics And Communication Engineering.**

Name of Project Supervisor

ACKNOWLEDGMENT

I express the sincere gratitude to our HOD Dr. **Suman Maloji** for his administration towards our academic growth.

I express sincere gratitude to our Course coordinator of Wireless Communication Dr. **VIPUL AGARWAL** for his leadership and constant motivation provided in successful completion of our academic semester.

I express my sincere thanks to my project supervisor….erp mapped faculty for lab…. and my teacher ……main faculty name for student section…….. for their novel association of ideas, knowledge, encouragement, appreciation and intellectual zeal which motivated us to venture this project successfully.

Finally, I am pleased to acknowledge the indebtedness to all those who devoted themselves directly or indirectly to make this project report success.

N. ESWAR -- 180040256

ABSTRACT

Frequency Division Multiple Access (FDMA) is one of the most common analogue multiple access methods. The frequency band is divided into channels of equal bandwidth so that each conversation is carried on a different frequency (as shown in the figure below).

FDMA Overview

In FDMA method, guard bands are used between the adjacent signal spectra to minimize crosstalk between the channels. A specific frequency band is given to one person, and it will received by identifying each of the frequency on the receiving end. It is often used in the first generation of analog mobile phone.

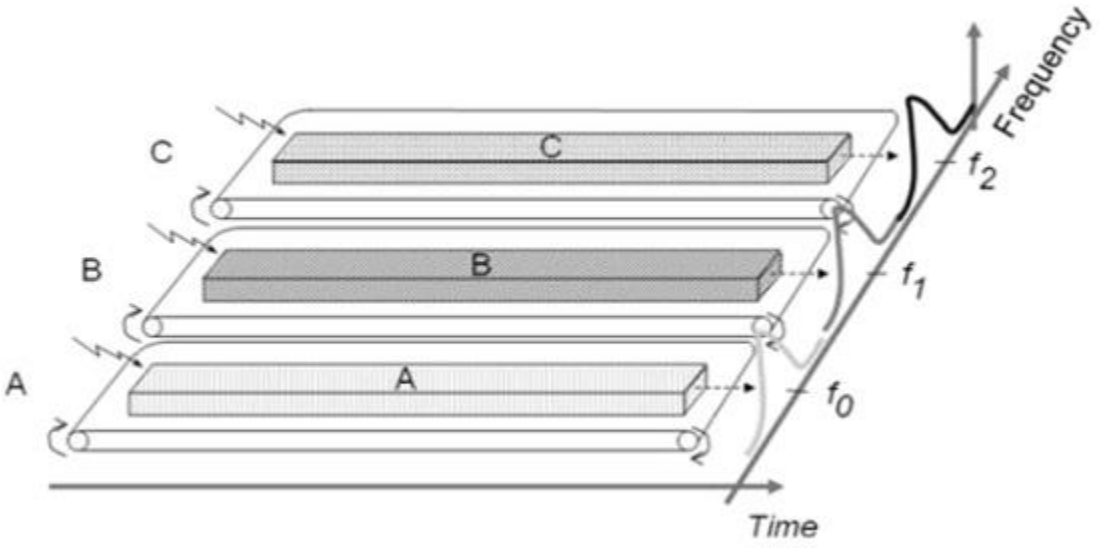


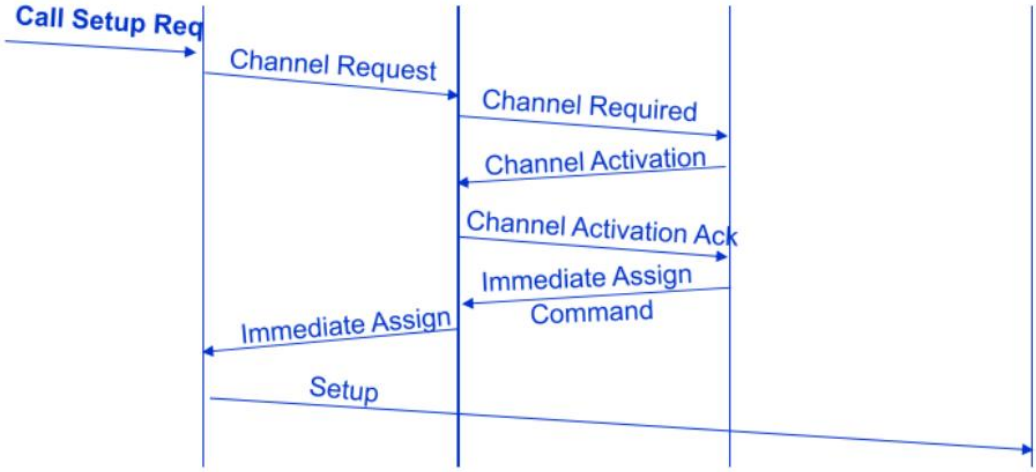
TABLE OF CONTENTS

\

OBJECTIVE OF THE PROJECT:-

Multiple Access in Wireless Communications • Multiple access techniques allow many mobile users to use a common limited spectrum band in a more efficient manner. ♣Mobile terminals send access request to base stations through random access channels. ♣If there are available message channels, base stations grant permission through paging channels, and assign a free pair of channels.

Multiple Access in Wireless Communications



SOFTWARE TOOLS USED AND THEIR DESCRIPTION:-

- **MATLAB**
- MATLAB is a proprietary multi-paradigm programming language and numerical computing environment developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages

THEORY:-

•As the mobile terminal receive the channel allocation message, it tunes to the assigned channels: ♣one for forward link; and ♣the other for reverse link. •It then sends acknowledgment message to the base station using the assigned reverse link.

The way the message channels are arranged depends on the multiple access technique employed which may be:

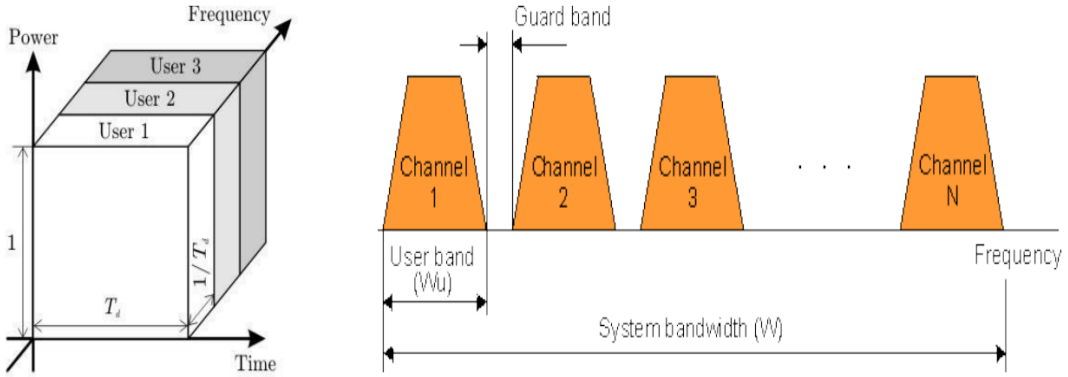
♣ Frequency Division Multiple Access (FDMA);

♣ Time Division Multiple Access (TDMA);

♣ Code Division Multiple Access (CDMA);

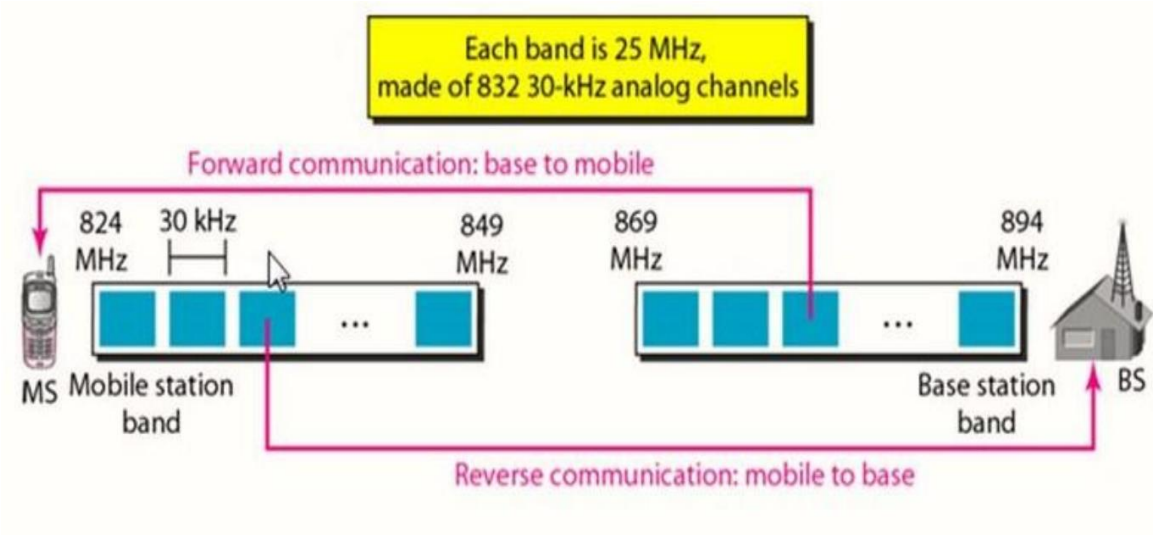
♣ Orthogonal Frequency Division Multiple Access (OFDMA)

Frequency Division Multiple Access (FDMA) • FDMA divides available bandwidth into a number of orthogonal channels of smaller bandwidths.



FDMA

Frequency Division Multiple Access (FDMA) •A channel is used continuously over the duration of the message. • FDMA is limited to narrowband applications due to its limited transmission rate. ♣If the same channel is reused at another physically separate location, an increase in transmit power will negatively affect the carrier-to-interference ratio at that location.•FDMA is employed in first generation cellular technology ♣ Advanced Mobile Phone Systems (AMPS) • A total bandwidth of 50 MHz is divided equally into two: ♣ 25 MHz for forward link; and ♣ 25 MHz for reverse link. • 12.5 MHz each is allocated to two competing network operators



•In AMPS, a channel bandwidth of 30 kHz and a total of 832 channels are available. •A guard band of 10 kHz is allowed at the edge to reduce inter-system interference.

CODE:-

```
% Design and simulation of Frequency Division
Multiplexing in MATLAB
clc;
clear all
close all
samples=1000;
% number of users
nos=8;
% modulating signal frequency in Hz
mfreq=[30 40 50 60 70 80 90 100];
% carrier frequency allocated to the different users in
Hz
cfreq=[300 600 900 12000 1500 1800 2100 2400];
% choose frequency deviation
freqdev=10;
% generate modulating signal
t=linspace(0,1000,samples);
parfor i=1:nos
    m(i,:)=sin(2*pi*mfreq(1,i)*t)+2*sin(pi*8*t);
end
% Generate the modulated signal
parfor i=1:nos

y(i,:)=fmmod(m(i,:),cfreq(1,i),10*cfreq(1,i),freqdev);
end
% pass the modulated signal through the channel
ch_op=awgn(sum(y),0,'measured');
% demodulate the received signal at the base station
parfor i=1:nos

z(i,:)=fmdemod(y(i,:),cfreq(1,i),10*cfreq(1,i),freqdev)
;
end
% display the transmitted signal  and received signal
at the base station
% figure
C = {'k','b','r','g','y',[.5 .6 .7],[.8 .2 .6],[.3 .2
.2]}; % Cell array of colros.
for i=1:nos
    figure (1)
    hold on
```

```
    plot(y(i,:),'color',C{i});
    xlabel('time index'); ylabel('amplitude');
title('Signal from different users combined in the
channel');
    figure
    subplot(3,1,1)
    plot(m(i,:))                % modulating signal
    xlabel('time index'); ylabel('amplitude');
title('modulating Signal from user');
    subplot(3,1,2)
    plot(y(i,:),'color',C{i}); % modulated signal
    xlabel('time index'); ylabel('amplitude');
title('modulated Signal from user');
    subplot(3,1,3)
    plot(z(i,:),'color',C{i}); % demodulated signal
    xlabel('time index'); ylabel('amplitude');
title('demodulated Signal from user at the base
station');
end
figure
plot(ch_op) % combination of all modulated signals
passed through the channel
xlabel('time index'); ylabel('amplitude');
title('Signal after passing through the channel');
```

OUTPUTS

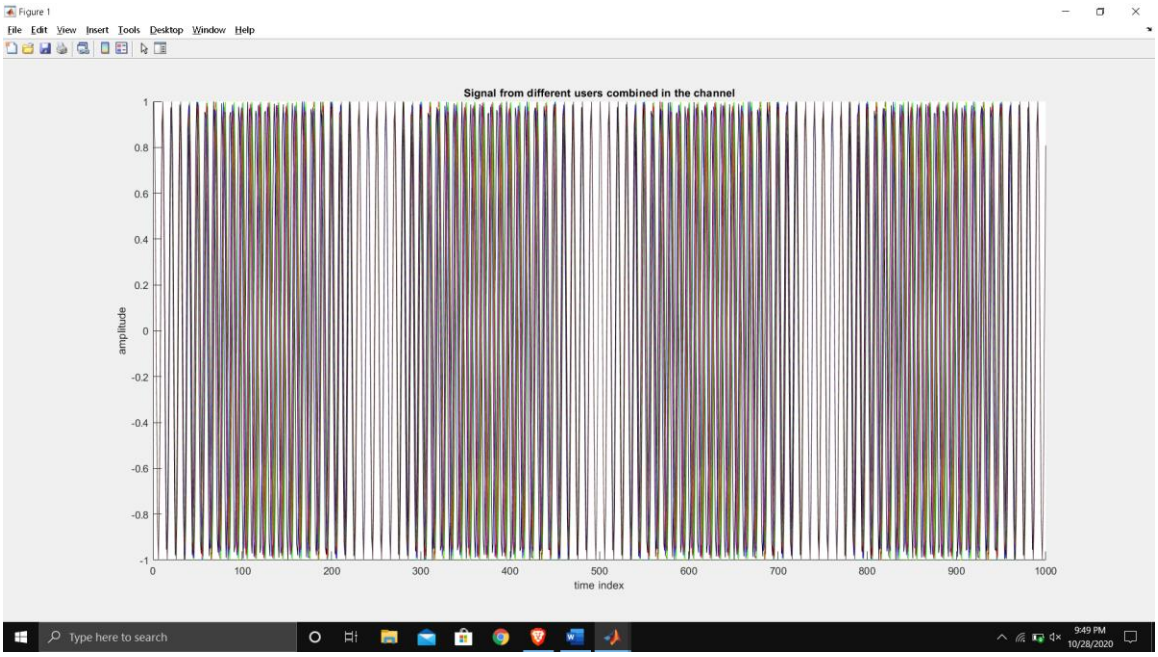


Figure 1
File Edit View Insert Tools Desktop Window Help
Signal from different users combined in the channel
amplitude
time index
Type here to search
9:49 PM
10/28/2020

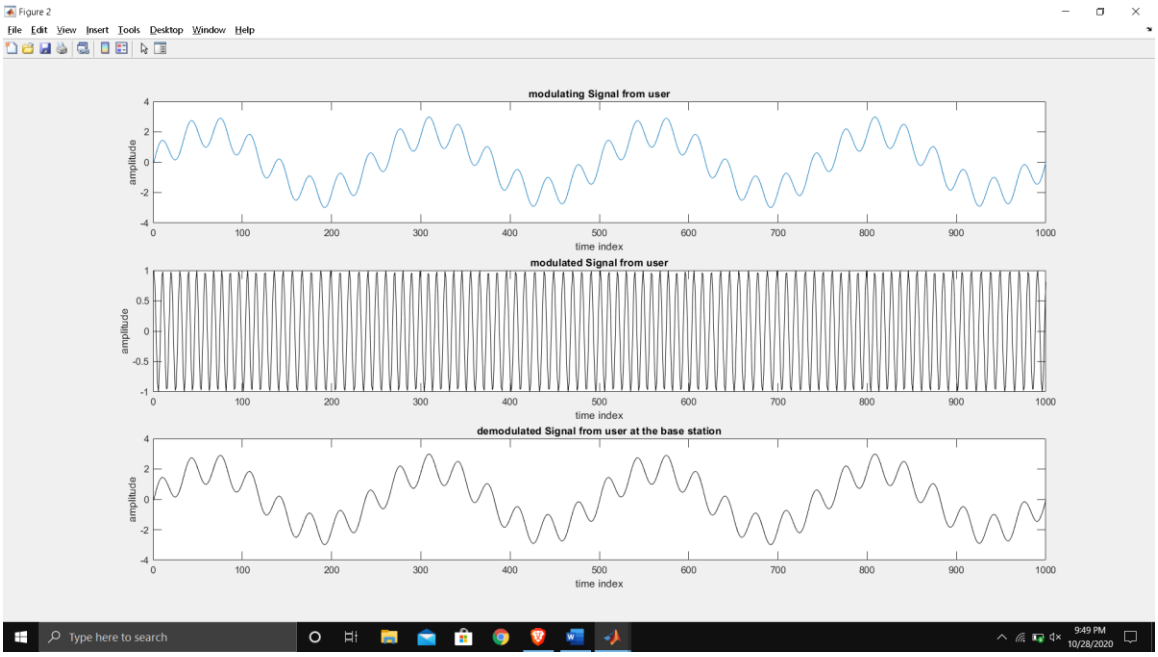


Figure 2
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
modulated Signal from user
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:49 PM
10/28/2020

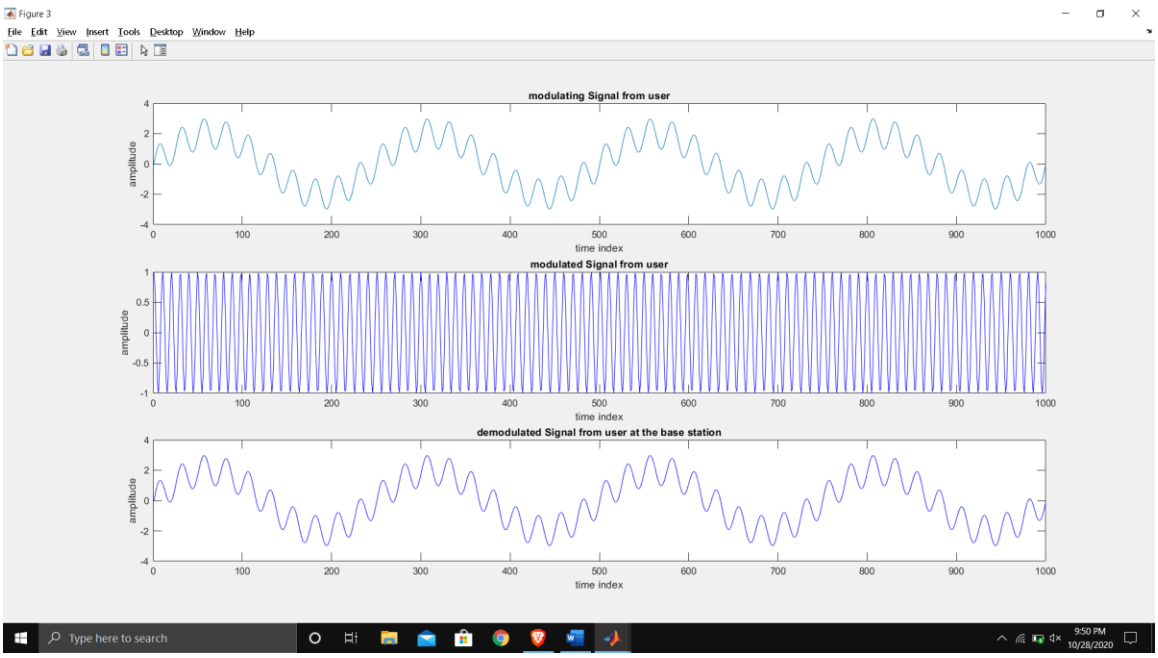


Figure 3
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

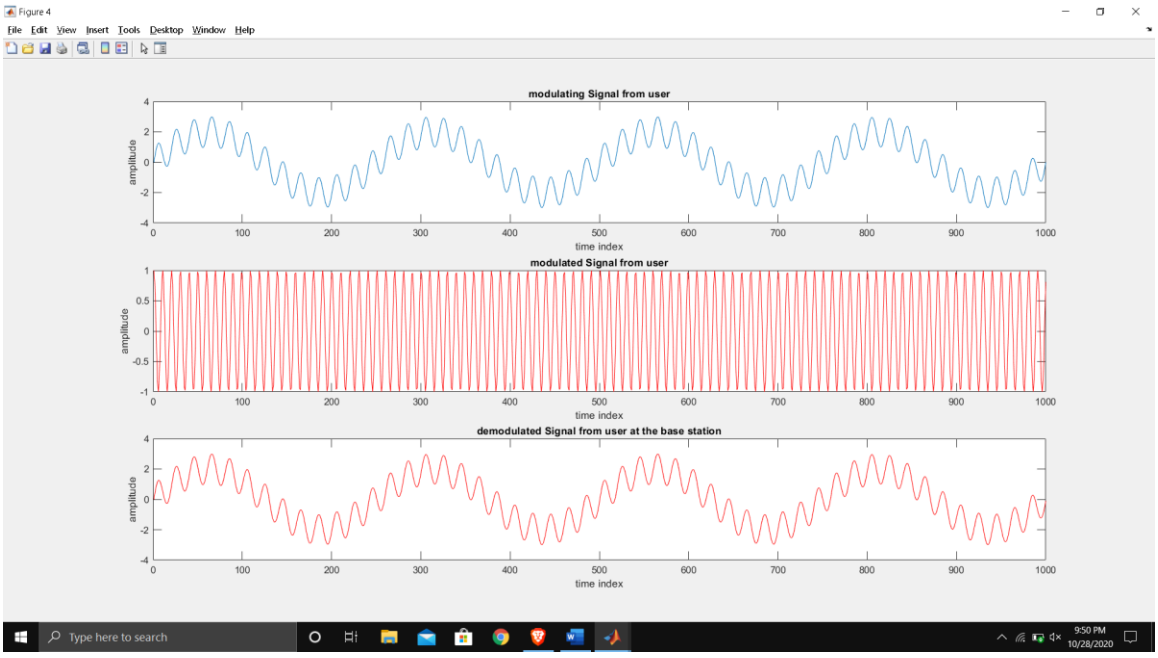


Figure 4
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

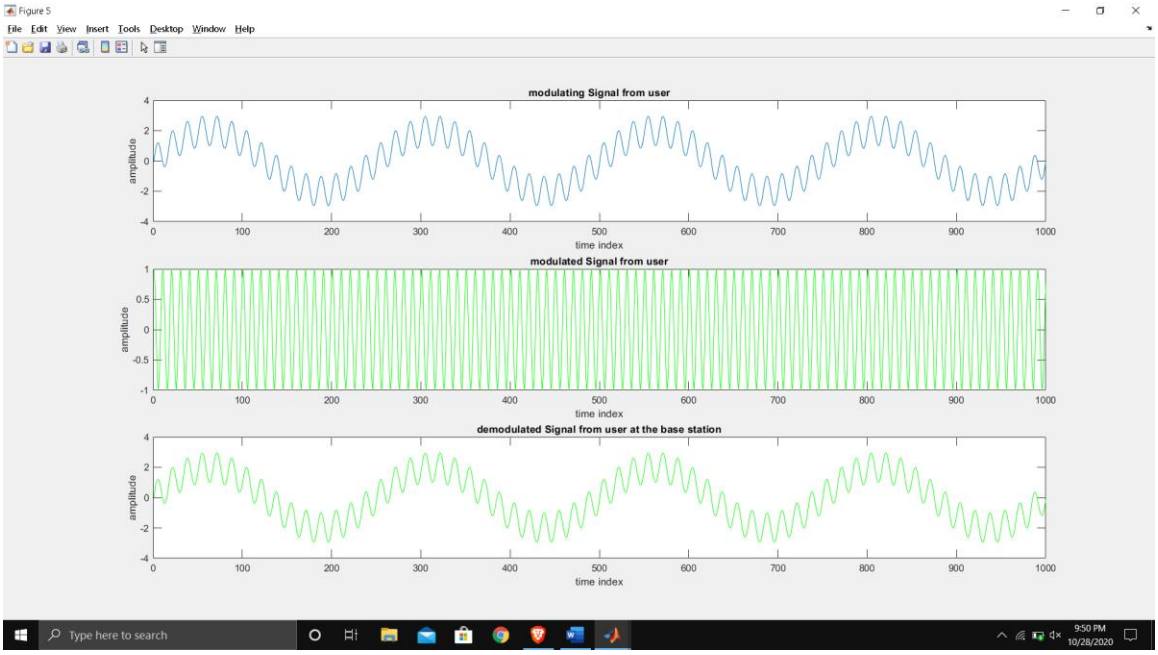


Figure 5
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

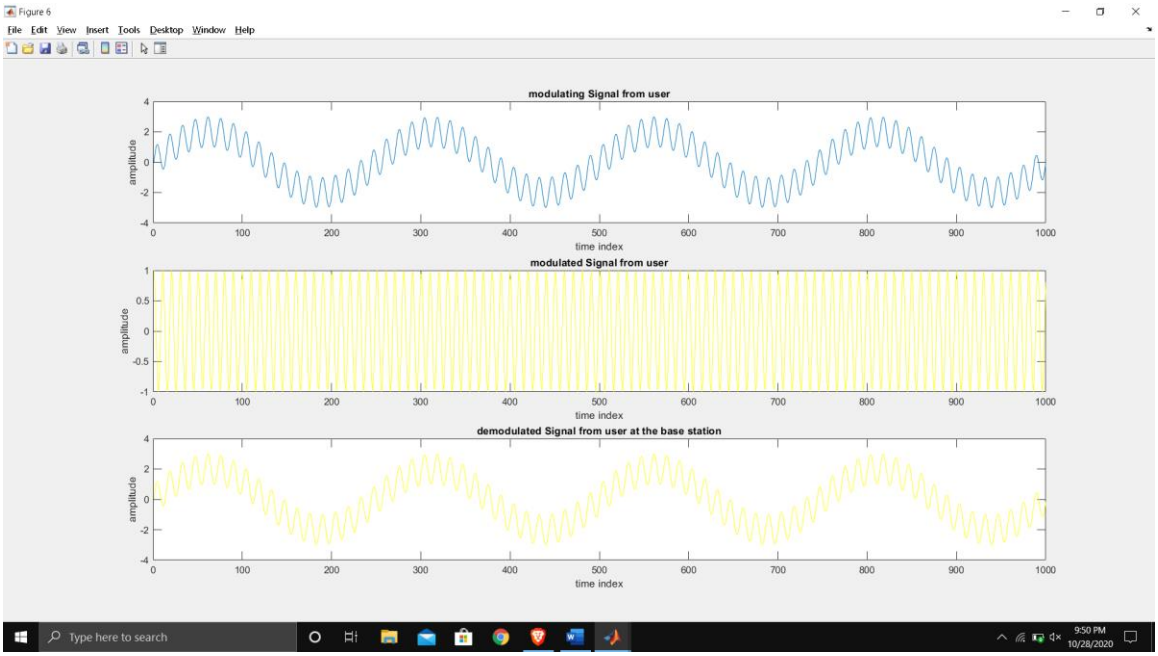


Figure 6
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

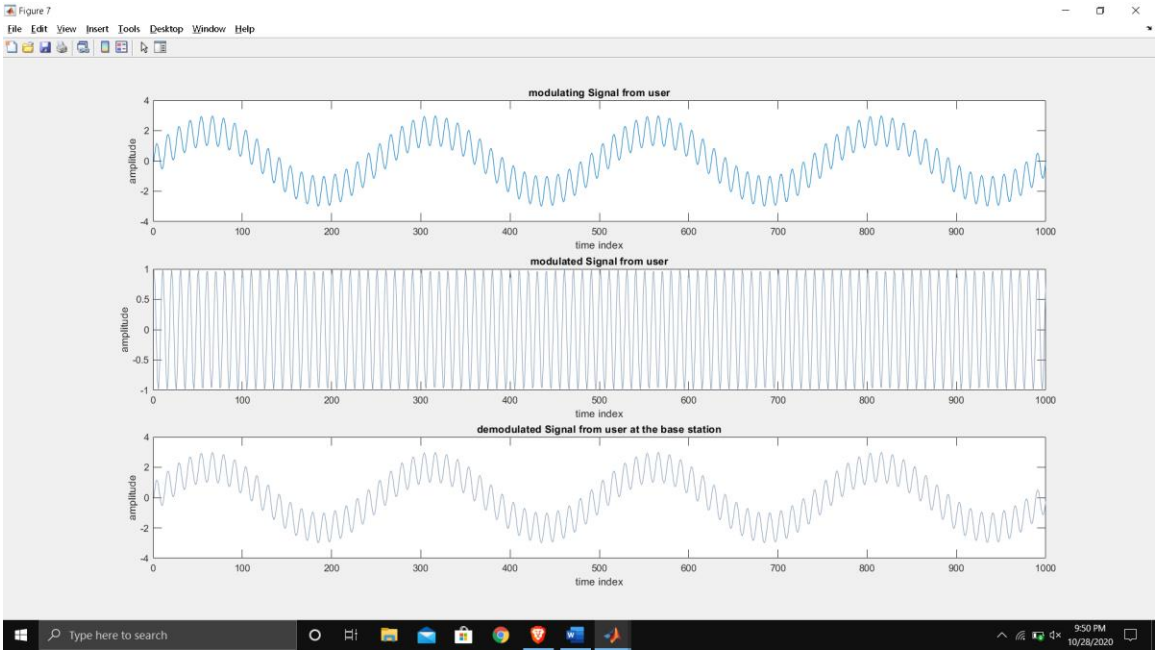


Figure 7
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

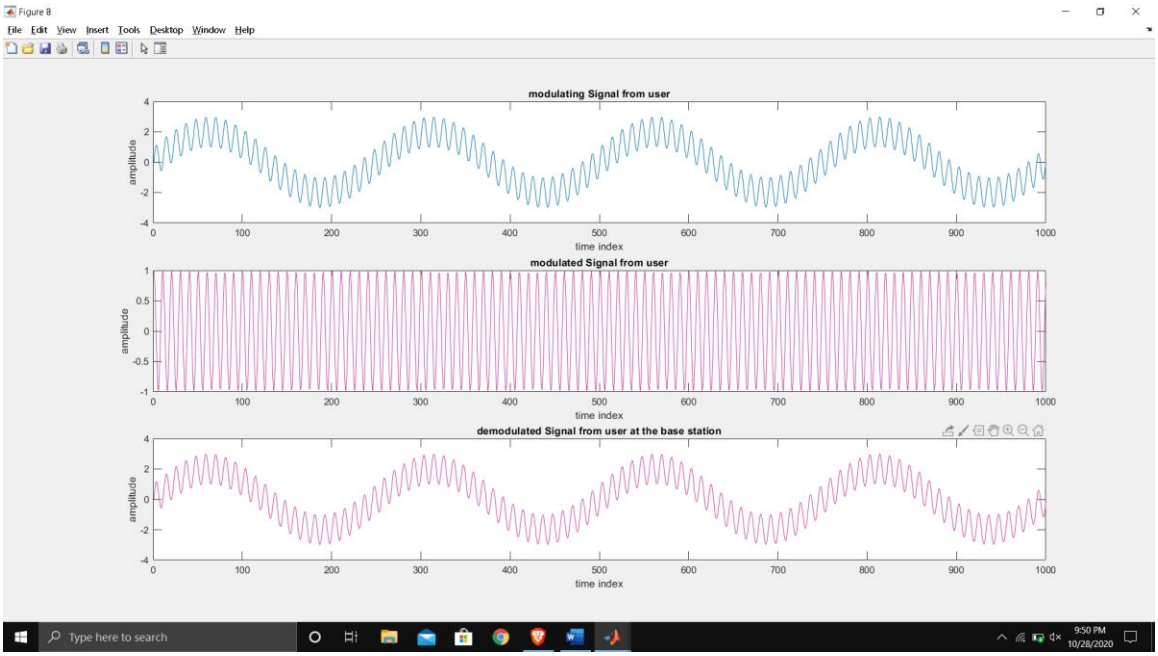


Figure 8
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

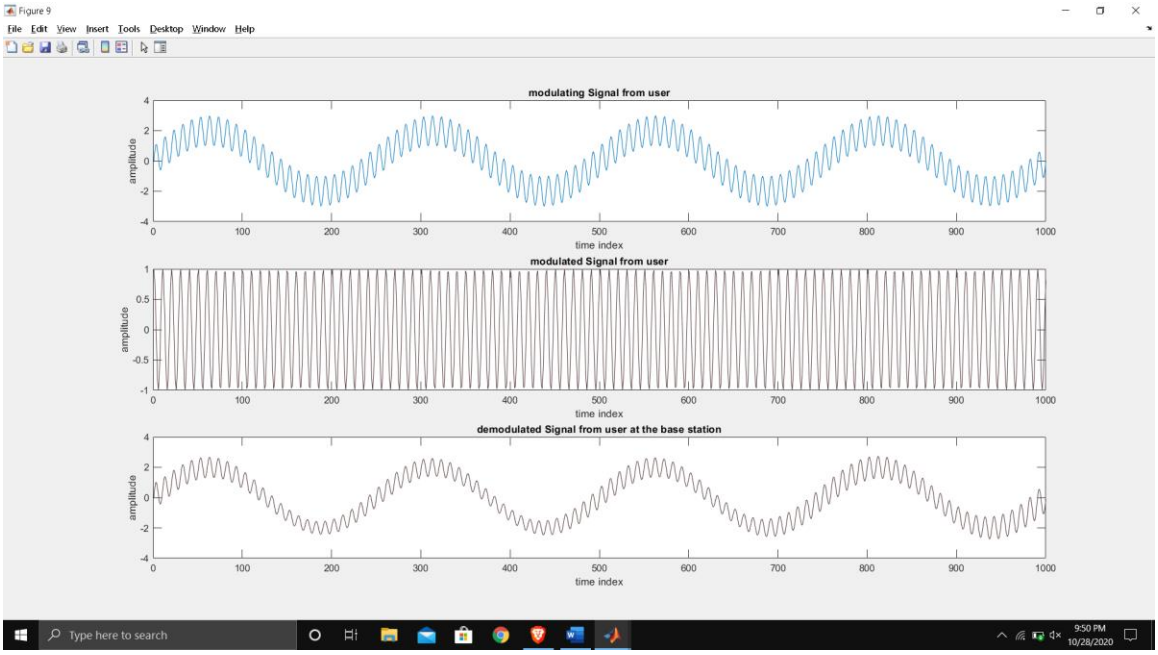


Figure 9
File Edit View Insert Tools Desktop Window Help
modulating Signal from user
amplitude
time index
modulated Signal from user
amplitude
time index
demodulated Signal from user at the base station
amplitude
time index
Type here to search
9:50 PM
10/28/2020

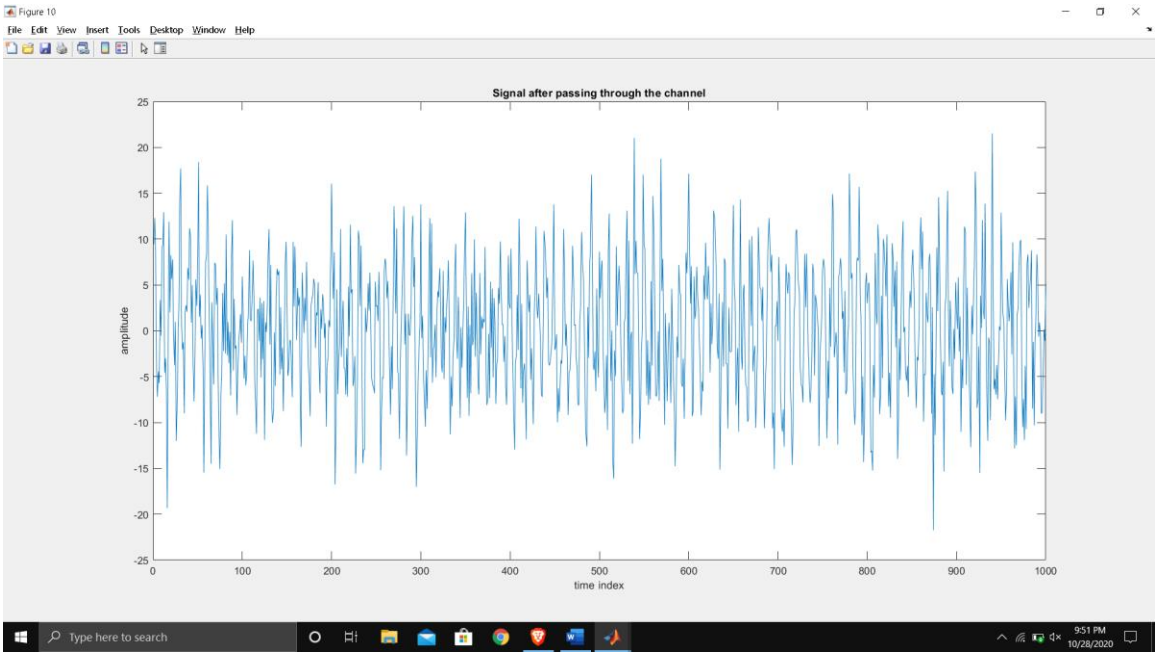


Figure 10
File Edit View Insert Tools Desktop Window Help
Signal after passing through the channel
amplitude
time index
Type here to search
9:51 PM
10/28/2020

Advantages of FDMA

As FDMA systems use low bit rates (large symbol time) compared to average delay spread, it offers the following advantages −

- Reduces the bit rate information and the use of efficient numerical codes increases the capacity.
- It reduces the cost and lowers the inter symbol interference (ISI)
- Equalization is not necessary.
- An FDMA system can be easily implemented. A system can be configured so that the improvements in terms of speech encoder and bit rate reduction may be easily incorporated.
- Since the transmission is continuous, less number of bits are required for synchronization and framing.

Disadvantages of FDMA

Although FDMA offers several advantages, it has a few drawbacks as well, which are listed below −

- It does not differ significantly from analog systems; improving the capacity depends on the signal-to-interference reduction, or a signal-to-noise ratio (SNR).
- The maximum flow rate per channel is fixed and small.
- Guard bands lead to a waste of capacity.
- Hardware implies narrowband filters, which cannot be realized in VLSI and therefore increases the cost.

RESULT AND CONCLUSION (AS PER THE OBJECTIVE)

The use of FDMA and TDMA in cellular environment requires substantial real time coordination in order to use system resources efficiently. Similarly slot-frequency assignment and management could become quite complex in TDMA system . To achieve very little channel coordination, robustness and high capacity than in FDMA and TDMA, Code Division Multiple Access (CDMA) and Orthogonal Frequency Division Multiple Access (OFDMA) are multiple access schemes to be employed.