Universal Radio Communication Tester R&S®CMU200

# Handover scenarios in GSM systems

**Modern mobile radio systems without handover functionality are inconceivable. The capability to hand over a mobile phone from a UMTS system to a GSM system, for example, is a basic prerequisite for the economic success of UMTS. It is the only way to guarantee UMTS customers full coverage from the start.**

## Intracell handover

The easiest type of handover is intracell handover where either the physical channel or the associated timeslot configuration is changed. This may become necessary if the connection on a physical channel is impaired. To evaluate connection quality, the mobile phone continuously transmits the measured RXLev (receive level measured by the telephone) and RXQual (bit error ratio determined) values to the base station.

If the base station wants to hand over the telephone to another physical channel, all it needs to do is to inform the telephone about the new channel number and the new timeslot configuration. The telephone changes directly to the new channel and is able to maintain both its previous settings for timing and the base station parameters.

Intracell handover is also possible between different GSM bands. Thus, a GSM cell in the 900 MHz band is quite able to use voice channels in the 1800 MHz band, which, by the way, is an enormous stress factor on the mobile phone since it is constantly required to switch the frequency bands: In addition to the voice connection in the 1800 MHz band, it must also cyclically analyze the BCCH information in the 900 MHz band. This "stress" on the mobile phone and the high performance speed make this handover version the favoured test method in production.

**FIG 1** The GSM neighbour cell list (BA list) of the R&S®CMU200 is user-editable. Up to 16 random channel numbers from any GSM band can be entered. The tester allows convenient and customized definition of the neighbour cells. The WCDMA neighbour cell can be defined in the 3G neighbour cell description.

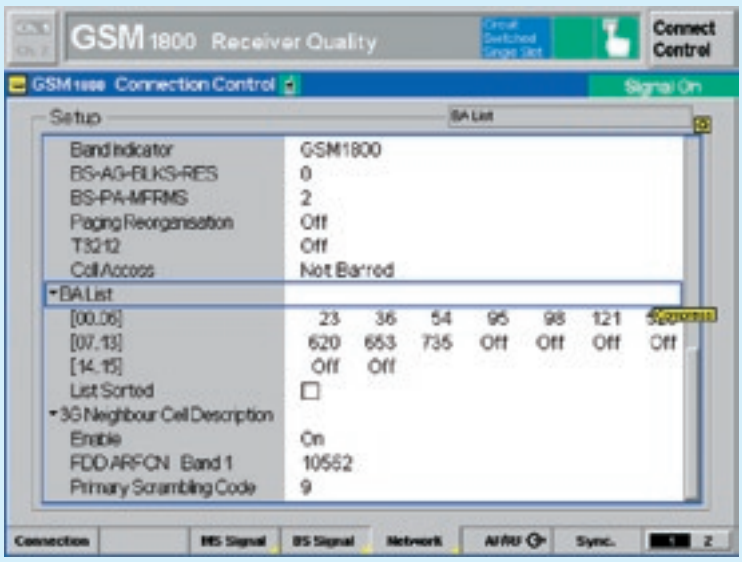
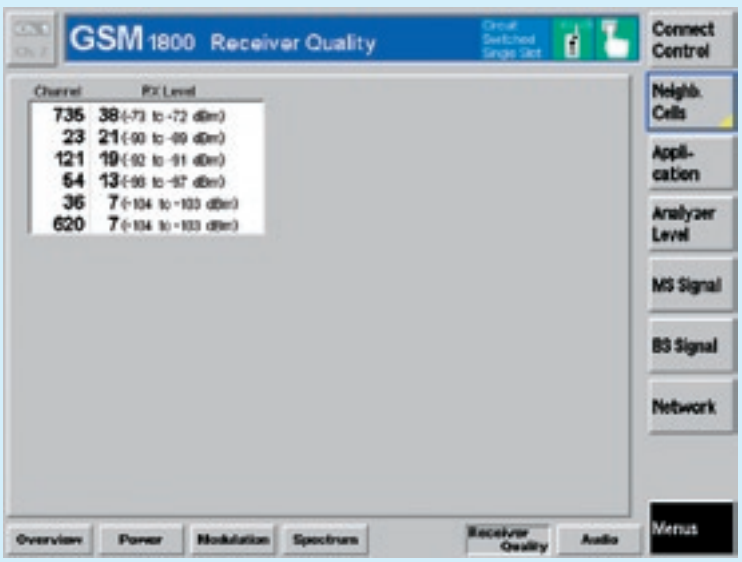



**FIG 2** The mobile phone cyclically determines the receive level on the RF channels listed in the neighbour cell list. The six most powerful RF channels are transmitted from the mobile phone to the base station. The R&S®CMU200 clearly displays these measurement results of the mobile phone.



## Intercell handover

If the mobile phone moves from one cell to another during a call, it must be handed over to the new cell. If the neighbour cell is time-synchronous with the current cell, the base station is able to effect a finely synchronized intercell handover. In this case, the mobile phone is transmitted on the new physical channel in the neighbour cell. Moreover, the mobile phone must be informed about the vital parameters of the new cell.

The mobile phone then optionally transmits four access bursts on the new channel. Compared to the normal bursts, these are shortened which is why they cannot cause interference with other calls even if the timing is slightly incorrect. If necessary, timing is corrected in a next step and the call continued.

If the two cells with time offset are synchronous, the base station will effect a pseudo-synchronized or presynchronized intercell handover. This handover is similar to the finely synchronized intercell handover, but differs in that the mobile phone is provided with information about the time offset. Usually, however, a non-synchronized intercell handover takes place. In this case, the mobile phone transmits up to 64 access bursts on the new channel by means of which the new base station determines the timing and hands it over to the mobile phone. The mobile phone then reestablishes the call connection with the correct timing.

The base station requires the mobile phone's help in order to know the new cell to hand it over to. By means of the neighbour cell list, the base station informs the mobile phone about the RF channels for the BCCH that are used by the neighbour cells. The mobile phone now cyclically measures the RF level on these channels and transmits the measurement results to the base station. Based on this information, the base station determines the point in time at which the mobile phone is handed over to which cell. Changing the physical channel both for the call and for the BCCH information is key to intercell handover.

## Handover with the R&S®CMU 200

The GSM signalling option of the Universal Radio Communication Tester R&S® CMU 200 makes it possible to perform intracell handover. It can use physical channels from all GSM bands. The problem of ambiguous channel numbers in GSM 1800 and GSM 1900 has also been solved in the R&S® CMU 200 by implementing the band indicator in accordance with the 3GPP standard. To perform neighbour cell measurements, the tester features user-definable lists for the GSM neighbour cells (FIG 1) and for the UMTS cells. It also outputs the receive levels of the GSM neighbour cells as measured by the mobile phone (FIG 2). In addition to the GSM intracell handover, the R&S® CMU 200 also features blind handover from WCDMA to GSM.

## Intersystem handover

If the mobile phone leaves a cell and no new cell can be found in the same system, the base station can hand over an appropriately equipped mobile phone to a cell in another system. These intersystem handovers are highly complex because two technically disparate systems must be combined with each other. Basically, there are two handover options from WCDMA to GSM:

In the case of **blind handover**, the base station simply transmits the mobile phone with all relevant parameters to the new cell. The mobile phone changes "blindly" to the GSM cell, i.e. it has not yet received any information about the timing there. It will first contact the transmitted BCCH channel, where it tries to achieve the frequency and time synchronization within 800 ms. Next, it will switch to the handed-over physical voice channel, where it will carry out the same sequence as with the non-synchronized intercell handover.

For the second type of handover from WCDMA to GSM, the **compressed mode** is used within the WCDMA cell; in this mode, transmission and reception gaps occur during the transmission between base station and mobile phone. During these gaps, the mobile phone can measure and analyze the nearby GSM cells. For this purpose, the base station, similar to the GSM system, provides a neighbour cell list, and the mobile phone transfers the measurement results to the base station. The actual handover in the compressed mode is basically analogous to blind handover.

There is, of course, an intersystem handover from GSM to WCDMA. A special neighbour cell list for WCDMA cells was established in GSM to support this handover.

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**More information and data sheet at www.rohde-schwarz.com (search term: CMU 200)**