

COMPUTER NETWORKS LABORATORY

Careers in Computer Networking



- **Cisco Certified Network Associate (CCNA)**
- **MCSE (Microsoft Certified Solutions Expert)**
- **Many more...**

Syllabus

Expt. No.	Contents	Mapped CO
1	Identify different types of Network devices/cables and Practically implement the cross-wired cable and straight through cable using crimping tool	CO1,CO2,CO3,CO4,CO5
2	Demonstrate connectivity of wired & wireless devices in Local Area Network using Hub, Switch and Router.	CO1,CO2,CO3,CO4,CO5
3	Experiment with the basic network commands like Ping, IPCONFIG, and Tracert in real networks.	CO1,CO2,CO3,CO4,CO5
4	Analyze Network Traffic Using Wireshark tool/ TCP dump tool	CO1,CO2,CO3,CO4,CO5
5	Implement Framing Mechanism using any Programming Language.	CO1,CO2,CO3,CO4,CO5
6	Implement Error Detection technique using any Programming Language.	CO1,CO2,CO3,CO4,CO5
7	Experiment with configuration of Host IP, Subnet Mask and Default Gateway of a device in LAN and establish Peer to Peer network connection.	CO1,CO2,CO3,CO4,CO5
8	Demonstrate Static and Dynamic Addressing Mechanisms	CO1,CO2,CO3,CO4,CO5
9	Implement Unicast Routing Algorithm using any Programming	CO1,CO2,CO3,CO4,CO5
10	Demonstrate Network Address Translation (NAT)	CO1,CO2,CO3,CO4,CO5
11	Show the working of Application Layer Protocols - FTP, DNS, Telnet	CO1,CO2,CO3,CO4,CO5
12	Case study: Analyze, Design and build a network for an organization using Network Simulation tool.	CO1,CO2,CO3,CO4,CO5

Text Books

1. Data Communications And Networking, Behrouz A. Forouzan, Fifth Edition, 2013, Mcgraw-Hill.

EXP. 1

- Identify different types of Network devices.
- Identify different types of cables.
- Practically implement the cross-wired cable and straight through cable using crimping tool.

EXP. No. 1: Identification of different types of network devices and cables. Implementation of the cross-wired cable and straight through cable using crimping tool.

I. AIM

- To identify different types of network devices and cables.
- Implement the cross-wired cable and straight through cable using crimping tool.

II. PARTS AND EQUIPMENT

- Network Devices
- Network Cables
- Ethernet cable – unshielded Cat5 or 6
- RJ-45 crimping tool
- RJ-45 Cat5 or 6 connectors
- RJ-45 boots
- Side cutters
- Ethernet cable tester

III. PROCEDURE

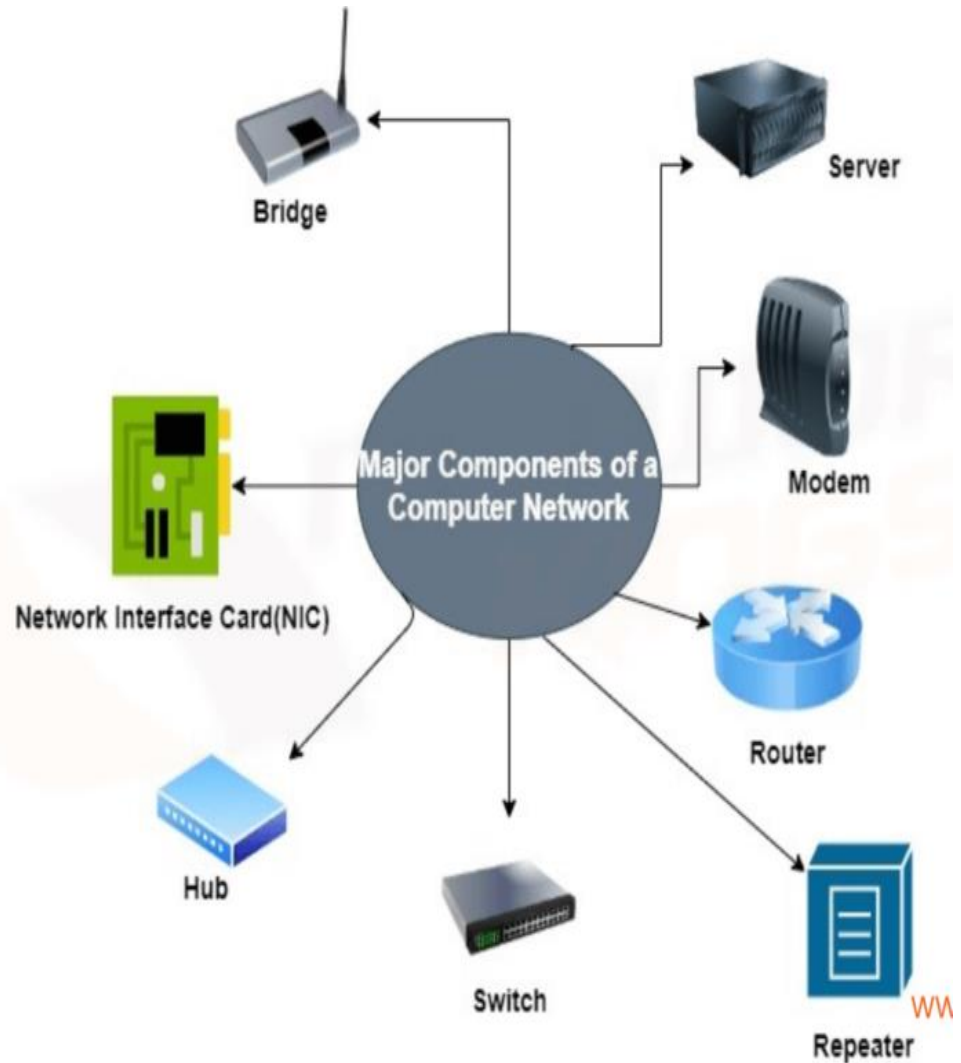
- Part 1:** Explain the roles and functionalities of Repeater, Hub, Bridge, Switch, Router, Gateway, Modem, Network Interface Card (NIC), Firewall, and access points in a typical network setup. Discuss how these devices work together to manage data traffic, ensure connectivity, and maintain network security. Provide examples of common configurations and scenarios where each device is essential.
- Part 2:** Explain guided transmission media and unguided transmission media used in computer networks in detail.
- Part 3:** What are the primary differences between Cat5e and Cat6 Ethernet cables in terms of data transfer speed, bandwidth, and maximum transmission distance? Additionally, describe the standard color code for the wiring of these cables according to the T568A and T568B wiring standards. Discuss their respective advantages and typical use cases.
- Part 4:** Create a fully functional Ethernet cable using the T568B wiring standard.

Part 1: Network Devices

- Networking devices are components used to connect computers or other electronic devices
- Together so that they can share files or resources like printers or fax machines.
- These are also called **communicating devices**.

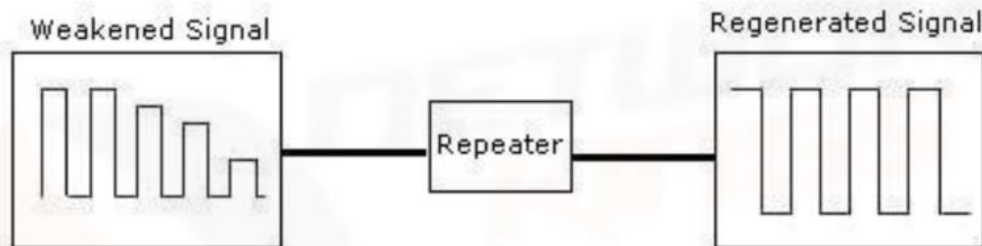
The following are the various networking devices.

- Repeater
- Hub
- Bridge
- Switch
- Router
- Gateway
- Brouter
- Modem
- Network Interface Card (NIC)
- Server



1. Repeater

- A repeater operates at the physical layer.
- Its task is to regenerate the signal over the same network before the signal becomes too weak or corrupted.
- A repeater is a regenerator, not an amplifier.
- When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength.
- It is 2 port dev

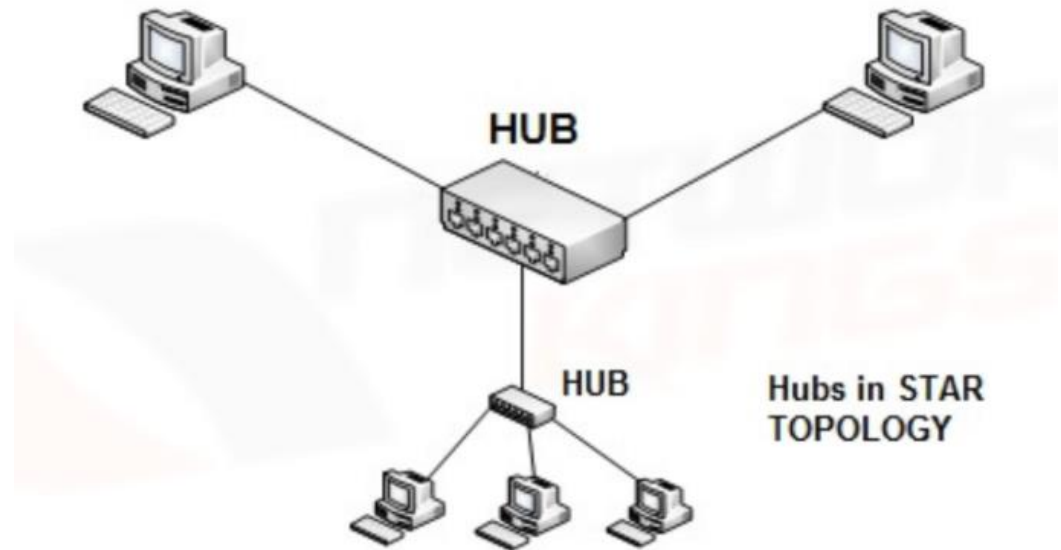


2. Hub

- A hub is device used to connect several computers together.
- Hubs cannot filter data, so data packets are sent to all connected devices.
- Also, they do not have intelligence to find out best path for data packets which leads to inefficiencies and wastage.
- **Hub does not provide any security.**

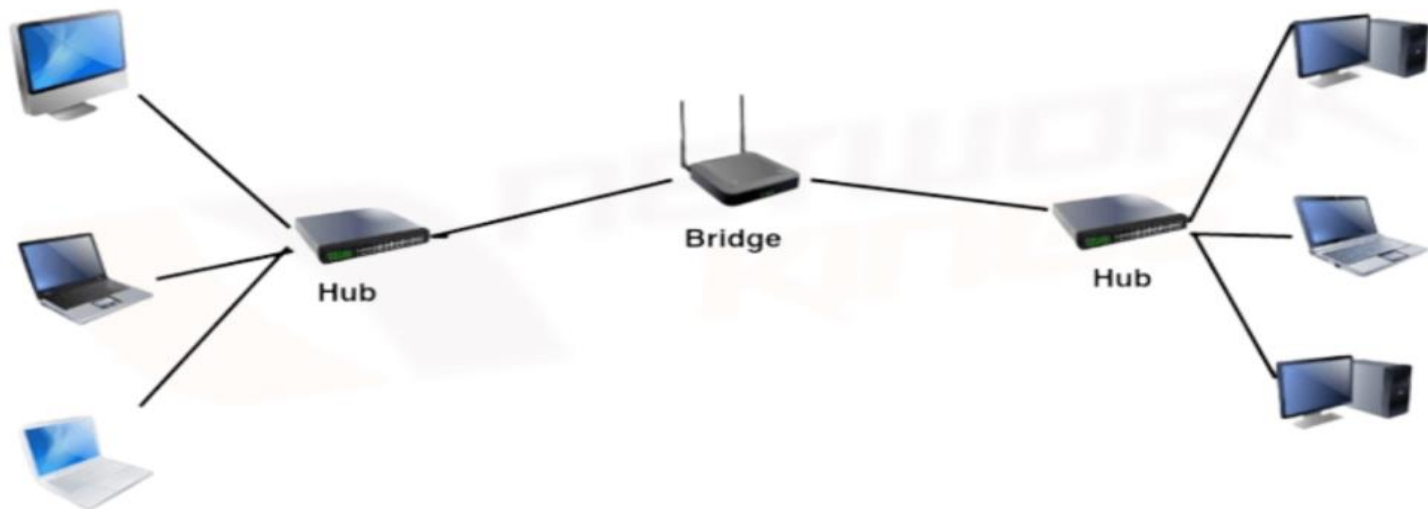
Types of Hub

- **Active Hub :-** Active hubs use electronics to amplify and clean up the signal before it is broadcast to the other ports.
- **Passive Hub :-** Passive hubs simply connect all ports together electrically and they are not powered.



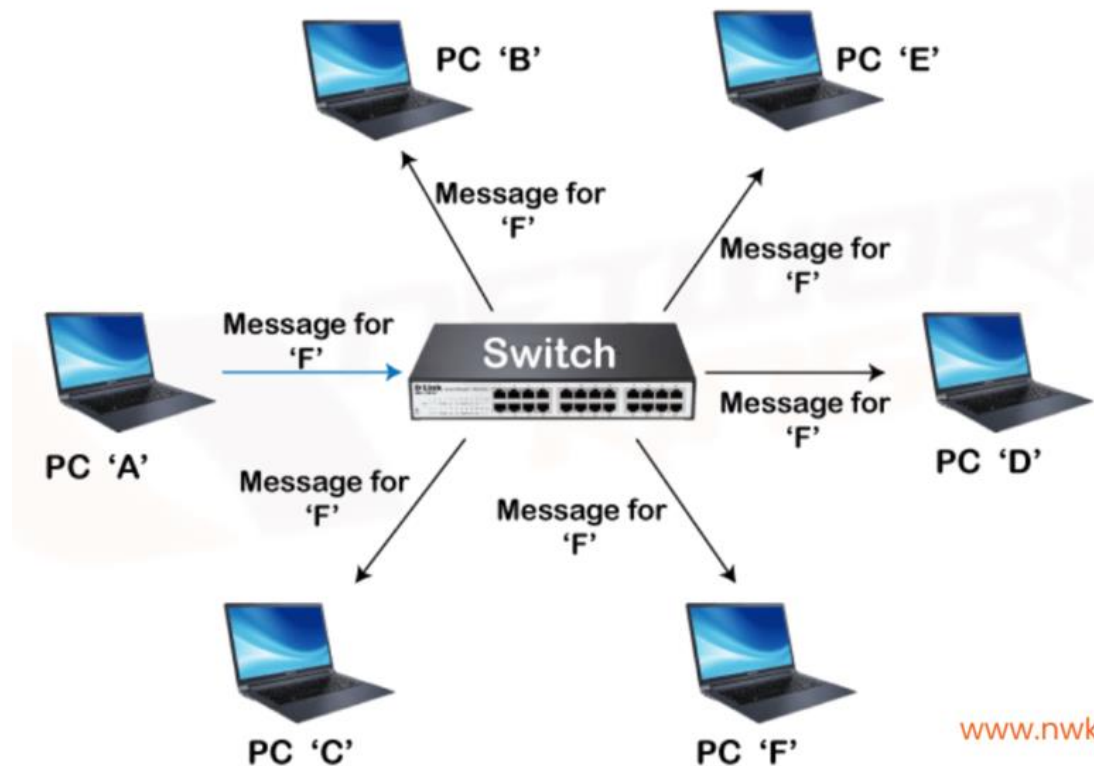
3. Bridge

- A bridge is a networking device that is used to **separate Local Area Network (LAN) into a number of sections.**
- A bridge operates at data link layer.
- A bridge is a repeater, with add on functionality of filtering content by reading the MAC addresses of source and destination.
- It is also used for interconnecting two LANs working on the same protocol.
- Bridges can filter out noise.
- We can extend a network by using a bridge.



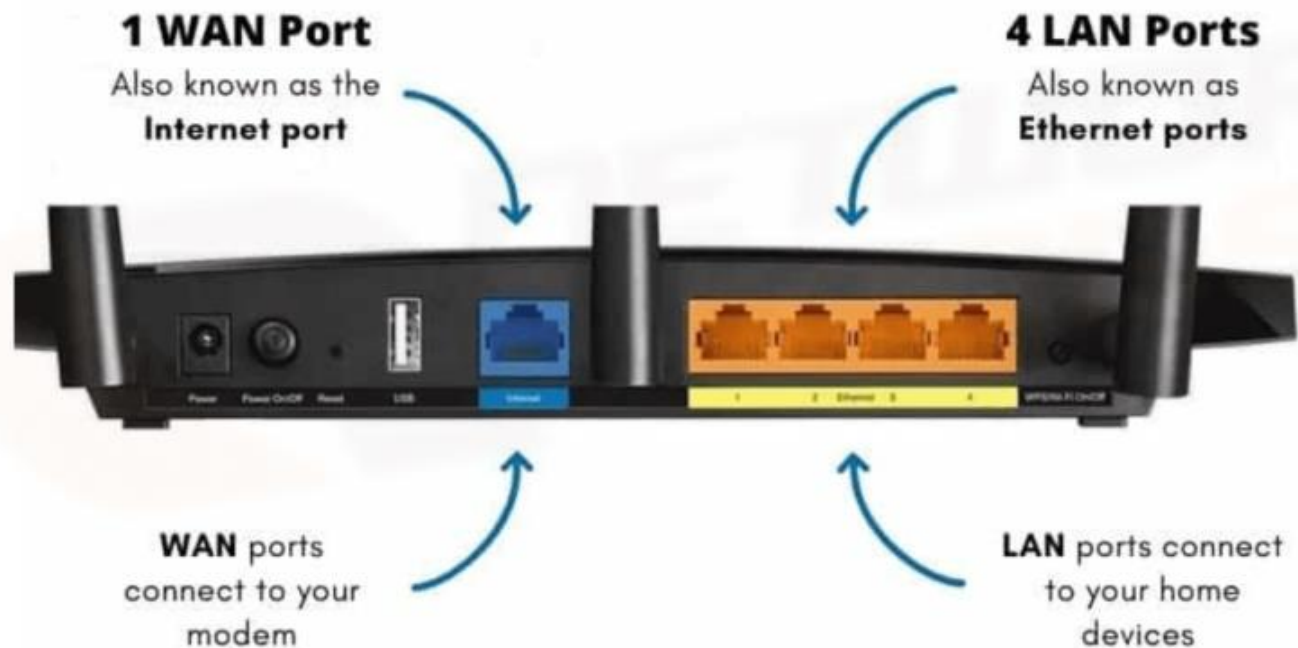
4. Switch

- A network switch is a computer networking device that **connects network segments**.
- Switch is data link layer device.
- Switch can **perform error checking** before forwarding data, that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only.



5. Routers

- A router is a device like a switch that routes data packets based on their IP addresses.
- Router is mainly a Network Layer device.
- Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets.



6. Gateway

- A gateway is a passage to connect two networks together that may work upon **different networking models**.
- They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system.
- Gateways are also called **protocol converters and can operate at any network layer**.

7. Brouter:

- It is also known as bridging router is a device which **combines features of both bridge and router**.
- It can work either at data link layer or at network layer.
- Working as router, it is capable of routing packets across networks; working as bridge, it is capable of filtering local area network traffic.

8. Modem

- Modem means Modulator- Demodulator.
- Modulation : digital information to analog signals.
- Demodulation: Analog signal back into digital information.

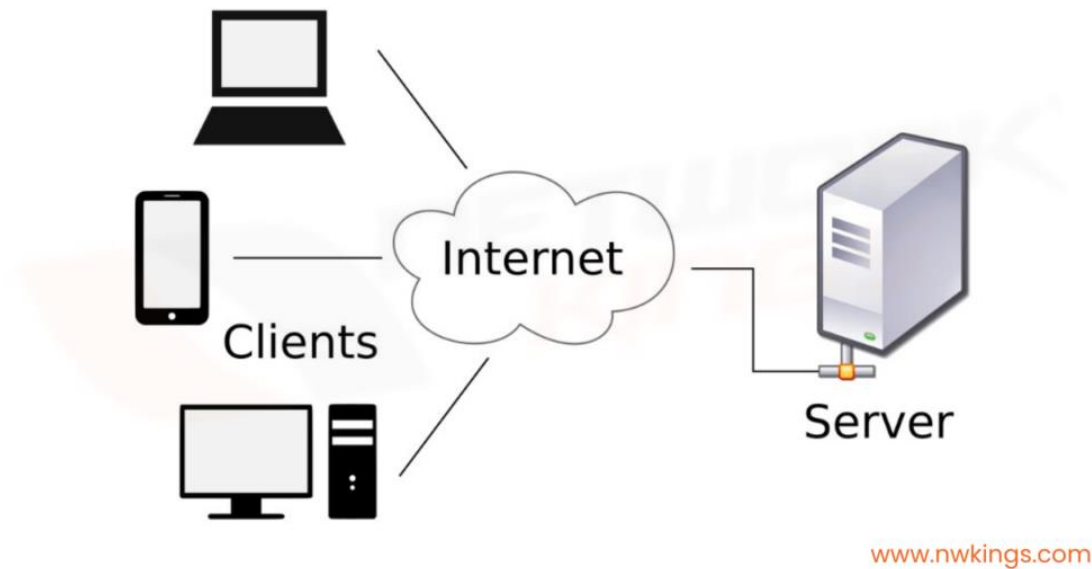
9. Network Interface Card (NIC)

- NIC provides physical **interface between computer and cabling**.
- NIC prepares data, sends data, and controls the flow of data.
- It can also receive and translate data into bytes for the CPU to understand.
- It has specific MAC address.



10. Server

- Suppose you're watching YouTube on your computer/mobile/laptop. The video that you're streaming is hosted by a server, which here will be a YouTuber server.
- In other words, a server **serves your (client) requests**. It stores, sends and receives data.



Part 2: Network Cables



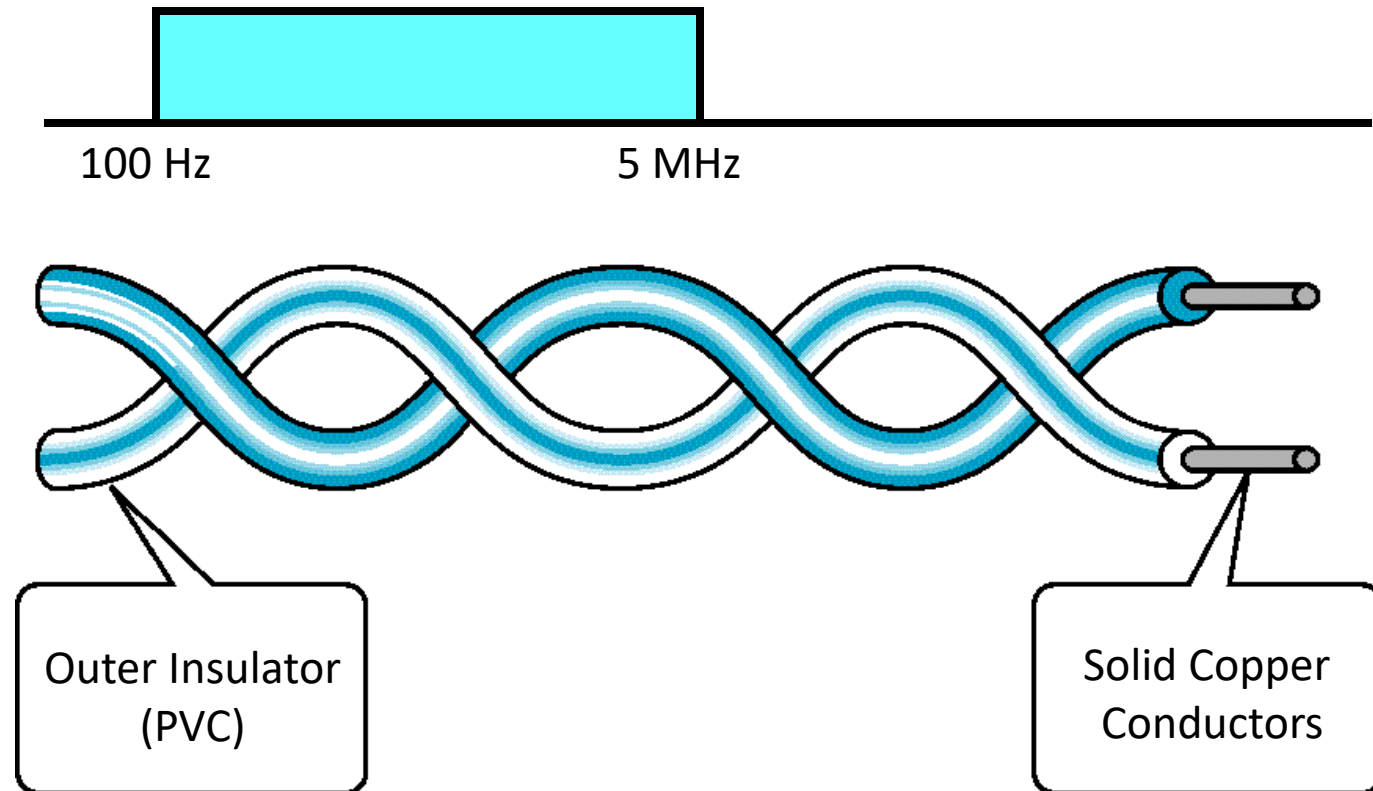
- Ethernet Cable (Cat5/Cat6), Twisted Pair Cable, UTP Cables, Shielded Twisted-Pair Cable, Coaxial Cable, Fiber Optic Cable, USB Cable, Serial Cable (RS-232), and Power Cable
- Connectors: RJ-45 Connector and BNC Connector

Ethernet cable

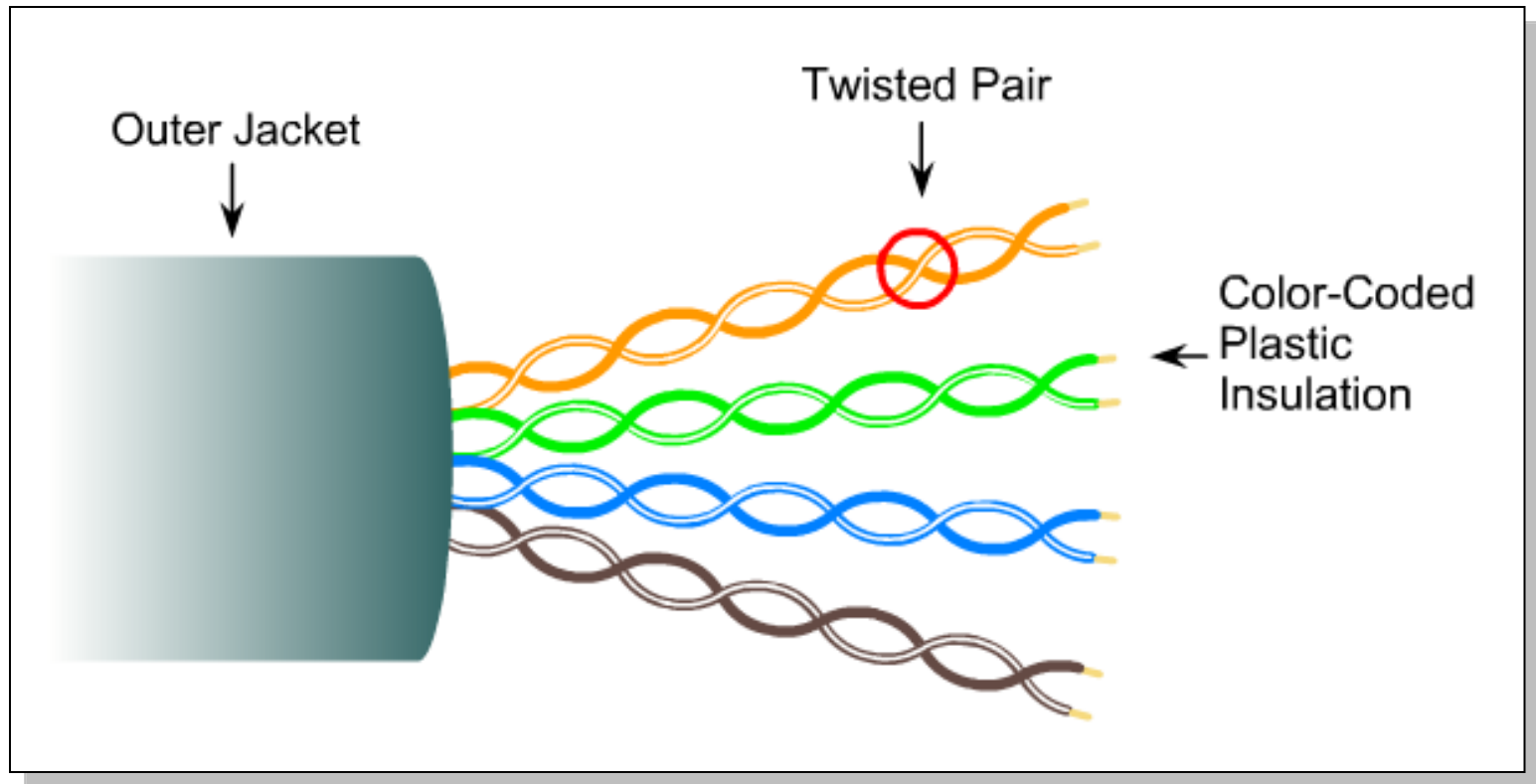
- An Ethernet cable is a network cable used for high-speed wired network connections between two devices.
- This network cable is made of four-pair cable, which consists of twisted pair conductors. It is used for data transmission at both ends of the cable, which is called RJ45 connector.
- The Ethernet cables are categorized as Cat 5, Cat 5e, Cat 6, and UTP cable.
- Cat 5 cable can support a 10/100 Mbps Ethernet network while Cat 5e and Cat 6 cable to support Ethernet network running at 10/100/1000 Mbps.



Twisted Pair Cable



UTP Cables



UTP cable standard

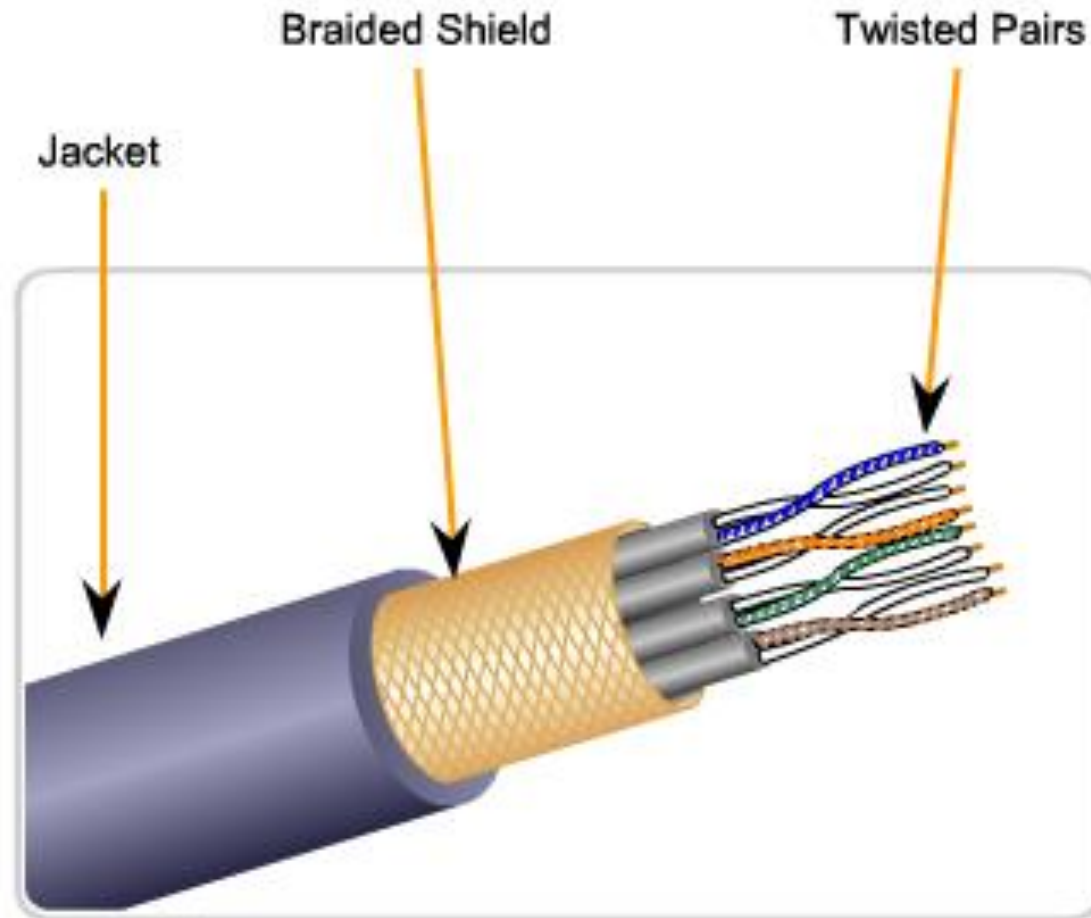
Category	Bandwidth	Digital/Analog	Use
1	very low	Analog	Telephone
2	< 2 MHz	Analog/digital	LANs
3	16 MHz	Digital	LANs
4	20 MHz	Digital	LANs
5	100 MHz	Digital	LANs
5e	100 MHz	Digital	LANs
6	250 MHz	Digital	LANs
6a	550 MHz	Digital	LANs
7	600 MHz	Digital	LANs

UTP Cables and Ethernet

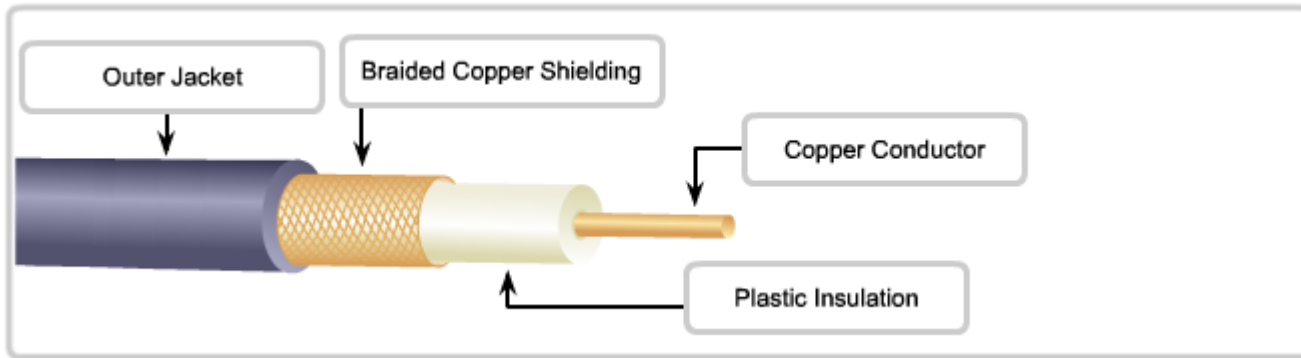
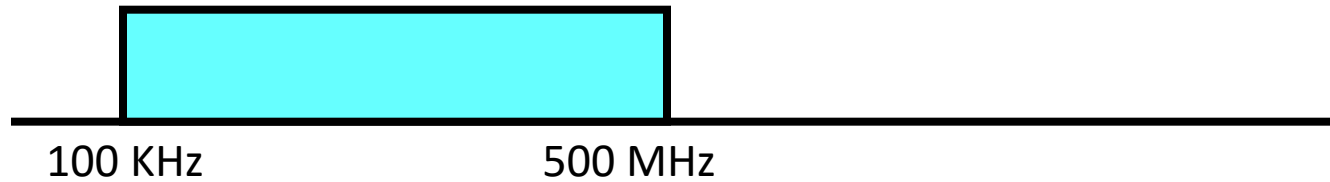
Types	UTP Cable Type	Duplex	Max Distance
10Base-T	Cat3/Cat5	Half/Ful 	100 m
100Base-T4	Cat3	Half/Ful 	100 m
100Base-TX	Cat5	Full	100 m
1000Base-T	Cat5e/Cat6	Full	100 m
1000Base-TX	Cat6	Full	100 m
10GBase-T	Cat6a/Cat7	Full	100 m

- 10 refers to a maximum transmission speed of 10 Mbps,
- BASE refers to baseband signaling,
- T-twisted-pair

Shielded Twisted-Pair Cable



Coaxial cable

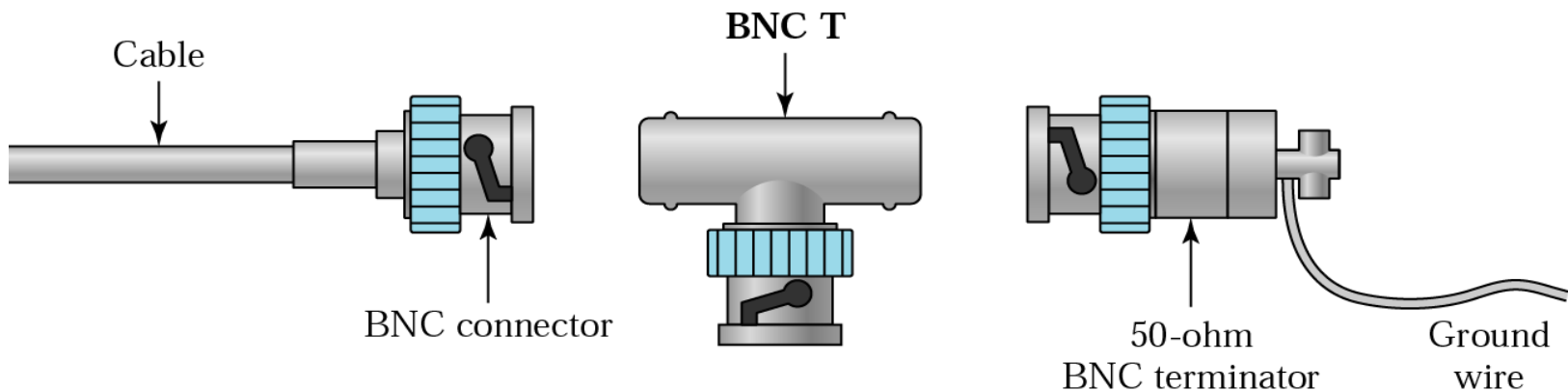


Coaxial cable standard

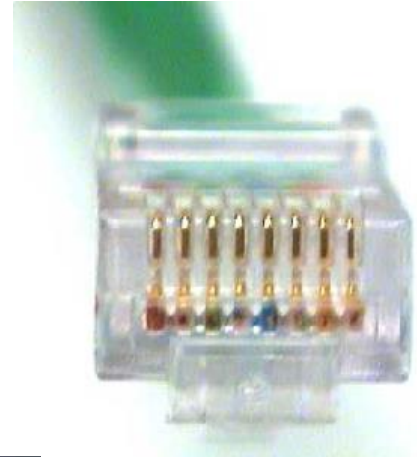
Category	Impedance	Use
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet

Coaxial cable connector

- Barrel Connectors
 - Bayonet network connector (BNC)
 - T-connector
 - Terminator



RJ-45 Connector



Wireless Media

- Wireless LAN or WLAN

- Wireless local area network that uses radio waves as its carrier

- Wi-Fi ("Wireless Fidelity")

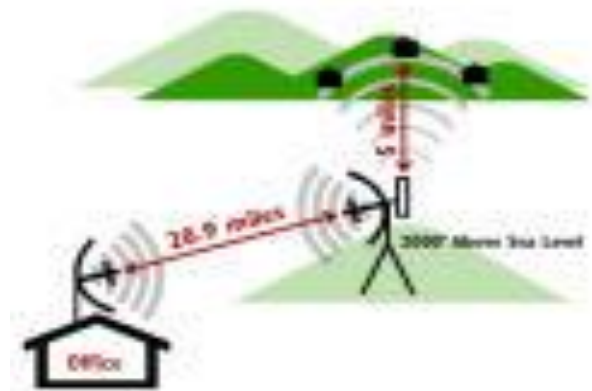
- A set of standards for WLANs based on IEEE 802.11

- Wi-Max

- Emerging technology that can cover ranges up to 10 miles or more

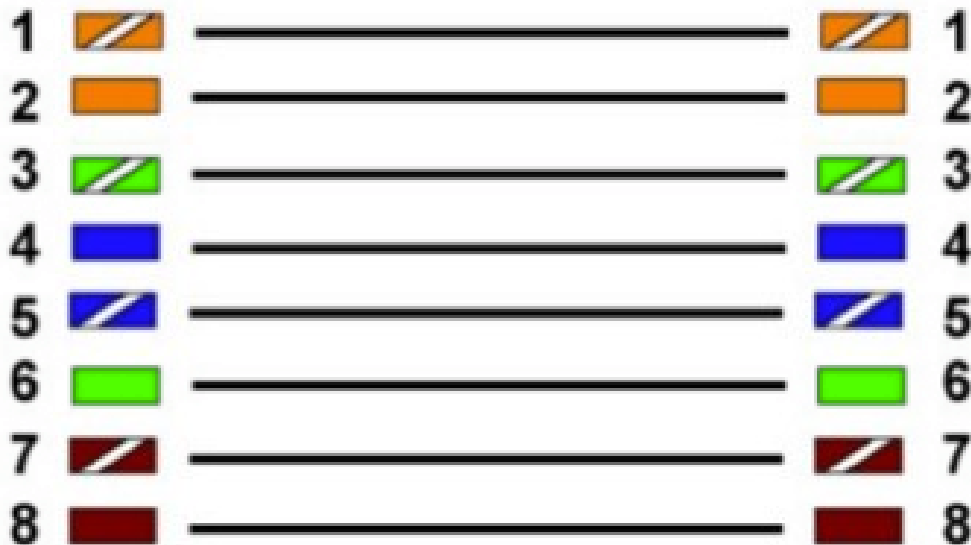
- Satellite/Microwave

- High speed media used for longer distances and remote locations

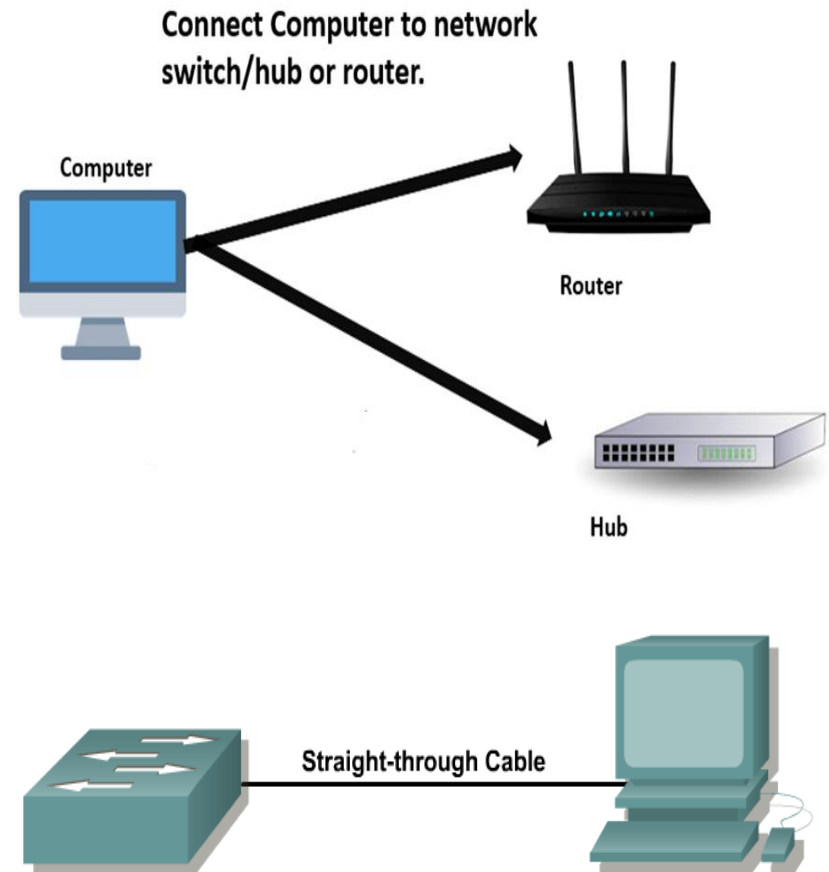


What is Straight Through Cable?

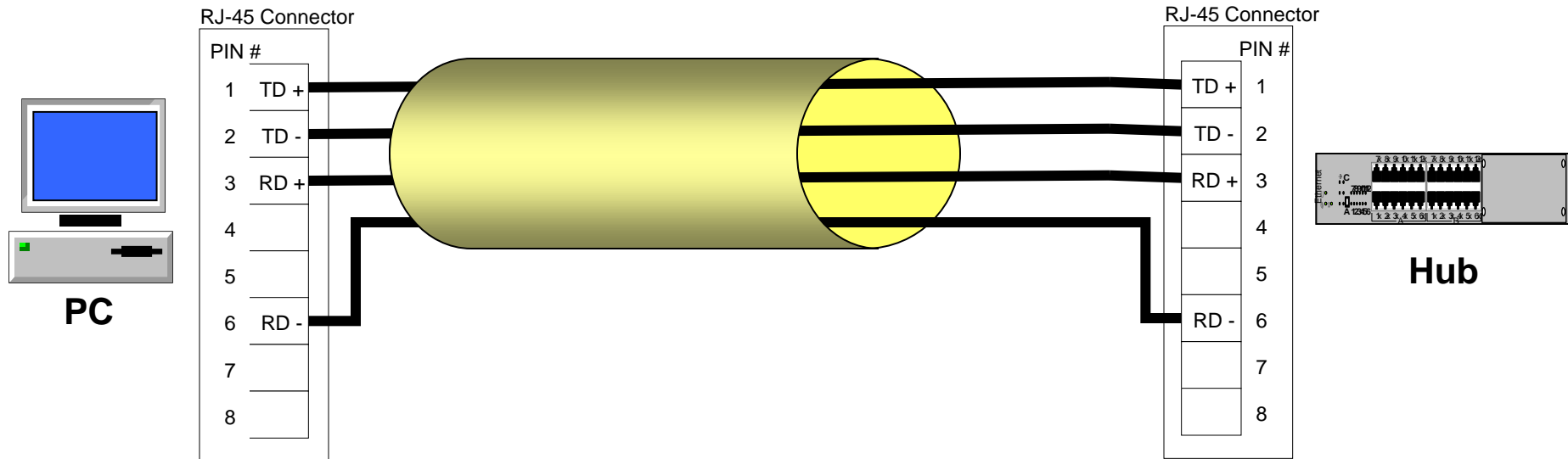
- Straight-through cable is a type of CAT5 with RJ-45 connectors at each end, and each has the same pin out. It is in accordance with either the T568A or **T568B** standards.



When to use Straight Through Cable?



Ethernet Straight-Thru Cable

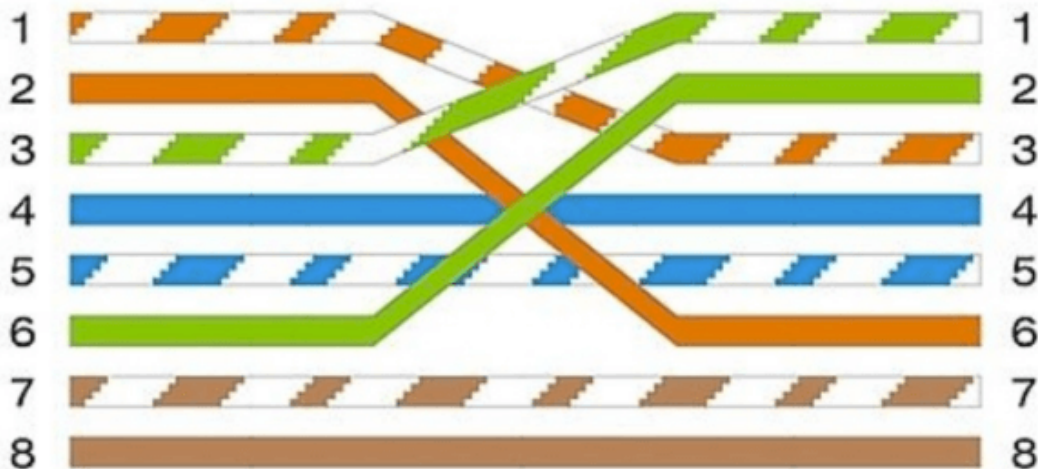


Applications of Straight Through Cable

- Connect a computer to a switch/hub's normal port.
- Connect a computer to a cable/DSL modem's LAN port.
- Connect a router's WAN port to a cable/DSL modem's LAN port.
- Connect 2 switches or hubs with one of the hub or switch using an upline port and the other one using a normal port.

What Is Crossover Cable?

- A Crossover cable is a type of CAT 5 where one end is T568A configuration and the other end as T568B Configuration.
- In this type of cable connection, **Pin 1 is crossed with Pin 3, and Pin 2 is crossed with Pin 6.**



When to use Crossover Cable?

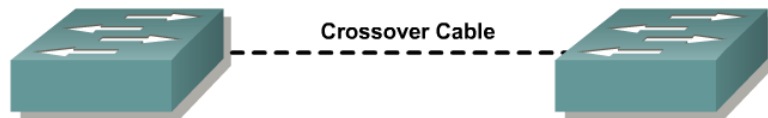
Computer to Computer with no switch or hub



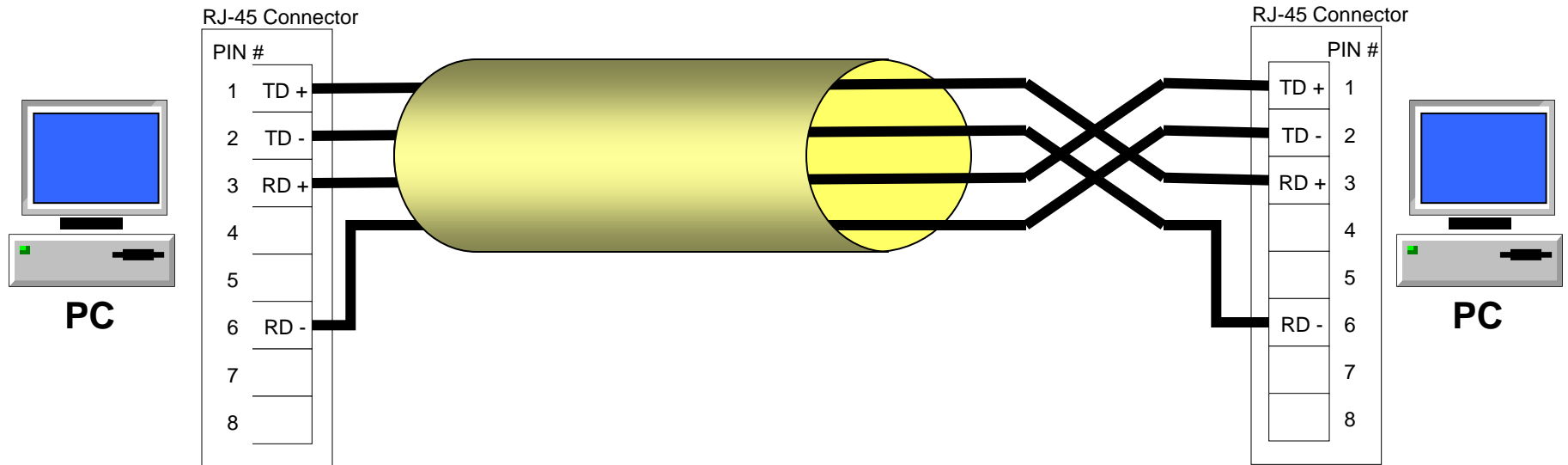
Router to Router



Crossover Cable



Ethernet Crossover Cable



Application of Crossover Cable

- It can use a computer to a computer with no switch or hub.
- Network device to the network device. For example, the route to the router.
- Crossover cable enables one to establish a direct connection between two computing devices using Ethernet ports.
- It Connects two computers directly.
- Connect two hubs/switches by using the normal port in both switches and hubs.

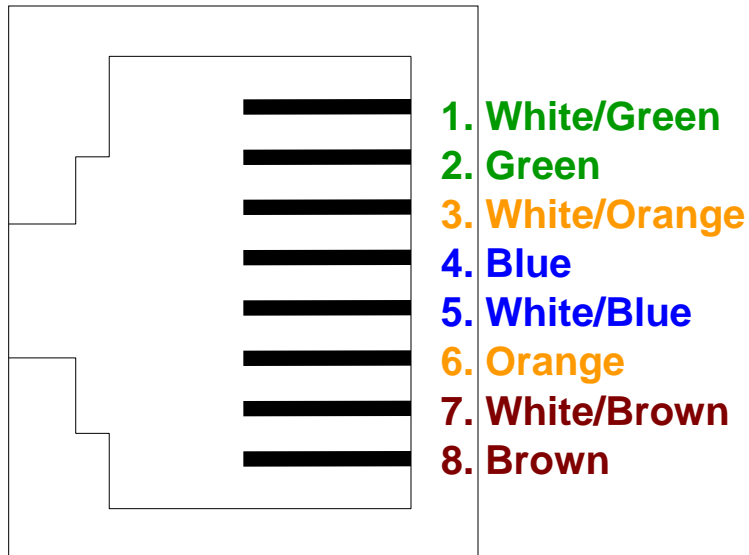
Straight Through vs. Crossover Cable, which one to choose?

Network Devices	HUB	SWITCH	ROUTER	PC
Hub	Crossover	Crossover	Straight	Straight
Switch	Crossover	Crossover	Straight	Straight
Router	Straight	Straight	Crossover	Crossover
PC	Straight	Straight	Crossover	Crossover

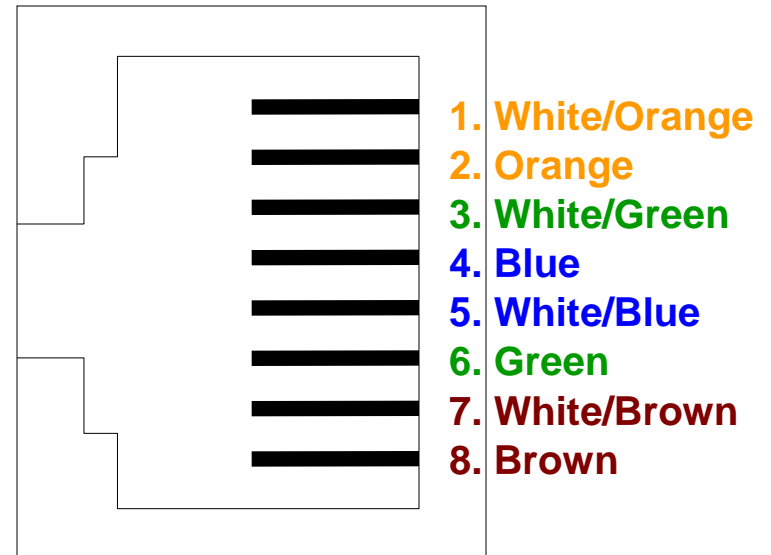
Ethernet Media and Connector

- **“Electronic Industries Association and the Telecommunications Industry Association” (EIA/TIA) standards**
 - EIA/TIA-568 (SP-2840)
 - Commercial Building Telecommunications Wiring Standards

RJ-45 Color Code



EIA/TIA 568 A



EIA/TIA 568 B

Telecommunications Industries Association/Electronic Industries Association

Part 4: Build an Ethernet Cable

Materials and Tools Needed:

- Cat5e or Cat6 Ethernet cable
- RJ-45 connectors
- Plug shields
- Crimping tool
- Wire stripper/cutter
- Ethernet cable tester (optional but recommended)

1. Bulk Ethernet Cable - or CAT5e or CAT6.



2. RJ45 Crimpable Connectors for CAT-5e (or for CAT-6).



3. Plug Shields for RJ45 Connectors (optional)!



4. HT- 568 Crimping Tool for RJ-45 (Crimper)



5. UTP Cable Stripper (optional)!





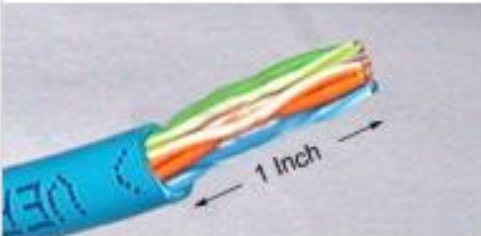
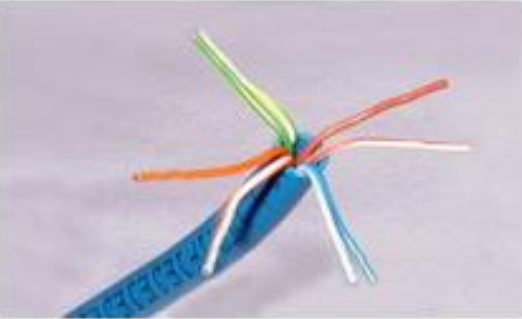
6. Cable Tester for RJ-45



Step-by-Step Procedure:

1. Prepare the Cable:
 - Cut the cable to the desired length using the wire cutter.
 - Strip about 1-2 inches of the outer jacket off the cable using the wire stripper. Be careful not to nick the inner wires.
2. Untwist and Arrange the Wires:
 - Untwist the pairs of wires and arrange them according to the T568B wiring standard:
 - T568B Color Order:
 - Pin 1: White/Orange
 - Pin 2: Orange
 - Pin 3: White/Green
 - Pin 4: Blue
 - Pin 5: White/Blue
 - Pin 6: Green
 - Pin 7: White/Brown
 - Pin 8: Brown
 - Hold the wires flat between your thumb and forefinger in the correct order.
3. Trim the Wires:
 - Trim the wires to make sure they are all even and about 1/2 inch in length from the cut end of the outer jacket.
4. Insert Wires into the RJ-45 Connector:
 - Carefully insert the arranged wires into the RJ-45 connector with the clip facing down. Make sure each wire goes into its correct slot and reaches the end of the connector.
5. Crimp the Connector:
 - Insert the RJ-45 connector into the crimping tool.
 - Squeeze the crimping tool firmly to secure the wires in the connector and to cut off any excess wire.
6. Repeat for the Other End:
 - Repeat steps 1-5 for the other end of the cable.
7. Test the Cable:
 - Use an Ethernet cable tester to ensure the cable is wired correctly and functioning.
 - Plug each end of the cable into the tester, and check that all pins are connected properly.

4.3.2. Make a EIA/TIA-568B Direct UTP Cable.

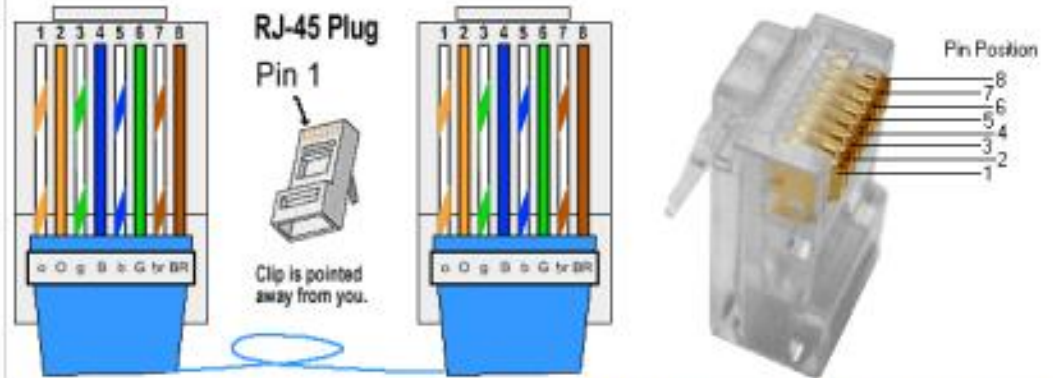
1	 or	Use Crimping Tool or Scissors, cut a cable 0.5 m long.
2		<p>Use Crimping Tool or Cable Stripper clean the outer shell about 1 Inch (2.5 cm) from the one end of the cable. The crimping tool has a razor blade that will do the trick with practice. To do this:</p> <ul style="list-style-type: none">• insert the end of the cable into the rear round hole of the crimper• clamp the ends of the crimper and rotate the outer shell 
3		Unwind and pair the similar colors.

4



Pinch the wires between your fingers and straighten them out as shown. The color order is important to get correct.

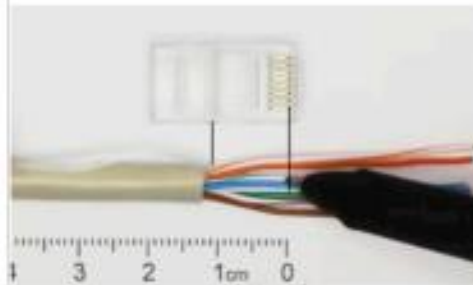
You make EIA/TIA-568B Direct UTP Cable Numbering in 8P8C (RJ45) connector



5



Use Crimping Tool or Scissors to make a straight cut across the 8 wires to shorten them to **1/2 inch** (1.3 cm) from the cut sleeve to the end of the wires.



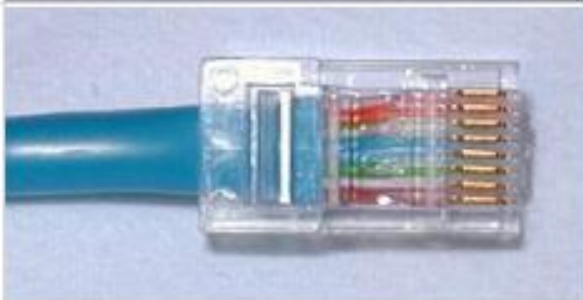
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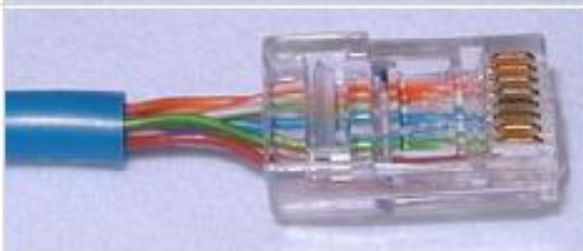
Carefully push all 8 unstripped colored wires into the connector.

TRUE WAY - Note the position of the blue plastic sleeve.

Also note how the wires go all the way to the end.






TRUE WAY - A view from the top. All the wires are all the way in. There are no short wires.



WRONG WAY - Note how the blue plastic sleeve is not inside the connector where it can be locked into place. The wires are too long. The wires should extend only 1/2 inch from the blue cut sleeve.



WRONG WAY - Note how the wires do not go all the way to the end of the connector.

7		<p>CRIMPING THE CABLE ... carefully place the connector into the Ethernet Crimper and cinch down on the handles tightly. The copper splicing tabs on the connector will pierce into each of the eight wires. There is also a locking tab that holds the blue plastic sleeve in place for a tight compression fit. When you remove the cable from the crimper, that end is ready to use.</p>
8		<p>Attach 2 cable plug shields (not required for lab work!)</p>
9	<p>REPEAT STEPS OTHER END</p> 	<p>For a standard "Direct" cable, repeat steps 2-7.</p> <p>(For a Cross-over cable, the other end will have a different color order as shown by the crossover pictures above.)</p>

Test Your Cable UTP Cat5e.



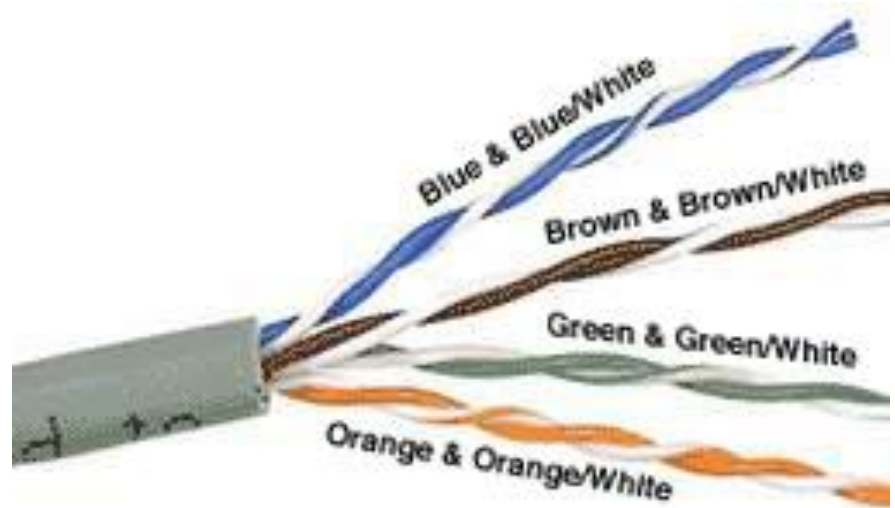
If you have Tester.

Make sure to test the cables before installing them. An inexpensive Ethernet cable tester does this quite well.

Testing results: Short-**Connected**-Non Parallel-No Connection

Internal Cable Structure and Color Coding

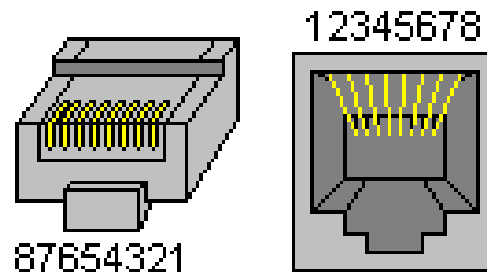
- Orange / Orange-white
- Green / Green-white
- Blue / Blue-white
- Brown / Brown-white



About the RJ45 Ends:

- The RJ45 end is a 8-position modular connector

Where is pin #1?











RJ45 Jack and Plug Pinout

Ethernet Cable Pin outs:

- A straight through cable
 - used to connect to a hub or switch, and
- A cross over cable
 - used to operate in a peer-to-peer fashion without a hub/switch.

Standard, Straight-Through Wiring (both ends are the same):

RJ45 Pin #	Wire Color	Wire Diagram	10Base-T Signal 100Base-TX Signal	1000Base-T Signal
1	White/Green		Transmit+	BI_DA+
2	Green		Transmit-	BI_DA-
3	White/Orange		Receive+	BI_DB+
4	Blue		Unused	BI_DC+
5	White/Blue		Unused	BI_DC-
6	Orange		Receive-	BI_DB-
7	White/Brown		Unused	BI_DD+
8	Brown		Unused	BI_DD-

Cross Over Cable

RJ45 Pin # (End 1)	Wire Color	Wire Diagram	RJ45 Pin# (End 2)	Wire Color	Wire Diagram
1	White/Orange		1	White/Green	
2	Orange		2	Green	
3	White/Green		3	White/Orange	
4	Blue		4	White/Brown	
5	White/Blue		5	Brown	
6	Green		6	Orange	
7	White/Brown		7	Blue	
8	Brown		8	White/Blue	

How to wire Ethernet Cables:

1. Strip off about 2 inches of the cable sheath.
2. Untwist the pairs - don't untwist them beyond what you have exposed
3. Align the colored wires according to the diagrams above.
4. Trim all the wires to the same length, about 1/2" to 3/4" left exposed from the sheath.

How to wire Ethernet Cables:

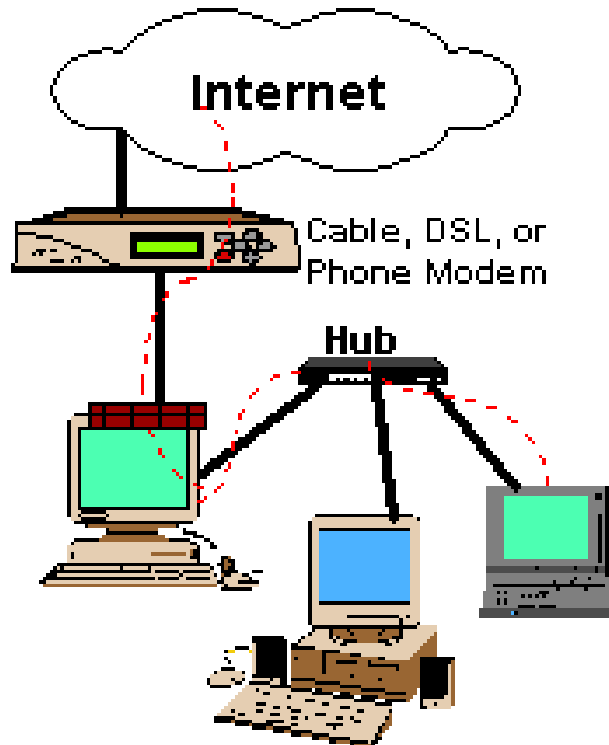
5. Insert the wires into the RJ45 end - make sure each wire is fully inserted to the front of the RJ45 end and in the correct order.
6. Verify the wires ended up the right order and that the wires extend to the front of the RJ45 end and make good contact with the metal contacts in the RJ45 end.
7. Crimp the RJ45 end with the crimper tool

How to wire Ethernet Cables:

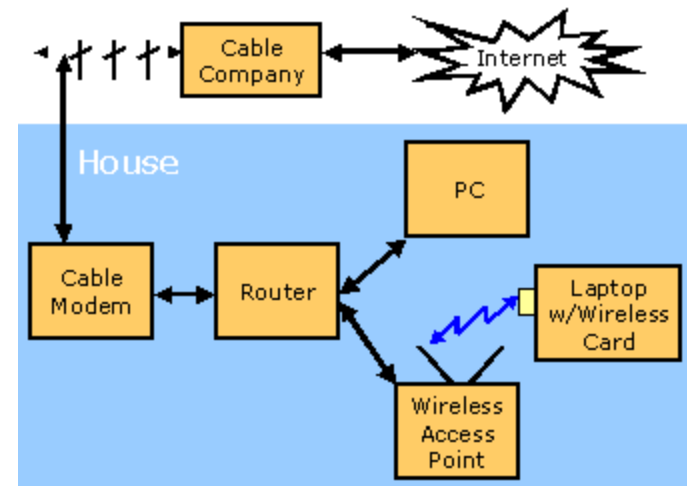
8. Cut the cable to length - make sure it is more than long enough for your needs
9. Repeat the above steps for the second RJ45 end.
10. Use a cable tester to verify the proper connectivity of the cable.

Sample LAN Implementation

Home Configuration

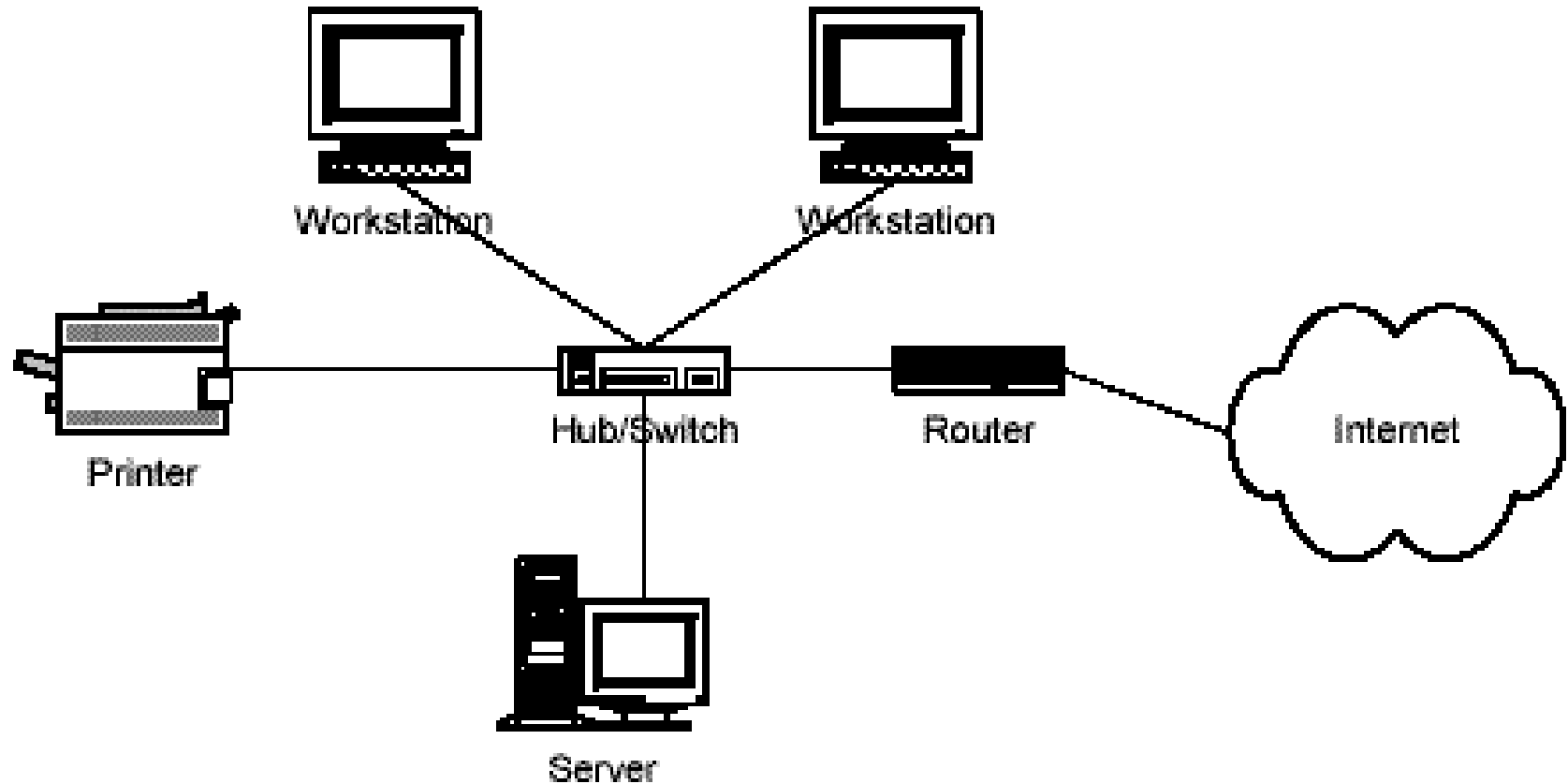


**Computers on a
standard Ethernet LAN**



Sample LAN Implementation

Business Configuration

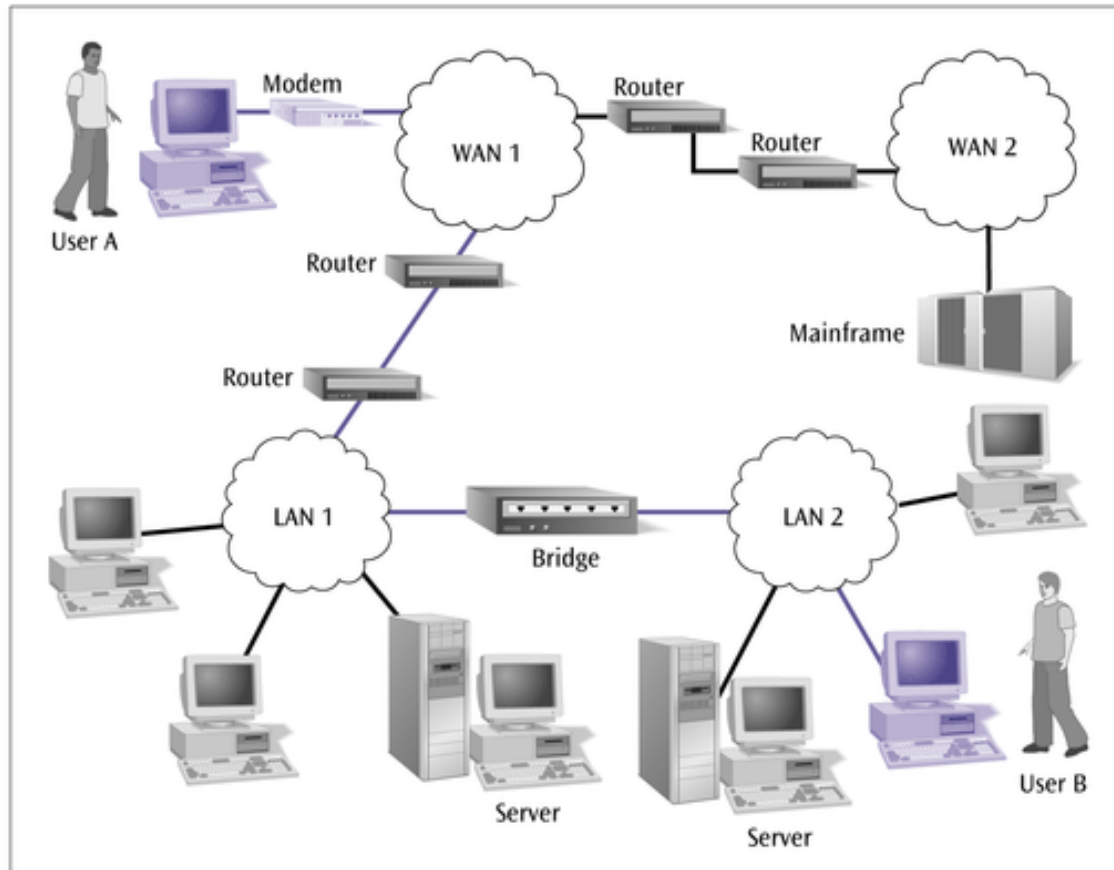


Sample LAN Implementation

Business Configuration

Figure 1-1

An overall view of the interconnection between local area networks and wide area networks



P.V.P. SIDDHARTHA INSTITUTE OF TECHNOLOGY, VIJAYAWADA. CAMPUS INTRANET CONNECTIVITY DIAGRAM

