

**Write a program for error detecting code using CRC-CCITT (16- bits).**

### DESCRIPTION

1. CRC-8, CRC-10, CRC-12, CRC-16, CRC-CCITT-16, CRC-CCITT-32, CRC-32
2. CRC Algorithm
3. Manual calculation of CRC- error and error free conditions
4. List other Error Detection and Correction Techniques

1.  $\text{CRC - 8} : x^8 + x^7 + x^6 + x^4 + x^2 + 1$  (3)

$\text{CRC - 10} : x^{10} + x^9 + x^5 + x^4 + 1$

$\text{CRC - 12} : x^{12} + x^{11} + x^3 + x^2 + x + 1$

$\text{CRC - 16} : x^{16} + x^{15} + x^2 + 1$

$\text{CRC - CCITT 16} : x^{16} + x^{12} + x^5 + 1$

$\text{CRC - 32} : x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$

2. CRC Algorithm :-

- 1 \* let  $R$  be the degree of  $g(x)$
- 2 \* Append  $R$  '0' bits to the lower order end of the frame or the information.
- 3 \* Divide the bit stream corresponding to  $g(x)$  into bit stream corresponding to  $x^R \cdot I(x)$  using modulo 2 division.
- 4 \* Subtract the remainder from the bit stream corresponding to  $x^R \cdot I(x)$  using modulo 2 subtraction.
- 5 \* The result is called checksum frame/ codeword which is transmitted to receiver.

The receiver is called checksum frame/codeword which is transmitted to the receiver.

The receiver divides the received codeword using the same generator. A remainder '0' indicates no error and a non zero remainder indicates error in transmission.

Manual calculation of CRC

Generator:  $x^{16} + x^{12} + x^5 + 1 \Rightarrow 10001000000010001$

$$\begin{array}{r} 1011 \\ \hline 10001000000010001 ) 10110000000000000000 \\ 10001000000010001 \downarrow \\ \hline 01110000001000010 \\ 00000000000000000 \\ \hline 11100000010000100 \\ 10001000000100001 \\ \hline 11010000101001010 \\ 10001000000100001 \\ \hline 1011000101101011 \end{array}$$

CRC : 1011000101101011

Transmitted frame : 10111011000101101011

the receiver:

Correct data:

received data : 10111011000101101011

$$\begin{array}{r}
 1011 \\
 \hline
 10001000000100001 \\
 )10111011000101101011 \\
 1.0001.000\ 000100001 \\
 \hline
 011001100000011000 \\
 000000000000000000 \\
 \hline
 11001000000110001 \\
 1000100000100001 \\
 \hline
 010001000000100001 \\
 10001000000100001 \\
 \hline
 000000000000000000
 \end{array}$$

Correct bits are received

incorrect data:

received data: 10111011000101101010

100010000000100001) 1011  
 10111011000101101010  
 10001000000100001  
 1100110000011000  
 100000000000000000  
 11001000000110001  
 10001000000100001  
 10000000001000000  
 10001000000100001  
 000000000000000000

~~Incorrect data bits received~~

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~~the receiver~~

error - detection techniques

- 1.) Parity
- 2) CRC (Cyclic Redundancy check)
- 3) Hamming code
- 4) Internet checksum

DATE: 19/09/18

**Program: 8**

**Write a program to find the shortest path between vertices using bellman-ford algorithm.**

**DESCRIPTION**

1. Bellman ford algorithm
2. Tracing of the algorithm with an example
3. Drawbacks of Bellman ford (count-to-infinity)

**Algorithm**

1. It helps us to find shortest path from a vertex to all other vertices of a weighted graph

bellmanford ( $G, s$ )

each vertex  $v$  in  $G$

    distance [ $v$ ]  $\leftarrow$  infinite

    previous [ $v$ ]  $\leftarrow$  NULL

    distance [ $s$ ]  $\leftarrow$  0

for each ~~edge~~ vertex  $v$  in  $G$

    for each edge  $(u, v)$  in  $G$

        temp  $\leftarrow$  distance [ $u$ ] + edge weight( $u, v$ )

        if temp  $<$  distance [ $v$ ]

            distance [ $v$ ]  $\leftarrow$  temp

            previous [ $v$ ]  $\leftarrow u$

    for each edge  $(u, v)$  in  $G$

        if distance [ $u$ ] + edge weight( $u, v$ )  $<$  distance [ $v$ ]

            error

    return distance [], previous []

**Disadvantages:**

1. It doesn't scale well.
2. changes in network topology are not reflected quickly.
3. Updates are spread node by node.

tree vertexdistance of vertex  
from all other vertices

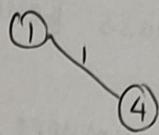
illustration

$$(1, 2) = 2 \quad (1, 3) = 3$$

1

$$(1, 4) = 1 \quad (1, 5) = 2$$

$$(1, 6) = 4$$

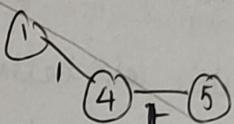


$$(2, 1) = 2 \quad (2, 3) = 3$$

2

$$(2, 4) = 2 \quad (2, 5) = 3$$

$$(2, 6) = 5$$



	1	2	3	4	5	6
1	0	2	3	1	2	4
2	2	0	3	2	3	5
3	1	2	3	4	5	6
4	3	3	0	2	1	3

	1	2	3	4	5	6
1	2	0	3	1	2	4
2	0	3	1	2	3	5
3	1	2	3	4	5	6
4	3	3	0	2	1	3

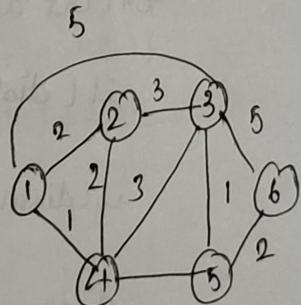
	1	2	3	4	5	6
1	3	0	2	1	0	2
2	1	2	3	4	5	6
3	2	3	1	1	0	2
4	3	3	0	2	1	3

	1	2	3	4	5	6
1	3	0	2	1	0	2
2	1	2	3	4	5	6
3	2	3	1	1	0	2
4	3	3	0	2	1	3

	1	2	3	4	5	6
1	3	0	2	1	0	2
2	1	2	3	4	5	6
3	2	3	1	1	0	2
4	3	3	0	2	1	3

	1	2	3	4	5	6
1	3	0	2	1	0	2
2	1	2	3	4	5	6
3	2	3	1	1	0	2
4	3	3	0	2	1	3

	1	2	3	4	5	6
1	3	0	2	1	0	2
2	1	2	3	4	5	6
3	2	3	1	1	0	2
4	3	3	0	2	1	3



Program: 9

DATE: 17/10/18

Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.

### DESCRIPTION

1. Definition of Socket, types of Sockets
2. Server Client interaction diagram
3. Primitives of TCP/IP Socket ( Socket, Bind, Accept, Connect, Read, Write etc.,)
4. Definition of Port , Reserved Port no., Ephemeral Port no.
5. List Port no. associated with application layer protocols

Sockets allow communication between two different processes on the same or different machines. There are 4 types of sockets

- 1) Stream sockets : Uses TCP for data transmission.
- 2) ~~Datagram~~ Raw sockets : Uses UDP for data transmission
- 3) Raw sockets : These provide users access to the underlying communication protocols which support socket abstractions.
- 4) Sequenced Packet Sockets : They are similar to a stream socket, with the exception that record boundaries are preserved.

- \* Socket : This class implements client sockets .
- \* accept : listens for a connection to be made to server socket and accepts it .
- \* connect : To connect client socket with server socket
- \* read : To read the next byte from input stream .
- \* write : To write bytes on to the output stream

Protocol	port - no		
Echo - protocol	#	SMTP	25
FTP	20, 21	HTTP	80
Secure Shell	22	IMAP	143
		SNMP	199

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Port number is used to identify the receiving process.  
Port numbers are assigned for few well known processes. These port numbers are called reserved port numbers.

An ephemeral port is a short lived transport protocol port for IP communications. Port numbers assigned to such port is known as ephemeral port number.

Server

(Running on serverIP)

Create socket, port = x,  
for incoming request:  
serverSocket = socket()

Wait for incoming connection request:

connectionSocket =  
serverSocket.accept()

Read request from connectionSocket

Write reply to connectionSocket

close

~~connectionSocket~~

TCP  
connection setup

Create socket, connect to serverIP, port = x:  
clientSocket = socket()

Send request using clientSocket

Read reply from clientSocket

close clientSocket.

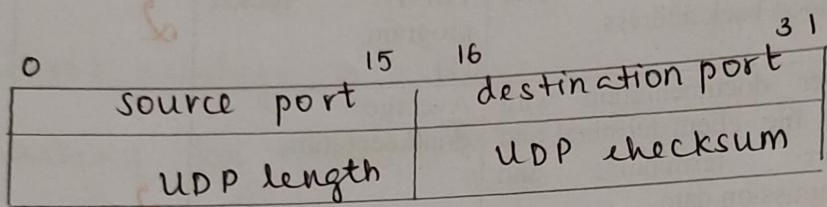
**Program: 10**

Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.

**DESCRIPTION**

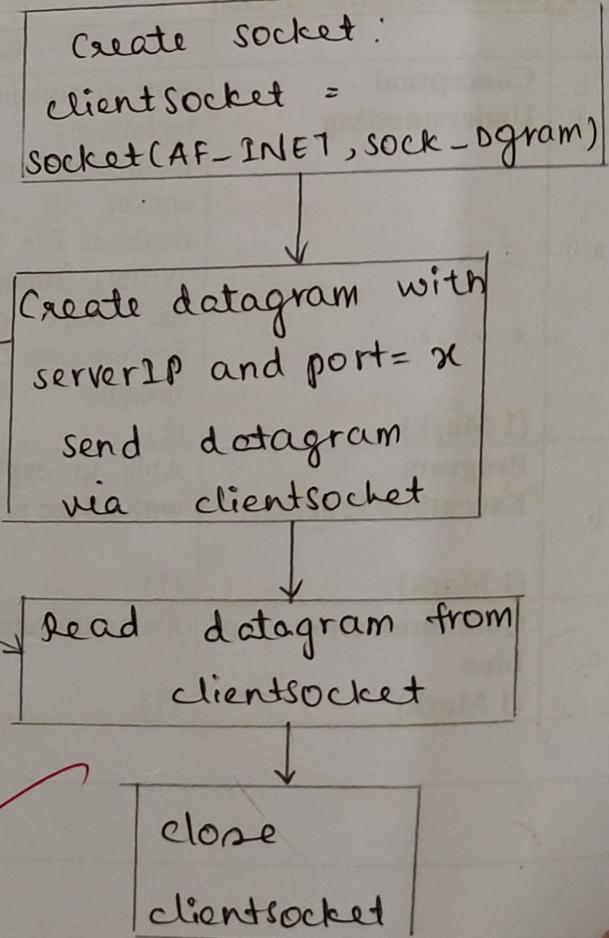
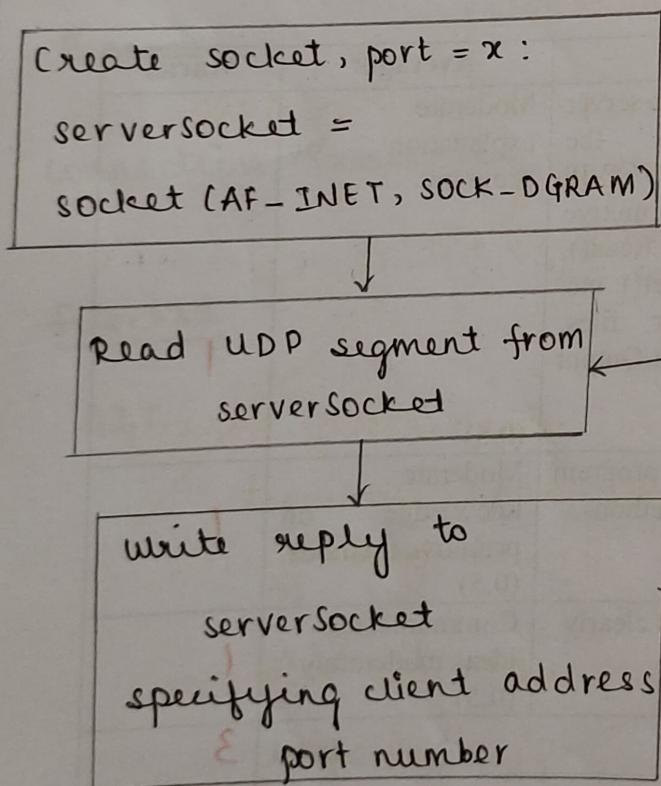
1. Definition of UDP Header Format (Datagram)
2. UDP Server Client interaction diagram
3. Primitives of UDP/IP Socket ( socket, connect, send , recv etc.,)
4. Difference between TCP and UDP

UDP Header format



Server

client



Socket: This class implements client socket.

sendto (sock, data, addr) - sends data in UDP to addr

recvfrom (sock, data, addr) - receives data from a UDP datagram sent from addr.

TCP

- > It provides a connection-oriented service to the invoking application.
- > Reliable data transfer
- > Congestion control
- > Error checking.
- > It uses three way handshake before it starts to transfer data
- > TCP segment has 20 bytes of header

UDP

- > It provides a connectionless service to the invoking application.
- > Process-to-process data delivery
- > Error-checking
- > It immediately passes the data without formal preliminaries.
- > UDP has 8 bytes of overhead.

**Program : 11**

Write a program for simple RSA algorithm to Encrypt and Decrypt the data.

**DESCRIPTION**

1. Definition Confidentiality, Message Integrity, Authentication
2. Symmetric Cryptography, Asymmetric Cryptography
3. RSA Algorithm
4. Step by step tracing of the algorithm.
5. Wrapper Classes

1. Confidentiality: Only the sender and intended receiver shall be able to understand the contents of the transmitted message.

Message Integrity: It is ensuring that content of communication is not altered, either maliciously or accidentally.

Authentication: Both sender and receiver should be able to confirm the identity of the other party involved in the communication.

2) Symmetric ~~2.0~~ cryptography: In this technique, both sender and receiver share identical keys which are secret.

Asymmetric ~~1~~ cryptography or public key cryptography is a technique where a pair of keys is used, one for encryption by sender and decryption by receiver.

3, 4)

Step 1 : Select two large prime numbers  $p$  and  $q$ .

Step 2 :

Compute  $n = p * q$  and  $z = (p-1) * (q-1)$

Step 3 : Choose a number  $e$  less than  $n$ , that has no common factors (other than 1) with  $z$

Step 4 : Find a number,  $d$  such that  $ed - 1$  is exactly divisible by  $z$

$$\textcircled{1} \quad p = 3 \quad \text{and} \quad q = 5$$

$$\textcircled{2} \quad n = 3 * 5 \quad z = 2 * 4$$

$$n = 15 \quad z = 8$$

$$\textcircled{3} \quad e = 11 \quad \gcd(e, z) = \gcd(11, 8) = 1$$

$$d = 3 \quad ed \bmod z = (11)(3) \% 8$$

$$= 33 \% 8$$

$$= 1$$

Wrapper classes are used to find primitive datatypes to objects. The wrapper classes for the primitive types are as follows:-

Primitive type      Wrapper class

int

Integer

short

Short

byte

Byte

long

Long

float

Float

char

Character

double

Double

boolean

Boolean

**Program: 12**

DATE: 19/09/18

**Write a program for congestion control using leaky bucket algorithm.**

### DESCRIPTION

1. Definition of Congestion,
2. Congestion Control Algorithms
  - (A) Leaky bucket Algorithm
  - (B) Token Bucket Algorithm
3. Advantage and disadvantage of both the algorithms
4. Difference between Leaky bucket and Token Bucket

Congestion :

It is the reduced quality of service that occurs when a network node or a link is carrying more data than it can handle.

Algorithm : Leaky bucket.

Step 1 : Initialise a counter to  $n$  at the tick of clock.

Step 2 : If  $n$  is greater than the size of packet, send the packet and decrement the counter by packet size.

Step 3 : Reset the counter and go to step 1.

Algorithm : Token Bucket

Step 1 : A token is added to the bucket every  $\frac{1}{r}$  seconds.

Step 2 : The bucket can hold at most  $b$  tokens. If a token arrives when the bucket is full, it is discarded.

Step 3 : When a packet of  $n$  bytes arrives,

i) If at least  $n$  tokens are in the bucket,  $n$  tokens are removed and packet is sent.

ii) If fewer than  $n$  tokens are available, no tokens are removed from bucket & packet is considered non-conformant

### Advantages

Leaky Bucket maintains a constant output rate even if the input rate varies.

If bucket is full in token bucket, tokens are discarded.

not packets while in leaky bucket, packets are discarded

Token bucket can send large bursts at faster rate while leaky bucket always sends packets at constant rate.

### Leaky Bucket

1) When host has to send a packet, packet is thrown in bucket.

2) Bucket leaks at constant rate. 2) Bucket has maximum capacity.

3) Bursty traffic is converted into uniform traffic by leaky bucket.

4) In practice, bucket is a finite queue ~~outputs~~ at finite rate.

### Token Bucket

1) In this token bucket holds tokens generated at regular intervals.

2) If there is no token in the bucket, packet cannot be sent.

3) If there is a ready packet, a token is removed from bucket and packet is sent.

4) If there is no token in the bucket, packet cannot be sent.

```
$ ns at 50.0 "finish"  
$ ns run
```

Structure of AWK program

```
BEGIN {action}  
{  
    Body of program  
}  
END {action}
```

Tracefile format:

Each line in tracefield consists of twelve fields.

Event	Time	From	To	Packet type	Packet size	Flag 1D	Flag 2D	Source	Destination	Sequence no	Packet ID
		Addr	Addr								

Bandwidth : It is the route at which the data can be transmitted over a channel. It is expressed in terms of number of bits per second.

Queue : It is a buffer allocated to each link where the packet is to be sent is stored (a copy) and it is removed after it is put on the link.

Point - to - point communication : A point - to - point connection provides a dedicated connection between two nodes.

DATE: 12/09/18

**Program: 2**

Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.

**DESCRIPTION**

1. PING utility, ICMP Protocol, Trace Route.
2. Congestion.

Ping utility :

Ping is a computer network administration software utility used to test the reachability of a host on an Internet protocol network. It measures the roundtrip time for messages sent from the originating host to a destination computer that are echoed back to the host. It uses ICMP . PING - Packet Internet Groper.

ICMP protocol :

ICMP : Internet control message protocol.

ICMP is a supporting protocol in the Internet protocol suite. It is used by network devices including routers to send error message and operational information (for example : when a requested service is not available or when a host or router could not be reached)

It is used in Ping and Traceroute.

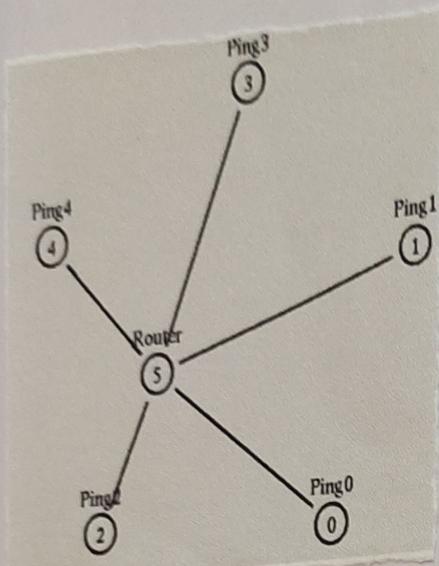
Trace Route:

It is a CN diagnostic tool for displaying the route (path) and measuring transit delays of packets across an internet protocol network.

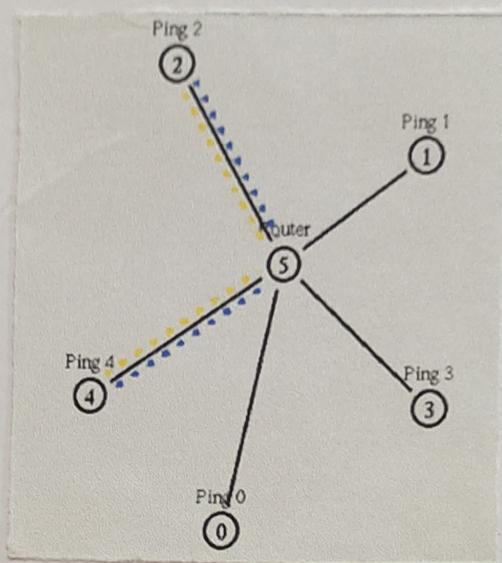
Congestion

It is the reduced quality of service that occurs when a network node or link is carrying more data than it can handle. Its effects include queuing delay, packet loss or blocking of new connections.

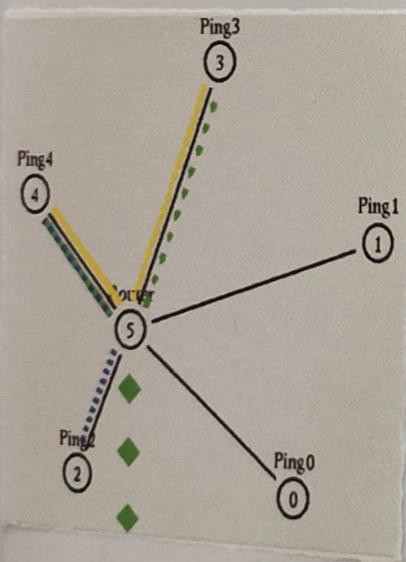
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NETWORK TOPOLOGY

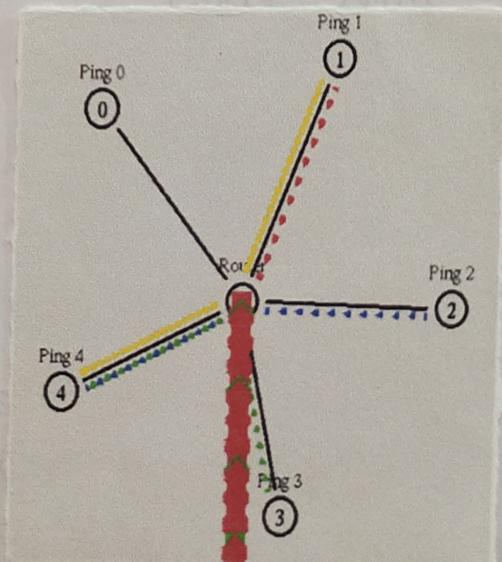
Topology.



One Ping Application



Two Ping Application



Three Ping Application

## OUTPUT & ANALYSIS

(1) Start one PING Application

Number of packet drops due to Congestion: 0

(2) Start two PING Application

Number of packet drops due to Congestion: 41

(3) Start three Ping Application

Number of packet drops due to Congestion: 1930

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19/11/18

DATE: 31/10/18

**Program: 3**

**Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.**

**DESCRIPTION**

1. LAN and its applications
2. Ethernet Standards for wired network
3. TELNET and FTP Protocol
4. TCP Congestion Control Phases (Slow start and Fast Recovery)

A local area network (LAN) is usually privately owned and connects some hosts in a single office, building or campus.

Few Applications of LAN :

- Personal computer LAN's
- Back-end networks and storage area networks
- High-speed office networks.
- Backbone LAN's

Different Ethernet standards for wired networks are :

1. Standard Ethernet
2. Fast Ethernet
3. Gigabit Ethernet
4. 10 Gigabit Ethernet

Telnet is a protocol used on the Internet or local area network to provide a bidirectional interactive oriented communication facility using a virtual terminal connection.

In FTP, a standard network protocol used for the transfer of computer files between a client and server on a computer network.

Slow start begins initially with a congestion window size (cwnd) of 1, 2, 4 or 10MSS. The value for the congestion window size will be increased by one with each acknowledgement received, effectively doubling window size each round trip time.

In fast recovery, the value of cwnd is increased by 1MSS, for every duplicate ACK received for missing segment that caused TCP to enter the fast-recovery state.

Eventually when ACK arrives for missing segment, TCP enters congestion-avoidance state. after

The value of cwnd is set to 1MSS, and the value of estthresh is set to half the value of cwnd when the loss event occurred.

**Program: 4****DATE: 31/11/18**

**Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.**

**DESCRIPTION**

1. About IEEE 802.11 standard
2. Infrastructure mode and Adhoc mode
3. Basic Service Set and Extended Service Set
4. Trace file format of wireless network.

IEEE has defined the specifications for a wireless LAN, called IEEE 802.11 which covers the physical and data-link layers. It is sometimes called wireless Ethernet.

Infrastructure mode is an 802.11 networking framework in which devices communicate with each other by first going through an access point.

Adhoc mode refers to a wireless network structure where devices can communicate directly with each other.

A basic service set is made of stationary or mobile wireless stations and an optional central base station known as access point (AP)

An extended service set is made up of two or more BSSs with APs. In this case, the BSSs are connected through a distributed system, which is a wired or a wireless network.

## 4) trace file format

ACTION : [ s | r | D ] s → sent r → received, d → dropped

WHEN : The time when the action happened.

WHERE : The node where action happened.

LAYER : AGT - application

RTR - routing

LL - link layer

IFQ - outgoing packet queue.

MAC - mac

PHY - physical

SEQNO : The sequence number of packet .

TYPE : the packet type

cbr - cbr data stream packet

DSR - dsr routing packet .

RTS - RTS packet generated by MAC 802.11

ARP - link layer ARP packet .

SIZE : The size of packet at current layer when packet goes down, size increases goes up.

[a b c d] : a → packet duration in MAC layer header  
 b → mac address of destination  
 c → mac address of source  
 d → mac type of packet body

flags : [.....]

[.....] : [ source node ip : port number  
 destination node ip (-1 means broadcast) : port-number  
 ip header ttl . ]

**Program: 5**

**Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or Equivalent environment.**

**DESCRIPTION**

1. 2G, 3G, 4G networks
2. GSM and its Application

2G - It uses GSM (Global system for Mobile communications). It is the first to use digital encryption of conversations. They offered data services, SMS text messages.

3G - They offered faster data transfer rates and are first to enable video calls. They provided constant high speed internet connection for many applications.

4G - fourth generation. It uses LTE and radio access network and evolved packet core. It is an-all IP network i.e both voice & data will be carried in IP datagrams. It combines circuit switched and packet switched data network.

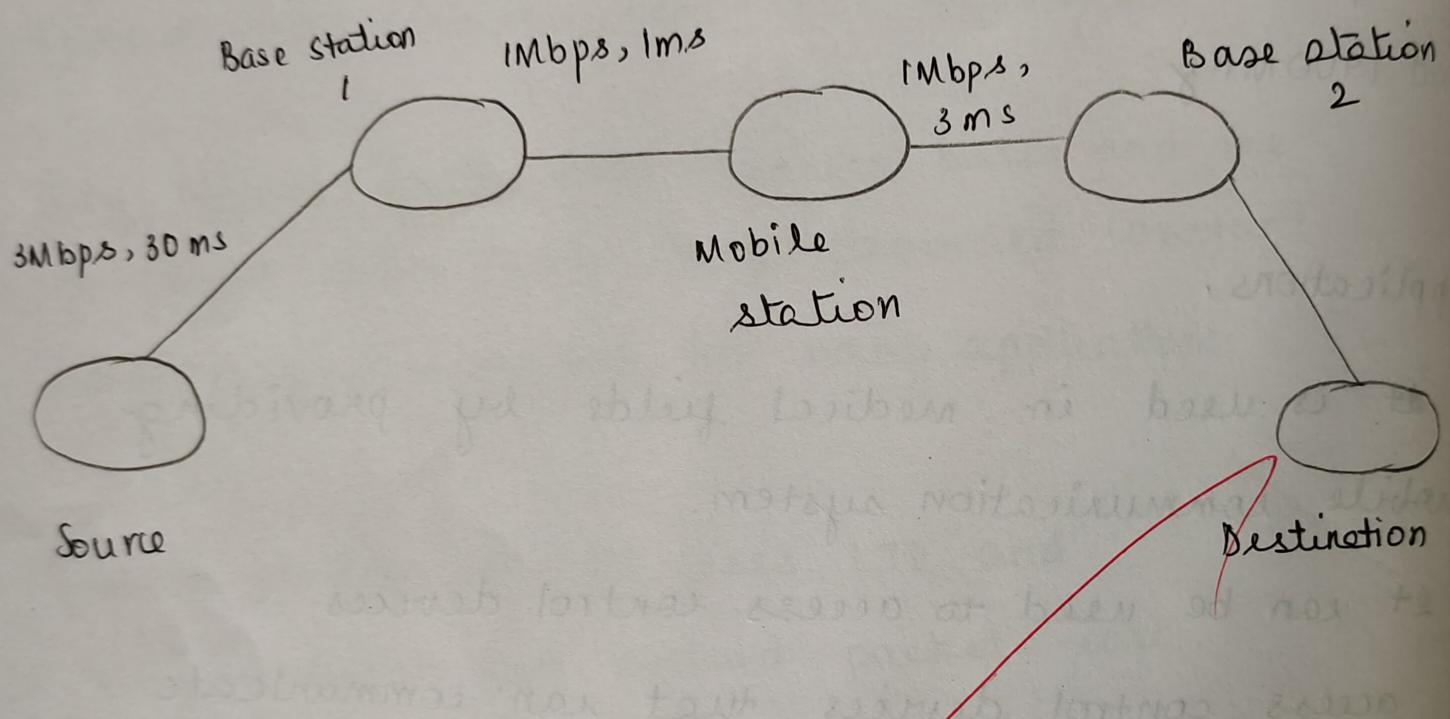
GSM

Global system for mobile communication. It is a digital mobile telephony system that is widely used. It uses a variation of time division multiple access and uses 3 digital wireless telephony technologies (TDMA, GSM and CDMA)

It operates at 850 MHz, 900 MHz, 1800 MHz and 1900 MHz

Applications.

- 1) It is used in medical fields by providing mobile communication system.
- 2) It can be used to access control devices. access control devices that can communicate with servers and security staff through sms
- 3) It is used in telemedicine systems.



Program: 6

DATE: 07/11/18

**Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment**

### DESCRIPTION

1. About CDMA and its Applications
2. Difference between CDMA and GSM
3. UMTS

1. CDMA (Code division Multiple Access) : It allows numerous signals to occupy a single transmission channel, optimizing the use of available bandwidth. It employs analog to digital conversion. They use technology called soft handoff which minimizes signal break up as a handset passes from one cell to another.

#### Applications :

1. CDMA is used in commercial cellular communications to make better use of radio spectrum.
  2. It supports in providing high speed push to talk and push to email services.
  3. used in military and some commercial applications.
  4. used in mobile applications.
- 2) Technology : CDMA is based on spread spectrum technology which makes the optimal use of available bandwidths.

GSM operates on the wedge spectrum called a carrier

Security: More security is provided in CDMA technology compared to GSM

Spectrum frequencies: CDMA operates in frequency spectrum of CDMA while GSM operates in frequency range of GSM 850 MHz & 1900 MHz.

Data Transfer Rate: CDMA has faster data rate compared to GSM

Radiation exposure:

GSM phones emit continuous wave pulses so there is a large need to reduce the exposures to electromagnetic fields focused on all phones with continuous wave pulses. CDMA cell phones do not produce these.

UMTS (universal mobile telecommunication service)

It is a third generation broadband packet based transmission of text, digitized voice, video and multimedia of data rates upto 2Mbps.

It offers a consistent set of services to mobile computers and phone users.

It is based on GSM. It specifies a complete network system which includes radio access network, core network.

## NETWORK TOPOLOGY

