

Lecture 9

CS 621

Mobile Computing

2G Cellular Systems

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Several slides and images in this presentation have been taken from Prof. Nityananda Sarma's class notes/ppt.
Several images have been taken from the book Mobile Communication by Jochen Schiller.

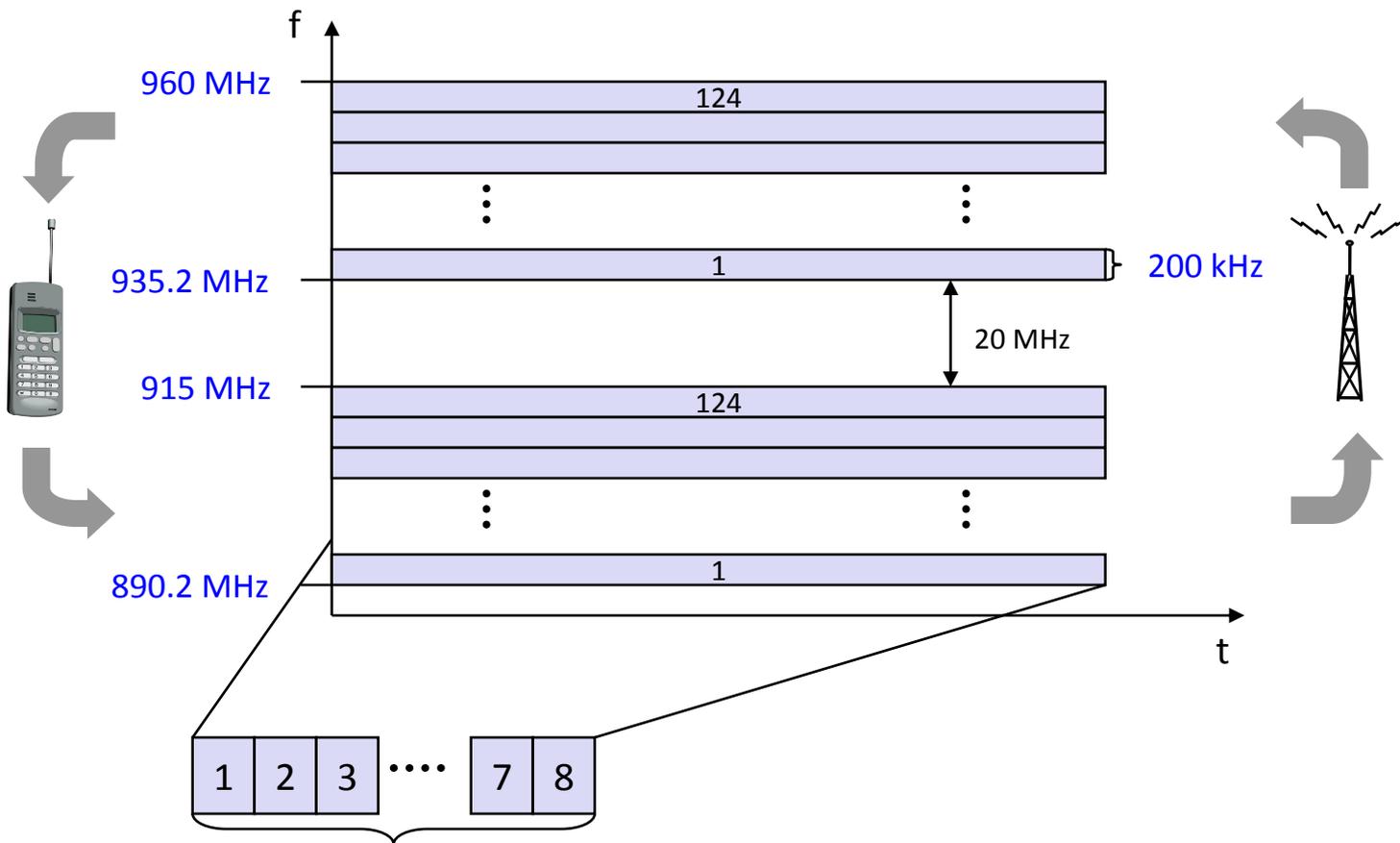
2G Cellular Systems

- Four Major Standards:
 - GSM (European)
 - IS-54 (later becomes IS-136, US)
 - JDC (Japanese Digital Cellular)
 - IS-95 (CDMA, US)

Example: GSM

- Frequency Band
 - 935-960 (forward or downlink), 890-915 (reverse or uplink) MHz
 - Two pieces of 25 MHz band
(same as AMPS)
- AMPS has 833 user channels
- How about GSM?

FDMA/TDMA, example GSM



Each freq. carrier is divided into 8 time slots.

Number of channels in GSM

- Freq. Carrier: 200 kHz
- TDMA: 8 time slots per freq carrier
- No. of carriers = $25 \text{ MHz} / 200 \text{ kHz}$
= 125
- No. of user channels = $125 * 8$
= 1000

Capacity Comparison

- Reuse factor
 - 7 for AMPS
 - 3 for GSM (*why smaller reuse factor?*)
- What's the capacity of GSM relative to AMPS?
 - A. one half of AMPS
 - B. the same
 - C. 3 times larger
 - D. 10 times larger

Answer

- AMPS
 - reuse factor = 7
 - no. of users / cell = $833 / 7 = 119$
- GSM
 - reuse factor = 3
 - no. of users / cell = $1000 / 3 = 333$
 - almost 3 times larger than AMPS!

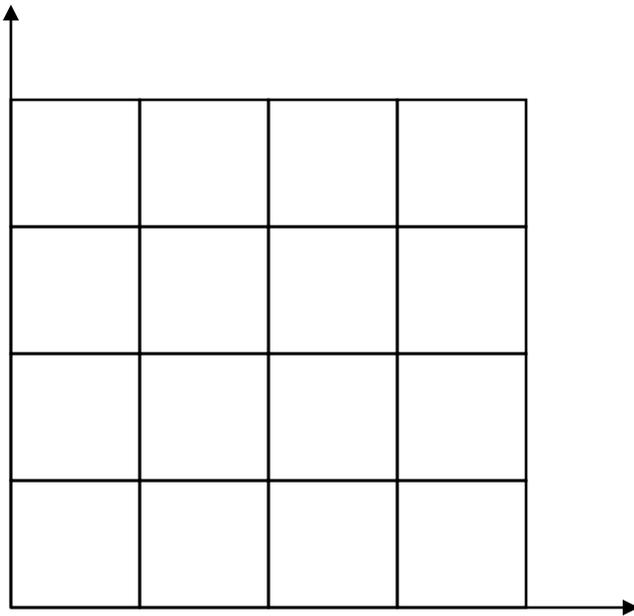
Multiple Access Methods

Three major types:

- Frequency Division Multiple Access (FDMA)
- Time Division Multiple Access (TDMA)
- Code Division Multiple Access (CDMA)
 - Frequency hopping (FH-CDMA)
 - Direct sequence (DS-CDMA)

Frequency-Time Plane

Frequency

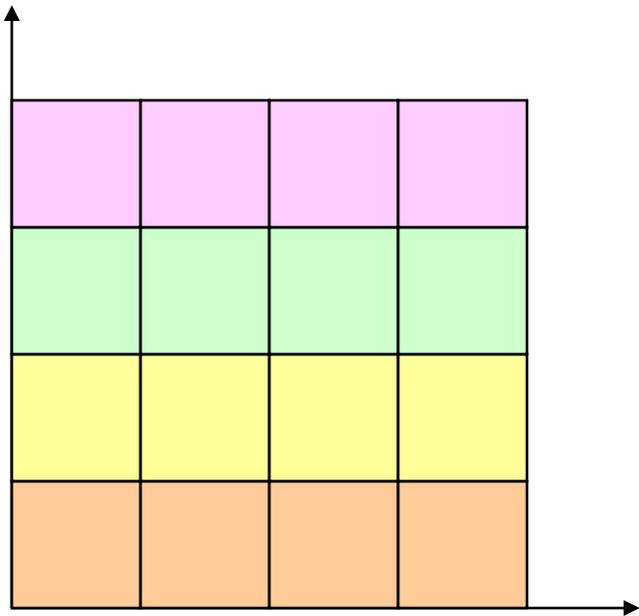


Time

Partition of signal space
into **time slots** and
frequency bands

FDMA

Frequency

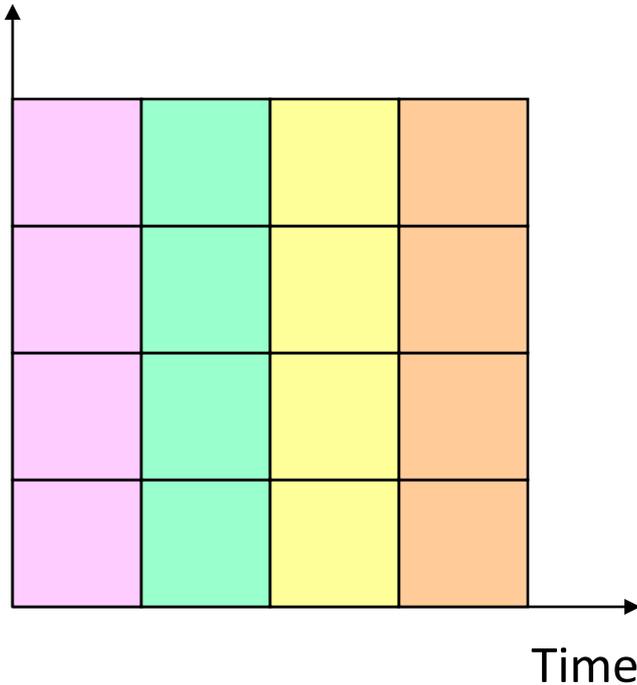


Time

Different users transmit at different frequency bands simultaneously.

TDMA

Frequency

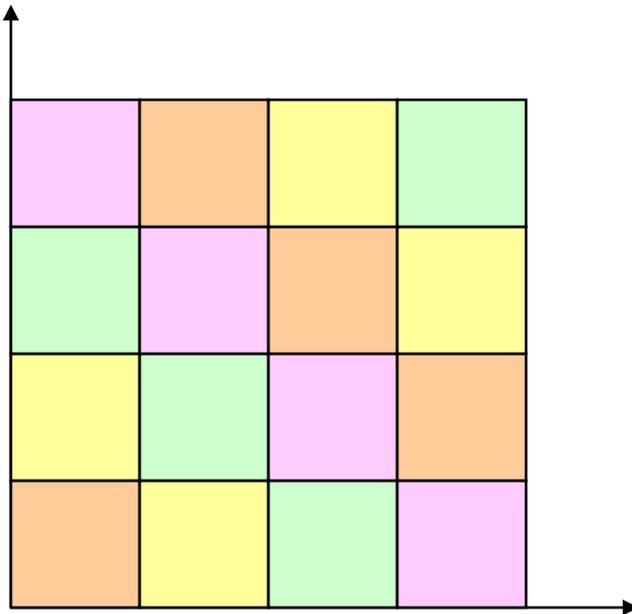


Different users transmit at
different time slots.

Each user occupies the
whole freq. spectrum.

Frequency Hopping CDMA

Frequency



Time

At each successive time slot, the frequency band assignments are reordered.

Each user employs a code that dictates the frequency hopping pattern.

Synchronization

- The previous figure implies that each signal **synchronizes** with each of the other signals.
- In practice, this is *not the case*.
- Frequency hops may collide, but it does not occur frequently.
 - How often collisions occur depends on the choice of *codes*.

THANKS!