Wireless and Mobile Network Architecture

Chapter 3: Handoff Management Detection and Assignment

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Outline

- 3.1 Handoff Detection
  - **Who** initiates the handoff process?
  - **How** is the need for handoff detected?
- 3.2 Strategies for Handoff Detection
  - **MCHO**
  - **NCHO**
  - **MAHO**
- 3.3 Channel Assignment
  - **Nonprioritized Scheme**
  - **Queuing Priority Scheme**
  - **Subrating Scheme**

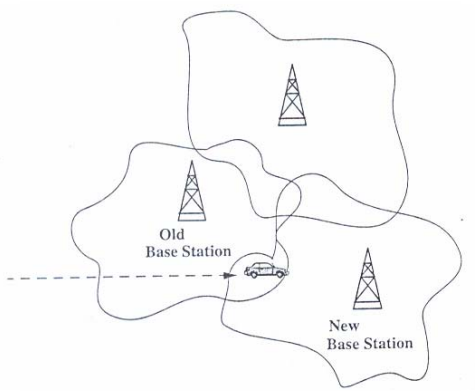

Fig 3.1 **Handoff**

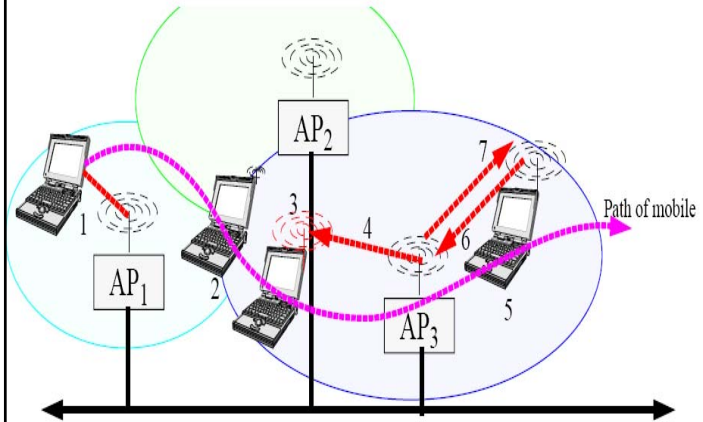

Fig 3.1 **Handoff**

Introduction

- Three issues for **handoff management**
  - **Handoff detection** (ch3)
  - **Channel assignment** (ch3)
  - **Radio link transfer** (ch4)

3.1 Handoff Detection

- To initiate a handoff:
  - **Who** initiates the handoff process?
  - **How** is the need for handoff detected?
- Three measurements are used for **handoff management**
  - **Word error indicator (WEI)**
  - **Received signal strength indicator (RSSI)**
    - **80db~100db**
  - **Quality indicator (QI)**
    - **5db~25db**

Three measurements

- Three measurements are used for **handoff management**
  - **Word error indicator (WEI)**
    - Metric that indicates whether the **current burst was demodulated properly** in the MS.
  - **Received signal strength indicator (RSSI)**
    - Measure of **received signal strength**.
    - The RSSI metric has large useful dynamic range 80db~100db
  - **Quality indicator (QI)**
    - Estimate of the "eye opening" of a radio signal, which relates to the **signal to interference** and **noise (S/I) ratio**.
    - The QI metric has narrow range 5db~25db

Cont.

- Handoff may depend more reliably on WEI of the current channel than RSSI.
- It is necessary to accumulate **WEI** measurements over a period of time, whereas **RSSI** is known instantaneously.
- To make sure the handoff decision accurately and quickly, it is desirable to use both **WEI** and **RSSI**.

Cont.

- RSSI measurements are affected by
  - **Distance-depend fading**
  - **Lognormal fading**
  - **Rayleigh fading (multipath fading)**
- Ideally, the handoff decision should be based on
  - **Distance-depend fading**
  - **Shadow fading**
  - Independent of **Rayleigh fading**

Cont.

- Channel comparison for handoff are based on RSSI and QI metrics.
- Filter should be applied on both RSSI and QI metrics.
  - ***Window averaging***
  - ***Leaky-bucket integration***

Cont.

- Short-term Rayleigh fading is usually handled in mobile system designs by techniques including
  - Diversity techniques
    - **Multiple receiver**
    - **Correlators with variable lines**
    - **Antenna diversity**
  - Signal processing techniques
    - **Bit interleaving**
    - **Convolutional coding**
    - **equalizer**

3.2 Strategies for Handoff Detection
Mobile-Controlled Handoff (MCHO)

- MCHO is employed by lower-tier DECT and PACS.
  - The MS continuously monitors the signal of the surrounding BSs
  - When some handoff criteria are met, the MS checks the "best" candidate BS for an available traffic channel and launches a handoff request
  - Automatic link transfer (ALT)
    - Handoff between two BSs
  - Time slot transfer (TST)
    - Handoff between channels on the same BS

Cont.

- The MS receiver generally obtains twp pieces of information: RSSI and QI.
- The required handoff time for
  - DECT is 100 msec to 500 msec.
  - PACS is 20 msec to 50 msec.

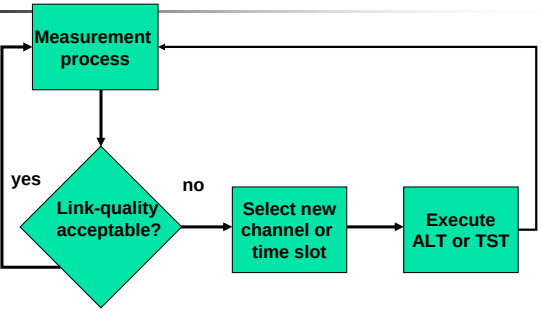

Fig 3.2 MS-quality maintenance processing

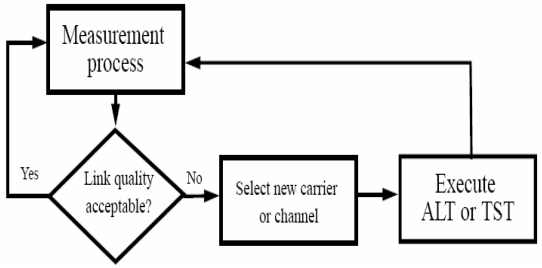

Fig 3.2 MS-quality maintenance processing

Network-Controlled Handoff (NCHO)

- NCHO is employed by the lower –tier CT-2 plus and high-tier AMPS
  - The network (MSC) asks all surrounding BSs to measure the signal (RSSI) from the MS and report the measurement results back the network.
  - The MSs supervise the quality of all current connections by making measurements of RSSI.
  - The required handoff time can be up to 10 seconds or more.

Mobile-Assisted Handoff (MAHO)

- NAHO is employed by the lower –tier CT-2 plus and high-tier GSM, IS-95 CDMA, and IS-136 TDMA
  - Both the MS and BS supervise the quality of the link
    - RSSI and WEI values
  - In GSM, the MS transmits the measurement results to BS twice a second.
  - When and where to execute handoff is made by the network
    - BS, MSC or BSC

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- The GSM handoff execution time is approximately 1 second.

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3.2.4 Handoff Failures

- Handoff Failures
  - No **channel** is available
  - Handoff is **denied by the network**
  - It takes the network **too long to set up** the handoff
  - The **target link fails** in some way during the execution of handoff

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3.3 Channel Assignment

- Channel assignment schemes attempt to achieve
  - high degree of spectrum utilization,
  - least number of database lookups,
  - simplest algorithm employed in both the MS and network

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Cont.

- Some trade-offs:
  - Service quality
  - Implementation complexity of the channel assignment algorithm
  - Number of database lookups
  - Spectrum utilization

Cout.

- Successful handoff access is intimately tied to the radio technology of the channel assignment process, which may be
  - Dynamic channel assignment **(DCA)**
  - Fixed channel assignment **(FCA)**
  - Quasi-static autonomous frequency assignment **(QSAFA)**
- Blocked call
  - There are no available channels at a busy BS

3.3.1 Nonpriority Scheme and the Reserved Channel Scheme

- Nonprioritized Scheme
  - The networks handle a handoff in the same manner as a new call attempt
  - **Fig 3.3**
- Reserved Channel Scheme
  - Similar to the nonprioritized scheme, except that some channels in each BS are reserved for handoff calls
  - **Fig 3.4**

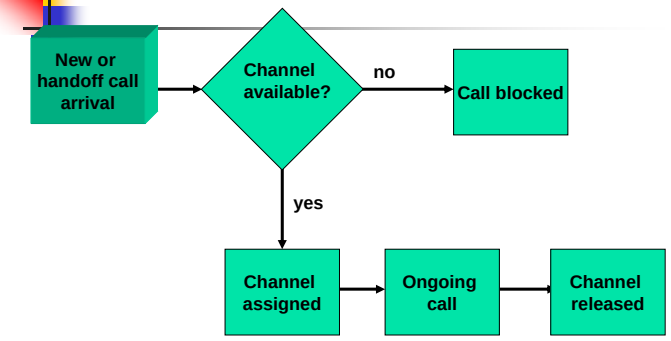

Fig 3.3 **Flowchart for nonprioritized scheme**

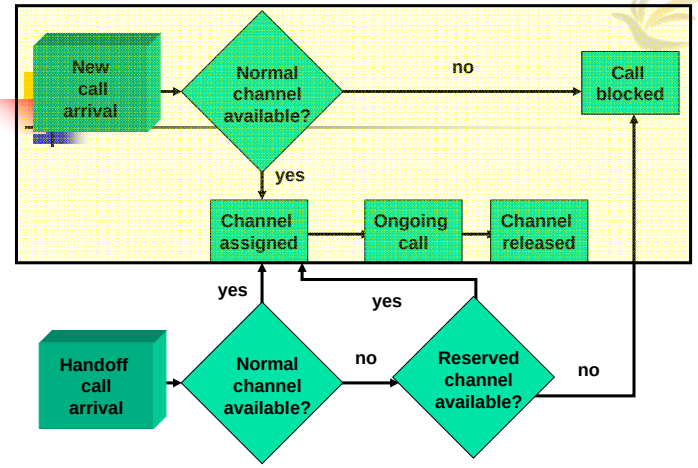

Fig 3.4 Flowchart for reserved channel scheme

3.3.2 Queuing priority Scheme

- Queuing Priority Scheme (**Fig 3.5**)
  - Based on the fact that adjacent coverage areas of BSs overlap
  - There is a considerable area where a call can be handled by either BS, which is called the handoff area
  - If no new channel is available in the new BS during handoff, the new BS buffers the handoff request in a waiting queue.
  - The MS continues to use the channel with the old BS until either a channel in the new BS becomes available

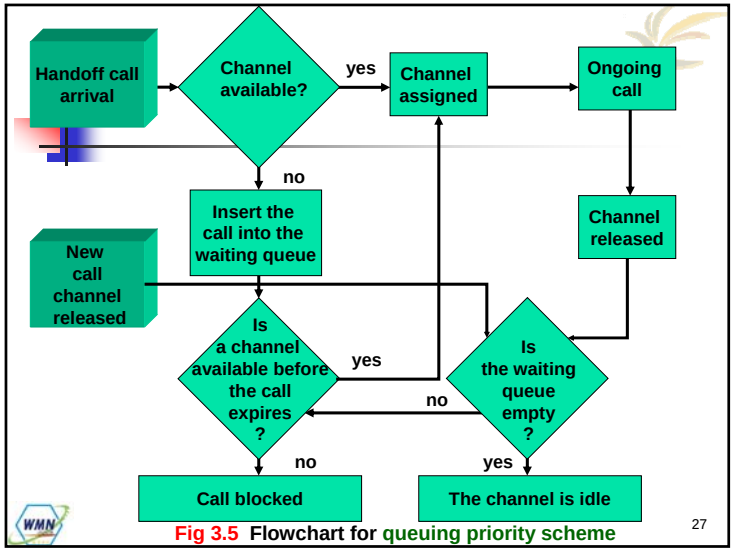

Fig 3.5 Flowchart for queuing priority scheme

3.3.3 Subrating Scheme

- Subrating Scheme
  - Creates a new channel on a blocked BS for a handoff access attempt by subrating a existing call.
  - **Fig 3.6**

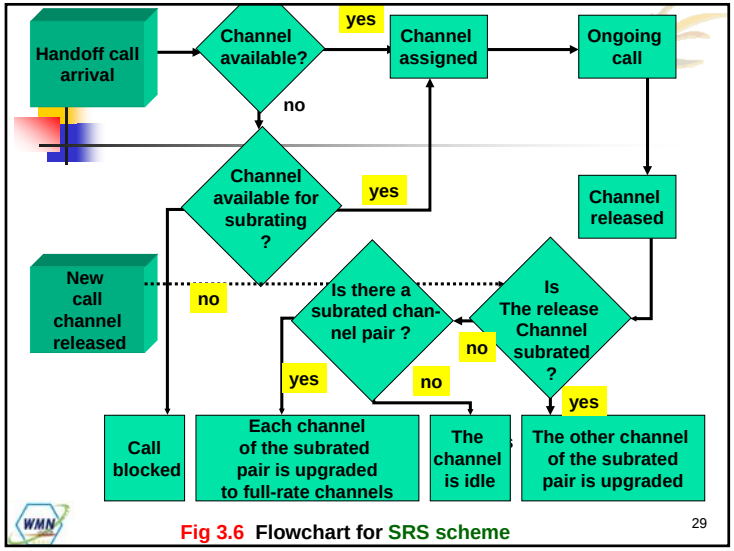

Fig 3.6 Flowchart for SRS scheme

3.4 Summary

- This chapter described two major issues for **PCS handoff management**
  - **Handoff detection**
    - Who initiates the handoff process?
    - How is the need for handoff detected?
  - **Channel assignment**
    - Nonpriority Scheme
    - Reserved Channel Scheme
    - Queuing Priority Scheme
    - Subrating scheme
    - MBPS scheme