

Lecture 7: 1.7 Channel assignment strategies

Fundamental of Cellular Communication

DI05011011: Mobile Communication

Agenda for Today

- 1. Why Channel Assignment?
- 2. Goals of Channel Assignment
- 3. Fixed Channel Assignment (FCA)
- 4. Borrowing Strategies in FCA
- 5. Dynamic Channel Assignment (DCA)
- 6. Advantages and Disadvantages of DCA
- 7. Comparison: FCA vs DCA
- 8. Summary and Next Steps

The Need for Channel Assignment

- The frequency spectrum allocated for cellular communication is strictly limited.
- To maximize capacity and minimize interference, this spectrum must be managed efficiently.
- When a user makes a call, the system must assign a specific radio channel for that communication.
- The strategy used to allocate these channels significantly impacts the system's overall capacity and call blocking probability.

Goals of Channel Assignment

- 1. Maximize spectrum utilization (serve as many users as possible).
- 2. Minimize the probability of a blocked call (user getting a 'busy' signal).
- 3. Minimize the probability of a dropped call (losing connection mid-conversation).
- 4. Maintain acceptable Signal-to-Interference Ratio (SIR) by managing co-channel and adjacent channel interference.

Types of Channel Assignment

- Channel assignment strategies can be broadly classified into two categories:
- **1. Fixed Channel Assignment (FCA):** Channels are permanently allocated to specific cells.
- **2. Dynamic Channel Assignment (DCA):** Channels are not allocated to cells permanently but are pooled and assigned on demand.

Fixed Channel Assignment (FCA)

- In FCA, each cell is allocated a predetermined set of voice channels.
- Any call attempt within the cell can only be served by the unused channels in that specific cell.
- If all channels in that cell are occupied, the call is blocked (user receives a busy signal).
- The assignment is done based on expected traffic patterns during network planning.

FCA: Channel Borrowing

- To handle sudden spikes in traffic, FCA is often augmented with a 'borrowing' strategy.
- If a cell's channels are full, the base station can request (borrow) a free channel from a neighboring cell.
- The Mobile Switching Center (MSC) supervises this borrowing process.
- Borrowed channels are locked in the donor cell to prevent co-channel interference.

Example: FCA with Borrowing

- Cell A is assigned channels 1-10. Cell B is assigned channels 11-20.
- Currently, 10 active calls are in Cell A. Channel 1-10 are busy.
- An 11th user tries to make a call in Cell A.
- Cell A's Base Station requests MSC to borrow a channel.
- MSC sees Cell B has channel 20 free. MSC assigns Channel 20 to the user in Cell A.
- Channel 20 cannot be used by Cell B until the call in Cell A finishes.

Dynamic Channel Assignment (DCA)

- In DCA, channels are not allocated to cells on a permanent basis.
- Instead, all channels are kept in a central pool maintained by the MSC.
- When a call request arrives, the Base Station requests a channel from the MSC.
- The MSC assigns a channel based on an algorithm that evaluates current interference levels and channel usage.

- When MSC receives a request, it checks for available channels in the pool.
- It evaluates candidate channels to ensure assigning them won't violate the minimum required Signal-to-Interference Ratio (SIR).
- If a channel meets the criteria, it is assigned.
- When the call ends, the channel is immediately returned to the central pool.

Advantages of DCA

- **1. Increased Efficiency:** Better utilization of spectrum, especially under varying or uneven traffic loads.
- **2. Lower Call Blocking:** Significantly reduces the probability of blocked calls during unexpected peaks.
- **3. No Need for Precise Planning:** Less upfront effort required for frequency planning compared to FCA.

Disadvantages of DCA

- **1. High Computational Load:** MSC must perform complex calculations for every call request in real-time.
- **2. Increased Signaling:** Constant communication between Base Stations and the MSC to update channel status.
- **3. Delay:** The time taken to calculate and assign a channel can introduce setup delays for the call.

FCA vs. DCA Summary

- — Feature — Fixed (FCA) — Dynamic (DCA) —
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- — Allocation — Permanent to cell — Central pool —
- — Flexibility — Low (without borrowing) — High —
- — Complexity — Low — High —
- — Signaling Overhead — Low — High —
- — Best For — Uniform, predictable traffic — Bursty, unpredictable traffic —

- Channel assignment is necessary to manage limited spectrum efficiently.
- FCA permanently assigns channels to cells based on predicted traffic.
- FCA can use borrowing to handle unexpected traffic spikes.
- DCA pools all channels and assigns them on-demand based on real-time conditions.
- DCA handles varied traffic better but requires more processing and signaling overhead than FCA.

- In the next lecture, we will explore techniques to increase network capacity:
- **Cell Splitting and Sectoring:**
 - 1. How to divide cells when they become congested.
 - 2. Using directional antennas to reduce interference.
 - 3. Methods to accommodate more users in a growing network.