

# 11 Handover

## Objectives

After this chapter the student will:

- be able to define the concepts of handover.
- be able to describe the measurement principles and the different handover cases.

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## 11.1 Introduction

The handover procedure is used when there is a need for a cell change when the MS is busy. The network is responsible for making the handover decision and performing the actual handover. To assist in the handover decision the MS will provide the network with measurements made on the downlink. Measurements will also be made on the network side.

Three types of handover can be distinguished depending on the network structure:

- Intra-BSC Handover - an MS changes between two cells, belonging to the same BSC. In this case the BSC has full control over the handover.
- Inter-BSC Handover - an MS changes between two cells belonging to different BSCs under the same MSC/VLR. In this case the “old” BSC will take the decision and initiate the handover.
- Inter-MSC Handover - an MS changes between two cells belonging to different BSCs under different MSC/VLRs. In this case the “old” BSC will take the decision and initiate the handover. The “old” MSC, called anchor-MSC, and the new MSC together with the new BSC will be parts of the link procedure to commit handover.

## 11.2 Measurements - a prerequisite for handover

When the MS is busy the decision about which cell is the best for the dedicated connection is done by the BSS. The procedure for the system to figure out which cell is the most suitable, and evaluate the measurements, is called handover preparation. This is normally done in the BSC although the option of doing most of it in the BTS is also available. In the following text we have assumed the BSC to be responsible for the evaluation of the measurement reports. The change of the dedicated connection (SDCCH or TCH) is called handover which is handled by the BSC, and MSC in one case. To be able to make the right handover decision, the BSC needs measurements on the connection to the serving cell as well as to the possible handover candidates, (i.e. the neighbouring cells).

### *Measurements in busy mode*

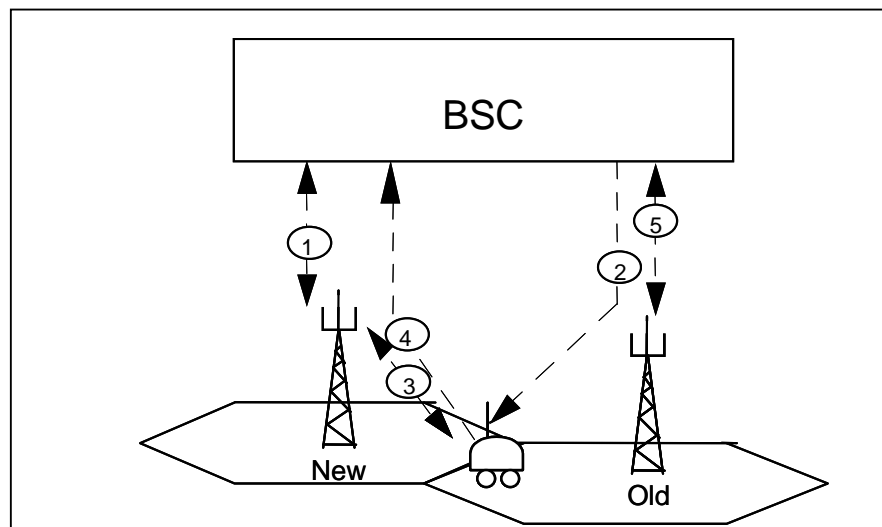
To perform a fast handover procedure the BSC is provided with all the necessary information about the serving and neighbouring cells beforehand. Measurements are done by the BTS and MS during the call and will be reported to the BSC every 480 ms. The BTS will measure signal strength and bit error rate on the uplink while the MS will measure the same parameters on the downlink. In addition the MS will measure signal strength on the BCCH-carriers of the neighbouring cells. The MS will send its reports on SACCH.

## 11.3 Handover cases

The measurement reports from the BTS and MS, together with system parameters set by the operator, are used in the preparation algorithm in the BSC. The outcome could be a handover if this is judged necessary. We will look at three handover cases. The difference between them is due to where the cells are located in the network structure, and thus how many nodes will be involved in the handover. One thing in common for all three cases is that the BSC that makes the handover decision will order and control the handover procedure from start to finish. The BSC will identify every specific handover by a handover reference number (HO ref. no.). This number will be used to ensure that the MS will get the right channel and call to continue.

### *Intra- BSC Handover*

In this case the handover is controlled by the BSC internally and the MSC will only be informed for statistical reasons.



*Intra-BSC handover*

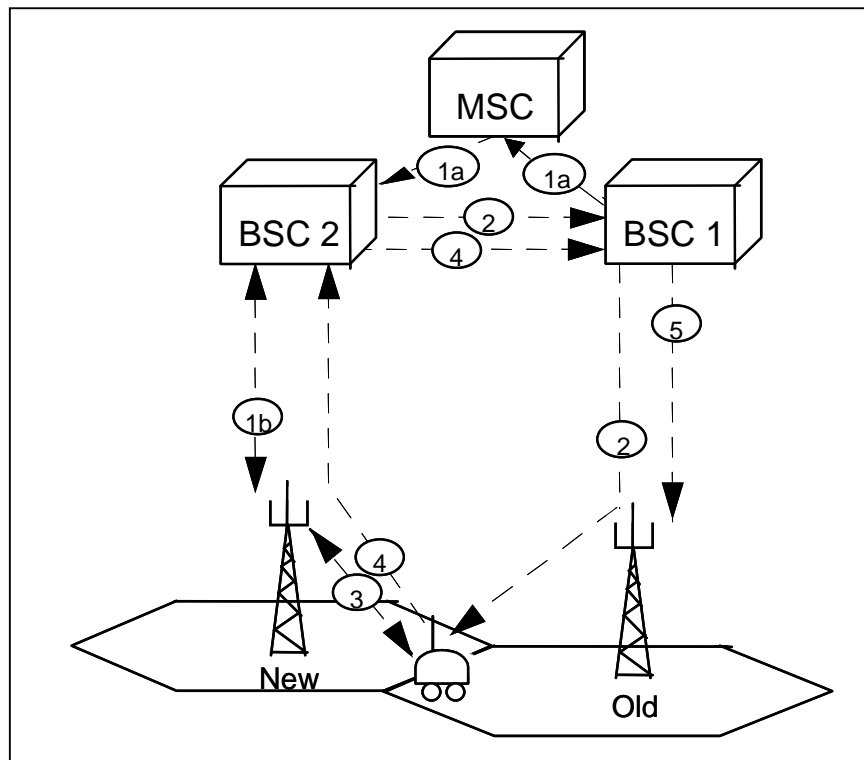
If a better candidate for the connection is identified, based on the measurements carried out by the MS and BTS, the following will happen:

1. Activation of new channel - BSC allocates a TCH in the new cell and orders that BTS to activate it. The chosen HO ref. no. will be part of the activation message. The BTS in the new cell will acknowledge that the TCH has been activated.

2. Handover command - After the activation the BSC commands the MS to change to the new channel. The message is sent on FACCH and will contain a full description of the new channel and the HO ref. no.
3. Handover bursts - The MS will tune in to the new channel and send handover bursts on the new channel. The information content is the HO ref. no. The bursts are as short as the access bursts, since the MS does not know the new Timing Advance (TA) value yet. On the detection of the handover bursts, and check of HO ref. no., the new BTS will send the new TA to the MS.
4. Handover complete - Now the MS is ready to continue the traffic and will send a handover complete message addressed to the BSC.
5. Release of old channel - When the BSC receives the Handover Complete from the MS, the BSC will know that the handover was successful. The BSC orders the old BTS to release the TCH and the BTS will acknowledge.

### *Inter- BSC Handover*

In this case BSC1, (old BSC) does not control the better cell which is the target for the handover. This means that the MSC will be part of the link procedure between BSC1 and BSC2 (new BSC).

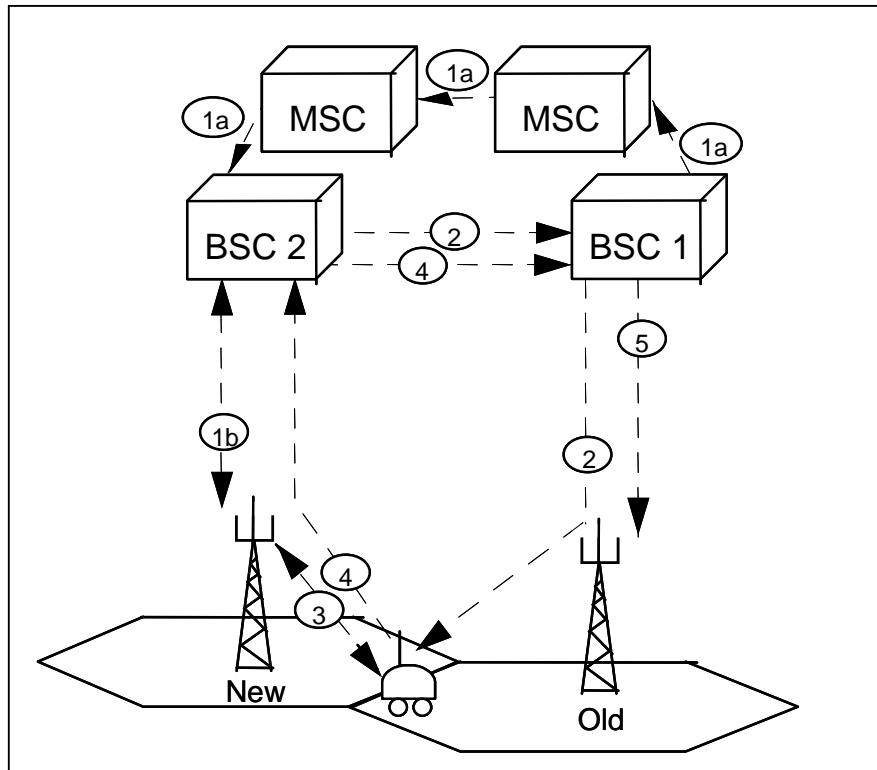


*Inter-BSC handover*

- 1a.** Handover request - BSC1 will use the MSC to send a handover request to BSC2. The MSC will know which BSC controls that cell.
  - b.** Activation of new channel - BSC2 will allocate a TCH in the target cell and then order the BTS to activate it. The chosen HO ref. no. will be part of the activation message. The BTS will acknowledge that the activation has been made.
- 2.** Handover command - After the activation the new BSC commands the MS to change to the new channel. The message is sent on FACCH via the old channel and will contain a full description of the new channel and the HO ref. no.
- 3.** Handover bursts - When the MS has changed to the new channel, it will send handover bursts on the new channel. The information content is the HO ref. no. The bursts are as short as the access bursts. This is because the MS does not know the new Timing Advance (TA) value yet. On the detection of the handover bursts, and check of HO ref. no., the new BTS will send the new TA.
- 4.** Handover complete - Now the MS is ready to continue the traffic and will send a handover complete message, which will be addressed to the old BSC as a clear command.
- 5.** Release of old channel - When the old BSC receives the clear command from the MSC, the BSC knows that the handover was successful. The BSC orders the BTS to release the TCH and the BTS will acknowledge.

### *Inter- MSC Handover*

In this case the old BSC is connected to a different MSC than the BSC that controls the target cell. This means that a new MSC will be part of the procedure. The old MSC will be called anchor-MSC and the new MSC will be called the target MSC



*Inter-MS-C handover*

- 1a. Handover request** - The old BSC will use the anchor-MS-C to send a request to the new BSC for a handover to the target cell. The anchor-MS-C knows which MS-C to contact, and the target-MS-C in turn knows which BSC that controls the target cell.
- b. Activation of new channel** - The new BSC allocates a TCH in the target cell and order the BTS to activate it. The chosen HO ref. no. will be part of the activation message. The BTS will acknowledge that the activation has been made.
- 2. Handover command** - After the activation the new BSC commands the MS to change to the new channel. The message is sent on FACCH via the old channel and will contain a full description of the new channel and the HO ref. no. In order to reroute the call, the target-MS-C will also send a handover number, similar to the MSRN, to the anchor-MS-C.
- 3. Handover bursts** - When the MS has changed to the new channel, it will send handover bursts on the new channel. The information content is the HO ref. no. The bursts are as short as the access bursts as the MS does not know the new Timing Advance (TA) value yet. On the

detection of the handover bursts, and check of HO ref. no., the new BTS will send the new TA.

4. Handover complete - Now the MS is ready to continue the traffic and will send a handover complete message, which will be addressed to the old BSC as a clear command.
  5. Release of old channel - When the old BSC receives the clear command from the anchor MSC, the BSC knows that the handover was successful. The BSC orders the BTS to release the TCH and the BTS will acknowledge.
- Note that the MSC that performed the call setup will be in charge of the call until it is released, no matter handovers. The call is always routed to the target-MSC through the anchor-MSC.
  - Also note that the MS after call release has to perform a "location updating, type normal". As a location area is part of only one MSC/VLR Service area the MS must be in a new location area after the handover.

