Need of Wireless and Mobile Communication?

The Need for Wireless/Mobile Networking

- Demand for Ubiquitous Computing
  - Anywhere, anytime computing and communication
    - You don't have to go to the lab to check your email
  - Pushing the computers more into background
    - Focus on the task and life, not on the computer
    - Use computers seamlessly to help you and to make your life more easier.
  - Computers should be location aware
    - Adapt to the current location, discover services

Some Example Applications of Ubiquitous Computing

- You walk into your office and your computer automatically authenticates you through your active badge and logs you into the Unix system

- You go to a foreign building and your PDA automatically discovers the closest public printer where you can print your schedule and give to your friend

More Examples

- You walk into a Conference room or a shopping Mall with your PDA and your PDA is smart enough to collect and filter the public profiles of other people that are passing nearby
    - ❑ Of course other people should also have smart PDAs.
- The cows in a village are equipped with GPS and GPRS devices and they are monitored from a central location on a digital map.
    - ❑ No need for a person to guide and feed them
- You can find countless examples

How to realize Ubiquitous Computing

- Small and different size computing and communication devices
  - Tabs, pads, boards
  - PDAs, Handhelds, Laptops, Cell-phones
- A communication network to support this
  - Anywhere, anytime access
  - Seamless, wireless and mobile access
  - Need for Personal Communication Services (PCS)
- Ubiquitous Applications
  - New software

What is PCS
Personal Communication Services

What is PCS

- Personal Communication Services
  - A wide variety of network services that includes wireless access and personal mobility services
  - Provided through a small terminal
  - Enables communication at any time, at any place, and in any form.
- The market for such services is tremendously big
  - Think of cell-phone market

Several PCS systems

- **High-tier Systems**
  - ❑ GSM: Global System for Mobile Communications
    - ■ The mobile telephony system that we are using
  - ❑ IS-136
    - ■ USA digital cellular mobile telephony system
    - ■ TDMA based multiple access
  - ❑ Personal Digital Cellular
  - ❑ IS-95 cdmaOne System
    - ■ CDMA based multiple access

Several PCS systems

- Low-tier systems
  - Residential, business and public cordless access applications and systems
    - Cordless Telephone 2 (CT2)
    - Digital Enhanced Cordless Telephone (DECT)
    - Personal Access Communication Systems (PACS)
    - Personal Handy Telephone System (PHS)

Several PCS systems

- Wideband wireless systems
  - For Internet access and multimedia transfer
    - Cdma2000
    - W-CDMA, proposed by Europe
    - SCDMA, proposed by China/Europe

Several PCS systems

- **Other PCS Systems**
  - Special data systems
    - CDPD: Cellular Digital Packet Data
    - RAM Mobile Data
    - Advanced Radio Data Information System (ARDIS)
  - Paging Systems
  - Mobile Satellite Systems
    - LEO, MEO, HEO satellites for data/voice
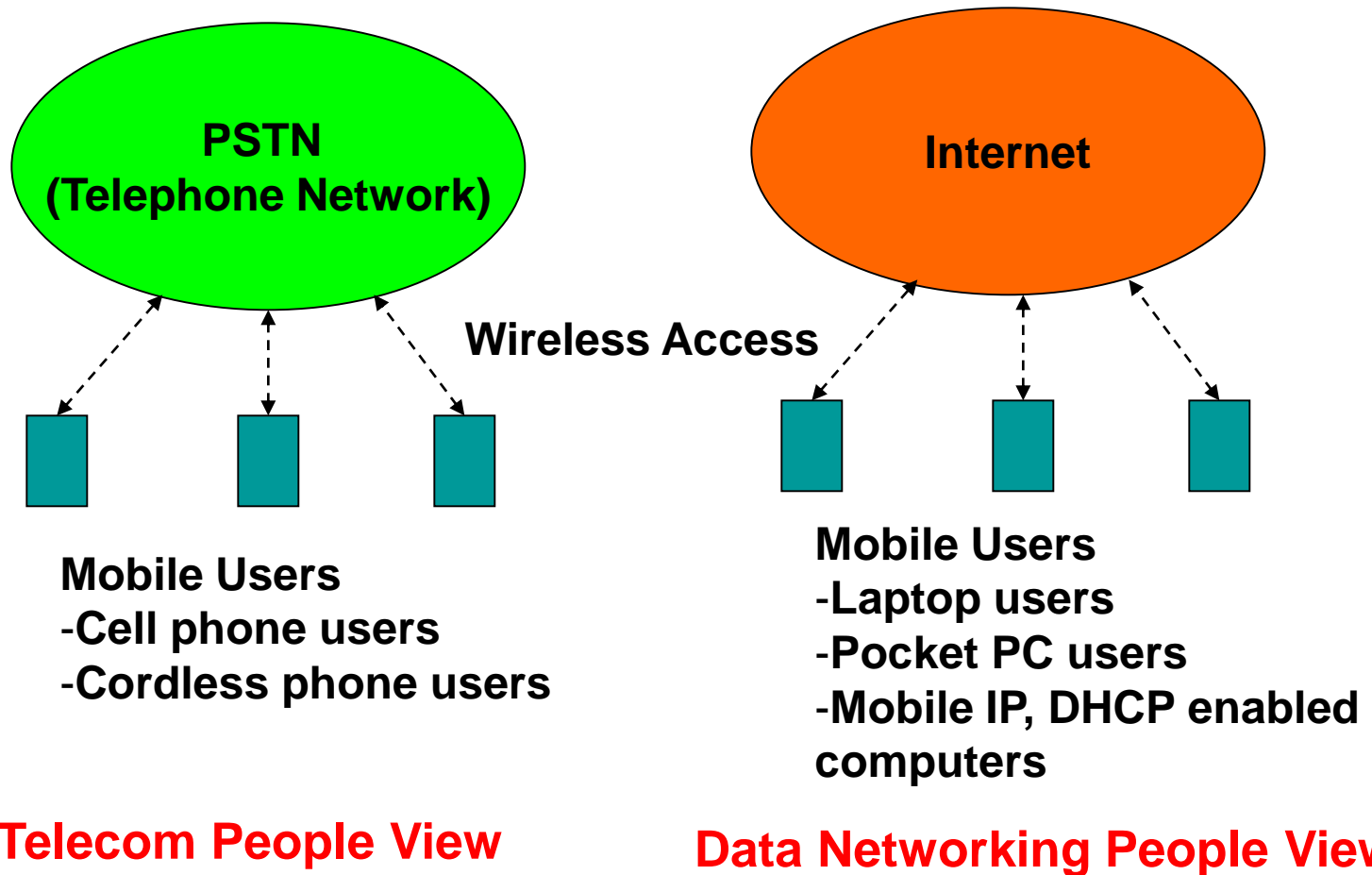 - ISM band systems: Bluetooth, 802.11, etc.

PCS Problems

- How to integrate mobile and wireless users to the Public Switched Telephone Network (PSTN) (Voice Network)
    - Cellular mobile telephony system
- How to integrate mobile and wireless users to the Internet (Data Network)
    - Mobile IP, DHCP, Cellular IP
- How to integrate all of them together and also add multimedia services (3G Systems)

Looking to PCS from different Angles

PSTN (Telephone Network)

Internet

Wireless Access

Mobile Users
-Cell phone users
-Cordless phone users

Mobile Users
-Laptop users
-Pocket PC users
-Mobile IP, DHCP enabled computers

Telecom People View

Data Networking People View

Telecom and Data Networking
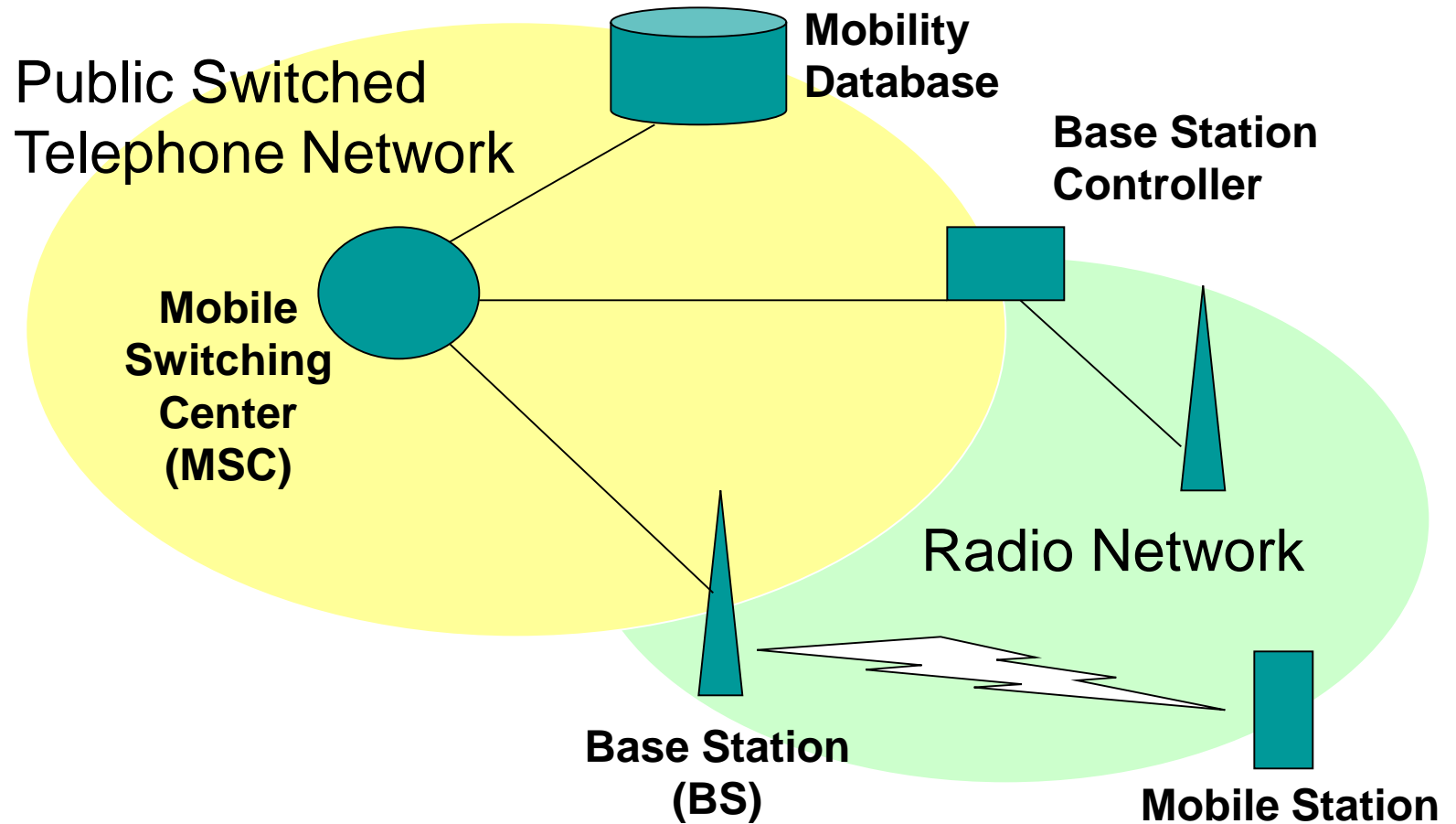
Telecom Interest   **Data Networking Interest**

- Voice Transmission
- Frequency Reuse
- Handoff Management
- Location Tracking
- Roaming
- QoS
- GSM, CDMA, Cordless Phones,
- GPRS, EDGE

- Radio Propagation
- Link Characteristics
- Error Models
- Wireless Medium Access (MAC)
- Error Control

- Data Transmission
- Mobile IP (integrating mobile hosts to internet)
- Ad-hoc Networks
- TCP over Wireless
- Service Discovery

Very Basic Cellular/PCS Architecture

Public Switched
Telephone Network

**Mobility
Database**

**Base Station
Controller**

**Mobile
Switching
Center
(MSC)**

Radio Network

**Base Station
(BS)**

Mobile Station

Wireless System Definitions

❑ Mobile Station

    ❑ A station in the cellular radio service intended for use while in motion at unspecified locations. They can be either hand-held personal units (portables) or installed on vehicles (mobiles)

❑ Base station

    ❑ A fixed station in a mobile radio system used for radio communication with the mobile stations. Base stations are located at the center or edge of a coverage region. They consists of radio channels and transmitter and receiver antennas mounted on top of a tower.

Wireless System Definitions

❑ Mobile Switching Center

   ❑ Switching center which coordinates the routing of calls in a large service area. In a cellular radio system, the MSC connections the cellular base stations and the mobiles to the PSTN (telephone network). It is also called Mobile Telephone Switching Office (MTSO)

❑ Subscriber

   ❑ A user who pays subscription charges for using a mobile communication system

❑ Transceiver

   ❑ A device capable of simultaneously transmitting and receiving radio signals

Wireless System Definitions

❏ ## Control Channel

  ❏ Radio channel used for transmission of call setup, call request, call initiation and other beacon and control purposes.

❏ ## Forward Channel

  ❏ Radio channel used for transmission of information from the base station to the mobile

❏ ## Reverse Channel

  ❏ Radio channel used for transmission of information from mobile to base station

Wireless System Definitions

❑ **Simplex Systems**

    ❑ Communication systems which provide only one-way communication

❑ **Half Duplex Systems**

    ❑ Communication Systems which allow two-way communication by using the same radio channel for both transmission and reception. At any given time, the user can either transmit or receive information.

❑ **Full Duplex Systems**

    ❑ Communication systems which allow simultaneous two-way communication. Transmission and reception is typically on two different channels (FDD).

Wireless System Definitions

- ❑ Handoff
  - ❑ The process of transferring a mobile station from one channel or base station to an other.

- ❑ Roamer
  - ❑ A mobile station which operates in a service area (market) other than that from which service has been subscribed.

- ❑ Page
  - ❑ A brief message which is broadcast over the entire service area, usually in simulcast fashion by many base stations at the same time.