EEC173B/ECS152C, Spring 2009

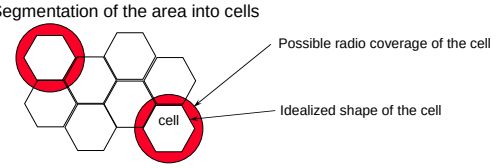
Fundamentals of Wireless Communications
- #4: Spread Spectrum
- #5: Multiplexing
- #6: Frequency Reuse (Cellular Concept)

Case Study: GSM Wireless cellular networks
- #7: Handoff

Acknowledgment: Selected slides from Prof. Schiller

GSM Cellular network

Segmentation of the area into cells



- Use of several carrier frequencies
- Not the same frequency in adjoining cells
- Cell sizes vary from some 100 m up to 35 km depending on user density, geography, transceiver power etc.
- Hexagonal shape of cells is idealized (cells overlap, shapes depend on geography)
- If a mobile user changes cells
  - handover of the connection to the neighbor cell

#7: Handoffs (or Handover)

- Required to support mobility when the user moves into a different cell
- Involves
  - Identifying a new BS in new cell
  - Find uplink/downlink channel pair from new cell to carry on the call
  - Drop the link from the old BS

Handoffs: Design Issues (1)

- Optimal BS selection:
  - BS nearest to MT may not necessarily be the best in terms of signal strength, especially new the cell boundaries
- Ping-pong Effect
  - Call gets bounced back and forth between two BS (a series of handoffs)
- Data loss
  - Interruption due to handoff may cause a loss in data
  - Delay in relinquishing channel in old cell and resume in new call may be acceptable for voice, but cause data loss

Handoff: Design Issues (2)

- Detection of handoff requirement
  - Mobile-initiated: MT monitors signal strength from BS and requests a handoff when signal drops below a threshold)
  - Network-initiated: BS forces a handoff when signals from an MT weaken, queries neighboring BS about signal strength from the MT and deduce which BS to handoff too
  - Mobile-assisted scheme: combination of mobile- and network-initiated schemes. MT evaluates signal strength, but final handoff decision is made by BS

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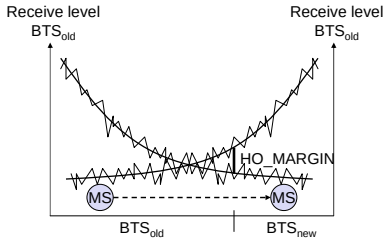
Handover Decision



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Handoff Quality

- Handoff delay:
  - Signaling during a handoff causes delay in transfer
  - If delay is too large, SINR may fall below minimum threshold, causing call to be dropped
- Duration of interruption
  - Hard handoff: channel pair from old BS cancel and then channel pair from next BS is used to continue the call
- Handoff success: probability of successful handoffs
  - Depends on number of available channel pairs, capacity to switch before SINR falls below threshold
- Probability of unnecessary handoff
  - E.g., Ping-Pong effect
  - Increase signaling overhead, leading to unwanted delays and interruptions

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Questions?

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