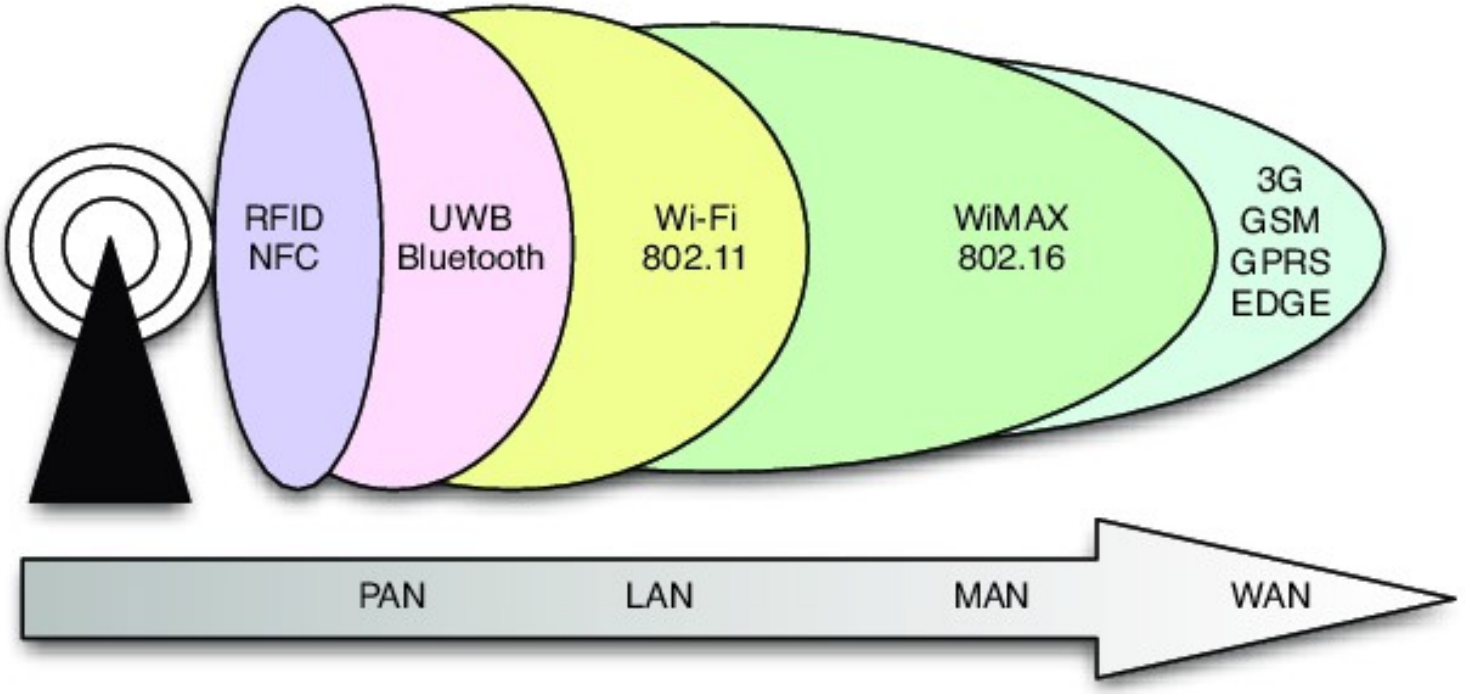
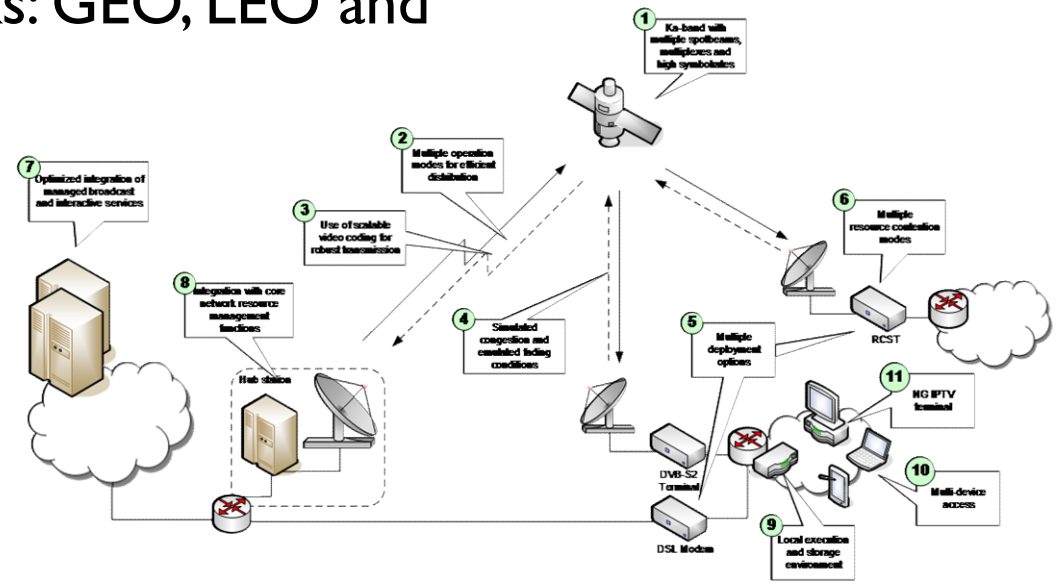
Chapter 16

Other Wireless Networks



Objective

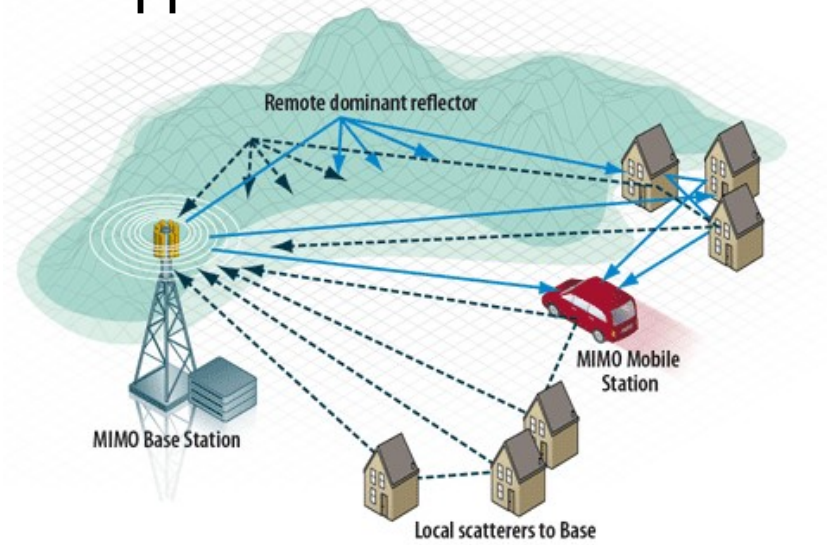
- WiMAX: IEEE 802.16 project and defines the link-layer and the physical layer of WiMAX.
- Cellular telephone networks.
- Satellite networks: GEO, LEO and MEO satellites



WiMAX

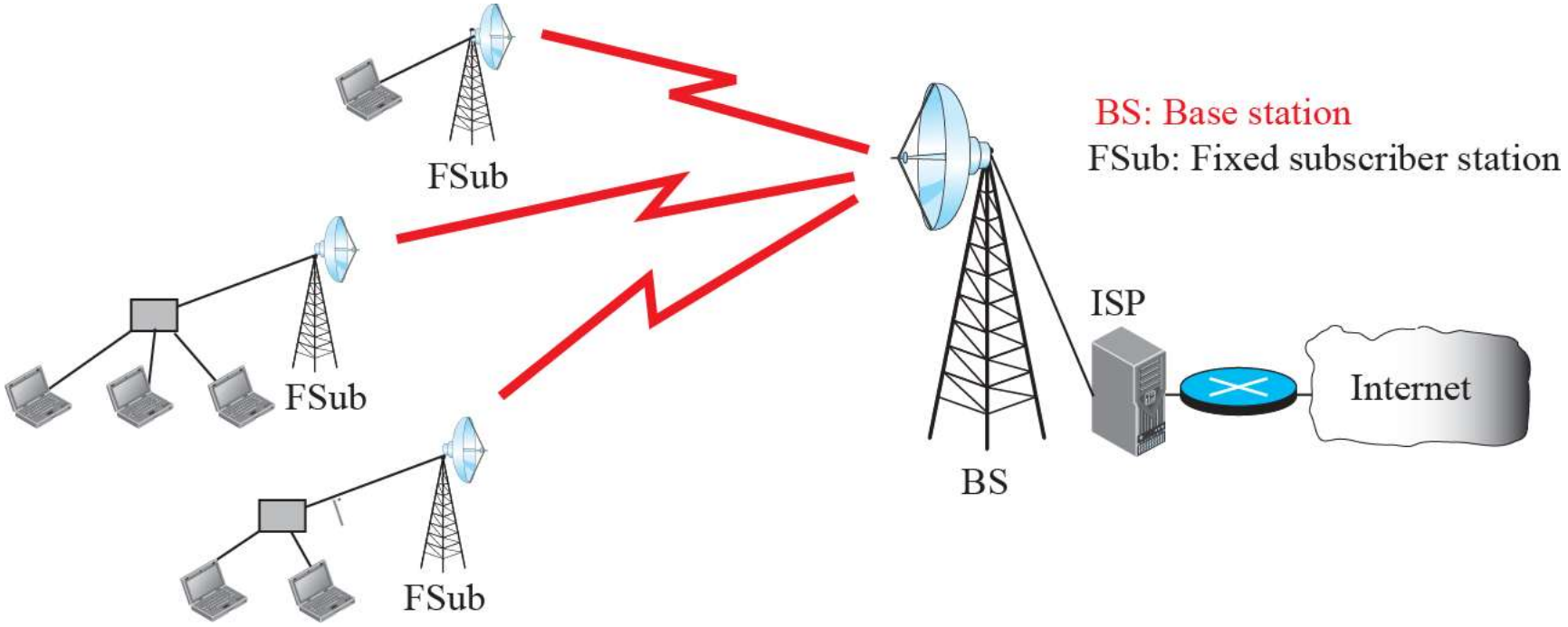
- People want to have access to the Internet from home or office (fixed) where the wired access to the Internet is either not available or is expensive.

- People also need to access the Internet when they are using their cellular phones. WiMAX has been designed for these types of applications.

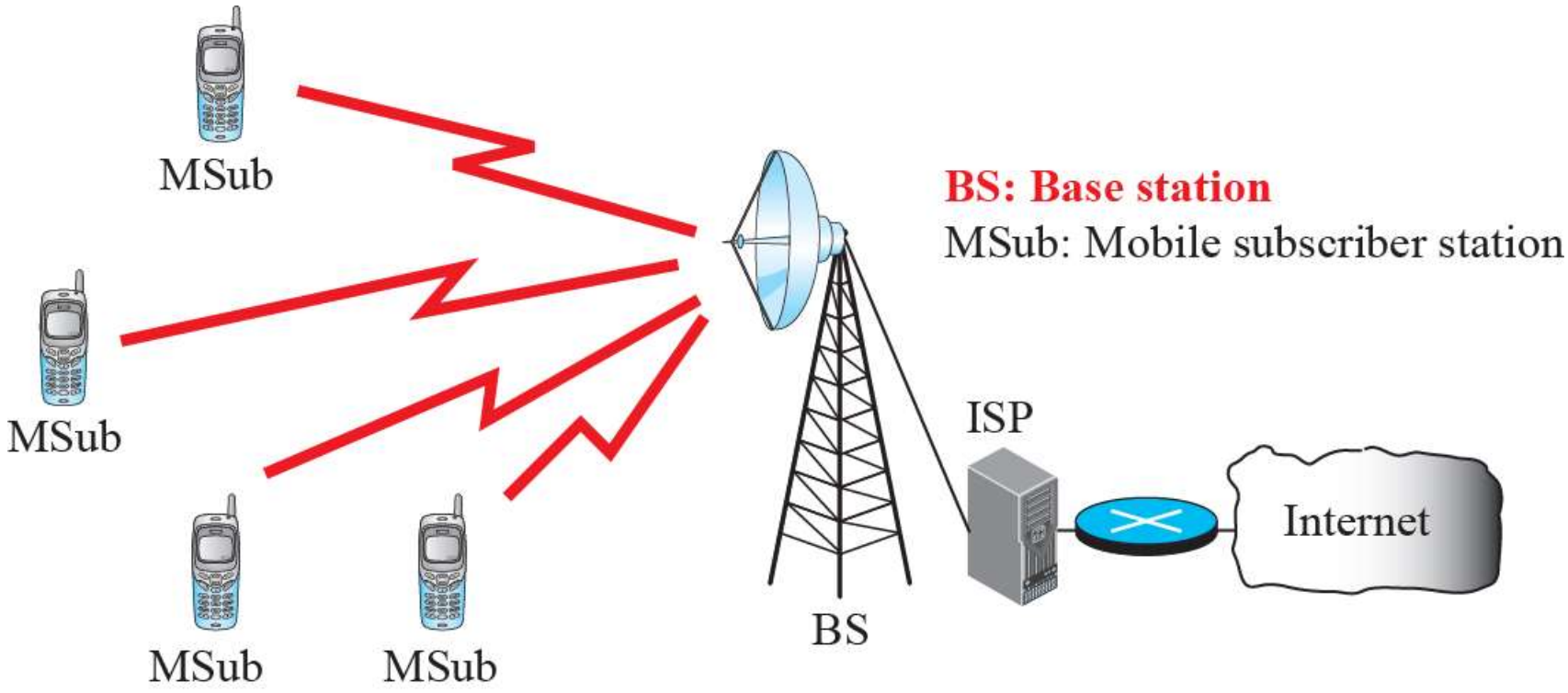


Services

- WiMAX provides two types of services to subscribers: fixed and mobile.



Fixed WiMAX



Mobile WiMAX

IEEE Project 802.16

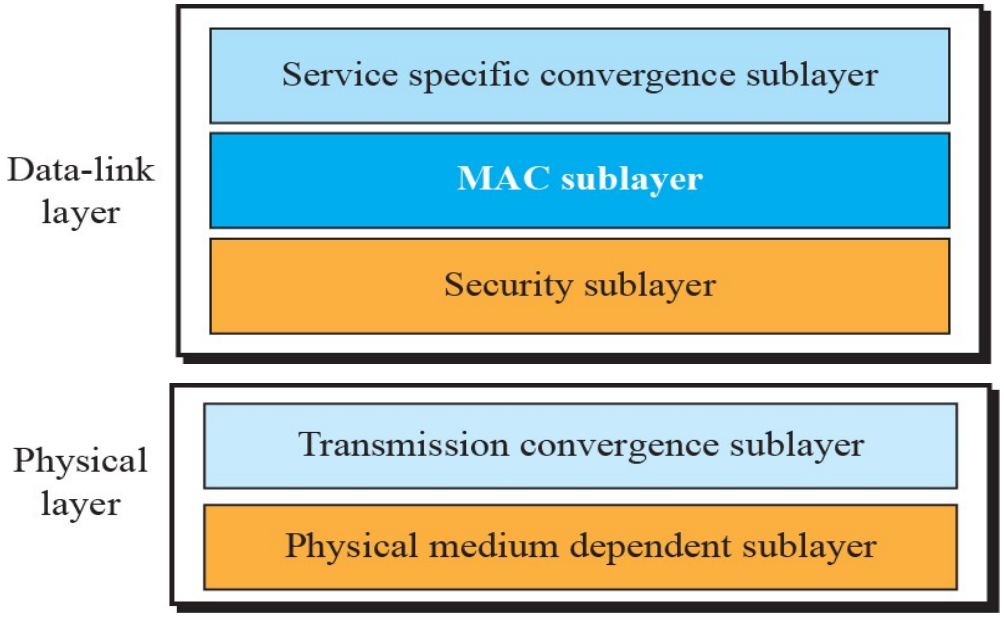
- WiMAX is the result of the IEEE 802.16 project. The standard is sometimes referred to as wireless local loop, in contrast with wired local loop (dial-up, DLS, or cable).

- Let us compare the 802.16 and 802.11 projects. First, 802.11 is a standard for a wireless LAN; 802.16 is a standard for a wireless WAN (or MAN).

- Project 802.11 defines a connectionless communication; project 802.16 defines a connection-oriented service.

Layers in Project 802.16

- In the 802.16 project. IEEE has divided the data-link layer into three sublayers and the physical layer into two sublayers.

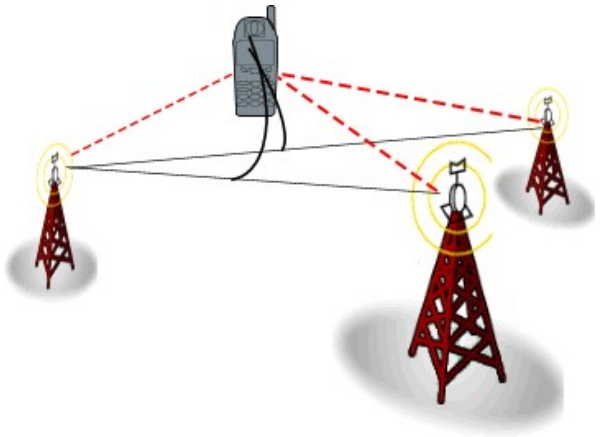


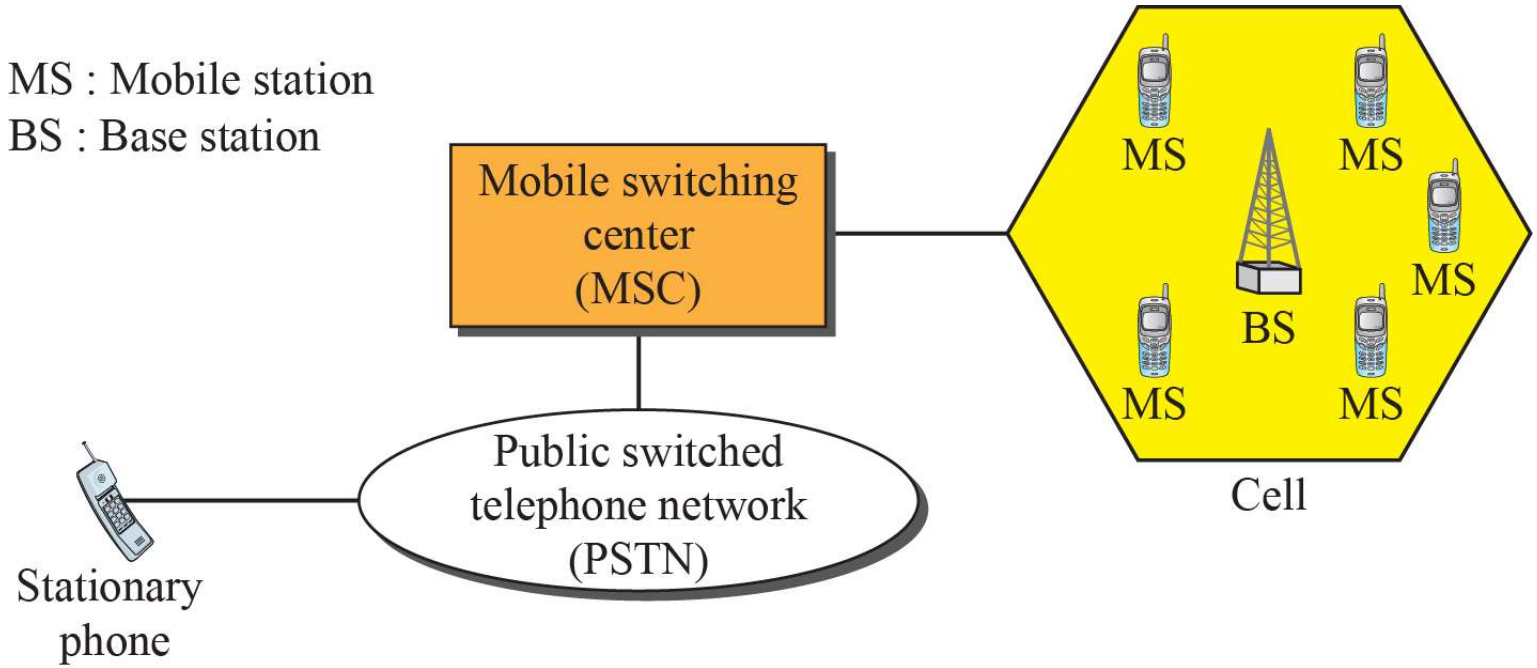
Data-link and physical layers

Cellular Telephony

- Cellular telephony is designed to provide communications between two moving units, called mobile stations (MSs), or between one mobile unit and one stationary unit, often called a land unit.

- A service provider must be able to locate and track a caller, assign a channel to the call, and transfer the channel from base station to base station as the caller moves out of range.

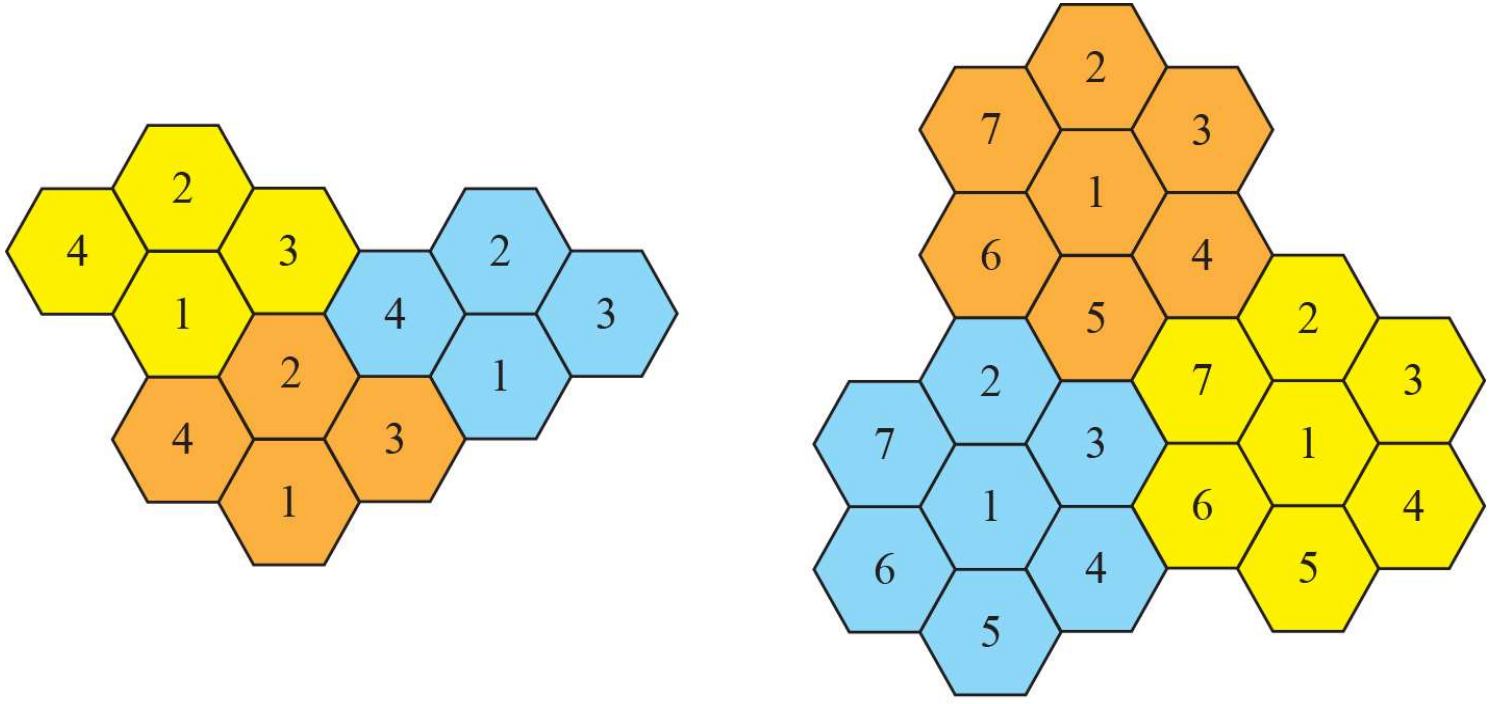




Cellular system

Operation

- Let us first briefly discuss the operation of the cellular telephony.



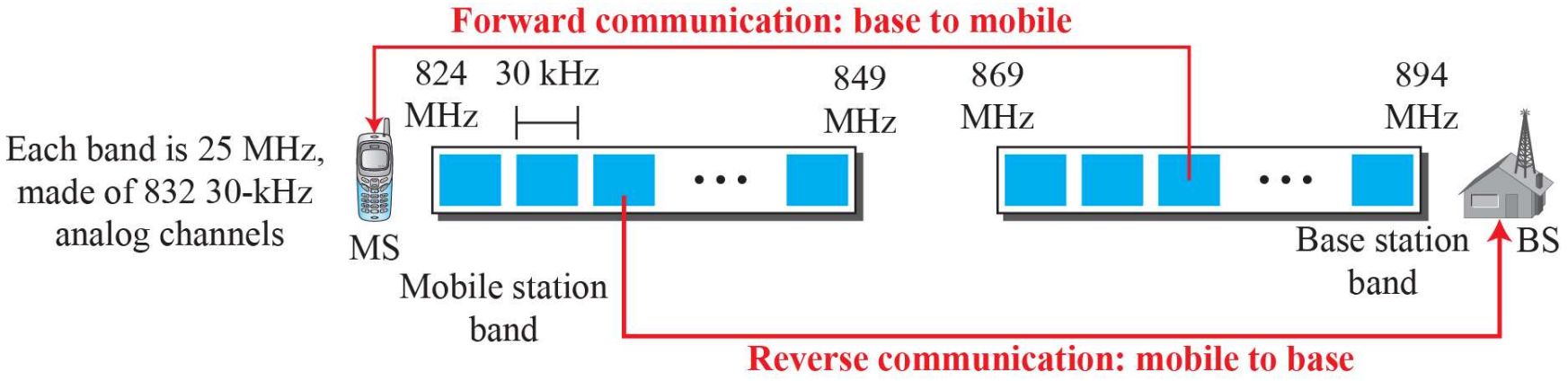
a. Reuse factor of 4

b. Reuse factor of 7

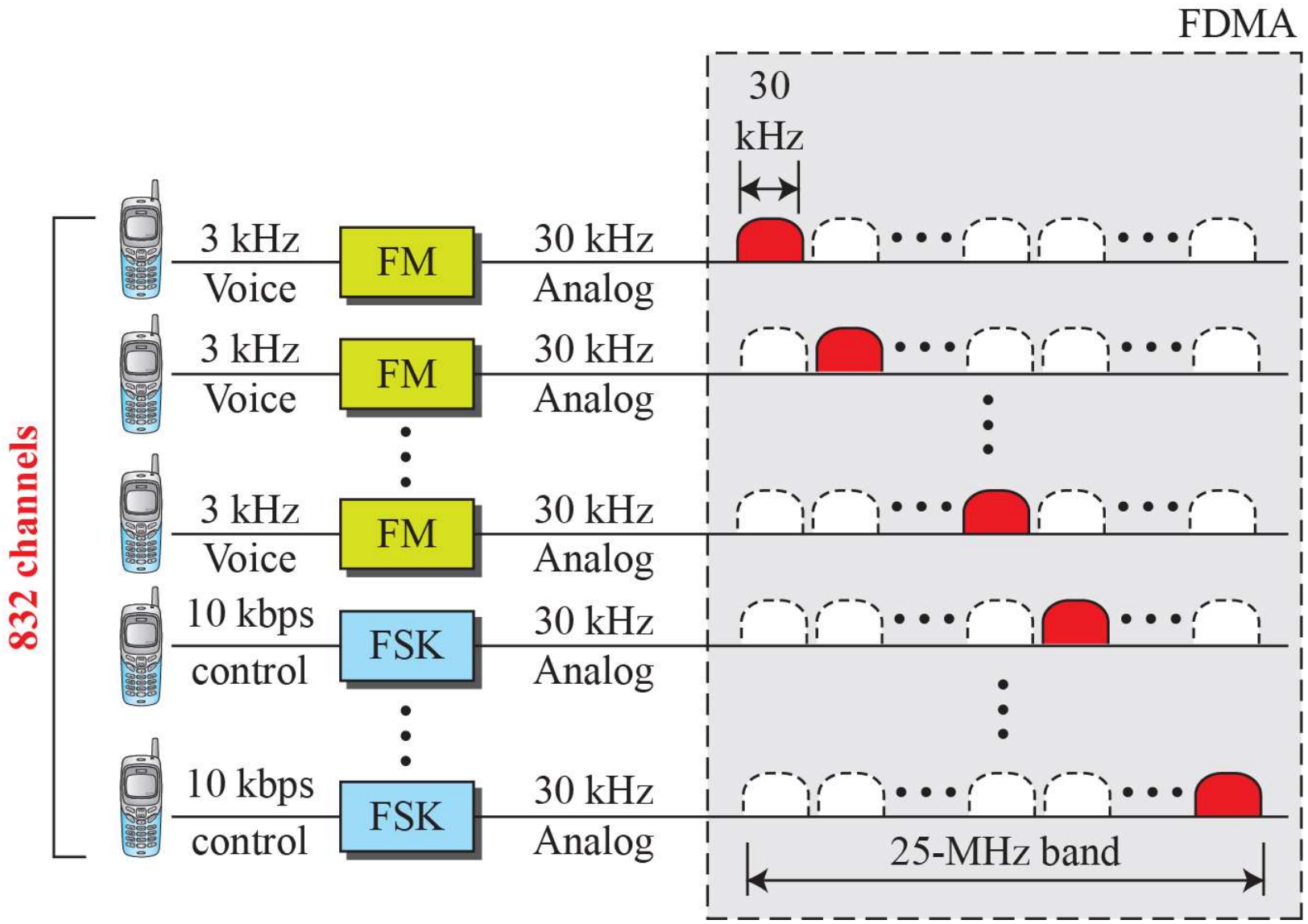
Frequency reuse patterns

First Generation (1G)

- Cellular telephony is now in its fifth generation. The first generation was designed for voice communication using analog signals. We discuss one first-generation mobile system used in North America, AMPS.



Cellular bands for AMPS

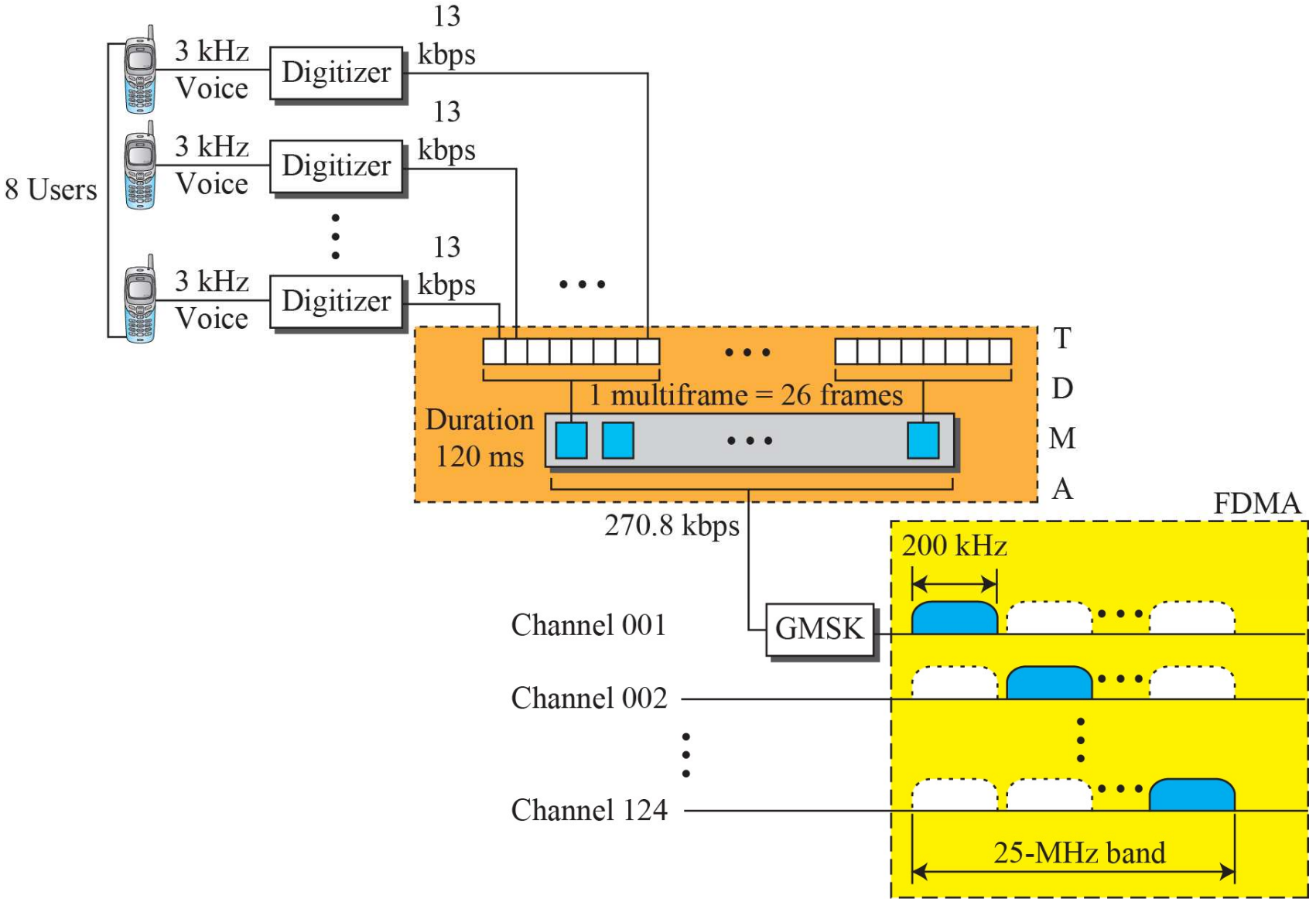


AMPS reverse communication band

Second Generation (2G)

- To provide higher-quality (less noise-prone) mobile voice communications, the second generation of the cellular phone network was developed.

- While the first generation was designed for analog voice communication, the second generation was mainly designed for digitized voice. Three major systems evolved in the second generation: D-AMPS, GSM, and IS-95.


8 Users
3 kHz
Voice
Digitizer
13
kbps
3 kHz
Voice
Digitizer
13
kbps
3 kHz
Voice
Digitizer
13
kbps
TDMA
1 multiframe = 26 frames
Duration
120 ms
270.8 kbps
FDMA
200 kHz
GMSK
Channel 001
Channel 002
Channel 124
25-MHz band

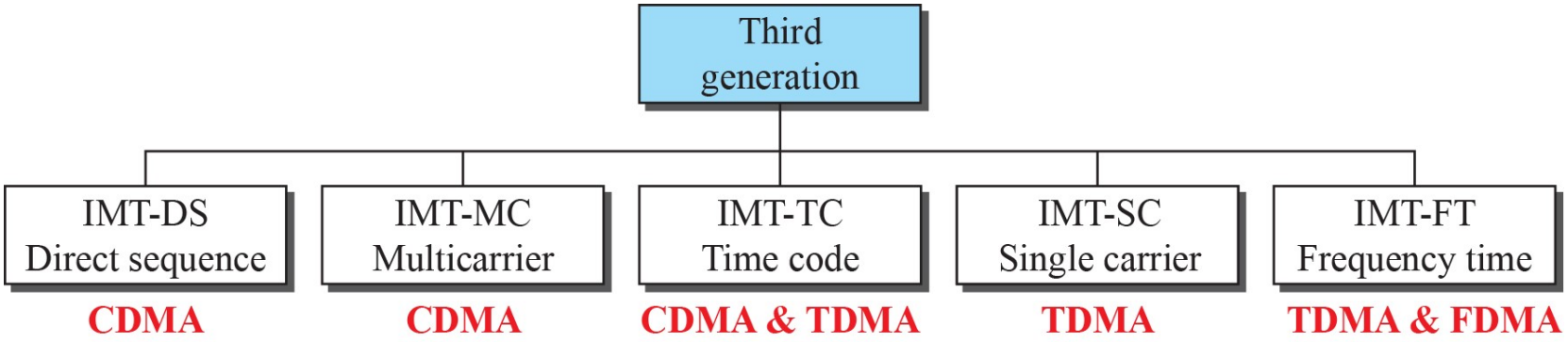
GSM

Third Generation (3G)

- The third generation of cellular telephony refers to a combination of technologies that provide both digital data and voice communication.
- Using a small portable device, a person is able to talk to anyone else in the world with a voice quality similar to that of the existing fixed telephone network.
- A person can download and watch a movie, download and listen to music, surf the Internet or play games, have a video conference, and do much more.

Third Generation (3G)

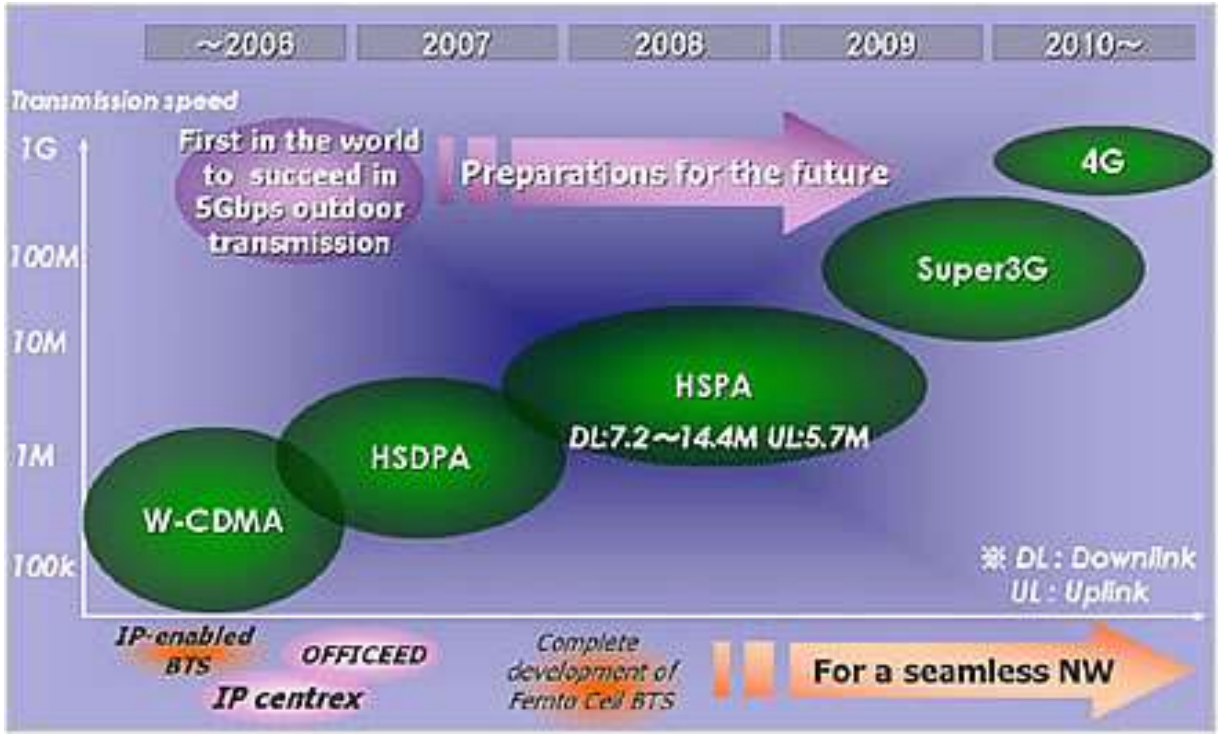
- The third-generation concept started in 1992, when ITU issued a blueprint called the Internet Mobile Communication 2000 (**IMT-2000**).



IMT-2000 radio interfaces

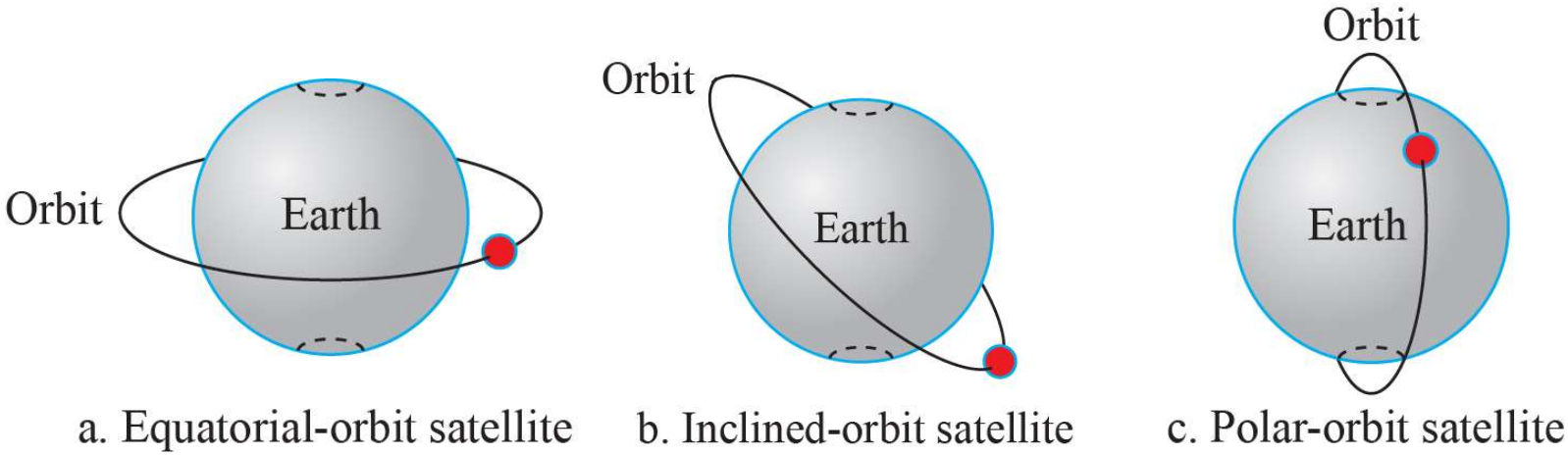
Fourth Generation (4G)

- The fourth generation of cellular telephony is expected to be a complete evolution in wireless communications.

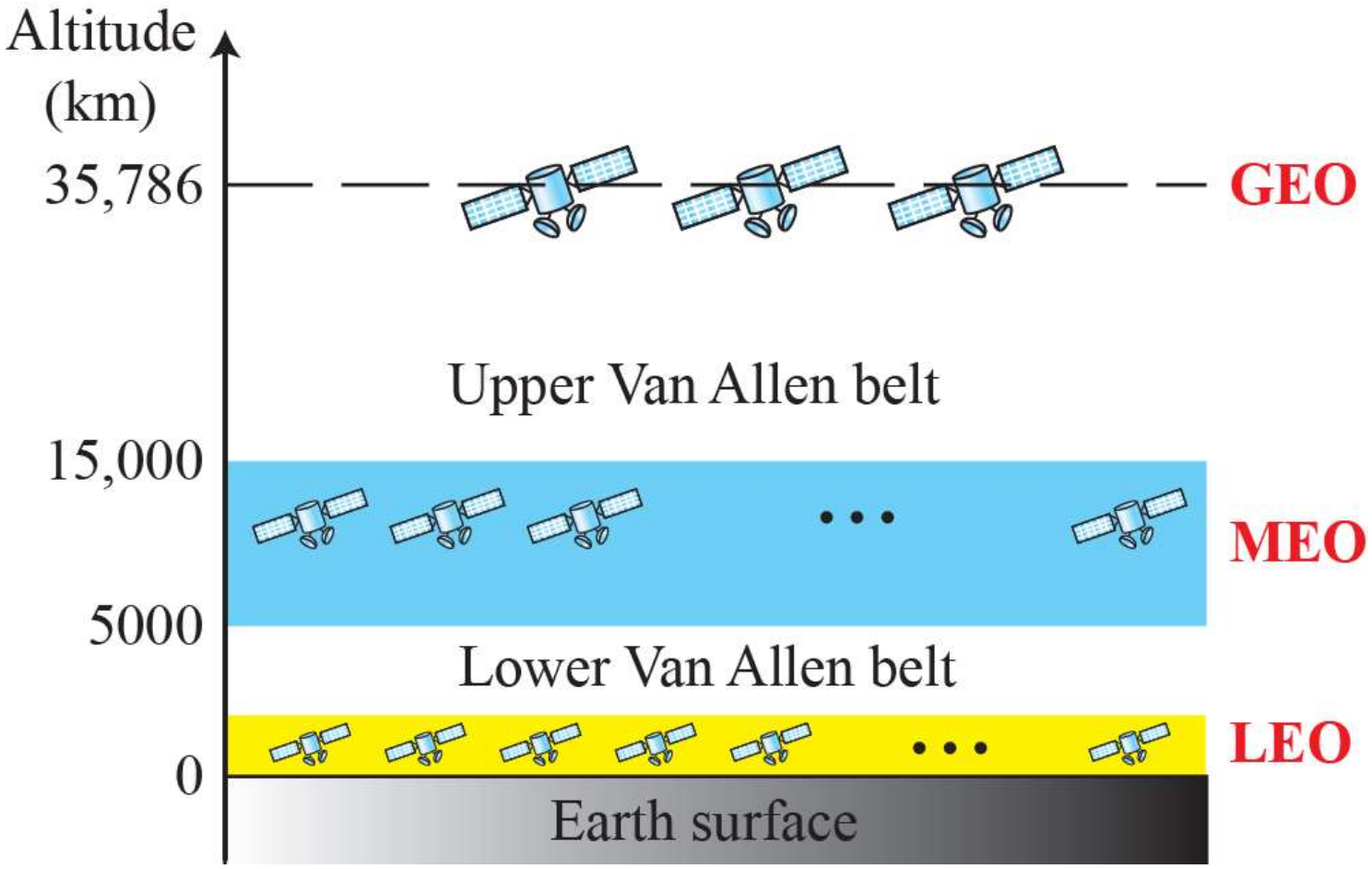


Satellite Network

- A satellite network is a combination of nodes, some of which are satellites, that provides communication from one point on the Earth to another.
- A node in the network can be a satellite, an Earth station, or an end-user terminal or telephone.



Satellite orbits



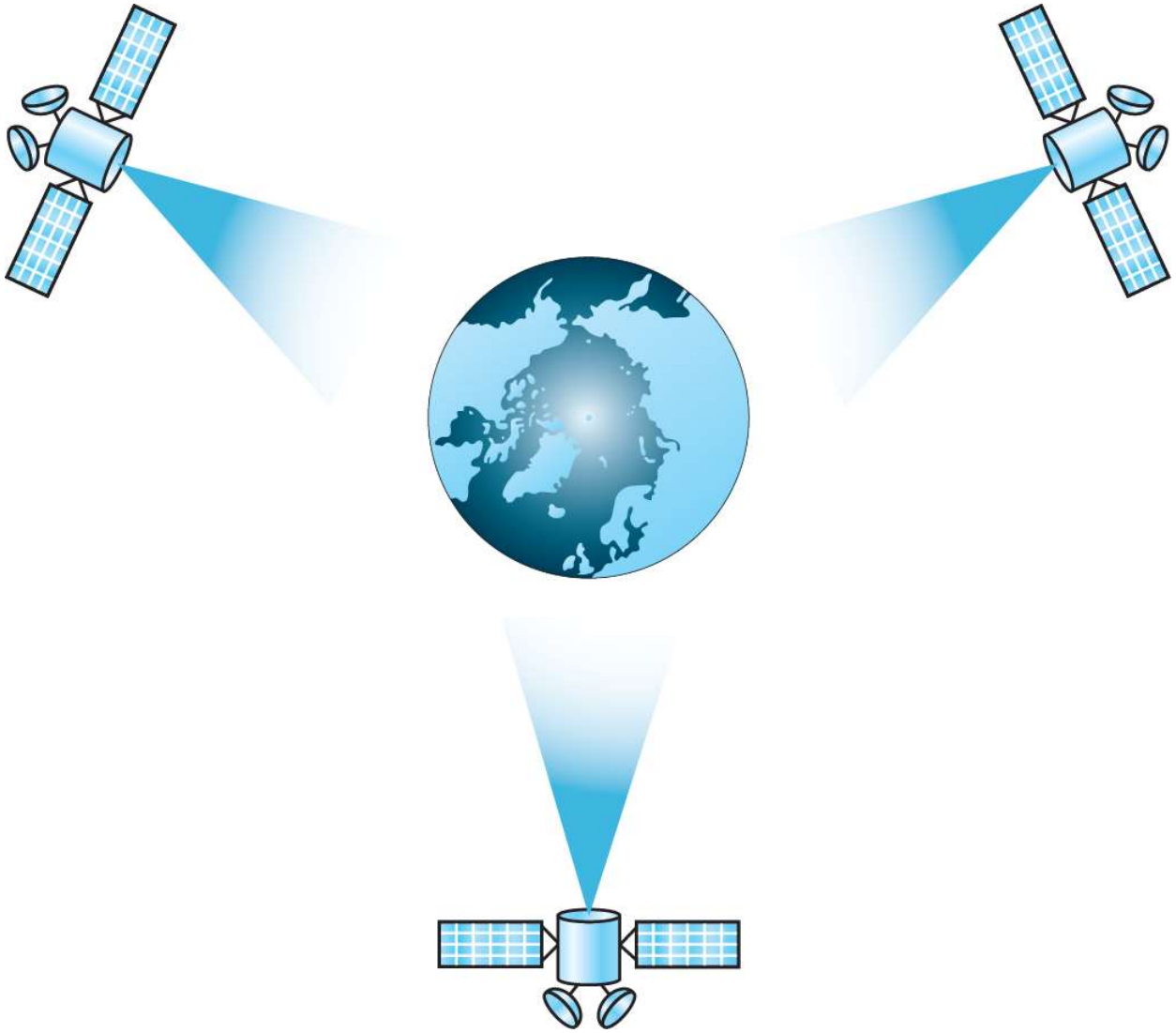
Satellite orbit altitudes

GEO Satellites

- Line-of-sight propagation requires that the sending and receiving antennas be locked onto each other's location at all times (one antenna must have the other in sight).

- For this reason, a satellite that moves faster or slower than the Earth's rotation is useful only for short periods.

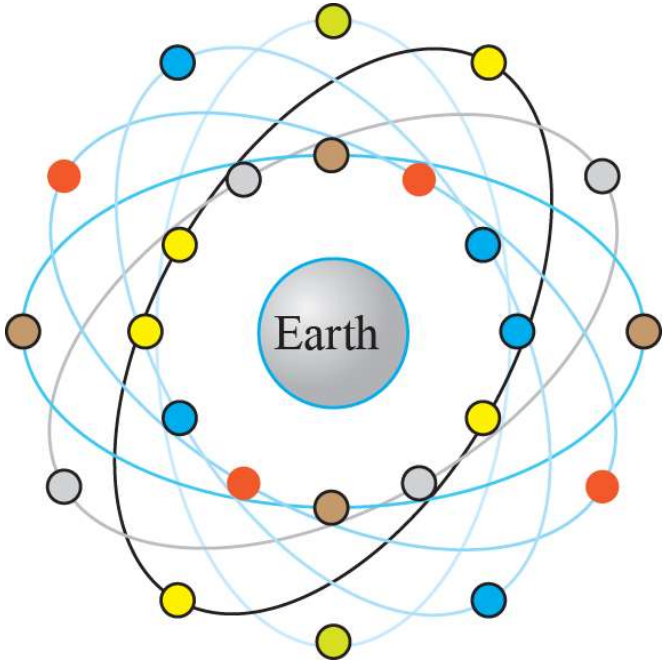
- To ensure constant communication, the satellite must move at the same speed as the Earth so that it seems to remain fixed above a certain spot. Such satellites are called geostationary.



Satellites in geostationary orbit

MEO Satellites

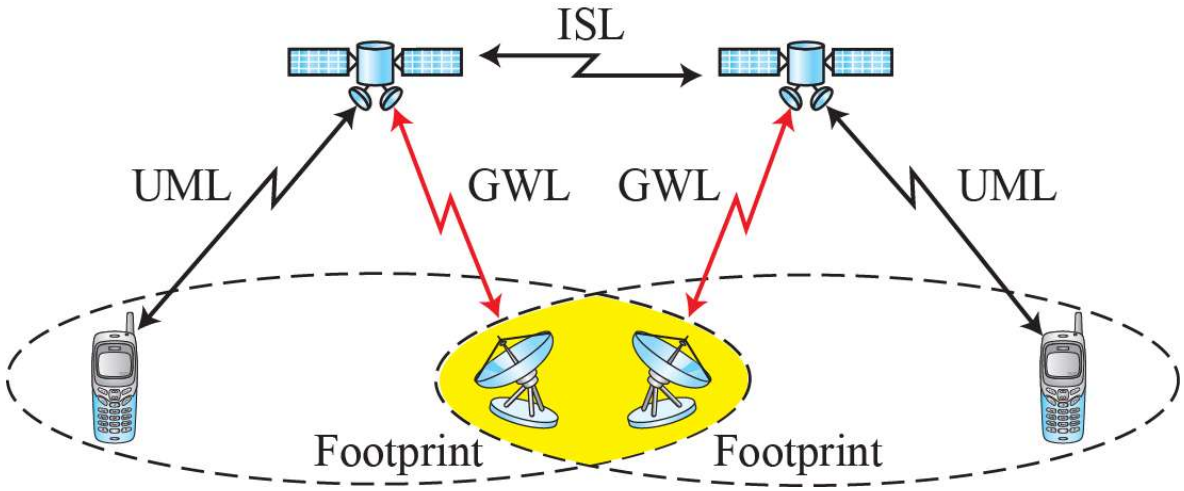
- Medium-Earth-orbit (MEO) satellites are positioned between the two Van Allen belts. A satellite at this orbit takes approximately 6 to 8 hours to circle the Earth.



Orbits for global positioning system (GPS) satellites

LEO Satellites

- A low Earth orbit requires the lowest amount of energy for satellite placement. It provides high bandwidth and low communication latency. Satellites and space stations in LEO are more accessible for servicing.



LEO satellite system