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.*

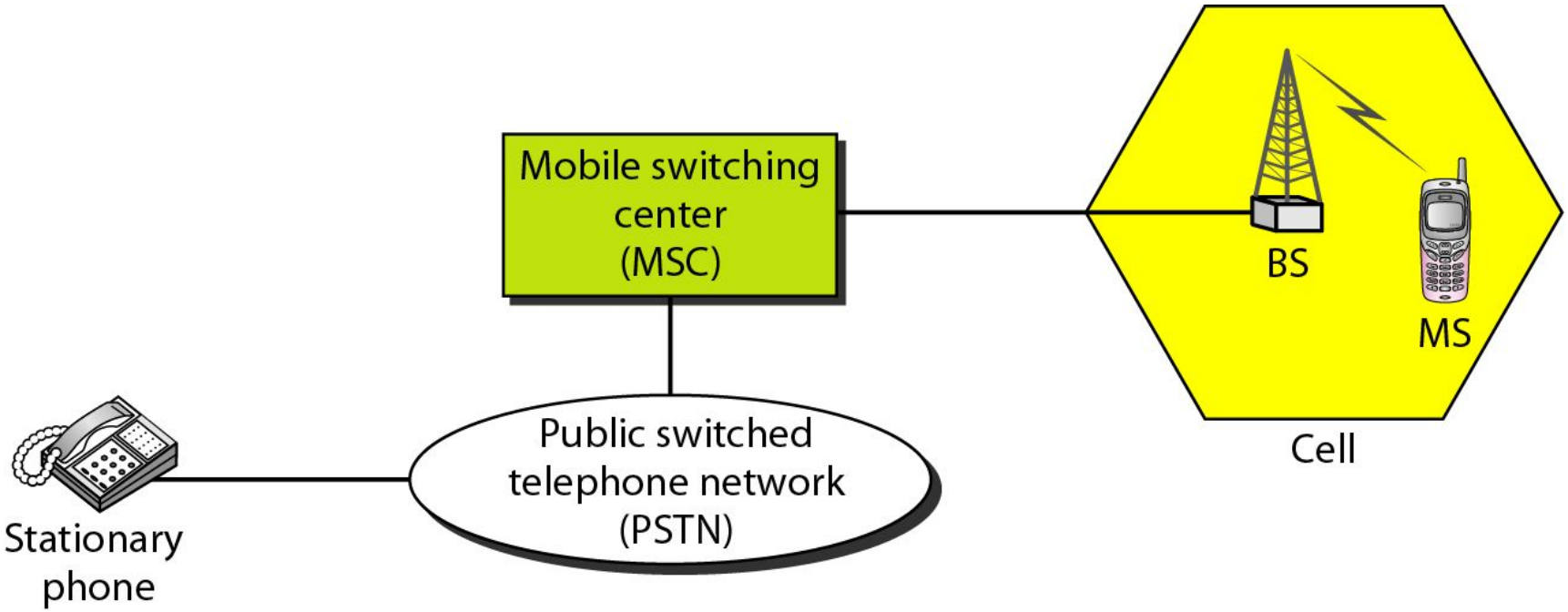
Topics discussed in this section:

Frequency-Reuse Principle
Transmitting
Receiving
Roaming
First Generation
Second Generation
Third Generation

CELLULAR TELEPHONY

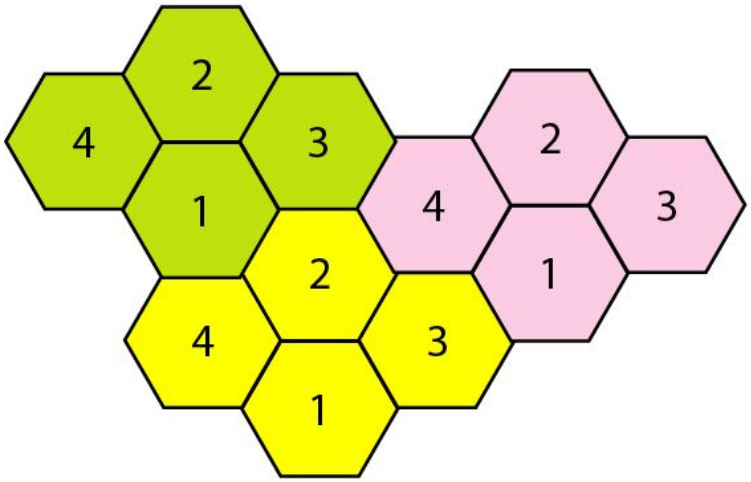
- To make this tracking possible, each cellular service area is divided into small regions called **cells.**
- Each cell contains an antenna and is controlled by a solar or AC powered network station, called the **base station (BS**).
- Each base station, in tum, is controlled by a switching office, called a **mobile switching center (MSC).**
- It is a computerized center that is responsible for connecting calls, recording call information, and billing.
- Cell size is not fixed and can be increased or decreased depending on the population of the area.
- The transmission power of each cell is kept low to prevent its signal from interfering with those of other cells.

Figure 16.1 *Cellular system*

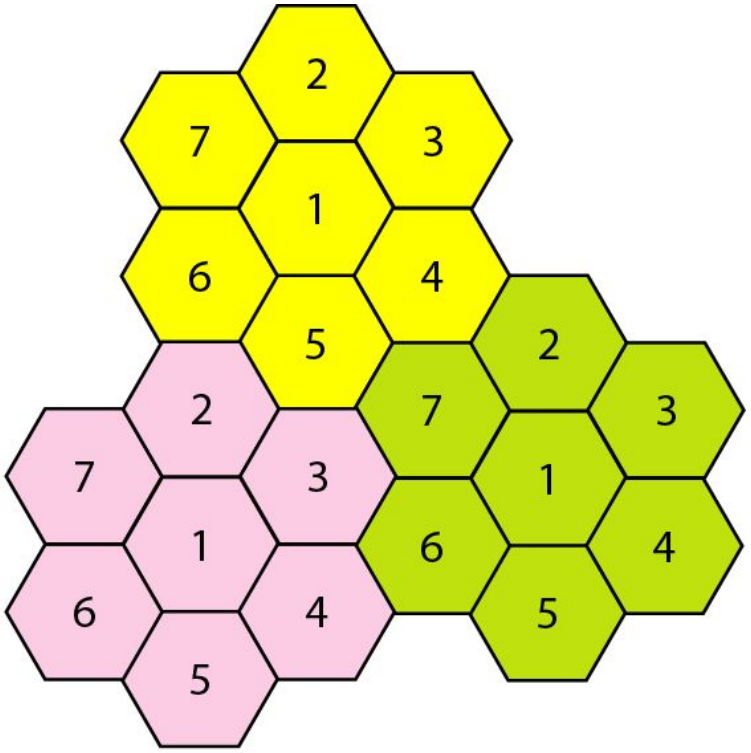


Frequency reuse patterns

the set of frequencies available is limited, and
frequencies need to be reused
frequency reuse pattern is a configuration of *N* cells,
N being the **reuse factor**



a. Reuse factor of 4



b. Reuse factor of 7

Transmitting:

- To place a call from a mobile station, the caller enters a code of 7 or 10 digits (a phone number) and presses the send button.
- The mobile station then scans the band, seeking a setup channel with a strong signal, and sends the data (phone number) to the closest base station using that channel.
- The base station relays the data to the MSC.
- The MSC sends the data on to the telephone central office.
- If the called party is available, a connection is made and the result is relayed back to the MSC.
- At this point, the MSC assigns an unused voice channel to the call, and a connection is established.
- The mobile station automatically adjusts its tuning to the new channel, and communication can begin.

Receiving

- When a mobile phone is called, the telephone central office sends the number to the MSC.
- The MSC searches for the location of the mobile station by sending query signals to each cell in a process called **paging**.
- Once the mobile station is found, the MSC transmits a ringing signal and, when the mobile station answers, assigns a voice channel to the call, allowing voice communication to begin.

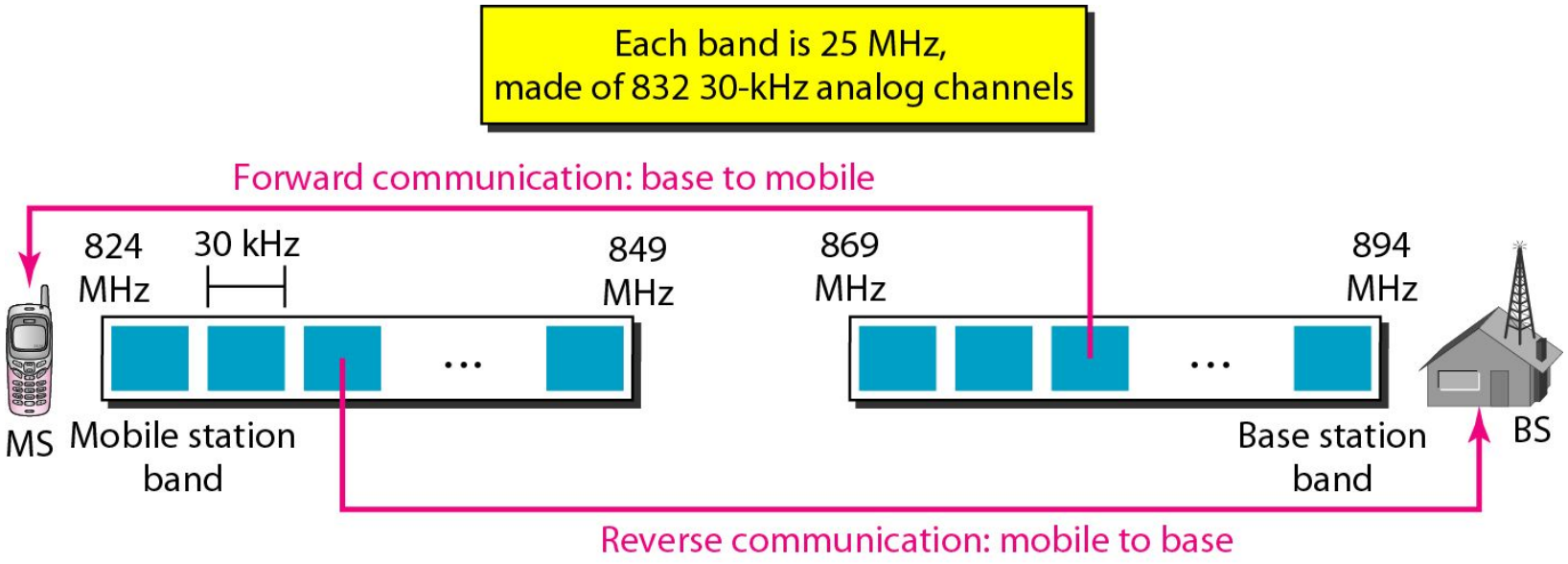
HandoFF:

- the MSC monitors the level of the signal every few seconds.

First Generation: voice communication using analog signals.

- Advanced **Mobile Phone** System (**AMPS) is an analog cellular phone system using FDMA.**
- ISM 800-MHz band.
- The system **uses two separate analog channels**, one for **forward (base station to mobile station)** communication and **one for reverse (mobile station to base station) communication.**
- The band **between 824 and 849 MHz carries reverse communication**; the band between **869 and 894 MHz carries forward communication**

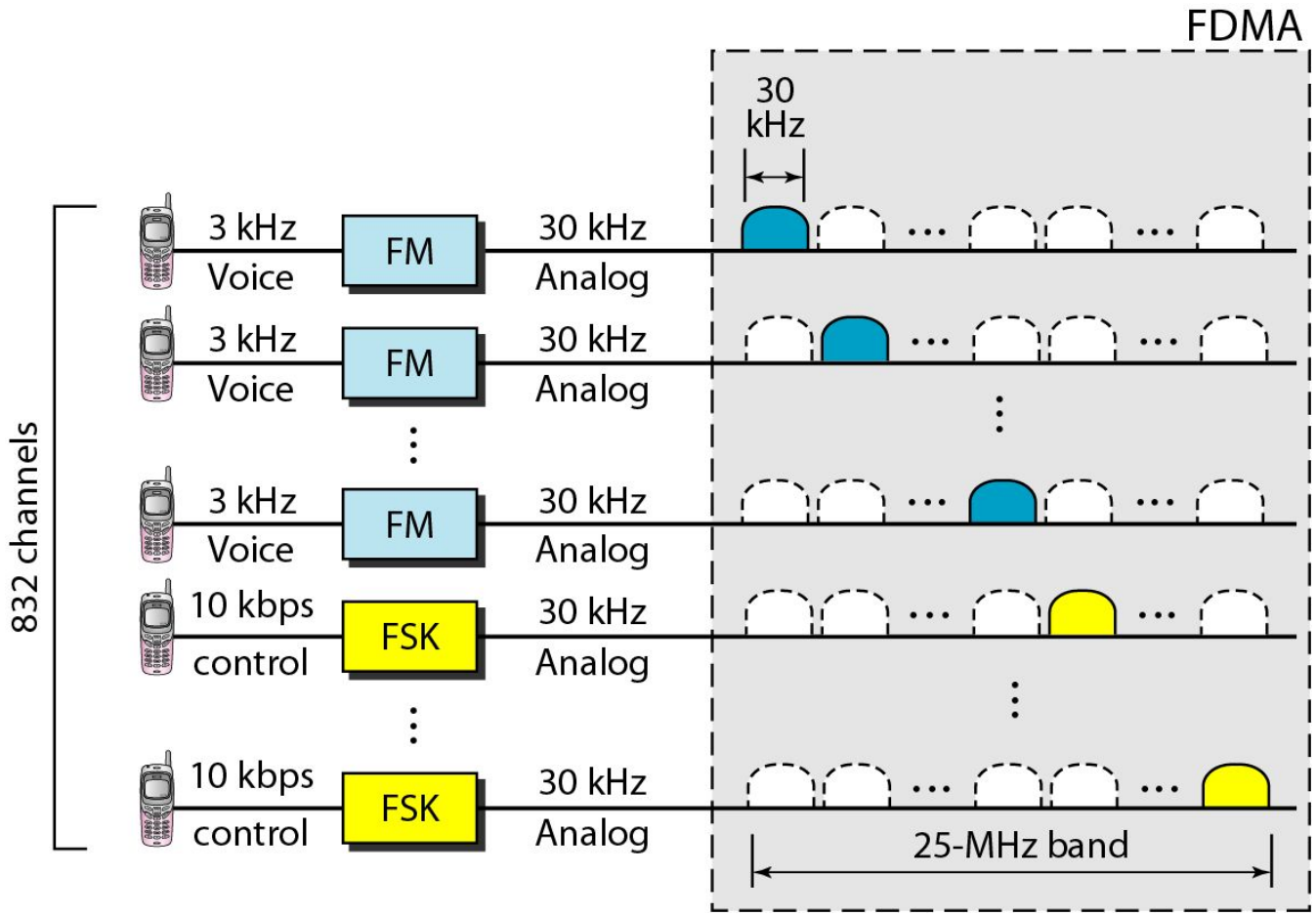
Figure 16.3 *Cellular bands for AMPS*



Advanced **Mobile Phone** System (**AMPS)**

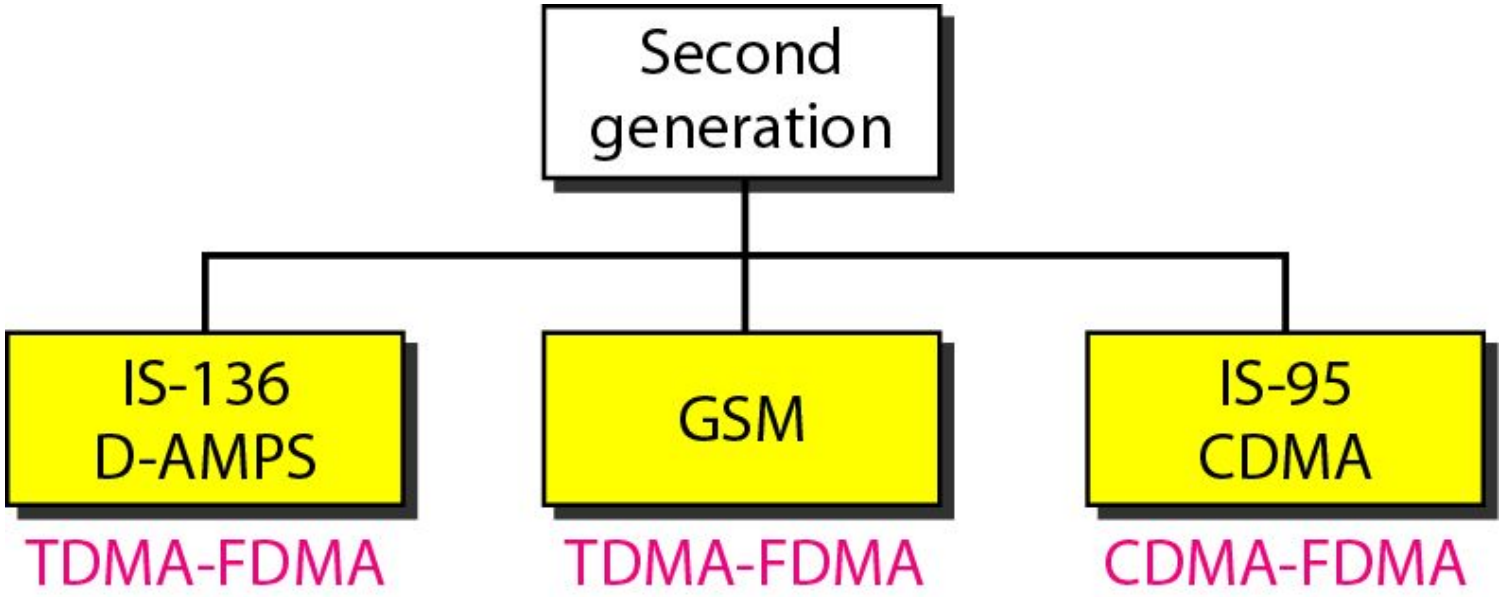
- Each band is divided into **832** channels.
- Two providers can share an area, which means **416** channels in each cell for each provider.
- Out of these 416, **21** channels are used for control, which leaves **395 channels**.
- AMPS has a frequency **reuse factor of 7**; this means only **one-seventh of these 395 traffic channels** are actually available in a cell.
- Transmission AMPS uses FM and FSK for modulation.
- **Voice channels** are modulated using **FM**, and **control channels** use **FSK** to create 30-kHz analog signals.
- AMPS **uses FDMA to divide each 25-MHz** band into **30-kHz channels**.

Figure 16.4 *AMPS reverse communication band*



Second-generation cellular phone systems

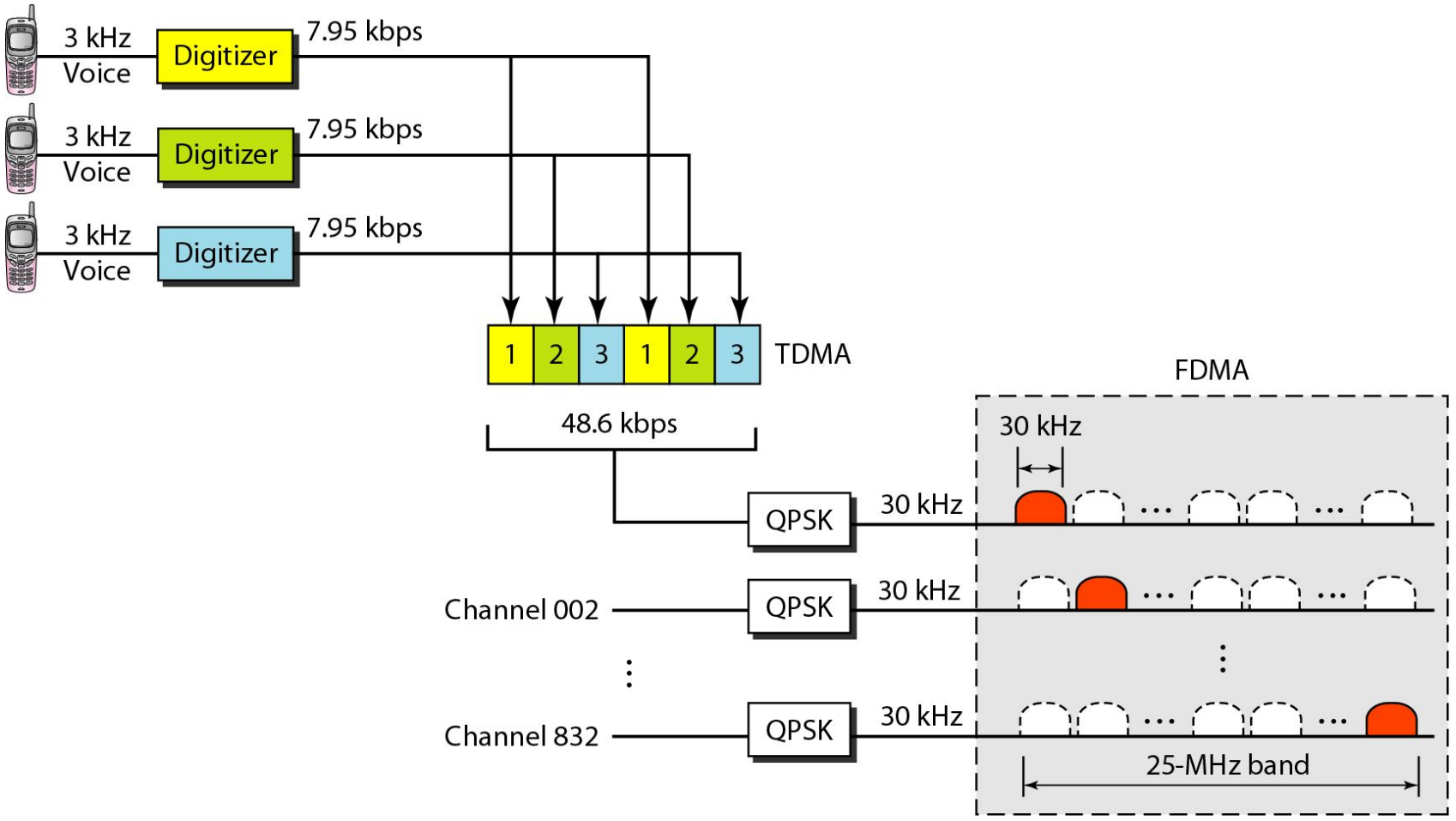
- To provide higher-quality (less noise-prone) mobile voice communications, the second generation of the cellular phone network was developed.
- mainly designed for digitized voice.



D-AMPS

- evolution of the analog AMPS into a digital system is digital AMPS.
- Each voice channel is digitized using a very complex PCM and compression technique.
- A voice channel is digitized to 7.95 kbps.
- For example, Three 7.95-kbps digital voice channels are combined using TDMA. The result is 48.6 kbps of digital data.

Figure 16.6 *D-AMPS*



Note

D-AMPS, or IS-136, is a digital cellular phone system using TDMA and FDMA.

Figure 16.7 *GSM bands*

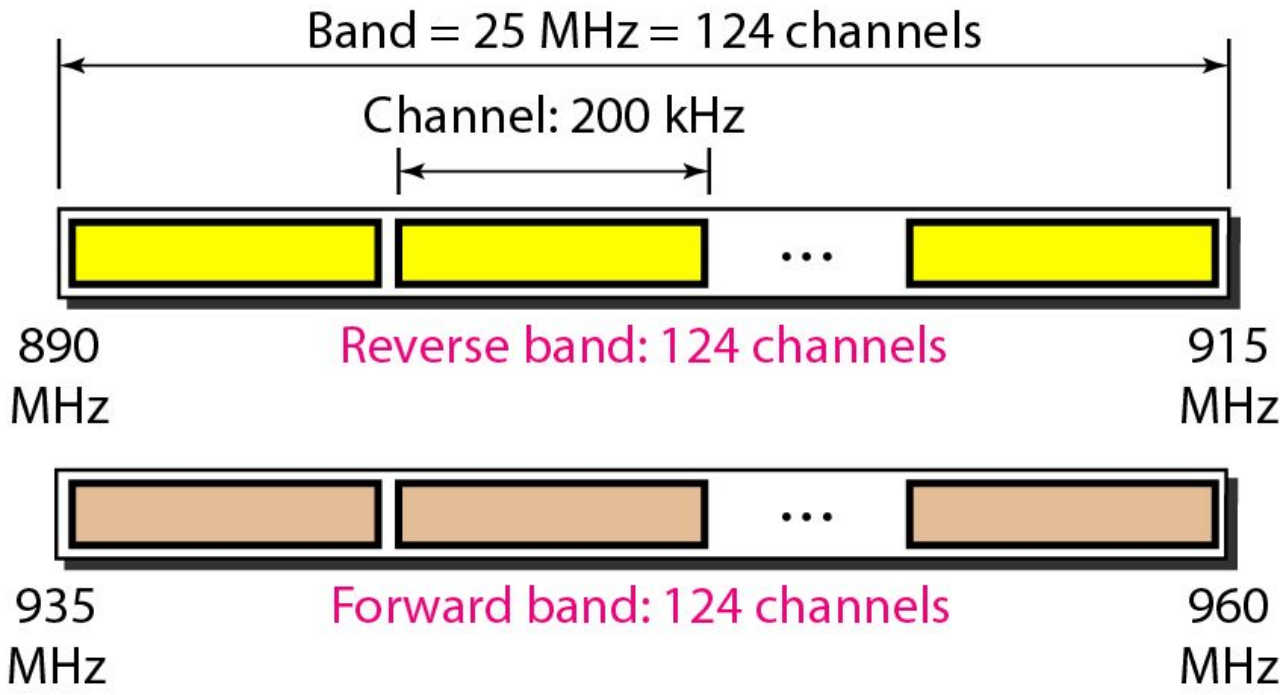


Figure 16.8 *GSM*

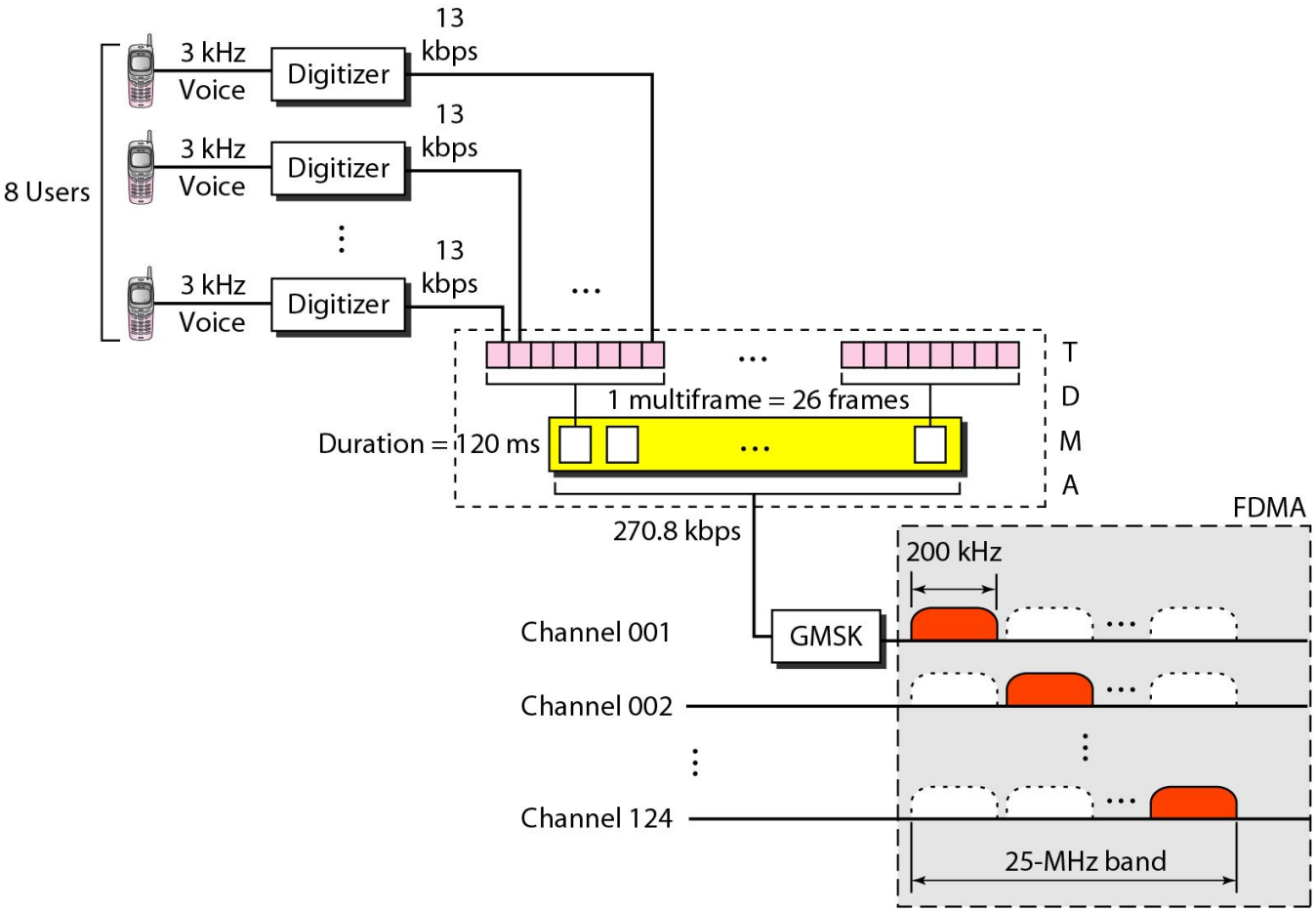
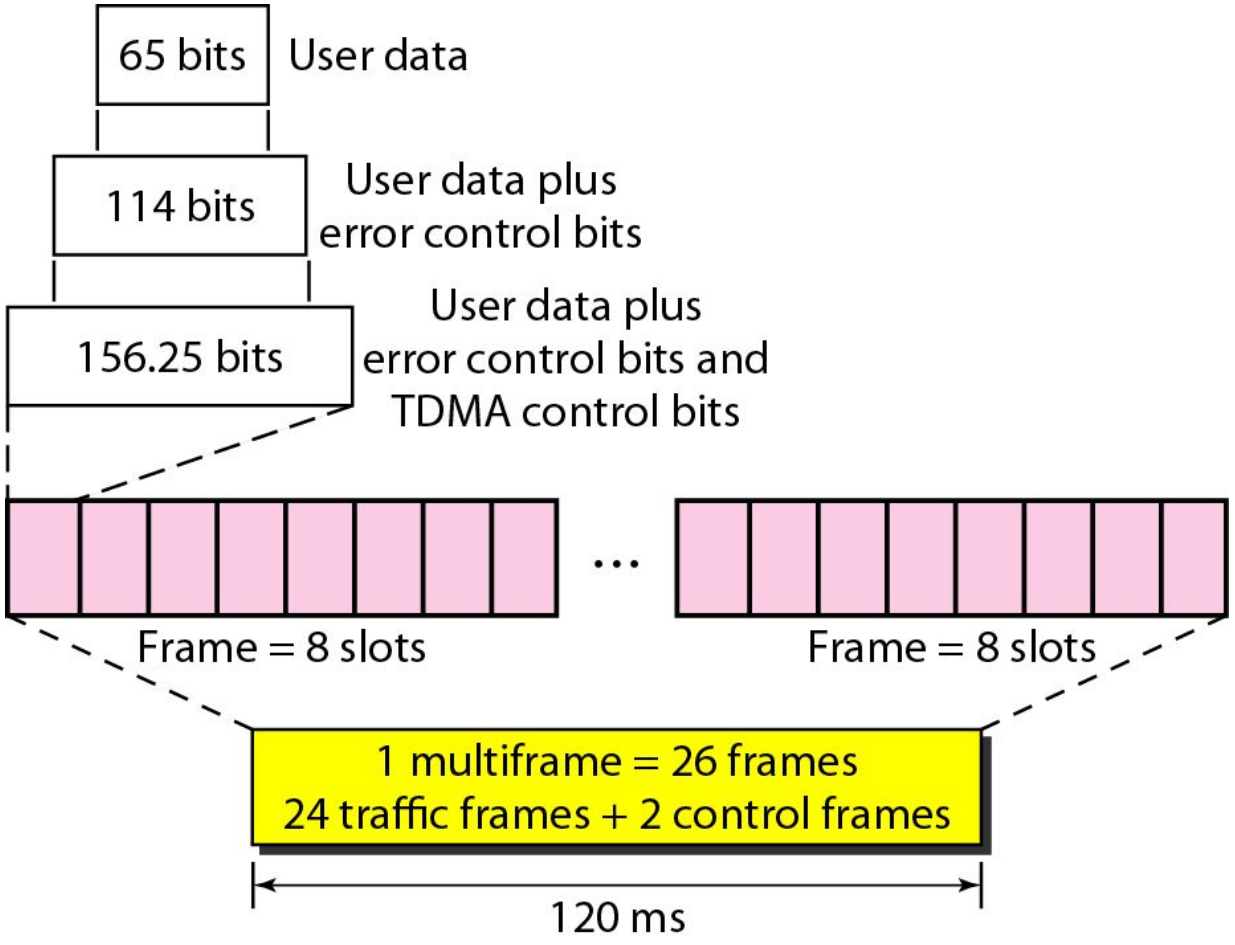


Figure 16.9 *Multiframe components*



Note

GSM is a digital cellular phone system using TDMA and FDMA.

Figure 16.10 *IS-95 forward transmission*

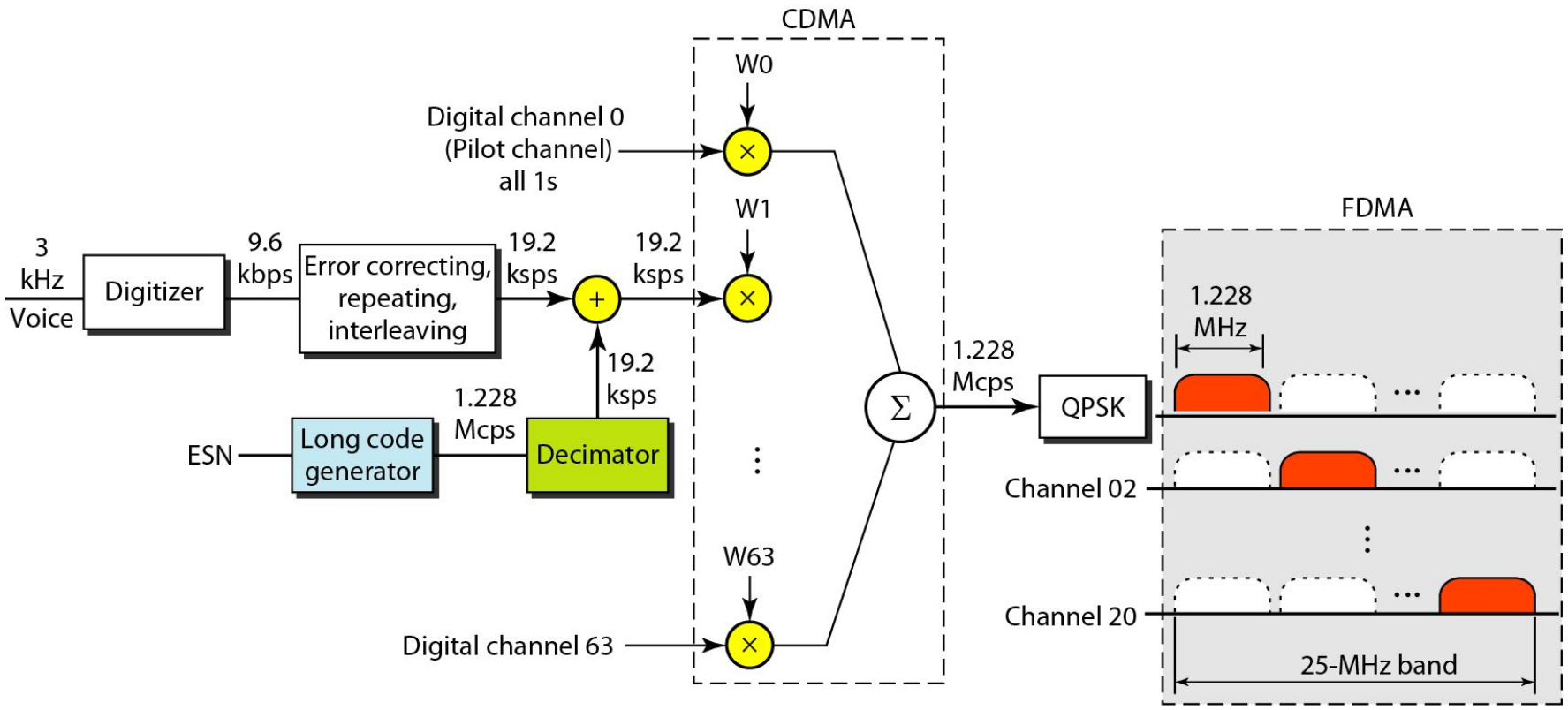
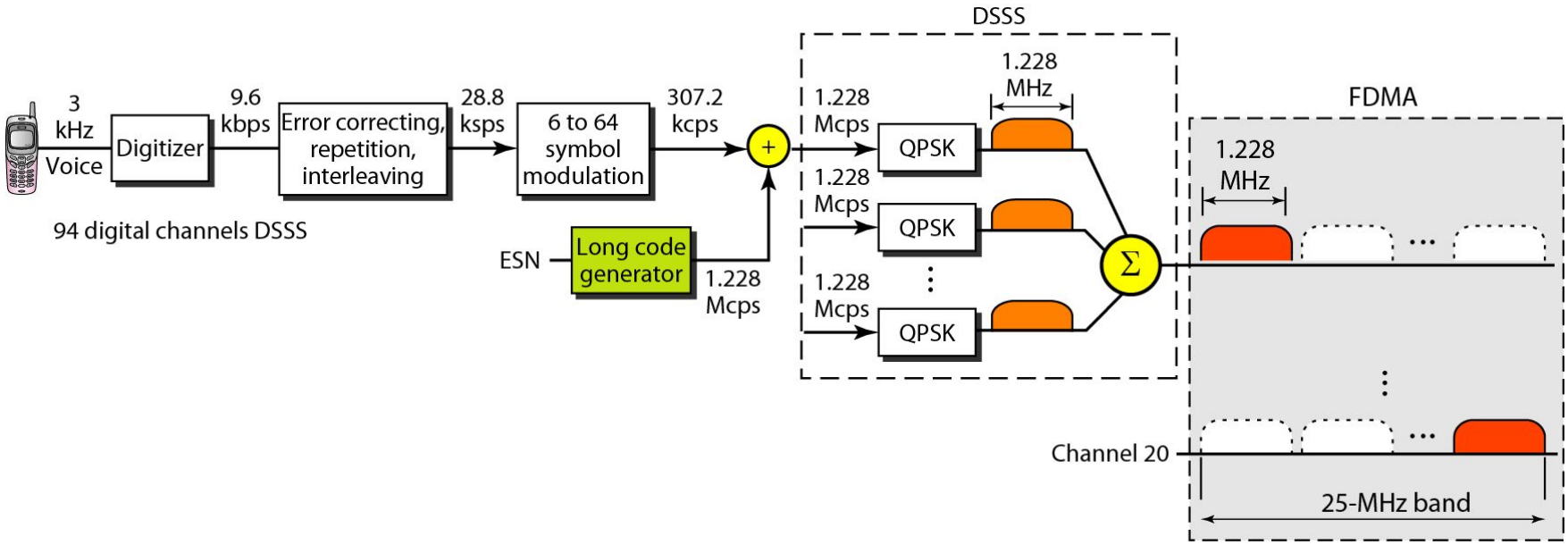


Figure 16.11 *IS-95 reverse transmission*



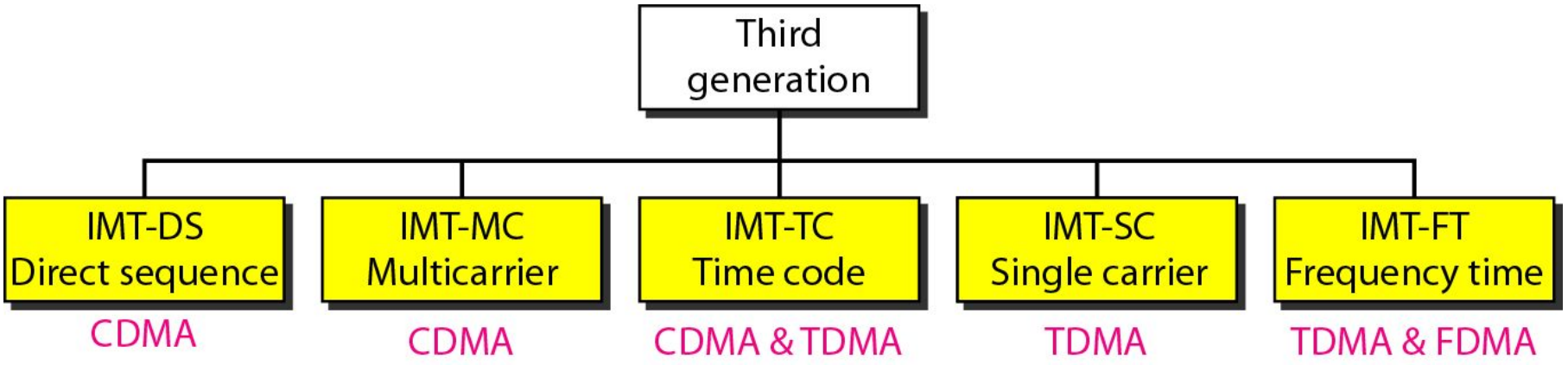
Note

IS-95 is a digital cellular phone system using CDMA/DSSS and FDMA.

Note

The main goal of third-generation cellular telephony is to provide universal personal communication.

Figure 16.12 *IMT-2000 radio interfaces*



Data Communications and Networking Fourth Edition

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Chapter 16

Wireless WANs: Cellular Telephone and Satellite Networks