Wireless Mobile Communication

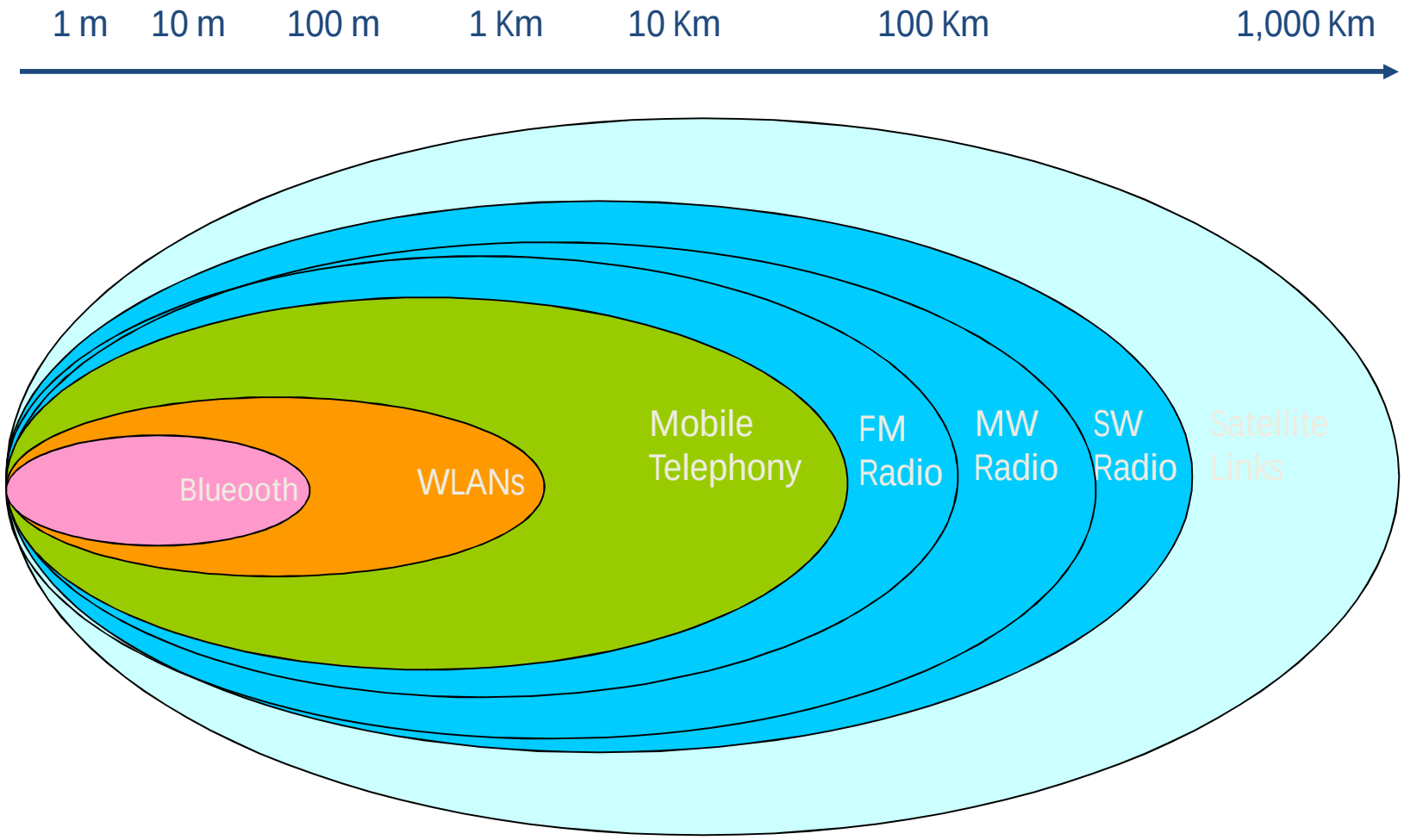
Lecture 3

- Various Wireless Systems

Topics to be covered

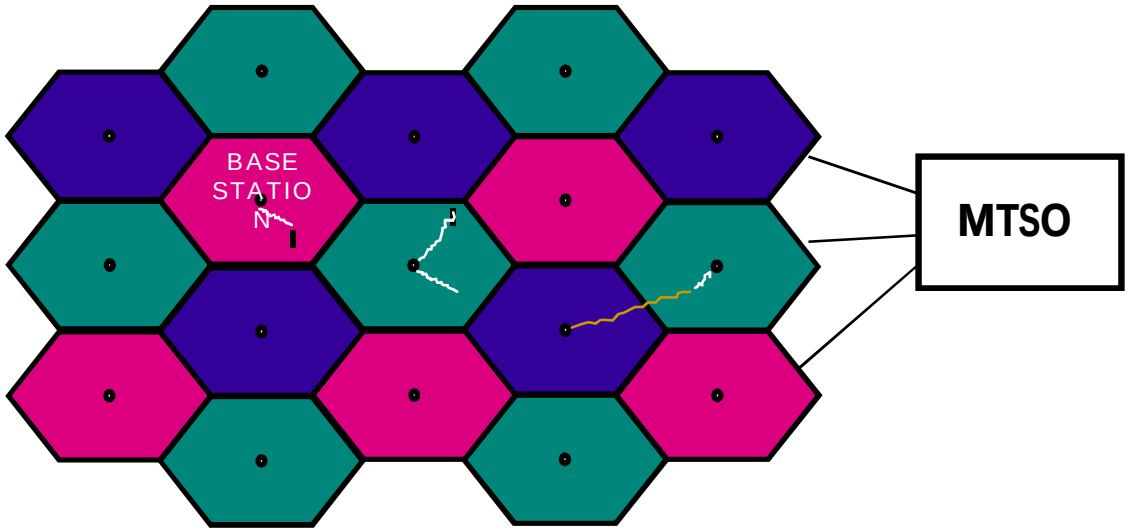
- Cellular systems
- Wireless LANs
- Satellite Systems
- Paging Systems
- Bluetooth
- Ultrawideband Radios
- Zigbee Radios

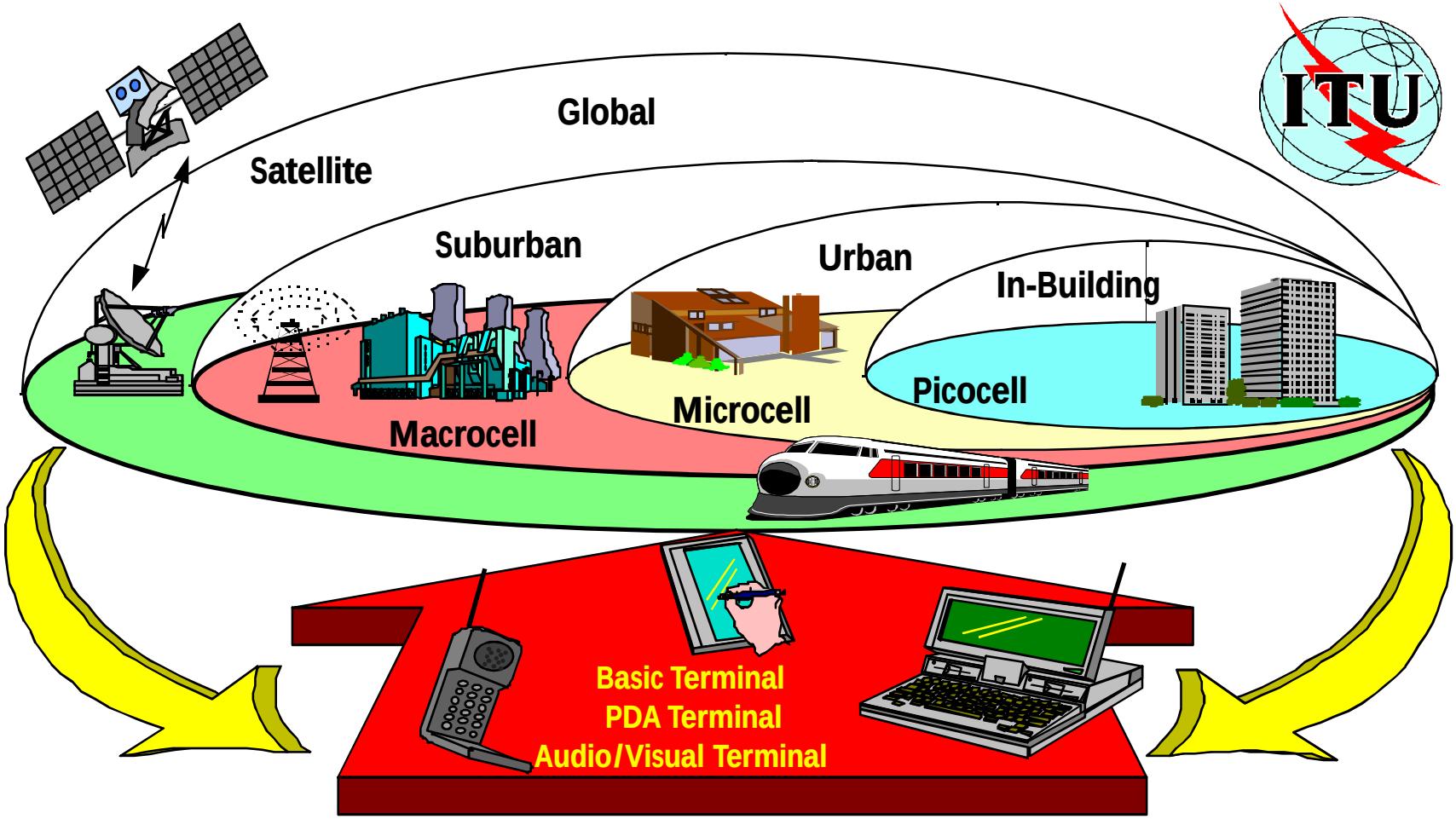
Wireless Systems: Range Comparison



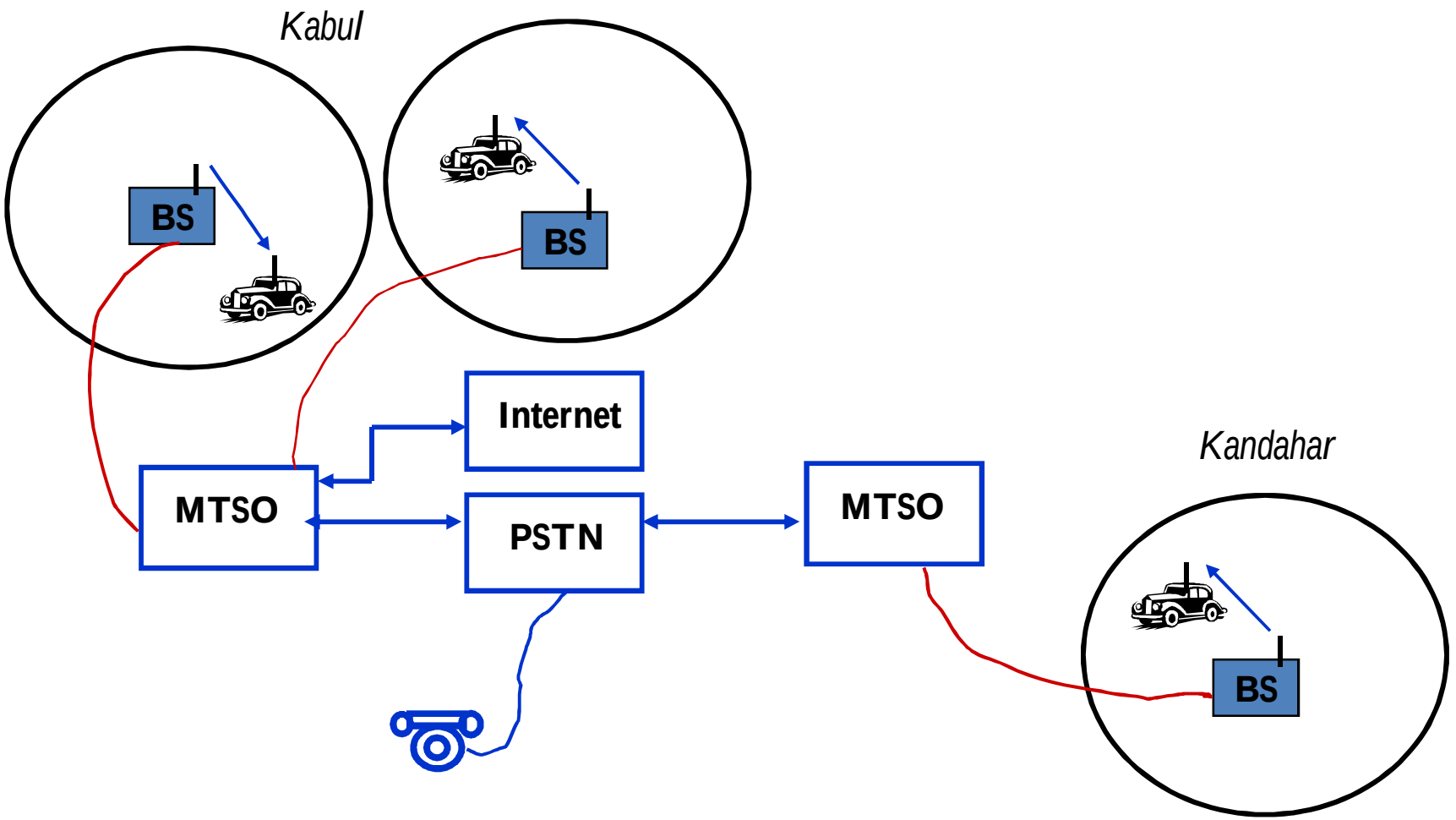
Cellular Systems:
Reuse channels to maximize capacity

- Geographic region divided into cells
- Frequencies/timeslots/codes reused at spatially-separated locations.
- Co-channel interference between same color cells.
- Base stations/MTSOs coordinate handoff and control functions
- Shrinking cell size increases capacity, as well as networking burden




Global
Satellite
Suburban
Urban
In-Building
Macrocell
Microcell
Picocell
Basic Terminal
PDA Terminal
Audio/Visual Terminal

Cellular Phone Networks



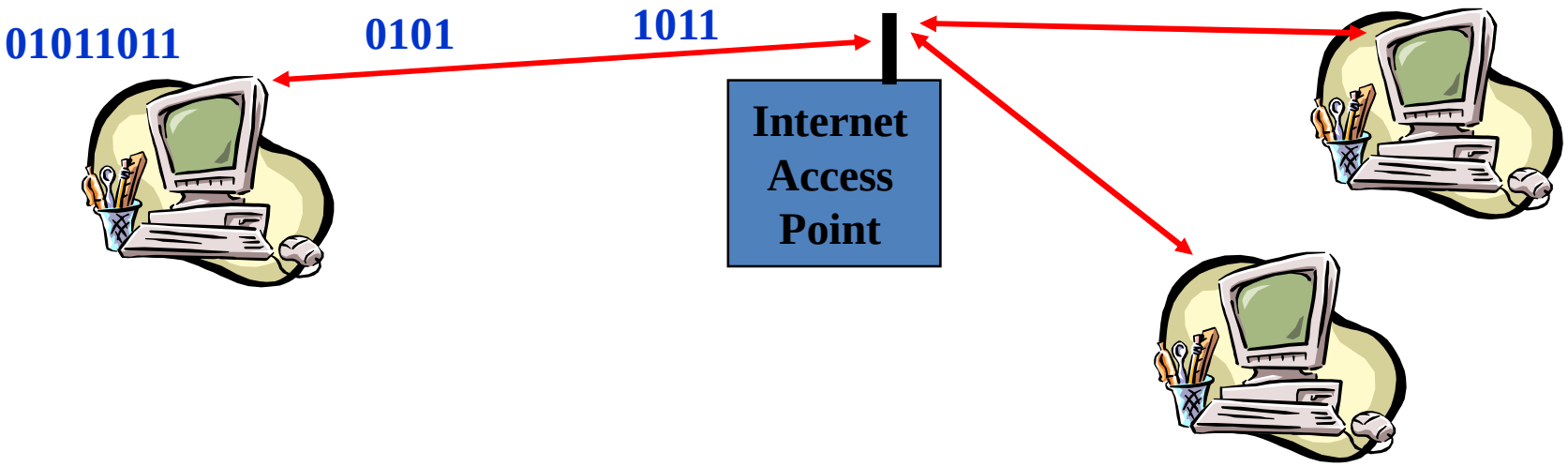
The Wireless Revolution

Cellular is the fastest growing sector of communication industry (exponential growth since 1982, with over 2 billion users worldwide today)

- Three generations of wireless
  - First Generation (1G): Analog 25 or 30 KHz FM, voice only, mostly vehicular communication
  - Second Generation (2G): Narrowband TDMA and CDMA, voice and low bit-rate data, portable units.

    2.5G increased data transmission capabilities
  - Third Generation (3G): Wideband TDMA and CDMA, voice and high bit-rate data, portable units

Wireless Local Area Networks (WLANs)



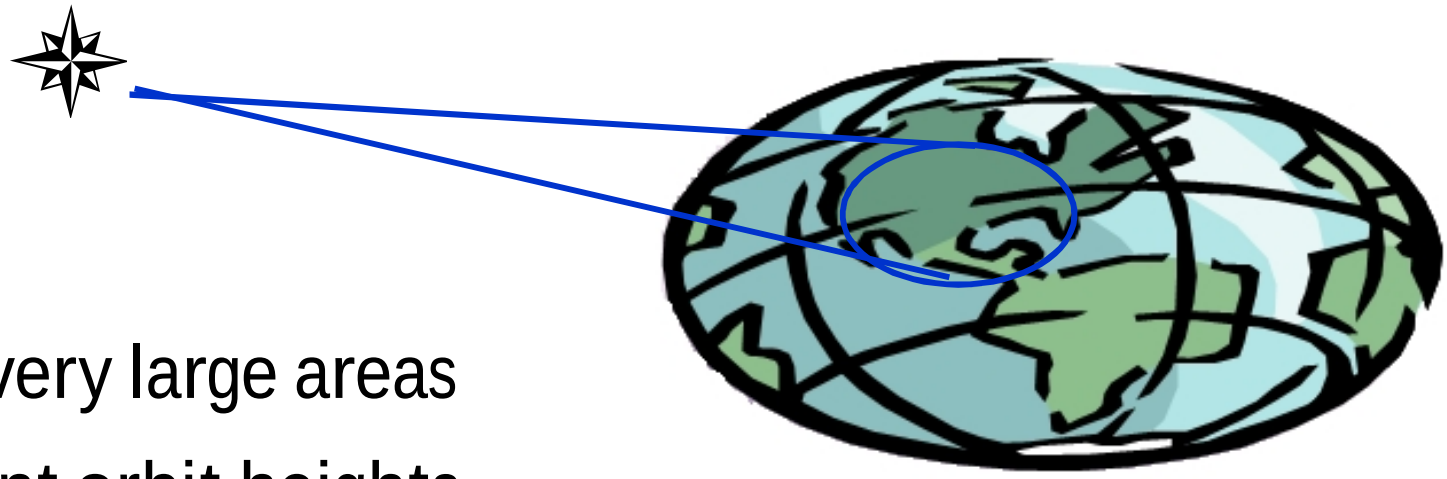
- WLANs connect “local” computers (100m range)
- Breaks data into packets
- Channel access is shared (random access)
- Backbone Internet provides best-effort service
- Poor performance in some apps (e.g. video)

Wireless LAN Standards

- 802.11b (Current Generation)
  - Standard for 2.4GHz ISM band (80 MHz)
  - Frequency hopped spread spectrum
  - 1.6-10 Mbps, 500 ft range
- 802.11a (Emerging Generation)
  - Standard for 5GHz NII band (300 MHz)
  - OFDM with time division
  - 20-70 Mbps, variable range
  - Similar to HiperLAN in Europe
- 802.11g (New Standard)
  - Standard in 2.4 GHz and 5 GHz bands
  - OFDM
  - Speeds up to 54 Mbps

In 200?, all WLAN cards will have all 3 standards

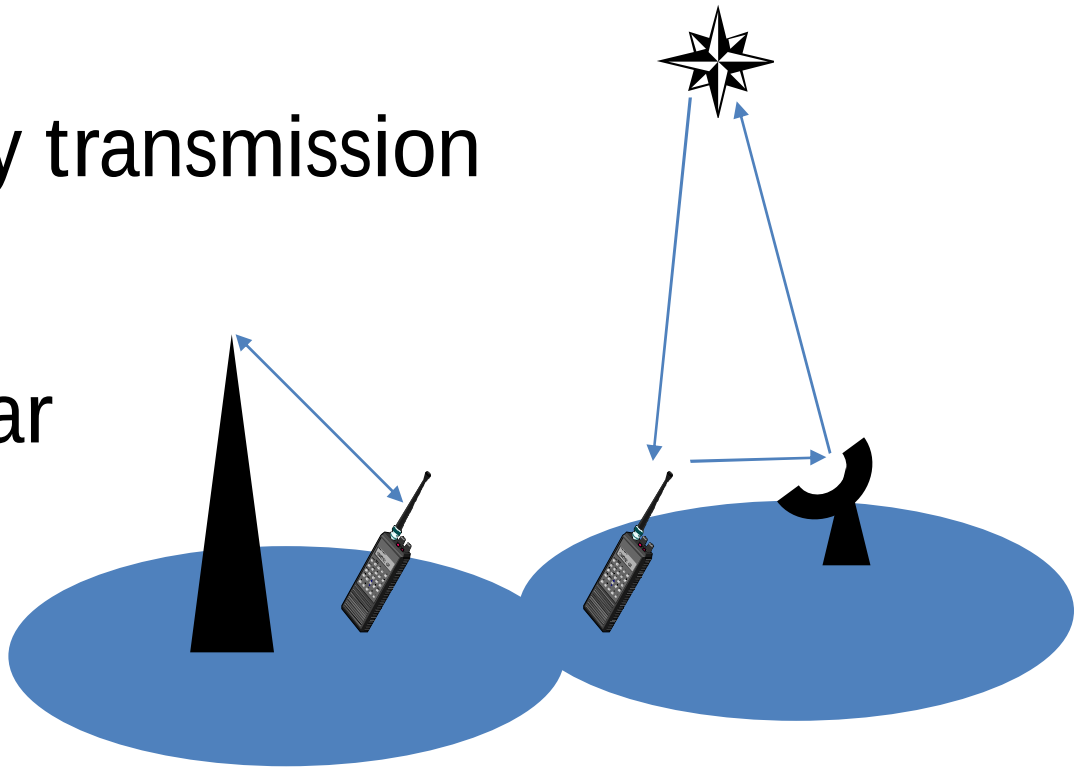
Satellite Systems



- Cover very large areas
- Different orbit heights
  - GEOs (39000 Km) versus LEOs (2000 Km)
- Optimized for one-way transmission
  - Radio (XM, DAB) and movie (SatTV) broadcasting
- Most two-way systems struggling or bankrupt
  - Expensive alternative to terrestrial system
  - A few ambitious systems on the horizon

Paging Systems

- Broad coverage for short messaging
- Message broadcast from all base stations
- Simple terminals
- Optimized for 1-way transmission
- Answer-back hard
- Overtaken by cellular



Bluetooth

- Cable replacement RF technology (low cost)
- Short range (10m, extendable to 100m)
- 2.4 GHz band (crowded)
- 1 Data (700 Kbps) and 3 voice channels
- Widely supported by telecommunications, PC, and consumer electronics companies
- Few applications beyond cable replacement

Design Challenges

- **Hardware Design**
  - Precise components
  - Small, lightweight, low power
  - Cheap
  - High frequency operations
  - System Design
- **Converting and transferring information**
  - High data rates
  - Robust to noise and interference
  - Supports many users
- **Network Design**
  - Connectivity and high speed
  - Energy and delay constrains