Department of Electronics Engineering

IIT (ISM), Dhanbad

Course Name- Computer Communication Lab
Course Code- ECC508
Location- 6th Floor Academic Complex

Experiment List

EXPERIMENT – 01

AIM: -

Study of ALOHA protocol.

Software Used: -

MATLAB

THEORY: -

ALOHA provides a wireless data network. It is a multiple access protocol (this protocol is for allocating a multiple access channel). There are two main versions of ALOHA: pure and slotted.

Pure ALOHA: The Original ALOHA protocol is called pure ALOHA. The idea is that each station sends a frame whenever it has a frame to send. Sender finds out whether transmission was successful or experienced acollision by listening to the broadcast from the destination station. If there is a collision, sender retransmits the frame after some random time.

Throughput:

Throughput for pure ALOHA is given as:

$$S = G * \exp(-2*G)$$

The maximum throughputSmax = 0.184

When G = (½)

Here, G = avg. no. of frames generated by the system

Slotted ALOHA: In Slotted ALOHA, time is divided up into discrete intervals, each interval corresponding to one frame. A station is required to wait for the beginning of the next time slot in order to send the next packet, if a station misses this moment, it must wait until the beginning of the next time slot.

Throughput:

Throughput for slotted ALOHA is given as:

$$S = G * \exp(-G)$$

The maximum throughput Smax= 0.368 when

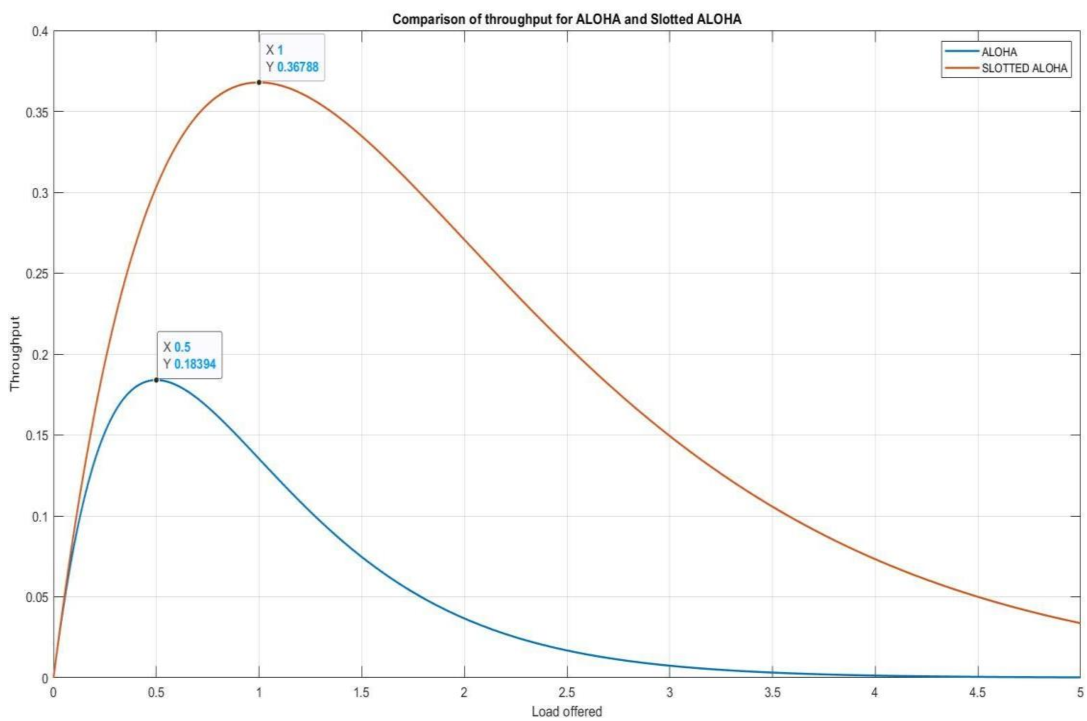
G= 1 Here, G = avg. no. of frames generated by

the system

MATLAB CODE:-

```
clc
clear all
closeall
G=0:0.01:10;
TPPA=G.* exp(-2*G);
%TPPA=ThroughPut of Pure Aloha
figure(1)
plot(G,TPPA)
hold on
TPSA=G.* exp(-G);
plot(G,TPSA)
%TPSA=ThroughPut of Slotted Aloha
title('Study of ALOHA Protocol')
xlabel('G(Avg No. of Frames Sent in One Frame Time)')
ylabel('Throughput (S)')
legend ('Pure ALOHA','Slotted ALOHA')
grid on
grid
```

OUTPUT :



EXPERIMENT:-2

AIM: -

Studyof CSMA protocol.

Software used: -

MATLAB2019 A

Theory:-

Carrier-sense multiple access (CSMA) is a media access control (MAC) protocol in which a nodeverifies the absence of other traffic before transmitting on a shared transmission medium, such as an electricalbusor a band of the electromagnetic spectrum. CSMA is based on the principle “sense before transmit”. CSMAcanreduce the possibilityof collision, but itcannoteliminate it.

TherearemainlythreetheoreticalversionsoftheCSMAprotocol:

1-Persitent:1-persistent CSMA is an aggressive transmission algorithm. When the transmitting node is ready totransmit,itsensesthetransmissionmediumforidleorbusy.Ifidle,thenittransmitsimmediately.Ifbusy,thenit senses the transmission medium continuously until it becomes idle, then transmits the message (a frame)unconditionally (i.e. with probability=1). In case of a collision, the sender waits for a random period of time andattemptsthesame procedure again.1-persistentCSMAis usedinCSMA/CDsystems includingEthernet.

Non-persistent: Non persistent CSMA is a non-aggressive transmission algorithm. When the transmitting nodeisreadytotransmitdata,itsensesthetransmissionmediumforidleorbusy.Ifidle,thenittransmitsimmediately. If busy, then it waits for a random period of time (during which it does not sense the transmissionmedium) before repeating the whole logic cycle (which started with sensing the transmission medium for idle orbusy) again. This approach reduces collision, results in overall higher medium throughput but with a penalty oflongerinitialdelaycompared to 1–persistent.

P-persistent: This is an approach between 1-persistent and non-persistent CSMA access modes.[1]When thetransmitting node is ready to transmit data, it senses the transmission medium for idle or busy. If idle, then ittransmits immediately. If busy, then it senses the transmission medium continuously until it becomes idle, thentransmits with probability p. If the node does not transmit (the probability of this event is 1-p), it waits until thenext available time slot. If the transmission medium is not busy, it transmits again with the same probability p.This probabilistic hold-off repeats until the frame is finally transmitted or when the medium is found to becomebusy again (i.e. some other node has already started transmitting). In the latter case the node repeats the wholelogic cycle (which started with sensing the transmission medium for idle or busy) again. P-persistent CSMA isusedin CSMA/CAsystemsincludingWi-Fiandotherpacketradiosystems.

CSMA/CD: CSMA/CD isused to improveCSMAperformanceby terminating transmissionassoon asacollisionisdetected,thusshorteningthetimerequiredbeforearetrycanbeattempted.CSMA/CDisusedbyEthernet.

CSMA/CA: In this method, collisions are avoided through the use of three strategies: Inter-frame space (IFS),thecontentionwindowandacknowledgements.

Whenanidlechannelisfound,thestationdoesnotsendimmediately.ItwaitsforaperiodoftimecalledtheIFS.The contention window is an amount of time divided into slots. A station that is ready to send chooses a randomno.ofslotsas its waittime. Thisisverysimilartothep-persistentmethod.

Unslottednon-persistent:

ThroughputS=G*exp(-a*T)/(G*(1+2a)+exp(-a*G)

Unslotted1-persistent:

ThroughputS=G(1+G+aG(1+G+aG/2)*exp(G(1+2a))/(G(1+2a)-(1exp(aG))+(1+aG)exp(-G(1+a)))

Slottednon-persistent:

ThroughputS=a*G*exp(-a*T)/(1+a-exp(-a*G))

Slotted1-persistent:

ThroughputS=G(1+a-exp(-aG))*exp(-G(1+a))/((1+a)(1-exp(-aG))+a*exp(-G(1+a)))

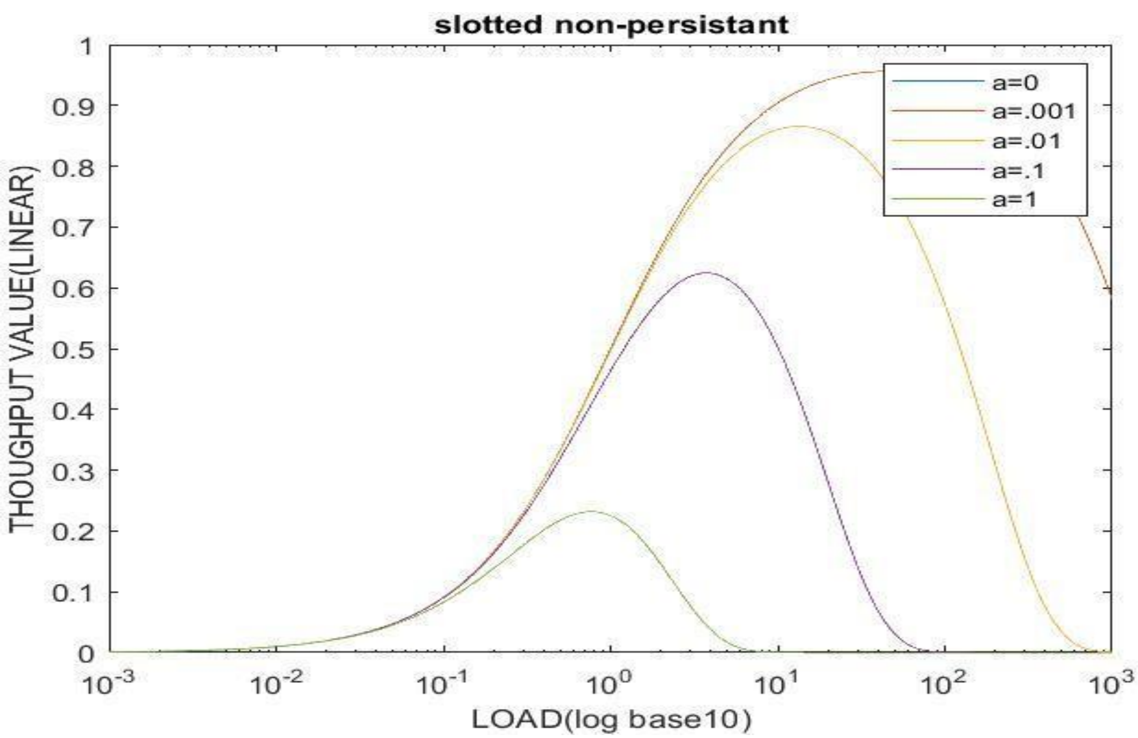
Matlabcode:

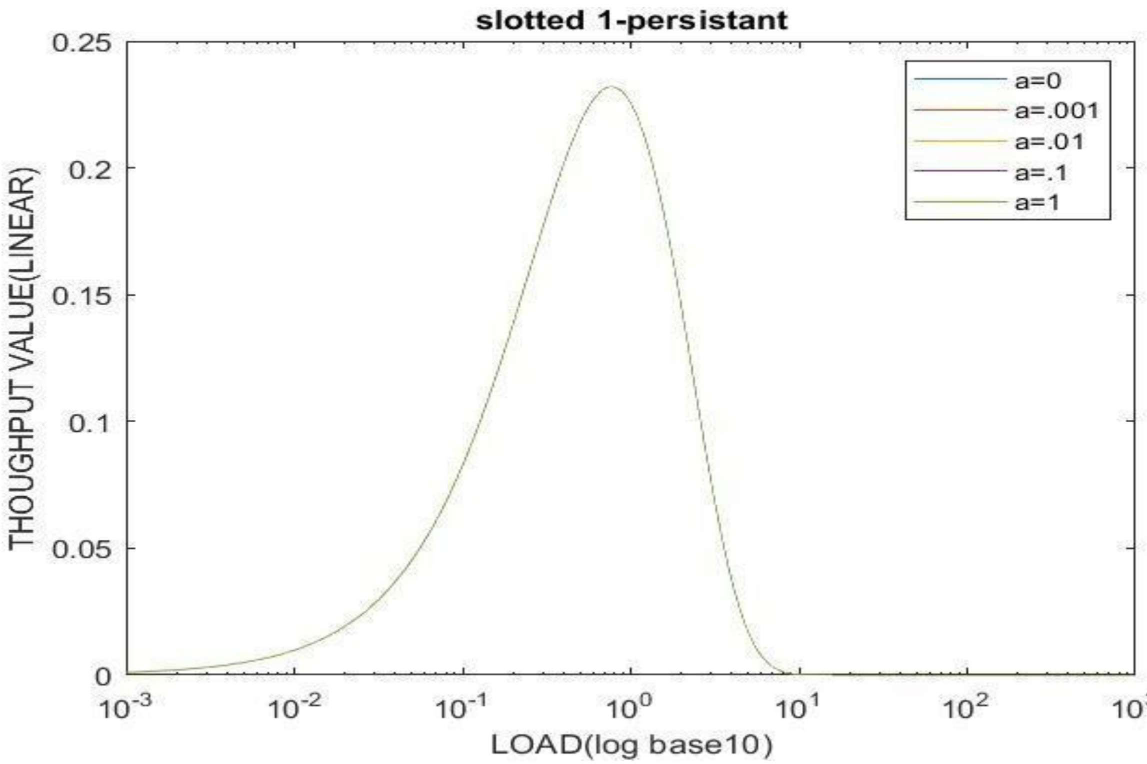
```
clc;clear
all;close
all;
G=0.001:.001:1000;
a=[0 .001 .01 .1
1];T=1;
figure(1);f
ori=1:1:5

Sn=G*T.*exp(- a(i)*G*T) ./ (G*T*(1+2*a(i))+exp(-
a(i)*G*T));semilogx(G,Sn);
holdon;

endlegend('a=0','a=.001','a=.01','a=.1','a=1')
;
title('unslotted non-
persistant');figure(2);
fori=1:1:5

Sn=G*T.*exp(-G*T*(1+2*a(i))).*(1+G*T+G*a(i)*T.*(1+G*T+G*a(i)*T/2))...
./ (G*T*(1+2*a(i))-(1-exp(-a(i)*G*T))+(1+G*a(i)*T).*exp(-G*T*(1+a(i))));%unslotted 1
persisctantsemilogx(G,Sn);
holdon;

endlegend('a=0','a=.001','a=.01','a=.1','a=1')
;
title('unslotted 1-
persistant');figure(3);

fori=1:1:5
```

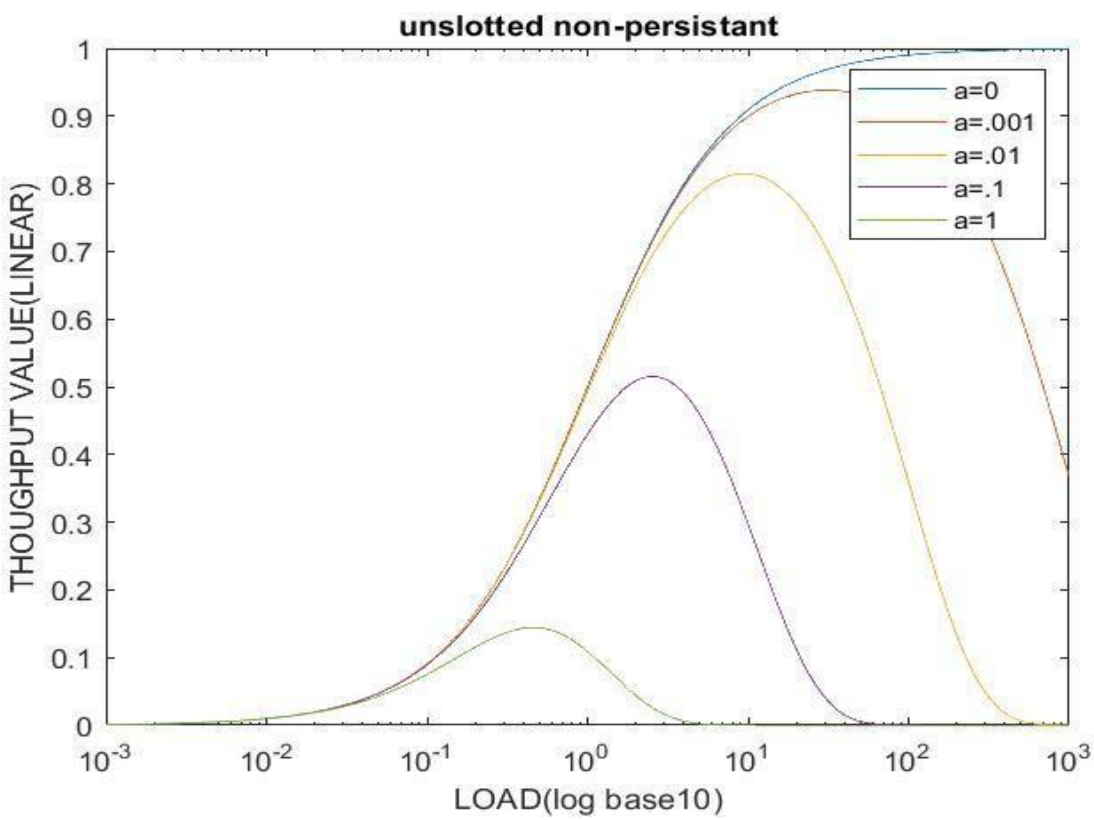
```
Sn=a(i)*G*T.*exp(-a(i)*G*T)./(1-exp(-a(i)*G*T)+a(i)*T);%slottednonpersiscta
```

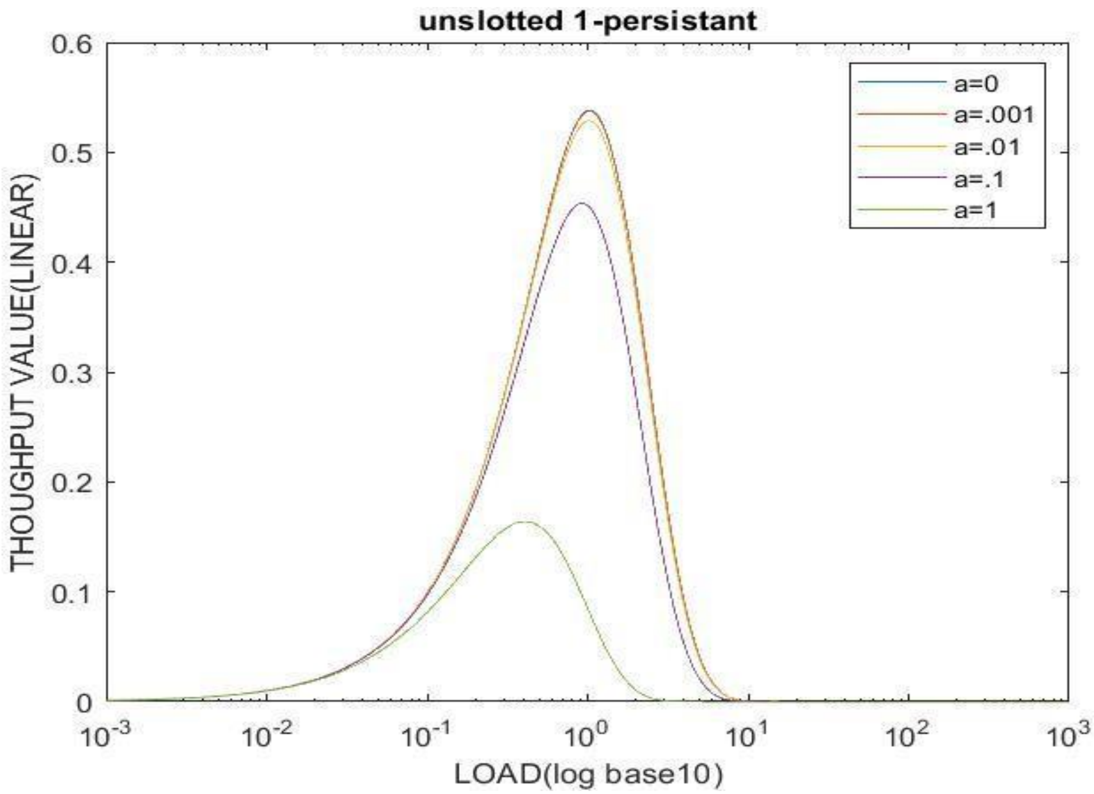
```
semilogx(G,Sn);
holdon;

 endlegend('a=0','a=.001','a=.01','a=.1','a=1')
 ;
 title('slotted non-
 persistant');figure(4);
 fori=1:1:5

 S_s1p=G*T.*exp(-G*T*(1+a(i))).*(1+a(i)-exp(-a(i)*G*T))...
  ./ ((1+a(i))*(1-exp(-a(i)*G*T))+a(i).*exp(-G*T*(1+a(i))));%slotted 1
 persisctantsemilogx(G,Sn);
 holdon;

 endlegend('a=0','a=.001','a=.01','a=.1','a=1')
 ;
 title('slotted1-persistant');
```

Output:




slotted 1-persistant
THOUGHPUT VALUE(LINEAR)
LOAD(log base10)
0.25
0.2
0.15
0.1
0.05
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
a=0
a=.001
a=.01
a=.1
a=1


unslotted non-persistant
THOUGHPUT VALUE(LINEAR)
LOAD(log base10)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
a=0
a=.001
a=.01
a=.1
a=1


unslotted 1-persistant
THOUGHPUT VALUE(LINEAR)
LOAD(log base10)
a=0
a=.001
a=.01
a=.1
a=1
0.6
0.5
0.4
0.3
0.2
0.1
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}

EXPERIMENTNO:-3

OBJECTIVE:-TostudydifferentLineCodingSchemes

SOFTWAREUSED:-MATLAB2018b

THEORY:-

A line code is the code used for data transmission of a digital signal over a transmissionline. This process of coding is chosen so as to avoid overlap and distortion of signalssuchasinter-symbol interference.

Differenttypesoflinecodingschemesare:-

- Polar NRZ code :-"One" is represented by one positive level (**A** volts), while"zero" is representedbynegativelevel (**-A**volts).
- Manchester code :-Manchester code always has a transition at the middle ofeach bit period and may have a transition at the start of the period also. Thedirection of the mid-bit transition indicates the data. Transitions at the periodboundaries do not carry information. They exist only to place the signal in thecorrectstate to allowthemid-bit transition.

- Alternate Mark Inversion(AMI) code **:-** AMI is a bipolar encoding systemwhereneutral(zero)voltagerepresentsbinary 0andalternating positiveandnegative voltages represents binary 1. With this line encoding it is the alternatingvoltagesthatdetermines the binayones.

- Pseudo ternarycode:-ThisencodingschemeissameasAMI,butalternatingpositiveandnegativepulsesoccurfor binary0 insteadof binary1.

- 2B1Q code **:-**It is a four-level pulse amplitude modulation (PAM-4) schemewithoutredundancy,mappingtwobits(2B)intoonequaternarysymbol(1Q).

MATLABCODE:-

```
clc;
closeall;c
learall;
x=[10010011 01];
N=length(x);
m=[];
y1=[];
y2=[];
y3=[];
y4=[];
y5=[];
count1=0;
count2=0;
check=0;f
ori=1:N
    ifx(i)==1
        m=[mones(1,100)];
        y1=[y1ones(1,100)];
        y2=[y2ones(1,50)];
        y2=[y2 -
        ones(1,50)];ifrem(cou
        nt1,2)==0
            y3=[y3ones(1,50)];
            y3=[y3
            zeros(1,50)];count1=
            count1+1;
        else
            y3=[y3-ones(1,50)];
            y3=[y3zeros(1,50)];c
            ount1=count1+1;
        end
        y4=[y4
        zeros(1,100)];ifcheck
        ==0
            check=1;
        elseifcheck==-1
            y5=[y5-
            3*ones(1,200)];check=0;
            else
                 y5=[y5
```

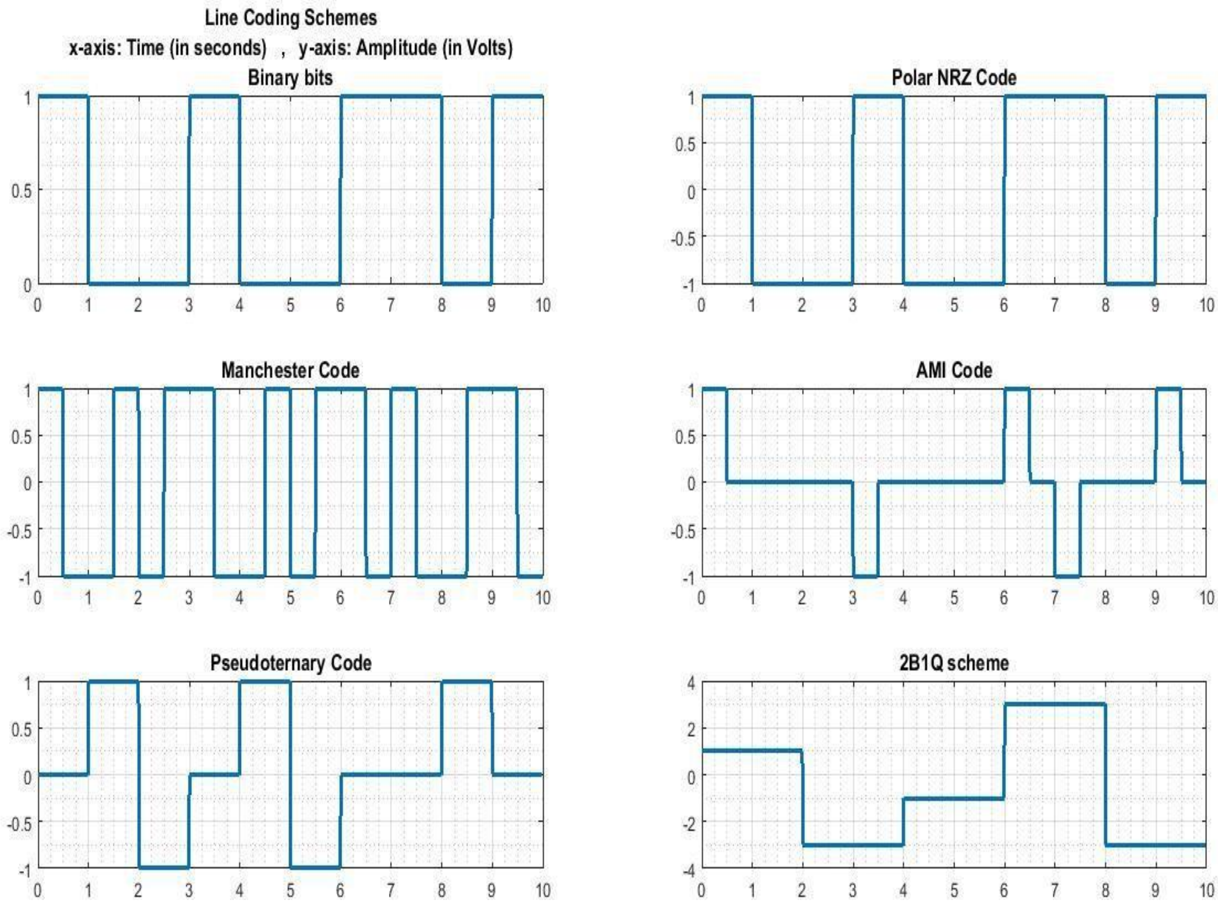
```
3*ones(1,200)];check=0;
```

```
            end
        end
    else
        m=[mzeros(1,100)];
        y1=[y1-ones(1,100)];
        y2=[y2-ones(1,50)];
        y2=[y2
        ones(1,50)];y3=[y3
        zeros(1,100)];ifrem(c
        ount2,2)==0
            y4=[y4
            ones(1,100)];count2=
            count2+1;
        else
            y4=[y4-
            ones(1,100)];count2=c
            ount2+1;
        end
        ifcheck==0
            check=-
        1;elseifcheck==-1
            y5=[y5-
            ones(1,200)];check=0;
            else
                 y5=[y5
            ones(1,200)];check=0;
            end
        end
    end

end
t=0:1/100:10-1/100;
subplot(321)plot(t,m,'LineWid
th',2)
title({'LineCodingSchemes','x-axis:Time(inseconds)
,   y-
axis:Amplitude(inVolts)','Binarybits'})gridon
gridminorsub
plot(322)
plot(t,y1,'LineWidth',2)
title('Polar NRZ
Code')gridon
```

```
gridminor
```

```
subplot(323)plot(t,y2,'L
ineWidth',2)title('Manches
terCode')gridon
gridminorsub
plot(324)
plot(t,y3,'LineWidth',2)title
('AMICode')
gridongrid
minor
subplot(325)plot(t,y4,'Line
Width',2)title('Pseudoterna
ry Code')gridon
gridminorsub
plot(326)
plot(t,y5,'LineWidth',2)
title('2B1Qscheme')grido
n
gridminor
```

OUTPUT:-



Line Coding Schemes
x-axis: Time (in seconds) , y-axis: Amplitude (in Volts)
Binary bits
Polar NRZ Code
Manchester Code
AMI Code
Pseudoternary Code
2B1Q scheme

CONCLUSION:-

- ImplementationofvariouslinecodingtechniquesusingMatlabisobservedbytaking10bits.
- InManchestercode,wehaveobservedthat
  1isrepresentedby+1voltforfirstTb/2durationand-1voltforthenextTb/2 duration
  While0isrepresentedby-1voltforfirstTb/2durationand+1voltforthenextTb/2duration
- In2B1Qscheme,wehaveobservedthat1stbitofthepairdecidespolaritywhile2ndbit of the pairdecides the magnitude.
  In our code 1as 1stbitrepresent+and 0as1stbit represent,
  While1as2ndbitrepresentamagnitudeof3 and0as2nd bitrepresentamagnitudeof1
  Sotherefore,11represents+3volts
  10represents +1 volt00
  represents -1
  volt01represents-3volts

EXPERIMENT:-4

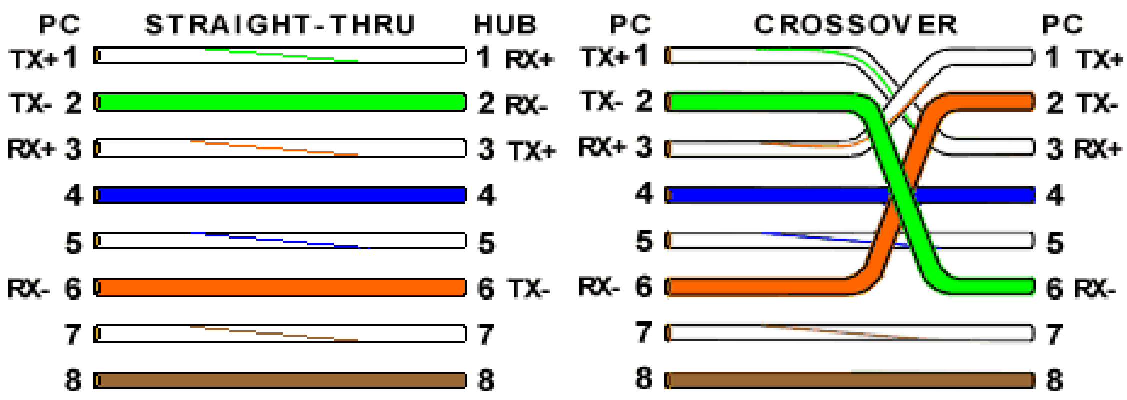
AIM: -

Perform the following:

a. Cable crimping
b. Standard Cabling
c. Cross Cabling
d. IO connector crimping
e. Testing the crimped cable using a cable tester

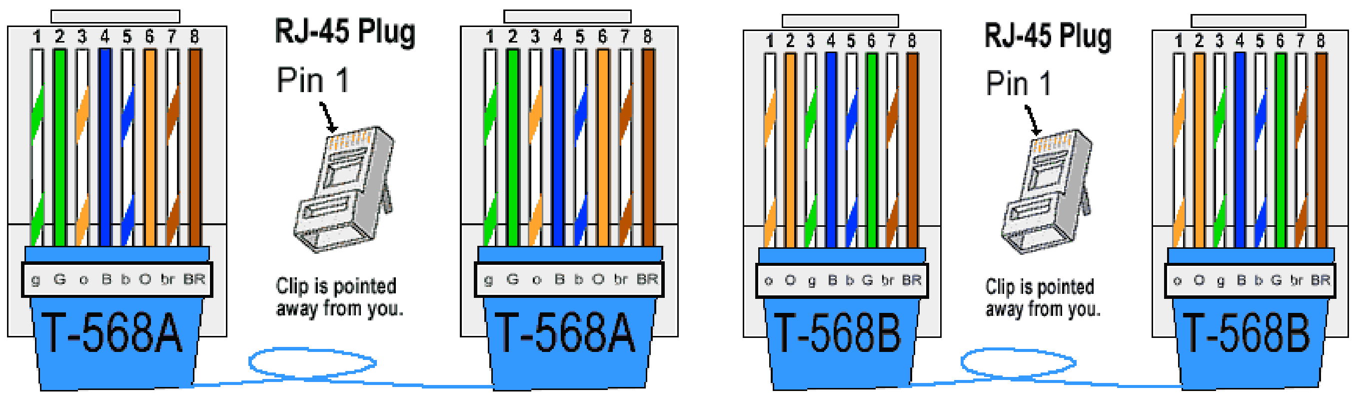
THEORY: -

Nowadays Ethernet is a most common networking standard for LAN (local area network) communication. TheEthernet cable used to wire a RJ45 connector of network interface card to a hub, switch or network outlet. Thecableis called wipe, patchcord,straight-thru cable.



By looking at a T-568A UTP Ethernet straight-thru cable and an Ethernet crossover cable with a T-568B end,we see that the TX (transmitter) pins are connected to the corresponding RX (receiver) pins, plus to plus andminus to minus. We can also see that both the blue and brown wire pairs on pins 4, 5, 7, and 8 are not used ineitherstandard.

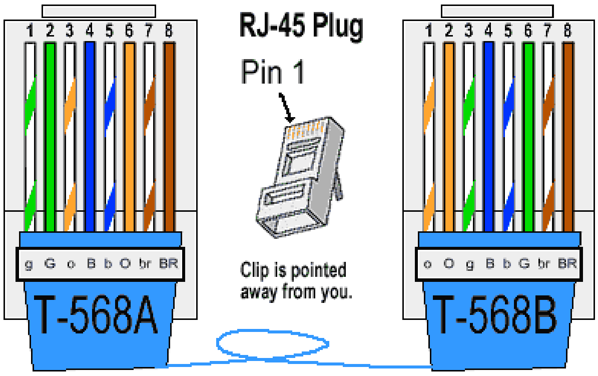
T-568A/BStraight-ThroughEthernetCable



The TIA/EIA 568-A standard which was ratified in 1995, was replaced by the TIA/EIA 568-B standard in2002andhasbeenupdatedsince.BothstandardsdefinetheT-568AandT-568BpinoutsforusingUnshielded Twisted Pair cable and RJ-45 connectors for Ethernet connectivity. The standards as and pin-outspecificationappeartoberelatedandinterchangeable,butarenotthesameandshouldnotbeusedinterchangeably.

BoththeT-568AandtheT-568BstandardStraight-Throughcablesareusedmostoftenaspatchcordsforyour Ethernet connections. If you require a cable to connect two Ethernet devices directly together without ahubor when youconnecttwo hubs together,youwillneedto use a Crossovercable instead.

RJ-45CrossoverEthernetCable



A good way of remembering how to wire a Crossover Ethernet cable is to wire one end using the T-568Astandard and the other end using the T-568B standard. Another way of remembering the color coding is tosimplyswitchtheGreensetofwiresinplacewiththeOrangesetofwires.Specifically,switchthesolidGreen (G)withthesolidOrange,andswitchthegreen/whitewiththeorange/white.

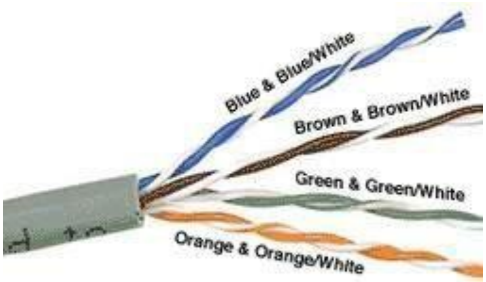
Requirement:
Ethernet Cable - bulk Category (Cat) 5, 5e, 6, 6a or higher
Ethernet cableWireCutters-to
cutandstriptheEthernetcableifnecessary

ForPatch Cables:
8P8C Modular Connector Plugs
("RJ45")Modular Connector Crimper
("RJ45")110 Punch DownTool

Recommended:
Wire
StripperCab
leTester

AbouttheCable:We can find bulk supplies of Ethernet cable at many computer stores or most electrical or home centers. Wewant UTP (Unshielded Twisted Pair) Ethernet cable of at least Category 5 (Cat 5). Cat 5 is required for basic10/100 functionality, we will want Cat 5e for gigabit (1000BaseT) operation and Cat 6 or higher gives ameasure of future proofing. We can also use STP (Shielded Twisted Pair) for extra resistance to externalinterference but we won't cover shielded connectors. Bulk Ethernet cable comes in many types; there are 2basic categories, solid and braided stranded cable. Stranded Ethernet cable tends to work better in patchapplications for desktop use. It is more flexible and resilient than solid Ethernet cable and easier to work with,but really meant for shorter lengths. Solid Ethernet cable is meant for longer runs in a fixed position. Plenumrated Ethernet cable must be used whenever the cable travels through an air circulation space. For example,above a false ceiling or below a raised floor. It may be difficult or impossible to tell from the package orlabelingwhattype of Ethernetcable it is, sopealoutan end andinvestigate.

HereiswhattheinternalsoftheEthernetcablelooklike:



Inside the Ethernet cable, there are 8 color coded wires. These wires are twisted into 4 pairs of wires, each pairhas a common color theme. One wire in the pair being a solid or primarily solid colored wire and the otherbeing a primarily white wire with a colored stripe (Sometimes Ethernet cables won't have any color on thestriped wire, the only way to tell which is which is to check which wire it is twisted around). The twists areextremely important. They are there to counteract noise and interference. It is important to wire according to astandardtogetproperperformancefromtheEthernetcable.TheTIA/EIA-568-Aspecifiestwowiringstandards for an 8-position modular connector such as RJ45. The two wiring standards, T568A and T568Bvaryonlyin the arrangementofthecoloured pairs.

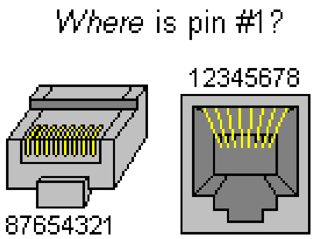
AboutModularConnectorPlugsandJacks:

The 8P8C modular connectors for Ethernet are often called RJ45 due to their physical resemblance. The plugis an 8-position modular connector that looks like a large phone plug. There are a couple variations available.The primary variation you need to pay attention to is whether the connector is intended for braided or solidwire. For braided/stranded wires, the connector has sharp pointed contacts that actually pierce the wire. Forsolid wires, the connector has fingers which cut through the insulation and make contact with the wire bygraspingitfromboth sides.

Modular connector jacks come in a variety styles intended for several different mounting options. The choiceis one of requirements and preference. Jacks are designed to work only with solid Ethernet cable. Most jackscomelabeledwithcolorcodedwiringdiagrams eitherforT568A,T568Bor both.

Hereis a wiringdiagramandpinout:

EthernetCablePinOuts:



ModularConnectorPlugandJackPinOut

There are two basic Ethernet cable pin outs. A straight through Ethernet cable, which is used to connect to ahub or switch, and a crossover Ethernet cable used to operate in a peer-to-peer fashion without a hub/switch.Generally, allfixedwiringshouldberunasstraightthrough.

HowtowireEthernetPatchCables:

- Stripoffabout2inchesoftheEthernetcablesheath.
- Untwist the pairs - don't untwist them beyond what you have exposed, the more untwisted cable youhavetheworsetheproblems you can run into.
- Alignthecoloredwiresaccordingtothewiringdiagramsabove.
- Trimallthewirestothe same length,about1/2"to 3/4"left exposedfromthe sheath.
- Insert the wires into the RJ45 plug - make sure each wire is fully inserted to the front of the RJ45 plugandinthecorrectorder.ThesheathoftheEthernetcableshouldextendintotheplugbyabout1/2"andwillbe heldinplacebythe crimp.

- CrimptheRJ45plugwiththecrimper tool.
- Verify the wires ended up the right order and that the wires extend to the front of the RJ45 plug andmakegoodcontactwith themetalcontactsintheRJ45plug

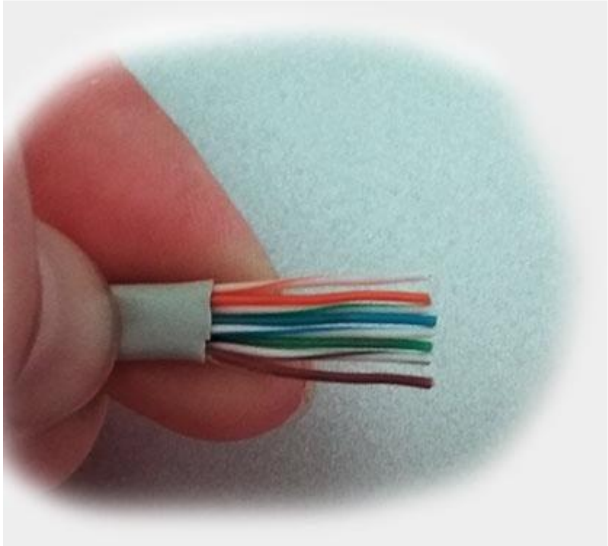
- Cut theEthernetcabletolength-make sureitismorethanlongenoughforyourneeds.
- RepeattheabovestepsforthesecondRJ45plug.

PROCEDURE:

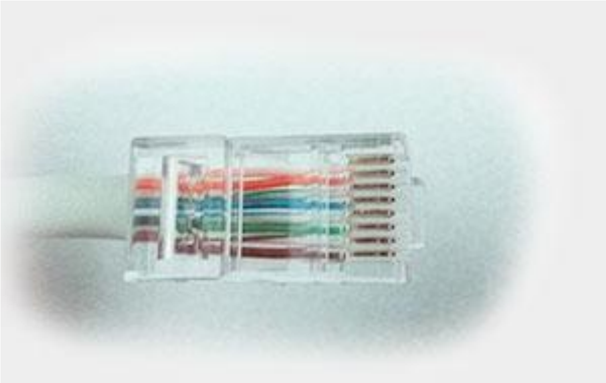
Pull the cable off the reel to the desired length and cut. The total length of wire segments between a PC and ahuborbetweentwoPC'scannotexceed100Meters(328feet)for100BASE-TXand300Metersfor10BASET.

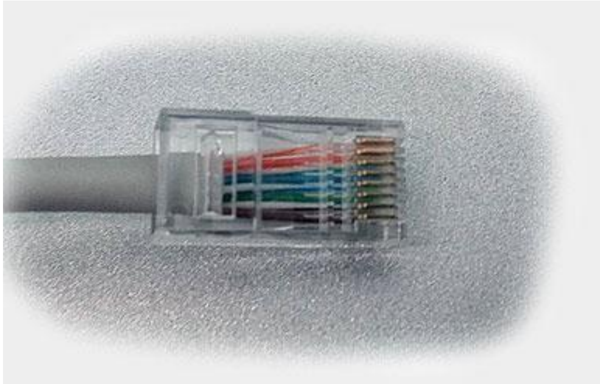
Startononeendandstripthecablejacketoff(about1″)usingastripperoraknife.Beextracarefulnottonickthe wires, otherwisewewillneedtostartover.

Spread, untwist the pairs, and arrange the wires in the order of the desired cable end. Flatten the end betweenthumb and forefinger. Trim the ends of the wires so they are even with one another, leaving only 1/2″ in wirelength.Ifitislongerthan1/2″itwillbeout-of-specandsusceptibletocrosstalk.Flattenandinsuretherearenospaces between wires.



Hold the RJ-45 plug with the clip facing down or away from you. Push the wires firmly into the plug. Inspecteach wire is flat even at the front of the plug. Check the order of the wires. Double check again. Check that thejacket is fitted right against the stop of the plug. Carefully hold the wire and firmly crimp the RJ-45 with thecrimper.





Check the color orientation, check that the crimped connection is not about to come apart, and check to see ifthe wires are flat against the front of the plug. If even one of these are incorrect,we will have to start over.TesttheEthernetcableusingtester

EthernetCableTips:

- Astraight-thrucablehasidentical ends.
- Acrossovercablehasdifferentends.
- Astraight-thru is usedasapatchcordinEthernetconnections.
- Acrossover is usedtoconnecttwoEthernetdeviceswithout a huborforconnectingtwohubs.
- AcrossoverhasoneendwiththeOrangesetofwiresswitchedwiththeGreenset.
- Oddnumberedpinsarealwaysstriped,evennumberedpinsarealwayssolidcoloured.
- LookingattheRJ-45withtheclipfacingawayfromyou,Brownisalwaysontheright,andpin1isontheleft.
- Nomorethan1/2″oftheEthernetcableshouldbeuntwistedotherwiseitwillbesusceptibletocrosstalk.
- Donotdeform,donotbend,donotstretch,donotstaple,donotrunparallelwithpowercables,anddonot runEthernetcablesnearnoiseinducingcomponents.

EXPERIMENTNO:- 5

AIM: -

Implementation of star topology and observation of packet transmissionusingstopandwait protocol.

SOFTWARE/PACKAGEUSED:-

MATLAB(R2020a)

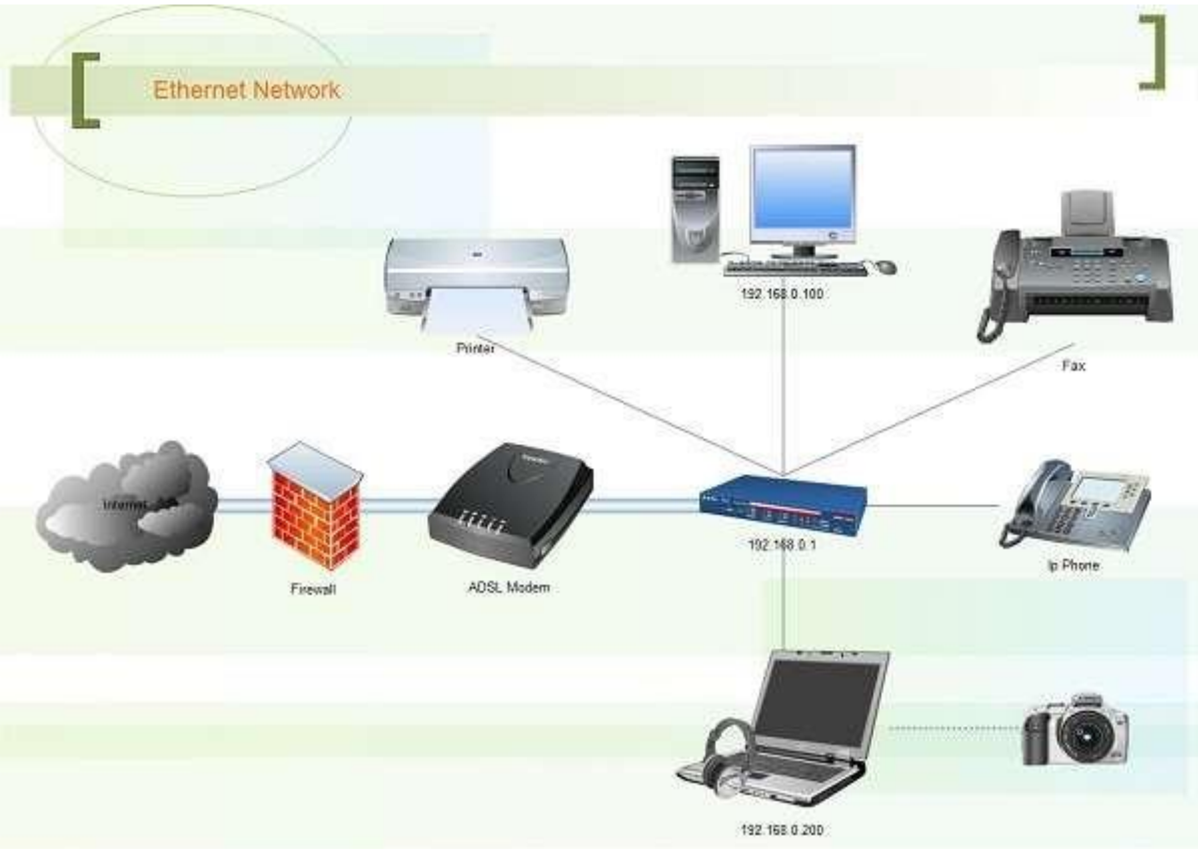
THEORY:-

- Originally known as **Alto Aloha Network**, **Ethernet** is a widely used**LAN**(local area network) **protocol** created at Xerox PARC in 1973 byRobertMetcalfeandothers.
- Being the first network to provide Carrier Sense Multiple Access / CollisionDetection (CSMA/CD), Ethernet is a fast and reliable network solution thatisstillwidelyusedtoday.
- **Ethernet** is the technology that is commonly used in wired **local areanetworks**(**LAN**s).
- A **LAN** is a network of computers and other electronic devices that covers asmall area such as a room, office, or building. It is used in contrast to a **wideareanetwork**(**WAN**),which spans alarge geographical area.
- Ethernet is a network protocol that controls how data is transmitted over aLAN and is referred to as the IEEE 802.3 protocol. The protocol has evolvedand improved over time to transfer data at the speed of more than a gigabitper second.
- **Ethernet** connects computers together with cable so the computers canshare information. Within each main branch of the network, "**Ethernet**" canconnectup to1,024personalcomputersandworkstations.
- **Ethernet** provides services on the **Physical Layer** (Layers 1) and **Data LinkLayer**(Layer2)of OSIreference model.
- The Data Link Layer is further divided into two sub layers that are LogicalLink Control (LLC) and Media Access Control (MAC), these sub layers can beused to establish the transmission paths and format data beforetransmittingonthesamenetworksegment.
- Systems that use Ethernet communication divide their data into packets,whicharealsoknownas frames.

- These frames further contain source and destination address, a mechanismwhichwasusedtodetecterrorsinthedataandretransmissionrequests.

WiredEthernet:

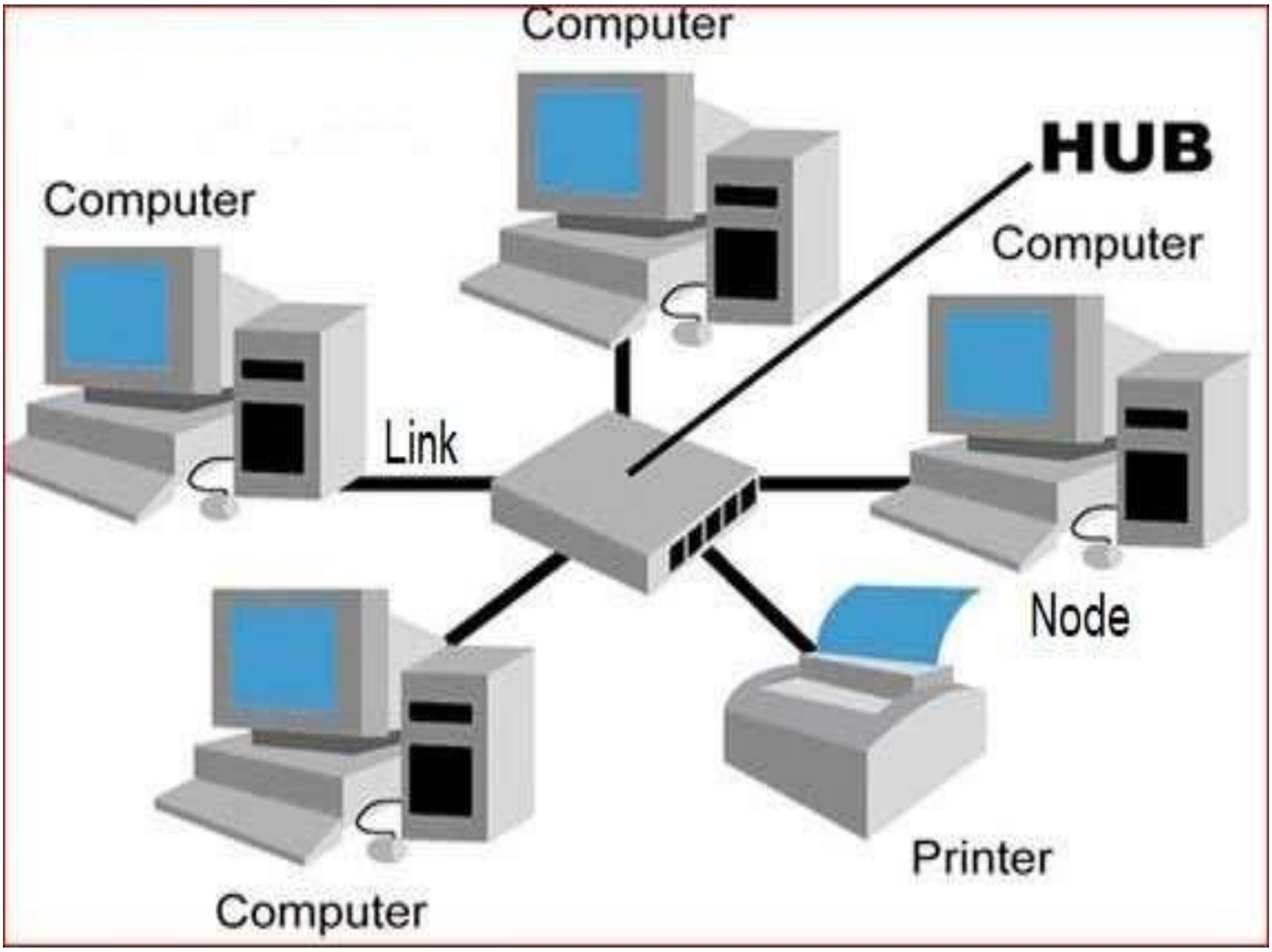
- Ethernet can be designed to run over coaxial cables, twisted pair cables,fiber optic cable.
- In Wired Ethernet network, devices are connected with the help of a CATcable or fiber optic cable, which connects the devices within a distance of10kmincaseof fiberopticcableand90m incase of CATcable.
- For this, we have to install a computer network interface card (NIC) in eachcomputer.Auniqueaddressisgiventoeachcomputerthatis connected.
- So, for sharing data and resources like printers, computers, and othermachines, Ethernet networking is used as it establishes a communicationsystem.
- Ethernet is a shared medium network technology, where all theworkstations are connected to the same cable and must connect with oneanothertosendsignalsoverit.



WiredEthernetNetwork

StarTopology:

- In **Star Topology,** all the Nodes are connected to the centrally locatednetworkdeviceornode,likeahub, switch,router,orcomputer.
- All the devices on the network are connected with a Hub through acommunication link. Each computer requires a single wire for theconnectiontothe Hub.
- In **Star Topology**, there exists a point-to-point connection between a nodeand Hub. The Hub takes a signal from any node and passes it to all the othernodes in the network. The hub works as a server and it controls andmanagesentirefunctionofthenetwork.
- If one host needs to send data to some other host, it will send the message tothe central connecting Hub. The central connecting Hub then replicates themessage and forwardsitontotheappropriate host.
- Depending on the network card used in each computer of the *star topology*,a RJ-45 network cable or a coaxial cable is used to connect computerstogether.



StarTopology

<u>AdvantagesofStar Topology:</u>

- Centralized management of the network, through the use of the centralcomputer,hub,or switch.
- Easy to add another computer to the network and No disruptions to thenetworkwhenconnectingorremovingdevices.
- If one computer on the network fails, the rest of the network continues tofunctionnormally.
- Easy fault detectionbecausethe links are often easilyidentified.
- Eachdevicerequiresjustoneporti.e.,toattachtothe hub.
- If N devices are connected to every other in star, then the number of cablesrequiredtoattachthemisN.So, it’seasytolineup.

DisadvantagesofStarTopology:

- May have a higher cost to implement, especially when using a switch orrouterasthecentralnetworkdevice.
- The central network device determines the performance and number ofnodesthenetworkcan handle.
- If the central computer, hub, or switch fails, the entire network goes downandallcomputersaredisconnectedfromthenetwork.
- Hub requires more resources and regular maintenance because it’s thecentralsystem of star Topology.

PING Command:

- **PING (Packet Internet Groper)** command is used to check the networkconnectivity between host and server/host i.e., it is a Command Promptcommand used to test the ability of the source computer to reach a specifieddestinationcomputer.
- It is usually used as a simple way to verify that a computer can communicateoverthenetworkwithanother computer ornetworkdevice.
- This command takes as input the IP address or the URL and sends a datapacket to the specified address with the message “PING” and get a responsefromthe server/host this timeisrecordedwhichis called latency.
- Ping operates by sending Internet Control Message Protocol (ICMP) echorequestpacketstothetargethostandwaitingforanICMPechoreply.

StopandWaitProtocol:

- It is a data-link layer protocol which is used for transmitting the data overthenoiselesschannels.
- It provides unidirectional data transmission which means that eithersendingor receiving ofdatawilltakeplace at atime.
- It provides flow-control mechanism but does not provide any error controlmechanism.
- The idea behind the usage of this is that when the sender sends the framethenhewaitsforthe acknowledgment before sendingthenextframe.

PrimitivesofStopandWaitProtocol:

SenderSide:

- ✓ **Rule1:**Sendersendsonedatapacketata time.
- ✓ **Rule 2:** Sender sends the next packet only when it receives theacknowledgmentoftheprevious packet.

- Therefore, the idea of stop and wait protocol in the sender's side is verysimple, i.e., send one packet at a time, and do not send another packet beforereceivingthe acknowledgment.

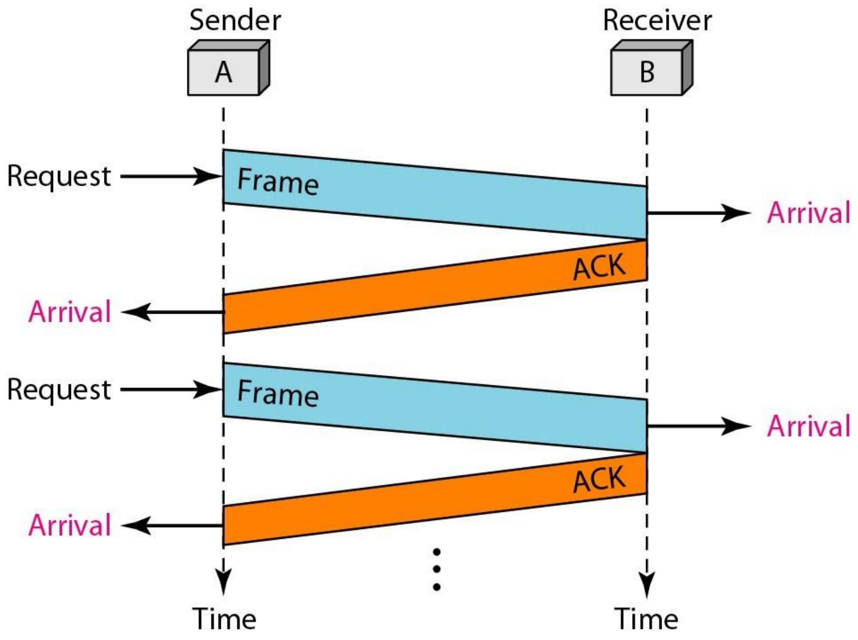
Receiver Side:

- ✓ **Rule1:**Receiveandthenconsumethe datapacket.
- ✓ **Rule 2:** When the data packet is consumed, receiver sends theacknowledgmenttothesender.

- Therefore, the idea of stop and wait protocol in the receiver's side is alsovery simple, i.e., consume the packet, and once the packet is consumed, theacknowledgmentissent. Thisisknownas a flow controlmechanism.

WorkingofStopand Wait Protocol:

- In this method of flow control, the sender sends a single frame to receiver &waitsforanacknowledgment.
- The next frame is sent by sender only when acknowledgment of previousframeis received.
- This process of sending a frame & waiting for an acknowledgment continuesas long asthe sender has datato send.
- To end up the transmission sender transmits end of transmission (EOT)frame.



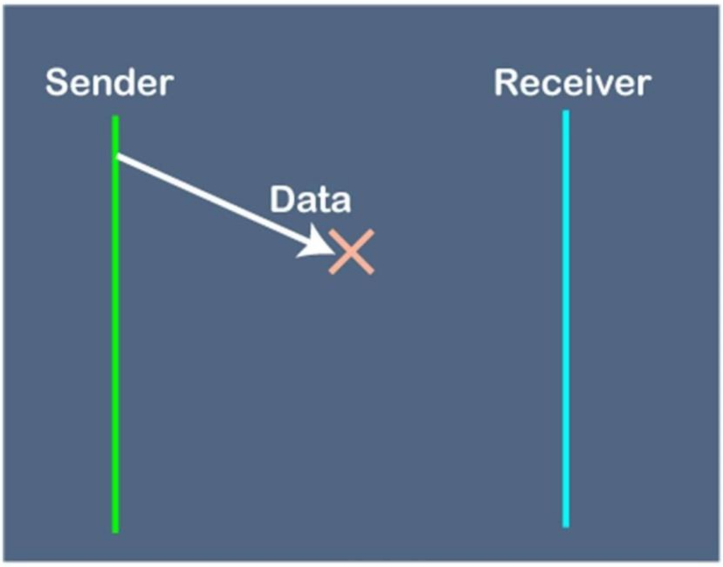
FlowDiagramofStopandWaitProtocol

- The main advantage of stop & wait protocols is its accuracy. Next frame istransmitted only when the first frame is acknowledged. So, there is no chanceofframebeinglost.

Disadvantages of Stop and

WaitProtocol:Problemsduetolostdata:

- Suppose the sender sends the data and the data is lost. The receiver is waitingforthedatafor a longtime.
- Since the data is not received by the receiver, so it does not send anyacknowledgment.
- Since the sender does not receive any acknowledgment so it will not send thenext packet.

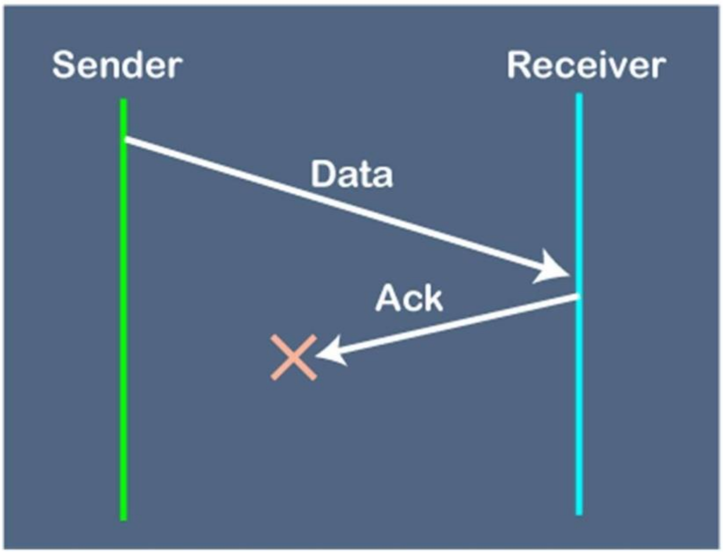


Problemsduetolostdata

- **Inthiscase,twoproblemsoccur:**
  - Senderwaitsforaninfiniteamount of time for anacknowledgment.
  - Receiverwaitsforaninfiniteamountoftimeforadata.

Problems duetolostacknowledgment:

- Suppose the sender sends the data and it has also been received by thereceiver.Onreceivingthepacket,thereceiversendstheacknowledgment.
- In this case, the acknowledgment is lost in a network, so there is no chanceforthe sender toreceivetheacknowledgment.
- There is also no chance for the sender to send the next packet as in stop andwait protocol, the next packet cannot be sent until the acknowledgment of thepreviouspacket is received.

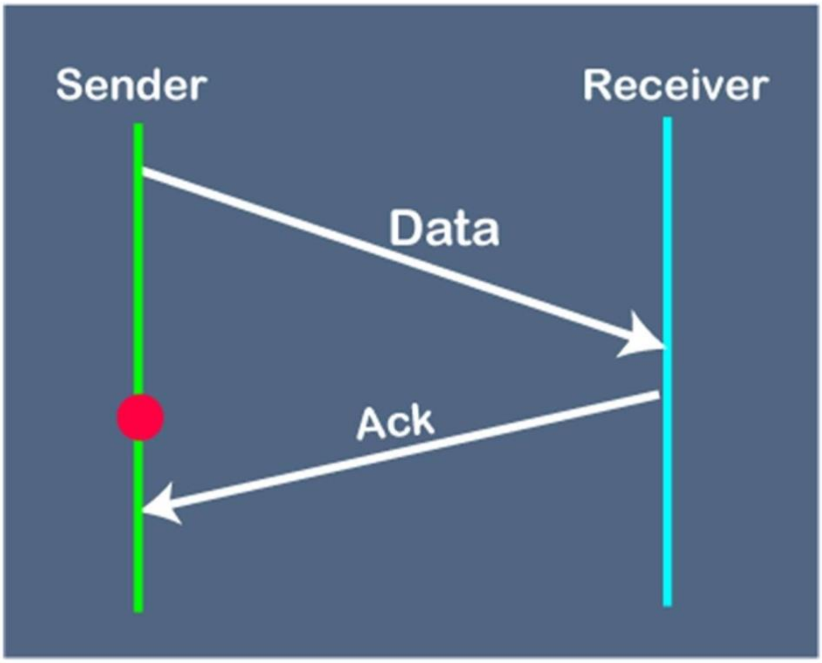


Problemsduetolostacknowledgement

- **Inthiscase,oneproblemoccurs:**
  - Senderwaitsforaninfiniteamount of time for anacknowledgment.

Problemduetothedelayeddataoracknowledgment:

- Suppose the sender sends the data and it has also been received by thereceiver.
- The receiver then sends the acknowledgment but the acknowledgment isreceivedafterthe timeout period onthesender's side.
- As the acknowledgment is received late, so acknowledgment can be wronglyconsideredastheacknowledgmentofsomeother data packet.



Problem duetothedelayeddataoracknowledgment

CONCLUSION:

- Steps involved in packet transmission using stop and wait protocol usingStarTopology are studied.
- Star Topology has Central communicating device called HUB, which acts as aserver and controls the data communication in that network. If it fails, thentheentirenetworkgoes down.
- PING command is used to check the connectivity between devices in theNetwork.
- Here, Stop and wait protocol is used for transmission of data from onedevice to other. It is unidirectional data transmission protocol where dataflowsinonlyone direction.
- In this method of flow control, if sent data frame or Acknowledgement islost, it may lead to infinite waiting time at sender or receiver. This is can besolved by usingtimeratsender side.

EXPERIMENT NO:- 6

AIM: -

Study of Spanning tree and Prim's Algorithm

Software Used: -

MATLAB

THEORY:-

The Spanning Tree Protocol is a network protocol that builds a loop-free logical topology for Ethernet networks. The basic function of STP is to prevent bridge loops and the broadcast radiation that results from them.

ConfigureSpanningTreeProtocolonSW1-SW4sothat:

1. IdentifywhichSwitchisRootBridge?
2. IdentifywhichSpanningTreetypeisrunningonSW1&SW2?
3. WhatistheSTP role&stateofPortFa0/1onSW4?
4. WhatistheSTP role&stateofPortFa0/1onSW2?
5. WhatistheSTP role&stateofPortFa0/3onSW3?
6. Interfaces,IPAddresses,GW&allotherrelateddetailismentionedonthetopology.

TOPOLOGY:ConsiderthefollowingLabTopologywheremultipleSwitchesareconnectedtoeachotherthroughTrunk Links:

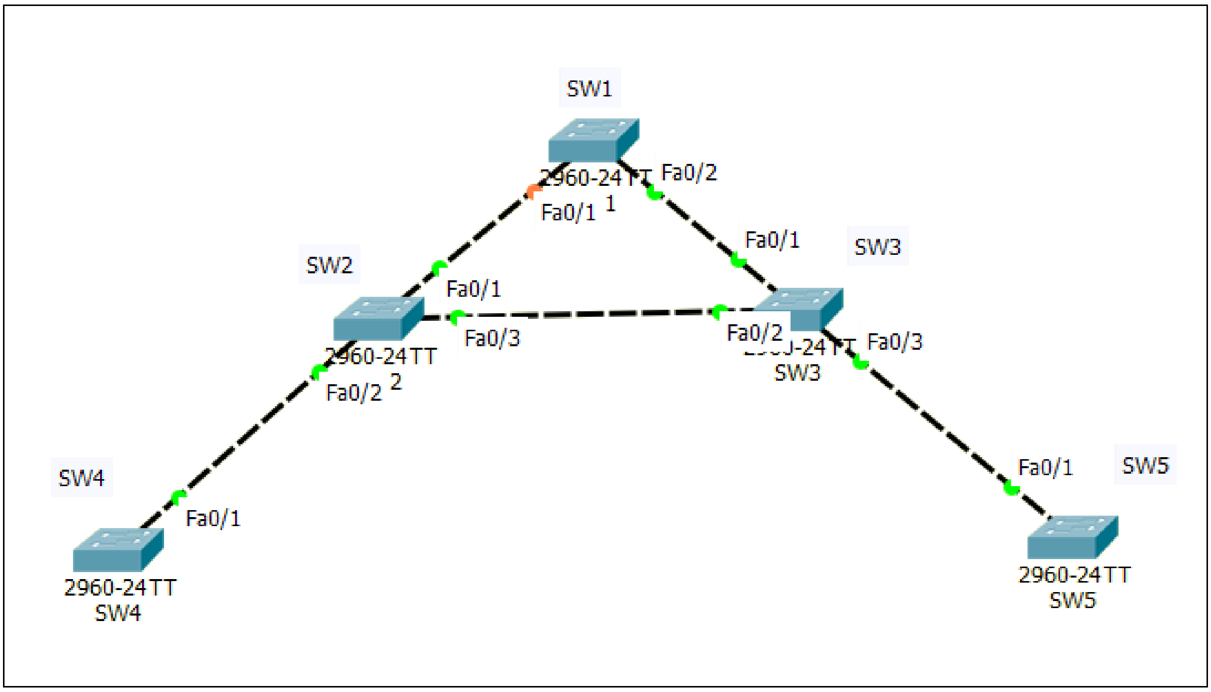


Fig: **SpanningTreeProtocol**

1-IdentifywhichSwitchisRootBridge?

SW5

Switch#show spanning-tree summarySwitch
is inpvst mode
Rootbridgefor:default
ExtendedsystemID isenabled
PortfastDefault is
disabledPortFast BPDU Guard
DefaultisdisabledPortfast BPDU Filter Default is
disabledLoopguardDefault isdisabled

2-IdentifywhichSpanningTreetypeisrunningonSW1&SW2?

SW1

Switch#show spanning-tree summarySwitch

is inpvst mode

Rootbridgefor:

ExtendedsystemID isenabled

PortfastDefault is

disabledPortFast BPDU Guard

DefaultisdisabledPortfastBPDUFilterDefaultisdisabled

LoopguardDefault is disabled

EtherChannelmisconfigguardis disabled

```
UplinkFast                    is disabled
BackboneFast                  is disabled
ConfiguredPathcostmethodused     isshort

Name                      Blocking Listening  LearningForwardingSTP  Active
---------------------------------- ---------- --------- ----------    --------
VLAN0001                          1          0        0          1          2
```

3-WhatistheSTProle&stateofPort Fa0/1onSW4?

```
SW4#show spanning-
treeVLAN0001
  SpanningtreeenabledprotocolieeeRootID
             Priority     32769
             Address      0001.421A.D959
```

4-WhatistheSTProle&state ofPortFa0/1onSW2?

```
SW2#show spanning-
treeVLAN0001
  SpanningtreeenabledprotocolieeeRootID
             Priority     32769
             Address      0001.421A.D959
             Cost         38
             Port         3(FastEthernet0/3)
             HelloTime2secMaxAge20secForwardDelay15sec

  BridgeIDPriority        32769(priority 32768 sys-id-ext 1)Address
                          0060.3E55.E404
             HelloTime2secMaxAge20secForwardDelay15secAgingTime20
Interface        Role Sts Cost       Prio.Nbr Type
---------------- ---- --- ---------  -------- ---------------------------
Fa0/2            Desg FWD 19         128.2    P2p
Fa0/3            Root FWD 19         128.3    P2p
             Fa0/1        DesgFWD19      128.1   P2p
```

5-WhatistheSTProle&state ofPortFa0/3onSW3?

```
SW3#show spanning-
treeVLAN0001
  SpanningtreeenabledprotocolieeeRootID
             Priority     32769
             Address      0001.421A.D959
             Cost         19
             Port         3(FastEthernet0/3)
             HelloTime2secMaxAge20secForwardDelay15sec

  BridgeIDPriority        32769(priority 32768 sys-id-ext 1)Address
```

0030.A3CA.4B33
HelloTime2secMaxAge20secForwardDelay15secAgingTime20

```
Interface           RoleSts  Cost        Prio.Nbr  Type
------------------- -------- ----------- --------- --------------------------------------
Fa0/2               DesgFWD  19          128.2     P2p
Fa0/3               RootFWD  19          128.3     P2p
Fa0/1               DesgFWD  19          128.1     P2p
```

EXPERIMENT NO:-7

AIM: -
To studyDijkastra’s Algorithm

SOFTWAREUSED: -
Cisco Software

THEORY: -

Dijkstra'salgorithm:isasolutiontothesingle-sourceshortestpathproblemingraphtheory.

Worksonbothdirectedandundirectedgraphs.However,alledgesmusthavenonnegativeweights.

Approach: Greedy

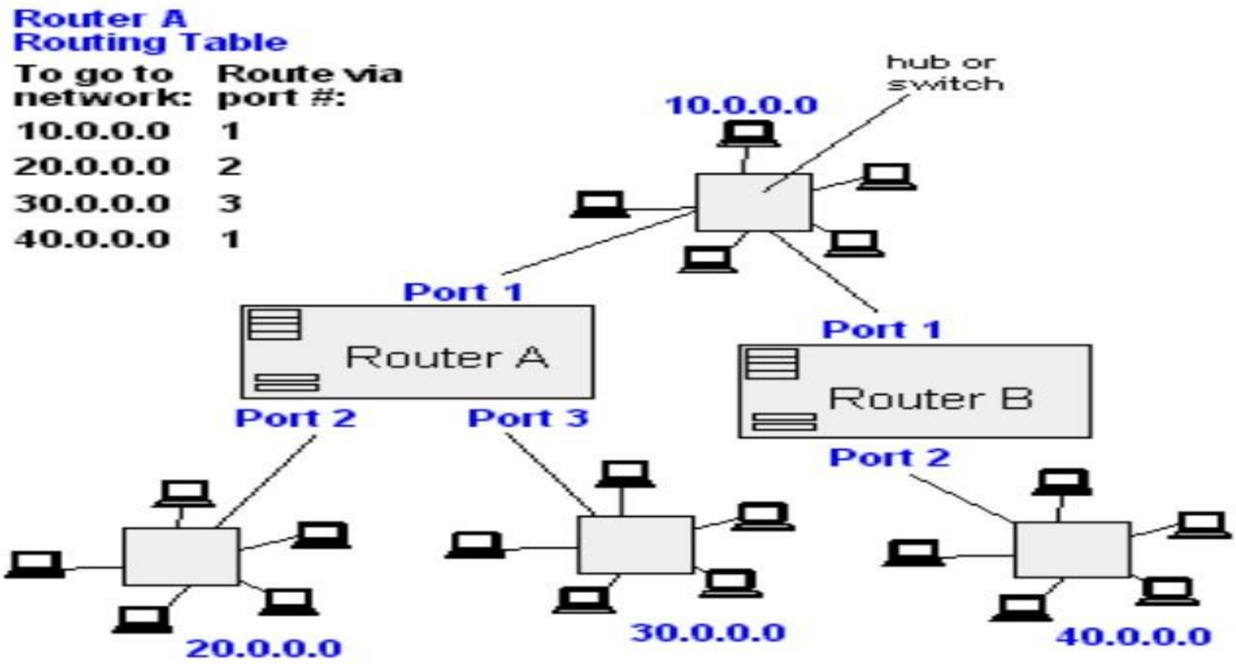
Input: WeightedgraphG={E,V}andsourcevertex,suchthatalledgeweightsarenonnegative

Output: Lengthsofshortestpaths(ortheshortestpathsthemselves)fromagivensourcevertex toallothervertice

DIJKSTRA'SALGORITHM-WHYUSEIT?
1-As mentioned, Dijkstra’s algorithm calculates the shortest path to every vertex.

2-However, it is about as computationally expensive to calculate the shortest path from vertex u to every vertex using Dijkstra’s as it is to calculate the shortest path to some particular vertex v.

3-Therefore, anytime we want to know the optimal path to some other vertex from a determined origin, we can use Dijkstra’s algorithm.



RouteComputation

Routersasnodes

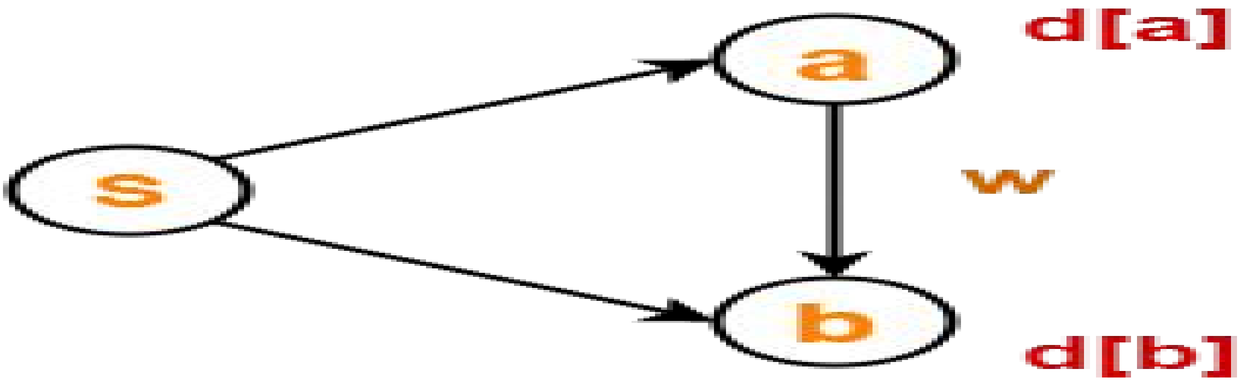
Ethernetcables/WIFISignal/Optical fiber edges

Computethepathfromonerouterto another.

Dijkstra'salgorithm-Pseudocode

dist[s]←0 (distancetosourcevertexiszero)forallv ∈V–{s}
dodist[v]←∞ (setallotherdistancestoinfinity)
S←∅ (S,thesetofvisitedverticesisinitiallyempty)
Q←V (Q,thequeueinitiallycontainsallvertices)
whileQ≠∅ (whilethequeueisnotempty)
do u←mindistance(Q,dist)
(selecttheelementofQwiththemin.distance)S←S∪{u} (addutolistofvisitedvertices)
forallv∈neighbors[u]
doif dist[v]>dist[u]+w(u,v)(if new shortest path found)then d[v]←d[u]+w(u,v)
(setnewvalueofshortestpath)
(ifdesired,addtracebackcode)returndist

WhatisEdgeRelaxation?

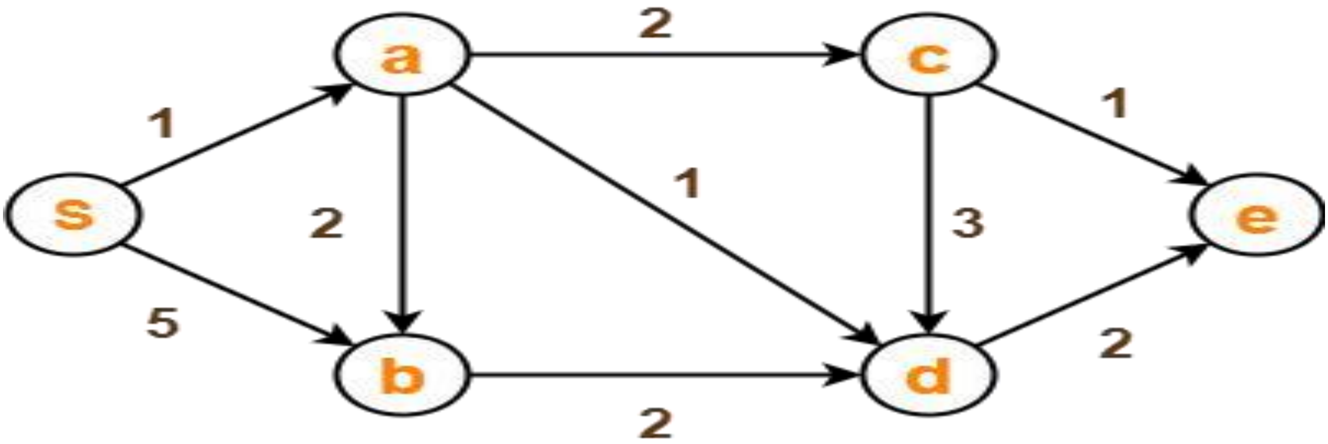


Considertheedge(a,b)inthefollowinggraph-

Here,d[a]andd[b]denotestheshortestpathestimateforverticesaandbrespectivelyfromthesourcevertex‘S’.
Now,
Ifd[a]+w<d[b]
thend[b]=d[a]+wandΠ[b]=aThisiscalledasedgerelaxation.

Example:

UsingDijkstra'sAlgorithm,findtheshortestdistancefromsourcevertex'S'toremainingverticesinthefollowinggraph-



Also,writetheorderinwhichtheverticesarevisited.

Step-01:

Thefollowingtwosetsarecreated-
Unvisitedset: {S, a,b,c,d,e}
Visitedset:{}

Step-02:

ThetwovariablesΠanddarecreatedforeachvertexandinitializedas-
Π[S]=Π[a]=Π[b]=Π[c]=Π[d]=Π[e]=NIL
d[S]=0
d[a]=d[b]=d[c]=d[d]=d[e]=∞

Step-03:

Vertex'S'ischosen.
Thisisbecauseshortestpathestimateforvertex'S'isleast.
Theoutgoingedgesofvertex'S'arerelaxed.

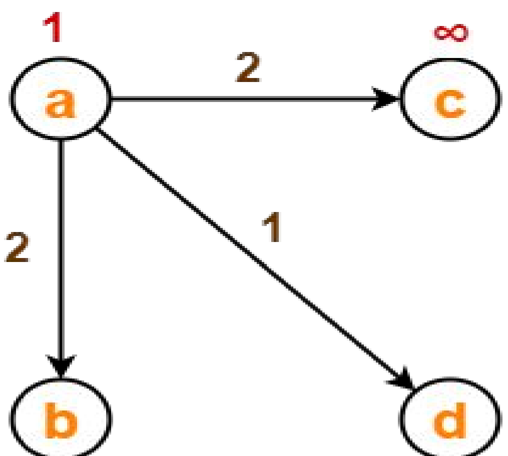
Step-04:

Vertex'a'ischosen.

Thisisbecauseshortestpathestimatesforvertex'a'isleast.

Theoutgoingedgesofvertex'a'arerelaxed.

BeforeEdgeRelaxation



Now,

d[a]+2=1+2=3<∞

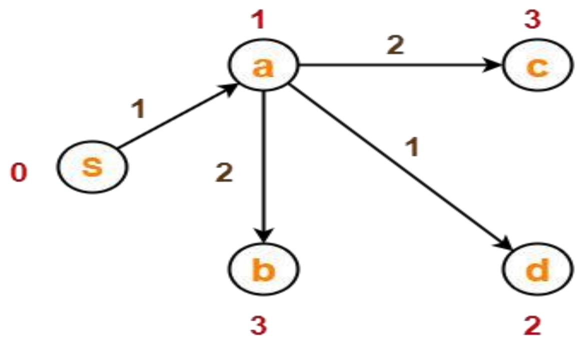
∴d[c] = 3 andΠ[c]=a

d[a]+1=1+1=2<∞

∴d[d] = 2 andΠ[d]=a

d[b]+2=1+2=3<5
∴d[b] = 3 andΠ[b]=a

Afteredgerelaxation,ourshortestpathtreeis-



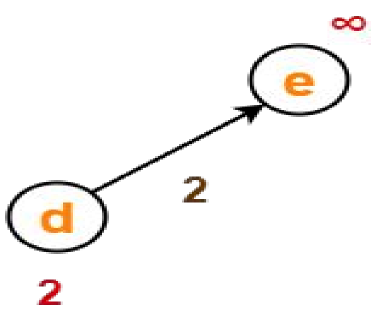
Now,thesetsareupdatedas-

Unvisitedset: {b,c, d,e}

Visitedset:{S, a}

Step-05:

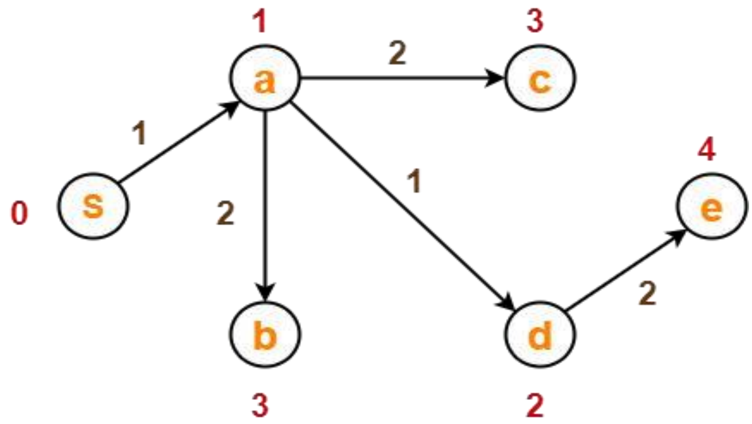
BeforeEdgeRelaxation-



Now,

d[d]+2=2+2=4<∞
∴d[e] = 4 andΠ[e]=d

Afteredgerelaxation,ourshortestpathtreeis-



Now,thesetsareupdatedas-

Unvisitedset:{b,c,e}

Visitedset:{S,a,d}

Step-06:

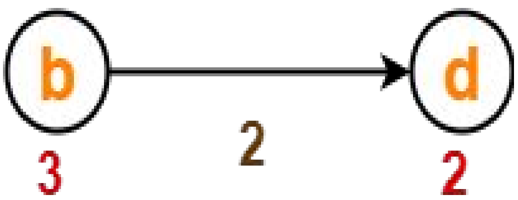
Vertex‘b’ischosen.

Thisisbecauseshortestpathestimateforvertex‘b’isleast.

Vertex‘c’mayalsobechosensinceforboththevertices,shortestpathestimateisleast.

Theoutgoingedgesofvertex‘b’arerelaxed.

BeforeEdgeRelaxation-



Now,

d[b]+2=3+2=5>2

∴Nochange

Afteredgerelaxation,ourshortestpathtreeremainsthesameas inStep-05.Now,thesetsareupdatedas-

Unvisitedset:{c,e}
Visitedset:{S,a,d,b}

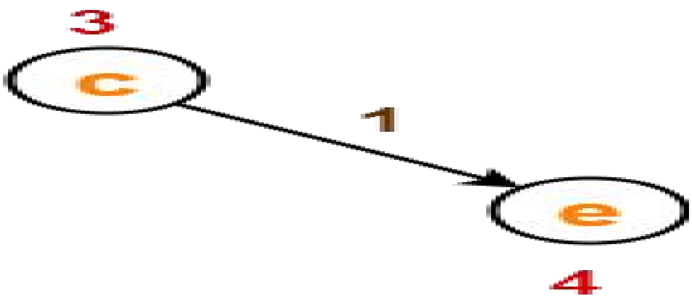
Step-07:

Vertex‘c’ischosen.

Thisisbecauseshortestpathestimateforvertex‘c’isleast.

Theoutgoingedgesofvertex‘c’arerelaxed.

<u>BeforeEdgeRelaxation-</u>



Now,

d[c]+1=3+1=4=4

∴Nochange

Afteredgerelaxation,ourshortestpathtreeremainsthesameasinStep-05.Now,thesetsareupdatedas-

Unvisitedset: {e}
Visitedset: {S, a,d,b,c}

Step-08:

Vertex‘e’ischosen.

Thisisbecauseshortestpathestimateforvertex‘e’isleast.

Theoutgoingedgesofvertex‘e’arerelaxed.

Therearenooutgoingedgesforvertex‘e’.

So,ourshortestpathtreeremainsthesameasinStep-05.

Now,thesetsareupdatedas-

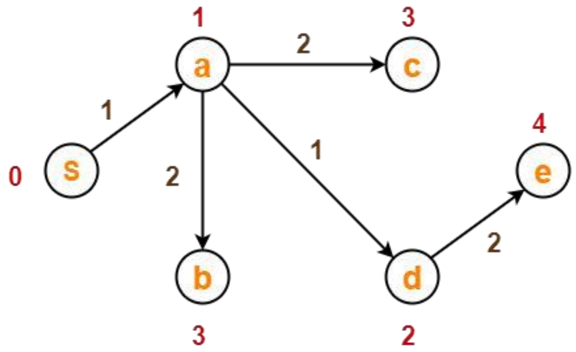
Unvisitedset:{}

Visitedset:{S,a,d,b,c,e}

Now,

Allverticesofthegraphareprocessed.

Ourfinalshortestpathtreeisasshownbelow. Itrepresentstheshortestpathfro msourcevertex‘S’toallotherre mainingvertices.



Shortest Path Tree

Theorderinwhichalltheverticesareprocessedis:
S,a ,d, b,c ,e.

EXPERIMENT:-08

AIM: -

Study of Spanning tress and Kruskal's Algorithm

Software Used:-

MATLAB

Theory:-

Minimum Spanning Tree: Minimum spanning tree can be defined as the spanning tree in which the sum of the weights of the edge is minimum. The weight of the spanning tree is the sum of the weights given to the edges of the spanning tree.

An edge is a pair of vertices (u, v)

Total no. of trees = $(V)^{v-1}$

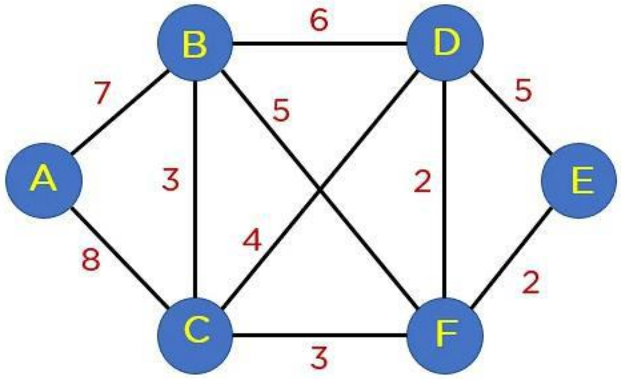
Number of edges= V-1

Kruskal Algorithm: Kruskal's algorithm to find the minimum cost spanning tree uses the greedy approach. This algorithm treats the graph as a forest and every node it has as an individual tree. A tree connects to another only and only if, it has the least cost among all available options and does not violate MST properties.

Steps for finding MST using Kruskal's Algorithm:

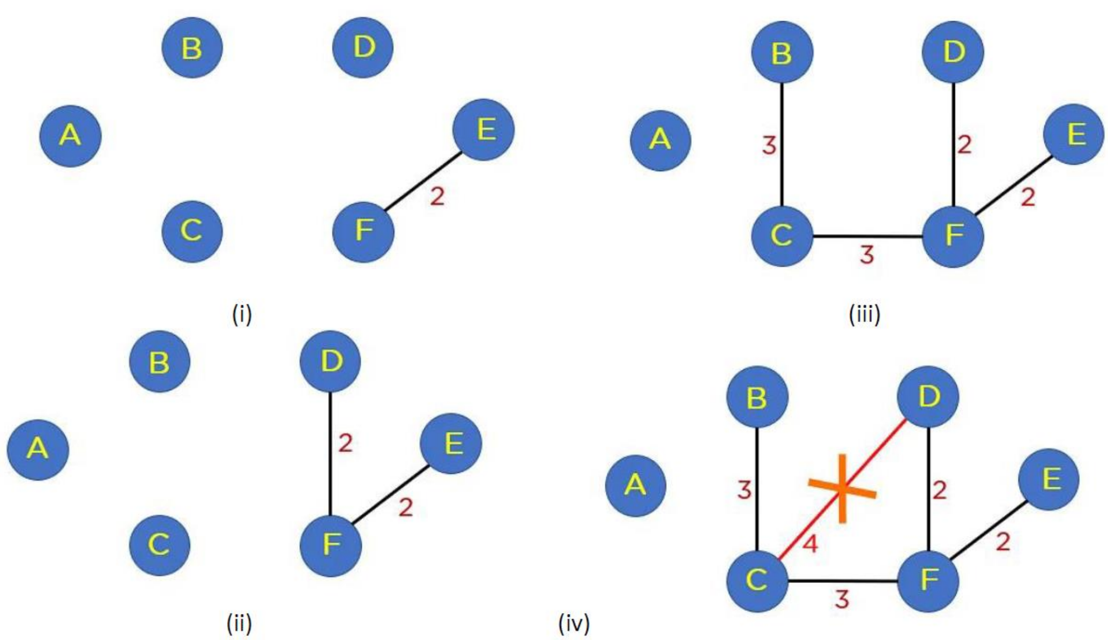
1. Sort all the edges in increasing order of their weight.
2.Pick the smallest edge. Check if it forms a cycle with the spanning tree formed so far. If cycle is not formed, include this edge. Else, discard it.
3.Repeat step#2 until there are (V-1) edges in the spanning tree.

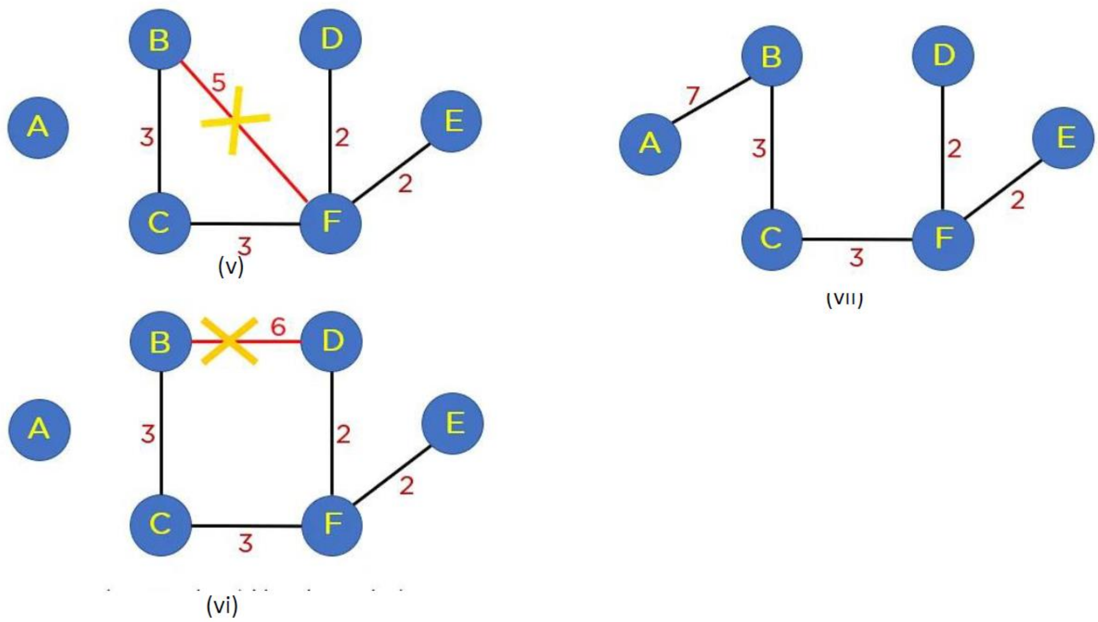
EXAMPLE 1



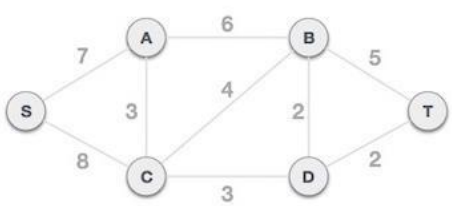
Total no. of vertices = 6
No. of edges in MST= 5

Source Vertex(u)	Destination Vertex(v)	Edge Weight
E	F	2
F	D	2
B	C	3
C	F	3
C	D	4
B	F	5
B	D	6
A	B	7
A	C	8





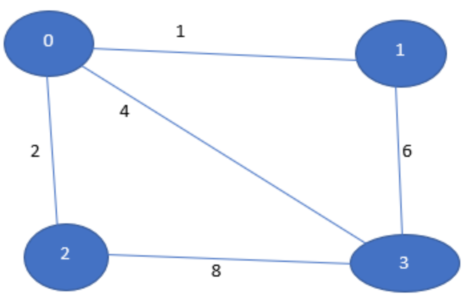
EXAMPLE 2:



Kruskal's algorithm –Pseudocode:

```
KRUSKAL(G):
A = ∅
For each vertex v ∈ G.V:
    MAKE-SET(v)
For each edge (u, v) ∈ G.E ordered by increasing order by weight(u, v):
    if FIND-SET(u) ≠ FIND-SET(v):
    A = A ∪ {(u, v)}
    UNION(u, v)
return A
```

Find & Union Operation
S={ 1, 2,3,4,5}
Disjoint set
S1={1,2}   s2={3}   s3={4}   s4={5}
Find set(1)=s1, Find set(3)=s2 &
s1Us2={1,2,3}
EXAMPLE:

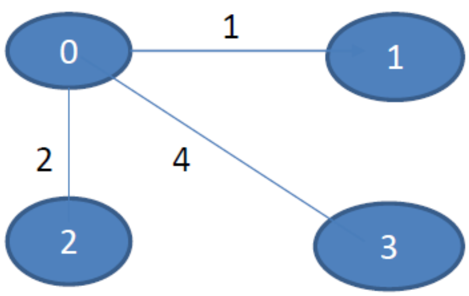


Line-1
A={   }
Line-2
V={0,1,2,3}
Line-3
{0}   {1}   {2}   {3}
s1   s2   s3   s4
Line-4

U	v	weight
0	1	1
0	2	2
0	3	4
1	3	6
2	3	8

Line-5 to 7
Find-set(0)=S1
Find-set(1)=S2

{0,1} = S1 **A={0-1, 0-2, 0-3,}**
Find-set(0)=S1
Find-set(2)=S3
{0,1,2}
S1
Find-set(0)=S1
Find-set(3)=S4
{0,1,2,3}
S1
Find-set(1)=S1 **NOT CONSIDER**
Find-set(3)=S1
Find-set(2)=S1 **NOT CONSIDER**
Find-set(3)=S1



MST = 7

Applications of MST:

1.In order to lay out electrical wiring
2.In computer network