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Course Tittle: Mobile and Broadband Networks
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Department of Electrical Engineering
Assignment
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Course Details

Course Title: Mobile and Broadband Networks **Module:** ____
Instructor: ____ **Total Marks:** 30

Student Details

Name: ____ **Student ID:** ____

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

Optical Access Networks

The set of approach links distributing the similar network side borders and held by optical fiber transmission systems.
Access networks are habitually low-cost or support multiple cost structures to permit the evolution and services in an cost-effectively possible manner. Much like in the other segments of the optical networks, the optical hardware technologies are the enabler for generation, switching, transmission, and amplification of optical signals. The challenges affect to physical layer matters and component technologies.

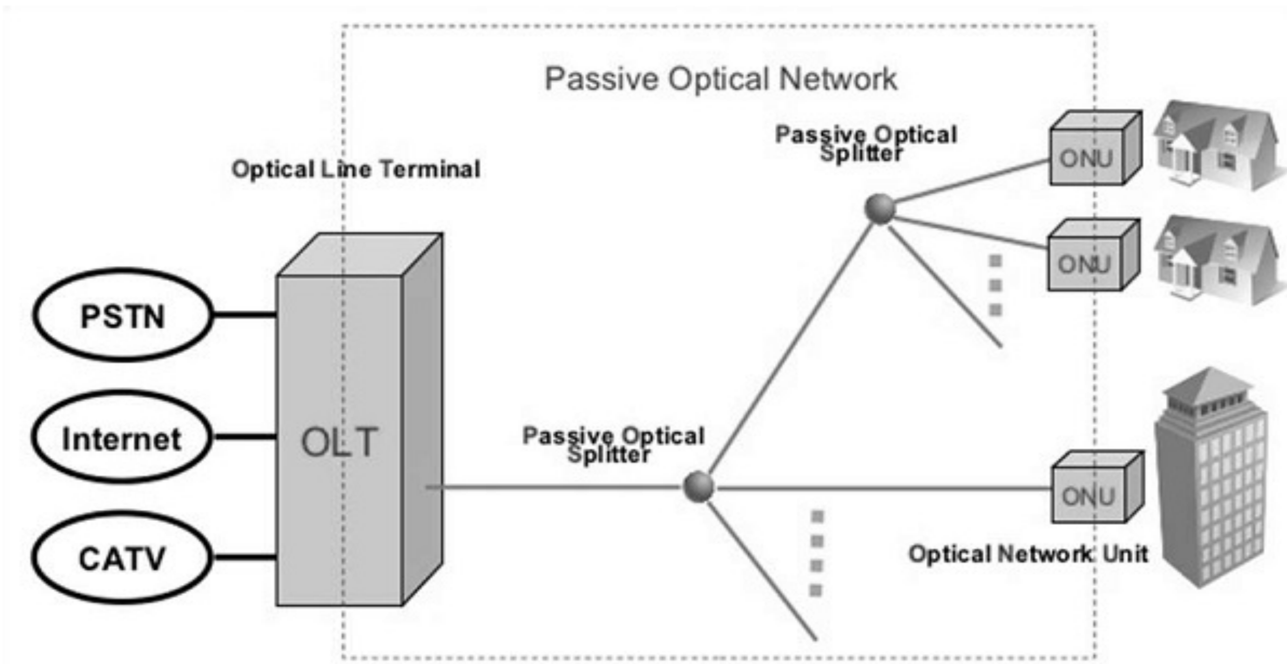
Types Of Optical Access Network

There are basically two different kinds of optical access networks, namely **active optical network** (AON) and **passive optical network** (PON). AON is also known as active Ethernet or point-to-point (p2p) Ethernet, Ethernet-to-the-home or similar names, and there are different variants of it. AON is standardized in, however without mentioning the term AON itself. PON - which is a point-to-multipoint (p2mp) architecture - can be divided into time division multiplexing (TDM) PON and wavelength division multiplexing (WDM) PON. New commercial TDM PON deployments are usually of the types GPON or EPON. Other types of PON have been proposed, and there are hybrids between TDM and WDM PONs and even between AON and PON. Within FSAN there are also major ongoing activities on next generation PON.
Different types of optical fiber access networks, based on how close the fiber gets to the end user. In many cases, the remote node may be located at the central office itself. The one is **Passive Optical Network** and 2 is **Active optical network**

Passive optical Network

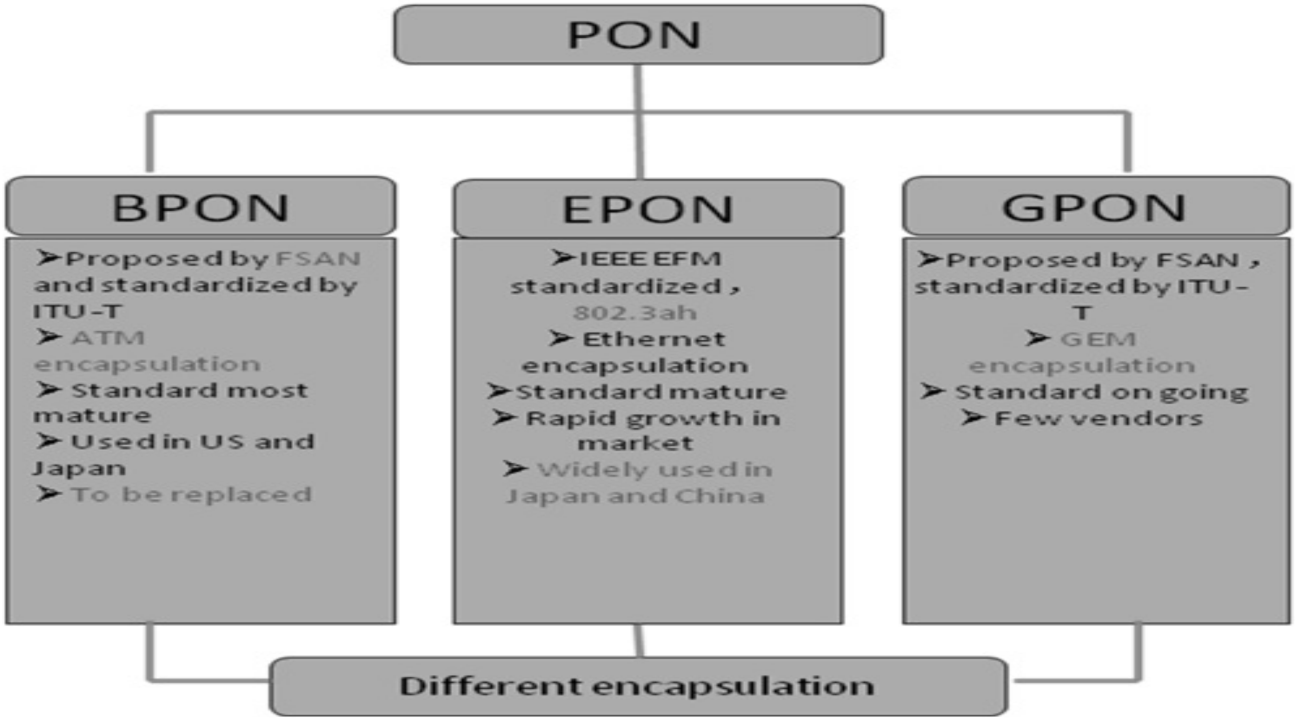
A passive optical network (PON) is a system that brings optical fiber cabling and signals all or most of the way to the end user. Depending on where the PON terminates, the system can be described as fiber-to-the-curb (FTTC), fiber-to-the-building (FTTB), or fiber-to-the-home (FTTH).
A PON consists of an Optical Line Termination (OLT) at the communication company's office and a number of Optical Network Units (ONUs) near end users. Typically, up to 32 ONUs can be connected to an OLT. The passive simply describes the fact that optical transmission has no power requirements or active electronic parts once the signal is going through the network.
ONUs terminates the fiber signal, and the links between the ONUs and the NIUs OAN must support the capacity requirements such as concentration and

grooming for enterprise and residential users, and they must also support multi-bit-rate interfaces (e.g., constant and variable bit rates as well as synchronous and asynchronous data streams). Various architectures and one such example, based on the FSAN concept, are illustrated
PON is Passive Optical Network featured with one-to-multiple-point architecture. As shown in the following image, it comprises of Optical Line Terminal (OLT), Optical Network Unit and Passive Optical Splitter.



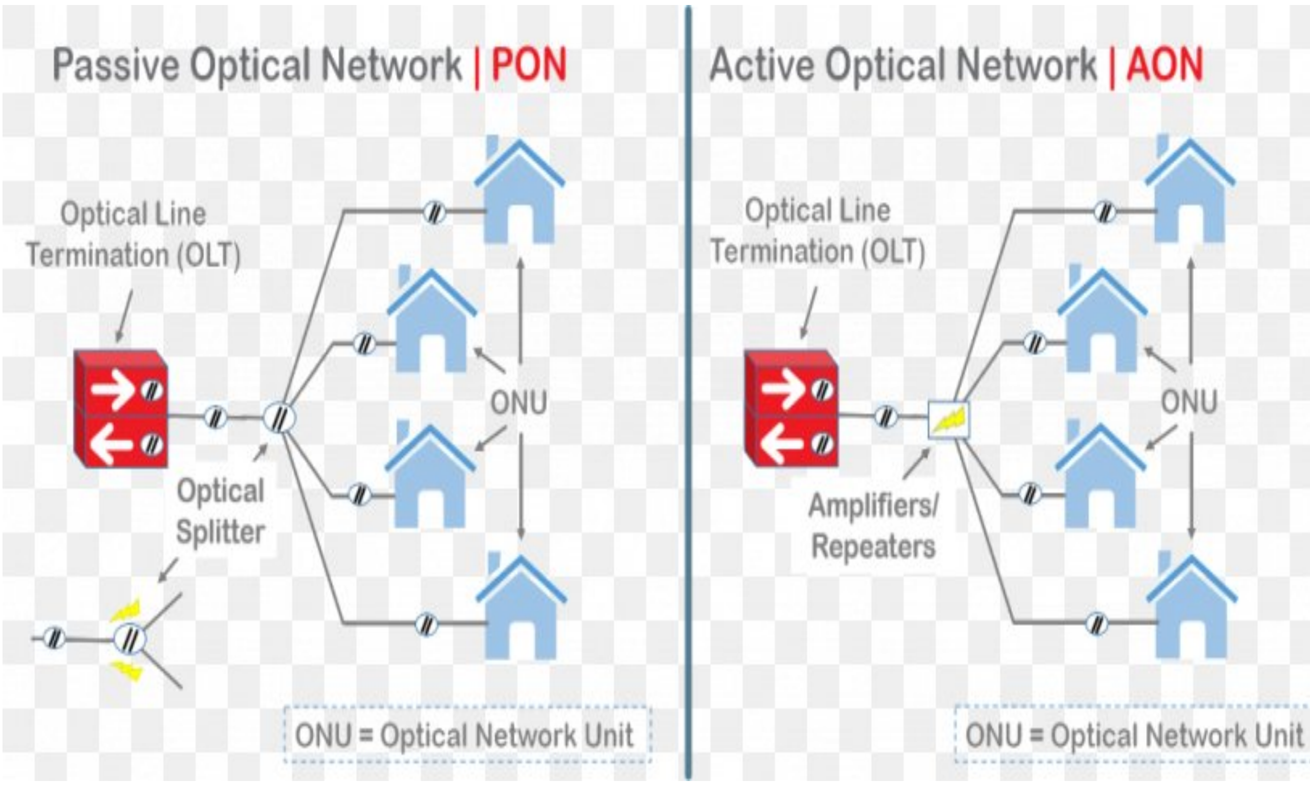
History of PON

The first Passive Optical Network (PON) activity was initiated by the FSAN group in the mid- 1990s. The initial standard covered 155 Mbps transmission based on ATM known as the APON/BPON standard. Later on, the standard enhanced to cover 622 Mbps.
In 2001, the IEEE started the development of an Ethernet based standard known as EPON. In 2001, the FSAN group started the development of a gigabit speed standard, i.e., GPON, to be ratified by the ITU-T.



Active Optical Network

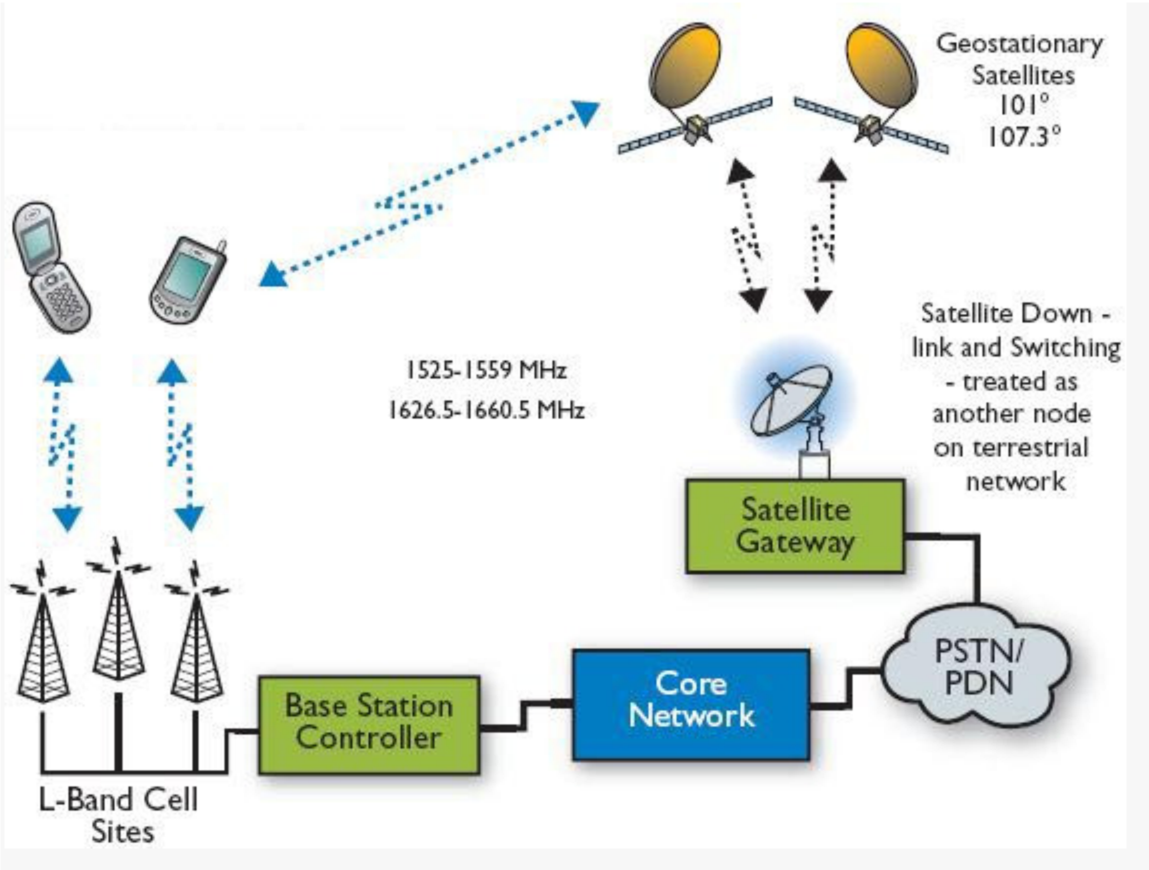
Active and passive optical networks are compared. Based on a reference model that covers AON and PON as well as the interfacing equipment, the different sites and locations in an access network are identified. Such a reference model is necessary in order to make a proper techno-economical comparison between the various optical access network architectures. Also, such a model makes it easier to compare functional differences between AON and PON. The reference model particularly focuses on identifying CAPEX contributions, but also OPEX contributions are regarded. Moreover, the definition of PON and AON has been refined in order to achieve a much more consistent terminology.
Passive Optical Networks (PONs) represent one of the most attractive access network solutions. As the demand for higher bandwidth per user is increasing and accelerating, there is an inevitable need for an evolution from the currently deployed passive optical networks (PONs) to next-generation optical access networks. Apart from meeting the bandwidth.
Any system that includes nodes which main function is to forward Steady state traffic, and that does not need active configuration to do so is called a Passive optical network. A system that needs active Configuration of such nodes in order to achieve the same result is an ACTIVE OPTICAL NETWORK.



Question # 2

Advantages of Satellite Communication over terrestrial Communication

The area of reporting of a satellite system far-off exceeds that of a terrestrial system. In the situation of geostationary satellite, a only satellite based antenna is visible to about one-fourth of the earth surface.
Conditions between communicating satellites are more time invariant than those between satellite and earth station or between two terrestrial wireless transmitters thus, satellite-to-satellite communication links can be designed with great precious



A terrestrial communication system, facilitating audio, video, data and any other type of communication within a local geographical area, and with an extremely large number of communication channels being made available simultaneously at a very low cost.

The Satellite systems cover all globes. Terrestrial wireless communication has delay that is not noticeable, whereas in satellite communication using geostationary satellites, at an altitude of 36000 km, the users experience a quarter of a second delay.

In today's world of wireless communications, high definition television and international access to the Internet, various people are undecided roughly the inherent benefits of satellite communications. Here is given some key advantages of satellite communications.

- **Cost Effectiveness** - Expense of satellite capacity does not increase with the number of users/receive sites, or with the gap between communication points. Whether crossing landmasses or staying local, satellite connection expense is distance insensitive.
- **Worldwide Availability** - Communications satellites covering all land masses and there is rising capacity to serve nautical and even aircraft markets. Customers in rural and remote regions around the world who cannot obtain high speed Internet access from a terrestrial provider are increasingly relying on satellite communications.

- **Superior Reliability** - Satellite communications can operate independently from terrestrial setup. When terrestrial outages occur from man-made and natural events, satellite connections remain operational.
- **Superior Performance** - Satellite is unmatched for broadcast applications like television. For two-way IP networks, the speed, uniformity and end-to-end control of today's advanced satellite solutions are resulting in greater use of satellite by corporations, governments and consumers.
- **Immediacy and Scalability** - Additional receive sites, or nodes on a network, can readily be added, sometimes within hours. All it takes is ground-based equipment. Satellite has proven its value as a provider of "instant infrastructure" for commercial, government and emergency relief communications.
- **Versatility and More** - Satellites effectively support on a global basis all forms of communications ranging from meek point-of-sale validation to bandwidth intensive multimedia applications. Satellite solutions are highly flexible and can operate freely or as part of a larger network.

Question # 3

Types of WIFI Technologies

Currently they are four major types of WIFI technologies.

- Wi-Fi-802.11a.
- Wi-Fi-802.11b.
- Wi-Fi-802.11g.
- Wi-Fi-802.11n.

Wi-Fi-802.11a.

802.11a was one of the first Wi-Fi communication standards created in the IEEE 802.11 standards family. It is often mentioned in relation to other standards that came later, such as 802.11b/g/n and 802.11ac. Knowing that they're different is useful when buying a new router or connecting new devices to an old network that might not support new tech.

WI-FI 802.11b

802.11b is one of several Wi-Fi standards developed by the Institute of Electrical and Electronics Engineers (IEEE). It was released in 1999 along with **802.11a.**as the first update to the initial 802.11 specifications, published in 1997. Both

802.11a and 802.11b are wireless transmission standards for LAN, but 802.11a uses a 5 GHz frequency, while 802.11b operates on a 2.4 GHz band.
The 802.11b Wi-Fi standard provides a wireless range of roughly 35 meters indoor and 140 meters outdoors. It supports transfer rates up to 11 Mbps, or 1.375 MB per second. In the late 1990s, this was significantly faster than Internet speeds available to most homes and businesses. Therefore, the speed was typically only a limitation for internal data transfers within a network. While 802.11b provided similar data transfer as 10Base-T Ethernet, it was slower than newer wired LAN standards, such as 100Base-T and gigabit Ethernet.

Wi-Fi-802.11g

802.11g is a Wi-Fi standard developed by the IEEE for transmitting data over a wireless network. It operates on a 2.4 GHz bandwidth and supports data transfer rates up to 54 Mbps. 802.11g is backward compatible with 802.11b hardware, but if there are any 802.11b-based computers on the network, the entire network will have to run at 11 Mbps (the max speed that 802.11b supports). However, you can configure your 802.11g wireless router to only accept 802.11g devices, which will ensure your network runs at its top speed.

Wi-Fi-802.11n

IEEE 802.11n-2009, commonly shortened to 802.11n, is a wireless-networking standard that uses multiple antennas to increase data rates. The Wi-Fi Alliance has also retroactively labeled the technology for the standard as Wi-Fi 4. 802.11 is a set of IEEE standards that govern wireless networking transmission methods.

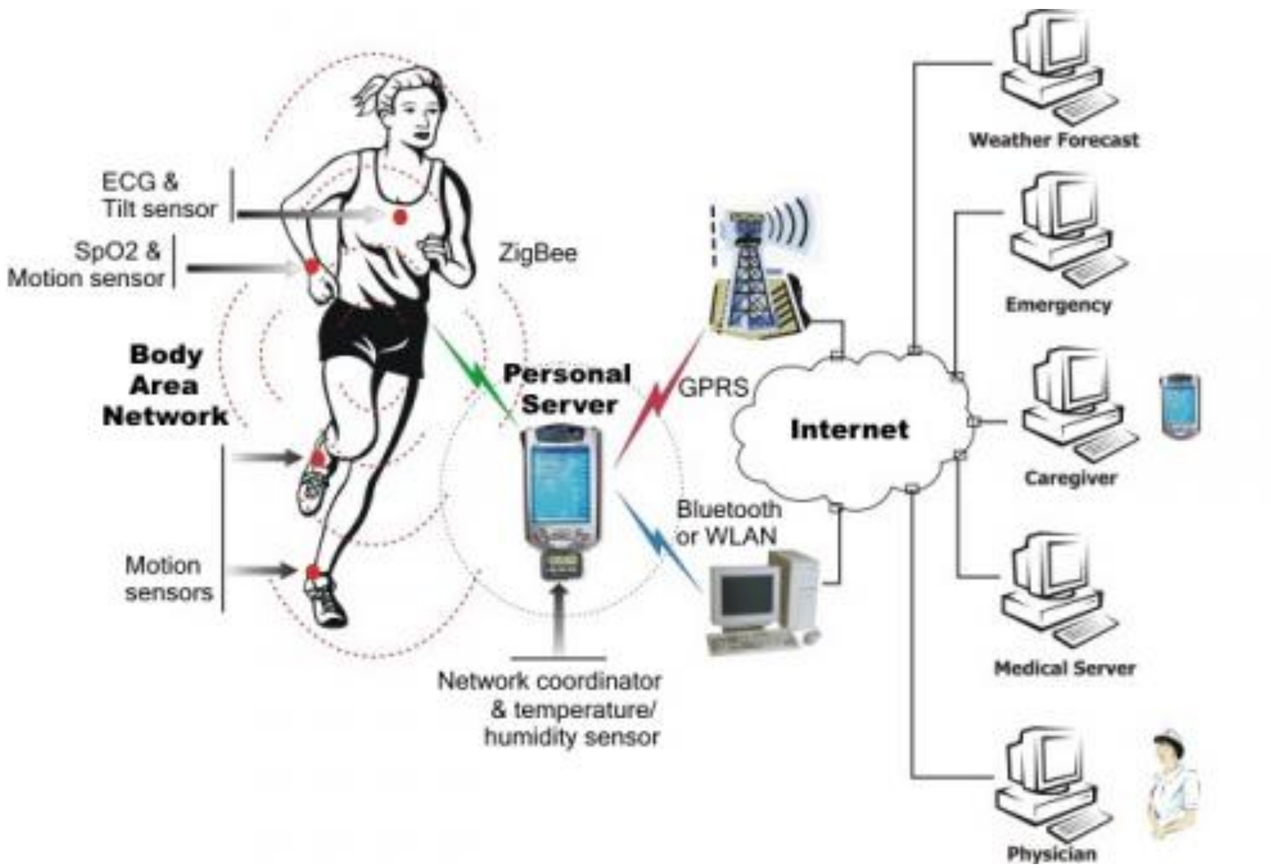
The **802.11n** standard can work over both the 2.4GHz and 5GHz bands, although most **802.11n** devices are restricted to the 2.4 GHz band only. ... Therefore, **802.11n routers** offer greater range and bandwidth than what is possible with the earlier 802.11g standard.

Question # 4

Wireless Body Network

A body area network also referred to as a wireless body area network or a body sensor network or a medical body area network, is a wireless network of wearable computing devices.

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 multichip topology.



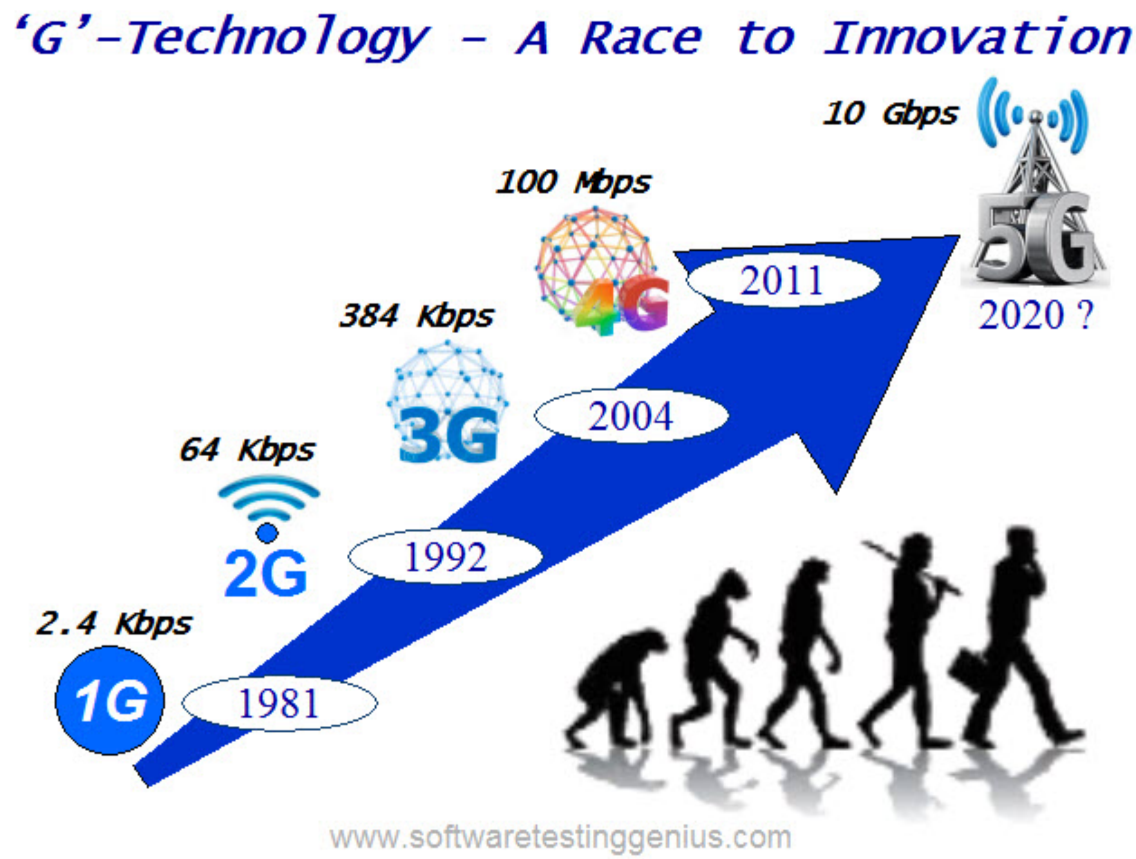
A WBAN offers many promising new applications in the area of remote health monitoring, home/health care, medicine, multimedia, sports and many other, all of which make advantage of the unconstrained freedom of movement a WBAN offers. In the medical field, for example, a patient can be equipped with a 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.
An important step in the development of a WBAN is the characterization of the physical layer of the network, including an estimation of the delay spread and the

path loss between two nodes on the body. This requires a detailed characterization of the electromagnetic wave propagation and antenna behavior near the human body.

Question # 5

Evolution Of Mobile technology 1G to 5G

Telecommunication and networking has been and will be one of the core technologies in helping the evolution of mankind and technology itself. If it wasn't for it for these channels of communications and data transmission, we would probably still be in an era where technology isn't as advanced as today. Wireless communication technology inside cell phones and other mobile devices has evolved over several decades. Starting with the then revolutionary 1G (referred to as the earliest form of voice only network) all the way to the 4G of today and the 5G of the near future. But what has really changed? and what is the core driving principles of these wireless communication technology?
First off, the G in "4G" or "5G" stands for generation and the number is just a representation of the evolution of technology. Currently, as you may know, we are using the 4th generation of wireless communication technology. But lets start from where it all began:



1G and 2G

There never was something called as 1G at first. It basically was a network with only voice call capabilities and only got the name 1G after 2G was put to use. During the 2G era, that lasted for quite a while from 1980's to 2003, there were quite a few advancements made within the spectrum itself such as GSM, GPRS and EDGE.

GSM: Short for *Global Systems for Mobile Communication e*nabled data transfer on top of voice communication at speeds that are seen as a joke today (30-35 kbps). It played a critical role in the evolution as mobile technology as right about the time it was being used mobile phone connectivity and popularity exploded.

GPRS: *General Packet Radio Service* operated on the similar 2G technology as GSM with a few refinements with gave it higher data speeds (110 kbps)

EDGE: Enhanced Data rates for GSM Evolution introduced in 2003 was somewhat known to be 2.9G or 3G due to its significant advancements over GPRS and GSM. It offered high speeds of 135 kbps and continues to be used on many mobile networks even today as is satisfies the basic needs of both carriers and users in various parts of the world.

3G

This was a big revolution in terms of technological advancement for network and data transmission. 3G had and has speed capabilities of up to 2 mbps. It enabled smartphones to provide faster communication, send/receive large emails and texts, provide fast web browsing, video streaming and more security amongst others. It was widely based on CDMA2000 (Code-division multiple access) and EDGE technologies. Now you might wonder why EDGE? Well, because EDGE was so advanced it was able to provide enough capabilities to be considered as 3G. CDMA2000, on the other hand, operated on similar key concepts but did it better. It enabled multiple channels to communicate at one same thus improvising on the over speed and connectivity.

4G

The 4G standard sets several requirements for mobile networks including mandating the use of Internet Protocol (IP) for data traffic and minimum data rates of 100 Mbps. [Life Wire] which was a huge jump from the 2 mbps for 3G. It is often referred to as MAGIC

M – Mobile multimedia
A – Anytime anywhere
G – Global mobility support
I – Integrated wireless solution
C – Customized personal service

It is not much to do with the technology it uses but rather than the requirements set forth by International Telecommunication Union's Radio communication Sector (ITU-R). These standards are known as International Mobile Telecommunications-Advanced (IMT-Advanced). The list of standards is quite complicated and thus was a barrier in fast adoption of the 4G spectrums.

Soon after 4G, 4G LTE was introduced. LTE stands for Long Term Evolution and it isn't as much a technology as it is the path followed to achieve 4G speeds. It was a complete redesign and simplification of 3G-network architecture, resulting in a significant reduction in transfer latency and thus, increasing efficiency and speeds on the network.

5G

It is still quite in its early stages and the technology likely to appear in the market only by 2020 at the earliest. Goals for future 5G include significantly faster speeds (a minimum of 1 Gbps and perhaps up to 10 Gbps) plus lower power requirements to better support huge numbers of new Internet of Things (IoT) devices. It will have capabilities to provide faster dialing speeds, multiple device connectivity, and higher data speeds just to name a few.

Conclusion

There has been a lot of advancements in the field of wireless network communication over the years in terms of overall development and change in core functionality, which has been crucial to put us in a era that is driven by technology all around us and with 5G a couple years away, technologies such as IoT, Cloud computing and AI will completely redefine our world by 2025.

Question # 6
What is DSL explain its architecture along with its types

DSL

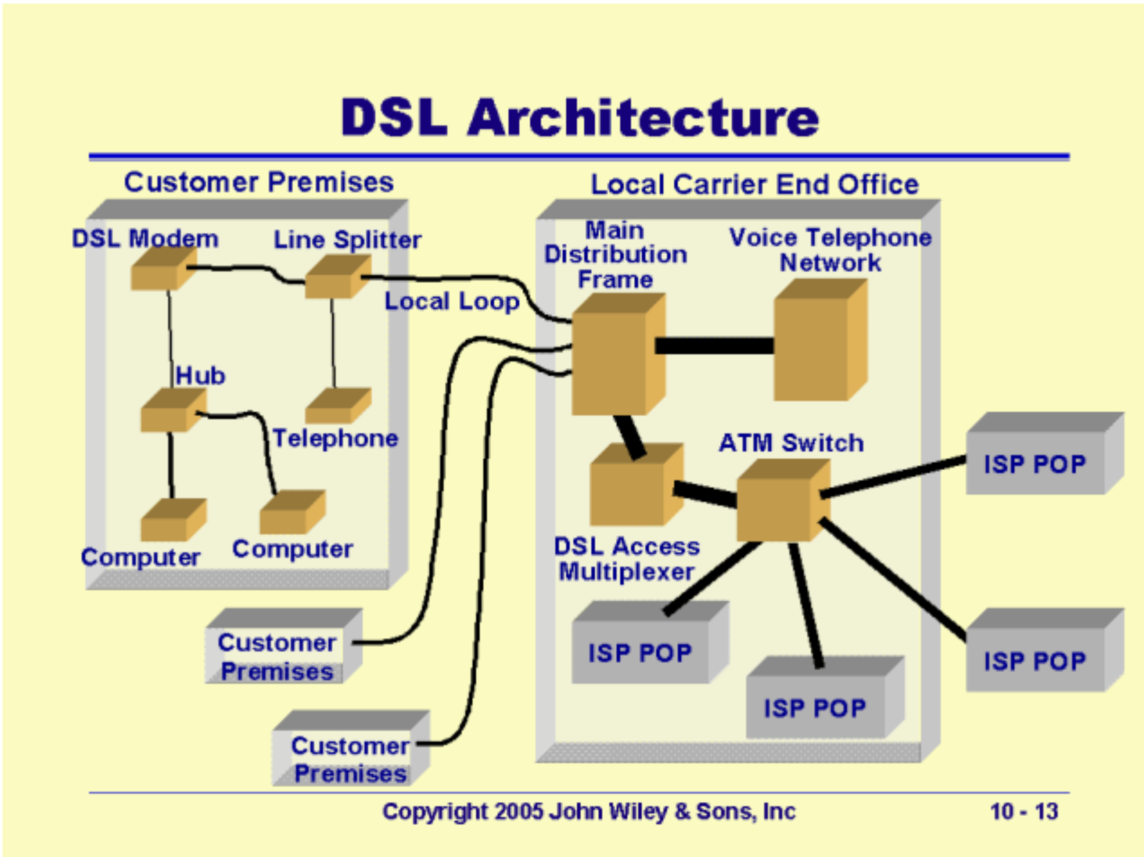
DSL stands for Digital Subscriber Line. Customers get a high-speed bandwidth connection from a phone wall jack on a present telephone network. DSL works within the frequencies that the telephone doesn't so you can use the Internet while making phone calls.

Architecture of DSL

Increasingly, **DSL** is delivered from a device situated closer to the subscriber's home or business that is connected to a CO via an optical fiber link, and then to the subscriber's premises via copper wires.

A typical ADSL service architecture is illustrated in Figure 2-1. In the architecture illustrated, the network consists of Customer Premise Equipment (CPE), the Network Access Provider (NAP) and the Network Service Provider (NSP). CPE refers to an end-user workstations (such as a PC) together with an ADSL modem or ADSL terminating unit router (ATU-R). The NAP provides ADSL line

termination by using DSL access multiplexers (DSLAMs). The DSLAM forwards traffic to the local access concentrator, which is used for Point-to-Point Protocol (PPP) tunneling and Layer 3 termination. From the Layer 2 Tunneling Protocol Access Concentrator (LAC), services extend over the ATM core to the NSP.
Figure 2-1 Overview of a DSL network deployment including CPE, NAP and NSP component



Types of DSL Technologies

RADSL - (Rate Adaptive Digital Subscriber Line)
ADSL - Asymmetrical Digital Subscriber Line.
ADSL Lite (or G.lite)
R-ADSL - Rate-Adaptive Digital Subscriber Line.
HDSL - High Bit-Rate Digital Subscriber Line.
IDSL - ISDN Digital Subscriber Line.
SDSL - Symmetric Digital Subscriber Line.

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