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جامعة المستقبل
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كلية العلوم
قسم الانظمة الطبية الذكية

المحاضرة الاولى

Introduction about

Wireless Networks

المادة : Wireless Body Sensor Networks
المرحلة : الثالثة
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Objectives

1. After studying this unit, you will be able to:
2. Describe the wireless network.
3. Explain the IEEE standards for wireless networks.
4. Explain the wireless networks applications.
5. Discuss the types of wireless networks.
6. Discuss the benefits of wireless networks.

1. Introduction to Wireless Networks

Wireless network (see Fig. 1) refers to any type of computer network that uses wireless (usually, but not always radio waves) for network connections.

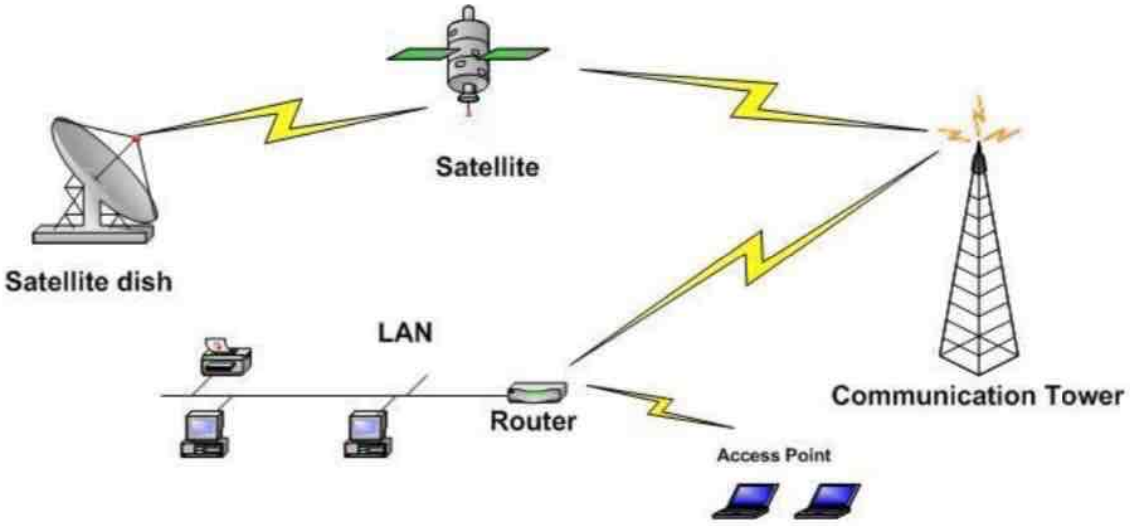

Figure 1. Wireless Network

It is a method by which homes, telecommunications networks, and enterprise (business) installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical level (layer) of the OSI model network structure.

Wireless networks use electromagnetic waves to communicate information from one point to another without relying on any physical connection. Radio waves are often referred to as radio carriers because they simply perform the function of delivering energy to a remote receiver. The data being transmitted is superimposed on the radio carrier so that it can be accurately extracted at the receiving end. Once data is superimposed (modulated) onto the radio carrier, the radio signal occupies more than a single frequency, since the frequency or bit rate of the modulating information adds to the carrier. Multiple radio

carriers can exist in the same space at the same time without interfering with each other if the radio waves are transmitted on different radio frequencies. To extract data, a radio receiver tunes in one radio frequency while rejecting all other frequencies. The modulated signal thus received is then demodulated and the data is extracted from the signal.

2. Wireless Networks

A wireless network is a flexible **data communications system**, which uses wireless media such. As radio frequency technology to transmit and receive data over the air, minimizing the need for wired connections (What is Wireless LAN, White Paper). Wireless networks are used to augment rather than replace wired networks and are most commonly used to provide last few stages of connectivity between a mobile user and a wired network.

Bluetooth and 802.11b have the potential to dramatically alter how people use devices to connect and communicate in everyday life. Bluetooth is a low-power, short-range technology for ad hoc cable replacement; it enables people to wirelessly combine devices wherever they bring them.

A wireless ad hoc network is a type of local area network (LAN) that is built spontaneously to enable two or more wireless devices to be connected to each other without requiring typical network infrastructure equipment, such as a wireless router or access point (see Fig. 2)

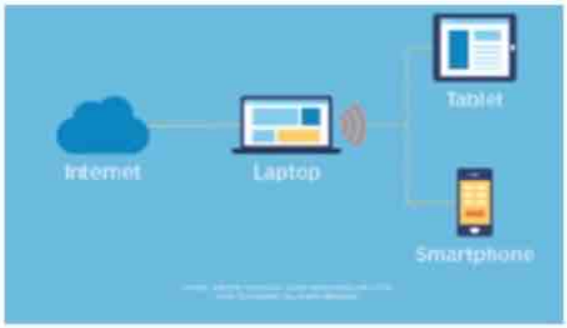

Figure 2. A wireless ad hoc network.

Advantage of Wireless Networking

The advantages of wireless networking include:

a) Wireless routers are equipped with modem, network switch (a device that has multiple connection ports for connecting computers and other network devices), wireless access points (See Fig 3).

Figure 3. Wireless Router.

b) Wireless Router can be connected to / from anywhere in your immediate environment or house. That means you can log on and surf the Internet from anywhere around your surroundings.

c) Some of the wireless routers are equipped with a built-in firewall to ward of intruders. The configuration options of the firewall are an important consideration when buying a router.

d) The broadband router wireless VoIP technology enables you to can connect to the Internet, using any ordinary phone device. You can then make calls to anybody in the world via your Internet connection.

IEEE Standards for Wireless Networks

Wireless networking hardware requires the use of underlying technology that deals with radio frequencies as well as data transmission. The most widely used standard is 802.11 produced by the Institute of Electrical and Electronic Engineers (IEEE). This is a standard defining all aspects of Radio Frequency Wireless networking.

Subcommittees of the 802 Committee have been responsible for the major networking standards that we use every day:

- 802.3: The entire family of Ethernet standards, defining both local and wide area communication on coaxial cable, twisted pair copper and optical fiber.
- 802.5: The legacy standards of Token Ring for network communication over coaxial cable and twisted pair copper and optical fiber.
- 802.11: The entire family of wireless local area network standards. Commercially known as Wi-Fi.

- 802.16: The entire family of wireless metropolitan area network standards. Commercially known as WiMAX.

the IEEE 802.11 Subcommittee is responsible for the family of evolving wireless local area network (WLAN) standards:

- 802.11: The original WLAN standard in 1997 using 1 and 2 Mbps PHY in the 2.4GHz band.
- 802.11b: The enhanced standard for the 2.4 GHz band in 1999 providing 11Mbps PHY.
- 802.11a: The enhanced PHY standard for the 5 GHz band providing 54 Mbps using OFDM (Orthogonal Frequency Division Multiplexing) modulation in 1999.
- 802.11g: The enhanced PHY standard for the 2.4 GHz band providing 54 Mbps using OFDM with backwards compatibility to 802.11b in 2003.

IEEE 802.11n is the most significant change in the wireless LAN world since the adoption of the original standard in 1997. 802.11n defines enhancements for both the MAC and the PHY.

3. Wireless Networks Applications

The various wireless application networks are as follows:

- **Internet Access:** If you've been in an airport, coffee shop, library or hotel recently, chances are you've been right in the middle of a wireless network. Many people also use wireless networking, also called WiFi or 802.11 networking, to connect their computers at home, and some cities are trying to use the technology to provide free or low-cost Internet access to residents.
- **Voice over Wireless:** VoWLAN (Voice over Wireless LAN) is the use of a wireless broadband network according to the IEEE 802.11 standards for the purpose of vocal conversation. In essence, it's VoIP over a Wi-Fi network. In most cases, the Wi-Fi network and voice components supporting the voice system are privately owned.
- **Inventory Control and Healthcare:** A high performance wireless network can help hospitals in numerous ways. Many benefits of wireless focus around improving quality care, decreasing hospital expenses, and increasing communication between patients, doctors and hospital staff. Here are just three main benefits of mobility in healthcare:

- **Asset Tracking & Inventory Management:** With RFID technology, hospitals can easily reduce the cost associated with loss of medical equipment, such as wheel chairs, infusion pumps and computers-on-wheels. Real Time Tracking capability also allows hospital staff the ability to locate these items quickly. This helps eliminate time spent wasted looking for particular items. (See Fig. 4)

Figure 4. Wireless Router.

- **Quality of Patient care and Clinical Communications**: There are many ways that wireless can help increase the quality of patient care. The mobility that doctors have allow them to be present with any patient in any hospital via video conferencing and allows them to view real time patient information instantly.
- **Patient & Staff Safety:** Using Wi-Fi RTLS can easily reduce the amount of safety incidents and improve safety and peace of mind for clinical staff. Many patients, including psychiatric patients, trauma patients and the elderly may pose a risk to themselves by wandering or leaving their hospital bed. Keeping track of any wandering patients can sometimes be the difference between life or death for that patient. (See Fig. 5)

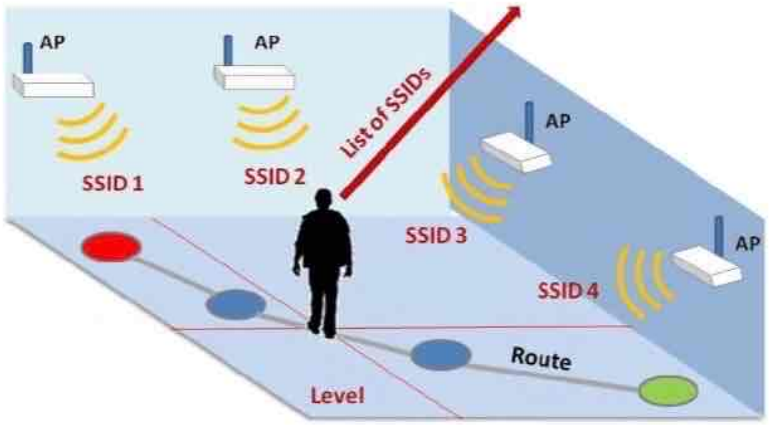

Figure 5. Wireless Router.

- **Education and Real Estate:** Wireless networks will play an important role in education. New educational models and wireless architectures have been proposed to enhance collaborative training. Wireless networks can provide a dynamic educational environment.
- **Public Networks:** Public WiFi 'hotspots' in places like cafés, airports, hotels and libraries are convenient but unlike your home computer you do not know what security these networks have or who else may be connected.

  Wireless enabled laptops or smartphones allow you to easily connect to the internet no matter where you are. The increasing availability of public WiFi 'hotspots' make getting using them to get online simple.
- **Location-based Services:** Location-based services (LBS) are a general class of computer program-level services used to include specific controls for location and time data as control features in computer programs. As such LBS is an information service and has a number of uses in social networking today as an entertainment service, which is accessible with mobile devices through the mobile network and which uses information on the geographical position of the mobile device. This has become more and more important with the expansion of the smartphone and tablet markets as well.

  LBS are used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc. (See Fig. 6)

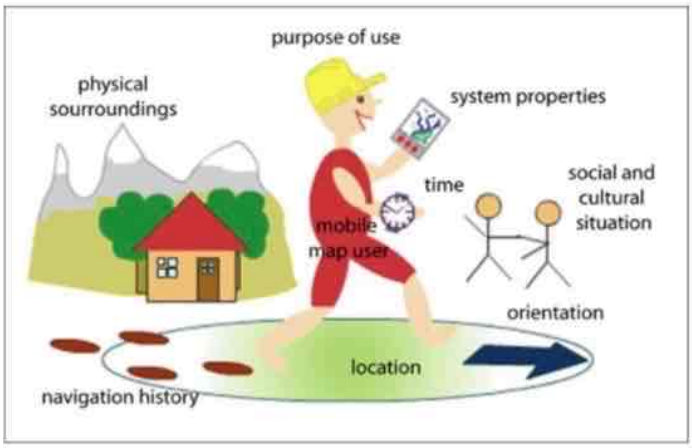

Figure 6. Location-based Services

4. Types of Wireless Network

Wireless network enable a user to move about within a wide coverage area and still be associated to the network. There are different types of wireless networking such as wide area network, local area network and personal area network but the most common are of two.

a) Wireless PANs:

Wireless personal area networks (WPANs) interconnect devices within a relatively small area, that is generally within a person's reach. For example, both Bluetooth radio and invisible infrared light provides a WPAN for interconnecting a headset to a laptop. ZigBee also supports WPAN applications. Wi-Fi PANs are becoming commonplace (2010) as equipment designers start to integrate Wi-Fi into a variety of consumer electronic devices. Personal Area Networks are a bit different than WANs and WLANs in one important respect. In the WAN and WLAN cases, networks are set up first, which devices then use. In the Personal Area Network case, there is no independent pre-existing network. The participating devices establish an ad-hoc network when they are within range, and the network is dissolved when the devices pass out of range. If you ever use Infrared (IR) to exchange data between laptops, you will be doing something similar. This idea of wireless devices discovering each other is a very important one and appears in many guises in the evolving wireless world. (See Fig. 7)

Figure 7. Wireless personal area networks

Wireless PANs don't require much battery power to operate, making them ideal for small user devices, such as audio headsets, cell phones, PDAs, game controls, GPS units, digital cameras, and laptops.

b) Wireless LANs:

Wireless LAN (WiFi) offers the promise of unhindered access to network resources even outside the reach of a wired setup.

Wireless LAN or Wireless Local Area Network is a term to refer to a Local Area Network that does not need cables to connect the different devices. Instead, radio waves are used to communicate. Technologies that can be used to do that include IEEE 802.11 and Bluetooth. (See Fig. 8)

Figure 8. Wireless personal area networks

Benefits of Wireless LANs

- People can access the network from where they want; they are no longer limited by the length of the cable

- Some cities have started to offer Wireless LANs. This means that people can access the internet even outside their normal work environment, for example when they ride the train home.
- Setting up a wireless LAN can be done with one box (called Access point). This box can handle a varying number of connections at the same time. Wired networks require cables to be laid. This can be difficult for certain places.
- Access points can serve a varying number of computers.

Disadvantages of Wireless LANs

- Wireless LANs use radio waves to communicate. Special care needs to be taken to encrypt information. Also the signal is much worse, and more bandwidth needs to be spent on error correction.
- A typical IEEE 802.11 access point has a range of meters from where devices can connect. To extend the range more access points are needed.
- There are many reliability problems, especially those connected to interference from other devices.
- Wireless LANs are much slower than wired ones; this may not matter for most users though, because the bottleneck in a home network is usually the speed of the ADSL line (used to connect to the Internet).

c) Wireless MANs:

Wireless MANs offer connections between buildings and users within a city or campus area through several system configurations. In most cases, the wireless MAN beams RF or infrared light from one point to another using directive antennae.

Point-to-Point Systems

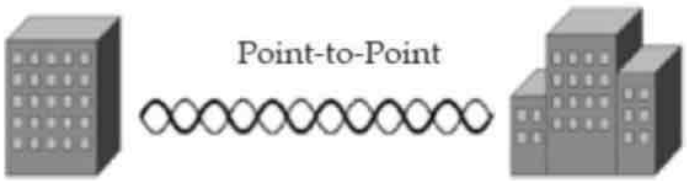

Figure 9. Point-to-Point Wireless MAN Directly Connects Two Points in the Network

Point-to-Multipoint System

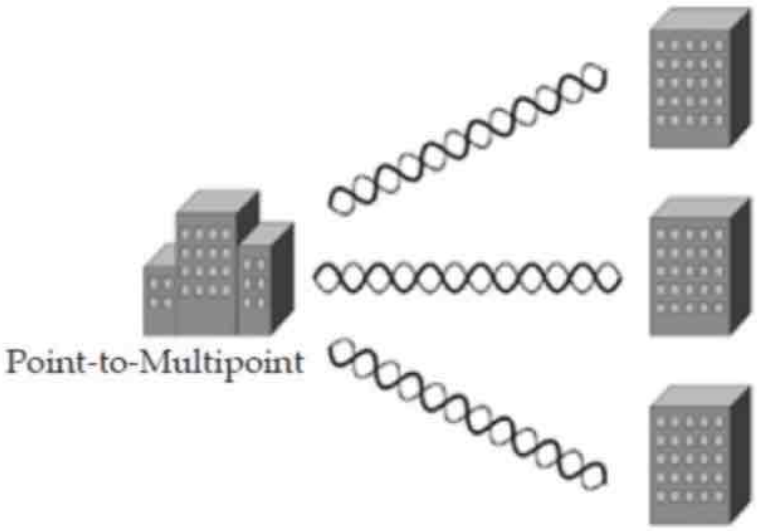

Figure 10. Point-to- Multipoint Interconnects Users Through a Common, Centralized.

Packet Radio Systems

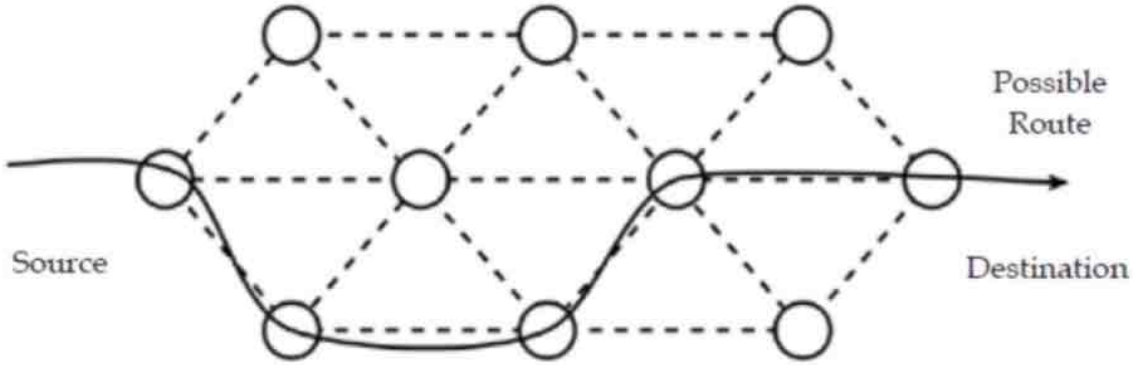

Figure 11. Packet Radio System Hops Data Packets from the Source to Destination.

5. Benefits of Wireless Networks

Wireless LANs offer the following productivity, convenience, and cost advantages over wired networks:

- ✓ **Mobility:** Wireless LAN systems can provide LAN users with access to real-time information anywhere in their organization. This mobility supports productivity and service opportunities not possible with wired networks. There are now thousands of universities, hotels and public places with public wireless connection. These free you from having to be at home or at work to access the Internet.

- ✓ **Installation Speed and Simplicity:** Installing a wireless LAN system can be fast and easy and can eliminate the need to pull cable through walls and ceilings.
- ✓ **Reduced Cost-of-Ownership:** While the initial investment required for wireless LAN hardware can be higher than the cost of wired LAN hardware, overall installation expenses and life-cycle costs can be significantly lower. Long-term cost benefits are greatest in dynamic environments requiring frequent moves and changes.
- ✓ **Scalability:** Wireless LAN systems can be configured in a variety of topologies to meet the needs of specific applications and installations. Configurations are easily changed and range from peer-to-peer networks suitable for a small number of users to full infrastructure networks of thousands of users that enable roaming over a broad area Wireless networks are a product of convenience for society.
- ✓ **Security:** When using wireless networks, security is an issue.
- ✓ **Convenience:** Wireless Networks can help make connecting to the internet much more convenient. You don't need an ethernet connection so you can connect anywhere with a strong enough signal and a wireless network that is publicly accessible without a password.
- ✓ **Devices:** Many different devices can be used over a wireless network. These include laptop computers, Cellular phones, Blackberry devices, and handheld computers.
- ✓ **Speed:** Wireless networks are less reliable with connection speeds than connections using an ethernet cable. This is due to the risk of dead spots where the signal is either weak or non-existent. Weather, and signal interference also play a role in weakening a connection.