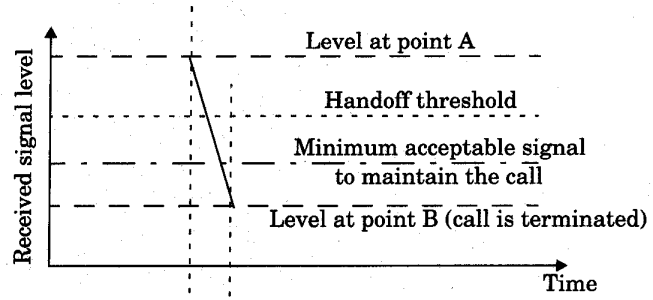


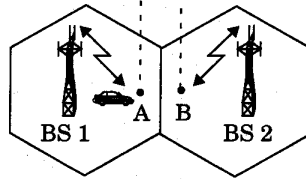
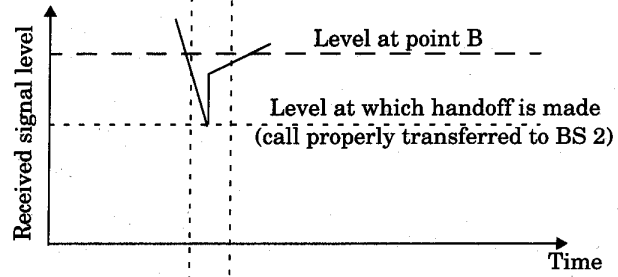
2.4 Handoff Strategies

- When a mobile moves into a different cell while a conversation is in progress, the MSC automatically transfers the call to a new channel belonging to the new base station.
- Handoff operation
 - identifying a new base station
 - re-allocating the voice and control channels with the new base station.
- Handoff Threshold
 - Minimum usable signal for acceptable voice quality (-90dBm to -100dBm)
 - Handoff margin $\Delta = P_{r,handoff} - P_{r,minimum\ usable}$ cannot be too large or too small.
 - If Δ is too large, unnecessary handoffs burden the MSC
 - If Δ is too small, there may be insufficient time to complete handoff before a call is lost.

(a) Improper handoff situation



(b) Proper handoff situation



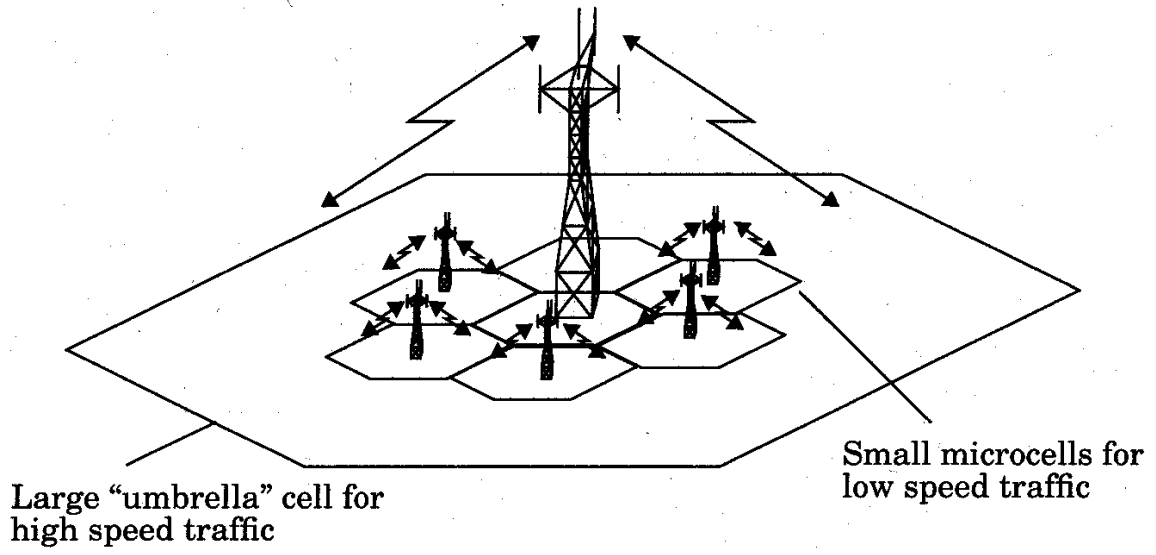
- Handoff must ensure that the drop in the measured signal is not due to momentary fading and that the mobile is actually moving away from the serving base station.
- Running average measurement of signal strength should be optimized so that unnecessary handoffs are avoided.
 - Depends on the speed at which the vehicle is moving.
 - Steep short term average -> the hand off should be made quickly
 - The speed can be estimated from the statistics of the received short-term fading signal at the base station
- Dwell time: the time over which a call may be maintained within a cell without handoff.
- Dwell time depends on
 - propagation
 - interference
 - distance
 - speed

- Handoff measurement
 - In first generation analog cellular systems, signal strength measurements are made by the base station and supervised by the MSC.
 - In second generation systems (TDMA), handoff decisions are mobile assisted, called mobile assisted handoff (MAHO)
- Intersystem handoff: If a mobile moves from one cellular system to a different cellular system controlled by a different MSC.
- Handoff requests is much important than handling a new call.

Practical Handoff Consideration

- Different type of users
 - High speed users need frequent handoff during a call.
 - Low speed users may never need a handoff during a call.
- Microcells to provide capacity, the MSC can become burdened if high speed users are constantly being passed between very small cells.
- Minimize handoff intervention
 - handle the simultaneous traffic of high speed and low speed users.
- Large and small cells can be located at a single location (umbrella cell)
 - different antenna height
 - different power level
- Cell dragging problem: pedestrian users provide a very strong signal to the base station
 - The user may travel deep within a neighboring cell



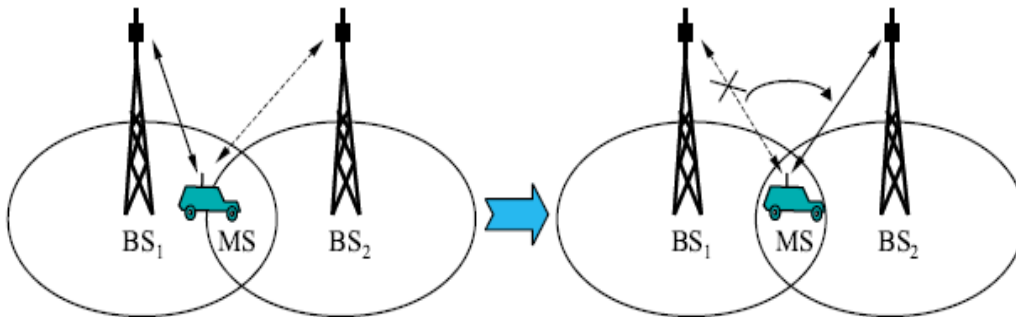


- Handoff for first generation analog cellular systems
 - 10 secs handoff time
 - Δ is in the order of 6 dB to 12 dB
- Handoff for second generation cellular systems, e.g., GSM
 - 1 to 2 seconds handoff time
 - mobile assists handoff
 - Δ is in the order of 0 dB to 6 dB
 - Handoff decisions based on signal strength, co-channel interference, and adjacent channel interference.
- IS-95 CDMA spread spectrum cellular system
 - Mobiles share the channel in every cell.
 - No physical change of channel during handoff
 - MSC decides the base station with the best receiving signal as the service station

-

Types of Handoffs:

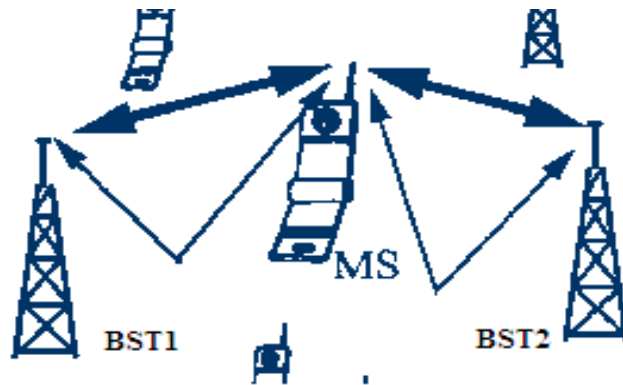
- ❖ Hard handoff: “break before make” connection
- ❖ Intra and inter-cell handoffs



Hard Handoff between the MS and BSs

Cont.

- ❖ Soft handoff: “make-before-break” connection.
- ❖ Mobile directed handoff.
- ❖ Multiways and softer handoffs



Soft Handoff between MS and BSTs

Handoff Prioritization:

Two basic methods of handoff prioritization are :

- ❖ Guard Channels
- ❖ Queuing of Handoff

2.5 Interference and System Capacity

- Sources of interference
 - another mobile in the same cell
 - a call in progress in the neighboring cell
 - other base stations operating in the same frequency band
 - noncellular system leaks energy into the cellular frequency band
- Two major cellular interference
 - co-channel interference
 - adjacent channel interference

