Computer Networks

Prepared by
Dr. Gaber Hassan

Lect_3

LAN NICs

- NIC stands for Network Interface Cards.
- Types of LAN cards (Ethernet cards):
  1. Ethernet 10 Mbps (Mega bit per second)
  2. Fast Ethernet 100 Mbps.
  3. Ten Giga Ethernet 10 Gbps.
  4. Hundred Giga Ethernet 100 Gbps.
  5. Wifi (Wireless Ethernet) 1Gbps
- The name on the word "ether" as a way of describing an essential feature of the system: the physical medium (i.e., a cable) carries bits to all stations, much the same way that the old "luminiferous ether" was once thought to propagate electromagnetic waves through space. Thus, Ethernet was born."
- **الأثير المضيء** (luminiferous aether)عبارة عن مصطلح ظهر في نهاية القرن التاسع عشر ويعني الأثير وهو الوسيط الحامل للضوء الذي من المفترض أن ينتشر من خلاله الضوء..

WAN NICs

- Types of WAN cards:

1. Public WAN
    1. DSL (Digital Subscriber Line)
2. Private WAN
    1. X.25
    2. Frame relay
    3. ATM (Asynchronous Transfer Mode).
    4. PPP
    5. HDLC (High Level Data Link Control)

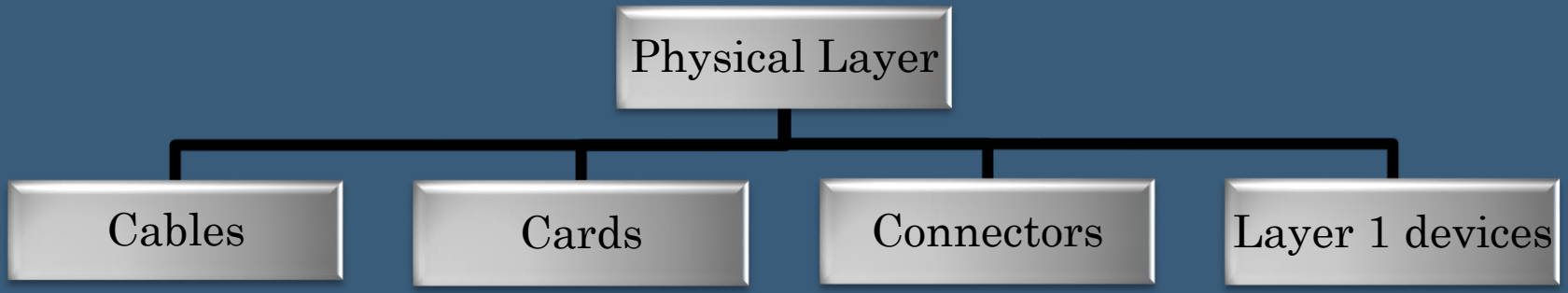
- All previous (types of LAN and WAN cards are protocols for transmitting data between network points. All these protocols exist in data link layer).

WAN NICs

- LAN cards can push data with high speed, but through short distances.
- WAN cards can push data with low speed, but through long distances

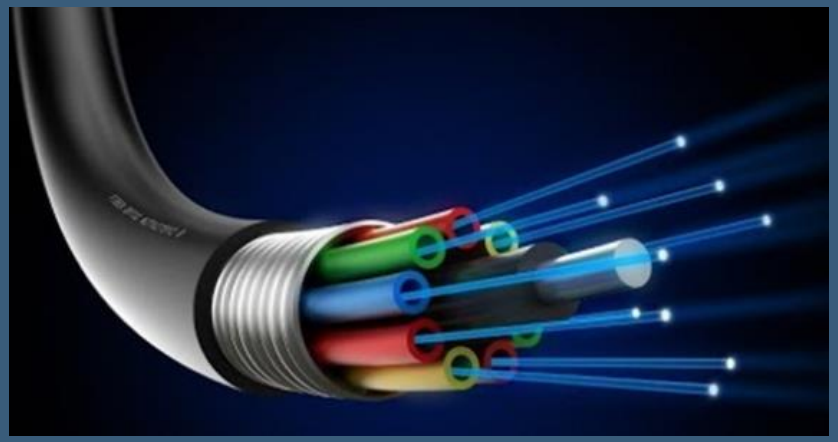
The Physical Layer

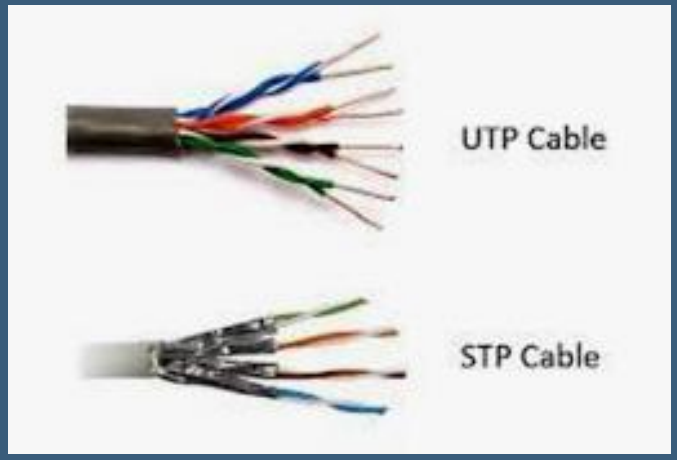
Physical Layer



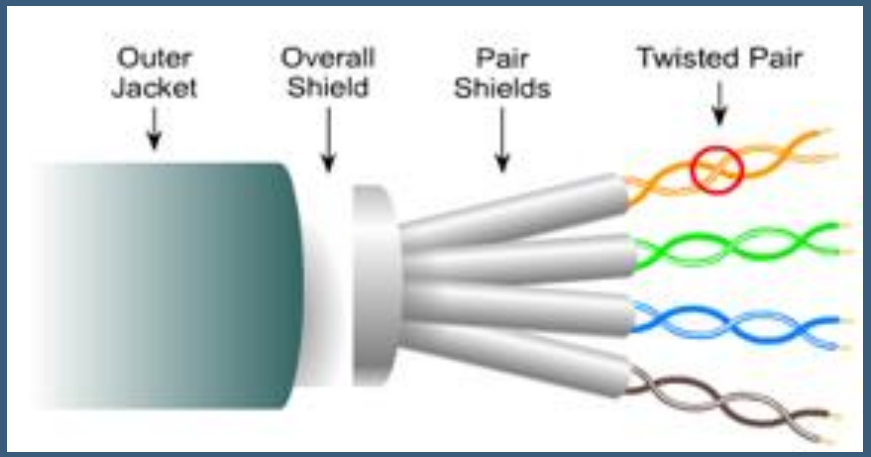
LAN Cables (Ethernet cables)

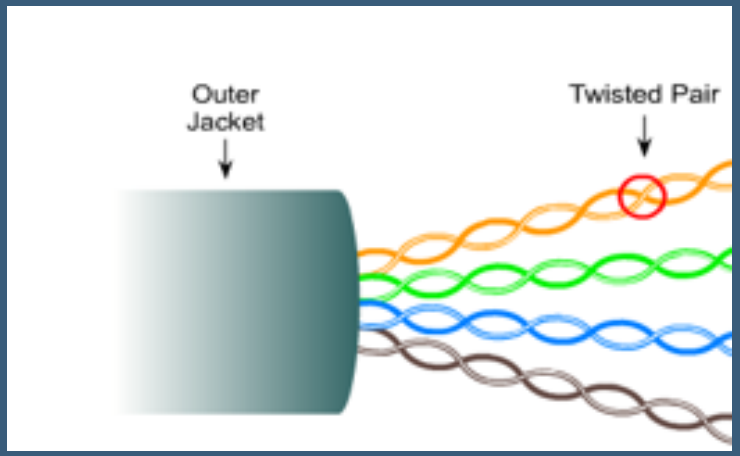
1. UTP (Unshielded Twisted Pair)
2. STP (Shielded Twisted Pair)
3. Fiber





LAN Cables (Ethernet cables)





UTP

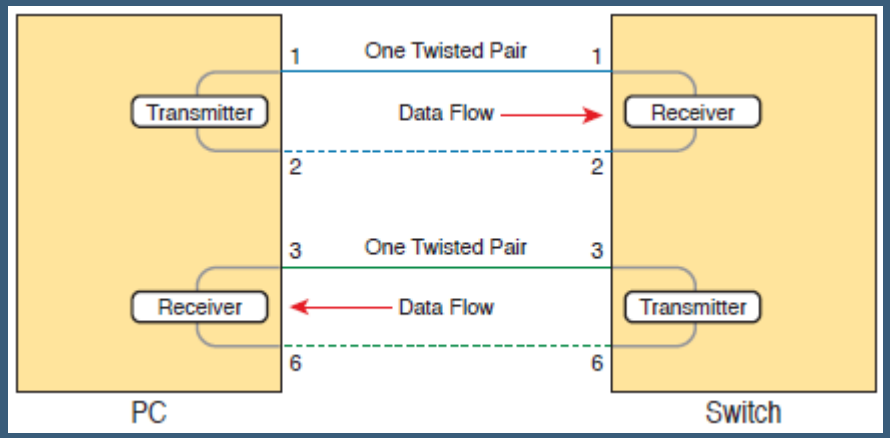
- Ethernet cables consist of 8 copper wires (4 pair copper wires) colored (blue , orange , green, brown)
- The binary data transmit in this cable as a voltage
- 2 wires (1 pair) for transmitter (TD)
- 2 wires (1 pair) for receiver (RD)
- 4 wires (2 pair) spare

8 wires usage

4wire only used (2 for transmit , 2 for receive) and 4 wires spare	**8 wires are used (4 for transmit , 4 for receive)**
Ethernet (10Mbps)	- Giga Ethernet (1 Gbps) - 4 spare wires are used for transmit data
Fast Ethernet (100 Mbps)	- 10Giga Ethernet (10 Gbps) - 4 spare wires are used for transmit data
	POE (Power Over Ethernet) {POE Switch can use 4 spare wires to send DC volt over Ethernet cable up to 48 volt to operate IPphone, IPcamera, wireless access point)

UTP

- When the PC want to send as a binary via UTP cable, send 5 volt power for every 1's and zero volt for zeros
- The PC receive power and decide the incoming data one or zero
- The receiver check the power on the cable every period of time (clock)
  1. In Ethernet the cable checked for power 10,000,000 time every second,
  2. Fast Ethernet 100,000,000 time ever second.
  3. Giga Ethernet 1,000,000,000 time every second.



UTP Category

Type	Speed of data flow
Cat 3 (cat stands for common authentication technology)	8 Mbps (not used now in ethernet, instead it used for WAN, now it is replaced with fiber)
Cat 5	100 Mbps
Cat 5e(enhanced)	Up to 1 Gbps
Cat 6	Up to 4 Gbps
Cat 6a (augmented or advanced)	10 Gbps
Cat 7	Up to 10 Gbps but high bandwidth
Cat 8	Up to 40 Gbps

Disadvantage of UTP

- It is affected by the electromagnetic field produced by the power cable, motor or air conditioning if it near with it at distance less than 60cm, if its necessary you must use the **STP** cable.
- Maximum distance 100m.

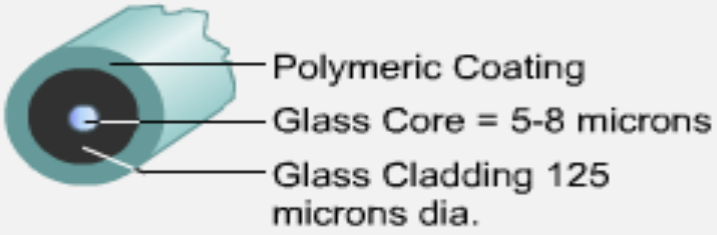
Fiber Cables

- This cable carry any data as photon beam
- The card that work with this cable can check the data over the cable 100,000,000,000,time ever second (100 Gbps)
- This cable contains 4 core one for send , one for receive, 2 spare
  1. SMF (Single Mode Fiber)
  2. MMF (Multi Mode Fiber)

Fiber Cables

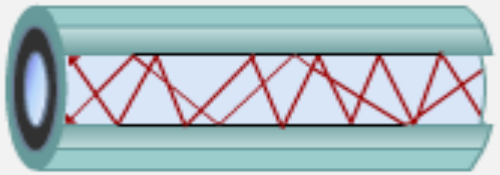
Single-mode

Requires very straight path

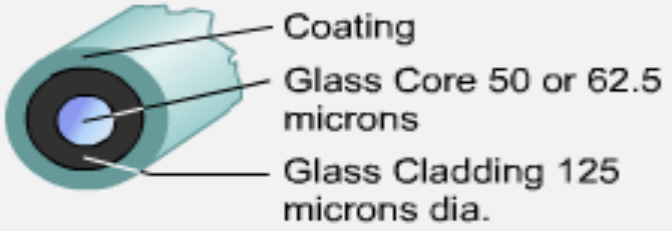


- Small core
- Less dispersion
- Suited for long distance applications (up to ~3km, 9,840 ft)
- Uses lasers as the light source often within campus backbones for distances of several thousand meters

Multimode



Multiple paths-sloppy



- Larger core than single-mode cable (50 or 62.5 microns or greater)
- Allows greater dipersion and therefore, loss of signal
- Used for long distance application, but shorter than single-mode (up to ~2km, 6,560 ft)
- Uses LEDs as the light source often within LANs or distances of a couple hundred meters within a campus network

Advantage of fiber cables

- This cable protect against EMI (Electromagnetic Interference)
- Larger distance (400m, 4Km, 10 Km, 100Km) according to the thickness of its core

MMF	Core diameter 62.5 micro m (μm)	400m
	Core diameter 50 micro m (μm)	4Km
SMF	Core diameter 9 micro m (μm)	10Km
	Core diameter 8 micro m (μm)	100Km

- Higher speed (up to 100 Gbps)

LAN Cards (standard)

- IEEE (Institute of Electrical and Electronic Engineering) is responsible for standard specifications of LAN technologies through department called IEEE 802.3.
- IEEE 802.3 standard is a working group of standard specifications for Ethernet (Cards and Cables).
- Nowadays there are many variations of this standard concern with Ethernet cards :

1. 10 Base T
2. 100 Base Tx
3. 1000 Base T
4. 10 G Base T
5. 10 Base F
6. 100 Base Fx

- Base stadns for Baseband or no modulation
- 10 stands for speed of transferring data 10 Mbps.
- T stands for Twister pair
- X stands for flexibility (i.e., speed start from 10 Mbps up to 100 Mbps).
- F stands for Fiber.

- In telecommunications, baseband is the range of frequencies occupied by a signal that has not been modulated to higher frequencies

LAN Cards (standard)

LAN Network Cards	Cables
10 Base T	Cat 5
100 Base Tx	Cat 5
1000 Base T	Cat 5e
10 G Base T	Cat 6a

LAN Cards (standard - Fiber)

LAN NIC
10 Base F
100 Base F
1000 Base (Sx, Lx, Zx)
10 G Base (Sx, Lx, Zx)
100G Base (Sx, Lx, Zx)

- F stands for Fiber
- Sx stands for Short distance (400m- 4Km)
- Lx stands for Long distance up to 10 Km
- Zx stands for Extra long distance up to 100 Km

LAN connectors

Fiber connectors	
SC	Square connectors (Cisco product)
ST	Straight Tip connectors (Cisco product)
LC	Lucent connectors (Juniper product)
Copper connectors	
DB	D stands for D shape
RJ 11 (6 pin)	RJ stands for Register Jac
RJ 45 (8 pin)	

LAN connectors

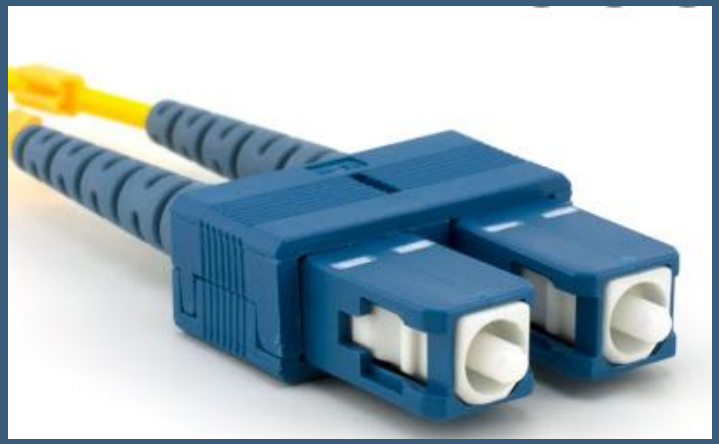
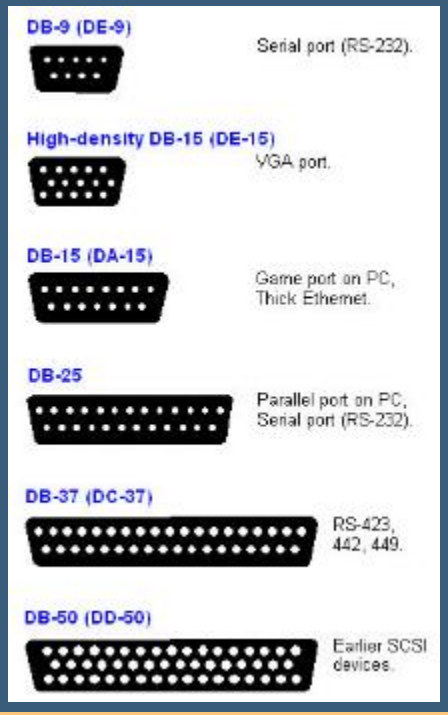


Figure 1: LC fiber connector



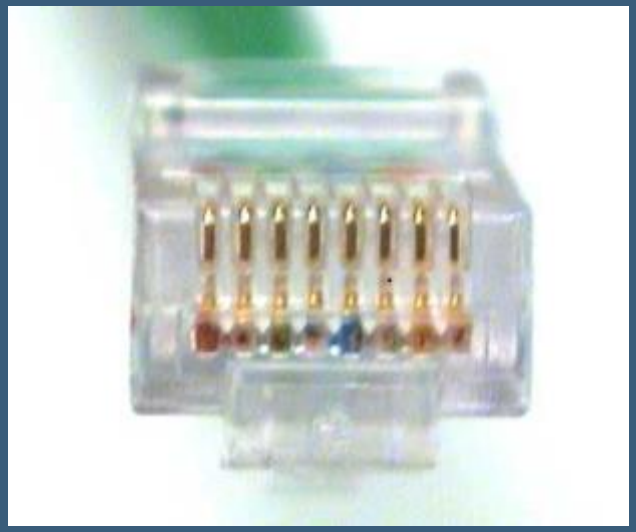
RJ-11	RJ-45
6 pin	8 pin
	

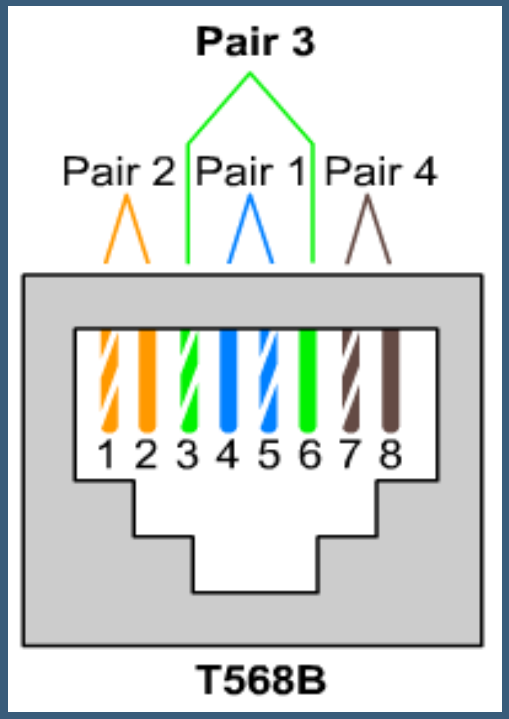
IEEE color code standard

- There are two color code standard:

1. Color code standard (T568B) in RJ 45
    1. white - orange
    2. orange
    3. White - green
    4. blue
    5. White - blue
    6. Green
    7. White - brown
    8. brown

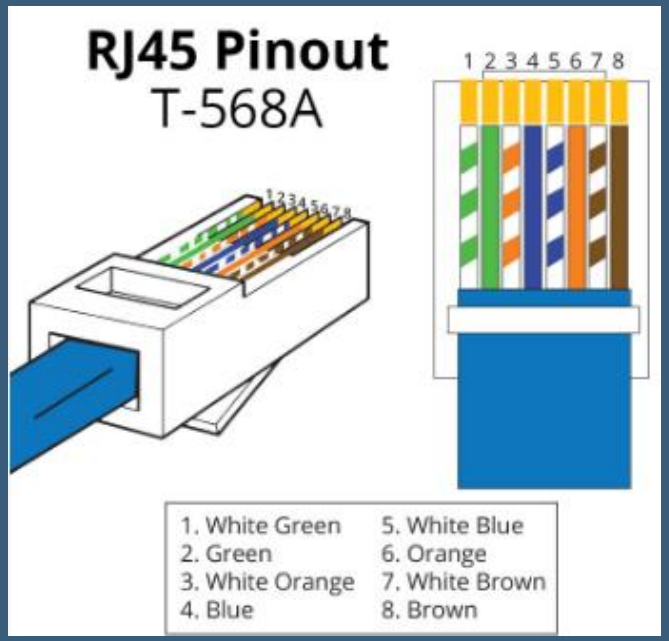
- Orange for transmit on pins 1, 2
- Green for receive on pins 3,6





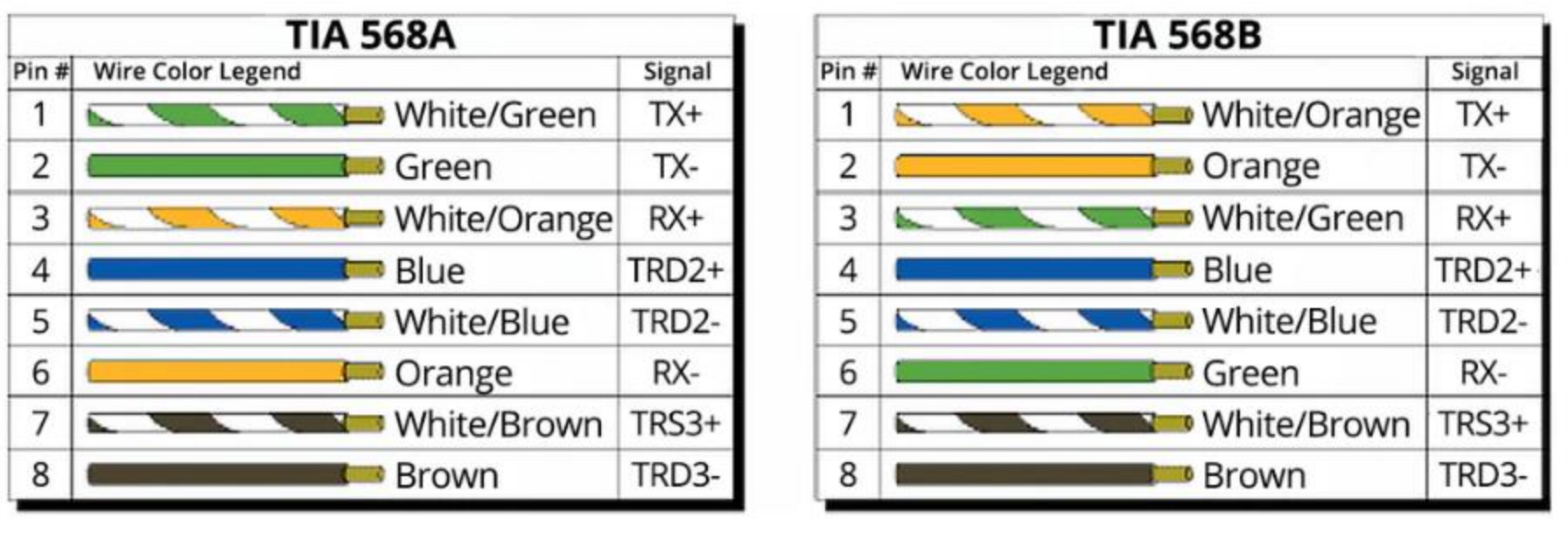
IEEE color code standard

2. Color code standard (T568A) in RJ 45
    1. white - green
    2. Green
    3. White - orang
    4. blue
    5. White - blue
    6. Orange
    7. White - brown
    8. brown



- Green for transmit on pins 1, 2
- Orange for receive on pins 3,6

IEEE color code standard



TIA 568A

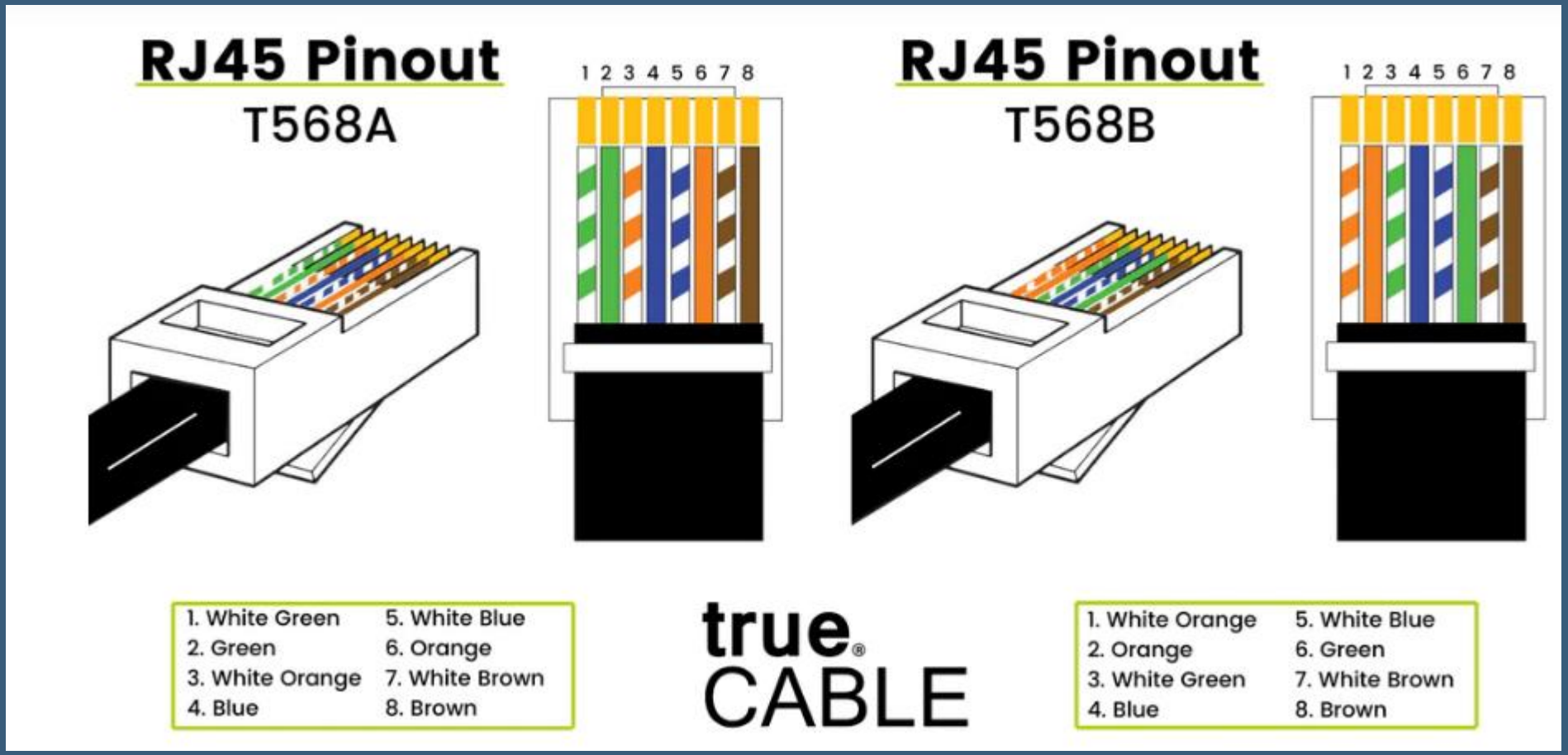
Pin #	Wire Color Legend	Signal
1	White/Green	TX+
2	Green	TX-
3	White/Orange	RX+
4	Blue	TRD2+
5	White/Blue	TRD2-
6	Orange	RX-
7	White/Brown	TRS3+
8	Brown	TRD3-

TIA 568B

Pin #	Wire Color Legend	Signal
1	White/Orange	TX+
2	Orange	TX-
3	White/Green	RX+
4	Blue	TRD2+
5	White/Blue	TRD2-
6	Green	RX-
7	White/Brown	TRS3+
8	Brown	TRD3-

Tx- means Transmit data ground
Rx- means Receive data ground

IEEE color code standard



Devices classification

	DTE (Data Terminal Equipment) (any End Device, Router)	DCE (Data Communication Equipment) (Hub , Switch, Access point)
TD	Pins 1,2	Pins 3,6
RD	Pins 3,6	Pins 1,2

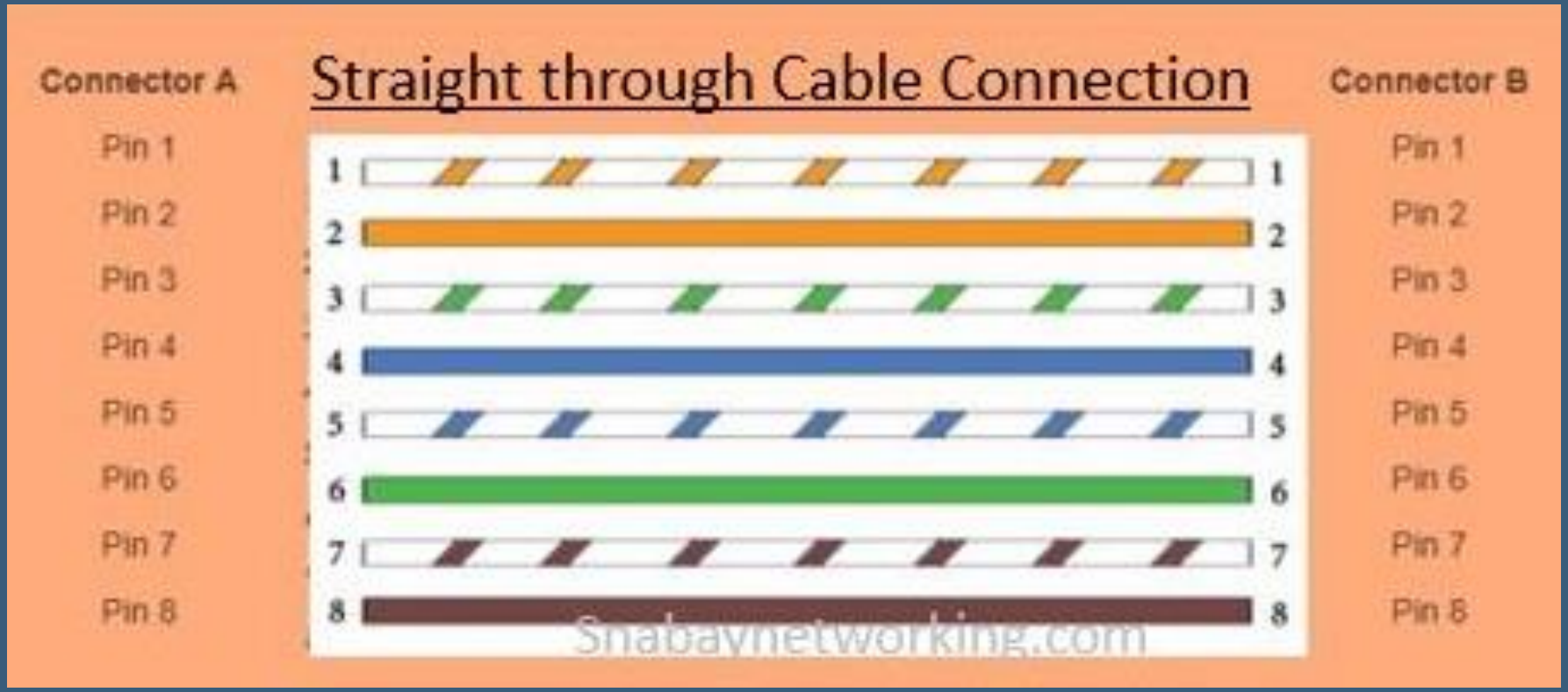
- DTE includes any device or unit that functions either as a source of or a destination for binary digital data.
- DTE devices are layer 3 or more

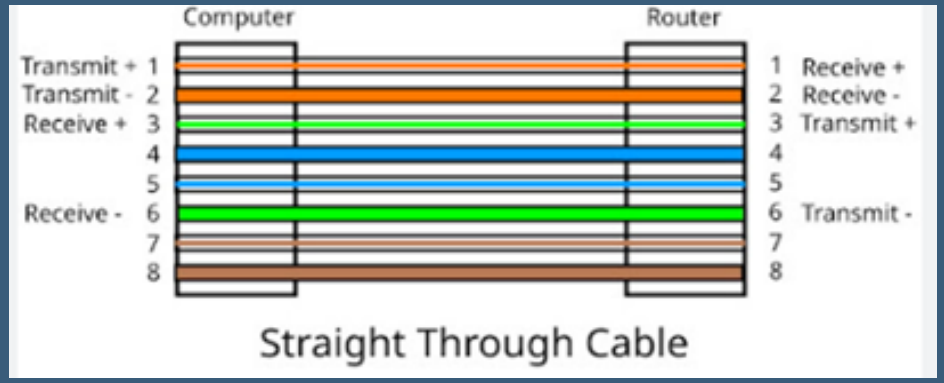
- DCE devices are layer 2 or less

Using UTP cable to connect devices

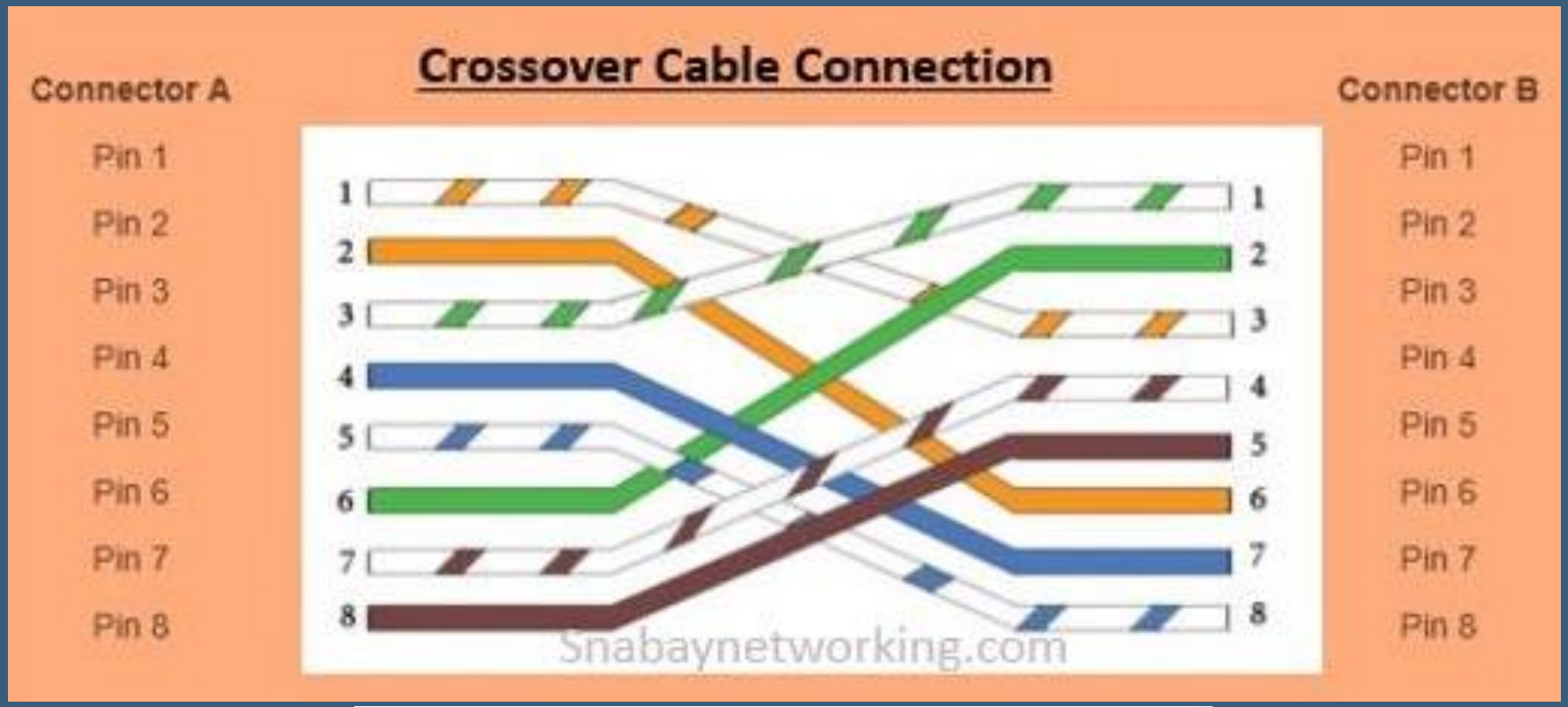
1. **Straight-through cable** :
    1. Cables have the same color code at both its ends.
    2. This type of connection used for connect any DTE with DCE
2. **Crossover cable** :
    1. Cables have reverse color code at both its ends.
    2. Used for connect two DTE with each other or two DCE with each other .
3. Roll over cable (Console cable):
    1. Cable has the color code at one end, and reverse color code at the other end.
    2. It used for console ports (configuration only)

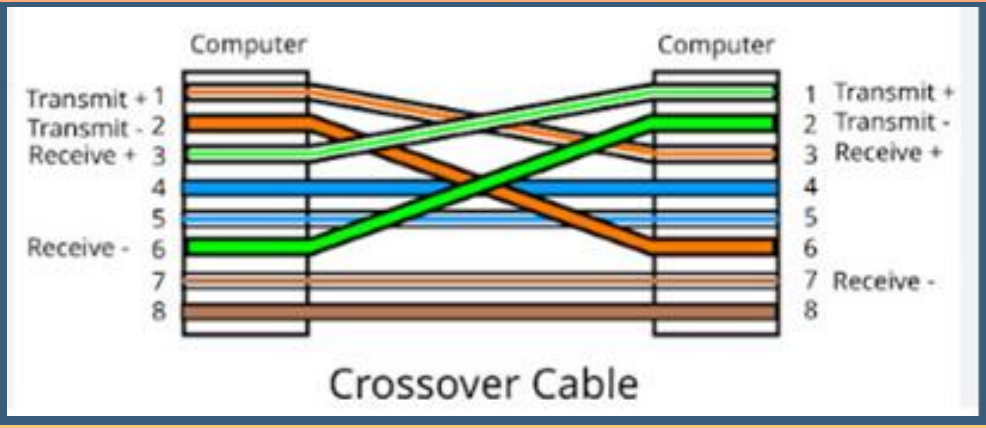
Straight-through Cable



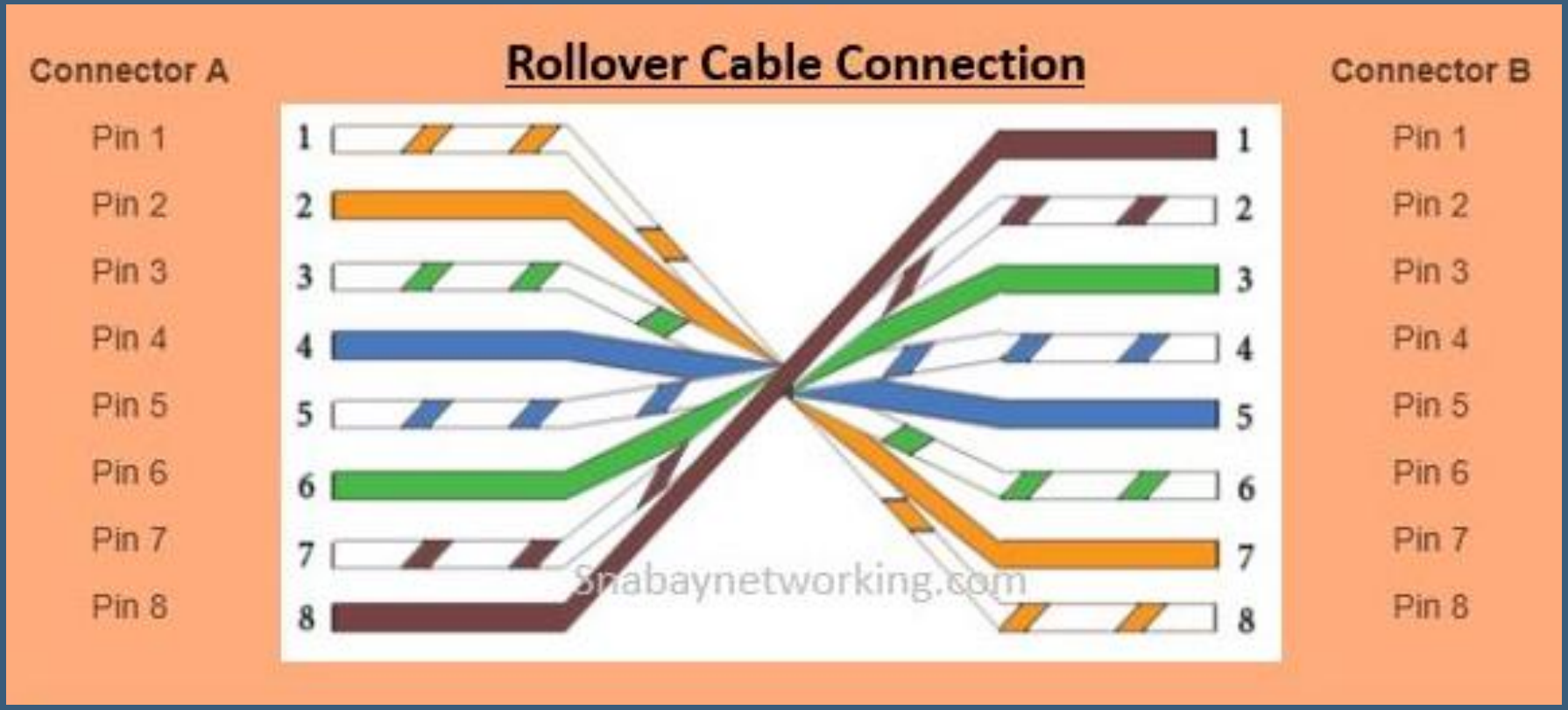


Crossover Cable





Rollover Cable



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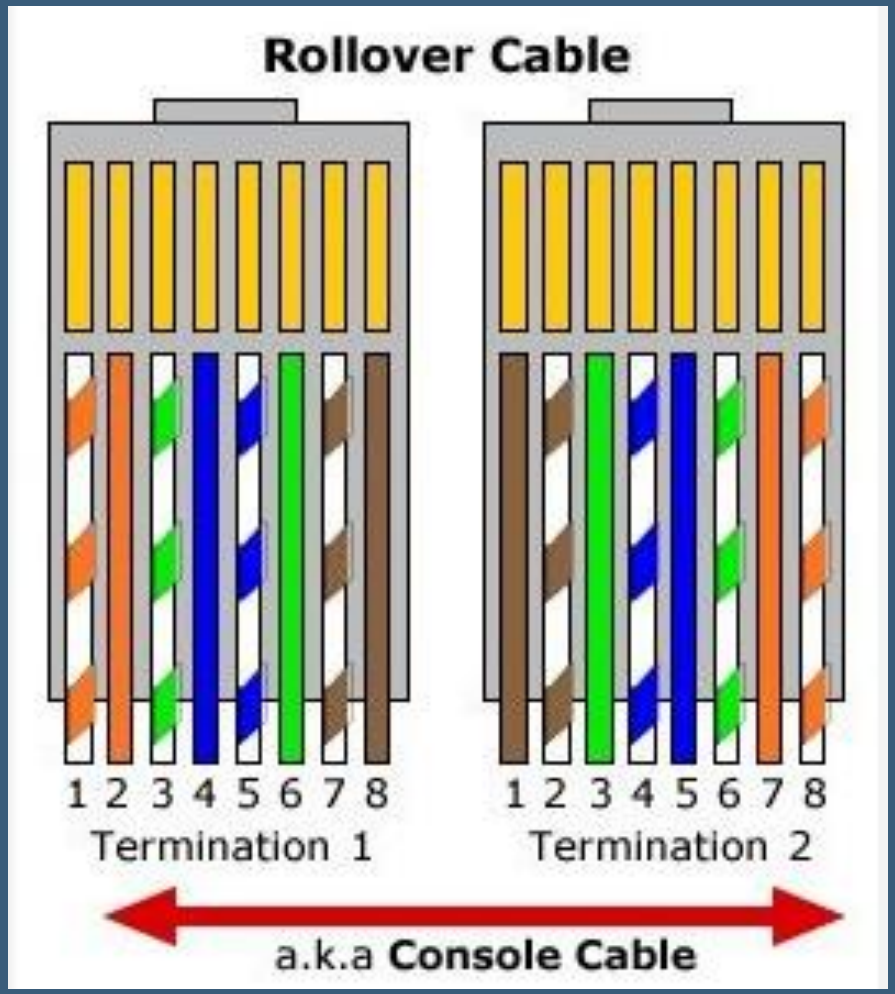
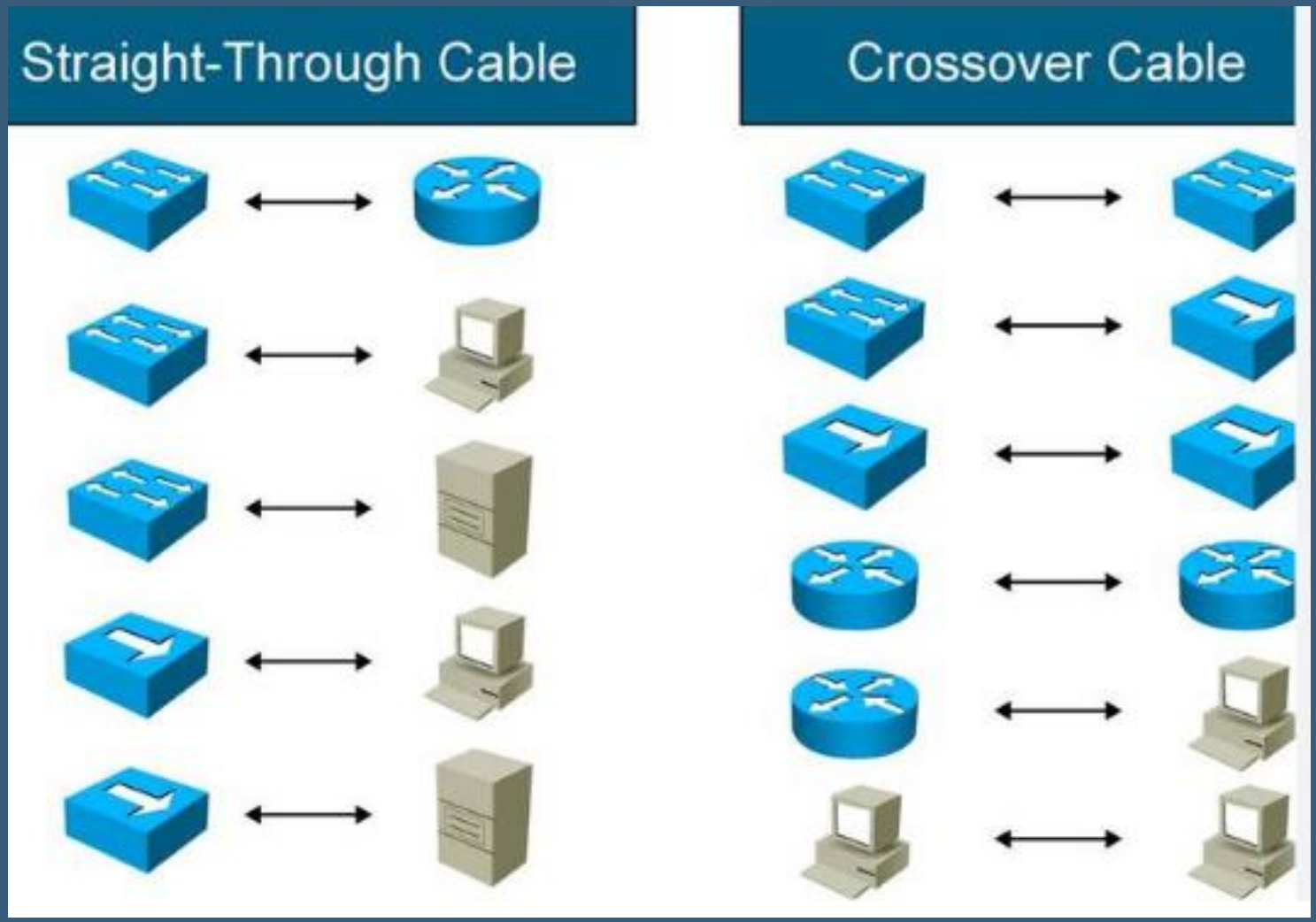


Using UTP cable to connect devices



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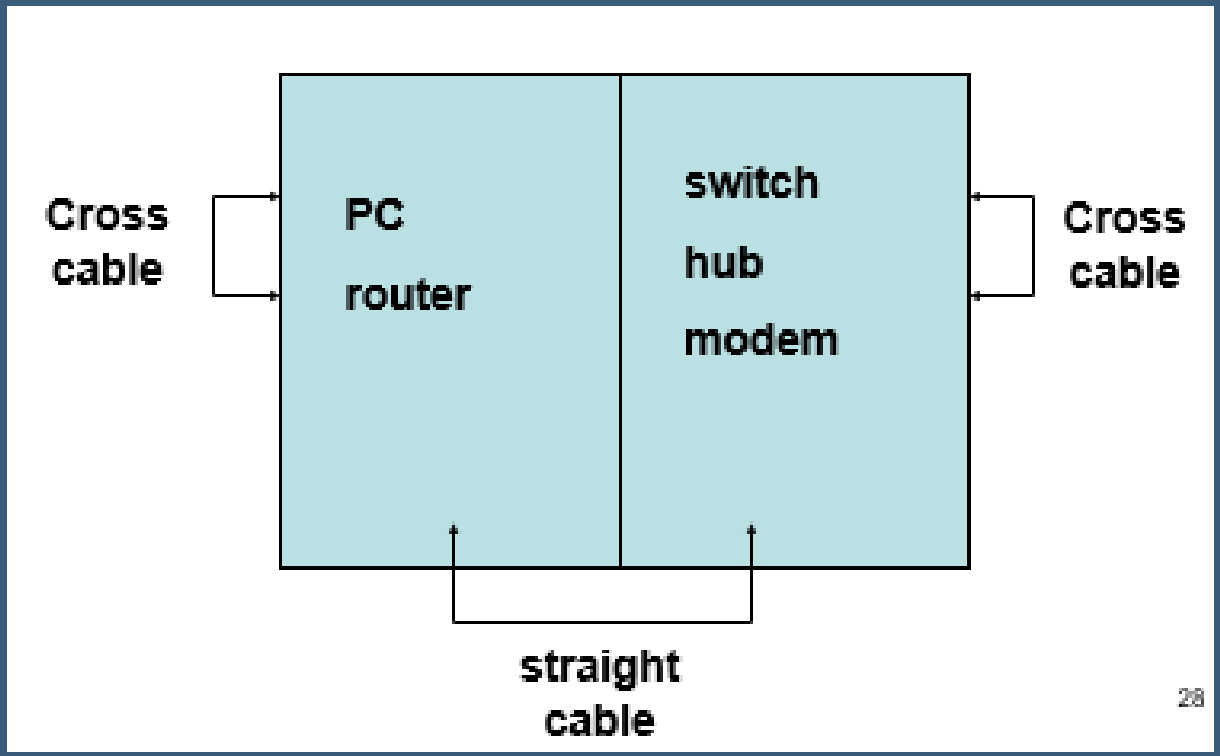
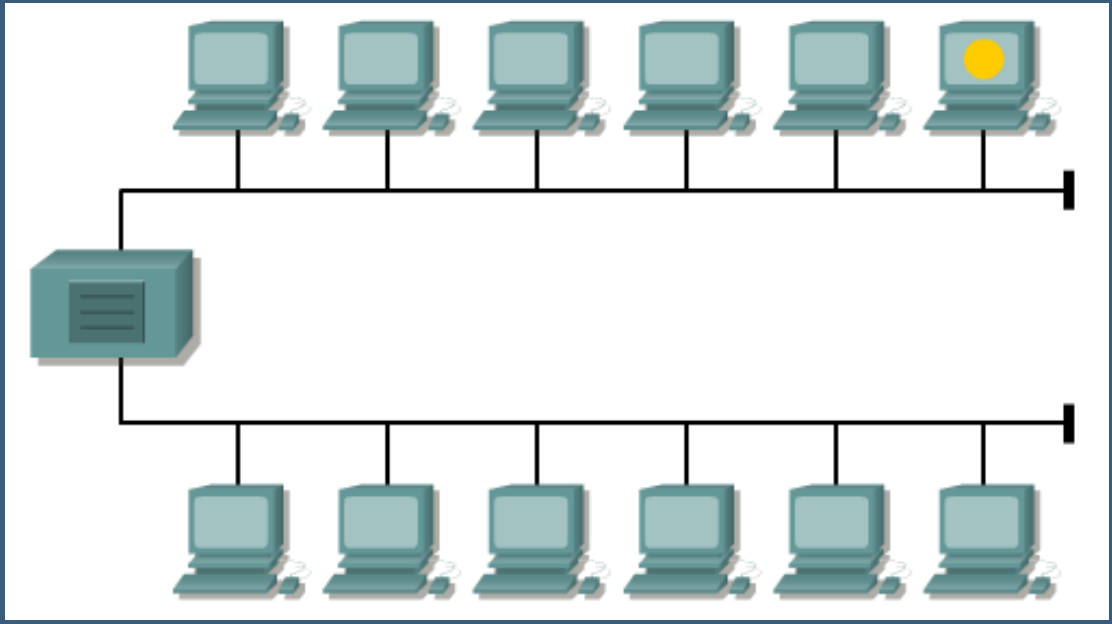


Layer 1 devices

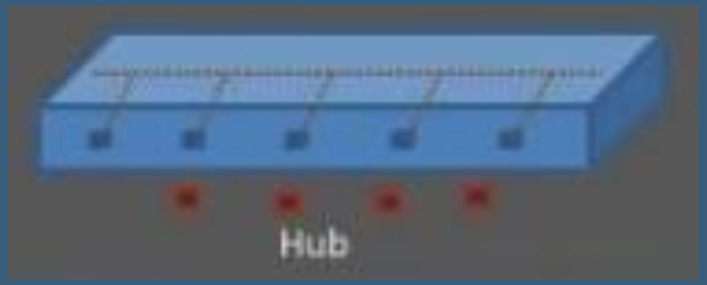
1. Repeater
   - A repeater is a network device used to regenerate a signal.
   - Repeaters regenerate analog or digital signals distorted by transmission loss due to attenuation.
   - No more than four repeaters can be used between hosts on a LAN.

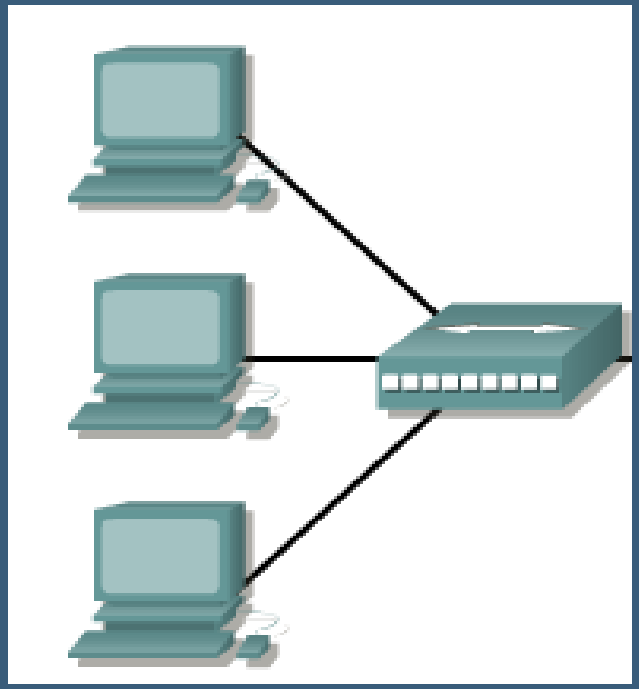


Layer 1 devices

2. Hub

- Multi port repeater
- Is a physically star topology device
- It floods data (i.e., Hubs takes data bits from input port and forward it to all other ports)





Layer 1 devices

- PDU is a unit of information that is sent by a protocol at a particular OSI Layer.

OSI Model	TCP/IP Model	PDU	Protocols	Network Devices
7. Application	Application	Data	HTTP, SMTP, FTP, Telnet, SSH, DNS, DHCP, POP, IRC, SMB	
6. Presentation			.jpg, .zip, ASCII, .mp3	
5. Session				
4. Transport	Transport	Segments	TCP, UDP Port Numbers	Layer 4 Switches
3. Network	Internet	Packets	IP Addresses Logical Addressing	Routers
2. Data Link	Network Access	Frames	MAC Addresses Physical Addressing	Nics, Switches, Bridges
1. Physical		Bits	Media, Medium	Nics, Hubs, Cables, Wires, Radiowaves

THANK YOU

For any questions feel free
to contact me by mail

Gh_mcs86@yahoo.com