CS8601 –MOBILE COMPUTING

UNIT 1

INTRODUCTION

1.1 Introduction to Mobile Computing and Applications of Mobile Computing:

The rapidly expanding technology of cellular communication, wireless LANs, and satellite services will make information accessible anywhere and at any time. Regardless of size, most mobile computers will be equipped with a wireless connection to the fixed part of the network, and, perhaps, to other mobile computers.

The resulting computing environment, which is often referred to as ***mobile or nomadic computing***, no longer requires users to maintain a fixed and universally known position in the network and enables almost unrestricted mobility.

Mobile Computing is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and anywhere

There are two different kinds of mobility: **user mobility and device portability**.

User mobility refers to a user who has access to the same or similar telecommunication services at different places, i.e., users communicate (wireless) "anytime, anywhere, with anyone"

With **device portability**,1 the communication device moves (with or without a user). Many mechanisms in the network and inside the device have to make sure that communication is still possible while the device is moving. devices can be connected anytime, anywhere to the network

A communication device can exhibit any one of the **following characteristics**:

- **Fixed and wired**: This configuration describes the typical desktop computer in an office. Neither weight nor power consumption of the devices allow for mobile usage. The devices use fixed networks for performance reasons.
- **Mobile and wired**: Many of today's laptops fall into this category; users carry the

laptop from one hotel to the next, reconnecting to the company's network via the telephone network and a modem.

- **Fixed and wireless**: This mode is used for installing networks, e.g., in historical buildings to avoid damage by installing wires, or at trade shows to ensure fast network setup.
- **Mobile and wireless**: This is the most interesting case. No cable restricts the user, who can roam between different wireless networks. Most technologies discussed in this book deal with this type of device and the networks supporting them. Today's most successful example for this category is GSM with more than 800 million users.

1.1 Applications of Mobile Computing:

In many fields of work, the ability to keep on the move is vital in order to utilize time efficiently. The importance of Mobile Computers has been highlighted in many fields of which a few are described below:

a. Vehicles:

- Music, news, road conditions, weather reports, and other broadcast information are received **via digital audio broadcasting (DAB) with 1.5 Mbit/s.**
- For personal communication, **GSM**, **universal mobile telecommunications system (UMTS)** phone might be available offering voice and data connectivity with 384 kbit/s.
- The current position of the car is determined **via the global positioning system (GPS).** Cars driving in the same area build a local ad-hoc network for the fast exchange of information in emergency situations or to help each other keep a safe distance. In case of an accident, not only will the airbag be triggered, but the police and ambulance service will be informed via an emergency call to a service provider.
- Buses, trucks, and trains are already transmitting maintenance and logistic information to their home base, which helps to improve organization (fleet management), and saves time and money.

b. Emergencies:

- An ambulance with a **high-quality wireless connection to a hospital can carry vital information** about injured persons to the hospital from the scene of the

accident.

- All the necessary steps for this particular **type of accident can be prepared** and specialists can **be consulted for an early diagnosis.**
- Wireless networks are the only means of communication in the case of natural disasters such as **hurricanes or earthquakes**. In the worst cases, only decentralized, wireless ad-hoc networks survive.

c. Business:

- Managers can use mobile computers say, **critical presentations to major customers**. They can access the latest market **share information**. At a small recess, they can revise the presentation to take advantage 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.
- **A travelling salesman today needs instant access to the company's database**: to ensure that files on his or her laptop reflect the current situation, to enable the company to keep track of all activities of their travelling employees, to keep databases consistent etc.
- **With wireless access, the laptop can be turned into a true mobile office**, but efficient and powerful synchronization mechanisms are needed to ensure data consistency.

d. 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**.

e. Replacement of Wired Networks:

- wireless networks can also be used to **replace wired networks, e.g., remote sensors, for tradeshows, or in historic buildings.**

- Due to economic reasons, **it is often impossible to wire remote sensors for**
- **weather forecasts, earthquake detection, or to provide environmental information**.
- **Wireless connections, e.g., via satellite, can help in this situation**. Other examples for wireless networks are computers, sensors, or information displays in historical buildings, where excess cabling may destroy valuable walls or floors.

f. Infotainment:

- Wireless networks can **provide up-to-date information at any appropriate location**.
- The **travel guide** might tell you something about the history of a building (knowing via **GPS**, contact to a local base station, or triangulation where you are) downloading information about a concert in the building at the same evening via a local wireless network.
- Another growing field of wireless network applications lies in **entertainment and games** to enable, e.g., ad-hoc gaming networks as soon as people meet to play together.

g. Location dependent services

- **It is important for an application to 'know' something about the location or the user might need location information for further activities**

- **Location aware services**
  - what services, e.g., printer, fax, phone, server etc. exist in the local environment
- **Follow-on services**
  - automatic call-forwarding, transmission of the actual workspace to the current location
- **Information services**
  - "push": e.g., current special offers in the supermarket
  - "pull": e.g., where is the Black Forrest Cheese Cake?

- **Support services**
  - caches, intermediate results, state information etc. "follow" the mobile device through the fixed network
- **Privacy**
  - who should gain knowledge about the location

1.2 Limitations of Mobile Computing

- Resource constraints: **Battery**
- **Interference:** Radio transmission cannot be protected against interference using shielding and result in higher loss rates for transmitted data or higher bit error rates respectively
- **Bandwidth:** Although they are continuously increasing, transmission rates are still very low for wireless devices compared to desktop systems. Researchers look for more efficient communication protocols with low overhead.
- **Dynamic changes in communication environment**: variations in signal power within a region, thus link delays and connection losses
- **Network Issues**: discovery of the connection-service to destination and connection stability
- **Interoperability issues:** the varying protocol standards
- **Security constraints**: Not only can portable devices be stolen more easily, but the radio interface is also prone to the dangers of eavesdropping. Wireless access must always include encryption, authentication, and other security mechanisms that must be efficient and simple to use.

Wireless networks in comparison to fixed networks

Higher loss-rates due to interference

- emissions of, e.g., engines, lightning

Restrictive regulations of frequencies

- frequencies have to be coordinated, useful frequencies are almost all occupied

Lower transmission rates

- local some Mbit/s, regional sometimes only, e.g., 53kbit/s with GSM/GPRS or about 150 kbit/s using EDGE – some Mbit/s with LTE

Higher delays, higher jitter

- connection setup time with GSM in the second range, several hundred milliseconds for other wireless systems –in ms range with LTE

Lower security, simpler active attacking

- radio interface accessible for everyone, base station can be simulated, thus attracting calls from mobile phones

Always shared medium

- secure access mechanisms important

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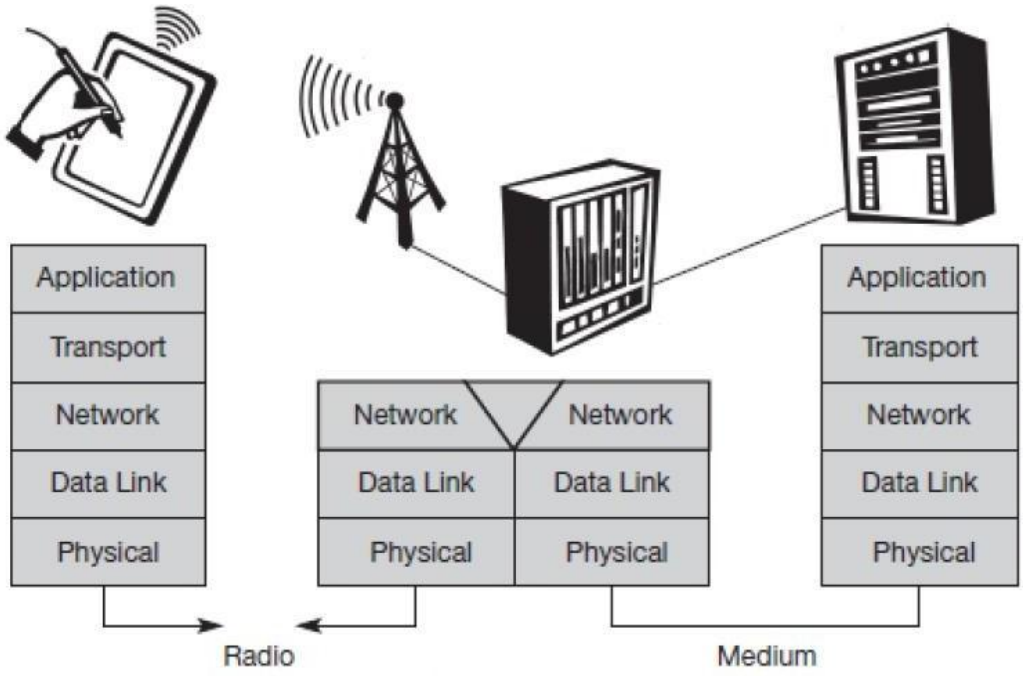
A simplified reference model

The figure shows the **protocol stack** implemented in the system according to the reference model. **End-systems**, such as the PDA and computer in the example, need a full protocol stack comprising the application layer, transport layer, network layer, data link layer, and physical layer. Applications on the end-systems communicate with each other using the lower layer services. **Intermediate systems**, such as the interworking unit, do not necessarily need all of the layers.



A Simplified 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** (although heavy interference may disturb the signal), modulation of data onto a carrier frequency and (depending on the transmission scheme) encryption.

Data link layer: The main tasks of this layer include **accessing the medium, multiplexing of different data streams, correction of transmission errors, and synchronization** (i.e., detection of a data frame).

Altogether, the data link layer is responsible for a **reliable point-to-point connection** between two devices or a point-to-multipoint connection between one sender and several receivers.

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

Transport layer: This layer is used in the reference model to **establish an end-to-end connection**

Application layer: Finally, the applications (complemented by additional layers that can support applications) are situated on top of all transmission oriented layers. Functions are **service location, 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.**

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