

Chapter 1

Fundamentals of Wireless Network and Mobile Computing

Outline

- Nature of Wireless Networks and Mobile Computing
- Why Mobile Computing
- Advantages and Disadvantages of Wireless Communication
- Applications of Wireless Communications
- Common Wireless communication Technologies
- Types of Wireless networks,
- Simple Reference Model
- Authentication, Encryption and Security
- Mobile Computing platform and Technologies

What is Wireless?

- Wireless refers to the method of transferring information between computing devices, such as a personal data assistant (PDA) and a data source such as an agency database server, without a physical connection or wires.
- The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometers for radio communications).
- Not all wireless communication technologies are mobile.

What is Wireless?

- For example, lasers are used in wireless data transfer between buildings, but cannot be used in mobile communication at this time.
- Because in this technology transmitter and receiver will remain at fixed position and if it changes the communication may be lost.

What is Mobile?

- Mobile simple describes a computing device that is not restricted to a desktop.
- Mobile device may be a PDA, a “smart” cell phone, a laptop computer, or any one of numerous other devices that allow the user to complete computing task without being connected to a any Network.

What is Wireless communication?

- Wireless communication is simply data communication without the use of landlines.
- This may involve cellular telephone, two-way radio, fixed wireless (broadband wireless), laser (free space optics), or satellite communications.

What is Mobile Computing?

- It is a technology that allows transmission of data via, a computer without having to be connected to a fixed physical link.
- Mobile computing environment as being made up of three main components: a computer (that moves), a N/W (that is either wired or wireless) & co-ordination S/W that ties them together.
- In mobile N/W computing activities are not disrupted when the user changes the computer's points of attachment to the internet.

What is Mobile Computing?

- Instead all the needed reconnection occurs automatically & no interactively.
- Truly mobile computing offers many advantages.
- Confident access to the internet any time, any where will help free us from the ties that bind us to our desktops.

Why Wireless communication?

- People now a day are demanding instant communication at the same time they do not want to stick to their desk or office.
- What they want is communication at any where and any time, even though they are on move.
- The solution for complete mobility is only.
- Wireless computing can make significant difference in your productivity, responsiveness to the customer.
- You can also reduce or eliminate cabling cost and relocate devices without having to rewire your facilities.

Advantages of Wireless Communication

- **Mobility:**
- Wireless network systems can provide network users with access to real-time information anywhere in there organization.
- The mobility supports productivity and service opportunities not possible with wired networks.

Advantages of Wireless Communication

- **Installation speed & simplicity:**
- Installation a wireless network system can be fast and easy and can eliminate the need to pull cable through walls and ceilings.
- **Installation Flexibility:**
- Wireless technology allows the network to go where wire can not go.

Advantages of Wireless Communication

- **Reduced cost of Ownership:**
- While the initial investment required for wireless network hardware can be higher than the cost of wired.
- N/W 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.

Advantages of Wireless Communication

- **Scalability:**
- Wireless N/W systems can be configured in a variety of topologies to meet the need of specific applications and installations.
- Configurations are easily changed and range from peer-to-peer N/W suitable for a small number of users to full infrastructure N/Ws of thousands of users that enable roaming over a broad area.

Disadvantage of wireless communication

- **Radio signal interference:**
- Because wireless devices operate using radio signals, the potential for two type of signal interference exists.
- Signals from other devices can disrupt what a wireless device is trying to transmit, or a wireless device may itself be a source of interference for other devices.
- several common office devices transmit radio signals that may interfere with a WLAN.

Disadvantage of wireless communication

- These devices include microwave ovens, elevator motors and other heavy electrical equipment.
- These may cause errors to occur in the transmission between a wireless device and an access point.
- In addition, Bluetooth and WLAN 802.11 devices both operate in the same radio frequency, potentially resulting in interference between such devices.

Disadvantage of wireless communication

- The solution for wireless devices is the same as that for standard cabled network devices: locate the source of the interference and eliminate it.
- This usually is solved by moving a photocopier or microwave oven across the room or another room.
- In addition many wireless devices can identify that an error has occurred in the transmission and retransmit the data as necessary.

Disadvantage of wireless communication

- **Security:**
- Because a wireless device transmits radio signals over a broad area, security becomes a major concern.
- It is possible for an intruder to be lurking outdoors with a note book computer and wireless NIC with the intent of intercepting the signals from a nearby wireless network.
- Because much of a business network traffic may contain sensitive information, this is a real concern for many users.

Disadvantage of wireless communication

- However, some wireless technologies can provide added levels of security.
- A special coded number can be programmed into every authorized wireless device and the device must transmit the special number prior to gaining access to the network, otherwise it is denied access.
- Network managers can also limit access to a wireless network by programming it with a list of approved wireless devices.(e.g:cyber roam)

Disadvantage of wireless communication

- Only those devices on the list will be allowed access.
- As a further protection, data transmitted between the access point and the wireless device can also be encrypted or encoded in such a way that only the recipient can decode the message.
- If an unauthorized user were to intercept the radio signals being transmitted, he or she could not read the messages being sent.

Disadvantage of wireless communication

- **Health risks:**
- Wireless devices contain radio transmitters and receivers that emit radio frequency (RF) energy.
- Typically, these wireless devices emit low levels of RF while being used.
- Scientists know that high levels of RF can produce biological damage through heating effects. (This is how a microwave oven is able to cook food.)

Disadvantage of wireless communication

- In the United States, the Food and Drug Administration (FDA) and the Federal Communications Commission (FCC) set policies and procedures for some wireless devices, such as cellular telephones.
- The latest FDA update stated that “ the available science does not allow us to conclude that (wireless devices) are absolutely safe, or that they are unsafe.”

Disadvantage of wireless communication

- Thus the available science does not permit a conclusion either way about the safety of wireless mobile devices.
- There is no evidence regarding any health risks associated with using any wireless device, it is always wise to be aware of the concern and to monitor ongoing scientific research.

Different between Mobile and Wireless

- Two aspects of mobility:
 - user mobility: users communicate (wireless) “anytime, anywhere, with anyone”
 - device portability: devices can be connected anytime, anywhere to the network

- **Wireless vs. mobile**

x
x
✓
buildings
✓
(PDA)

x
✓
x
✓

Examples

stationary computer
notebook in a hotel
wireless LANs in historic
Personal Digital Assistant

Mobile and Wireless Devices

Pager

- receive only
- tiny displays
- simple text messages



Mobile phones

- voice, data
- simple graphical displays

PDA

- graphical displays
- character recognition
- simplified WWW



Smart phone

- tiny keyboard
- simple versions of standard applications

Laptop/Notebook

- fully functional
- standard applications



Application of Mobile and Wireless Communications

- **Education:**
- Wireless technology is an ideal application of colleges and schools.
- An instructor can create a classroom presentation on the notebook computer in his home or school office and this presentation can access in classroom using wireless devices.
- Teachers can also distribute handouts directly to students who have brought their own wireless devices to class.

Application of Mobile and Wireless Communications

- The wireless connection also frees students from having to go to a specific computer lab or the library to get on the college campus network.
- They can access the campus network “wirelessly” from almost any location on campus.

Application of Mobile and Wireless Communications

- **Home Entertainment:**
- Several large computer manufacturers are introducing specialized media PCs that enable movie and audio enthusiasts to download, distribute and control all forms of digital entertainment from anywhere in the house.
- Some of the systems also have the ability to control lights, air conditioners and other household devices.

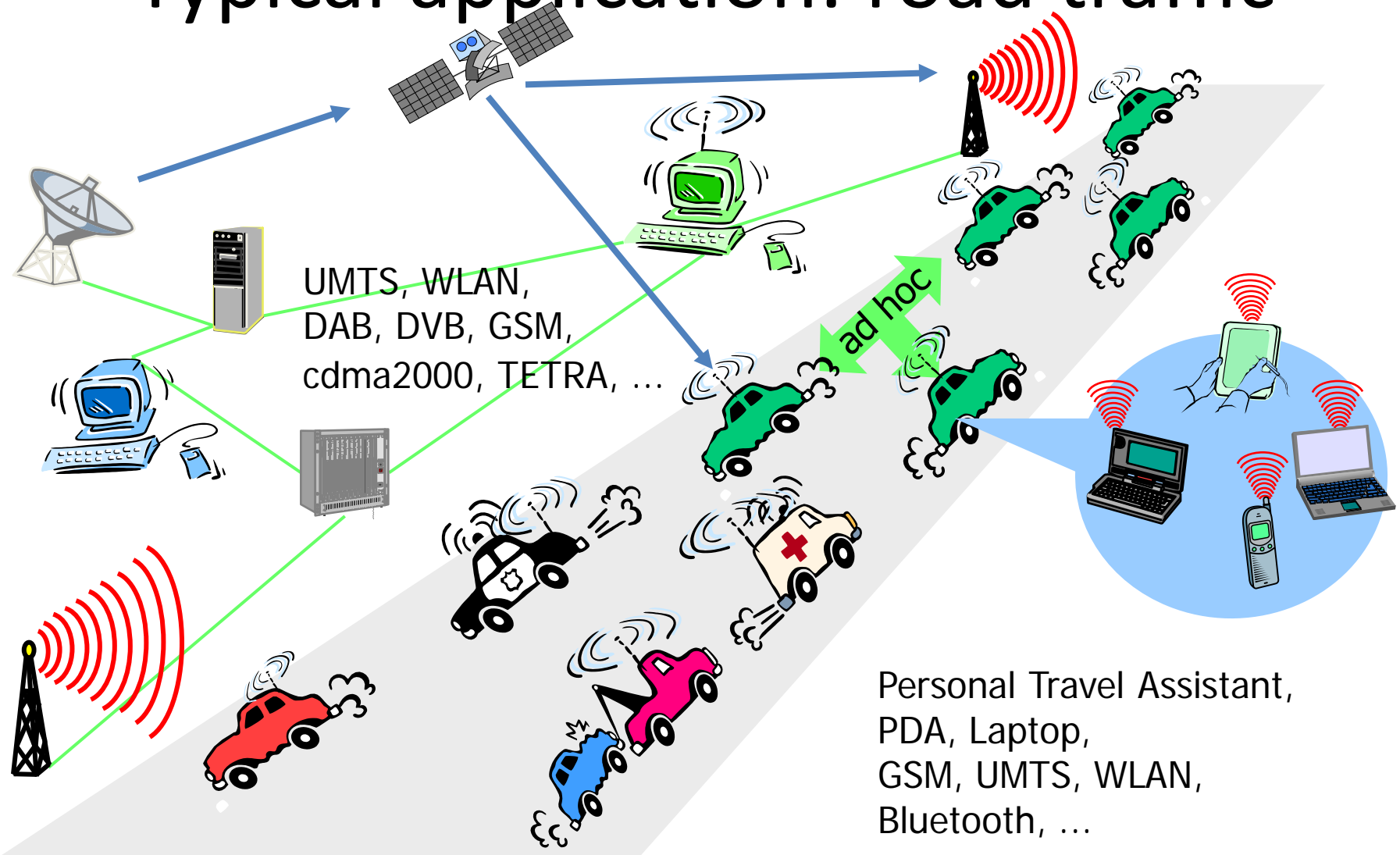
Application of Mobile and Wireless Communications

- You can send music, movies, or pictures to a stereo receiver, portable device or PC located anywhere in the house.
- You can also download the files to your digital media portable devices, such as MP3 and video players that can be used while roaming throughout the house.

Application of Mobile and Wireless Communications

- **Vehicles :**
 - Transmission of news, road condition, weather, music via DAB(*Digital Audio Broadcasting*)
 - Personal communication using GSM(Global System for Mobile Communications)/UMTS(*Universal Mobile Telecommunications System*)
 - Position via GPS(*Global Positioning System*)
 - local ad-hoc network with vehicles close-by to prevent accidents, guidance system
 - vehicle data (e.g., from busses, high-speed trains) can be transmitted in advance for maintenance

Typical application: road traffic



Application of Mobile and Wireless Communications

- **In Companies:**
- In companies managers can use mobile computer in, say critical presentations to major customers.
- They can access the latest market share information.
- At a small recess, they can revise the presentation take advantages of this information.
- They can communicate with the office about possible new offers and call meetings for discussing responds to the new proposals.
- Therefore, mobile computers can leverage competitive advantages.

Application of Mobile and Wireless Communications

- **Government:**
- Government applications center around assessments, inspections and work orders.
- Most of these applications involve auditing some sort of facility or process
- For e.g.: food service, restaurant, child care, schools, and residential buildings.

Application of Mobile and Wireless Communications

- **Emergency Services:**
- Emergency services ability to receive information on the move is vital where the emergency services are involved.
- Information regarding the address, type and other details of an incident can be dispatched quickly, via CDPD(*Cellular Digital Packet Data*) system using mobile computers.
- Here, the reliability and security implemented in the CDPD system would be of great advantage.

Application of Mobile and Wireless Communications

- **Healthcare:**
- The focus in the industry has been on automating patient records, medication dispensation and sample collection.
- A common goal is to leverage mobile computing in the implementation of positive patient identification.

Application of Mobile and Wireless Communications

- **Market Research:**
- Automating the survey process has enable these companies to get their data more accurately and quickly while being able to customize their queries at will.

Application of Mobile and Wireless Communications

- **Credit Card Verification:**
- At Point of Sale (POS) terminals in shops and supermarkets, when customers use credit cards for transactions, the intercommunication required between the bank central computer and the POS terminal, in order to effect verification of the card usage, can take place quickly and securely over cellular channels using a mobile computer unit.
- This can speed up the transaction process and relieve congestion at the POS terminals.

Application of Mobile and Wireless Communications

- **Electronic Mail/Paging:**
- Usage of mobile unit to send and read emails is a very useful asset for any business individual, as it allow him/her to keep in touch with any colleagues as well as any urgent developments that may affect their work.
- Access to the internet, using mobile computing technology, allows the individual to have vast array of knowledge at his/her fingertips.

Application of Mobile and Wireless Communications

- Paging is also achievable here, giving even more intercommunication capability between individuals, using a single mobile computer device.

Wireless Operating Systems and Languages

- **Major Operating System**
 - Palm OS
 - EPOC (Symbian)
 - Windows CE
 - JAVA Micro Edition
- **Wireless Languages**
 - HDML
 - WML
 - cHTML

Types of Wireless Systems

- AMPS and European Analog cellular (Advanced Mobile Phone System)
- TDMA (Time Division Multiple Access)
- CDMA (Code-Division Multiple Access)
- GSM (Global System for Mobile Communication)
- GPRS (General Packet Radio Service)
- EDGE (Enhanced Data Rates for Global Evolution)

Types of Wireless Technologies

- Radio Waves
- Microwave
- Wi-Fi
- Wi-Max
- ZIGBEE

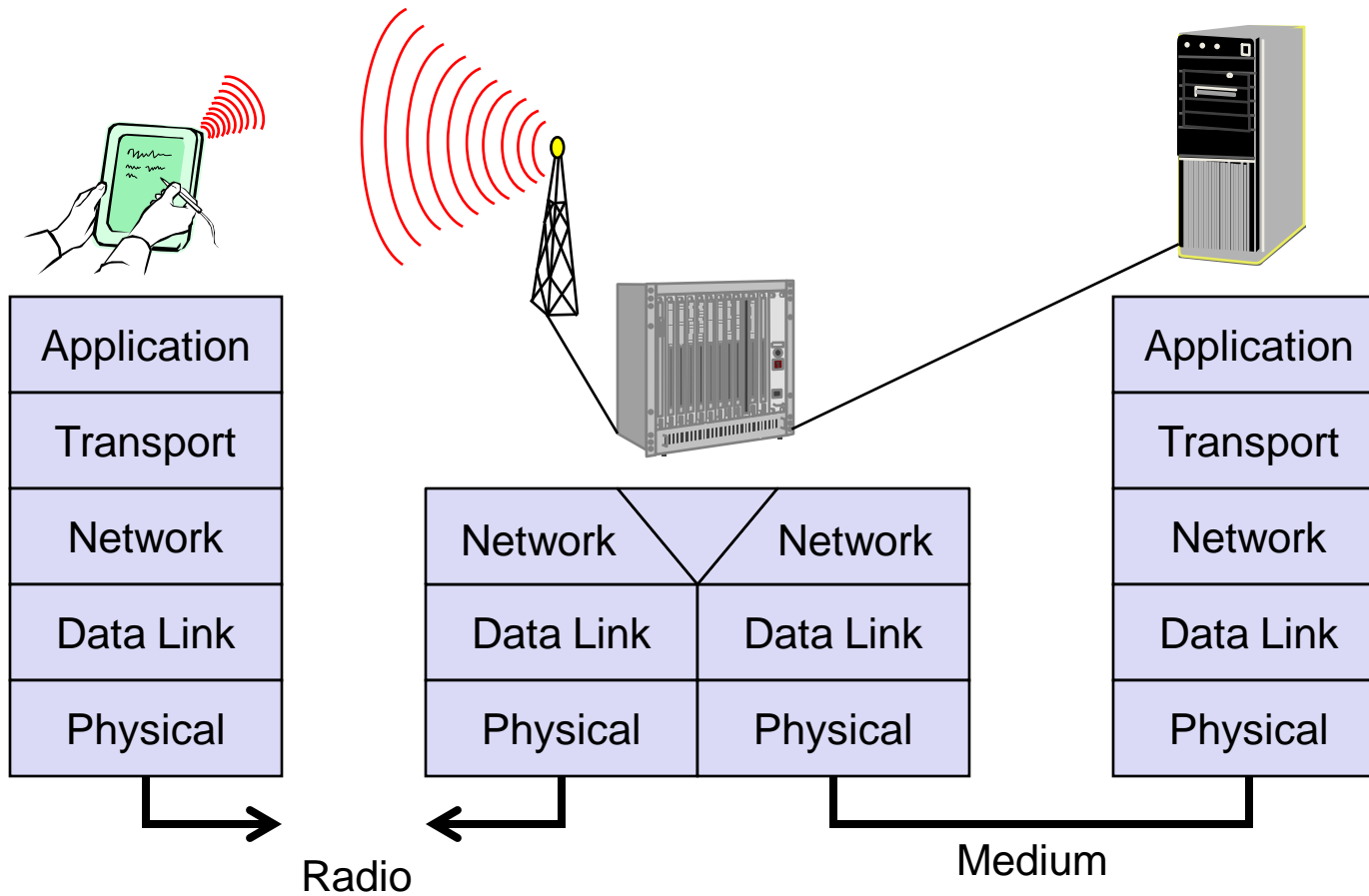
Simple Reference Model

- The basic reference model used to structure communication system.
- In next slide figure a personal digital assistant (PDA) which provides an example for a wireless and portable device.
- This PDA communicates with a base station in the middle of the picture.
- The base station consists of a radio transceiver (sender & receiver) and an inter working unit connecting the wireless link with the fixed link.

Simple Reference Model

- The communication partner of the PDA, a conventional computer, is shown on the right-hand side.
- Each N/W element (such as PDA, inter working unit, computer), the figure shows the **protocol stack** implemented in the system according to the reference model.

Simple Reference Model used here



Simple Reference Model

End-System, such as the PDA and computer in the example need a full protocol stack comprising the application, transport, network, data link and physical layer.

- Applications on the end-systems communicate with each other using the lower layer services.

Intermediate system, such as the inter working unit, do not necessarily need all of the layers.

- Next slide to explain the functions of each layer in more detail in a wireless and mobile environment.

Simple Reference Model

Physical layer:

- This is the lowest layer in a communication system and is responsible for the conversion of a stream of bits into signals that can be transmitted on the sender side.
- The physical layer of the receiver then transforms the signals back into a bit stream.
- For wireless communication the physical layer is responsible for frequency selection, generation of the carrier frequency, signal detection, modulation of data onto a carrier frequency and encryption.

Simple Reference Model

Data link layer:

- The main tasks of this layer include accessing the medium, multiplexing of different data streams, correction of transmission errors, and synchronization.
- The data link layer is responsible for a reliable point-to-point connection between two devices or a point-to-multipoint connection between one ender and several receivers.

Simple Reference Model

Network layer:

- This third layer is responsible for routing packets through network or establishing a connection between two entities over many other intermediate systems.
- Important topics are addressing, routing, device location and handover between different networks.

Simple Reference Model

Transport layer:

- This layer is used in the reference model to establish an end-to-end connection.
- The quality of service, flow and congestion control are relevant, especially if the transport protocols known from the internet, TCP and UDP are to be used over a wireless link.

Simple Reference Model

Application layer:

- Finally, the application are situated on top of all transmission-oriented layers.
- And support for multimedia applications, adaptive applications that can handle the large variations in transmission characteristics and wireless access to the world wide web using a portable device.
- Very demanding applications are video and interactive gaming.