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Source: Nokia

Monitoring of UTRA FDD Cells on the Same Frequency

Introduction

In the current version of S1.15, FDD Measurements, the reporting to the UTRAN by UE is handled in very generic way. The for UE to report regularly or event driven are given only briefly as to include:

- The Cell ID
- The relative signal strength
- The relative timing information, accuracy TBD.

It is evident that this needs to be taken further in order to allow handover algorithms and signalling protocols to proceed in their design work. This contribution concentrates on the value needed for handover decision, the relative signal strength, while the cell ID and relative timing information are naturally essential information but not needed for the actual handover decisions on whether handover should take place or not.

Measurements from cells on the same frequency

The proposed refinement on the relative signal strength to measure is given as follows:

The UE shall measure from the cells that UE is expected to measure the E_c/I_0[1] of the Primary CCPCH (Common Control Physical Channel) channel. This value is signaled back to UTRAN with higher layer signaling. The number of bits needed for this is next step to be defined. (The Primary CCPCH is carried by Perch channel in ARIB)

This method offers the following benefits from the implementation point of view:

[1] E_c/I_0 is being defined as chip energy per total received channel power density

- No need for decoding of common channels for the performing of measurements, this would require a lot more processing and would also result in increased transmit power level on common channels.

- Measurement process is fast and not tied with any common channel frame or interleaving period timing.

- Allows network to control the HO regions by setting the Primary CCPCH power level.

- If Primary CCPCH power levels are kept the same in all cells, this is in practice giving the same outcome as the path loss based method. Still it is simpler to measure as absolute power measurement always contain relatively large uncertainty in UE as has been noted for example in the RACH related discussions.

In the case of timing uncertainty between the cells is such that there is no need to find frame number for that (timing difference max. +-5 ms) then Primary CCPCH E_c/I_0 is the only value that needs to be obtained on regular basis. If the timing uncertainty is large, still decoding the Primary CCPCH once successfully is valid for long time with respect the frame timing and cell identification information. Thus E_c/I_0 measurement remains sufficient after timing uncertainty on frame level timing is resolved.

If the method used in the earlier Nokia contribution to ETSI is used, Tdoc SMG2 UMTS-L1 561/98, where timing information as provided between different cells, then UE typically does not need decode Primary CCPCH during measurements at all. The timing contribution is given as information in Annex 1.

Conclusions

It is proposed that the item to be measured by UE, relative signal strength, is defined in S1.15 more precisely as:

The UE shall measure from the cells on the same frequency, belonging to the handover monitoring set, the E_c/I_0 of the Primary CCPCH. This value is signaled back to UTRAN with higher layer signaling.

ANNEX 1.

ETSI SMG2 UMTS Physical Layer Expert Group, Tdoc SMG2 UMTS-L1 561/98
Sophia Antipolis, France
November 9-12, 1998

Source: Nokia

UTRA Network Timing Issues

Introduction

UTRA FDD network timing issues in respect to handover and handover measurements were discussed previously in Tdocs SMG2 UMTS-L1 314/98 & 424/98 in the UMTS-L1 meetings No. 6. & 7 respectively. This document continues on the topic further on this area. This document concentrates on the handovers within UTRA FDD base stations, although the principles can be used between FDD and TDD as well.

Required network timing level

The earlier argumentation is summarised here:

- In general the UTRA FDD timing requirements can be kept very loose
- Better knowledge of the neigbouring BS timing will improve both intra and inter-frequency handover in terms of handover speed.
- Avoidance of BCCH decoding in connection with measurement to find out timing will consume less processing (and battery) power and will be faster than via BCCH.

Proposed solution

The proposed solution contains on the UTRA FDD BCCH information of the relative timing for the surrounding base stations that mobile is expected to measure. The proposed solution divides the base stations to several timing classes:

Code	Measurement accuracy (step)	Estimate of timing difference
00	Asynchronous (or 720ms)	-
01	62.5µs (symbol)	0 to $1.15x10^4$ steps of 62.5µs
10	625µs (slot)	0 to $1.15x10^3$ steps of 625µs
11	10ms (frame)	0 to $7.2x10^2$ steps of 10ms

In the table, the signalling is done with 16 bits, 2 + 14 division among accuracy information and timing difference estimate.

This kind of division allows to insert to the system also such base stations that can not be ensured a certain level of timing stability in their operation. The actual timing information can be obtained e.g. from a common clock in the network (or in RNC etc.) or by measurements performed by the mobile stations.

Since there are uncertainties in the measurement/clock provision accuracy, the estimated accuracy of the timing differences is reported as well.

Raised Questions around the proposal

A couple of questions were raised around the proposal and this chapter provides some further consideration on the issues raised in the last meeting.

For implementing the signalling obviously two solutions exists:

- BCCH signalling, where all mobiles get the same set of cells
- MS specific signalling

It's foreseen that as the mobiles in idle mode require the same information as well, then relaying it on the BCCH is needed at least. For other mobiles the set of cells can be as well signalled via the active connection, thus allowing the network to define the refresh rate of the information

The refresh rate can be estimated from base station frequency accuracy, assuming the same source is used to generate the frame/symbol clock as well. The 0.02 ppm accuracy in the BS would give around a bit less 1 hour for the relative timing to slip of one symbol, thus the refresh rate will not be very high.

With light of this, when measurement report for handover preparation has been obtained from a mobile, the result is usable for a relative long time. If the handover takes place very seldom then the performance it not a major

concern either, but in practise there will be sufficient number of soft handovers for enough measurement data on cell timings.

Benefits of the solution

The solution offers the following benefits:

- The need for MS to decode the BCCH frame is minimised, and can be eliminated if network provides timing information in all cases. This contributes significantly to mobile power consumption.
    - This affects both active mode as well as idle mode.
- The delays associated with UTRA handover measurements can be minimised
    - The BCCH decode takes always time and must be repeated in case of error in CRC check.
- The method allows to take advantage for the MS measurements reports in providing timing information
    - If desired so, network modifications are not necessary when required signalling is supported by the network
- Base station deployment flexibility in asynchronous network is not compromised.
- No new functionality is added to the MS with respect to the measurements. All the measurement functionality needs to be there in any case.

Proposed Text (For XX.15, section 8.2)

8.2.1.2 Handover monitoring set in FDD

The handover monitoring set contains the cells to be monitored by the UE in active mode. It may be provided by the UTRAN via the BCCH of the serving cell(s) or via UE specific signalling on the DCH.

The handover monitoring set may contain cells on the same frequency and/or cells on different frequencies. The following sections indicate which information are included in the handover monitoring set for cell on the same frequency and cells on different frequencies.

8.2.1.2.1 FDD cells on the same frequency

For each cell to monitor at the same frequency, the handover monitoring list contains at least the following information:

- The cell scrambling code used for downlink scrambling.
- The cell ID number

Additionally there can be the following information on those networks where timing information between base station is used:

- The relative timing difference between the base station transmitting the BCCH list and each neighbouring base station.
- The estimated accuracy of the timing difference indication.

This can be given for example in the following format:

Example of the timing information with 16 bits reserved for the message.

Code	Measurement accuracy (step)	Estimate of timing difference
00	Asynchronous (or 720ms)	-
01	62.5µs (symbol)	0 to 1.15×10^4 steps of 62.5µs
10	625µs (slot)	0 to 1.15×10^3 steps of 625µs
11	10ms (frame)	0 to 7.2×10^2 steps of 10ms

It is assumed that the mapping of the cell scrambling codes in relation to the synchronisation channel codes (groups indicated by the secondary synchronisation channel) is known beforehand with the code grouping being determined beforehand.

8.2.1.2.2 FDD cells on different frequencies

For each cell to monitor at another frequency, the handover monitoring list contains at least the following information:

- The cell scrambling code used for downlink scrambling.
- The cell ID number
- The carrier center frequency of the cell

Additionally there can be the following information on those networks where timing information between base station is used:

- The relative timing difference between the base station transmitting the BCCH list and each neighbouring base station.
- The estimated accuracy of the timing difference indication.

8.2.1.2.3 TDD cells

Conclusions

As conclusions, it is recommended that with UTRA, the information of the relative timing accuracy and relative timing difference of the surrounding base stations is included. This will allow the MS e.g. to avoid BCCH decoding when measuring other base station for soft handover purposes. The text proposal included is proposed to be included in XX.15 to allow further develop the UTRA handover issues.

This will be extended in further contributions to TDD cells when sufficient details on other working assumptions around TDD are available.