Cellular/PCS Structure
System Block Diagram
Cellular/PCS

Mobile → BTS → BSC → MTSO/MSC → PSTN

forward

reverse

BTS  Base Transceiver Station
BSC  Base Station Controller
MTSO Mobile Telephone Switching Office
MSC  Mobile Switching Center

Radio Link
Bearer Trunk
Signaling Trunk
Signaling Channels

• Dedicated Control Channels (CC)
  – System information
• Paging Channels (PC)
  – Used to Initiate Calls to a Mobile
• Access Channels (AC)
  – Used to Initiate Calls from a Mobile
Hand-Off
Call Handoff

• Base Stations monitor the signal strength.
• If strength drops below hand-off level, all base stations are asked to look for the mobile; strongest becomes new BS.
• MTSO instructs the new base station to activate a voice channel to receive the handoff.
Call Handoff cont....

- MTSO sends command to mobile giving the new channel assignment.
- Hard Handoff
  - Mobile tunes to the new channel
- Soft Handoff
  - Mobile combines both signals for a time
Call Handoff cont...

- **Hard Handoff**
  - “Break before Make”, i.e. disconnect the current path and the establish the new one.

- **Soft Handoff**
  - Specific to CDMA
  - Forward: Station combines signals from multiple base stations
  - Reverse: BSCs select the better frame after decoding
Mobile Handset

- ESN - Electronic Serial Number
- Programmable NAM (Number Assignment Module)
- Contains among other things
  - System ID
  - First control channel to scan
  - System selection preferences
  - MIN (Mobile Identification Number)
Mobile Identification Number

- **MIN1** - Mobile System Id (3 digits)
  - US: Area Code
  - International: Mobil Carrier Identification

- **MIN2** - Station Number
  - US: NXX and line number
  - International: internal mobile number
Roaming

MTSO

Mobile

Mobile

Mobile

Mobile

Mobile

MTSO

Mobile

Mobile

Mobile

Mobile
Roaming Details

Authentication Center

Request

Response

Billing Information
Service Profile

Current Location
Temporary Directory Number

MS

AC

MTSO

BS

VLR

HLR

HLR

MTSO
Example: IS-41C

- Mobile and AC share a secret authentication key (A-Key)
  - installed during provisioning
  - used in challenge/response authentication
- Two SSDs (Shared Secret Data)
  - Temporary secret keys computed from A-key, MIN, ESN, and a random seed
  - Used for temporary authentication and channel encryption.
Intersystem Hand-Off
The “Shoe-Lace” Effect
Multi-System Tandem
The “Trombone” Effect

- **MS**
- **BS**
- **MTSO**
- **Fixed Station**

Diagram showing connections between MTSO and Fixed Station.