

Cellular Technology

1 1st Generation Advanced Mobile Phone System (AMPS, 1980s)

In first generation cellular technology, the system was fully analog, and is not in use today. The features were:

- 12.5MHz uplink
- 12.5MHz downlink
- 416 channels, of 30Hz each
- Control and traffic channels
- Every device has a hardware Numeric Assignment Module (NAM) used to identify the device.
- The Mobile Telephone Switching Office (MTSO) maintains a blacklist of NAMs. Devices in the blacklist may not communicate in the network.

Call placement occurs in the following steps (taken from [Stallings,283]):

1. Sender keys in telephone number and presses the send key
2. The MTSO checks the number and the status of the subscriber
3. The MTSO sends the channels the subscriber may use for this call
4. The MTSO sends a ring signal to the called party
5. When the called party answers, the MTSO establishes a circuit.
6. When one party hangs up, the circuit is freed.

2 2nd Generation

For the second generation, data and digitized voice appeared in the system. The mobile handset samples the voice signal and sends digital data through the air. Also, channels may be shared.

Two main competing technologies appeared: GSM, which uses TDMA and slow frequency hopping, and IS-95 which uses CDMA.

2.1 Global System for Mobile Communication (GSM)

Developed in Europe, it was designed to provide a common interface for handsets. The textbook by Stallings shows the GSM architecture at page 291. One notable difference with other technologies is the use of a Subscriber Identification Module (SIM) card to separate the device from the information associated with the subscriber.

Some of its features are:

- Control and Traffic Channels
- Complex Hierarchy of TDMA frames
- Does slow frequency hopping for diversity
- Does delay equalization (base-station controlled)

In the U.S. the main carriers that use it are AT&T and T-mobile

2.2 CDMA (IS-95)

Main advantages over GSM are:

- Fast Frequency hopping to provide frequency diversity
- Resistant to Multipath effects
- Graceful degradation

Disadvantages:

- Self jamming
- Needs very accurate power control: handsets very near the base station can drown out the one far from it

- Soft handoffs (when changing cells, the new cell must be acquired before giving up the old one) is more complicated than handoffs in other schemes
- The technique used to avoid the multipath effects (correlating delayed input to a predefined training sequence) makes equipment pricey

2.3 Third Generation

CDMA is the main technique used in Third-generation systems. The different implementations are:

- CDMA
 1. CDMA2000
 2. W-CDMA
 3. TD-CDMA
- TDMA: TDD
- FDMA: DECT+

From these, CDMA2000 (also known as IS-856) supports data transfers through what is called 1x EVDO (same chipping rate, EVolution, Data-Only) and HSDPA. It supports 3Mbps and 1Mbps data rates.