Sinhgad Institutes

SINHGAD TECHNICAL EDUCATION SOCIETY'S

Sinhgad College of Engineering

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

LAB MANUAL

B.E (Electronics & Telecommunication Engineering)

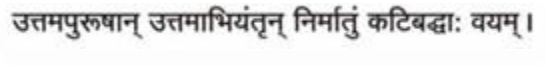
(Course 2019)

MOBILE COMPUTING

Teaching Scheme	Examination Scheme
Practical: 2Hrs/ Week	**TW : 25 Marks**
	PR : 50 Marks

SINHGAD INSTITUTES

VISION



We are committed to produce not only good engineers but good human beings, also.

MISSION

“Holistic development of students and teachers in what we believe in and work for. We strive to achieve this by imbibing a unique value system, transparent work culture, excellent academic and physical environment conducive to learning, creativity and technology transfer. Our mandate is to generate, preserve and share knowledge for developing a vibrant society”.

SINHGAD COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

MISSION

To create an ambience and provide broad based education where students are urged to develop new ideas and professional skills in equilibrium with the needs of the nation.

VISION

Department of Electronics & Telecommunication Engineering shall continue to innovate and practice the processes to propel development in engineering education, keeping excellence in focus and render services to match the needs of technical education system, industry and society.

CERTIFICATE

This is to certify that Mr. /Ms._____
of class BE E&TC Div. Roll No._____Examination Seat No._____ PRN No._____
has completed all the practical work in the ***Mobile Computing Lab*** *satisfactorily, as prescribed by Savitribai Phule Pune University, Pune in the academic year 2023 -24 (Semester II).*

Practical Teacher **Head of Department** **Principal**

Date :-

Place:-

Sinhgad Institutes

SINHGAD COLLEGE OF ENGINEERING, PUNE – 41

Department of Electronics & Telecommunication Engineering

List of Practicals

Subject: 404191 (E): Mobile Computing (Elective - V)

Year: 2023 – 24 **Class:** B. E. **Semester – II**

Experiment No	Title of Experiment	Signature
1	Simulate to elaborate operation of multiple access techniques for CDMA.	
2	Study of GSM architecture and signaling techniques.	
3	Study of GPRS services.	
4	Simulate BER performance over Rayleigh Fading wireless channel with BPSK transmission for SNR 0 to 60 dB.	
5	Configuring a Cisco Router as a DHCP Server.	
6	To understand the handover mechanism.	
7	To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC (Flat Fading).	
8	To Perform File Transfer in Client & Server Using TCP/IP.	
9	**To Study AWGN channel and to measure Bit Error Rate.**	
	Case Study on different real time mobile computing services.	

Savitribai Phule Pune University, Pune
B.E. (Electronics & Telecommunication) 2019 Course
(With effect from Academic Year 2022-23)

Semester-VIII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
404190	Fiber Optic Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
404191	Elective - 5	03	-	-	30	70	-	-	-	100	03	-	-	03
404192	Elective - 6	03	-	-	30	70	-	-	-	100	03	-	-	03
404193	Innovation & Entrepreneurship	-	-	02	-	-	50	-	-	50	-	-	02	02
404194	Digital Business Management	-	-	02	-	-	50	-	-	50	-	-	02	02
404195	Fiber Optic Lab	-	02	-	-	-	25	-	50	75	-	01	-	01
404196	Lab Practice - 3 (Elective - 5)	-	02	-	-	-	25	50	-	75	-	01	-	01
404197	Project Stage - II	-	10	-	-	-	100	-	50	150	-	05	-	05
	Total	**09**	**14**	**04**	**90**	**210**	**250**	**50**	**100**	**700**	**-**	**-**	**-**	**-**
									Total Credits		**09**	**07**	**04**	**20**

Elective - 5	Elective - 6
1. Biomedical Signal Processing	1. System on Chip
2. Industrial Drives & Automation	2. Nano Electronics
3. Android Development	3. Remote Sensing
4. Embedded System Design	4. Digital Marketing
5. Mobile Computing	5. Open Elective

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404191 (E): Mobile Computing (Elective - V)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Basics of Communication Technologies.
2. Fundamental of Networking

Companion Course, if any:

Course Objectives:

1. To learn Wireless technologies and planning Ad-hoc Network.
2. To study the basics of wireless, cellular technology and the working of Mobile IP, ad hoc network, features of mobile operating systems.
3. To understand the use of M-Commerce application.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Understand concepts of Mobile Communication.

CO2: Analyse next generation Mobile Communication System.

CO3: Understand network layers of Mobile Communication.

CO4: Understand IP and Transport layers of Mobile Communication.

CO5: Study of different mathematical models.

CO6: Understand different mobile applications.

Course Contents

Unit I	Introduction to Mobile Computing	6 Hrs.

Introduction to Mobile Computing: Applications of Mobile Computing- Generations of Mobile Communication Technologies, Multiplexing: Spread spectrum, MAC Protocols: SDMA, TDMA, FDMA, and CDMA.

Mapping of Course Outcomes for Unit I	CO1: Understand concepts of Mobile Communication.

Unit II	Mobile Telecommunication System	7 Hrs.

Introduction to Cellular Systems, GSM architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS and UMTS: Architecture, Handover, Security.

Introduction to 5G: Introduction, 5G network architecture, Applications, 5G enable technologies, Recent trends in Telecommunication Industries.

Mapping of Course Outcomes for Unit II	CO2: Analyse next generation Mobile Communication System.

Unit III	Network Layer	6 Hrs.
Mobile IP, DHCP, AdHoc, Proactive protocol-DSDV, Reactive Routing Protocols: DSR, AODV, Hybrid routing: ZRP, Multicast Routing: ODMRP, Vehicular Ad Hoc networks (VANET), MANET Vs VANET: Security.		
Mapping of Course Outcomes for Unit III	**CO3: Understand network layers of Mobile Communication.**	
Unit IV	**Mobile IP and Transport Layer**	**8 Hrs.**
Mobile IP: Need of mobile IP, IP packet delivery, Agent Discovery, Registration, Tunnelling and encapsulation, Route optimization, IP Handoff. **Transport Layer:** Overview of Traditional TCP and implications of mobility control. Improvement of TCP: Indirect TCP, Snoop TCP, Mobile TCP, Fast Retransmit/fast recovery, Time-out freezing, Selective retransmission, Transaction-oriented TCP.		
Mapping of Course Outcomes for Unit IV	**CO4: Understand IP and TCP layers of Mobile Communication.**	
Unit V	**Fading Channels**	**7 Hrs.**
Rayleigh Fading and Statistical Characterization, Properties of Rayleigh Distribution, BER in Fading, Narrowband vs Wideband Channels, Characterization of Multipath Fading Channels, Choice of Modulation, Coherent versus Differential Detection, BER in Fading , Ricean Fading.		
Mapping of Course Outcomes for Unit V	**CO5: Study of different mathematical models.**	
Unit VI	**Operating System & Applications of Mobile Computing**	**8 Hrs.**
Operating System: A Few Basic Concepts, Special Constraints and Requirements of Mobile OS, A Survey of Commercial Mobile Operating Systems, Windows Mobile, Palm OS, Symbian OS, iOS, Android, Blackberry OS, A Comparative study of Mobile OS, OS for sensor Network. **Applications:** M-Commerce, Business to Consumer (B2C) Applications, Business to Business (B2B) Applications. Structure of M-Commerce, Pros and Cons of M-Commerce, Mobile Payment System, Mobile Payment Schemes, Desirable properties of a Mobile Payment system, Mobile Payment solutions, Process of Mobile Payment, Security Issues.		
Mapping of Course Outcomes for Unit VI	**CO6:** Understand different mobile applications.	

Learning Resources

Text Books:

1. Clint Smith, Daniel Collins, "Wireless Networks", 3rd Edition, McGraw Hill Publications,
2. Share Conder, Lauren Darcey, "Android Wireless Application Development", Volume I, 3rd Edition, Pearson.

Reference Books:

1. Jochen Schiller, "Mobile Communications", 2nd Edition, Pearson.
2. Paul Bedell, "Cellular networks: Design and Operation – A real world Perspective", Outskirts Press.
3. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, "Programming Android", O"Reilly.
4. Alasdair Allan, "iPhone Programming", O"Reilly.
5. Donny Wals, "Mastering iOS 12 Programming".
6. Reza B"Far, "Mobile Computing principles", Cambridge University Press.

MOOC / NPTEL Courses:

1. NPTEL Course **"**Mobile Computing**"b**y Prof. Sridhar Iyer and Prof. Pushpendra Singh IIT Madras

   Link of the Course: https://nptel.ac.in/courses/106106147

2. NPTEL Course **"Funadamentals of MIMO Wireless Communication"** by Prof. Suvra Sekhar Das IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/117105132

3. NPTEL Course **"Principles of Modern CDMA/MIMO//OFDM Wireless Communications"** by Prof. Aditya. K. Jagannatham IIT Kanpur
   Link of the Course: https:// nptel.ac.in/courses/117104115

Subject: Mobile Computing (Elective - V)	
List of Experiments (Any 8 to be performed)	
1.	Simulate to elaborate operation of multiple access techniques for CDMA.
2.	Study of GSM architecture and signaling techniques.
3.	Study of GPRS services.
4.	Simulate BER performance over Rayleigh Fading wireless channel with BPSK transmission for SNR 0 to 60 dB.
5.	Configuring a Cisco Router as a DHCP Server.
6.	To understand the handover mechanism. **http://vlabs.iitkgp.ernet.in/fcmc/exp8/index.html**
7.	To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC (Flat Fading). **http://vlabs.iitkgp.ernet.in/fcmc/exp9/index.html**
8.	To Perform File Transfer in Client & Server Using TCP/IP.
9.	Case Study on different real time mobile computing services.

Virtual LAB Links:

1. **http://vlabs.iitkgp.ernet.in/fcmc/** **(Fading Channels and Mobile Communication Lab.)**

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Sinhgad Technical Educational Society's
SINHGAD COLLEGE OF ENGINEERING
VADGAON PUNE-41
Department of Electronics & Telecommunication

Experiment No. _

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

TITLE:

To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonally & autocorrelation of a code to be used for CDMA operation.

AIM:
Basic function of Code Division Multiple Access (CDMA).

OBJECTIVES:

To understand function of CDMA used to testorthogonally and autocorrelation of a code

SOFTWARE & HARDWARE REQUIREMENTS:

OS.: Unix or windows 7/8/10,

Processor: i3/i5/i7

Software: Python (Jupyter Notebook) or java

THEORY-CONCEPT

CDMA stands for Code Division Multiple Access. It is a digital cellular standard that utilizes spread Spectrum Technology. It spreads the signal over a fully available spectrum or over multiple channels through division. It is a channelization protocol for Multiple Access, where information can be sent simultaneously through several transmitters over a single communication channel.

It is achieved in below steps: A signal is generated which extends over a wide bandwidth. The code which performs this action is called spreading code. Later, a specific signal can be selected with a given code even in the presence of many other signals. It is mainly used in mobile networks like 2G and 3G. It is a more secure and private line. It has good voice and data communication capabilities.

Procedure or Working

1.The station encodes its data bit as follows.

If bit = 1 then +1 If bit = 0 then -1

no signal (interpreted as 0) if station is idle

2. Each station is allocated a different orthogonal sequence (code) which is N bit long for N stations
3. Each station does a scalar multiplication of its encoded data bit and code sequence.
4. The resulting sequence is then stored on the channel.
5. Since the channel is common, amplitudes add up and hence resultant channel sequence is the sum of sequences from all channels.
6. If station 1 wants to listen to station 2, it multiplies (inner product) the channel sequence with code of station S2.
7. The inner product is then divided by N to get data bit transmitted from station 2.

How does CDMA work?

To see how CDMA works, we must understand orthogonal sequences (also known as chips).

Let N be the number of stations establishing multiple access over a common channel.

Then the properties of orthogonal sequences can be stated as follows:

An orthogonal sequence can be thought of as a 1xN matrix.

Eg: [+1 -1 +1 -1] for N = 4.

Scalar multiplication and matrix addition rules follow as usual.

Eg: 3.[+1 -1 +1 -1] = [+3 -3 +3 -3]

Eg: [+1 -1 +1 -1] + [-1 -1 -1 -1] = [0 -2 0 -2]

Inner Product: It is evaluated by multiplying two sequences element by element and then adding all elements of the resulting list.

Inner Product of a sequence with itself is equal to N

[+1 -1 +1 -1].[+1 -1 +1 -1] = 1 + 1 + 1 + 1 = 4

Inner Product of two distinct sequences is zero

[+1 -1 +1 -1].[+1 +1 +1 +1] = 1-1+1-1 = 0

Code:

```
import numpy as np c1=[1,1,1,1] c2=[1,-1,1,-1] c3=[1,1,-1,-1] c4=[1,-1,-1,1] rc=[]

print("Enter the data bits :")

d1=int(input("Enter D1 :")) d2=int(input("Enter D2 :")) d3=int(input("Enter D3 :"))
d4=int(input("Enter D4 :")) r1=np.multiply(c1,d1) r2=np.multiply(c2,d2) r3=np.multiply(c3,d3)
r4=np.multiply(c4,d4) resultant_channel=r1+r2+r3+r4;
print("Resultant Channel",resultant_channel)
Channel=int(input("Enter  the station to listen for C1=1 ,C2=2, C3=3 C4=4 : "))

if Channel==1:
rc=c1
elif Channel==2:
rc=c2
elif Channel==3:
rc=c3
elif Channel==4:
rc=c4
inner_product=np.multiply(resultant_channel,rc)

print("Inner Product",inner_product) res1=sum(inner_product)

data=res1/len(inner_product)
print("Data bit that was sent",data)
```

CONCLUSION:

QUESTIONS:

1. Write a note on MAC Protocol?

2. Write down difference between FDMA TDMA and CDMA?

Marks (Out of 20)				Signature of Faculty with Date
MR (6)	MP (6)	MU (8)	Total (20)	
MR – Marks for Regularity, MP – Marks for Presentation, MU – Marrk for Understanding				

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Sinhgad Technical Educational Society's
SINHGAD COLLEGE OF ENGINEERING
VADGAON,PUNE-41

Department of Electronics and Telecommunications

Experiment No. –

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

Title: Study of GSM architecture and signaling techniques.

INTRODUCTION

The development of Global System for Mobile Communication (GSM) started in 1982 when the Conference of European Posts and Telegraphs (CEPT) formed a study group called Groupe Special Mobile (the initial meaning of GSM) whose aim was to study and develop a pan-European public cellular system in the 900 MHz range [6]. Some of the basic criteria for their proposed system were

- Good subjective speech quality
- Low terminal and service cost
- Support for international roaming
- Ability to support handheld terminals
- Support for range of new services and facilities
- Spectral efficiency
- ISDN compatibility

Commercial operation of GSM networks started in mid-1991 in European countries. By the beginning of 1995, there were 60 countries with operational or planned GSM networks in Europe, the Middle East, the Far East, Australia, Africa, and South America, with a total of over 5.4 million subscribers. GSM uses a mixture of both Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA). FDMA parts include the division by frequency of the 25 MHz bandwidth into 124 carrier frequencies spaced 200 MHz for GSM900. TDMA further divides each carrier frequencies into 8-time slots such that each carrier frequency is shared by 8 users. In GSM, the basic radio resource is a time slot with duration of 577 µs. 8 Time slots of 577 µs constitute a 4.615 ms TDMA Frame. GSM uses Gaussian Minimum Shift Keying (GMSK) modulation scheme to transmit information over Air Interface. GSM uses number of channels to carry data over air interface; these channels are broadly divided into following two categories:

- Physical Channels
- Logical Channels

This paper is divided into five parts. Starting with an introduction (Section-I), next section covers the need of GSM (Section-II). Moving ahead, GSM architecture is discussed (Section-III). Next section is about the interfaces in between the GSM subsystems (Section-IV). After that GSM channels are discussed (Section-V). This section is about the call origination using GSM channels (Section-VI). Finally, conclusions summarize the last section (Section-VII).

NEED OF GSM

Features of GSM that account for its popularity and wide acceptance are listed below.

- Improved spectrum efficiency
- International roaming
- Low-cost mobile sets and base stations (BSs)
- High-quality speech
- Compatibility with Integrated Services Digital Network (ISDN) and other telephone company services
- Support for new services.

Architecture

GSM architecture is classified into three subsystems i.e., BSS, NSS, and OSS.

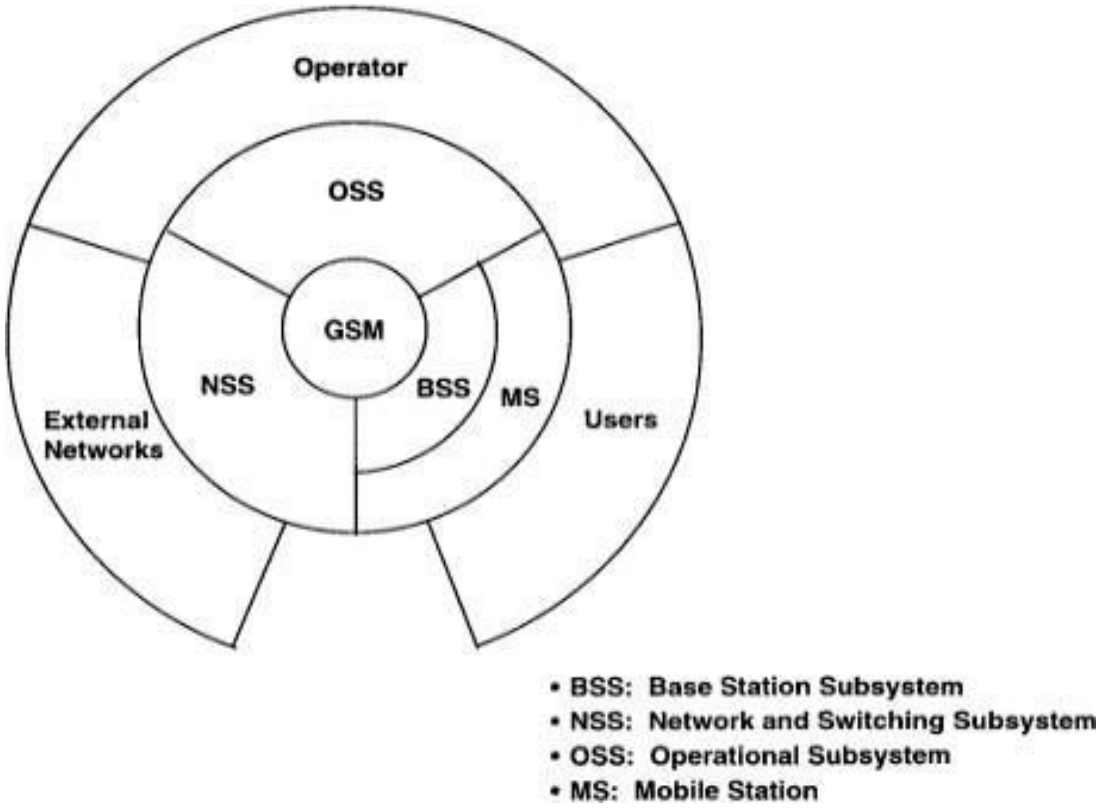

Fig: Basic Architecture

The BSS provides and manages communication paths between the MSs and the NSS. It includes management of the radio interface between MSs and the whole GSM system. The NSS has the province of managing communications and linking MSs to the relevant networks or other MS's. Neither NSS is in direct contact with the MSs, nor is the BSS in direct contact with external networks. In the GSM, interaction between the subsystems can be grouped into two main parts:

- **Operational:** External networks to or from NSS to or from BSS to or from MS to or from subscriber
- **Control:** OSS to or from service provider

1. GSM Subsystem Entities

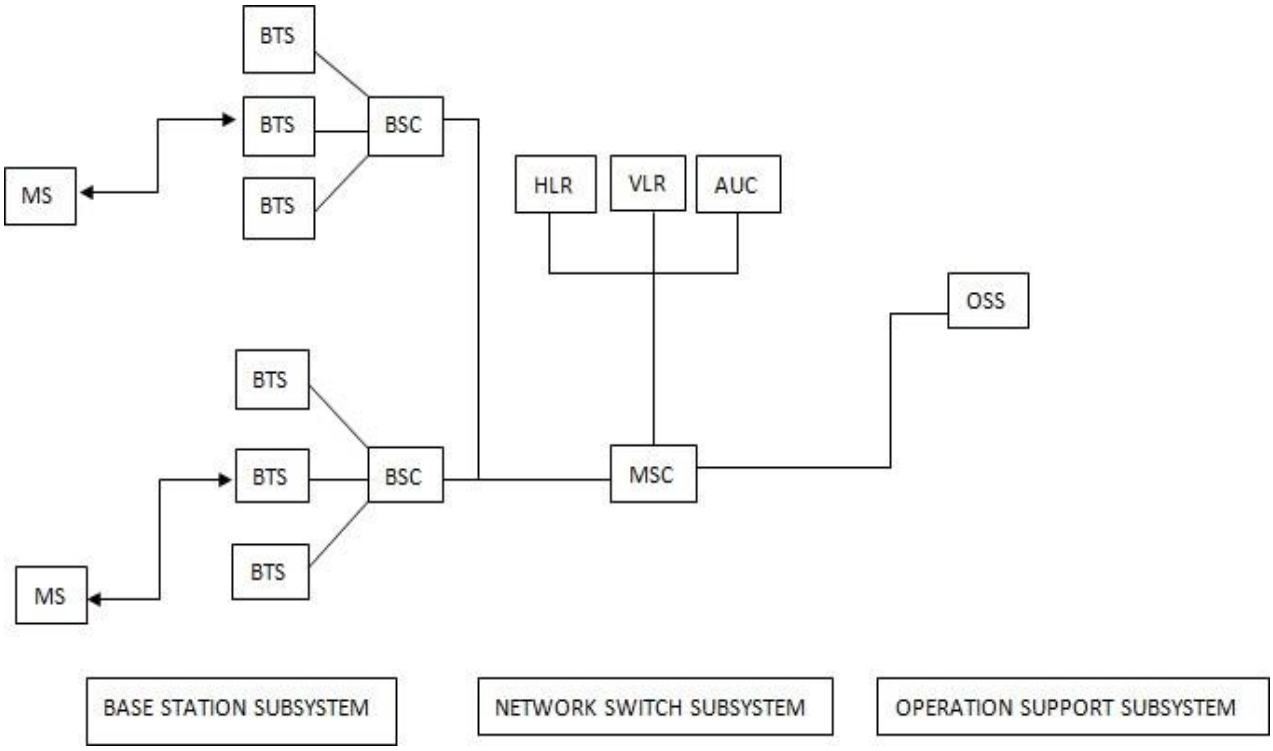

Fig: GSM Architecture

a) Mobile Station (MS):

A Mobile Station is used by a mobile subscriber to communicate with the cellular system. GSM MSs consist of:

- A mobile terminal
- A Subscriber Identity Module (SIM)

b) Base Station Subsystem (BSS):

BSS is the section which is responsible for handling and signaling traffic between a MS and the NSS It consists of these two devices:

- **Base Transceiver System (BTS) -** The BTS is the radio equipment. It handles the radio interface to the mobile station. A group of BTSs is controlled by a BSC.
- **Base Station Controller (BSC) -** The BSC is a high-capacity switch which provides all the control functions and physical links between the MSC and BTS such as handover, cell configuration data, and control of radio frequency (RF) power levels in base transceiver stations. Several BSCs are served by an MSC.

c) Network Switching Subsystem (NSS):

The NSS main role is to manage the communications between GSM and other network users. Another task of it includes the main switching functions of GSM, databases required for the subscribers, and mobility management.

- **Mobile Station Controller (MSC):** The MSC is the central unit of NSS. It performs the telephony switching functions of the system. It controls the traffic among all the BSCs.
- **Home Location Receiver (HLR):** The HLR is the functional unit used for management of mobile subscribers. The information stored in it are subscriber's identity, location, and authentication. It acts as a permanent store for a person's subscription information until that subscription is canceled.
- **Visitor Location Receiver (VLR):** The VLR is the functional unit which temporarily stores subscription information so that the MSC can service all the subscribers currently visiting that MSC service area. The VLR is regarded as distributed HLR because it holds a copy of the HLR information stored about the subscriber.
- **Authentication Centre (AUC):** The AUC is a database connected to the HLR which provides it with the authentication parameters and ciphering keys used to ensure network security.

d) Operation Support Subsystem (OSS):

The operations and maintenance center (OMC) are connected to all equipment in the switching system and to the BSC. The implementation of OMC is called the operation support system (OSS). The OMC provides a single point for the maintenance personnel to maintain the entire system. One OMC can serve multiple MSCs.

I. GSM INTERFACES

The interfaces between various elements of the GSM network facilitates the information interchange. It also enables the case that network elements from different manufacturers can be used

- **Um interface:** This interface is linking the Mobile Equipment (ME) and the Base Station (BTS/BSC). It exchanges information in air.

- **Abis interface:** This interface is linking the BSC and a BTS, and it has not been totally standardized. It is an internal interface as the BTS and the BSC are both part of the BSS. The Abis interface allows control of the radio equipment and radio frequency allocation in the BTS.
- **An interface:** This interface is linking the BSS and the MSC. This interface carries information to enable the channels, timeslots. The messaging required within the network to enable handover etc. to be undertaken is carried over this interface.
- **B interface:** This interface is linking the MSC and the VLR. It uses a protocol known as the MAP/B protocol, the letter "B" indicating that the protocol is used for "B" interface. This is an internal interface as the VLR is a part of the MSC. The interface is used by the MSC when it needs to access data regarding a MS located in its area.
- **C interface:** This interface is linking the HLR and the MSC. The protocol used for communication is MAP/C, the letter "C" indicating that the protocol is used for the "C" interface. It helps in communication between the MSC and the HLR regarding various aspects, for example, subscriber information.
- **D interface:** This interface is linking the VLR and the HLR. It uses the MAP/D protocol, the letter "D" indicating that the protocol is used for the "D" interface. It is used to exchange the data related to the location of the Mobile Equipment and to the management of the subscriber.
- **E interface:** This interface is linking two MSCs. The E interface exchanges data related to handover between the two MSCs. It uses the MAP/E protocol, the letter "E" indicating that the protocol is used for the "E" interface.
- **F interface:** This interface is linking the MSC and EIR. It uses the MAP/F protocol, the letter "F" indicating that the protocol is used for the "F" interface. The communications along this interface are used to confirm the status of the International Mobile Equipment Identity (IMEI) of the Mobile Equipment (ME) gaining access to the network.
- **H interface:** This interface is linking the MSC and the AUC. It uses the MAP/H protocol, the letter "H" indicating that the protocol is used for the "H" interface. It transfers short messages.
- In a system, information flows forward, backward and sideways. This information flow is referred to as communication. Communication channels refer to the way this information flows within the system

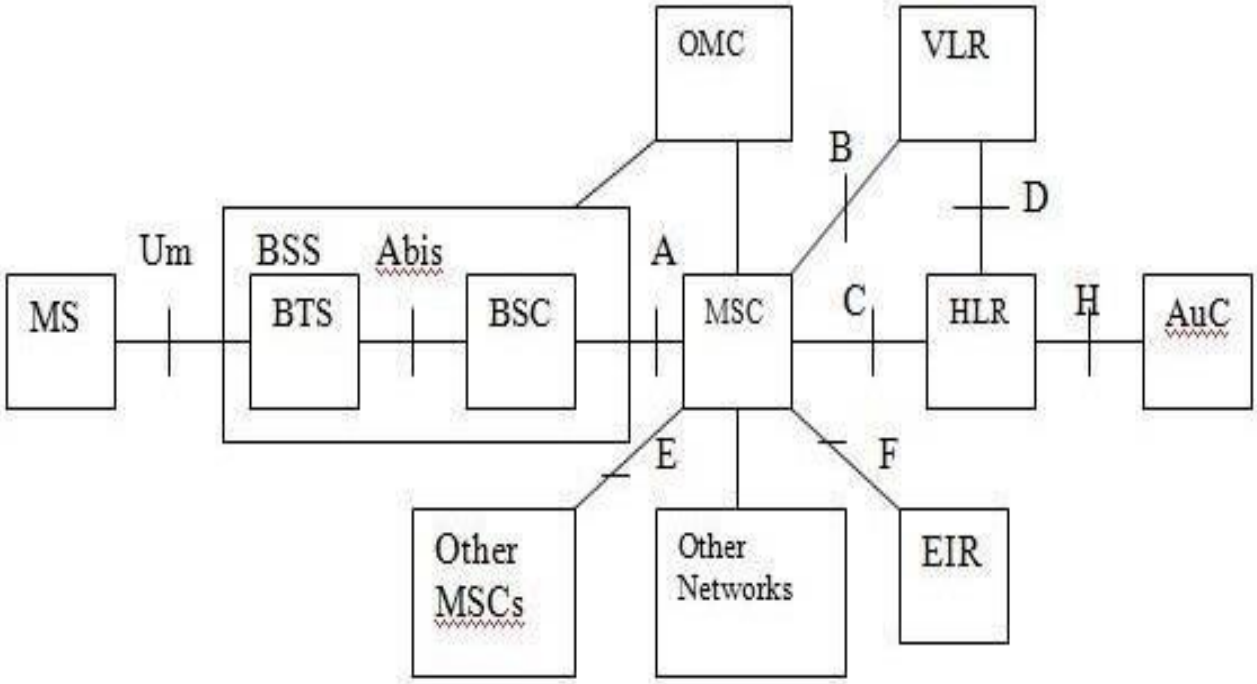

Fig: GSM Interfaces

I. GSM CHANNELS

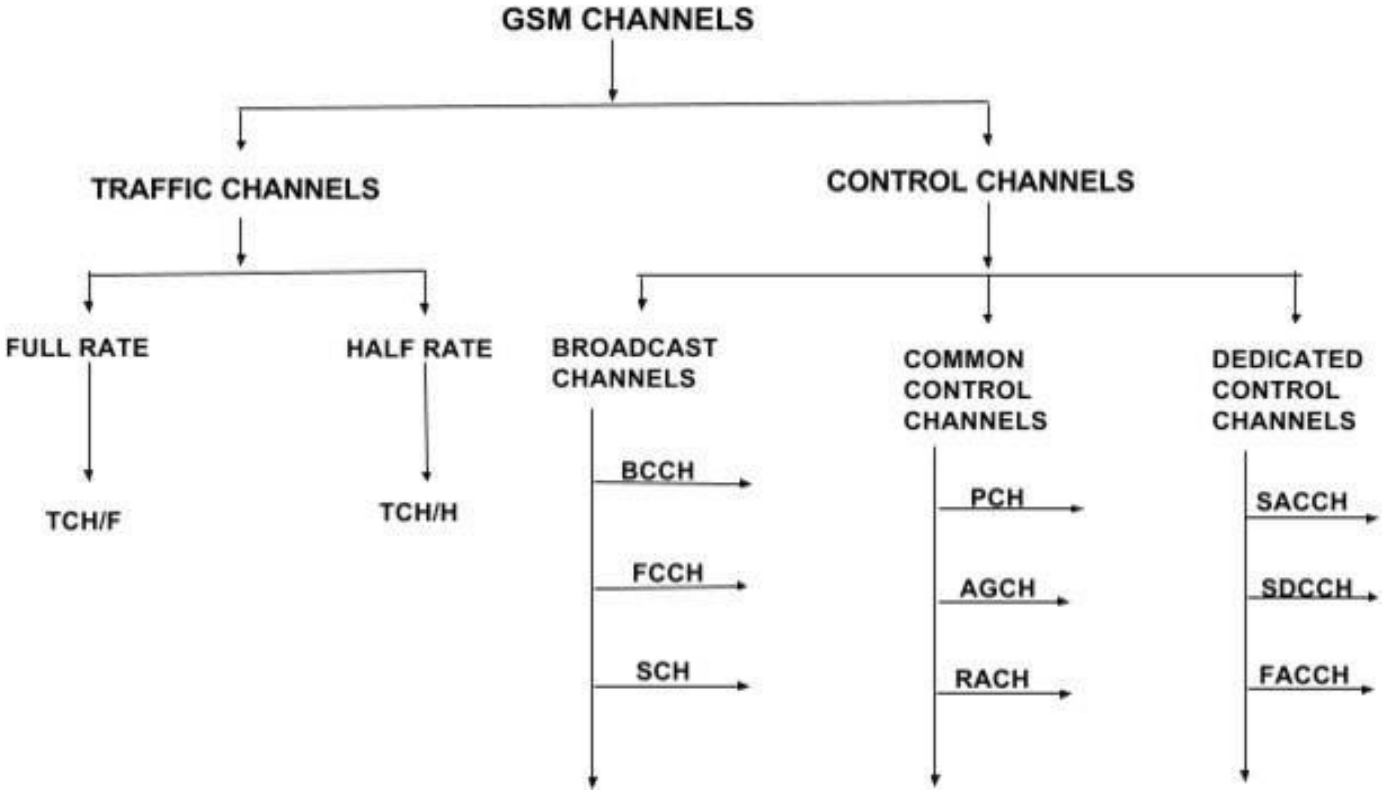

Fig: GSM Channels

1. **Traffic Channels (TCH):** This channel carries digitally encoded user's speech or data and has identical functions and formats on both the forward and reverse link.

   a) **Full Rate Traffic Channels (TCH\F):** This channel carries information at a rate of 22.8 Kbps.

   b) **Half Rate Traffic Channels (TCH\H):** This channel carries information at a rate of 11.4 Kbps.

2. **Control Channels (CCH):** This channel carries control information to enable the system to operate correctly. There are three main categories of control channels in GSM which are further divided into several categories:

1. **Broadcast Channels (BCH):** The broadcast channel operates on the forward link of a specific Absolute Radio Frequency Channel Number (ARFCN) within each cell, and transmits data only in the first time slot (TS0) of certain GSM frames.

   a) **Broadcast Control Channels (BCCH) – DOWNLINK**

   This channel broadcasts network and cell specific information required to identify the network and gain access.

   b) **Frequency Control Channels (FCCH) – DOWNLINK**

   This channel contains frequency correction bursts which are used by the mobiles for frequency correction. It bears information for frequency synchronization. It allows each subscriber unit to synchronize its internal frequency standard to the exact frequency of the base station.

   c) **Synchronization Channel (SCH) – DOWNLINK**

   This channel is used by the MS to learn the Base Station Information Code (BSIC) as well as the TDMA frame number (FN). There are 6 bits of BSIC which have two parts; 3 bits NCC and 3 bits BCC. NCC stands for Network Color Code and used to identify the BTS for which measurement is made. BCC stands for Base Station Color Code and used for a better transmission in case of interference. BICS avoids ambiguity or interference.

2. **Common Control Channels (CCCH):** This channel is responsible for transferring control information between all mobiles and the BTS. It is necessary for call origination.

a) Paging Channel (PCH) – DOWNLINK

This channel is used for alerting to Mobile Subscribers for incoming calls, SMS, and other mobility services. Every MS in a cell periodically listens to this channel.

b) Random Access Channel (RACH) – UPLINK

This channel is used to send a request to the network for a dedicated resource to the MS. If the request is not granted within a specific time period by the network, the MS repeats the request on the RACH.

c) Access Grant Channel (AGCH) - DOWNLINK

This channel is used by a BTS to notify the MS of the assignment of a dedicated control channel.

3. **Dedicated Control Channels (DCCH):**

Like traffic channels, they are bidirectional and have the same format and function on both the forward and reverse links.

a) Standalone Dedicated Control Channel (SDCCH) – UPLINK/DOWNLINK

In response of RACH, the network allocates SDCCH over AGCH for further communication between MS and BTS. This channel is used for the Location Update, Voice Call Setup and SMS.

b) Fast Associated Control Channel (FACCH) – UPLINK/DOWNLINK

This channel is used to convey Handover information. There is no time slot and frame allocation dedicated to this channel. This channel can be associated with SDCCH or TCH and works on the principle of stealing. The burst of TCH is replaced by FACCH signaling when required.

c) Slow Associated Control Channel (SACCH) – UPLINK/DOWNLINK

This channel is always associated with TCH or SDDCH used for control and supervision of signals associated with the traffic channels.

II. CALL FLOW USING CHANNELS

The call origination made by the Mobile Station (MS) is a multi-step process on the network side. First of all, broadcast channels are already being transmitted by the BTS continuously. When a number is dialed by the MS, Random Access Channels (RACH) is sent to the BSC for allocation of the channel. In respond to that Access Grant Channel (AGCH) is send by BSC as a confirmation. Standalone Dedicated Control Channel (SDCCH) can be used for both downlinks as well as uplink Hence, it is used for multiple purposes in this flow. It is sent by the MS to MSC with its location update information.

Through SDCCH MSC request for the International Mobile Subscriber Identity (IMSI) number and then this information is sent back to MSC by MS by SDCCH. Along with IMSI to MSC, SDCCH gives location update to HLR and information about equipment to Equipment Identity Register (EIR) which is a part of Authentication Centre (AUC). Using the same channel security and ciphering of call is done. After all, this process connection is established and ringing begins. Also, the Traffic Channel (TCH) is allocated for the call. Hence, the conversation starts between the two MS's.

Conclusion:

_____

_____

_____

_____

Questions:

1. What is GSM technique?

2. What is GSM Signaling?

Marks (Out of 20)				Signature of Faculty with Date
MR (6)	MP (6)	MU (8)	Total (20)	

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SINHGAD COLLEGE OF ENGONEERING
VADGAON, PUNE 41
Department of Electronics & Telecommunication

Experiment No. _

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature:-

Subject Teacher

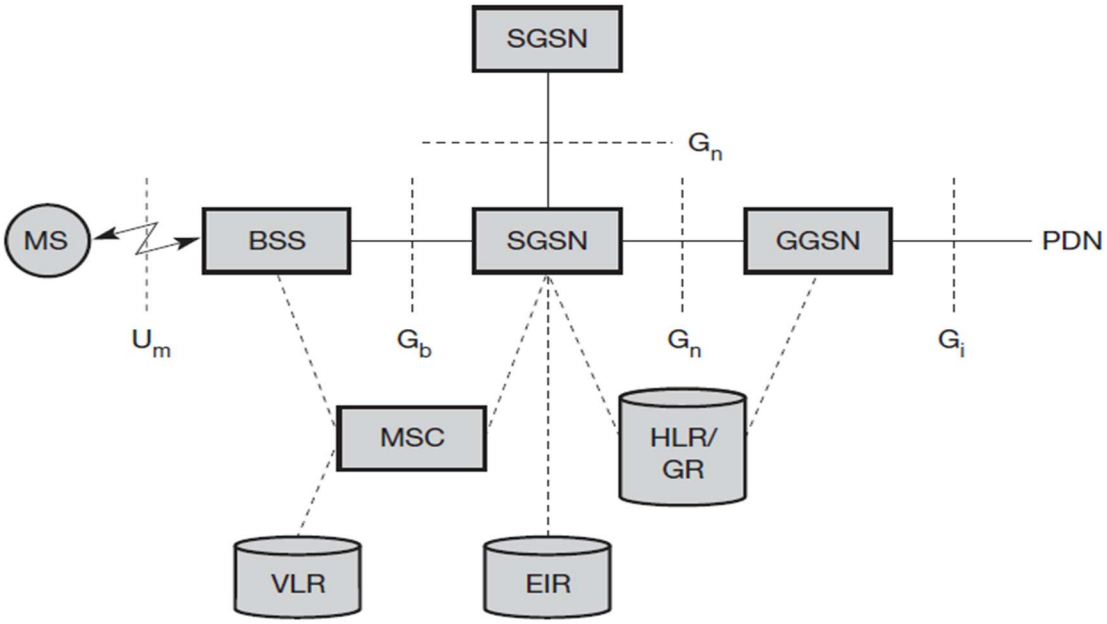
Title: Study of GPRS services.

GPRS is an expansion Global System for Mobile Communication. It is basically a packet-oriented mobile data standard on the 2G and 3G cellular communication network's global system for mobile communication. GPRS was built up by European Telecommunications Standards Institute (ETSI) because of the prior CDPD, and I-mode packet switched cell advances. GPRS overrides the wired associations, as this framework has streamlined access to the packet information's network like the web. The packet radio standard is utilized by GPRS to transport client information packets in a structured route between GSM versatile stations and external packet information networks. These packets can be straightforwardly directed to the packet changed systems from the GPRS portable stations.

The GPRS architecture

It introduces two new network elements, which are called GPRS support nodes (GSN) and are in fact routers. All GSNs are integrated into the standard GSM architecture, and many new interfaces have been defined. The gateway GPRS support node (GGSN) is the

interworking unit between the GPRS network and external packet data networks (PDN). This node contains routing information for GPRS users, performs address conversion, and tunnels data to a user via encapsulation. The GGSN is connected to external networks (e.g., IP or X.25) via the Gi interface and transfers packets to the SGSN via an IP-based GPRS backbone network (Gn interface). The other new element is the serving GPRS support node (SGSN) which supports the MS via the Gb interface. The SGSN, for example, requests user addresses from the GPRS register (GR), keeps track of the individual MSs' location, is responsible for collecting billing information (e.g., counting bytes), and performs several security functions such as access control. The SGSN is connected to a BSC via frame relay and is basically on the same hierarchy level as an MSC. The GR, which is typically a part of the HLR, stores all GPRS-relevant data. GGSNs and SGSNs can be compared with home and foreign agents, respectively, in a mobile IP network .



As shown in Figure packet data is transmitted from a PDN, via the GGSN and SGSN directly to the BSS and finally to the MS. The MSC, which is responsible for data transport in the traditional circuit-switched GSM, is only used for signaling in the GPRS scenario. Additional interfaces to further network elements and other PLMNs can be found in ETSI

(1998b). Before sending any data over the GPRS network, an MS must attach to it, following the procedures of the mobility management. The attachment procedure includes assigning a temporal identifier, called a temporary logical link identity (TLLI), and a ciphering key sequence number (CKSN) for data encryption. For each MS, a GPRS context is set up and stored in the MS and in the corresponding SGSN. This context comprises the status of the MS (which can be ready, idle, or standby; ETSI, 1998b), the CKSN, a flag indicating if compression is used, and routing data (TLLI, the routing area RA, a cell identifier, and a packet data channel, PDCH, identifier). Besides attaching and detaching, mobility management also comprises functions for authentication, location management, and ciphering (here, the scope of ciphering lies between MS and SGSN, which is more than in standard GSM). In idle mode an MS is not reachable and all context is deleted. In the standby state only movement across routing areas is updated to the SGSN but not changes of the cell. Permanent updating would waste battery power, no updating would require system-wide paging. The update procedure in standby mode is a compromise. Only in the ready state every movement of the MS is indicated to the SGSN.

Goals Of GPRS:

1. Consistent IP services
2. Leverage industry investment in IP
3. Open Architecture
4. Service innovation independent of infrastructure **Services Offered:**

1. SMS messaging and broadcasting
2. Push-to-talk over cellular.
3. Instant messaging and presence
4. Multimedia messaging service
5. Point-to-Point and Point-to-Multipoint services **Protocols supported:**

   (i) Internet Protocol (IP)
   (ii) Point-To-Point Protocol (PPP)

Benefits Of GPRS:

- **Mobility:** The capacity to keep up consistent voice and information interchanges while moving.
- **Cost Efficient:** Communication via GPRS is cheaper than through the regular GSM network.
- **Immediacy:** Allows customers to obtain connectivity when needed, regardless of location and without a lengthy login session.
- **Localization:** Enables customers to acquire data applicable to their present area.
- **Easy Billing:** GPRS packet transmission offers an easier to use billing than that offered by circuit switched administrations.

Conclusion:

_____

_____

_____

_____

QUESTION:

1. What is protocol architecture of GPRS?

_____

_____

_____

_____

_____

_____

_____

2. What are features of GPRS?

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Department of Electronics and Telecommunications

Experiment No. –

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

Tittle: Simulate BER Performance over Rayleigh Fading wireless channel with BPSK Transmission

Problem Statement:

Simulate BER Performance over Rayleigh Fading wireless channel with BPSK Transmission for SNR 0 to 60 db..

Objectives:

- What is a Rayleigh Fading
- Study of BPSK transmission

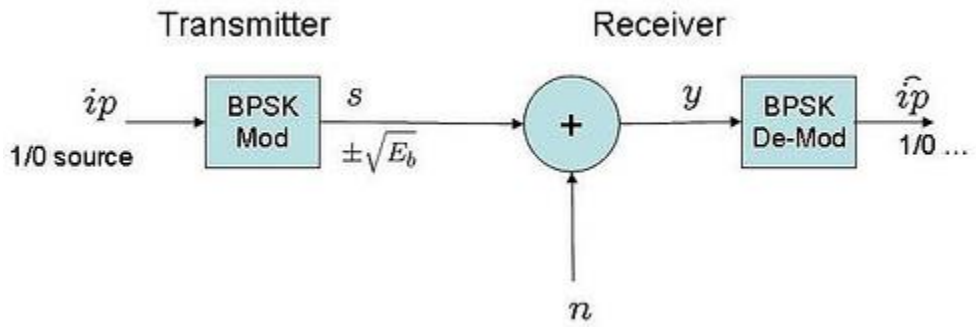
Software Requirements:

- Windows 7/10/11
- Matlab

THEORY:

In this experiment, we will derive the theoretical equation for bit error rate (BER) with Binary Phase Shift Keying (BPSK) modulation scheme in Additive White Gaussian Noise (AWGN) channel. The BER results obtained using Matlab/Octave simulation scripts show good agreement with the derived theoretical results.

With Binary Phase Shift Keying (BPSK), the binary digits 1 and 0 maybe represented by the analog levels $+\sqrt{E_b}$ and $-\sqrt{E_b}$ respectively. The system model is as shown in the Figure below.



Channel Model

The transmitted waveform gets corrupted by noise n, typically referred to as **Additive White Gaussian Noise** (AWGN).

Additive : As the noise gets 'added' (and not multiplied) to the received signal

White : The spectrum of the noise if flat for all frequencies.

Gaussian : The values of the noise n follows the Gaussian probability distribution function, $p(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$ with $\mu = 0$ and $\sigma^2 = \frac{N_0}{2}$.

Computing the probability of error

Using the derivation provided

The received signal,

$y = s_1 + n$ when bit 1 is transmitted and

$y = s_0 + n$ when bit 0 is transmitted.

The conditional probability distribution function (PDF) of y for the two cases are:

$$p(y|s_0) = \frac{1}{\sqrt{\pi N_0}} e^{\frac{-(y+\sqrt{E_b})^2}{N_0}}$$

$$p(y|s_1) = \frac{1}{\sqrt{\pi N_0}} e^{\frac{-(y-\sqrt{E_b})^2}{N_0}}$$

.

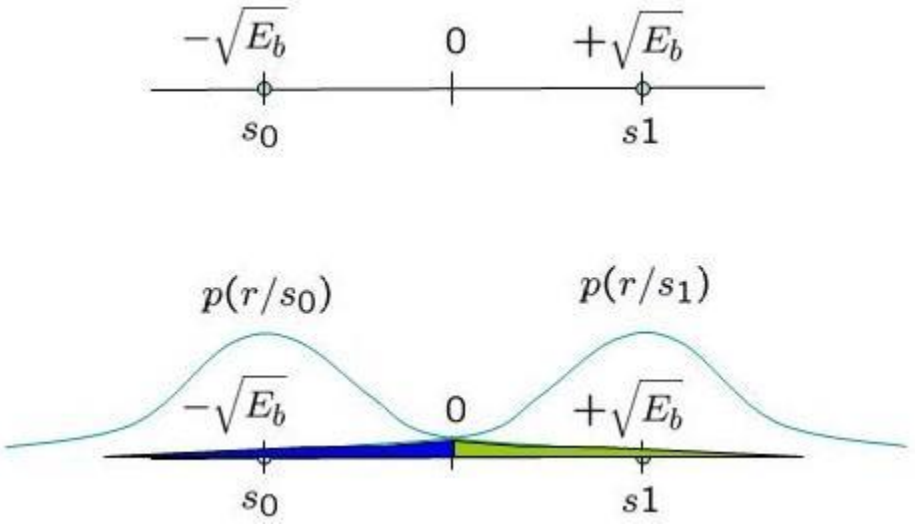


Figure: Conditional probability density function with BPSK modulation

Assuming that s_1 and s_0 are equally probable i.e. $p(s_1) = p(s_0) = 1/2$, the **threshold 0** forms the optimal decision boundary.

- if the received signal is y is greater than 0, then the receiver assumes s_1 was transmitted.
- if the received signal is y is less than or equal to 0, then the receiver assumes s_0 was transmitted.

i.e.

$y > 0 \Rightarrow s_1$ and

$y \leq 0 \Rightarrow s_0$.

Probability of error given s_1 was transmitted.

With this threshold, the probability of error given s_1 is transmitted is (the area in blue region):

$$p(e|s_1) = \frac{1}{\sqrt{\pi N_0}} \int_{-\infty}^{0} e^{\frac{-(y-\sqrt{E_b})^2}{N_0}} dy = \frac{1}{\sqrt{\pi}} \int_{\sqrt{\frac{E_b}{N_0}}}^{\infty} e^{-z^2} dz = \frac{1}{2} erfc\left(\sqrt{\frac{E_b}{N_0}}\right)$$

,

where,

$$erfc(x) = \frac{2}{\sqrt{\pi}} \int_{x}^{\infty} e^{-x^2} dx$$

Probability of error given s_0 was transmitted

Similarly the probability of error given s_0 is transmitted is (the area in green region):

$$p(e|s_0) = \frac{1}{\sqrt{\pi N_0}} \int_0^{\infty} e^{\frac{-(y+\sqrt{E_b})^2}{N_0}} dy = \frac{1}{\sqrt{\pi}} \int_{\sqrt{\frac{E_b}{N_0}}}^{\infty} e^{-z^2} dz = \frac{1}{2} erfc\left(\sqrt{\frac{E_b}{N_0}}\right).$$

Total probability of bit error

$$P_b = p(s_1)p(e|s_1) + p(s_0)p(e|s_0).$$

Given that we assumed that s_1 and s_0 are equally probable i.e. $p(s_1) = p(s_0) = 1/2$, the **bit error probability** is,

$$P_b = \frac{1}{2} erfc\left(\sqrt{\frac{E_b}{N_0}}\right).$$

Simulation model

Matlab/Octave source code for computing the bit error rate with BPSK modulation from theory and simulation. The code performs the following:

(a) Generation of random BPSK modulated symbols +1's and -1's

(b) Passing them through Additive White Gaussian Noise channel

(c) Demodulation of the received symbol based on the location in the constellation

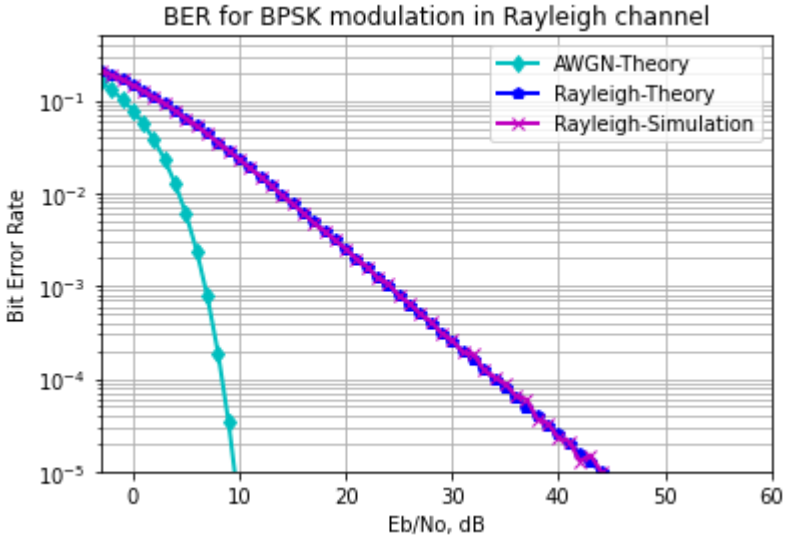
(d) Counting the number of errors

(e) Repeating the same for multiple Eb/No value.

In [1]:

```
# There are several types of wireless communication channels, and two common examples a
# (AWGN) channel and the Rayleigh fading channel.
# AWGN channel: In this type of channel, the received signal is corrupted by additive w
    # which is a type of random noise that is characterized by its mean and variance.
    # The AWGN channel is often used to model wireless communication channels
    # where the signal experiences random noise due to factors such as atmospheric inte
    # electronic noise, and thermal noise.
# Rayleigh fading channel: In this type of channel, the signal experiences random varia
# due to multiple signal paths between the transmitter and receiver.
# This effect is known as multipath fading, and it can result in signal distortion and
# The Rayleigh fading channel is commonly used to model wireless communication channels
# in urban or indoor environments where there are many obstructions that cause signal r
# Other types of wireless communication channels include:
# Rician fading channel: This is a variation of the Rayleigh fading channel that includ
# a dominant line-of-sight path in addition to the scattered paths.

# Nakagami-m fading channel: This is a generalization of the Rayleigh fading channel th
# a parameter m that determines the severity of the fading.

# Flat fading channel: In this type of channel, the signal experiences a constant atten
# over the entire bandwidth of the signal.

# Frequency selective fading channel: In this type of channel,
# different frequency components of the signal experience different levels of attenuati
# resulting in distortion of the signal waveform.
# The Bit Error Rate (BER) performance over a Rayleigh fading channel
# with Binary Phase Shift Keying (BPSK) transmission can be analyzed using the followin

# BER = 0.5 * erfc(np.sqrt(10 ** (Eb_N0_dB / 10)))

# where erfc is the complementary error function and SNR is the Signal-to-Noise Ratio.
# To simulate the BER performance over a range of SNR values from 0 to 60 dB, we can us

import numpy as np
from scipy.special import erfc
import matplotlib.pyplot as plt

# Parameters
N = int(1e6) #number of bits or symbols
Eb_N0_dB = np.arange(-3, 60) #multiple Eb/N0   (SNR) values

# Transmitter
ip = np.random.rand(N) > 0.5 #generating 0,1 with equal probability
s = 2*ip - 1 #BPSK modulation 0 -> -1; 1 -> 1

# Simulation
nErr = np.zeros(len(Eb_N0_dB))
for i, Eb_N0 in enumerate(Eb_N0_dB):
    n = np.sqrt(0.5) * (np.random.randn(N) + 1j*np.random.randn(N)) #white gaussian noi
    h = np.sqrt(0.5) * (np.random.randn(N) + 1j*np.random.randn(N)) # Rayleigh fading c
    y = h*s + np.sqrt(10**(-Eb_N0/10))*n #received Signal
    ipHat = (np.real(y/h) > 0).astype(int) #receiver - hard decision decoding
    nErr[i] = np.sum(ip != ipHat)

# BER calculation
simBer = nErr / N
theoryBerAWGN = 0.5*erfc(np.sqrt(10**(Eb_N0_dB/10)))
theoryBer = 0.5*(1 - np.sqrt(10**(Eb_N0_dB/10) / (1 + 10**(Eb_N0_dB/10))))
```

```
# Plot
plt.semilogy(Eb_N0_dB, theoryBerAWGN, 'cd-', linewidth=2)
plt.semilogy(Eb_N0_dB, theoryBer, 'bp-', linewidth=2)
plt.semilogy(Eb_N0_dB, simBer, 'mx-', linewidth=2)
plt.axis([-3, 35, 1e-5, 0.5])
plt.grid(True, which="both")
plt.legend(['AWGN-Theory', 'Rayleigh-Theory', 'Rayleigh-Simulation'])
plt.xlabel('Eb/No, dB')
plt.ylabel('Bit Error Rate')
plt.title('BER for BPSK modulation in Rayleigh channel')
plt.show()
```



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Department of Electronics and Telecommunications

Experiment No. –

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

Tittle: Configure a Cisco Router as a DHCP Server

Problem Statement:

Configuring a Cisco Router as a DHCP Server.

Objectives:

- What is a DORA PROCESS?
- Benefits of DHCP
- How it works?

Outcome:

Deploy Client-Server architectures and prototypes by the means of correct standards and technology to assign IP address.

Software Requirements:

Open-source Linux operating system, Cisco Packet Tracer.

THEORY:

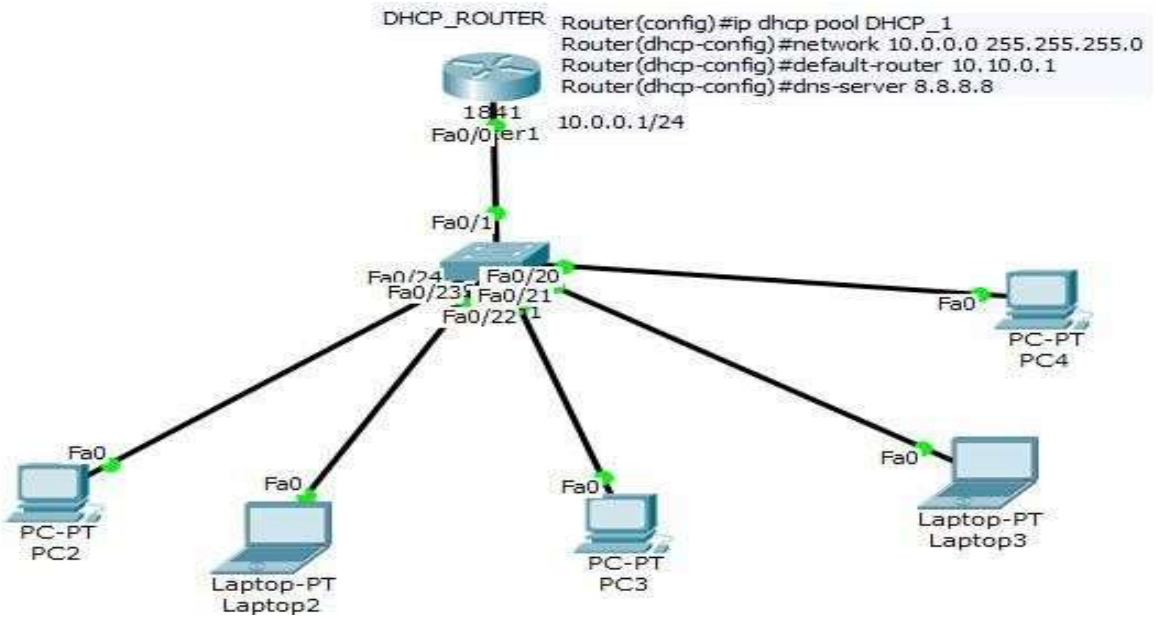
Dynamic Host Configuration Protocol (DHCP) is a standardized client/server network protocol that dynamically assigns IP addresses and other related configuration information to network devices. Every device on a TCP/IP-based network must have a unique unicast IP address to access the network and its resources. Without DHCP, IP addresses for new computers or computers that are moved from one subnet to another must be configured manually.

Configuring the DHCP server

The DHCP server uses address pools when responding to DHCP client requests. Address pools contains specific IP configuration details that the DHCP server can allocate to a client. You can configure multiple address pools on the device for different networks.

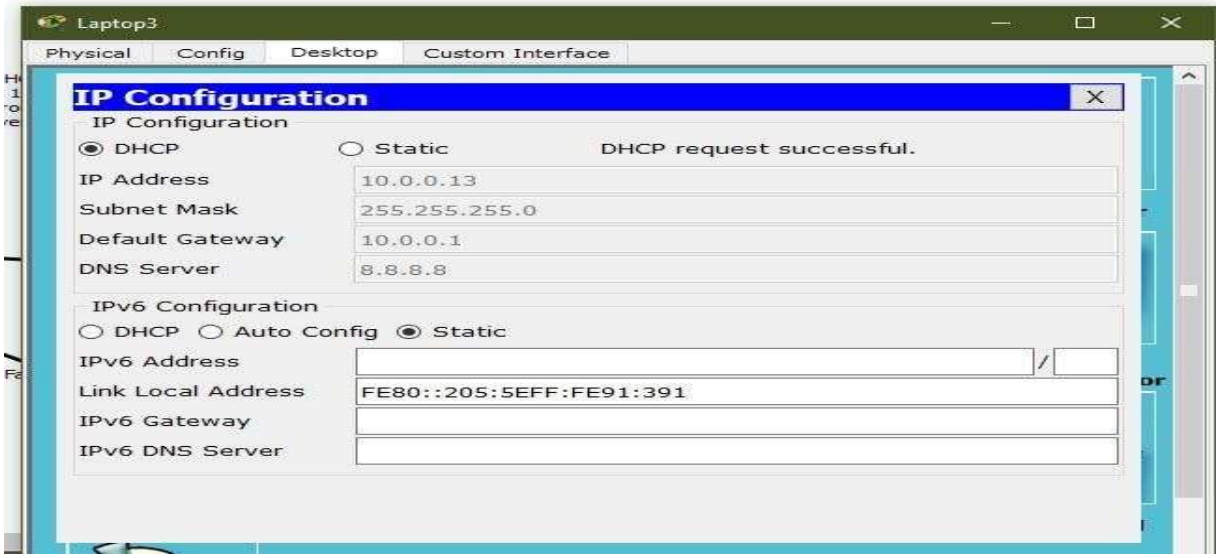
To configure an address pool, you must:

1. Create the pool and enter its configuration mode.
2. Define the network the pool applies to.
3. Define the range of IP addresses that the server can allocate to clients. You can specify multiple address ranges for each pool.
4. Set the lease for the clients. This defines whether the clients receive a dynamic, permanent, or static IP address.
5. Set the options (standard and user-defined) that the clients of a pool require when configuring their IP details.
6. After configuring the address pools, enable the DHCP server by using the command:



On Client Side:

Select IP allocation as a Dynamic allocation.



DORA Process

The following diagram shows the changing port numbers and the source and destination addresses used during the DHCP transaction. UDP port 68 is reserved for DHCP clients, and UDP port 67 is reserved for DHCP servers.

Step 1

DHCP Discover

Sent by the client looking for the IP address. The source IP is 0.0.0.0 because the client doesn't. have an IP address. The destination is 255.255.255.255, which is the broadcast address, as the client doesn't know where the DHCP server is located, so it broadcasts to all devices on the network.

Step 2 DHCP Offer

Sent by the DHCP server offering an IP address to the client. The source address is the DHCP server address. The DHCP server doesn't know the client address yet, so it broadcasts the offer to all devices on the network.

Step 3 DHCP Request

 Sent by the client to the DHCP server to say "I will take that IP address, thanks." The client IP address is still 0.0.0.0 and it is again broadcast to all so that any other servers on the network that may have offered an IP address will know to stop communicating with the client for now.

Step 4 DHCP Acknowledgment

 Sent by the DHCP server to the client. It confirms the IP address and other details such as subnet mask, default gateway, and lease time with the client. The source address is the DHCP server and the destination is still the broadcast address.

The DHCP process

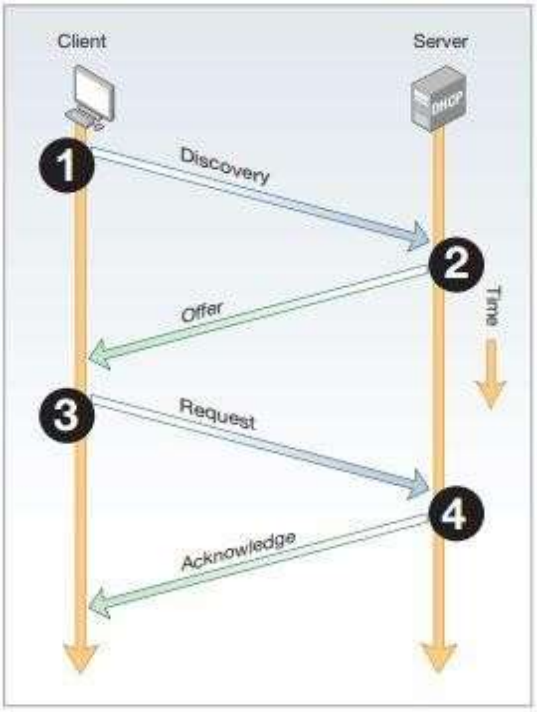
There are four basic steps the DHCP process follows when a client connects to the network:

1. The client broadcasts a DHCP Discover message to say "I need an IP address, are there any DHCP servers out there?"

2. Multiple DHCP servers may respond (via broadcast) with an OFFER for a leased IP address back to the client.

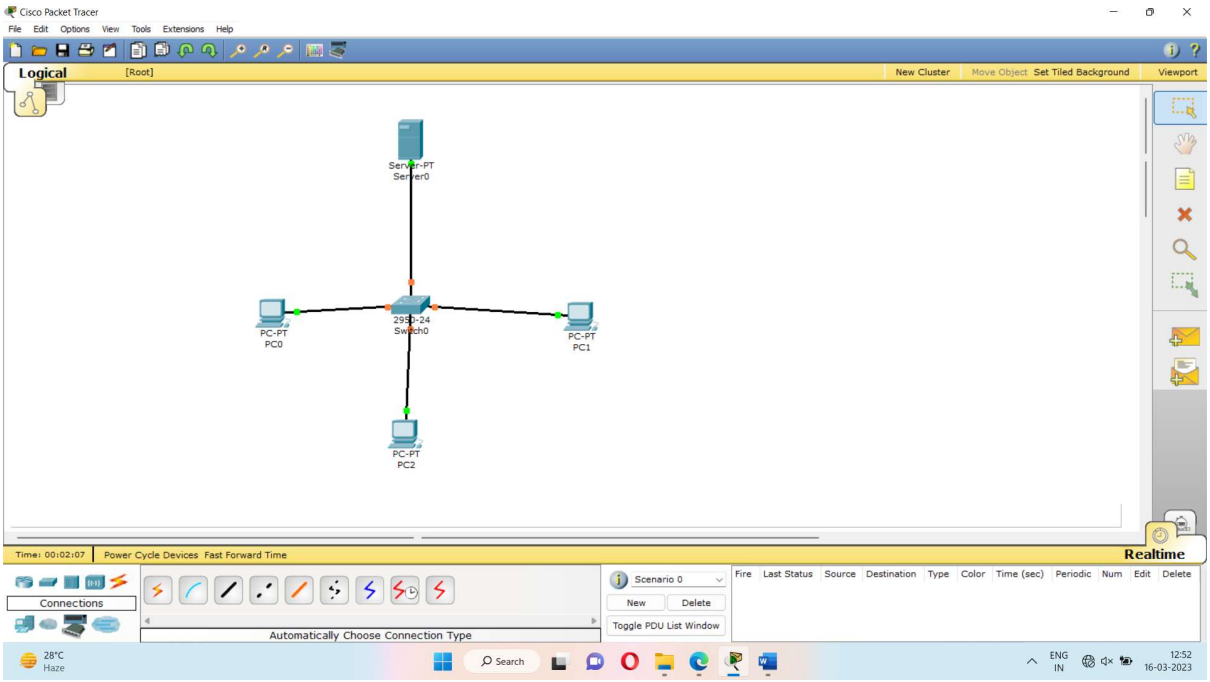
3. The client will choose a DHCP server offer and then broadcast a DHCP REQUEST back to the DHCP server(s) to say "Thanks, I have selected an offer from this DHCP server." All servers will see which offer the client selected.

4. Finally, the selected DHCP server will send (broadcast) an ACKNOWLEDGEMENT back to the client to confirm the IP address, lease time, and other details.

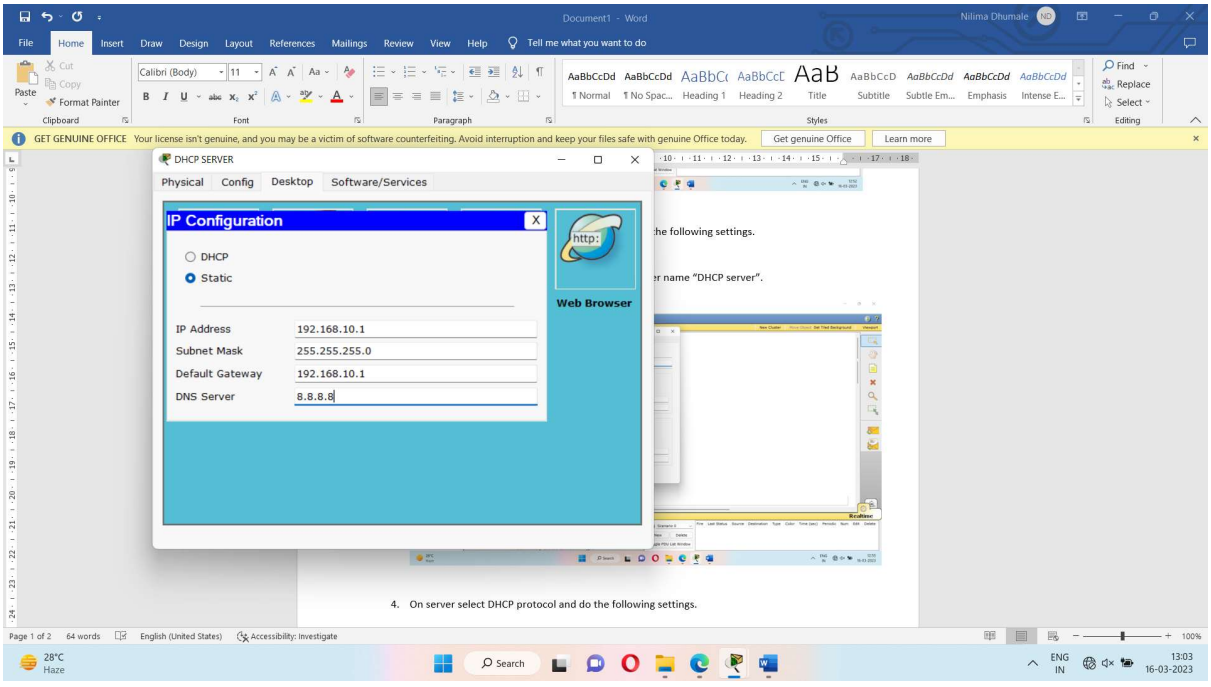


PROCEDURE

1. Select end devices, switch, server with drag and drop option and connect them.

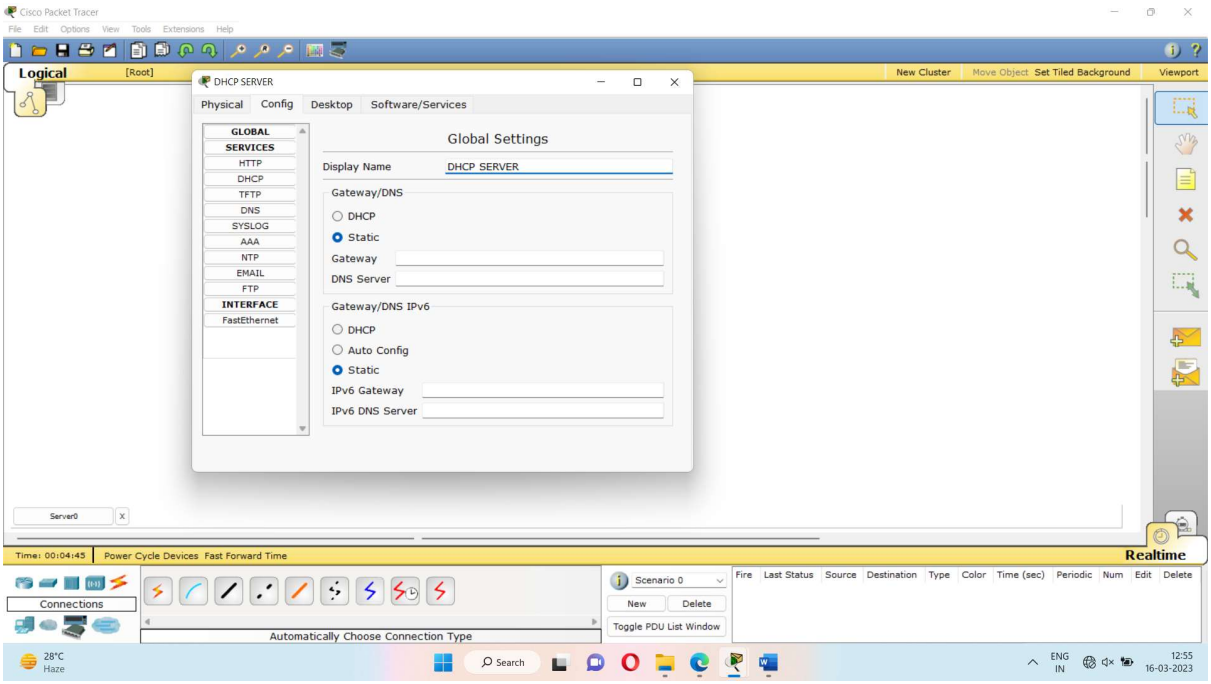


2. Double click on DHCP server. Go to Desktop and do the following settings.

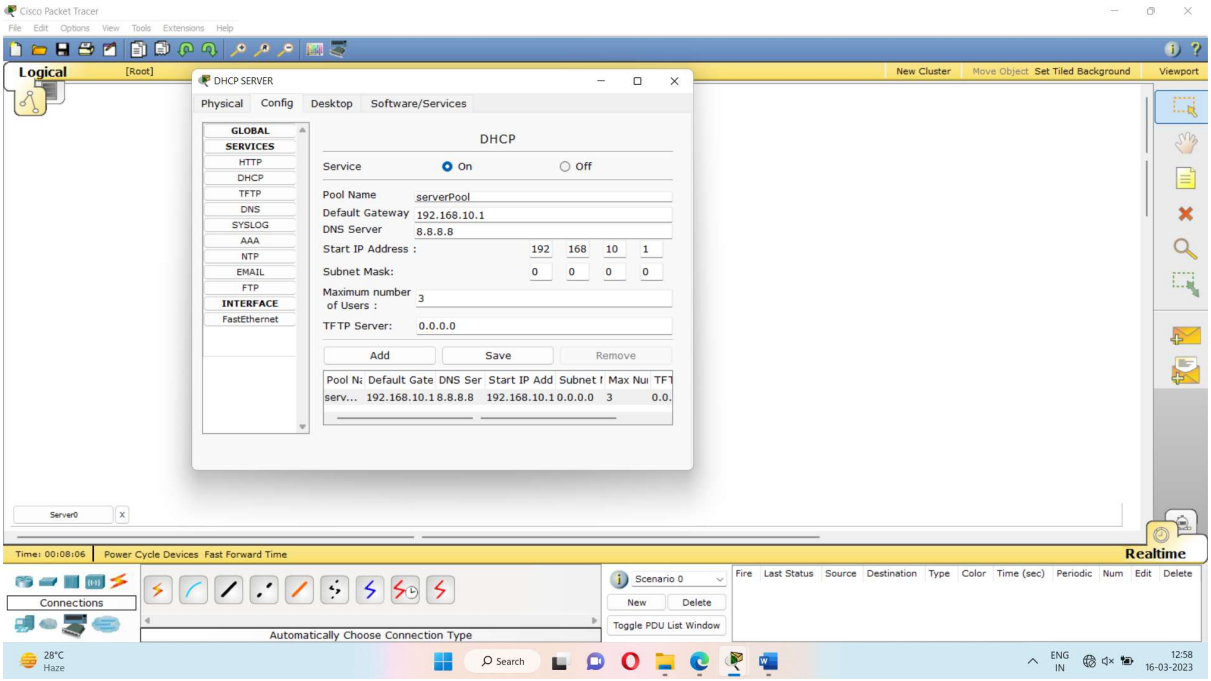


3. On DHCP server follow steps as

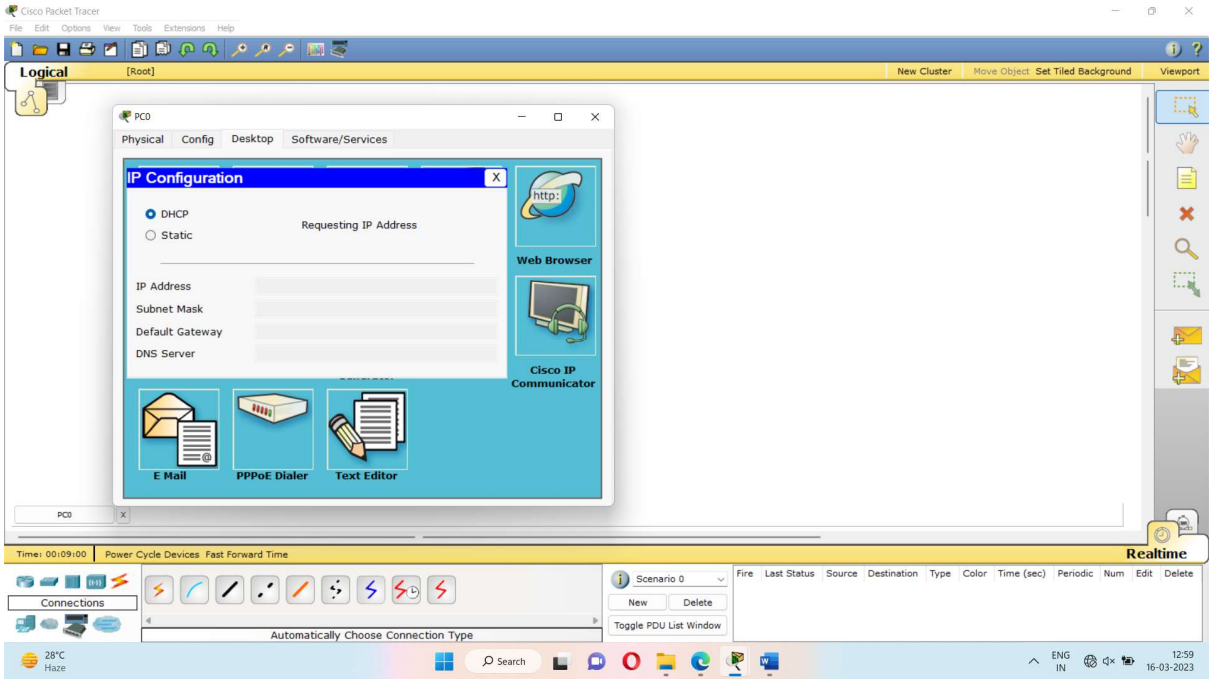
config – set server name “DHCP server”.

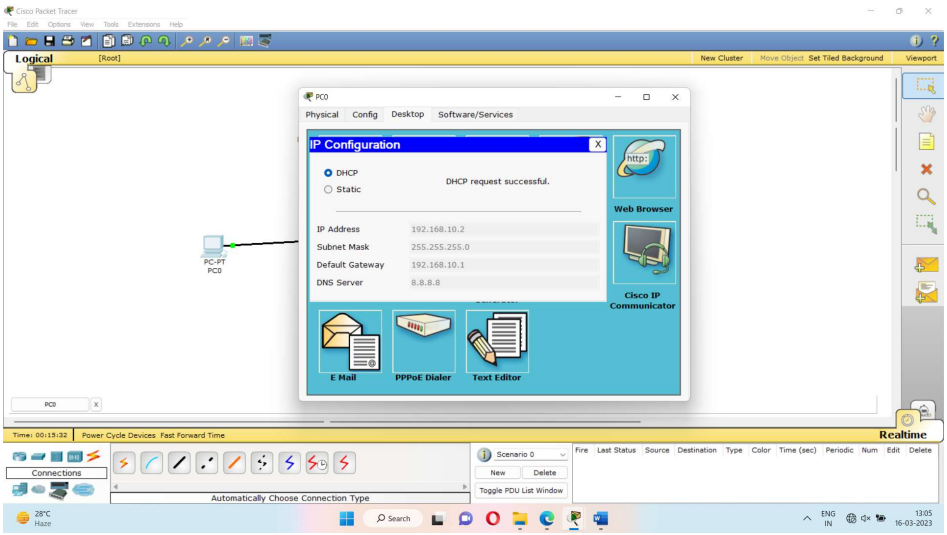


4. On server select DHCP protocol and do the following settings.



5. Go to Desktop – IP configuration- select DHCP option on all end devices one by one.





Conclusion:

Conclusion questions:

1] Explain DORA Process?

2] What are benefits of DHCP Process?

3] Why DORA works on UDP...?

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Department of Electronics and Telecommunications

Experiment No. –

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

Aim: To understand the handover mechanism.

Objectives:

To study the effect of handover threshold and margin on SINR and call drop probability and handover probability

Prerequisite:
Operating System: Windows 7
Java Version: 6 only
Mozilla Firefox: version: 47.0.1
Link to download software:
https://drive.google.com/uc?id=0B9mNeu43jUidckFYVTlnenpJRGs&export=download

Virtual Labs
IIT Kharagpur

An MoE Govt of India Initiative

Fading Channels and Mobile Communications Virtual Lab

Intructions for simulator use

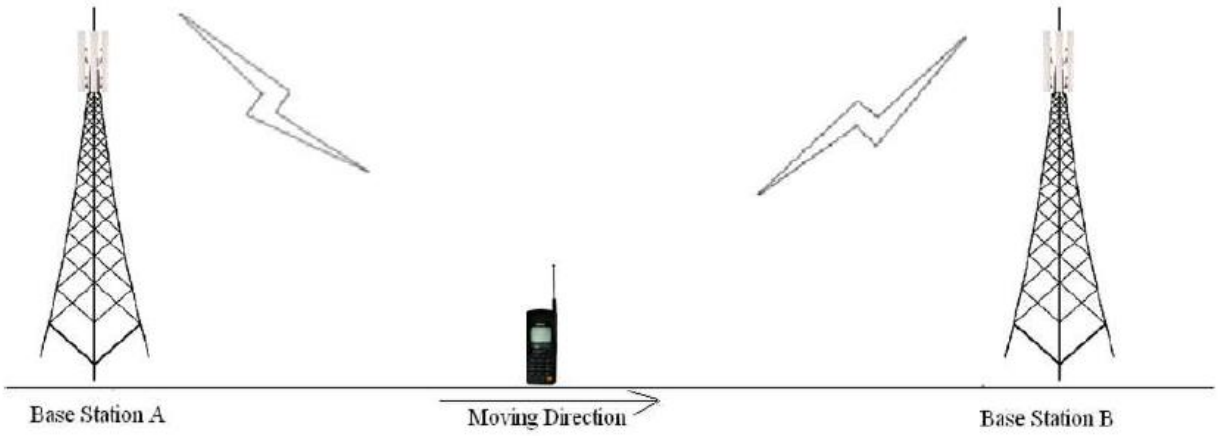
Prerequisites

- Your PC/Laptop loaded with Java and JRE 6 or 7 only
- If not there kindly install from ORACLE site
- Add the JAVA path to Environment Variables
  - Java runtime environment is needed (may get from java.com)
  - Install downloaded Java and JRE
  - Right click on My Computer/This PC
  - Select Properties
  - Select Advanced System Settings
  - Select Advanced tab
  - Select Environment Variables
  - Select Path under System Variables
  - Click on Edit button
  - In Variable value editor paste this at the start of the line
  - C:\Program Files\Java\ **"jdk_version"** \bin;
  - Click Ok then Ok again
- Go through the steps below to perform the experiment with simulator.

Prerequisites Steps

Theory: Handoff

Consider the figure below Initially say the mobile M is quite close to the base station A and hence receives signal strength from A PArx>PBrx . As the mobile moves away from the base station. A and goes towards B then the signal strength from A keeps falling (pathloss increases).Let there be a minimum sensibility level P0rx0 for the mobile, i.e. if the signal from the B.S.to which the mobile is connected falls below P0rx0 then the call drops. In order to prevent call drop the mobile monitors receive signal strength from the neighboring 3-6 B.S.. These neighboring 3-6 B.S. also monitor Rx signal strength from the M.S.



The mobile should get connected to B.S. which has the highest signal strength. However, if the M.S. continuously attaches itself to the B.S. with instantaneous height signal strength then the h/o rate may very high in server condition.

Thus, some hysten's condition is used for h. If PTrx (T= target B.S.) > Phrx*h* higher h/o threshold and $\overline{\quad}$Pcrx^{-} (c=current B.S.) < Phrx*h* minimum h/o threshold the execute h/o to B·ST from B·Sc. Thus, it is threshold impeditive to study in part of the handoff process.

$$\Delta\gamma=\text{Phrx}-\text{Plrx}\Delta=h\text{-}$$

A successful handoff is one where the call gets from and continuous without call or in other words the h occurs before h/o Pcrx becomes <P0rx<0. If Pcrx<P0rx0 then call drop event occurs.

One would like to minimize the no of handoff events as well as minimize call drop probability. The experiment provides opportunity to study the inherent of these three parameters on h/o.

Further the averaging window for calculating PTrx and Pcrx also plays a role in the process. In the experiment small scale fading is not considered and hence the averaging considered only shadowing.

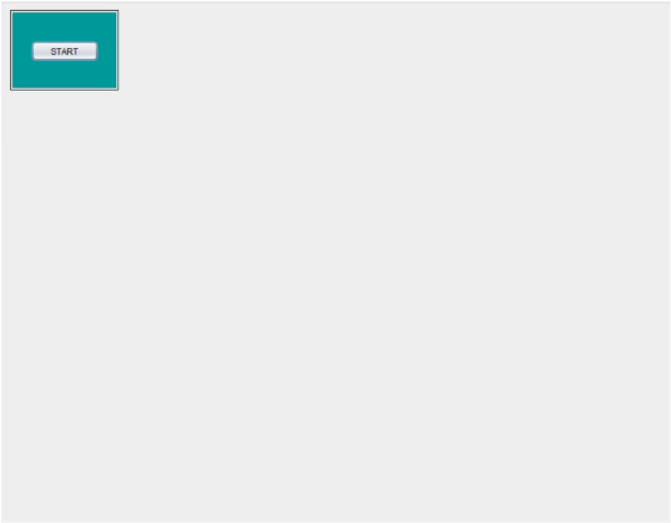
Students conducting the experiment is expected to study the impact of these on h/0. He/She is encouraged to respect the experiment for several sets of values of these parameters these draw conclusion.

Instruction

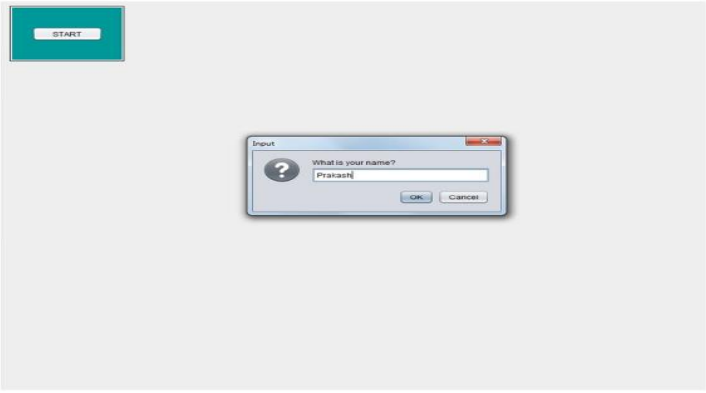
Follow the instructions given below to perform the experiments.

1.1 Starting the Experiments: -

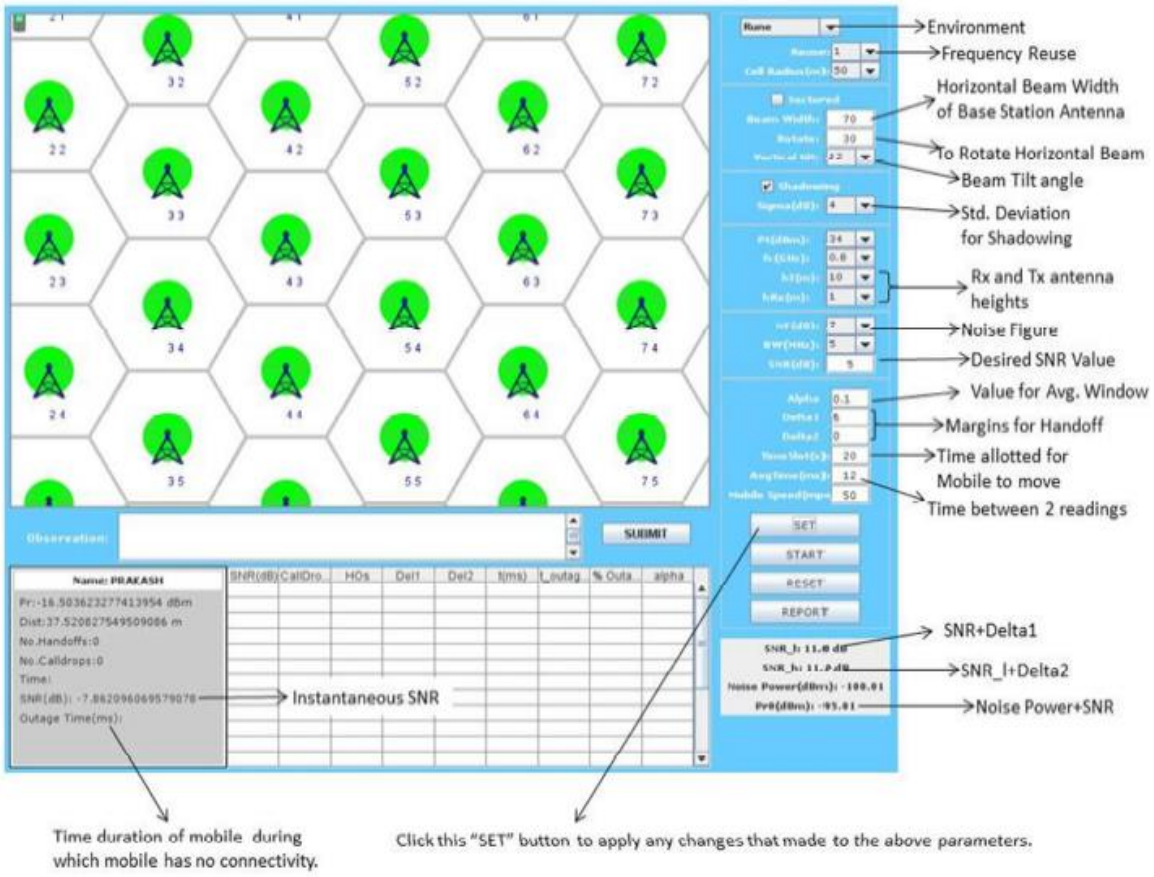
- . Step1: Click on START button to start experiment.



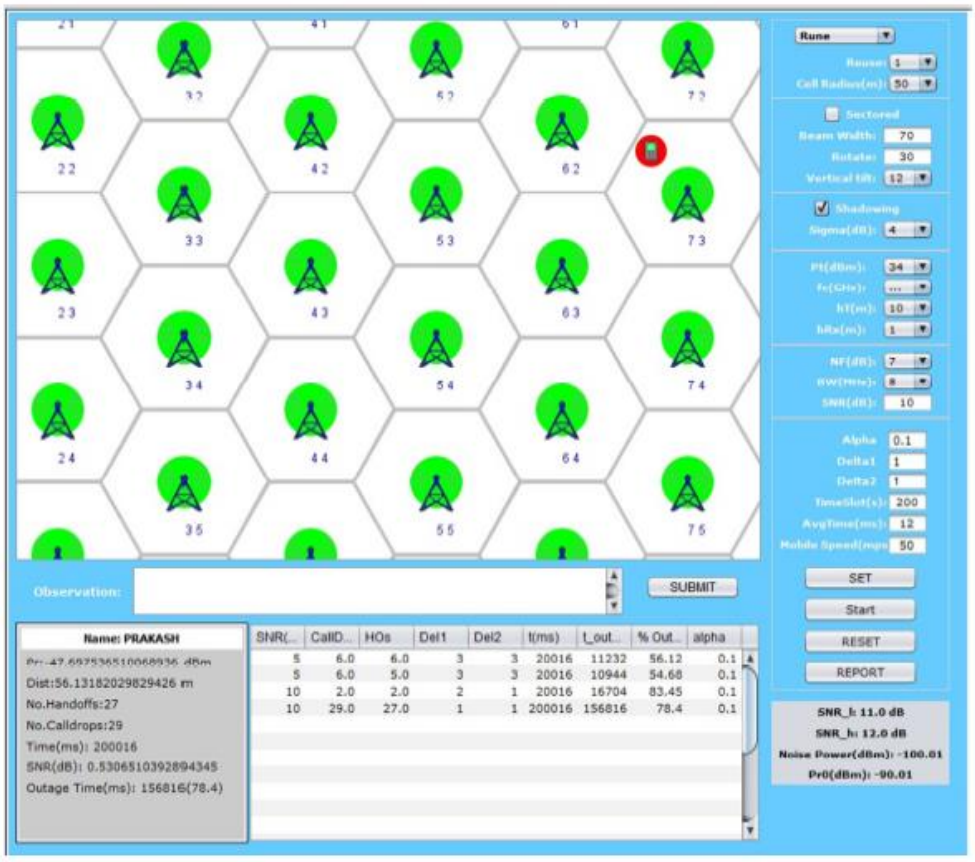
- Step2: Enter your name then click OK button.



- Step3: Select the parameters (e.g.: Reuse, Environment, Beamwidth, Carrier frequency etc.)

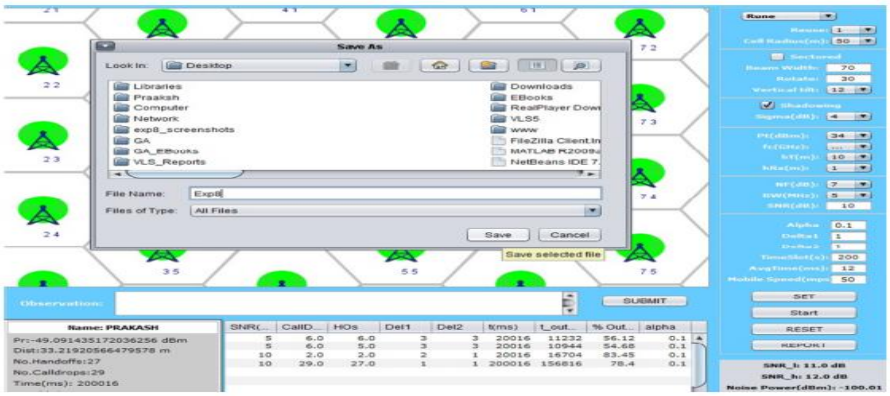


- Step4: Click on START button and observe No. of Call Drops and No. of Handoffs.



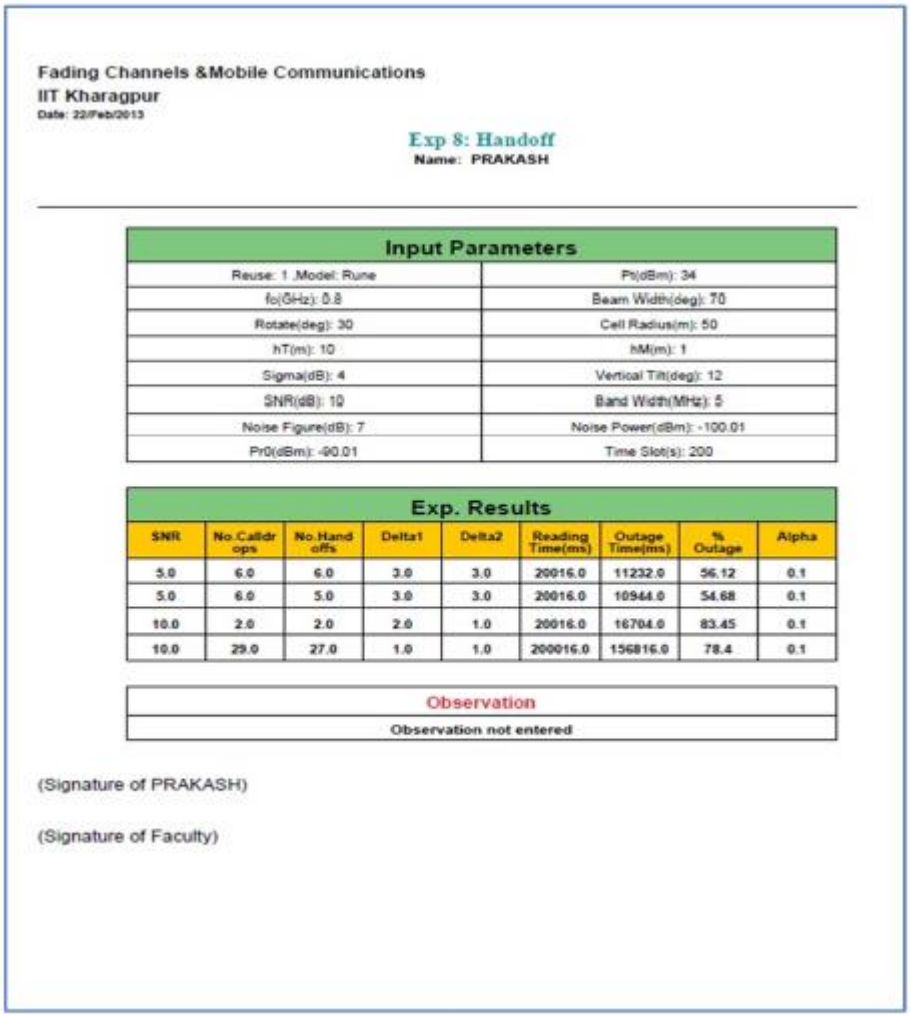
- Step5: Enter your observation in the OBSERVATION box and Click on SUBMIT button.

- Step6: Finally, click on REPORT to generate PDF report of the experiment.



- Step7: After PDF report generation you will get following message.

- Step8: PDF report will appear like this.



Fading Channels &Mobile Communications
IIT Kharagpur
Date: 22/Feb/2013

Exp 8: Handoff
Name: PRAKASH

Input Parameters	
Reuse: 1 ,Model: Rune	Pt(dBm): 34
fo(GHz): 0.8	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 50
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 10	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -90.01	Time Slot(s): 200

Exp. Results

SNR	No.Calldr ops	No.Hand offs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	6.0	6.0	3.0	3.0	20016.0	11232.0	56.12	0.1
5.0	6.0	5.0	3.0	3.0	20016.0	10944.0	54.68	0.1
10.0	2.0	2.0	2.0	1.0	20016.0	16704.0	83.45	0.1
10.0	29.0	27.0	1.0	1.0	200016.0	156816.0	78.4	0.1

Observation
Observation not entered

(Signature of PRAKASH)

(Signature of Faculty)

- Step9: To redo experiment click on RESET button.

Observation Table:

Reuse	No of Hand Off	Mobile Speed	Outage	Outage Percentage
1				
3				

Keep reuse ratio 3 and set mobile speed to 50 mps and 100 mps and record the below data. What do we observe after increasing the speed of the mobile station?

Reuse	Mobile Speed	No of Hand off	Outage	Outage Percentage
3	**50**			
3	**100**			

FAQ:

1. What is handoff?
2. What is the condition for handoff?
3. Explain Handoff and its types.

Marks (Out of 20)				Signature of Faculty with Date
MR (6)	MP (6)	MU (8)	Total (20)	
MR – Marks for Regularity, MP – Marks for Presentation, MU – Marrk for Understanding				

Sinhgad Institutes

Sinhgad Technical Educational Society's
SINHGAD COLLEGE OF ENGINEERING
VADGAON, PUNE-41

Department of Electronics and Telecommunications

Experiment No. –

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

Aim:

To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC.

Theory

Small scale fading characterizes the fluctuation of signal (strength) over a spatial distance of fraction of wavelength. The fluctuation is also observed in both time and frequency domain at a gain location.

The variation of signal (strength) at the receiver is due to random interference between the different copies of the transmitted signal. The interference is sometimes constructive and sometimes destructive. The multiple copies of the transmitted signal are generated due to scattering, reflection, and diffraction due to obstacle present in the path of radio signal between the Tx and Rx movement of the Tx and Rx or the obstacle cause time domain variation of the signal (strength) and the phenomenon is called Doppler effect. Since each path of the radio wave may exhibit difference doppler its cumulative effect results in spread of the carrier/ frequency content of the signal and hence is also known as Doppler spread.

If v is the maximum velocity (m/s) then the maximum Doppler shift is given by

$$fm=\upsilon(m/s)c=$$

Where,

- c=velocitylight=3∗108m/s.=*h*=3∗10*8
- fc=carrierequency.

Coherence time is defined as interval in time over which the signal remains correlated. It is defined as

$$Tc= 9/16\Pi fm\ (s)$$

If symbol duration T_s << T_c it experience slow fading while if Ts>Tc it experience fast fading. The enveloped level crossing rate is defined as the rate at which the signal envelope crosses a specified level R in the positive (or negative) going direction.
It requires the joint pdf (α,.α) of the enveloped level α=|r| and enveloped slope .α=|r|

$$LR=\sqrt{2\pi}(k+1)fm\rho e-k-(k+1)\rho 2I0(2\rho\sqrt{k(k+1)})\rho=R\sqrt{\Omega p}=RRrms$$

Rrms=√Ωp is the enveloped level

Rayleigh fading (k=0) and isotropic scattering $LR=\sqrt{2\pi}fm\rho e-\rho 2$

Level Crossing Rate For Selection Combining

$Lr=fm\sqrt{\pi}M\gamma\sqrt{\sigma}\exp(-\gamma 22\sigma)[1-\exp(-\gamma 22\sigma)]M-1$

Where,

- fm is the Maximum doppler frequency.
- σ is the r.m.s value of the received signal voltage.
- γ is the threshold voltage.
- M = No. of channels

Average enveloped fade duration

The average duration the enveloped remains below a specified level R.

$t=1NRPr[r\leq R]$

Average fade duration For Selection Combining

$ADF=\sqrt{\rho}*\exp(\gamma 22\sigma-1)\sqrt{2\pi}fdM\gamma$

For Rayleigh distribution fading

$Pr[r\leq R]=\int R0Pr(dr)=1-\exp(-\rho 2)$

$\bar{}t=e\rho 2-1\rho fm\sqrt{2\pi}$

In case of flat fading the plot of signal enveloped of transmitting 'r' is given as

$$p(r)=r\sigma 2\exp(-r22\rho 2)(0\leq r\leq \infty)$$

$$=0(r<0)$$

Where,

- σ is the r.m.s value of the received voltage signal before detection.
- σ2is the time average power of the received signal before enveloped detection.

Probability of outage is defined as

$$P(R)=Pr(r\leq R)=\int R0p(r)dr=1-\exp(-R22\sigma 2)$$

The mean value rmean of rayleigh distribution is given by

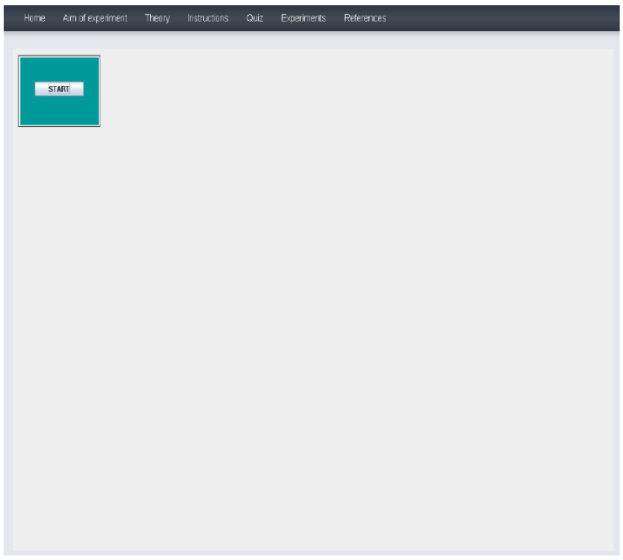
$$rmean=E[r]=\int \infty 0rp(r)dr=\sigma\sqrt{\pi}2=1.2533\sigma=1.2533$$

$$\sigma 2r=E[r2]-E2[r]=\int \infty 0r2p(r)dr-\sigma 2\pi 2$$

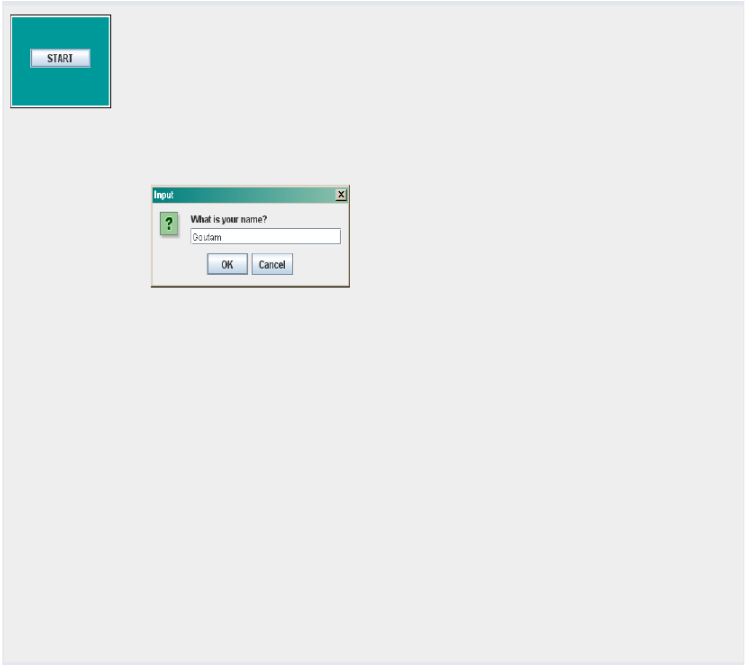
$$=\sigma 2(2-\pi 2)=0.4292\sigma 2$$

Instructions for Experiment: - Flat Fading

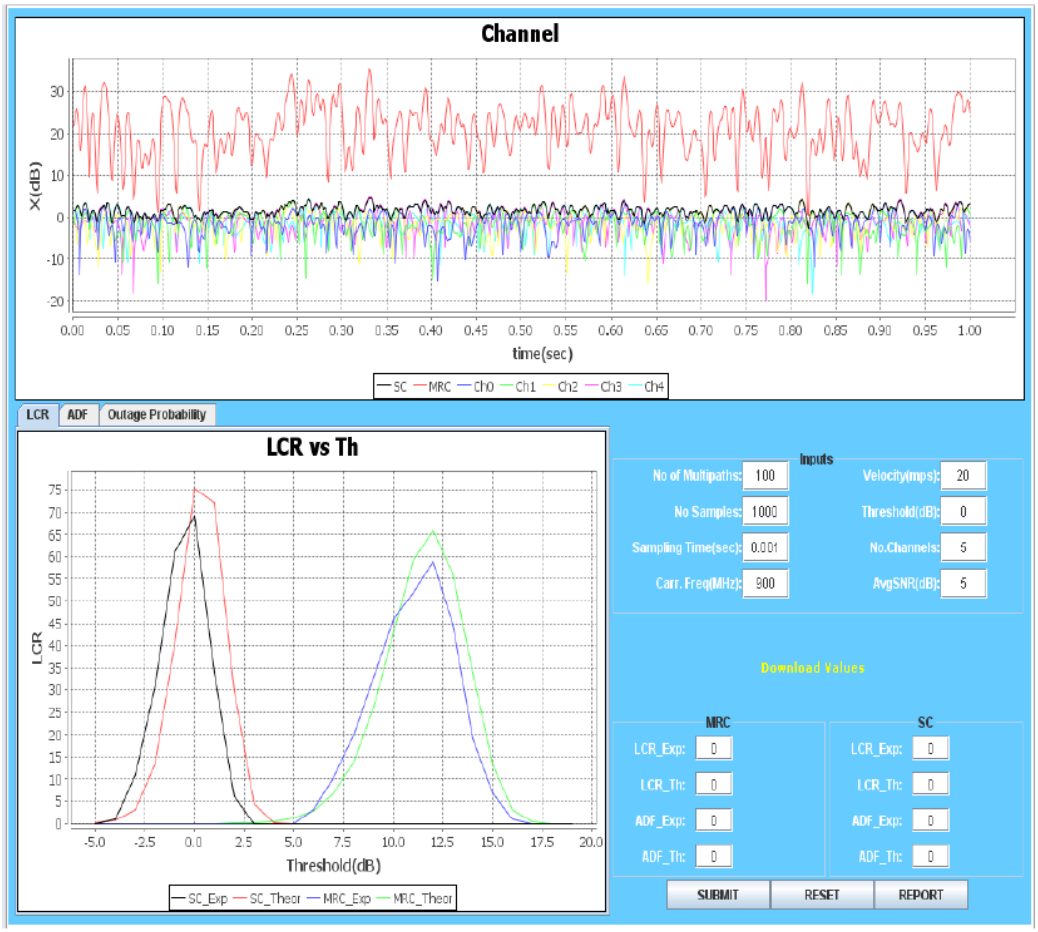
- Step1:- Click on the button START. A page appears with a dialogue box asking for your name.

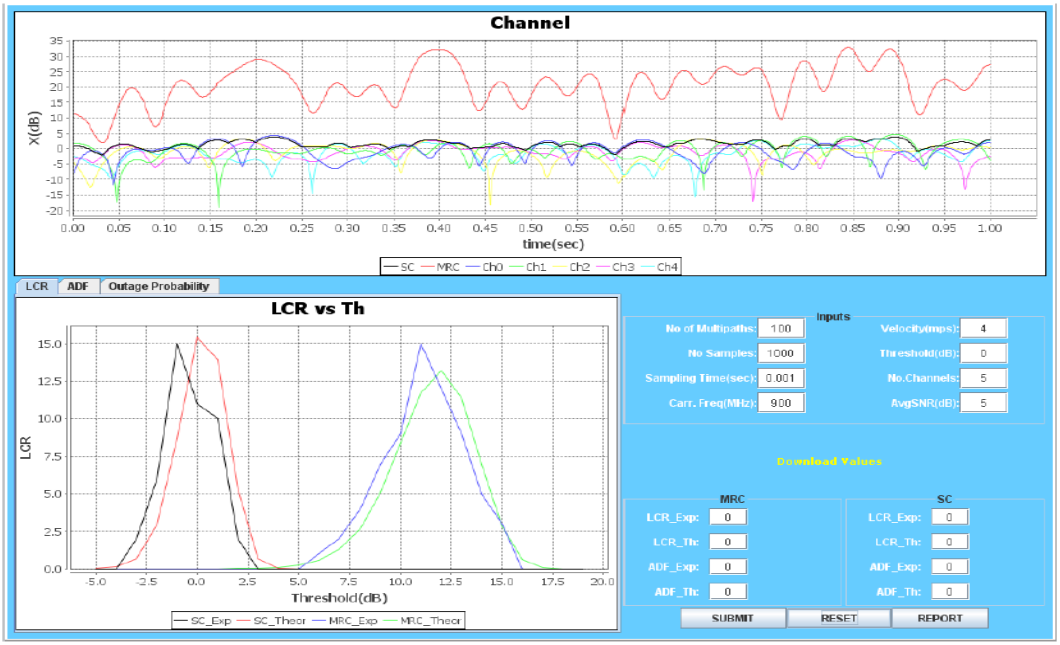


- Step 2:- Enter your name then Click Ok.

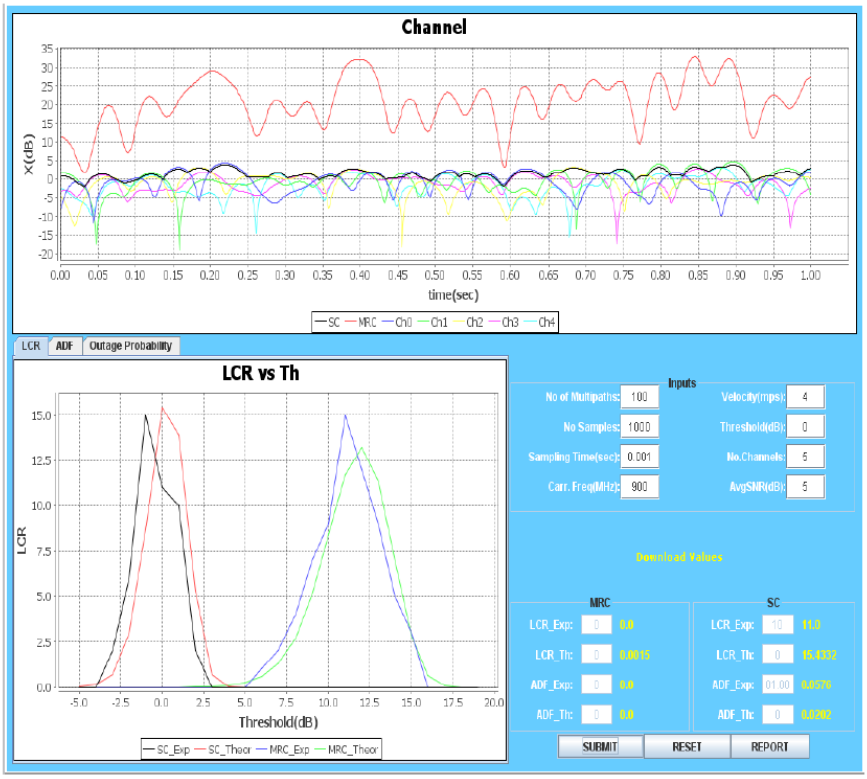


Step3: - Enter the input parameters value. Then click on "RESET" Button. Observed the waveform.

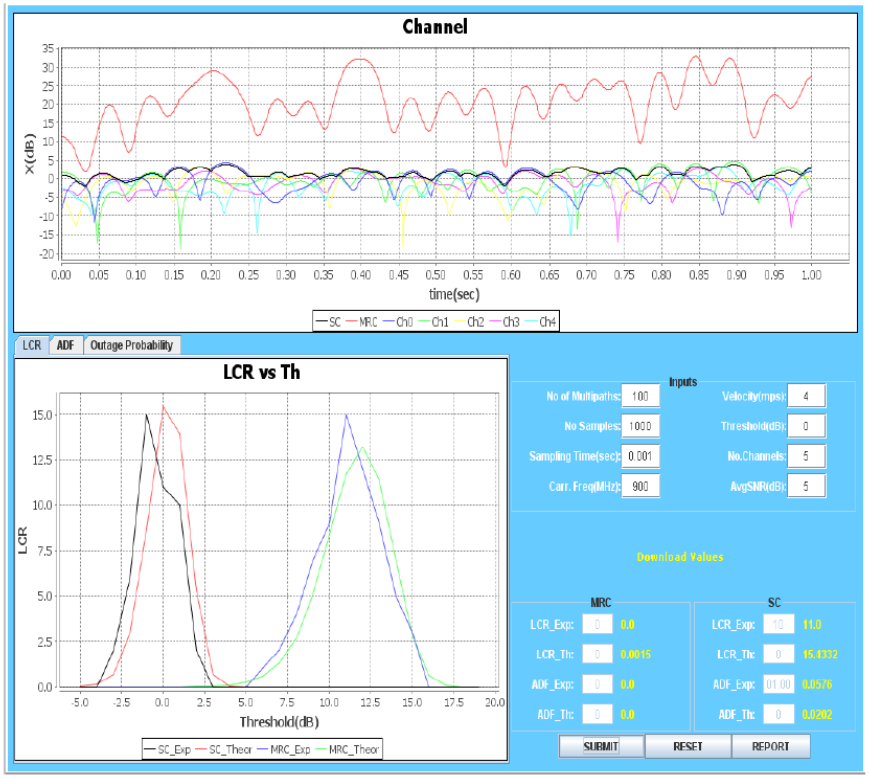




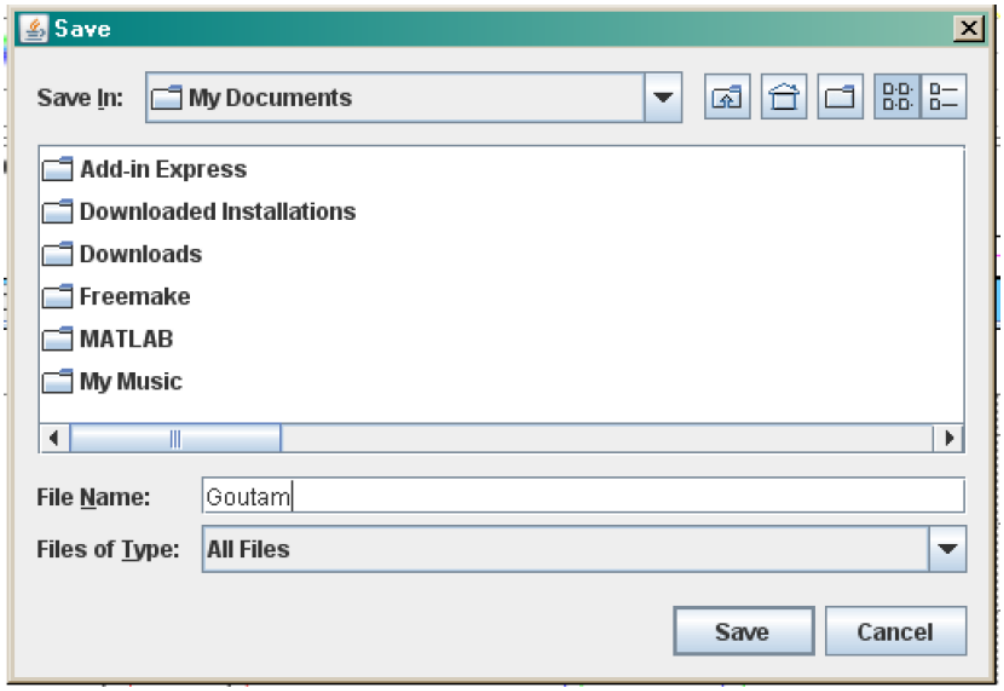
- Step4: - Enter value of LCR Exp and ADF Exp in both MRC and SC from the waveform. Then Click on "SUBMIT" Button.



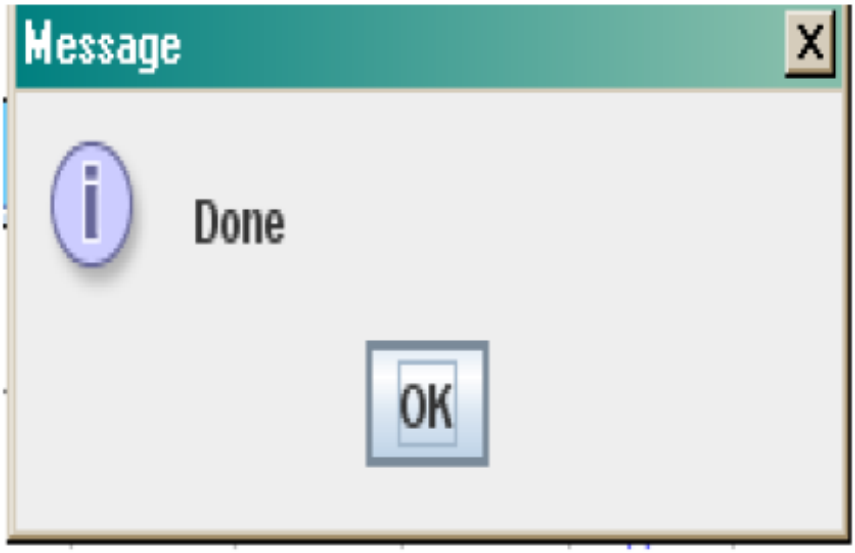
- Step5:- Click on the "Report" button.



- Step6:- PDF report of the experiment is generated.



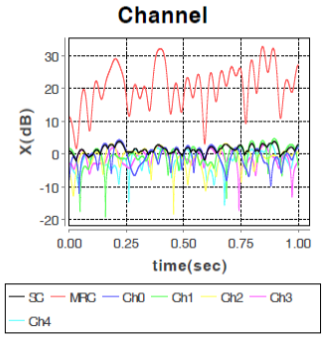
- Step7:-After generation of the Report you will get following message.

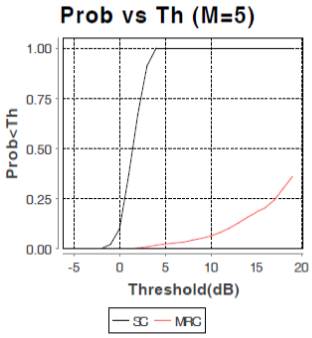


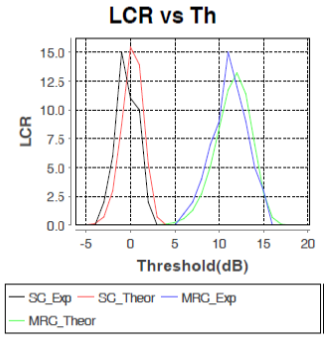
- Step8:- Click on the "Ok" and you will get your Report.

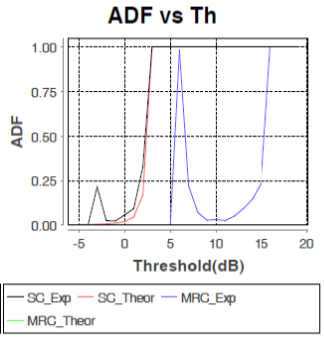
Fading Channels &Mobile Communications
IIT Kharagpur
Date: Nov/6/2012

Exp9: Flat Fading
Name: GOUTAM









Input Parameters	
No.of Multipaths	100
No.Samples	1000
Sampling Time(sec)	0.001
fc(Hz)	9.0E8
Velocity(mps)	4.0
Threshold(dB)	0.0
No.of Branches	5
Avg SNR(dB)	5.0

Results				
Type	LCR(Exp)	LCR(Th)	ADF(Exp)	ADF(Th)
SC(Actual)	11.0	15.4332	0.0576	0.0202
SC(Entered)	10.0	0.0	1.0	0.0
MRC(Actual)	0.0	0.0015	0.0	0.0
MRC(Entered)	0.0	0.0	0.0	0.0

(Signature of GOUTAM)

(Signature of Faculty)

- Step9: - To Redo the experiment click on "RESET" button.

Conclusion:

FAQ;

1. What is Flat Fading?
2. What is the difference between flat and selective fading?
3. What are the types of fading?

Marks (Out of 20)				Signature of Faculty with Date
MR (6)	MP (6)	MU (8)	Total (20)	
MR – Marks for Regularity, MP – Marks for Presentation, MU – Marrk for Understanding				

Sinhgad Institutes

Sinhgad Technical Educational Society's
SINHGAD COLLEGE OF ENGINEERING
VADGAON PUNE-41

Department of Electronics and Telecommunications

Experiment No. –

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

Tittle: File sharing by using TCP Protocol

Problem Statement:

To Perform File Transfer in Client & Server Using TCP/IP.

Objectives:

- What is a socket?
- The client-server model.
- Remote Communication

Outcome:

Develop Client-Server architectures and prototypes by the means of correct standards and technology.

Software Requirements:

Python, Open-source Linux operating system.

THEORY:

The basics

What is mean by Socket

Sockets allow communication between two different processes on the same or different machines. To be more precise, it's a way to talk to other computers using standard Unix file descriptors. In Unix, every I/O action is done by writing or reading a file descriptor. A file descriptor is just an integer associated with an open file and it can be a network connection, a text file, a terminal, or something else.

To a programmer, a socket looks and behaves much like a low-level file descriptor. This is because commands such as read() and write() work with sockets in the same way they do with files and pipes.

Types of Socket

A Unix Socket is used in a client-server application framework. A server is a process that performs some functions on request from a client. Most of the application-level protocols like FTP, SMTP, and POP3 make use of sockets to establish connection between client and server and then for exchanging data.

Socket Types

There are four types of sockets available to the users. The first two are most commonly used and the last two are rarely used.

Processes are presumed to communicate only between sockets of the same type but there is no restriction that prevents communication between sockets of different types.

Stream Sockets − Delivery in a networked environment is guaranteed. If you send through the stream socket three items "A, B, C", they will arrive in the same order − "A, B, C". These sockets use TCP (Transmission Control Protocol) for data transmission. If delivery is impossible, the sender receives an error indicator. Data records do not have any boundaries.

Datagram Sockets − Delivery in a networked environment is not guaranteed. They're connectionless because you don't need to have an open connection as in Stream Sockets − you build a packet with the destination information and send it out. They use UDP (User Datagram Protocol).

Raw Sockets − These provide users access to the underlying communication protocols, which support socket abstractions. These sockets are normally datagram oriented, though their exact characteristics are dependent on the interface provided by the protocol. Raw sockets are not intended for the general user; they have been provided mainly for those interested in developing new communication protocols, or for gaining access to some of the more cryptic facilities of an existing protocol.

Sequenced Packet Sockets − They are similar to a stream socket, with the exception that record boundaries are preserved. This interface is provided only as a part of the Network Systems (NS) socket abstraction, and is very important in most serious NS applications. Sequenced-packet sockets allow the user to manipulate the Sequence Packet Protocol (SPP) or Internet Datagram Protocol (IDP) headers on a packet or a group of packets, either by writing a prototype header along with whatever data is to be sent, or by specifying a default header to be used with all outgoing data, and allows the user to receive the headers on incoming packets.

The client-server model

The client-server model is one of the most commonly used communication paradigms in networked systems. Clients normally communicate with one server at a time. From a server's perspective, at any point in time, it is not unusual for a server to be communicating with multiple clients. Client need to know of the existence of and the address of the server, but the server does not need to know the address of (or even the existence of) the client prior to the connection being established. The client and the server on the same local network (usually called LAN, Local Area Network), the client and the server may be in different LANs, with both LANs connected to a Wide Area Network (WAN) by means of *routers*

Transmission Control Protocol (TCP)

TCP provides a *connection oriented service*, since it is based on connections between clients and servers.

TCP provides reliability. When a TCP client sends data to the server, it requires an acknowledgement in return. If an acknowledgement is not received, TCP automatically retransmit the data and waits for a longer period of time for acknowledgement.

T**CP Socket API**

The sequence of function calls for the client and a server participating in a TCP connection is presented in following Figure

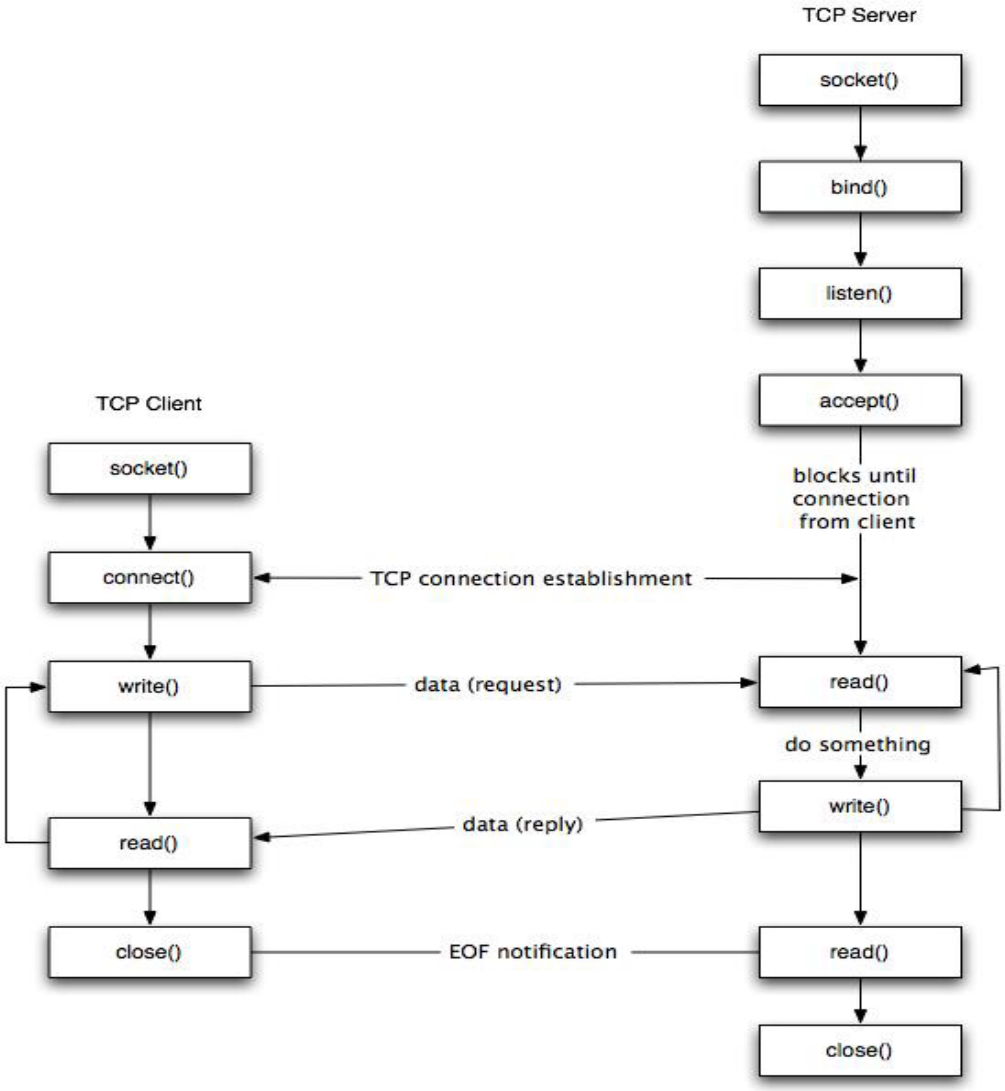


Figure: TCP client-server.

As shown in the figure, the steps for establishing a TCP socket on the client side are the following:

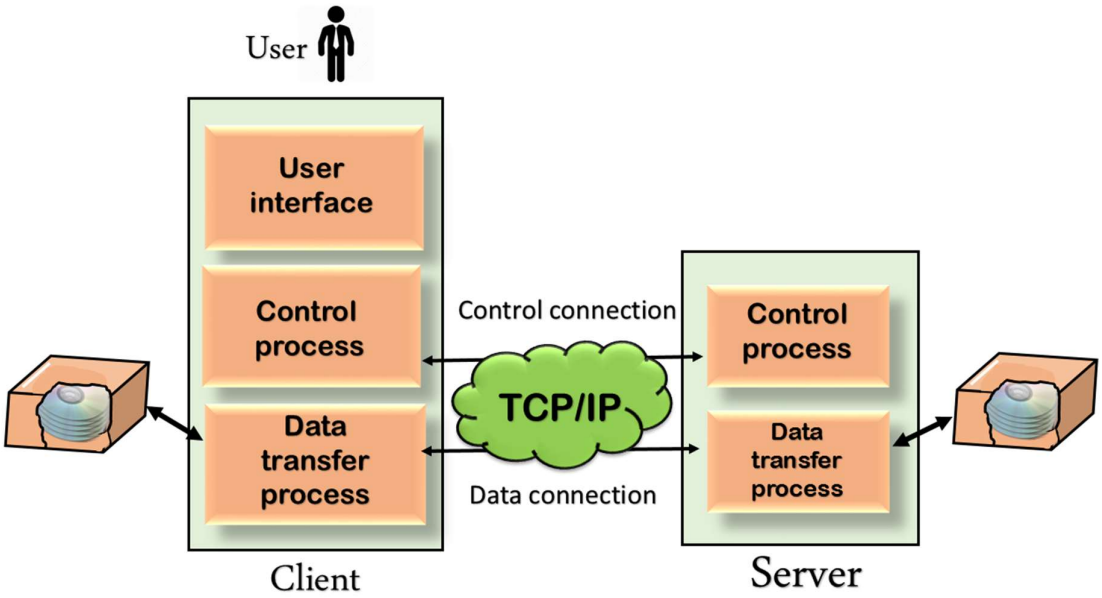
- Create a socket using the socket() function;
- Connect the socket to the address of the server using the connect() function;
- Send and receive data by means of the read() and write() functions.
- Close the connection by means of the close() function.

- The steps involved in establishing a TCP socket on the server side are as follows:
- Create a socket with the socket() function;
- Bind the socket to an address using the bind() function;
- Listen for connections with the listen() function;

- Accept a connection with the accept() function system call. This call typically blocks until a client connects with the server.
- Send and receive data by means of send() and receive().
- Close the connection by means of the close() function.

- FTP stands for File transfer protocol.
- FTP is a standard internet protocol provided by TCP/IP used for transmitting the files from one host to another.
- It is mainly used for transferring the web page files from their creator to the computer that acts as a server for other computers on the internet.
- It is also used for downloading the files to computer from other servers.

FTP Mechanism:

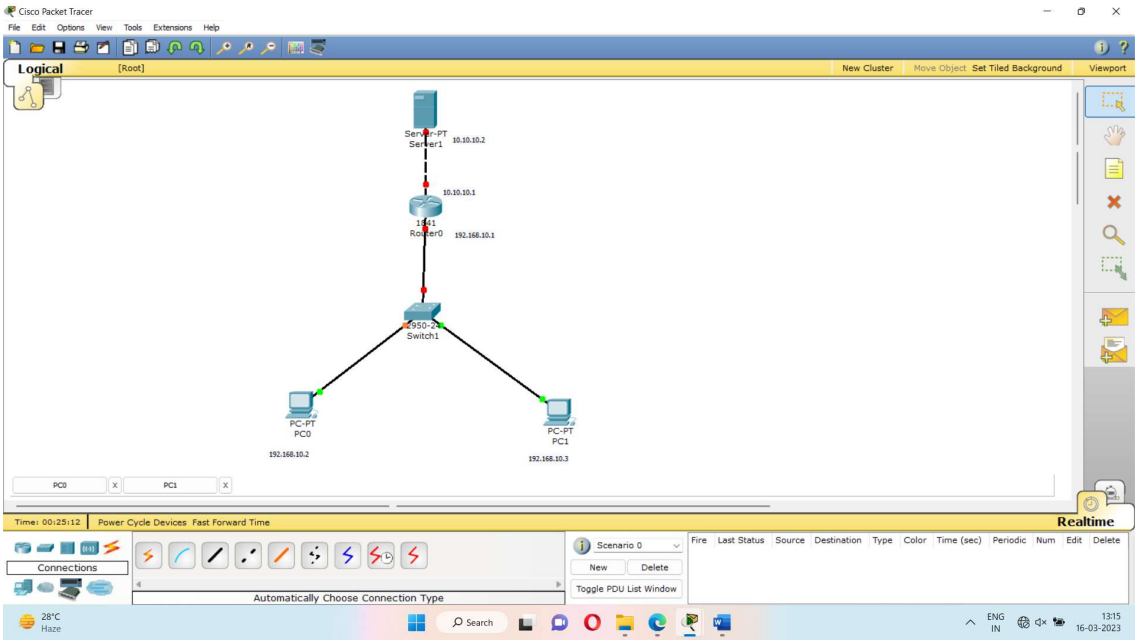


There are two types of connections in FTP:

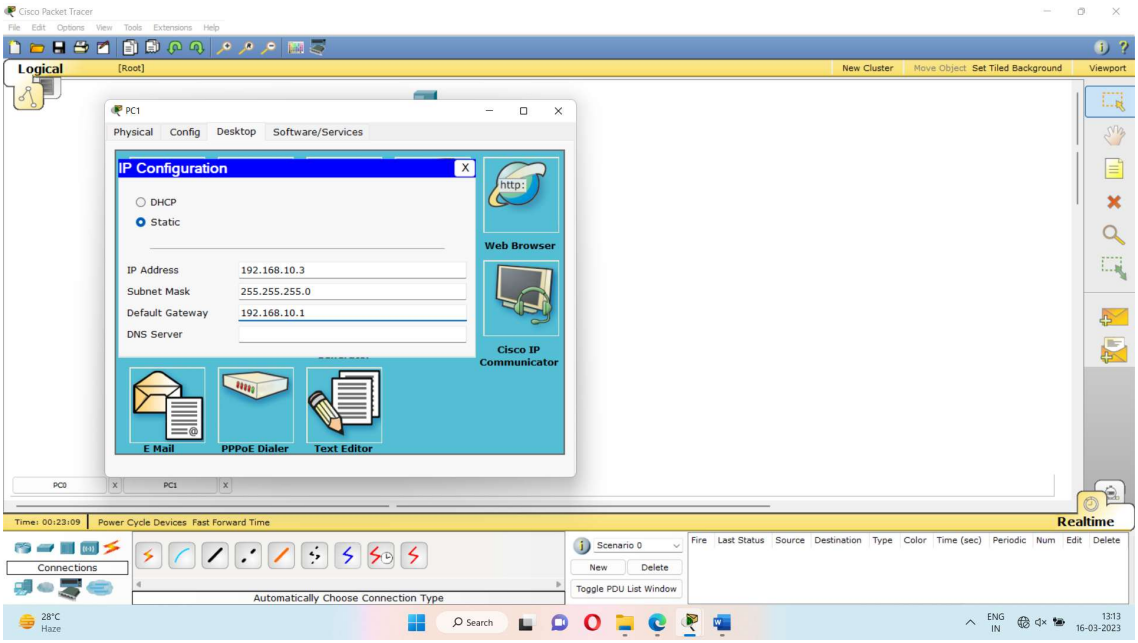
- **Control Connection:** The control connection uses very simple rules for communication. Through control connection, we can transfer a line of command or line of response at a time. The control connection is made between the control processes. The control connection remains connected during the entire interactive FTP session.
- **Data Connection:** The Data Connection uses very complex rules as data types may vary. The data connection is made between data transfer processes. The data connection opens when a command comes for transferring the files and closes when the file is transferred.

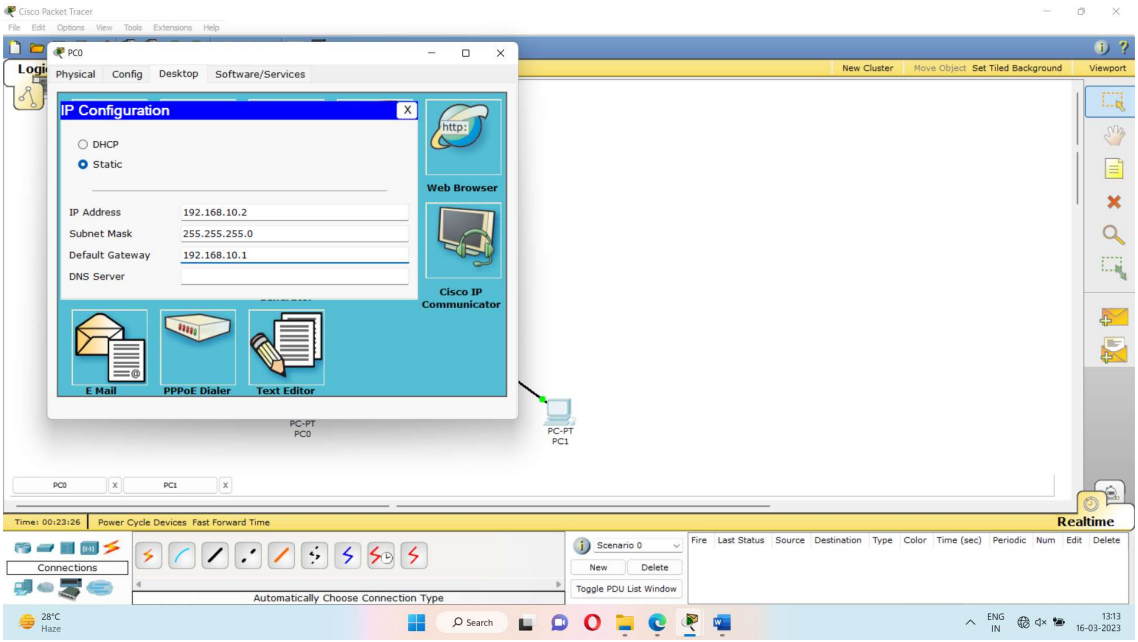
Procedure:

1. Select end devices, switch, router, server with drag and drop option and connect them.

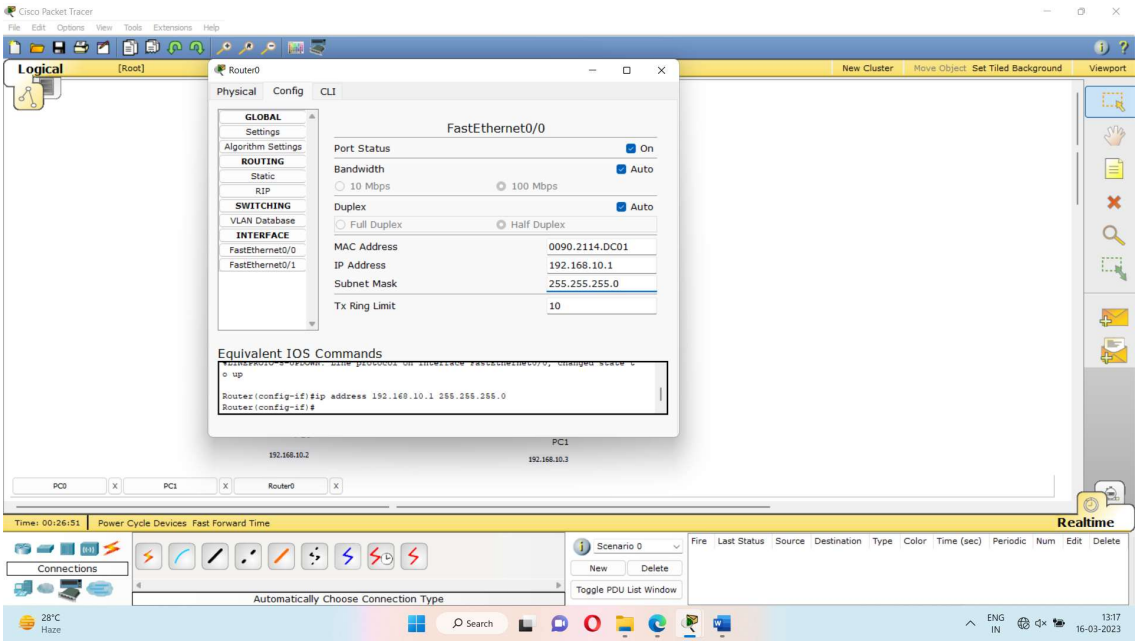


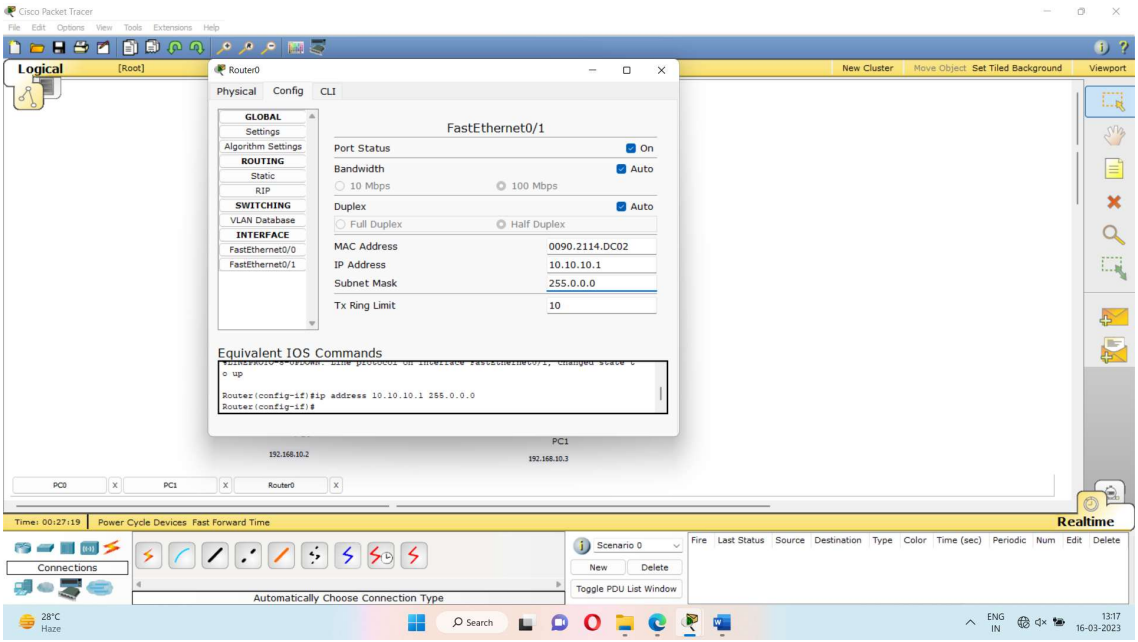
2. On end devices like PC0, PC1 double click and do following settings.
   Go to Desktop – IP configuration



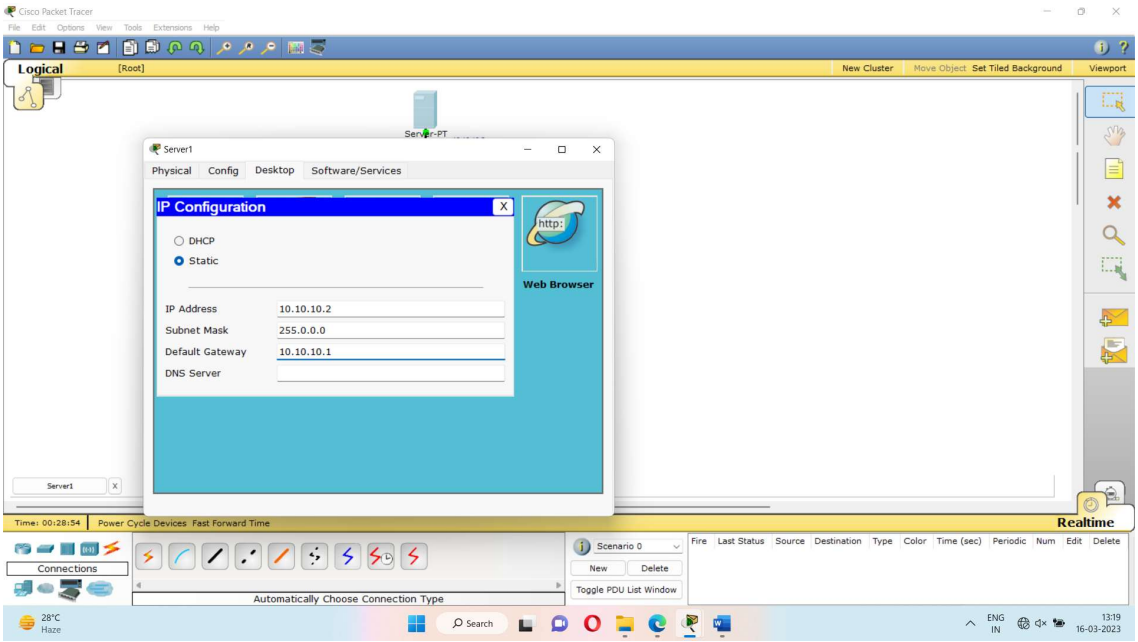


3. Click on Router and do following settings.

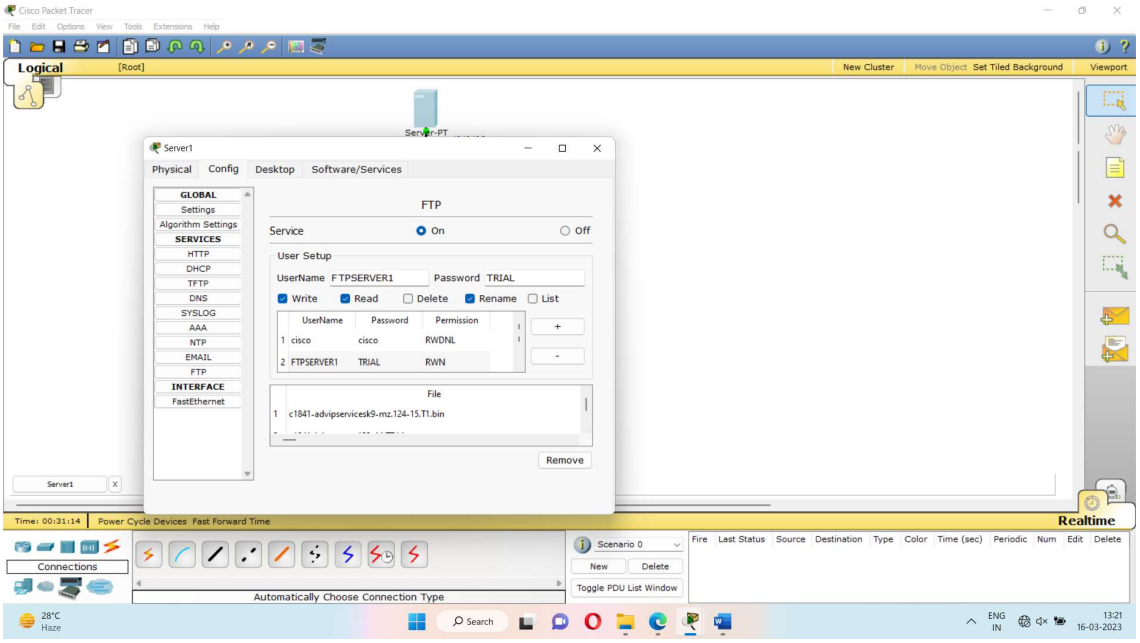




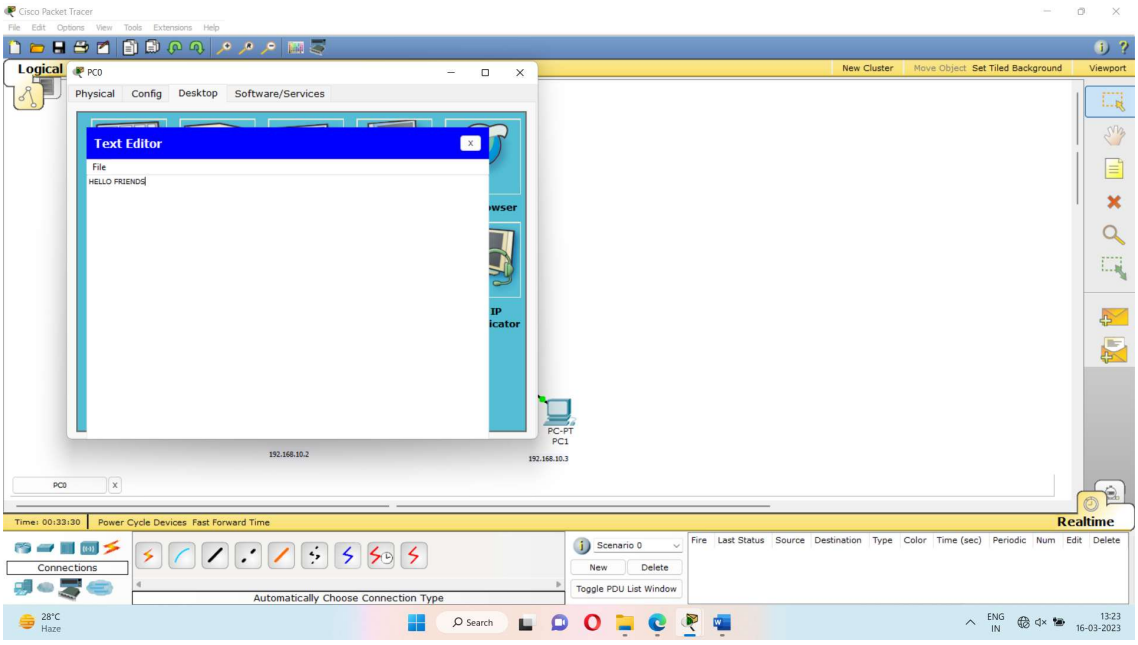
4. Click on server. Go to desktop – IP configuration.

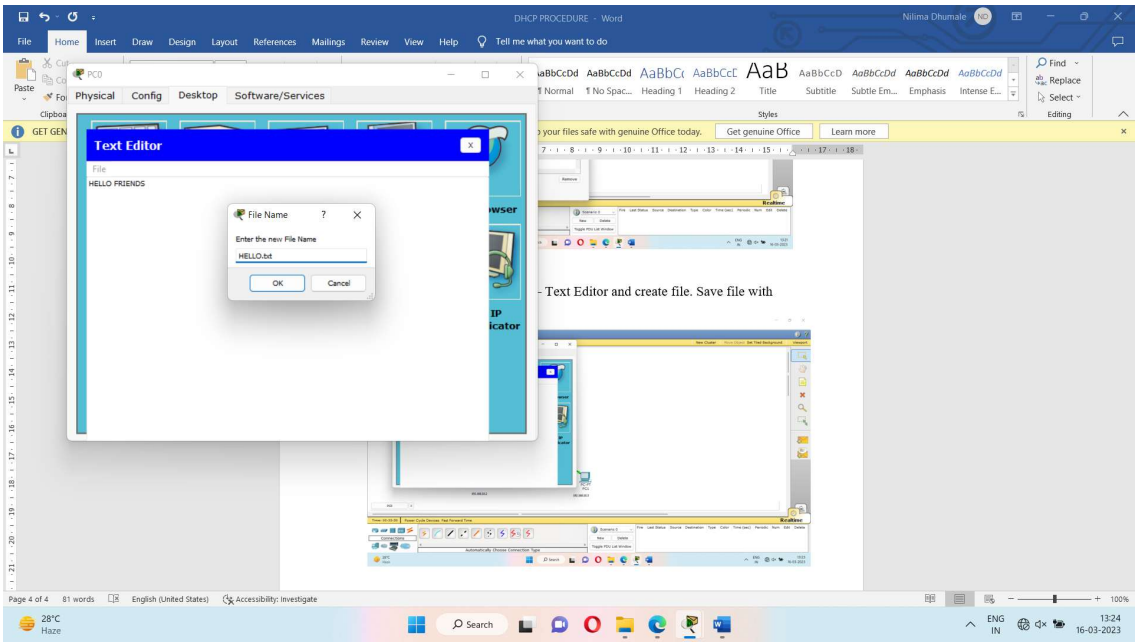


5. On server go to Config – FTP – USERNAME – PASSWORD – Click on "+".

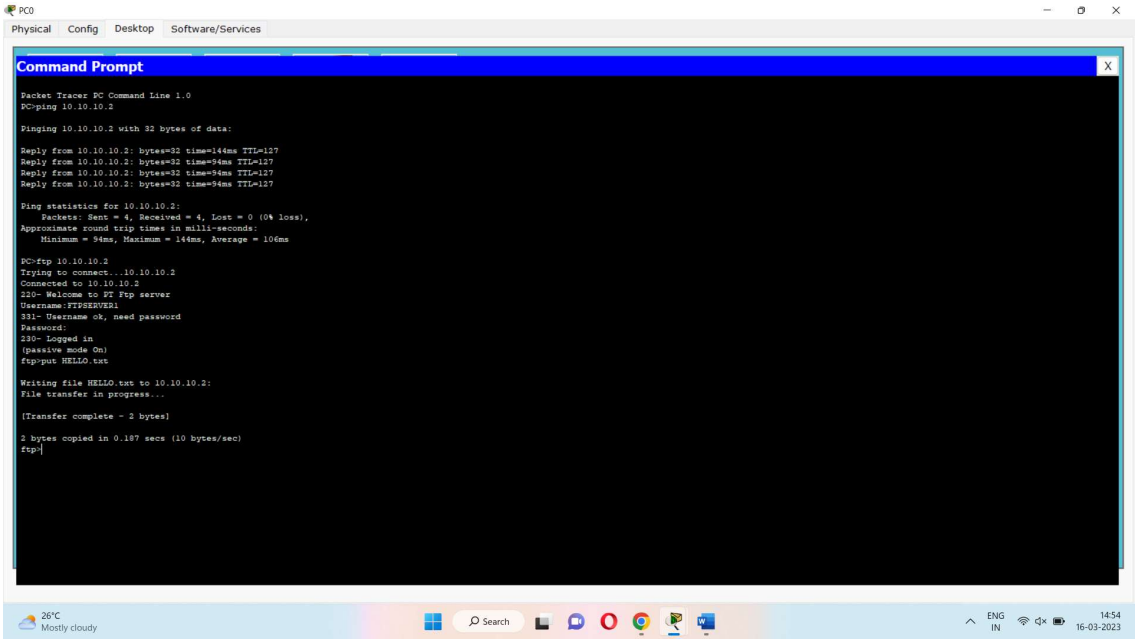


6. Click on PC0. Select Desktop – Text Editor and create file. Save file with file name. txt(e.g. HELLO.txt)

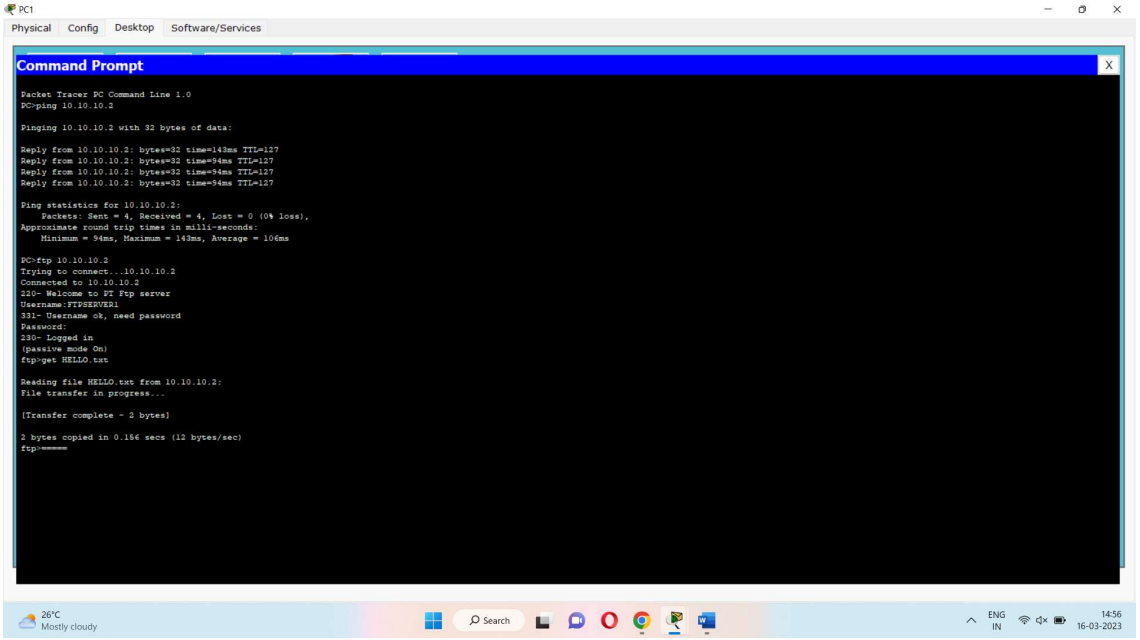




7. On desktop run following commands on one PC.



8. On desktop run following commands on second PC.



Marks (Out of 20)				Signature of Faculty with Date
MR (6)	MP (6)	MU (8)	Total (20)	

MR – Marks for Regularity, MP – Marks for Presentation, MU – Marrk for Understanding

Sinhgad Institutes

Sinhgad Technical Educational Society's
SINHGAD COLLEGE OF ENGINEERING
VADGAON PUNE-41
Department of Electronics & Telecommunication

Experiment No. _

Subject: - Mobile Computing

Name of the Student:_____ Roll No._____

Date: _____ Marks & Signature: -

Subject Teacher

TITLE:

To plot BER for AWGN Channel using python

AIM:
To Study AWGN channel and to measure Bit Error Rate.

SOFTWARE & HARDWARE REQUIREMENTS:

OS.: Unix or windows 7/8/10,

Processor: i3/i5/i7

Software: Python (Jupyter Notebook) or java

Theory:

AWGN stands for Additive White Gaussian Noise, which is a common model used to describe the channel in digital communication systems. An AWGN channel is a type of noise channel that adds random Gaussian noise to the transmitted signal. The term "additive" refers to the fact that the noise is added to the signal, "white" means that the noise has a constant power spectral density across all frequencies, and "Gaussian" means that the noise follows a Gaussian distribution with zero mean and a given variance.

The AWGN channel is a useful model for many real-world communication scenarios, since noise in communication channels often has these characteristics. For example, thermal noise in electronic components and devices can be modeled as AWGN, as can radio frequency interference and atmospheric noise in wireless communication systems. The Gaussian distribution is also a natural model for many types of noise, since it arises from the central limit theorem, which states that the sum of many independent random variables tends to follow a Gaussian distribution.

The effects of AWGN on a digital communication system can be analyzed using statistical methods such as signal-to-noise ratio (SNR) analysis and bit error rate (BER) analysis. The SNR is defined as the ratio of the signal power to the noise power, and is a measure of the quality of the received signal. The BER is the fraction of received bits that are in error compared to the transmitted bits, and is a measure of the accuracy of the communication system. Both the SNR and BER depend on the power of the transmitted signal, the bandwidth of the channel, and the characteristics of the noise, such as its variance.

In summary, the AWGN channel is a widely used model for noise in digital communication systems, and its effects on the system can be analyzed using statistical methods. Understanding the AWGN channel is important for designing and optimizing communication systems for different noise environments.

Procedure:

1. Set up a communication system consisting of a transmitter, a channel, and a receiver. The transmitter should generate a sequence of bits and modulate them using BPSK modulation. The channel should add noise to the signal according to the AWGN model. The receiver should demodulate the signal and decode the received symbols back to bits.

2. Set the signal-to-noise ratio (SNR) to a desired value, e.g., 10 dB. You can use a signal generator and a noise generator to simulate the transmitted signal and the noise, respectively. Alternatively, you can use a hardware transmitter and receiver and set the SNR by adjusting the power levels of the transmitted and received signals.

3. Transmit a large number of bits, e.g., one million. Measure the bit error rate (BER) by comparing the received bits to the transmitted bits and counting the number of errors. The BER can be expressed as the ratio of the number of errors to the total number of bits transmitted.

4. Repeat step 3 for different values of SNR, e.g., 5 dB, 0 dB, -5 dB, etc. Plot the BER as a function of SNR. You should observe that the BER decreases as the SNR increases, and eventually approaches zero as the SNR becomes very large.

5. Compare your results to the theoretical BER curve for BPSK modulation in the presence of AWGN, which is given by the formula:

BER = 0.5*erfc(sqrt(SNR))

where erfc is the complementary error function and SNR is the signal-to-noise ratio in linear scale (not dB).

You can use this formula to calculate the expected BER for different values of SNR and compare it to your measured BER. You should observe good agreement between theory and experiment for high SNR values, but some deviation for low SNR values due to the statistical nature of the noise. you can gain a better understanding of the effects of noise on digital communication systems and how the BER depends on the SNR. This can be useful for designing and optimizing communication systems for different noise environments.

Python program that implements the experiment to measure the bit error rate in the presence of an AWGN model:

```
import numpy as np
import matplotlib.pyplot as plt

# Set the parameters
n_bits = 1000000     # Number of bits to be transmitted
SNRdBs = np.arange(-10, 11, 1)   # SNR range in dB
SNRs = 10**(SNRdBs/10)  # SNR range in linear scale

# Generate random bits
bits = np.random.randint(0, 2, n_bits)

# Loop over SNR values
BERs = []
for SNR in SNRs:
   # BPSK modulation
   symbols = 2*bits - 1

   # Add noise
   noise_power = 1/SNR
   noise = np.sqrt(noise_power)*np.random.randn(n_bits)
```

```
    received = symbols + noise

    # BPSK demodulation
    decoded_bits = (received >= 0).astype(int)

    # Calculate the bit error rate
    BER = np.sum(bits != decoded_bits) / n_bits
    BERs.append(BER)

# Plot the results
plt.semilogy(SNRdBs, BERs)
plt.xlabel('SNR (dB)')
plt.ylabel('Bit Error Rate')
plt.title('Bit Error Rate vs. SNR for BPSK modulation with AWGN')
plt.grid(True)
plt.show()
```

In this program, we first set the number of bits to be transmitted (n_bits) and the SNR range in dB (SNRdBs). We then generate a random sequence of bits using NumPy's randint() function. We loop over the SNR values in the range and for each value, we perform BPSK modulation by mapping each bit to a symbol (-1 or 1). We add noise to the signal according to the AWGN model using NumPy's randn() function. We decode the signal by comparing the received symbols to a threshold of 0, and convert the decoded symbols back to bits. Finally, we calculate the bit error rate by counting the number of bits that are not correctly decoded and dividing by the total number of bits transmitted. We store the BER values in a list BERs.

We then plot the BER values as a function of SNR using Matplotlib's semilogy() function to show the results on a logarithmic scale. We label the x-axis as SNR in dB, and the y-axis as Bit Error Rate. We also add a title and gridlines to the plot. The show() function displays the plot.

By running this program, you can observe how the bit error rate decreases as the SNR increases and eventually approaches the theoretical BER curve for BPSK modulation in the presence of AWGN. You can modify the parameters n_bits and SNRdBs to change the number of bits transmitted and the SNR range, respectively, and see how the results change.

Conclusion

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_____

In [6]:

```
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import matplotlib.pyplot as plt

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SNRs = 10**(SNRdBs/10)  # SNR range in linear scale

# Generate random bits
bits = np.random.randint(0, 2, n_bits)

# Loop over SNR values
BERs = []
for SNR in SNRs:
    # BPSK modulation
    symbols = 2*bits - 1

    # Add noise
    noise_power = 1/SNR
    noise = np.sqrt(noise_power)*np.random.randn(n_bits)
    received = symbols + noise

    # BPSK demodulation
    decoded_bits = (received >= 0).astype(int)

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    BER = np.sum(bits != decoded_bits) / n_bits
    BERs.append(BER)

# Plot the results
plt.semilogy(SNRdBs, BERs)
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```

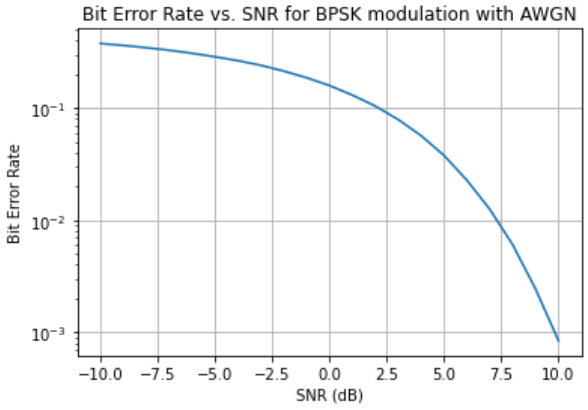

In [ ]:

Title :- Case Study on different real time mobile computing services.

- Internet Access
- Mobile Communications
- Web Browsing
- Mobile Applications
- Entertainment Streaming Media
- E-Commerce

Conclusion :-

Marks (Out of 20)				Signature of Faculty with Date
MR (6)	MP (6)	MU (8)	Total (20)	
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