MOBILE COMPUTING

Unit-1
Handoff in Cellular System

B. Mohapatra
(MIEEE, LMIETE, LMISTE, LMOBA)
Galgotias University, Greater Noida

Source & References:

The materials presented in this lecture has been taken from internet sites and books. This can be used only for academic purpose only.

1.   **J. Schiller, Mobile Communications, Pearson, 2nd Ed**

2.   **Asok K. Talukder, Mobile Computing-Technology, Applications & Service Creation, TMH**

Handoff

- In cellular telecommunications, the term **handoff** refers to the process of transferring an ongoing call or data session from one channel connected to the core network to another. In satellite communications it is the process of transferring satellite control responsibility from one earth station to another without loss or interruption of service. The British English term for transferring a cellular call is **handover**, which is the terminology standardised by 3GPP within such European originated technologies as GSM and UMTS.

- In telecommunications there may be different reasons why a handoff (handover) might be conducted:

Handoff

- When the phone is moving away from the area covered by one cell and entering the area covered by another cell the call is transferred to the second cell in order to avoid call termination when the phone gets outside the range of the first cell;

- When the capacity for connecting new calls of a given cell is used up and an existing or new call from a phone, which is located in an area overlapped by another cell, is transferred to that cell in order to free-up some capacity in the first cell for other users, who can only be connected to that cell.

Handoff

- In non-CDMA networks when the channel used by the phone becomes interfered by another phone using the same channel in a different cell, the call is transferred to a different channel in the same cell or to a different channel in another cell in order to avoid the interference.

Handoff

- In non-CDMA networks when the user behavior changes, e.g. when a fast-travelling user, connected to a large, umbrella-type of cell, stops then the call may be transferred to a smaller macro cell or even to a micro cell in order to free capacity on the umbrella cell for other fast-travelling users and to reduce the potential interference to other cells or users (this works in reverse too, when a user is detected to be moving faster than a certain threshold, the call can be transferred to a larger umbrella-type of cell in order to minimize the frequency of the handoffs due to this movement)

- in CDMA networks a soft handoff may be induced in order to reduce the interference to a smaller neighboring cell due to the "near-far" effect even when the phone still has an excellent connection to its current cell

Handoff Management

- **Handoff Management Phases:**
  o The **initiation phase** may employ a decision making strategy based on the measured received signal level, with and without hysteresis.
  o **Without hysteresis,** a handoff is initiated as soon as the average signal level from the new BS exceeds that from the current BS.
  o **With hysteresis**, handoff is initiated when the average signal level from the new BS exceeds that from the current BS by threshold amount.
  o The **execution phase** will include the allocation of new radio resource and the exchange of control messages

Handoff Strategies

Depending on the information used and the action taken to initiate the handoff, the methods for handoff can be

- **Mobile controlled handoff(MCHO):** is a desirable method because it reduces the burden on the network. However, this will increase the complexity of the mobile terminal. Overall delay in handoff is 0.1s e.g.DECT

- **Network controlled handoff(NCHO):** the BS monitors the signal quality from the mobile and reports the measurements to the MSC. The MSC is responsible for choosing the candidate BS. Overall delay in handoff is in the range of 5-10s eg. AMPS, CT-2 Plus

- **Mobile assisted handoff(MAHO):** is a variant of NCHO and is employed by GSM. In MAHO, the mobile measures the signal levels from the various BSs. The mobile collects set of powers levels from different BSs and feeds it back to the MSC. Overall delay in handoff is 1s e.g. GSM, IS-95 CDMA

Handoff Features

The Effective handoff scheme should have the following features.

1. Fast & Lossless
2. Minimal no. of Control signal exchanges
3. Scalable with network size
4. Capable of recovering from link features , such as abrupt loss of radio link.

The design goals of an effective Handoff scheme include

1. Less Handoff delay
2. Low cell loss
3. Small buffer required
4. Efficient use of resources.

Hand-off Phases initiated when mobile moves from area of one BS into area of another BS.

- **BS initiated:**
  - BS monitors the signal level of the mobile
  - Handoff occurs if signal level falls below threshold
  - Increases load on BS
    - Monitor signal level of each mobile
    - Determine target BS for handoff
- **Mobile assisted:**
  - Each BS periodically transmits beacon
  - Mobile, on hearing stronger beacon from a new BS, sends it a greeting
    - changes routing tables to make new BS its default gateway
    - sends new BS identity of the old BS
  - New BS acknowledges the greeting and begins to route mobile's call

- **Intersystem:**
  - Mobile moves across areas controlled by different MSC's
  - Handled similar to mobile assisted case with additional HLR / VLR effort
  - Local call may become long-distance

How to cope with handovers?

- Treat a handover as a new call => blocking =) connection drop=> angry users
- A guard channel concept: set aside some channels for handover calls=> wasted capacity
- **Queuing off handovers:** between initiation of handover and the actual event some time passes (in GSM: 1-2 seconds), this time can be used to wait for ending / leaving calls, the waiting call is then treated next
- Umbrella cells for highly mobile users

Merits and Demerits of Cellular System

Advantages of Cellular Systems with small cells

- higher capacity, higher number of users
- less transmission power needed
- more robust, decentralized
- base station deals with interference, transmission area etc. locally

Disadvantages
- Infrastructure Needed
- Handover Needed
- Frequency Planning

Merits and Demerits of Cellular System

Problems:

- fixed network needed for the base stations
- handover (changing from one cell to another) necessary
- interference with other cells: co-channel, adjacent-channel

Important Issues:

- Cell sizing
- Frequency reuse planning
- Channel allocation strategies

Thank You
Any Questions??