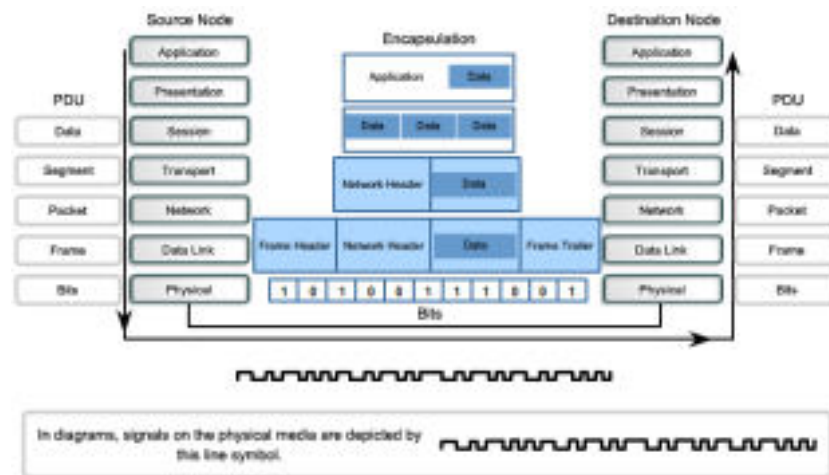


**Tutorial 3: Physical Layer (OSI Model)**

Q1.

(a) Based on the diagram below, explain the encapsulation and decapsulation process at the physical layer. (6 Marks)

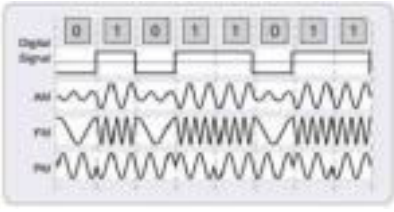



At Sender's end : Physical layer accepts a complete frame from the data link layer, encodes the frames and creates the electrical, optical, or radio wave signals that represent the bits in each frame. These signals are then sent over the media, one at a time.

At destination node : physical layer retrieves these individual signals from the media, restores them to their bit representations, and passes the bits up to the data link layer as a complete frame.

(b) The physical layer must generate the electrical, optical, or wireless signals that represent the "1" and "0" on the media. The way that bits are represented is called the signaling method. Identify the media for the following signals.

(6 Marks)

Signals	Signaling Type	Media Type
	Microwave Signals	Wireless
	Electrical Signals	Copper Cable



1 updated by Sangeetha V Feb 2024



## BAIT1013 Introduction to Computer

### Networks Tutorial 3: Physical Layer (OSI

#### Model)

Q2.


- (a) Data is transmitted on copper cables as electrical pulses. The timing and voltage values of the electrical pulses are susceptible to interference from two sources. Explain the two sources.



(4 Marks)

**Electromagnetic interference (EMI) / radio frequency interference (RFI)** - EMI and RFI signals can distort and corrupt the data signals being carried by copper media.

**Crosstalk** - Crosstalk is a disturbance caused by the electric or magnetic fields of a signal on one wire to the signal in an adjacent wire.

- (b) Identify the type of the copper cable , briefly describe the cable and indicate One usage for that cable..

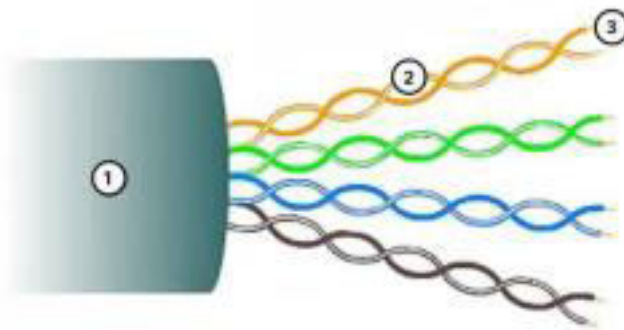
	Cable Type	Description	Usage
	Unshielded Twisted-Pair (UTP) Cable	the most common networking media. UTP cabling, terminated with RJ-45 connectors, is used for interconnecting network hosts with intermediary networking devices, such as switches and routers	Cable internet installations

	<b>Shielded Twisted-Pair (STP) Cable</b>	STP cables combine the techniques of shielding to counter EMI and RFI, and wire twisting to counter crosstalk. To gain the full benefit of the shielding, STP cables are terminated with special shielded STP data connectors. If the cable is improperly grounded, the shield may act as an antenna and pick up unwanted signals.	Cable internet installations
	<b>Coaxial Cable</b>	electrical cable that has an inner conductor surrounded by a tubular insulating layer, which is then surrounded by a tubular conducting shield	Wireless installations

(c) Unshielded twisted-pair (UTP) cabling is the most common networking media. The figure shows UTP cable. The number in the figure below shows the general structure of a UTP cable. Identify the structure and explain the functions

(6 Marks)

The outer jacket protects the copper wires from physical damage. Twisted-pairs protect the signal from interference. Color-coded plastic insulation electrically isolates wires from each other and identifies each pair.

**Tutorial 3: Physical Layer (OSI Model)**

Number	Name of structure	Function
1	Outer jacket	Protects the copper wires from physical damage
2	Twisted-pairs	Protect the signal from interference
3	Color-coded plastic insulation	Electrically isolates wires from each other and identifies each pair

(d) Fiber-optic cables are broadly classified into single-mode fiber (SMF) and multimode fiber (MMF). Differentiate SMF and MMF.

(10 Marks)

Single Mode Fiber (SMF)	Multimode Fiber (MMF)
<ul style="list-style-type: none"> <li>• Small Core</li> <li>• Less Dispersion</li> <li>• Suited with long distance applications</li> <li>• Uses lasers as the light sources</li> <li>• Commonly used with campus backbones for distances of several thousand meters</li> </ul>	<ul style="list-style-type: none"> <li>• Larger core than single mode cable</li> <li>• Allows greater dispersion and therefore, loss of signal</li> <li>• Suited for long distance applications, but shorter than single mode</li> <li>• Uses LEDs as the light sources</li> <li>• Commonly used with LANs or distances of a couple hundred meters within a campus network</li> </ul>

(e) Discuss the application of each of the following UTP cable types.

(6 marks)

Cable Type	Cable Use / Applications
Straight-through cable	Connecting a network host to a network device such as a switch or hub.

Crossover cable	Connecting two network hosts Connecting two network intermediary devices (switch to switch, or router to router)
Rollover cable (also known as “Cisco” cable)	Connect a workstation serial port to a router console part, using an adapter

(f) When is a wired connection preferred to a wireless connection by an end-user device? (8 Marks)

Wired connections are generally more reliable than wireless connections because they are less susceptible to interference and signal degradation. In environments where consistent and stable connectivity is critical, such as for online gaming, video streaming, or critical business operations, a wired connection is preferred. Wired connections often offer faster and more consistent data transfer speeds compared to wireless connections. Wired connections are not limited by the physical distance between the device and the network router or access point, unlike wireless connections which have a maximum range.

### **BAIT1013 Introduction to Computer**

### **Networks Tutorial 3: Physical Layer (OSI**

### **Model)**

3 updated by Sangeetha V Feb 2024



Q3.

Mr Jason and his son, Alfred lives in a double storey house. Alfred’s room is on the 3<sup>rd</sup> floor, and the home router is connected to the Internet is at the Ground Floor. Alfred wanted to play online computer games and preferred to have a wired connection, whereas Mr Jason wanted Alfred to use the wi-fi connection. Both had arguments over this issue for a while. Since no solid conclusion could be made, they decided to ask your help. You are their reliable neighbor who helps out with some technology solutions. They decided to ask for your advice.

Propose whether the media for the situation should be cabled and/or wireless and justify your selection.  
***[You need to relate your answer to the above situation].***

(12 Marks)

Given that Alfred's room is on the 3rd floor and the home router is located on the ground floor, it might be challenging to establish a stable and reliable wired connection directly from the router to Alfred's computer. However, they could consider installing a powerline adapter or a network switch on the 3rd floor, connected to the router on the ground floor via Ethernet cables. This setup would provide Alfred with a wired connection for gaming without the need for extensive cabling throughout the house.

For general internet usage and connectivity on other devices throughout the house, including devices on

different floors, Wi-Fi would be the more convenient and practical option. Mr. Jason can continue using Wi-Fi for his devices, and other family members can also connect their devices wirelessly without the need for additional cabling.

**Q4.** Propose the best media or type of connection that can be used to connect devices in these environments.

(i) connect two branches of company that is 100km distance from each other

Fiber optic connection

(ii) high speed connection between two routers in the same campus.

Fiber optic connection

(iii) connection between clients (PC) to a server in an area with much radio waves

Wireless connection

(iv) connection of a campus which is located in a hilly terrain

Wireless connection

(v) connect a device to the microwave dish acting as an antennae

Coaxial cable connection

(vi) home PC connection to a router

Wired Ethernet connection or Wifi connection