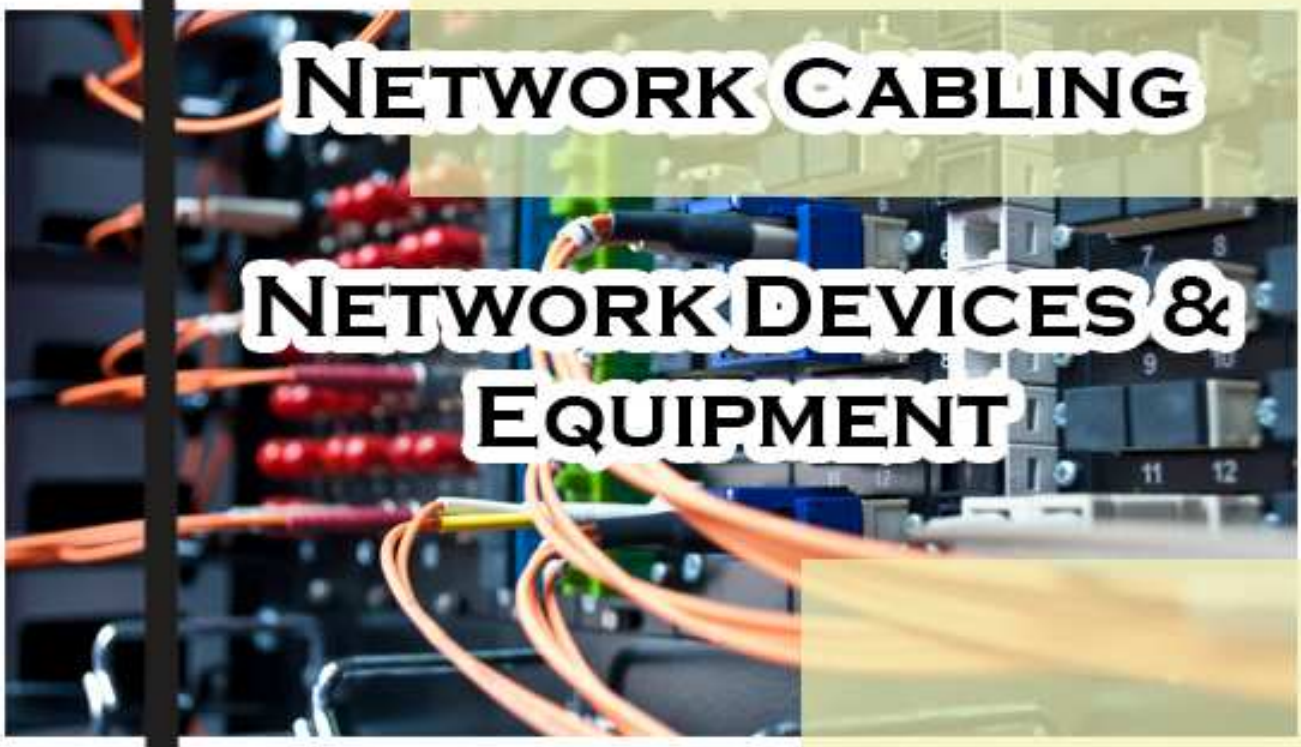
UNIT FIVE:



Network Cabling

Network Devices & Equipment

UNIT FIVE – NETWORK CABLING, DEVICES AND EQUIPMENTS

This unit describes the different network standards in terms of cabling, network devices and other equipments. This will be able to define the differences of network cables with its uses and differences in terms of transmission speed and also the different network devices and its functions.

Essential Questions:

- What are the different types and standards of network cables?
- How do they differ in terms of its functionality and performance?
- What are the different Network devices?
- How do those devices functions and how to maximize/implement into computer networks?

Intended Learning Outcomes:

- Identify network devices and equipment used to implement computer networks.

Diagnostic Assessment Tasks:

What do you think are the function/s of the following devices?

1. Hub
2. Switch
3. Router
4. Modem
5. Network Interface Card

LESSON:

NETWORK CABLING

The following are the different components that can be used on network cabling.

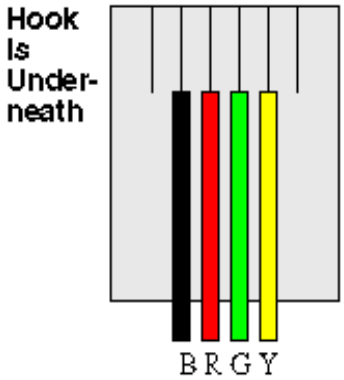
RJ (Registered Jack)

- Is a standardized telecommunication network interface for connecting voice and data equipment to a service provided by a local exchange carrier of long distance carrier.

RJ11

- The most widely implemented registered jack in telecommunications

RJ11 PIN CONFIGURATION



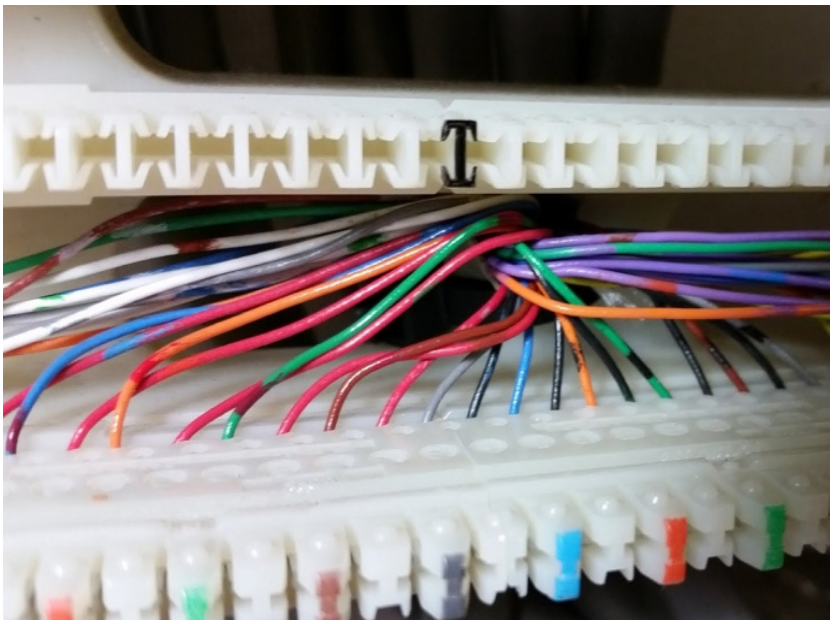
MULTI-PAIR UTP

- originally known as even-count color code, is a color code used to identify individual conductors in twisted-pair wiring for telecommunications.

Color Coding of 25 Pair Cable

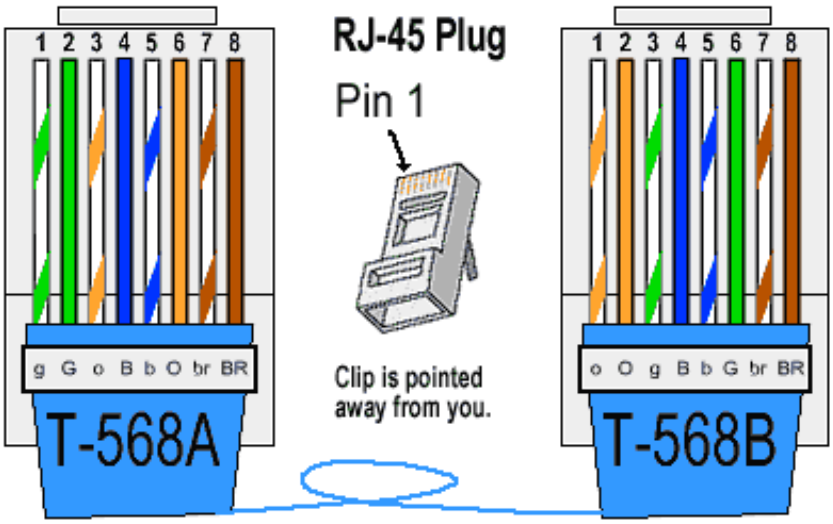
110 BLOCK

- is a type of punch block used to terminate runs of on-premises wiring in a structured cabling system.



RJ45

- a commonly-used name for the 8P8C modular connector used in Ethernet and other data links



SHIELDED RJ45

- Shielding - prevents interference
  e.g. EMI and RFI
- Grounding - Drains electrostatic from the cable preventing damage to equipment, has nothing to do with speed.

RJ45 RUBBER BOOT

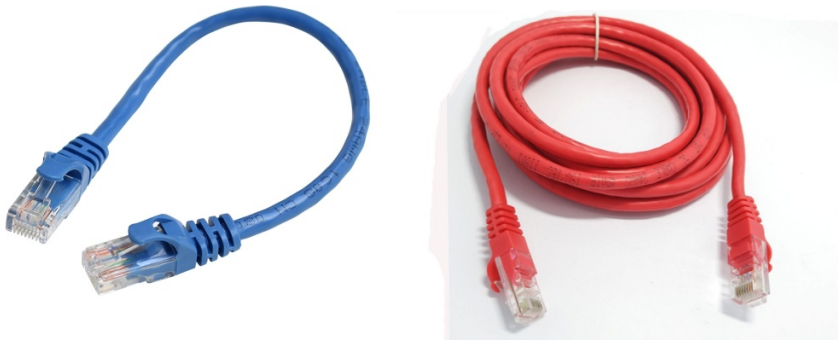
- **This rubber thing is known as "plug boot". A booted cable has the plug boot on the Ethernet patch cable end of the connector.**

Functions of RJ45 Boot

- **can prevent the connector clip from flipping up or even breaking off from the cable.**
- **is also a protection for your own nails.**
- **Prevent the clip on stucking on a bunch of cables when pulling.**

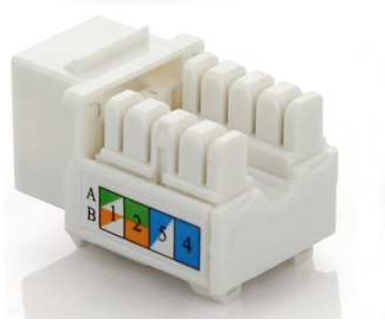
PATCH CABLE

- patch cord or patch lead is an electrical or optical cable used to connect ("patch in") one electronic or optical device



KEYSTONE MODULE

- is a standardized snap-in package for mounting a variety of low-voltage electrical jacks or optical connectors into a keystone wall plate, face plate, surface-mount box, or a patch panel.



FACEPLATE

- Data outlet, also referred to as a wall plate, outlet cover, or socket cove.
- Used with keystone module for connectivity of network on walls.

Single port faceplate Dual port faceplate

SURFACE MOUNTED BOX

PATCH PANEL

- patch bay, patch field or jack field is a device or unit featuring a number of jacks, usually of the same or similar type, for the use of connecting and routing circuits for monitoring, interconnecting, and testing circuits in a convenient, flexible manner.

OPEN BAY RACK

- Mounting rack for switches, patch panel and other networking devices.
- Unenclosed rack for devices.

SERVER RACK

- A 19-inch rack is a standardized frame or enclosure for mounting multiple electronic equipment modules. Each module has a front panel that is 19 inches (48.3 cm) wide.

DATA CABINET

NETWORK MEDIA TYPES

TWISTED-PAIR CABLE

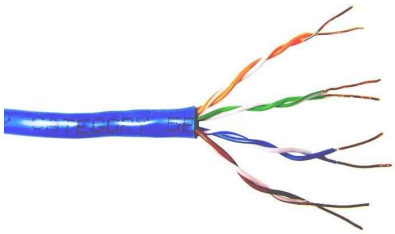
- *Twisted-pair cable* is a type of cabling that is used for telephone communications and most modern Ethernet networks.
- The pairs are twisted to provide protection against *crosstalk*, the noise generated by adjacent pairs.
- They also cancel out any outside magnetic fields.

UTP Cable

- UTP cable is a medium that is composed of pairs of wires; UTP cable is used in a variety of networks. Each of the eight individual copper wires in UTP cable \is covered by an insulating material. In addition, the wires in each pair are twisted around each other.

features of UTP cable:

- Speed and throughput—10 to 1000 Mbps
- Average cost per node—Least expensive
- Media and connector size—Small
- Maximum cable length—100 m (short)



Commonly used types of UTP cabling

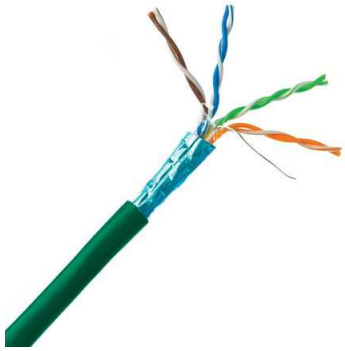
- **Category 1 -** Used for telephone communications. Not suitable for transmitting data.
- **Category 2 -** Capable of transmitting data at speeds up to 4 megabits per second (Mbps).
- **Category 3 -** Used in 10BASE-T networks. Can transmit data at speeds up to 10 Mbps.
- **Category 4 -** Used in Token Ring networks. Can transmit data at speeds up to 16 Mbps.
- **Category 5 -** Can transmit data at speeds up to 100 Mbps.
- **Category 5e -** Used in networks running at speeds up to 1000 Mbps (1 gigabit per second [Gbps]).
- **Category 6 -** Typically, Category 6 cable consists of four pairs of 24 American Wire Gauge (AWG) copper wires. Category 6 cable is currently the fastest standard for UTP.

UTP Categories - Copper Cable

UTP Category	Data Rate	Max. Length	Cable Type	Application
CAT1	Up to 1Mbps	-	Twisted Pair	Old Telephone Cable
CAT2	Up to 4Mbps	-	Twisted Pair	Token Ring Networks
CAT3	Up to 10Mbps	100m	Twisted Pair	Token Rink & 10BASE-T Ethernet
CAT4	Up to 16Mbps	100m	Twisted Pair	Token Ring Networks
CAT5	Up to 100Mbps	100m	Twisted Pair	Ethernet, FastEthernet, Token Ring
CAT5e	Up to 1 Gbps	100m	Twisted Pair	Ethernet, FastEthernet, Gigabit Ethernet
CAT6	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT6a	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT7	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (100 meters)

Shielded Twisted-Pair Cable

- cable combines the techniques of shielding, cancellation, and wire twisting. Each pair of wires is wrapped in a metallic foil.
- STP reduces electrical noise both within the cable (pair-to-pair coupling, or crosstalk) and from outside the cable (EMI and RFI).



FIBER OPTICS

- One of the latest transmission medium for telecommunication.
- It utilizes lightwave transmission to carry/send information.

Advantages over other Media

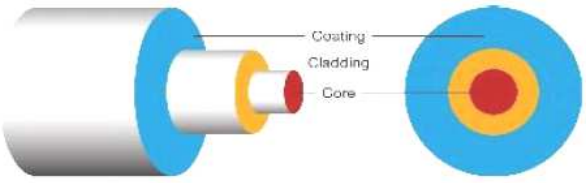
- Large Bandwidth. Can handle several Gbps/Tbps
- Smaller-diameter, lighter weight cables
- Negligible Crosstalk
- Immunity to inductive interferences
- High quality transmission at long distance

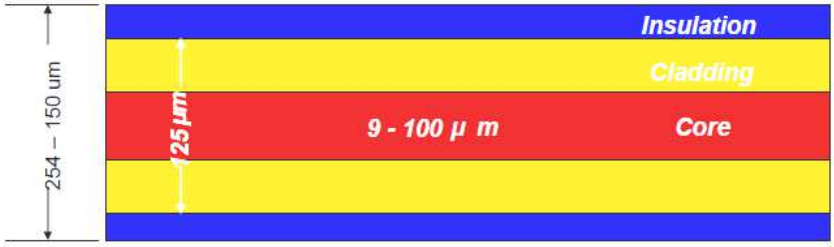
Limitations

- Cabling, splicing, and connecting fibers; expertise is required
- Non-conductor
- High cost in low bandwidth applications

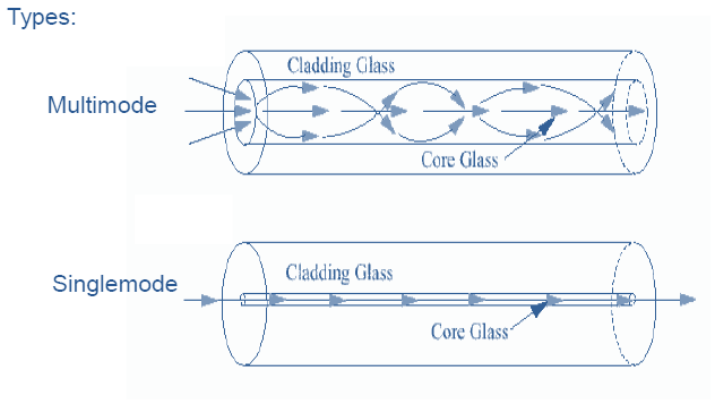
FIBER OPTICS PROPERTIES

Elements:





Types of Fiber Optic (Mode)



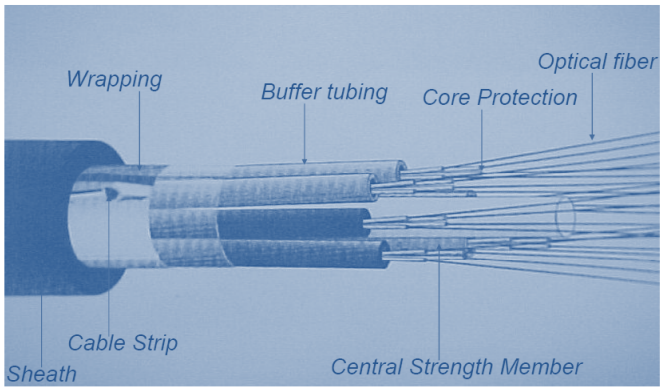
INTERFACE TYPE - MULTIMODE

INTERFACE TYPE	WAVELENGTH (NM)	FIBERS SUPPORTED	REACH in meters
1000BASE-SX	850	FDDI-grade, OM1, OM2 & OM3	220 – 550
1000BASE-LX	1300	FDDI-grade, OM1, OM2 & OM3	550
10GBASE-SR	850	FDDI-grade, OM1, OM2 & OM3	26 - 300
10GBASE-LX4	1300	FDDI-grade, OM1, OM2 & OM3	300
10GBASE-LRM	1300	FDDI-grade, OM1, OM2 & OM3	220

INTERFACE TYPE – SINGLE MODE

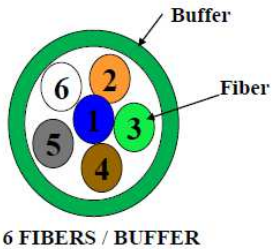
INTERFACE TYPE	WAVELENGTH (NM)	TYPICAL REACH* (KM)
1000BASE-LX 1000BASE-BX 10GBASE-LR 10GBASE-LW 10GBASE-LX4	1310	10
10GBASE-ER	1550	30-40
1000BASE-ZX 10GBASE-ZR	1550	80-100
CWDM	1470 to 1610	80-120
DWDM	1530 to 1565	80-100

Optical Fiber Cable Construction

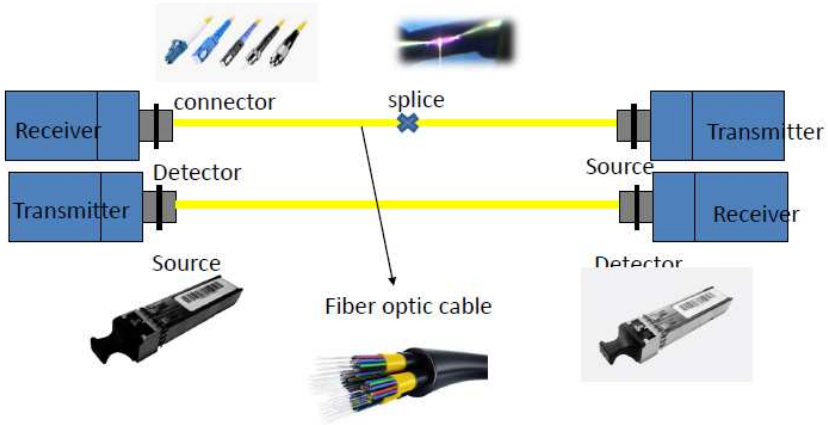


➢ **A buffer can consists of 4 fibers, 6 fibers or 12 fibers depending on cable size**

Fiber/Buffer no.	Fiber/Buffer color
1	Blue
2	Orange
3	Green
4	Brown
5	Gray
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink
12	Aqua Blue



6 FIBERS / BUFFER



NETWORK DEVICES

Repeater

- In telecommunications, a repeater is an electronic device that receives a signal and retransmits it.

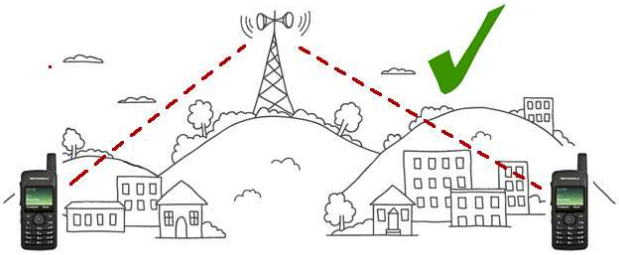
Types of Repeater

- Telephone Repeater - is an amplifier in a telephone line
- Optical Repeater - is an optoelectronic circuit that amplifies the light beam in an optical fiber cable
- Radio Repeater - a radio receiver and transmitter that retransmits a radio signal.

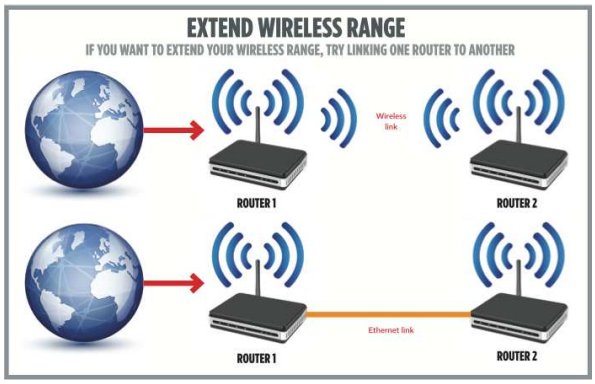
Telephone Repeater

Signal Booster

Radio Repeater



WiFi Repeater/Extender



Optical Repeater

Wired Network Repeater

HUB

- also called a network hub, is a common connection point for devices in a network.
- In a hub, a frame is passed along or "broadcast" to every one of its ports. It doesn't matter that the frame is only destined for one port.
- The hub has no way of distinguishing which port a frame should be sent to. Passing it along to every port ensures that it will reach its intended destination.

SWITCH

- also called switching hub.
- It is a networking hardware that connects devices on a computer network by using packet switching to receive, and forward data to the destination device.

Types of Switch

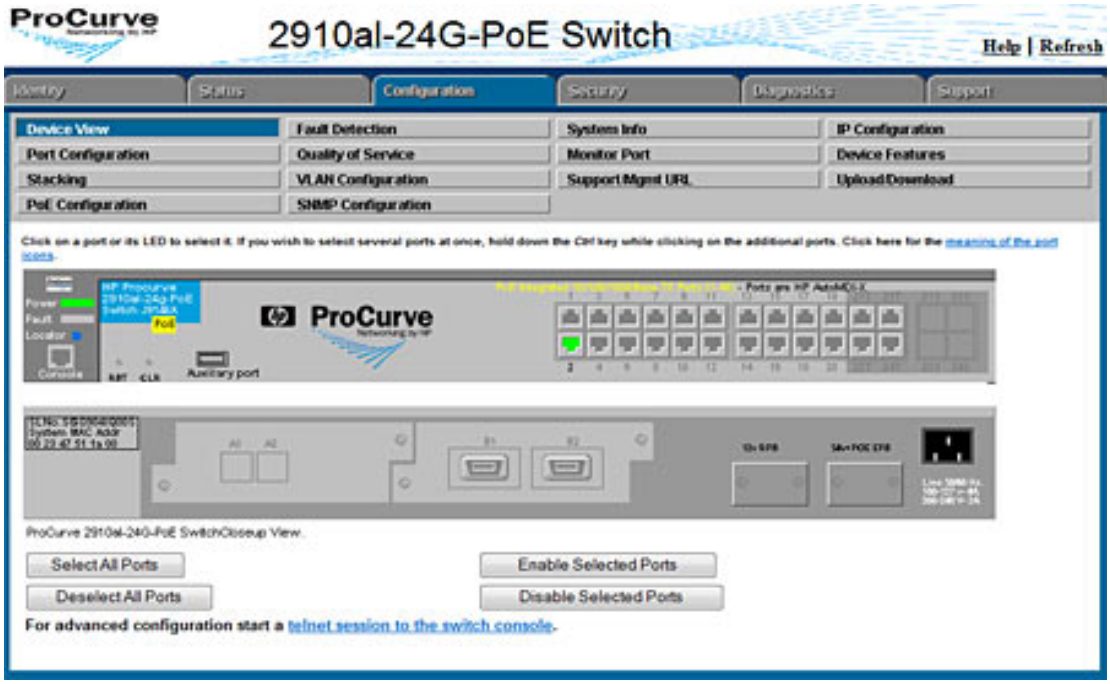
- Unmanaged Switch - are frequently used in home networks, small companies and businesses.
  - It does not necessarily need to be configured or watched.
- Managed Switch - the advantage of managed switches is that they can be customized to enhance the functionality of a certain network.
  - They offer some features like QoS & SNMP and so on.

Considerations for Network Switches

- Number of Ports – 8/16/24
- Speed - (10/100/1000/10000 Mbps)
- POE vs Non-POE - allows you to power a device like an IP phone or wireless access point over the same cable as your data traffic.
- Rackmountable vs Desktop Switch

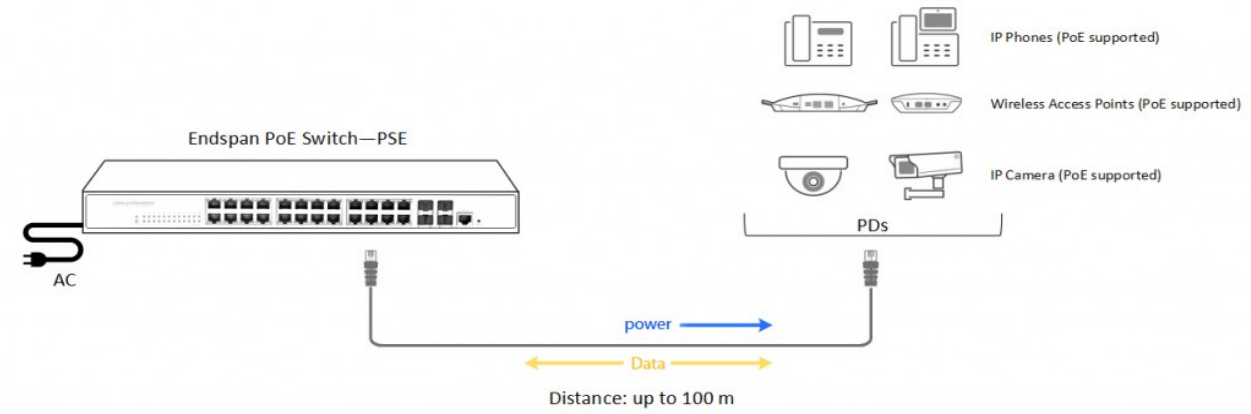
Unmanaged Switches

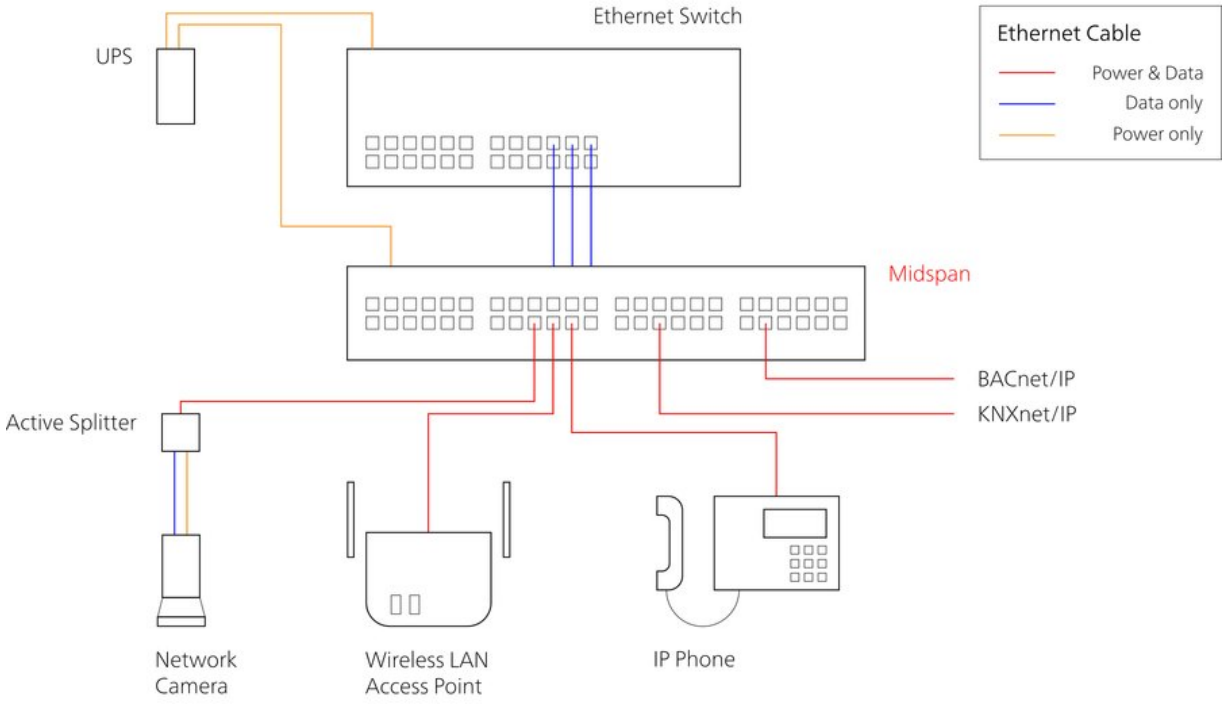
Managed Switch



POE Switch

- This allows a single cable to provide both data connection and electric power to devices such as wireless access points, IP cameras, and VoIP phones.




Ethernet Switch
UPS
Ethernet Cable
Power & Data
Data only
Power only
Midspan
BACnet/IP
KNXnet/IP
Active Splitter
Network Camera
Wireless LAN Access Point
IP Phone

Desktop Network Switch

Rackmountable Switch

BRIDGE

- A network bridge, also known as an Ethernet bridge, connects two segments of a network together.
- The purpose of the bridge is to divide a network into manageable sections.
- Avoids collision among segments.

ROUTER

- is a networking device that forwards data packets between computer networks.
- Perform the traffic directing functions on the Internet.

Router can act as:

a. Switch
b. DHCP Server
c. Wireless Access Point

FIBER MEDIA CONVERTER

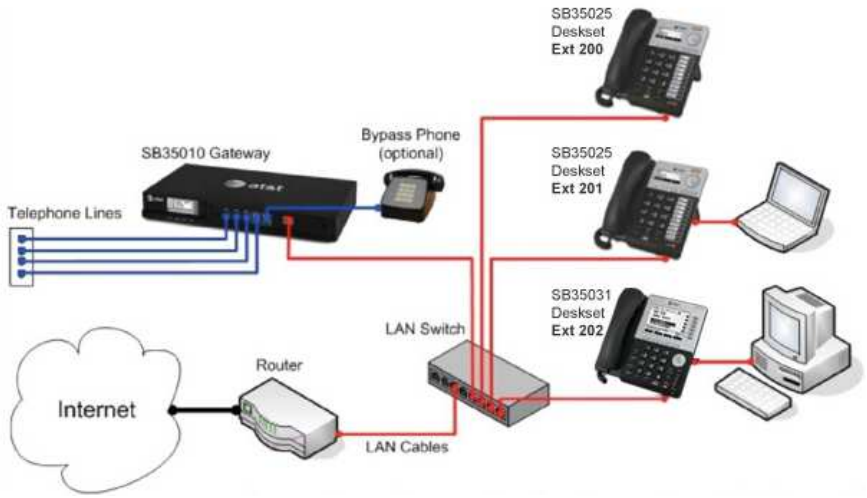
- is a simple networking device that makes it possible to connect two dissimilar media types such as twisted pair with fiber optic cabling.

PABX

- Private Automatic Brach Exchange - is an automatic telephone switching system within a private enterprise.

VOIP

- Voice Over IP - also called IP telephony, is a method and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet.



NAS STORAGE

- Network-Attached Storage - is dedicated file storage that enables multiple users and heterogeneous client devices to retrieve data from centralized disk capacity.
- Each NAS resides on the LAN as an independent network node, defined by its own unique Internet Protocol (IP) address.

Considerations on Purchasing NAS Device

- Storage Space
- Costs
- To RAID or not to RAID
- Number of hard drives
- Aethetics
- Reputation

CCTV

- Closed-Circuit TeleVision - also known as video surveillance, is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors.

Considerations on Purchasing CCTV System

- Quality and Output Resolution
- Retention Period
- Location of Installation
- Knowing what to cover

Dome Type

Bullet Type

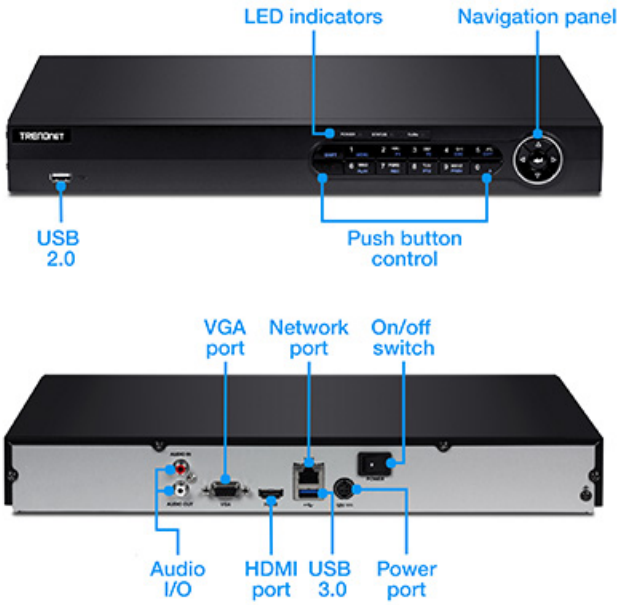
PTZ Camera – Pan/Tilt/Zoom

Analog CCTV

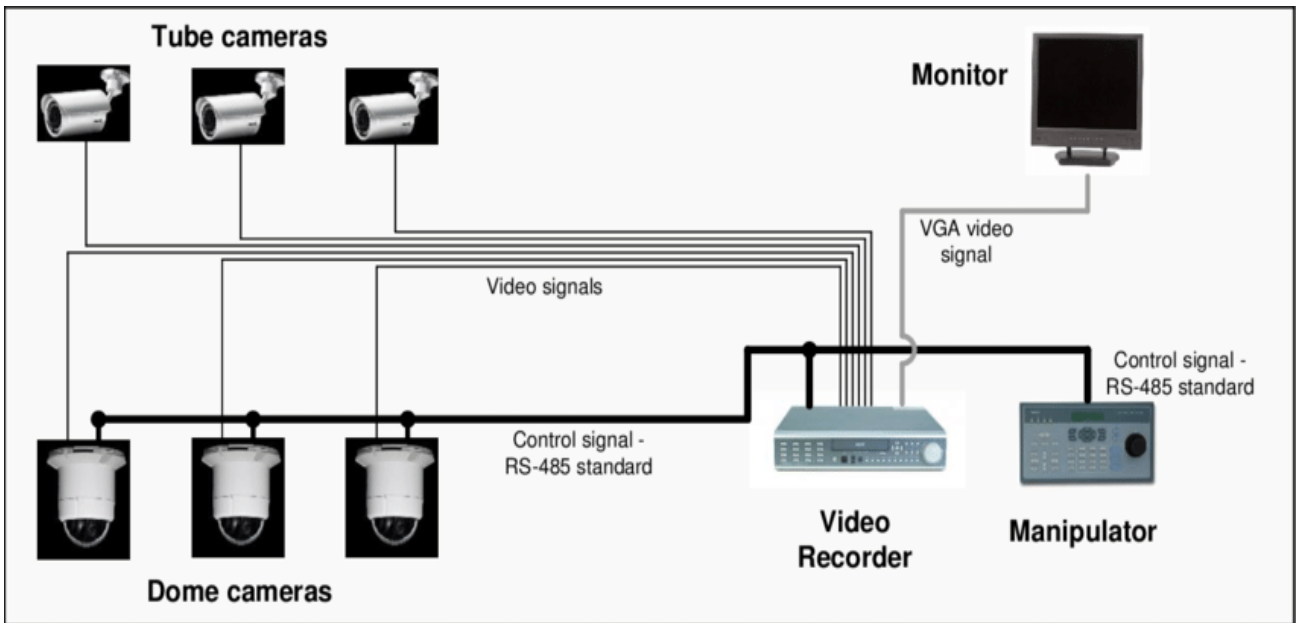
Digital IP CCTV

NVR

- Network Video Recorder - is a specialized computer system that includes a software program that records video in a digital format to a disk drive, USB flash drive, SD memory card or other mass storage device.



CCTV DIAGRAM



Considerations on Purchasing CCTV System

- **Quality and Output Resolution**
- **Retention Period**
- **Location of Installation**
- **Knowing what to cover.**

SERVER

- is a computer, a device or a program that is dedicated to managing network resources.
- Servers are often referred to as dedicated because they carry out hardly any other tasks apart from their server tasks.

Consideration on Purcahsing Dedicated Servers

- Budget
- Space
- Storage
- Memory capacity
- CPU support
- Connectivity
- Management

Tower Server

- is a computer intended for use as a server and built in an upright cabinet that stands alone.

Rackmount Server

- is a type of hardware that is placed in a downright horizontal rack, rather than in an upright tower server system.
- It provides the ability to install more than one server within a single rack-mount server chassis or casing.

BIOMETRICS

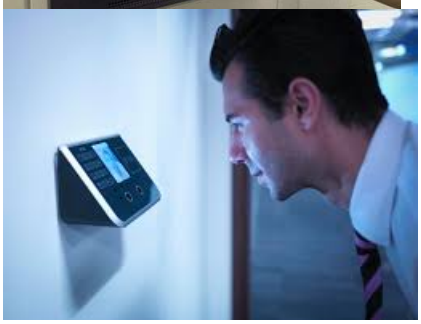
- Biometric identification authenticates secure entry, data or access via human biological information such as fingerprints.
- e.g. Time and Attendance
  Door Access Lock

Fingerprint Scanner

RFID

Palm Scanner

Face Recognition



LABORATORY 5

STRAIGHT THROUGH CABLE

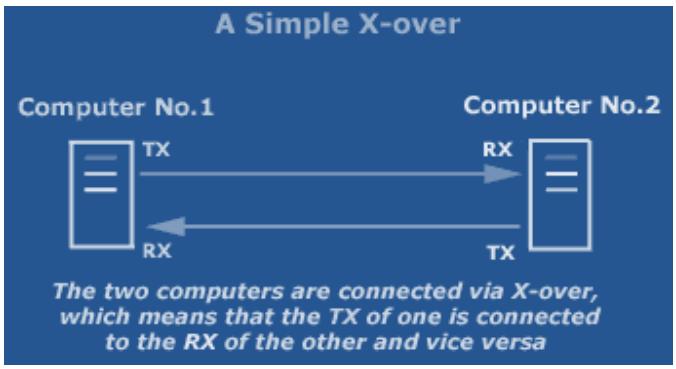
- The most common application for a straight through cable is a connection between a PC and a hub/switch

CROSS-OVER CABLE

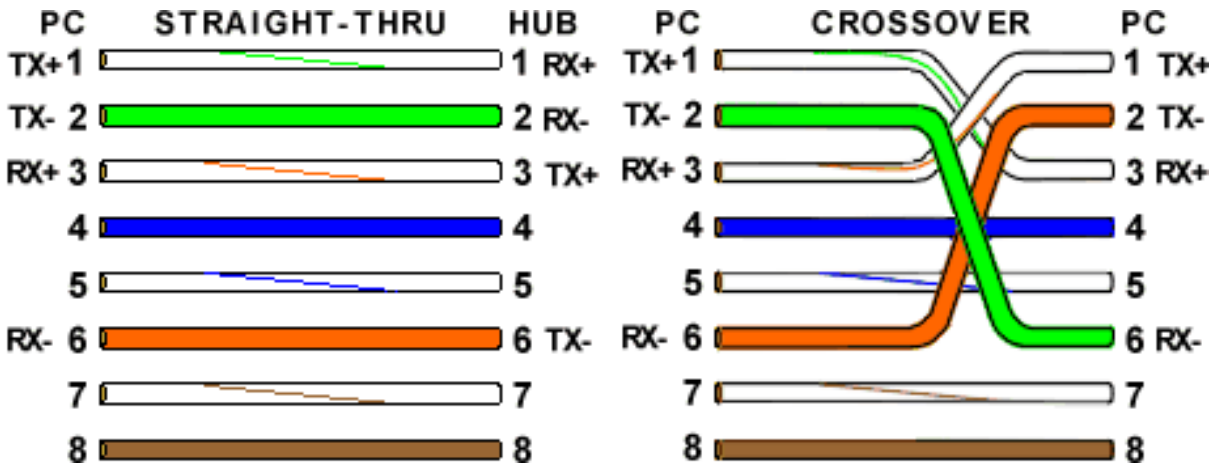
(To connect two computers – peer-to-peer networking)

CAT 5 UTP Cross Over Cable

The Cross-Over (x-over) cable allows us to connect two computers without needing a hub or switch. When sending or receiving data between two devices. e.g computers, one will be sending while the other receives.



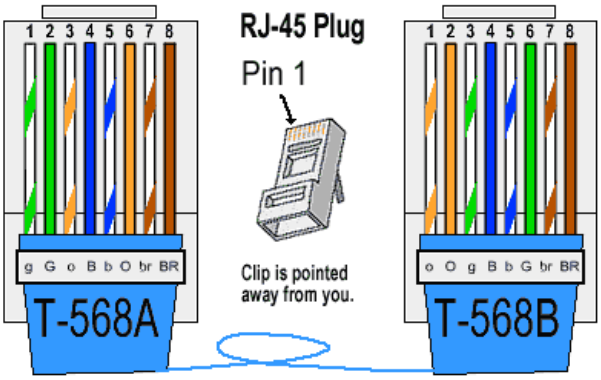
COLOR CODING



BUILDING A CROSS-OVER CABLE

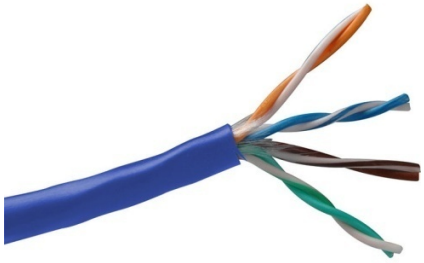
For x-over cable, use T-568A on one side of the cable and T-568B on the other side of the cable as shown on the diagram of pin assignment.

RJ45 Pin Assignment



Step 1 – Strip cable end

- Strip 1 – 1½" of insulating sheath
- Avoid cutting into conductor insulation

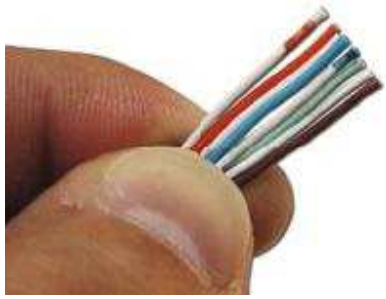


Step 2 – Untwist wire ends

- Sort wires by insulation colors

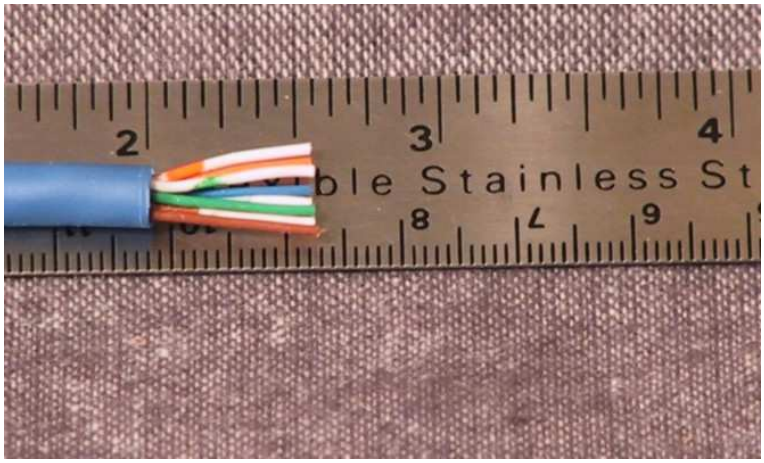
Step 3 – Arrange wires

- Arrange wires according to its color coding. Since it is a cross-over cable, use T568A on one side and T568B on the other side.



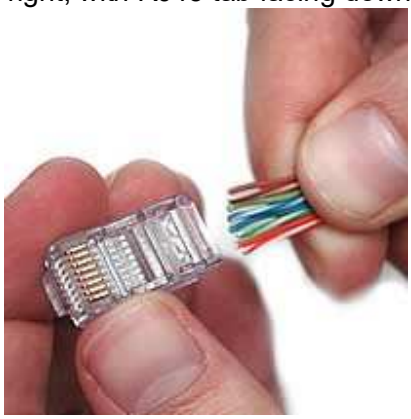
Step 4 – Trim wires to size

- Trim all wires evenly
- Leave about ½" of wires exposed



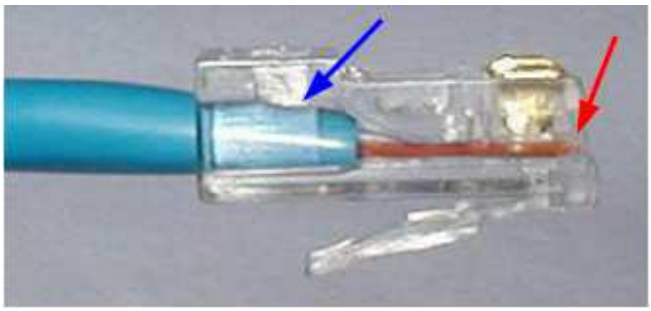
Step 5 – Attach connector

- Maintain wire order, left-to-right, with RJ45 tab facing downward



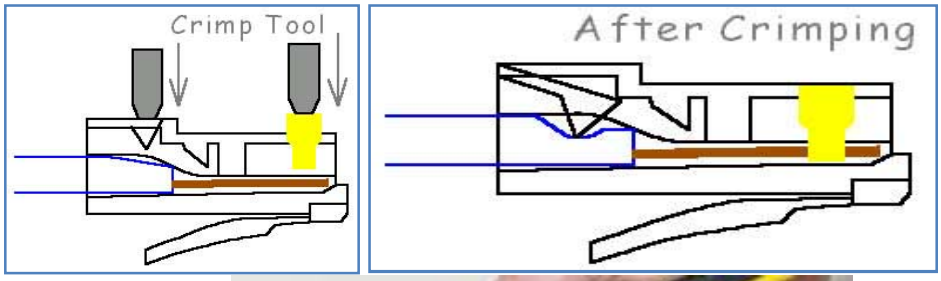
Step 6 – Check

- Do all wires extend to end?
- Is sheath well inside connector?



Step 7 – Crimp

- Squeeze firmly to crimp connecter onto cable end (8P)



Step 8 – Test

- Check if the cable works.

Formative Task

1. **What are the known cable/s used in networking and telecommunication?**
2. **What are the different devices, connectors, and tools used in networking.**

ASSESSMENT TASK

1. List down the network devices, cables, and equipments that falls under the following categories.

CABLES	STORAGE
SERVERS	**DATA CENTER/MDF/IDF**
BIOMETRICS	**COMMUNICATION**

2. What are the advantages of fiber-optic cabling?
3. What is the purpose of having the wires twisted inside the UTP Cable?

REFERENCE

ComputerNetworkingNotes. (2019, November 06). Network Cable Types and Specifications. Retrieved June 28, 2020, from https://www.computernetworkingnotes.com/networking-tutorials/network-cable-types-and-specifications.html

Curt M. White (2016) Data Communications & Computer Networks (A Business User's Approach) 8th Edition (p. 175). Cengage.

Ultimate Handyman. (2014, July 5). How to crimp a network cable [Video]. Youtube https://www.youtube.com/watch?v=LXcbZ_l5E0U