Department of Electrical Engineering

Assignment

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Course Details

Course Title:	**Mobile and Broadband Networks**	**Module: 03**
Instructor: Pir Meher Ali Shah	**Total Marks:**	**30**

Student Details`

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Q1.(a)	In how many types, an optical access network can be classified, explain each of them.	Marks 6
(b)	What are the advantages of Satellite Communication over terrestrial Communication?	Marks 4
Q2.(a)	Write are the types of WiFi Technologies, Discuss each type	Marks 4
(b)	Explain in detail about Wireless Body Area Network along with its type.	Marks 6
Q3.(a)	Write a comparative detail about the evolution of mobile technology from 1st Generation to 5th Generation.	Marks 6
(b)	What is DSL? Explain its architecture along with its types.	Marks 4

Q1(a) In how many types, an optical access network can be classified, explain each of them?

Ans: 1. The main network may well always be fiber but there are alternatives when it comes to connecting the last mile. “The last mile” is the last few hundred meters nearest the consumer’s home or the business premises of the end-user. More than likely, this will use fiber to the home (FTTH) or curb (FTTC), where the final few meters consist of copper cables. All together these variants are known as FTTx.

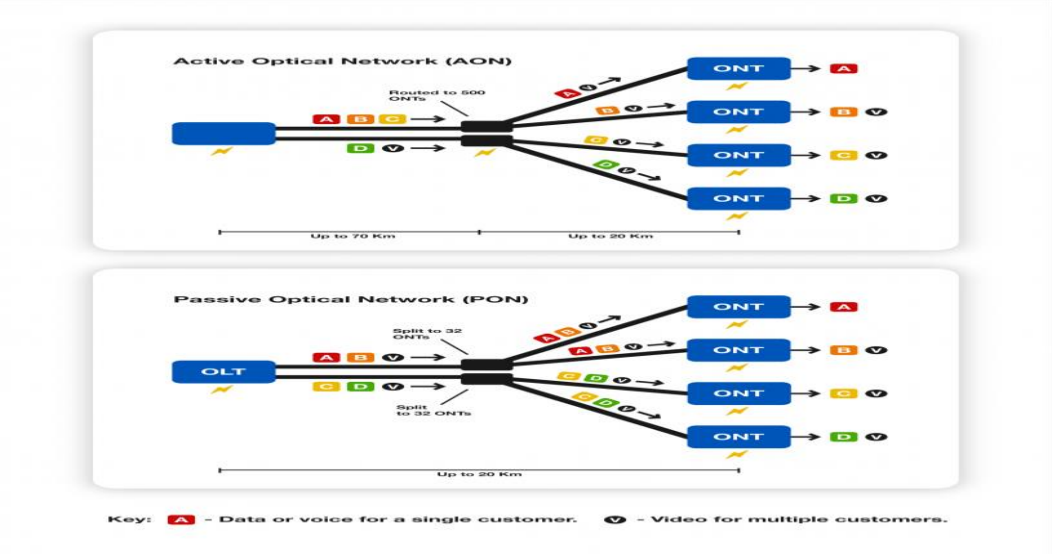
Fiber has proven to be an expensive connection, it’s simply too expensive to run a dedicated and direct link all the way to each end-user. If there’s already an existing copper telephone cable that’s running to each home it will make it cheaper for the last few meters. It will, however, make the connection slower.

What are AON and PON?

There are two common ways this problem can be solved, both based on the principle of splitting the signal so that each fiber from the central office in the network’s core is shared between multiple end-users. The two methods are called Active Optical Networks (AON) or Passive Optical Networks (PON), and in both cases, the split into individual fibers for each user happens fairly close to the customer; within a few kilometers at most.

The key difference between AON and PON is how the signal is split between the multiple fibers going to each customer. AONs use active, electrically powered devices to direct the appropriate signal only to the relevant customer - you can see this below in the diagram. Ethernet is commonly used, and a switching device will

typically route signals to up to about 500 customers.



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In contrast, a PON uses optical splitters, which require no electrical power, to send the signal to each customer. Each switching cabinet can handle up to 128 end users. You can see from the diagram that each customer also receives signals intended for someone else, so encryption ensures privacy is maintained. For upstream signals sent back from customers, these are combined into one signal at the switching cabinet, typically using Time Division Multiple Access (TDMA). The PON also uses wavelength division multiplexing (WDM) to carry both upstream and downstream traffic over single-mode fibers.

Benefits of each approach

PONs have a number of key advantages; for a start, because they don't require electrical power for the splitter, they have lower installation and operating costs than AONs. They also use less energy, and less network infrastructure, than AONs, and are highly reliable. Compared to the copper wiring that is being replaced by fiber, using PONs means the fiber is smaller, easier to manage, and more secure than the legacy cabling it replaces.

On the other hand, AONs enable the fiber 'last mile' link to operate over longer distances than with a PON: typically, up to around 70 to 100km, compared to about

20km for PONs. Troubleshooting and finding a problem is easier with AONs than with PONs, because each fiber is carrying signals dedicated to one customer. AONs also don't suffer from the drop-in speeds that PONs experience at peak times, due to multiple customers' traffic being sent down each fiber.

b) What are the advantages of satellite communication over terrestrial communication?

Ans: The advantages of satellite communication over terrestrial communication are as follows:

1. Satellite are mainly wide area broadcast media as transmitter antenna may be designed to provide signals to service areas as small as a city or as large as a country.
2. Terrestrial communication is point-to-point whereas Satellites communication is point to multipoint approach.
3. Relatively fast installation. Once satellite is in position, earth station can be installed and communication can be established in days or hours. But terrestrial circuits require time consuming installations.
4. The satellite costs are independent of distance whereas the terrestrial network costs are proportional to distance.
5. The satellite itself is a single repeater. For terrestrial links antennas are located at a specific height to overcome obstacles and also repeaters are to be used in between the links to compensate for path losses.
6. Satellite systems can provide coverage to remote places where terrestrial system fails. For communication between remote areas (hilly terrains, island etc) and the main land satellite communication is the only cost effective option
7. Mobile communication is easy to achieve using satellite communication because of its broader coverage area and its flexibility in connecting mobile vehicles.
8. Satellites have average low operating cost. Manufacturing of satellite is expensive but after that it would operate typically for years.
9. As compared to optical fiber cable where the signal quality changes with the distance travelled by signal through the cable, satellite communication has an advantage that signal quality is independent of

distance as long as the two stations fall within the same geographic coverage areas.
10. Wide area of application such as whether forecasting, search ,navigation, military.

Q2.

a) Types of WiFi Technologies ?

Ans: Currently they are four major types of WIFI technologies.

1. Wi-Fi-802.11a
2. Wi-Fi-802.11b
3. Wi-Fi-802.11g
4. Wi-Fi-802.11n

802.11a is the one of a series of wireless technology. That defines the format and structure of the radio signals sent out by WI-FI networking routers and antennas.

Wi-Fi-802.11b:

802.11b is the one of a series of wireless technology. 802. 11b support bandwidth 11mbps. Signal in unregulated frequency spectrum around 2.4 GHz. This is a low frequency compared with Wi-Fi-802.11a means it is working reasonable distance. It is interference with micro owns cordless phones and other appliance. It is low-cost; signal range is good using home appliance.

Wi-Fi-802.11g:

In 2002 and 2003, This Technology supporting a newer standard products. It is best technology of 802.11a and 802.11b. The 802.11 b support bandwidth upto 54mbps and it use a 2.4 GHz frequency for greater range. This cost is more than 802.11b. It is fast accessing and maximum speed.

Wi-Fi-802.11n:

The 802.11n is the newest WIFI technology. It was designed to improve on 802.11g. The amount of bandwidth supported by utilizing multiple wireless

signals and antennas instead of one. It supports 100 mbps bandwidth and increased signal intensity.

b) Explain in detail about wireless body area network. Discuss with types.

Ans: A Wireless Body Area Network (WBAN) connects independent nodes (e.g. sensors and actuators) that are situated in the clothes, on the body or under the skin of a person. The network typically expands over the whole human body and the nodes are connected through a wireless communication channel. According to the implementation, these nodes are placed in a star or multihop topology.

A WBAN offers many promising new applications in the area of remote health monitoring, home/health care, medicine, multimedia, sports and many other, all of which make advantage of the unconstrained freedom of movement a WBAN offers. In the medical field, for example, a patient can be equipped with a wireless body area network consisting of sensors that constantly measure specific biological functions, such as temperature, blood pressure, heart rate, electrocardiogram (ECG), respiration, etc. The advantage is that the patient doesn't have to stay in bed, but can move freely across the room and even leave the hospital for a while. This improves the quality of life for the patient and reduces hospital costs. In addition, data collected over a longer period and in the natural environment of the patient, offers more useful information, allowing for a more accurate and sometimes even faster diagnosis.

Q3.a)

Evolution of mobile technology.

Ans: FIRST GENERATION (1G):

1G technology replaced 0G technology, which featured mobile radio telephones and such technologies as Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT).

1. Developed in 1980s and completed in early 1990's
2. 1G generation of analog cell phones speed up to 2.4kbps
3. Advance mobile phone system (AMPS) was first launched by the US and is a 1G mobile system

Second Generation Technology (2G to 2.7G):

2G is the Second-Generation wireless cellphones, based on digital technologies in the early 1990's. In 1991 2G was launched in Finland. 2G provided services such as text message, picture messages and MMS. 2G has greater security for both sender and receiver. All text messages are digitally encrypted, which allows for the transfer of data in such a way that only intended receiver can receive and read it. GSM uses TDMA to multiplex upto 8 calls per channel in the 900 and 1800 MHZ bands. GSM can not only deliver voice but also circuit switched data at sped up to 14.4kbps.

3G:

3G is the third generation of mobile phone standards and technology. It is based on the International Telecommunication Union (ITU) who formulated a plan to implement a global frequency band in the 2000 MHZ range, which supports a single, ubiquitous wireless communication standard for all countries throughout the world. This paln was called International Mobile Telephone 2000 (IMT-2000), Standard. 3G has the following enhancements over 2.5G and previous networks:

- Enhanced audio and video streaming.

- Several Times higher data speed.
- Video-conferencing support.
- Web and WAP browsing at higher speeds.
- IPTV (TV through the Internet) support.

3.5 G — HSDPA (High-Speed Downlink Packet Access):

High-Speed Downlink Packet Access (HSDPA) is a mobile telephony protocol which provides a smooth evolutionary path for UMTS-based 3G networks allowing for higher data transfer speeds. HSDPA is a packetbased data service in W-CDMA downlink with data transmission up to 8–10 Mbit/s (and 20 Mbit/s for MIMO systems) over a 5MHz bandwidth in WCDMA downlink.

3.75G — HSUPA (High-Speed Uplink Packet Access):

HSUPA will enhance advanced person-to-person data applications with higher and symmetric data rates, like mobile e-mail and real-time person-to person gaming. Traditional business applications along with many consumer applications will benefit from enhanced uplink speed. HSUPA will initially boost the UMTS / WCDMA uplink up to 1.4Mbps and in later releases up to 5.8Mbps.

4G:

4G is the fourth generation of broadband cellular network technology, succeeding 3G. A 4G system must provide capabilities defined by ITU in IMT Advanced. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, and 3D television. 4G is a concept of inter-operability between different sorts of networks, which is all about high speed data transfer such as 0–100MBPS of either the server or the data receiver set is moving at a speed of 60 Kmph. If the server and the receiver are stationary, the data transfer would be a minimum of 1GBPS.

5G:

5G network technology will open a new era in mobile communication technology. The 5G mobile phones will have access to different wireless technologies at the same time and the terminal should be able to combine different flows from different technologies. 5G allows up to 900,000 more devices to be connected per square kilometer than 4G, which supports the connection of at most 100,000 devices per square kilometer. The 5G network will be 100 times more energy efficient than 4G. So even as the number of wireless devices increases, the energy required to power them will decline.

b) What is DSL ? types.

Ans:

DSL stands for Digital Subscriber Line. Users get a high speed bandwidth connection from a phone wall jack on an existing telephone network. DSL works within the frequencies that the telephone doesn't so you can use the Internet while making phone calls.

Consider DSL Internet the big brother to dial-up. Many local phone services provide DSL offering High Speed Internet access delivered through existing telephone networks. Telephone wires carry hundreds of thousands of frequencies. Only a few thousand are for telephone communications so the telephone and DSL modem can work at the same time.

There are two main types of DSL technology.

Symmetrical DSL– Symmetrical connections offer equal bandwidth for upload and download speeds.

Asymmetrical DSL– This is the most popular type of DSL connection. Most people download more information than they are uploading. Because of this, an asymmetrical connection has more downstream bandwidth and less upstream bandwidth.

DSL is a generic term used for a family of related technologies, including RADSL, ADSL, SDSL, IDSL, and others. The leading DSL technologies being deployed today include:

RADSL - (Rate Adaptive Digital Subscriber Line):

- Most robust business DSL available today;
- Developed to overcome line impediments;
- Automatically adjusts for environmental conditions; - Because RADSL is a type of SDSL, it supports symmetric (equal downstream and upstream) data transmissions up to 768K.

ADSL - Asymmetrical Digital Subscriber Line:

ADSL supports a range of asymmetric (higher downstream than upstream) data speeds that can reach up to 7Mbps downstream and 1.5Mbps upstream. ADSL can deliver simultaneous high-speed data and telephone service over the same line.

ADSL Lite (or G.lite):

This is a lower speed version of ADSL and provides downstream speeds of up to 1Mbps and upstream speeds of 512 kbps, at a distance of 18,000 feet from the service provider's premises. It is intended to simplify DSL installation at the user's end.

R-ADSL - Rate-Adapative Digital Subscriber Line:

The R-ADSL provides the same transmission rates as ADSL, but an RADSL modem can dynamically adjust the speed of the connection depending on the length and quality of the line.

HDSL - Hight Bit-Rate Digital Subscriber Line

The HDSL provides a symmetric connection, that is, upstream speeds and downstream speeds are the same, and range from 1.544Mbps to 2.048Mbps at a distance of 12,000–15,000 feet. Symmetric connections are more useful in applications like videoconferencing, where data sent upstream is as heavy as data sent downstream. HDSL-II, which will provide the same transmission rates but over a single copper-pair wire, is also round the block.

IDSL - ISDN Digital Subscriber Line:
The ISDN Digital Subscriber Line provides up to 144 kbps transmission speeds at a distance of 18,000 feet (can be extended with a repeater), and uses the same techniques to transfer data as ISDN lines. The advantage is that, unlike ISDN, this is an 'always on' connection.

SDSL - Symmetric Digital Subscriber Line:
SDSL supports symmetric (equal downstream and upstream) data transmissions up to 1.54Mbps.

VDSL - Very High Bit-rate Digital Subscriber Line:
VDSL is the fastest of all xDSL flavors and provides transmission rates of 13–52Mbps downstream and 1.5–2.3Mbps upstream over a single copperpair wire, at a distance of 1,000–4,500 feet from the service provider's premises.

VDSL2 - Very High Bit-rate Digital Subscriber Line 2:
VDSL2 is faster than VDSL and provides transmission rates up to 100Mbps at longer distances.