Department of
Computer Science and Engineering

Title: Study of LAN transmission media's, topologies, interconnection devices & LAN standards and practically implement the cross-wired cable and straight through cable using clamping tool.

Data Communication Lab

CSE 308

Green University of Bangladesh

1 Objective(s)

- To familiar with different types of transmission media.
- To familiar interconnection devices & LAN standards.
- To gain practical knowledge on cable clamping.

2 Problem analysis

Transmission media is a communication channel that carries the information from the sender to the receiver. It is a physical path between transmitter and receiver in data communication. In a copper-based network, the bits in the form of electrical signals. In a fibre based network, the bits in the form of light pulses. Transmission Media is broadly classified into the following types:

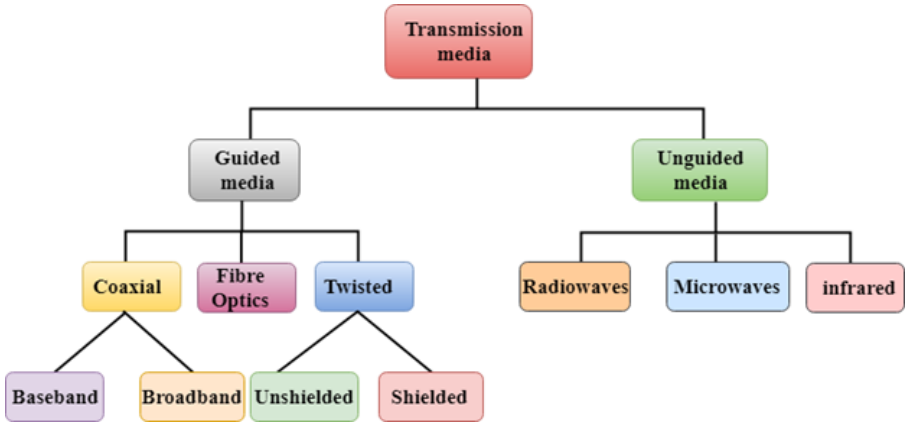

Figure 1: Different types transmission media

2.1 Guided Media

It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.
Features:

- High Speed
- Secure
- Used for comparatively shorter distances
- **Twisted pair:**
  It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

  1. Unshielded Twisted Pair (UTP): UTP consists of two insulated copper wires twisted around one another. This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.
  Features:

  – Least expensive
  – Easy to install
  – High-speed capacity
  – Lower capacity and performance in comparison to STP
  – Short distance transmission due to attenuation

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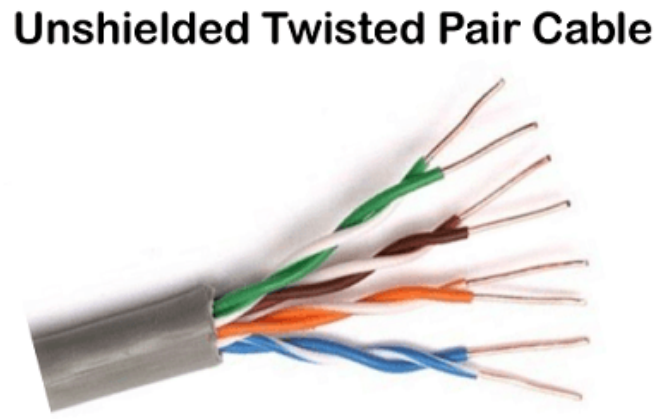

Figure 2: Unshielded Twisted Pair (UTP) cable

2. Shielded Twisted Pair (STP):
This type of cable consists of a special jacket (a copper braid covering or a foil shield) to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.
Features:

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster
- Comparatively difficult to install and manufacture
- More expensive

Figure 3: Shielded Twisted Pair (UTP) cable

- **Coaxial Cable:** It has an outer plastic covering containing an insulation layer made of PVC or Teflon and 2 parallel conductors each having a separate insulated protection cover. The coaxial cable transmits information in two modes: Baseband mode(dedicated cable bandwidth) and Broadband mode(cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.

- **Optical Fiber Cable:** It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for

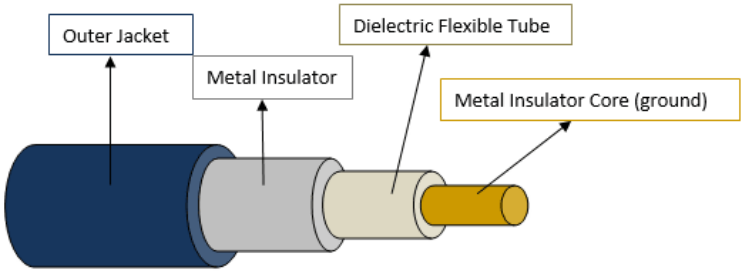

Figure 4: Coaxial Cable

the transmission of large volumes of data. The cable can be unidirectional or bidirectional. The WDM (Wavelength Division Multiplexer) supports two modes, namely unidirectional and bidirectional mode.

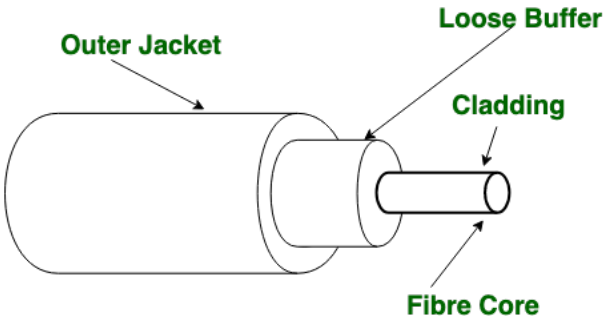

Figure of Optical Fibre Cable

2.2 Unguided Media

It is also referred to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.The features are given below:

- The signal is broadcasted through air
- Less Secure
- Used for larger distances

1. Radio waves:
These are easy to generate and can penetrate through buildings. The sending and receiving antennas need not be aligned. Frequency Range:3KHz – 1GHz. AM and FM radios and cordless phones use Radio waves for transmission.
2. Microwaves:
It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range:1GHz – 300GHz. These are majorly used for mobile phone communication and television distribution.
3. Infrared:
Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range:300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.

3 Interconnection Devices

Network devices, or networking hardware, are physical devices that are required for communication and interaction between hardware on a computer network.

- **NIC:** NIC or network interface card is a network adapter that is used to connect the computer to the network. It is installed in the computer to establish a LAN. It has a unique id that is written on the chip, and it has a connector to connect the cable to it. The cable acts as an interface between the computer and router or modem. NIC card is a layer 2 device which means that it works on both physical and data link layer of the network model.
- **Repeater:** A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.
- **Hub:** A hub is basically a multi-port repeater. A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations. Hubs cannot filter data, so data packets are sent to all connected devices. In other words, the collision domain of all hosts connected through Hub remains one. Also, they do not have the intelligence to find out the best path for data packets which leads to inefficiencies and wastage.
- **Bridge:** A bridge operates at the data link layer. A bridge is a repeater, with add on the 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. It has a single input and single output port, thus making it a 2 port device.
- **Switch:** A switch is a multi-port bridge with a buffer and a design that can boost its efficiency(a large number of ports imply less traffic) and performance. A switch is a data link layer device. The switch can perform error checking before forwarding data, which makes it very efficient as it does not forward packets that have errors and forward good packets selectively to the correct port only. In other words, the switch divides the collision domain of hosts, but broadcast domain remains the same.
- **Routers:** A router is a device like a switch that routes data packets based on their IP addresses. The 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. Router divide broadcast domains of hosts connected through it.
- **Gateway:** A gateway, as the name suggests, 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. Gateways are generally more complex than switches or routers. Gateway is also called a protocol converter.
- **Brouter:** It is also known as the bridging router is a device that combines features of both bridge and router. It can work either at the data link layer or a network layer. Working as a router, it is capable of routing packets across networks, and working as the bridge, it is capable of filtering local area network traffic.

4 LAN Standards

Each network has its own rules and standards. Therefore, protocols are use in network technology to govern the communication between network and network. There are many different kinds of protocols, the most common protocol used in the OSI data link layer in LAN are Ethernet and Token Ring.

- **Ethernet:**
  Ethernet is the most well-known type of local area network that most widely installed in offices, home offices and companies. The standard of an Ethernet is IEEE 802.3. Ethernet normally are used coaxial cable and sometimes different grades of twisted-pair cable as the transmission medium.
- **Token Ring:**
  Token Ring is a network that connects computers in a star or ring topology. It is originally developed by IBM Company. There will have a token ring that passed through the network to allow computers to access the network. The standard for Token Ring network is IEEE 802.5. A token bit will move around the ring from computer to another computer. If the computer wants to transmit a data, the data will attach to

the token and pass to the next computer. It has to keep passing through computers in the network until it comes to the destination. If the computer doesn't want to transmit any data, the token ring will just pass to the next computer.

5 cable clamping

To do these practically following steps should be done:

- Start by stripping off about 2 inches of the plastic jacket off the end of the cable. Be very careful at this point, as to not nick or cut into the wires, which are inside. Doing so could alter the characteristics of your cable, or even worse render is useless. Check the wires, one more time for nicks or cuts. If there are any, just whack the whole end off, and start over.
- Spread the wires apart, but be sure to hold onto the base of the jacket with your other hand. You do not want the wires to become untwisted down inside the jacket. Category 5 cable must only have 1/2 of an inch of 'untwisted' wire at the end; otherwise it will be 'out of spec'. At this point, you obviously have ALOT more than 1/2 of an inch of un-twisted wire.
- You have 2 end jacks, which must be installed on your cable. If you are using a pre-made cable, with one of the ends whacked off, you only have one end to install - the crossed over end. Below are two diagrams, which show how you need to arrange the cables for each type of cable end. Decide at this point which end you are making and examine the associated picture below.

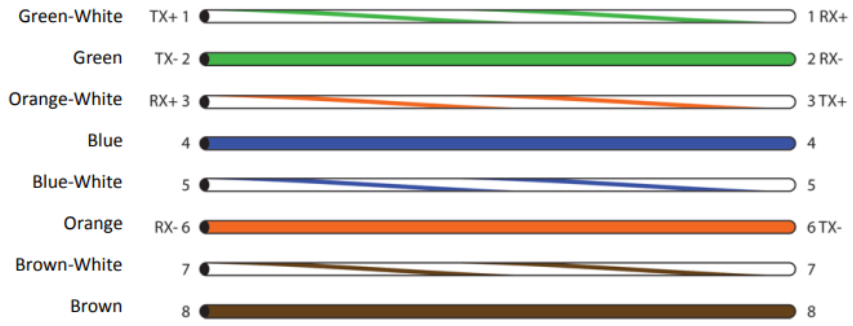

Figure 5: Straight through cable

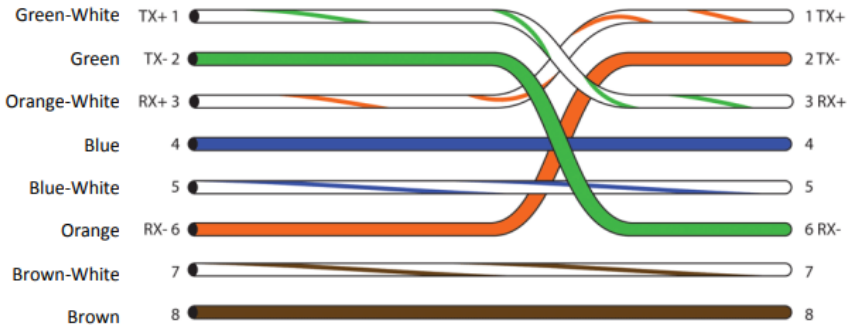

Figure 6: Cross-wired cable

5.1 Ethernet Cable Tips

- A straight-thru cable has identical ends.
- A crossover cable has different ends.
- A straight-thru is used as a patch cord in Ethernet connections.

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- A crossover is used to connect two Ethernet devices without a hub or for connecting two hubs.
- A crossover has one end with the Orange set of wires switched with the Green set.
- Odd numbered pins are always striped; even numbered pins are always solid coloured.
- Looking at the RJ-45 with the clip facing away from you, Brown is always on the right, and pin 1 is on the left.
- No more than 1/2" of the Ethernet cable should be untwisted otherwise it will be susceptible to cross-talk.
- Do not deform, do not bend, do not stretch, do not staple, do not run parallel with power cables, and do not run Ethernet cables near noise inducing components.

6 Discussion & Conclusion

Based on the focused objective(s) to understand about transmission media, interconnecting devices and different types of cabling, the additional lab exercise made me more confident towards the fulfilment of the objectives(s).

7 Lab Task (Please implement yourself and show the output to the instructor)

1. Construct a straight through cable.
2. Construct a cross-wired cable.
3. Describe different interconnection devices.

8 Lab Exercise (Submit as a report)

- Construct a straight through and cross-wired cables using clamping tool.
- Describe LAN transmission media.

9 Policy

Copying from internet, classmate, seniors, or from any other source is strongly prohibited. 100% marks will be *deducted* if any such copying is detected.

10 Resources

https://blog.netwrix.com/2019/01/08/network-devices-explained/

https://www.educba.com/types-of-lan/

https://www.ukessays.com/essays/information-technology/local-area-network-protocol-standards-information-technology-essay.php

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