Technical Specification Group, Radio Access Network *TSGR#3(99)242*
Meeting #3, Yokohama, 21-23 April 1999

Agenda Item **:**
Source **:** **3GPP RAN WG1**
Title **:** S1.31 version 2.0.0
Document for **:** Approval

TS S1.31 V2.0.0 (1999-04)

Technical Specification

3rd Generation Partnership Project (3GPP);
Technical Specification Group (TSG)
Radio Access Network (RAN);
Working Group 1 (WG1);
Physical layer - Measurements

Reference

<Workitem> (<Shortfilename>.PDF)

Keywords

<keyword[, keyword]>

3GPP

Postal address

Office address

Internet

secretariat@3gpp.org
Individual copies of this deliverable
can be downloaded from
http://www.3gpp.org

Contents

1 Intellectual Property Rights

<editor's note : this section will be completed when an official format for the document is agreed>

2 Foreword

This Technical Specification (TS) has been produced by the 3G Partnership Project (3GPP) of the European Telecommunications Standards Institute (ETSI).

The contents of this TS are subject to change as the work continues

<Editor's note : this version is the very first version produced in the merging phase between the ETSI and ARIB reference documents. The document incorporates decisions from the ad-hoc 8 (handover) that had been approved by the plenary of RAN WG1 #2.The text was edited with the following rules :

- *the text is restricted to layer 1 issues. However in order not to loose material regarding other layers that was present in the XX.xy documents or ARIB vol 3 and not yet incorporated in the documentation of WG2 and WG3 , annexes were created to cover Handover execution aspects.*
- *When for a particular subjects, when ETSI and ARIB had different solutions documented and if the work of ad-hocs in particular ad-hoc 8 had not allowed to find a merged solution, then both ETSI and ARIB schemes were documented when difference identified with explicit note.*
- *When only one proposal from either ETSI or ARIB was available x for a particular subject and ad-hoc 8 had not agreed to the proposal and then it was documented again with explicit indication, in an editor's note.*
- *Text from ETSI and ARIB sometimes required some change either due to terminology or to consistency with other documents from WG1 or WG2. Modifications appear in the form of change bars.*
- *Editor's notes were incorporated in order to seek progress on some particular areas and to provide a description of the scope of each section of the document*

>

3 Scope

This 3GPP Telecommunication Specification TS contains the description of the measurements done at the UE and network in order to support operation in idle mode and connected mode.

As far as the measurements in idle mode are concerned, this TS described the following :

- measurements for the cell selection for a UE supporting FDD and/or TDD
- measurements for cell reselection for a UE camping on an FDD or TDD cell

As far as the measurements in connected mode are concerned, this TS describes measurements when the UE is connected to an FDD cell or cells (in Soft handover) or a TDD cell for the cell connected state (see reference [8]), or camping on an FDD cell for the UTRA connected state. This TS provides the minimum requirements for the UE and networks. Some explanatory text is also contained in the TS but it is more of a descriptive nature than normative.

As far as the measurements for the handover preparation, this specification defines the requirements to the UE and UTRAN, as well as parametrisation rules for the compressed mode in order to accommodate idle periods. This latter aspects may need to be moved to some other specifications. The description of the compressed mode (different type of compressed frames define by the compressed mode A/B, the number if idle slots and the position of such transmission gap) is outside the scope of this specification and is covered in S1.11 and S1.12.

4 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] 3GPP RAN S1.11 Transport channels and physical channels (FDD)
[2] 3GPP RAN S1.12 Multiplexing and channel coding (FDD)
[3] 3GPP RAN S1.13 Spreading and modulation (FDD)

[4] 3GPP RAN S1.14 Physical layer procedures (FDD)
[5] 3GPP RAN S1.21 Transport channels and physical channels (TDD)
[6] 3GPP RAN S1.22 Multiplexing and channel coding (TDD)
[7] 3GPP RAN S1.23 Spreading and modulation (TDD)
[8] 3GPP RAN S1.24 Physical layer procedures (TDD)
[9] 3GPP RAN S2.02 Services provided by the Physical layer
[10] 3GPP RAN S2.03 UE functions and interlayer procedures in connected mode
[11] 3GPP RAN S2.04 UE procedures in idle mode
[12] XX.15, version 1.0.0 UTRA Handover
[13] XX.07, version 1.0.0 UTRA FDD, Physical layer procedures
[14] XX.13, version 1.0.0 UTRA TDD, Physical layer procedures
[15] ARIB, Vol 3

5 Measurements in idle mode

5.1 Measurements for cell selection

<Editor's note : In both ETSI and ARIB measurements for cell selection are not described apart from the initial cell search. Measurement to support Cell selection and cell reselection rely on synchronisation acquisition procedures currently described in section related to the Initial cell search procedures in [4] and Physical layer procedures (FDD) and Physical layer procedures (TDD) [8] for FDD cells and TDD cells respectively.

This section, measurements for cell selection, of this specification could contained the following sub-sections with scopes as provided in each section. This is not to be found in any of the reference documents and is only a suggestion for progress by the editor>

5.1.1 Cell selection monitoring frequency or cell set

<Editor's note : this section should define how the frequencies or cells to measure for the cell selection process are determined. This set should be provided by higher layers in the primitive that triggers the measurement process. Two following two cases might be considered and would lead to two different cell selection monitoring, defined in section 67.1.1, as in GSM. This is to be discussed with WG2.

- *Normal cell selection : the UE has no information at switch on. It would perform measurements on frequencies/cell that correspond to the mode it support and that was manually selected if applicable.*
- *Cell selection from stored list. The UE stored some information at switch off. At switch on cell selection is performed based on this stored information.*

>

5.1.2 Measurement from the cell selection monitoring set and reporting to higher layers

<Editor's note : requirements need to be defined based on collaborative work with other WGs>

5.2 Measurements for cell reselection

5.2.1 Cell reselection monitoring frequency or cell set

<Editor's note : this section should define how the frequencies or cells to measure for the cell reselection process are passed to the physical layer of the UE by higher layers and what information is passed in terms of cell mode, frequency, synchronisation information, in form of scrambling codes…. This set should be provided by the MAC layer in the primitive that triggers the measurement process. This is referred to as the priority list in ETSI as far as the FDD and TDD cell/frequencies are concerned>.

From a very general descriptive point of view, when in idle mode, the UE continuously searches for new cells on the current and other carrier frequencies. The measurement for the cell reselection are performed in basically the same way as the cell selection. The main difference compared to the cell selection is that a UE has received a priority list from the UTRAN, called the cell re-selection monitoring set, which provides information relative to the cells to monitor.
As far as FDD cells are concerned, provision of the list significantly reduces the time and effort needed for the scrambling-code search (step 3) (see [4]). Also the complexity in the second step may be reduced if the priority list only

includes scrambling codes belonging to a subset of the total set of code groups. The priority list is continuously updated to reflect the changing neighbourhood of the moving UE.
Content of the cell reselection monitoring set is further discussed in the following sections for FDD, TDD and GSM cells respectively.

5.2.1.1 Content of the cell reselection monitoring set for FDD cells

<Editor's note : the text contained here comes from section 5.2 in [13] (UTRA FDD , Physical layer procedures>)

The content of the cell reselection monitoring set as far as FDD cells are concerned provides the list of FDD cells/frequencies including the downlink scrambling codes and the order in which they should be searched for.

5.2.1.2 Content of the cell reselection monitoring set for TDD cells

<Editor's note : the text contained here comes from section 6.6.2 in [14] (UTRA TDD , Physical layer procedures>)

The cell reselection monitoring set priority list describes in which order to search for TDD cells.

5.2.1.3 Content of the cell reselection monitoring set for GSM cells

To be added

5.2.2 Measurements for cell reselection and reporting to higher layers

<Editor's note : requirements need to be defined based on collaborative work with other WGs>

6 Measurements at call set-up

<editor's note : this section should be moved to either the connected mode or idle mode>

6.1 Measurements for DCA

DCA is used to optimise the resource allocation by means of a channel quality criteria or traffic parameters. The DCA measurements are configured by the UTRAN.
The UE reports the measurements to the UTRAN. DCA measurements in the idle mode should be minimised.

6.1.1 Measurements reported from UE to Node B

At call set-up the UE is requested from Node B to report the interference on specified timeslots. Based on these measurements the Node B selects appropriate resource units for the requested service.

7 Measurements in connected mode

7.1 Measurements for the handover preparation

7.1.1 Cell sets for the handover preparation

<editor's note : A cell set corresponds a list of cells that the UE needs to monitors for a given period of time, with associated requirements, as seen from the physical layer. Several sets are defined since different requirements might be defined, e.g. some cells might need to be monitored more often than others…It is not clear at this stage how such sets will be provided by higher layers. The primitives that allow the higher layers to control the measurement process in the layer 1 are under definition by the RAN WG2. Several cases might be considered :

- *the MAC has a very fine control of the measurement, upto the frame level, decides on the measurement of particular cells at particular instant and the physical layer report measurement back to the MAC layer e.g. after a slotted frame, some processing being possibly needed by the MAC*
- *The MAC provides sets of cells to monitor and monitoring periods in the form of e.g. slotted frame or DTX period and it is up to the physical layer to organise the monitoring*

In the following we consider the second case, because it is more in line with the available documentation from . It the first case of some intermediate case was to be considered in the future then some material of the section would need to be move to the relevant RAN WG2 documentation.
>

7.1.1.1 Overview of the different sets

The physical layer of the UE should be provided by higher layers the following lists of cells :

- *Handover Monitoring set* : All cells (UTRA or from other systems like GSM) that the UE has been tasked by the UTRAN to monitor when in active mode.

- *Active Set*: The UTRA cells currently assigning a downlink DPCH to the UE, which corresponds to the cell between which the UE in a soft handover with. The active set may only correspond to UTRA cells.
- *Handover candidate Set*: The cells that are not currently in the Active Set but have been received by the UE with sufficient strength to indicate that the associated DPCHs could be successfully demodulated. These correspond to the cells that are effectively reported by the UE to the UTRAN. These cells may be on the same or different frequencies from the current frequency assignment. Cells in the handover candidate set may be UTRA or GSM cells.

<Editor's note : Since the scope of this specification to the measurement only, there might not be a need to define the same sets. Only set that would lead to different requirements or process for the measurement need to be defined. Here it is anticipated that cells in the active set, which are the serving cell are measure for each frame, whereas cell which are not part of the active set are not measured as often as every frame. Cells which have been identified by the higher layers as candidate cell may need to be measured more often than other cell, since they are among the x strongest. >

7.1.1.2 Content of the sets

7.1.1.2.1 handover monitoring set

The handover monitoring set contains the cells to be monitored by the UE in active mode. It is provided to the physical layer by higher layers, as part of the primitives (see [8]). 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.

7.1.1.2.1.1 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

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.
<editor's note : this may be better described in the WG2 documentation. Some text may be however useful here for explanatory purposes>

7.1.1.2.1.2 FDD cells on different frequencies

<editor's note : to be added>

7.1.1.2.1.3 TDD cells

The handover monitoring set contains for each TDD cell to monitor a frequency information and an information field CELL_PARAM for the cell parameters (t_{offset}, long basic midamble code, short basic midamble code, scrambling code).

Each UE has stored a 'cell parameter list' (see table below) for the TDD carrier which is common to the whole network and which contains 128 sets of cell parameters.

Each set has a unique long basic midamble code, a unique short basic midamble code (optional) and a unique scrambling code. Furthermore, each set has a t_{offset} out of 32 different values.
The information whether a long or a short basic midamble code is used for specific resources is configured by the UTRAN, e.g. BCH may be used.

CELL_PARAM	Long basic midamble	Short basic midamble	Scrambling code	t_{offset}
0	m_{PL0} (see m_P in S1.21)	m_{PS0} (see m_P in S1.21)	Code 0	t_0
1	M_{PL1}	m_{PS1}	Code 1	
2	M_{PL2}	m_{PS2}	Code 2	
3	M_{PL3}	m_{PS3}	Code 3	
4	M_{PL4}	m_{PS4}	Code 4	t_1
5	M_{PL5}	m_{PS5}	Code 5	
6	M_{PL6}	m_{PS6}	Code 6	
7	M_{PL7}	m_{PS7}	Code 7	

. . .				
124	m_{PL124}	m_{PS124}	Code 124	t_{31}
125	m_{PL125}	m_{PS125}	Code 125	
126	m_{PL126}	m_{PS126}	Code 126	
127	m_{PL127}	m_{PS127}	Code 127	

7.1.1.2.1.4 GSM cells

<editor's note : to be added>

7.1.1.2.2 active set

<editor's note : to be added>

7.1.1.2.3 candidate set

<editor's note : to be added>

7.1.2 Measurement triggering criteria

<Editor's note : >

7.1.3 Measurements for the handover preparation from UTRA FDD at the UE

7.1.3.1 In general

To be added

7.1.3.2 Monitoring of FDD cells on the same frequency

<Editor's note : no requirement has been defined yet, in terms e.g. of number of cells to be able to monitor in a given time, precision of individual measurements... Text included in this section is more of a descriptive nature and provide the list of measurements to be reported by the physical layer to higher layer >

During the measurement process of cells on the same frequencies, the UE shall find the necessary synchronisation to the cells to measure using the primary and secondary synchronisation channels and also the knowledge of the possible scrambling codes in use by the neighbouring cells.
As the UE does measurement, at least the following information is obtained:
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
Relative timing between the cells, measured for example from the phase difference between the scrambling code, depending on the timing difference between the cells.

7.1.3.3 Monitoring of cells on different frequencies (FDD, TDD and GSM)

7.1.3.3.1 Use of compressed mode/dual receiver for monitoring

UE shall, on upper layers commands, monitor cells on other frequencies (FDD, TDD, GSM). To allow UE to perform measurements, upper layers shall command that the UE enter in compressed mode, depending on UE capabilities.
In case of compressed mode decision, UTRAN shall communicate to the UE the parameters of the compressed mode, described in reference [2], S1.12.
UE with a single receiver shall support downlink compressed mode.
Every UE shall support uplink compressed mode, when monitoring frequencies which are close to the uplink transmission frequency (i.e. frequencies in the TDD or GSM 1800/1900 bands).
< Editor note : the use of uplink compressed mode for single receiver UE when monitoring frequencies outside TDD and GSM 1800/1900 bands is for further study >

UE with dual receivers can perform independent measurements, with the use of a "monitoring branch" receiver, that can operate independently from the UTRA FDD receiver branch. Such UE do not need to support downlink compressed mode.
The following section provides rules to parametrise the compressed mode.

7.1.3.3.2 Parametrisation of the compressed mode

In response to a request from upper layers, the UTRAN shall signal to the UE the compressed mode parameters.

The following parameters characterize a transmission gap :

- TGL : Transmission Gap Length is the duration of no transmission, expressed in number of slots (e.g. used for switching frequency, monitoring).
- SFN : The system frame number when the transmission gap starts
- SN : The slot number when the transmission gap starts

With this definition, it is possible to have a flexible position of the transmission gap in the frame, as defined in S1.12.

The following parameters characterize a compressed mode pattern :

- TGP : Transmission Gap Period is the period of repetition of a set of consecutive frames containing up to 2 transmission gaps (*).
- TGL : As defined above
- TGD : Transmission Gap Distance is the duration of transmission between two consecutive transmission gaps within a transmission gap period, expressed in number of frames. In case there is only one transmission gap in the transmission gap period, this parameter shall be set to zero.
- PD: Pattern duration is the total time of all TGPs expressed in number of frames.
- SFN : The system frame number when the first transmission gap starts

In a compressed mode pattern, the first transmission gap starts in the first frame of the pattern. The gaps have a fixed position in the frames, and start in the slot position defined in S1.12.

(*) : Optionally, the set of parameters may contain 2 values TGP1 and TGP2, where TGP1 is used for the 1st and the consecutive odd gap periods and TGP2 is used for the even ones. Note if TGP1=TGP2 this is equivalent to using only one TGP value.

In all cases, upper layers has control of individual UE parameters. The repetition of any pattern can be stopped on upper layers command.

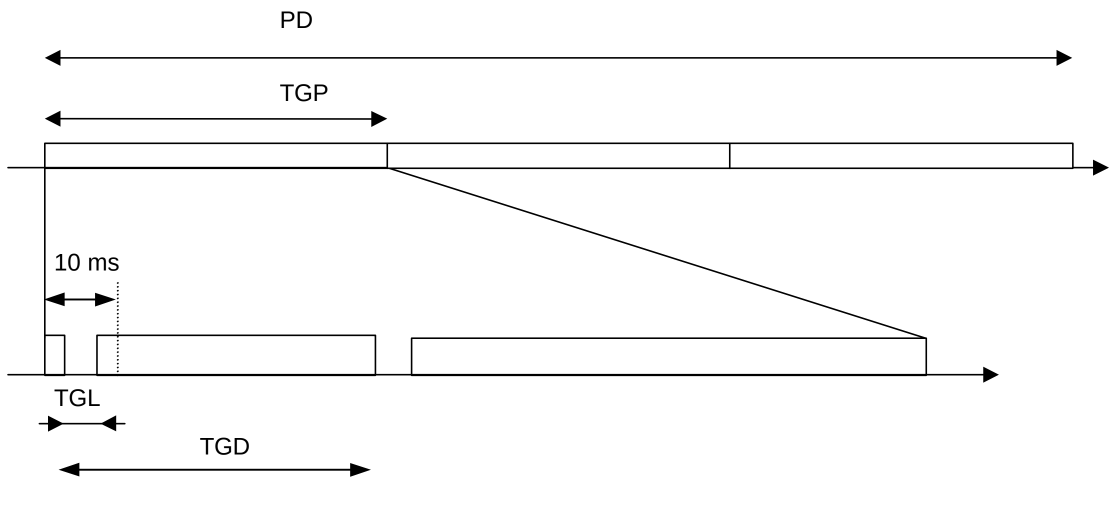

Figure 1 : illustration of compressed mode pattern parameters

7.1.3.3.3 Measurement requirements

<Editor's note : there is no requirement currently specified). The reported value itself is not specified but is expected to correspond to a useful received power level, and potentially some relative timing information.   The requirements could also be expressed minimum of samples for the monitoring time assigned by higher layers, precision of the relative received power, taking into account to structure of the monitoring set….The requirement should be specified in the WG4 documentation. There can be left here in an interim basis and copied here for reference >

7.1.3.3.4 Monitoring of FDD cells on other frequencies at the UE for the handover preparation from UTRA FDD to UTRA FDD

Upper layers may ask FDD UE to perform preparation of inter-frequency handover to FDD. In such case, the UTRAN signals to the UE the handover monitoring set, and the if needed, the compressed mode parameters used to make the needed measurements. Setting of the compressed mode parameters defined in section 7.1.3.3.2 for the preparation of handover from UTRA FDD to UTRA FDD is indicated in the following section. Measurements to be performed by the physical layer is defined in section 7.1.1.3.3.4.2.

7.1.3.3.4.1 Setting of the compressed mode parameters

During the transmission gaps, the UE shall perform measurements so as to be able to report to the UTRAN the frame timing, the scrambling code and the Ec/Io of Primary CCPCH of up to the [x] FDD cells in the handover monitoring set.
When compressed mode is used for cell acquisition at each target FDD frequency, the parameters of compressed mode pattern are fixed to be :

TGL	TGD	TGP	PD

7.1.3.3.4.2 Measurements

During the measurement process of FDD cells on a different frequency, the UE shall measure the following information:

- The UE shall measure from the FDD cells on another frequency, belonging to the handover monitoring set, the E_c/I_0 of the Primary CCPCH.

Relative timing between the scrambling codes of the serving and measured cell as derived from the scrambling codes used on the Primary CCPCH.

7.1.3.3.5 Monitoring of TDD cell at the UE for the handover preparation from UTRA FDD to UTRA TDD

This section should describes particular rules to set the compressed mode parameters when monitoring TDD cell, both for the downlink and uplink compressed mode depending on the handover monitoring set, as well as provide some descriptive text on the monitoring process itself.

7.1.3.3.5.1 Setting of the compressed mode parameters

7.1.3.3.5.2 Measurements

7.1.3.3.6 Measurements for the handover preparation from UTRA FDD to GSM at the UE

7.1.3.3.6.1 Introduction

Upper layers may ask dual mode FDD/GSM UE to perform preparation of inter-frequency handover to GSM. In such case, the UTRAN signals to the UE the handover monitoring set, and if needed, the compressed mode parameters used to make the needed measurements.
The UE shall perform measurements so as to be able to report every [x msec] to the UTRAN the BSIC and the signal strength of up to [y] GSM cells in the handover monitoring set.
The involved measurements are GSM BCCH power measurements (Section 7.1.3.3.6.3), initial GSM SCH or FCCH acquisition (Section 7.1.3.3.6.4), acquisition/tracking of GSM SCH or FCCH when timing information between UTRA serving cells and the target GSM cell is available (Section 7.1.3.3.6.5), and BSIC reconfirmation (Section 7.1.3.3.6.6).

7.1.3.3.6.2 Setting of compressed mode parameters for Power measurements

When compressed mode is used for GSM BCCH power measurements, the parameters of compressed mode pattern are fixed to be :

TGL	TGD	TGP	PD

In order to fulfill the expected GSM power measurements requirement, the UE can get effective measurements samples during a time window of length Tmeas, equal to the transmission gap length reduced by an implementation margin of [x], that includes the maximum allowed delay for a UE's synthetizer to switch from one FDD frequency to one GSM frequency and switch back to FDD frequency, plus some additional implementation margin.

7.1.3.3.6.3 Setting of compressed mode parameters for first SCH decoding without prior knowledge of timing information

The setting of the compressed mode parameters is described in this section when used for first SCH decoding of one cell when there is no knowledge about the relative timing between the current FDD cells and the neighbouring GSM cell.

On upper layers command, UE shall pre-synchronise to the each of GSM cells in the handover monitoring set and decode their BSIC. < *Note : the proper reference to GSM specs should be added here* >

When compressed mode is used to perform initial FCCH/SCH acquisition, the compressed mode pattern belongs to the list of patterns in table 1.

In order to fulfill the expected GSM SCH speed requirement, the UE can get effective measurements samples during a time window of length Tmeas, equal to the transmission gap length reduced by an implementation margin of [x], that includes the maximum allowed delay for a UE's synthetizer to switch from one FDD frequency to one GSM frequency and switch back to FDD frequency, plus some additional implementation margin.

	TGL	TGD	TGP	PD
Pattern 1	Tbd	Tbd	Tbd	Tbd
Pattern 2	Tbd	Tbd	Tbd	Tbd
Pattern 3	Tbd	Tbd	Tbd	Tbd
Pattern 4	Tbd	Tbd	Tbd	Tbd
Pattern 5	Tbd	Tbd	Tbd	Tbd
…	…	…	…	…
Pattern 2^N	Tbd	Tbd	Tbd	Tbd

Table 1.- List of compressed mode patterns used for initial GSM FCCH/SCH acquisition without timing information

Each pattern corresponds to a different compromise between speed of GSM SCH search and rate of use of compressed frames. On upper layers command, the repetition of the selected pattern can be stopped and/or replaced by one of the other listed patterns. Upper layers may also decide to alternate the use of different patterns periods.

Depending on the UE's capabilities, the search procedure may be sequential (tracking of FCCH burst before decoding of the first SCH) or parallel (parallel tracking of FCCH and SCH bursts). The latter solution achieves SCH decoding faster than the first one, thus decreasing the needed number of repeated patterns.

Once the UE has completed the search it signals the UTRAN with the timing of the associated SCH burst or with SCH-not-found (see < *Editor's note : reference to be inserted here* >).

Whenever UE receives a new neighbour cell with a sufficiently high power level (see < *Editor's note : reference to be inserted here* >), it shall perform a new SCH search procedure.

When a compressed mode pattern is available, then it is up to the UE to trigger this search procedure with the available transmission gaps. In this case, no specific signalling is needed between the UE and the UTRAN.

When a compressed mode pattern is not available, the UE shall initiate the search procedure by sending a "request new cell search" message to the upper layers also signalling its capabilities for serial or parallel search as described above. The UTRAN then determines a suitable compressed mode pattern and signals this to the UE. The upper layers can delay the onset of this pattern depending on the timing priority the Network Operator has set for new BSIC identification.

7.1.3.3.6.4 Setting of compressed mode parameters for first SCH decoding with prior timing information between UTRAN serving cells and GSM target cells

UTRAN or UE may have some prior knowledge of timing difference between some FDD cells in UE active set and some GSM cells. When this information is acquired by the UE (e.g. after initial FCCH/SCH detection) and on upper layers command, the UE shall report it to the upper layers for verification of UTRAN's information, and feedback of this information from UTRAN to the other UE.

When UTRAN or UE have this prior timing information, the compressed mode shall be scheduled by upper layers with the intention that SCH (or FCCH if needed) on a specific GSM band can be decoded at the UE during the transmission gap.

In such case, a transmission gap is scheduled once over 306 frames, equal to 13 GSM « 51 multi-frame » duration. As the UTRA 720 ms superframe shifts ¼ of superframe during the period, the 4 times 306 period can be used to fully align the timings of a UTRA FDD and a GSM cells.

The transmission gap parameters used for GSM FCCH/SCH tracking with prior timing information are :

TGL	SFN	SN

In addition to normal compressed mode parameters, UTRAN signals the following information to the UE :

- The frame number where compressed mode occurs (frame number x+n times 306, where n=0,1,2,3)
- The GSM carrier for which the particular compressed frame is intended (BS ID, carrier no, etc.)

Once the UE has completed the search, it signals the UTRAN with the timing of the associated SCH burst or with SCH-not-found and the UTRAN ceases the compressed mode pattern.

7.1.3.3.6.5 Setting of compressed mode parameters for SCH decoding for BSIC reconfirmation and procedure at the UE

In this paragraph it is assumed that the UE has successfully decoded one SCH burst of a given neighbouring GSM cell during the call.
When a compressed mode pattern is available, then it is up to the UE to trigger and perform the BSIC reconfirmation procedure with the available transmission gaps. In this case, no specific signalling is needed between the UE and the UTRAN for BSIC reconfirmation procedure.
When no compressed mode pattern is available then it is up to the UE to trigger and perform the BSIC reconfirmation procedure. In that case, UE indicates to the upper layers the schedule of the SCH burst of that cell, and the size of the necessary transmission gap necessary to capture one SCH burst. The Network Operator decides the target time for BSIC reconfirmation and the upper layers uses this and the schedule indicated by the UE to determine the appropriate compressed mode parameters.
Depending on whether UTRAN has an a priori timing knowledge of neighbouring GSM cells, the compressed mode parameters shall be one of those described in section 7.1.3.3.6.3, or in section 7.1.3.3.6.4.

7.1.3.3.6.6 Parametrisation of the compressed mode for handover preparation to GSM

Whereas section 7.1.3.3.6.3 described the compressed mode parametrisation for the initial synchronisation tracking or reconfirmation for one cell and the compressed mode parameters for power measurement for one of multiple cells, there is a need to define the global compressed mode parameters when considering the monitoring of all GSM cells.
<Editor’s note : the overall description for the handover to GSM preparation is still missing. Some text was available in XX.15 but was either outside the scope of this document or inconsistent with previous sections. Moreover it did not address the point for the global measurement process and associated minimum requirement. Some work is therefore needed on this. >

7.1.3.4 Overall handover preparation at the UE

This section should explain how the inter-frequency handover preparation from UTRA FDD to UTRA (either FDD or TDD) and from UTRA to GSM are co-ordinated in terms of measurement and reporting at the UE. Whereas Section 7.1.3.3.4, 7.1.3.3.5, and 7.1.3.3.6 give some principle for the monitoring of a given cell type and requirement in e.g. the dimensioning of the slotted mode, this section provides the overall requirement and measurement procedure.
<Editor’s note : no text is available is either of the reference documents, XX.15 or ARIB volume 3>

7.1.4 Mesurements for the Handover preparation in FDD at the UTRAN side

<editor’s note : this is not described in either of the documents. However the handover triggering might not be due only to conditions on the downlink. Measurements performed by the cells in the active set might be needed as in GSM. This section has been created for that purpose >

7.1.5 Measurements for the handover preparation from UTRA TDD at the UE

7.1.5.1 In general

7.1.5.2 Measurements for the handover preparation from UTRA TDD to UTRA TDD at the UE

7.1.5.2.1 In general

For the preparation of a handover from TDD to TDD the UE measures in its idle timeslots the received strength of other cells. A mechanism that introduces idle timeslots on demand is for further study.
For the search for other cells the UE is provided by a handover monitoring set by the UTRAN.

7.1.5.2.2 Monitoring of TDD cells

<Editor’s note : no requirement has been defined yet, in terms e.g. of number of cells to be able to monitor in a given time, precision of individual measurements>

During the measurement process the UE shall find synchronisation to the cells to measure using the synchronization channel with the primary and the secondary synchronization code as well as the information contained in the cell parameter list.
The following information is obtained by the UE either from measuring the synchronisation channel or the CCPCH:
- signal strength of the measured cell
- relative timing between the cells, measured from the timing of the primary synchronisation code

7.1.5.2.2.1 Parametrisation/introduction of idle periods

<Editor's note : there is no text in the equivalent section of reference [12]XX.15, UTRA Handover. This section will be needed if there is a need to introduce additional idle periods in either up or dl if idle periods between Tx and Rx are not sufficient>

7.1.5.2.2.2 Measurement requirements

<Editor's note : there is no requirement specified in either of the reference documents (XX.15 or Vol 3 of ARIB). The reported value itself is not specified but is expected to correspond to a useful received power level, and potentially some relative timing information. The requirements could also be expressed minimum of samples for the monitoring time assigned by higher layers, precision of the relative received power, taking into account to structure of the monitoring set….>

7.1.5.3 Measurements for the handover preparation from UTRA TDD to UTRA FDD at the UE

7.1.5.4 Measurements for the handover preparation from UTRA TDD to GSM at the UE

7.1.5.4.1 Introduction

The handover between UTRA and GSM system offering world-wide coverage already today has been one of the main design criteria taken into account in the UTRA frame timing definition. The GSM compatible multi-frame structure, with the super-frame being multiple of 120 ms, allows similar timing for inter-system measurements as in the GSM system itself. The compatibility in timing is important, that when operating in UTRA mode, a multi-mode UE is able to catch the desired information from the synchronisation bursts in the synchronisation frame on a GSM carrier with the aid of the frequency correction burst. This way the relative timing between a GSM and UTRA carriers is maintained similar to the timing between two asynchronous GSM carriers.
UTRA/TDD-GSM dual mode terminals can be implemented without simultaneous use of two receiver chains. Although the frame length is different from GSM frame length, the GSM traffic channel and UTRA TDD channels rely on similar 120 ms multi-frame structure.
A UE can do the measurements either by efficiently using idle slots (Slot left idle between Tx and Rx and/or rRx and TX as a result of the resource allocation) or by requesting free continuous periods in the downlink part obtained by reducing the spreading factor and compressing in time TS occupation in a form similar to the FDD slotted mode. The details of the latter are for further study. Other alternatives, e. g. dual receiver, are for further study. Basic requirements to correctly perform a handover in GSM are described in GSM 05.08 "Radio subsystem link control".

7.1.5.4.2 Monitoring GSM from TDD using idle TDD timeslots

Two kinds of UE should be distinguished: A single synthesiser UE has to switch in its idle periods from the TDD frequency to the considered GSM frequency, monitor GSM and switch back to TDD afterwards, that means two times a synthesiser switching time has to be considered. A dual synthesiser UE avoids this synthesiser switching time and the monitoring periods are equal to the idle periods.
For preparation of a handover from TDD to GSM there are two procedures possible
- To detect at first the FCCH burst and then the SCH burst (following one GSM frame later)
- or searching parallel for FCCH and SCH bursts.

<Editor's note : the following sections reflect current working assumptions but due to their descriptive nature they should not be included in the final version of the specification>

7.1.5.4.2.1 Low data rate traffic using 1 uplink and 1 downlink slot

<The section evaluates the time to acquire the FCCH if all idle slots are devoted to the tracking of a FCCH burst, meaning that no power measurements is done concurrently. The derived figures are better than those for GSM. The section does not derive though any conclusion. A conclusion may be that the use of the idle slots is a valid option. An alternative conclusion may be that this is the only mode to be used, removing hence the use of the slotted frames for low data traffic or the need for a dual receiver, if we were to considering the monitoring of GSM cells only, rather than GSM, TDD and FDD

If a single synthesiser UE uses only one uplink and one downlink slot, e.g. for speech communication, the UE is not in transmit or receive state during 8,75 ms in each frame. According to the TS numbers allocated to the traffic, this period can be split into two continuous idle intervals A and B as shown in figure 3.

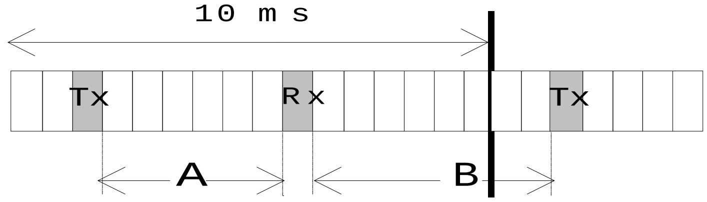

Figure 2: possible idle periods in a 16 TS frame with two occupied TS.

A is defined as the number of idle slots between the Tx and Rx slots and B the number of idle slots between the Rx and Tx slots. It is clear that A+B=14 time slots.
In the scope of low cost terminals, a [0.8] ms period is supposed to be required to perform a frequency jump from UMTS to GSM. As detailed in table 1, this will let free periods of A*0,625-1.6 ms and B*0,625-1.6 ms during which the mobile station can monitor GSM. In this table, the UL traffic is assumed to occupy TS0, and the duration of monitoring periods are indicated for each possible location of the DL TS.
Table 1 evaluates the average synchronisation time and maximum synchronisation time, where the announced synchronisation time corresponds to the time needed to find the FCCH. The FCCH is supposed to be perfectly detected meaning that the FCCH is found if it is entirely present in the monitoring window. The FCCH being found the SCH location is unambiguously known from that point.

DL TS n°	Number of free TS in A	Number of free TS in B	Monitoring period within A (ms)	Monitoring period within B (ms)	Synchronisation average time (ms)	Maximum synchronisation time (ms)
1	0	14	Not Used	7,15	43	140
2	1	13	NU	6,525	48	187
3	2	12	NU	5,900	56	188
4	3	11	NU	5,275	63	188
5	4	10	0.9	4,65	68	189
6	5	9	1,525	4,025	75	233
7	6	8	2,15	3,4	74	189
8	7	7	2,775	2,775	48	189
9	8	6	3,4	2,15	73	189
10	9	5	4,025	1,525	73	235
11	10	4	4,65	0.9	66	186
12	11	3	5,275	NU	61	186
13	12	2	5,900	NU	54	186
14	13	1	6,525	NU	47	186
15	14	0	7,15	NU	43	139

Table1: example-monitoring periods and associated synchronisation time in a 16 TS frame with two busy TS and with 0.8 ms switching time (*).

(*) All simulations have been performed with a random initial delay between GSM frames and UMTS frames
Each configuration of TS allocation described above allows a monitoring period sufficient to acquire synchronisation.

7.1.5.4.2.2 Higher data rate trafic using more than 1 uplink and/or 1 downlink TDD timeslot

The minimum idle time to detect a complete FCCH burst for all possible alignments between the GSM and the TDD frame structure (called ‘guaranteed FCCH detection’), assuming that monitoring happens every TDD frame, can be calculated as follows (t_{FCCH} = one GSM slot):

(e.g for t_{synth} =0ms: 3 TDD **consecutive** idle timeslots needed, for t_{synth} =0,3ms: 4 slots, for t_{synth} =0,5ms: 4 slots, for t_{synth} =0,8ms: 5 slots). Under this conditions the FCCH detection time can never exceed the time of 660ms.

$$t_{min,guaranteed} = 2\times t_{synth} + t_{FCCH} + \frac{10ms}{13} = 2\times t_{synth} + \frac{35ms}{26}$$

(For a more general consideration t_{synth} may be considered as a sum of all delays before starting monitoring is possible.)
For detecting SCH instead of FCCH (for a parallel search) the same equation applies.
In the equation before the dual synthesiser UE is included if the synthesiser switching time is 0ms.

occupied slots= 16-idle slots	cases	FCCH detection time in ms	
		Average	maximum
2	120	37	189
3	560	46	328
4	1820	56	419
5	4368	70	568
6	8008	87	659
7	11440	110	660
8	12870	138	660
9	11440	169	660
10	8008	195	660
11	4368	215	660
12	1820	227	660
13	560	229	660
14	120	-	-
15	16	-	-

Table 2: FCCH detection time for a dual synthesizer UE monitoring GSM from TDD every TDD frame

In table 2 for a given number of occupied slots in the TDD mode all possible cases of distributions of these occupied TDD slots are considered (see ‘cases’). For every case arbitrary alignments of the TDD and the GSM frame structure are taken into account for calculating the average FCCH detection time (only these cases are used which guarantee FCCH detection for all alignments; only the non-parallel FCCH search is reflected by the detection times in the table 2).
The term ‘occupied slots’ means that the UE is not able to monitor in these TDD slots.

For a synthesiser switching time of one or one half TDD timeslot the number of needed consecutive idle TDD timeslots is summarized in the table 3.

One-way switching time for the synthesiser	Number of free consecutive TDD timeslots needed in the frame for a guaranteed FCCH detection
1 TS (= 625µs)	5
0.5 TS (=312µs)	4
0 (dual synthesiser)	3

Table3: link between the synthesiser performance and the number of free consecutive TSs for guaranteed FCCH detection , needed for GSM monitoring

7.1.5.4.2.3 Use of TDD TSs release to accommodate monitoring windows

In high data-rate, when it is not possible to free the number of TS needed for an effective monitoring to prepare a handover from UMTS to GSM, the data rate can be slightly reduced for the duration of the monitoring. This should be acceptable as in any case, the data rate needs to be adapted to the available resource in GSM before the handover can be performed.

7.1.5.4.3 Overall handover preparation at the UE

This section should explain how the inter-frequency handover preparation from UTRA TDD to UTRA (either FDD or TDD) and from UTRA to GSM are co-ordinated in terms of measurement and reporting at the UE. This section provides the overall requirement and measurement procedure.
<Editor’s note : no text is available is either of the reference documents, XX.15 or ARIB volume 3>

7.1.6 Mesurements for the Handover preparation in TDD at the UTRAN side

<editor’s note : this is not described in either of the documents. However the handover triggering might not be due only to conditions on the downlink. Measurements performed by the cells in the active set might be needed as in GSM. This section has been created for that purpose >

7.1.7 Measurement reporting to the higher layers in TDD

<Editor’s note : This section should be updated in order not to make any assumption on the reporting scheme between the UE and the UTRAN but deal with only reporting to higher layers>

7.1.7.1 Reporting scheme

The UE sends regular (or event driven) measurement reports to the UTRAN. The level of filtering done by the physical layer vs. the filtering done by higher layers needs to be further discussed.

7.1.7.2 Measurement report content for cells on the same frequency

These measurements include (for cells on the same frequency)

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

Measurement report content for FDD cells on different frequencies

7.1.7.2.1 Measurement report content for TDD cells

7.1.7.2.2 Measurement report content for GSM cells

7.1.7.2.3 Measurement report content for DCA

- Pathloss of a sub-set of cells ([7]bit quantisation; max. number of cells is [30])
- Inter-cell interference measurements of all DL time slots requested by the UTRAN ([5] bit quantisation)
- BER of serving link before channel decoding ([4] bit quantisation)

- Transmission power of the UE on serving link ([6] bits quantisation)
- DTX flag indicating, whether measurements have been performed during DTX periods

7.2 Measurements for the cell reselection in active mode

<Editor's note : Depending on state the UE is in while in connected mode, the cell change operation can be performed using various procedures, such handover or cell reselection. Cell reselection might be appropriate for packet transmission. As an example this is what is done in GSM GPRS. The text included in this section is copied from reference [13], but is of a descriptive nature. Requirements will need to be defined as soon as the procedure is clarified by WG2>

When in active mode, the UE continuously searches for new base stations on the current carrier frequency. This cell search is carried out in basically the same way as the idle mode cell search.

7.3 measurements for power control ?

<Editor's note : there is presently no measurement defined for the support of power control that is reported over the radio. There might be however layer some measurements exchanged between the different UTRAN entities and that will need to be standardised in relation with power control. This is to be clarified with WG2 and WG3>

7.4 Measurements to support DCA when in connected mode with TDD

7.4.1 Measurements by the UE

While in active mode the DCA needs measurements for the reshuffling procedure (intra-cell handover). The following measurements have to be performed by theUE:

- Pathloss of a set of cells provided by the UTRAN
- Inter-cell interference measurements of downlink time slots (also on different frequencies) according to a list provided by the UTRAN.
- Estimation of BER of serving link before channel decoding

7.4.2 Measurements by the NodeB

The following measurements have to be performed by the nodeB in order to support DCA:

- Inter-cell interference measurements of uplink time slots (also on different frequencies) according to a list provided by the UTRAN ([5] bit quantisation).
- Estimation of BER of serving link before channel decoding ([4] bit quantisation)

<editor's note: In addition, the RLC informs the DCA about transmission errors. The interaction between DCA and RLC depends on the RLC operation mode. Details are for further study.>

7.5 Measurements adjacent protection channels

<Editor's note : some additional measurement might be needed in order to provide the network with information on adjacent channel interference. The text in this section is copied from reference [15], section 3.2.6.11.5). There is no equivalent text in ETSI documents. This text requires further study>

7.5.1.1 Frequencies to measure

On the BCCH, UTRAN transmits frequency information of candidate frequencies and neighbouring frequencies. A candidate frequency is defined as a frequency that can be used by the own network, and a neighbouring frequency is defined as a frequency that is adjacent to a candidate frequency. Candidate frequencies are classified into adjacent frequencies and non-adjacent frequencies. An adjacent frequency is defined as a candidate frequency that is adjacent to a neighbouring frequency, and a non-adjacent frequency is defined as a candidate frequency that is not adjacent to a neighbouring frequency. A pair of dl-link and up-link non-adjacent frequencies may be allocated to all UE.

7.5.1.2 Measurement to perform

To support adjacent channel protection rule, an MS measures Q_1 and Q_2 , where Q_1 is the received power in dBm of the downlink adjacent frequency, and Q_2 is the received power in dBm of the downlink neighbouring frequency that is adjacent to the downlink adjacent frequency.

7.6 Measurements for radio-link time-out (or sync loss) ?

8 Radio link measurements

<editor's note : this section should described the measurements that are performed either at the UE or UTRAN side and that are

- *either reported and can be checked on the interfaces*
- *or lead to some procedures in the mobile, leading to an expected behaviour of the said UE.*

This section can provide some requirements on the measurement in terms of precision for various conditions, although some of this might be more applicable to the WG4 documentation. The mapping of the raw values onto reported values with a limited range, where such reported values transit between layers or across the interface should be also given. Only the acronyms are provide here>

RSSI : Received signal strength for useful part
ISSI : Interference signal strength
SIR : Signal to interference ratio
Relative signal strength (for Handover)

Relative timing difference between cells = for FDD this corresponds to the phase difference between the scrambling codes

9 Annex 1 : Handover scenarios (Informative)

<Editor's note : This whole section is based on section 7 in XX15 version 1.0.0 from ETSI>

9.1 Introduction

This section studies the handover scenarios from the deployment point of view. It should in particular provide the rules for setting the handover monitoring set (see section), in particular the number of GSM, FDD and TDD cells to monitor. Based on deployment scenarios and UE's speed, it should also set the requirement in terms of detection time and reporting time of a strong cell.

As far as the handover between UTRA and GSM, the handover scenario will be based on interoperability aspects described in XX.16, which among other things will indicate when a handover is needed between UTRA and GSM from the service availability point of view.

9.2 UTRA-UTRA handover scenarios

9.3 UTRA-GSM handover scenarios

10 Annex 2 : Handover execution (Should be moved to S2.04 at some stage)

10.1 Soft handover

<Editor's note : the handver complete procedure is outside the scope of this specifciation. However it order not to loose information and before the documentation of WG2 covers this, the content of the reference document is put here. Detailed study of the differences is still to be made>

<Editor's note : text from XX.15>

The serving cell (s) (the cells in the active set) are expected to have knowledge of the service used by the UE. The new cell decided to be added to the active set shall be informed that a new connection is desired, and it needs to have the following minimum information forwarded to it via UTRAN.

- Maximum data rate of the connection and other service parameters, such as coding schemes, number of parallel code channels etc. parameters which form the set of parameters describing the different transport channel configurations in use both uplink and downlink.
- The UE ID and uplink scrambling code

- The relative timing information of the new cell, in respect to the timing UE is experiencing from the existing connections (as measured by the UE at its location). Based on this the new cellcan determine what should be the timing of the transmission initiated in respect to the timing of the common channels (BCCH) of the new cell.

As a response the UE needs to know via the existing connections:

- From which frame (assuming active set update accepted) does the new cell initiate the transmission to the UE
- What channelisation code(s) are used for that transmission. The channelisation codes from different cells are not required to be the same as they are under different scrambling code anyway.
- The relative timing information, which needs to be made available at the new cell is indicated in Figure 1 (shows the case where the two involved cells are managed by different Node Bs).

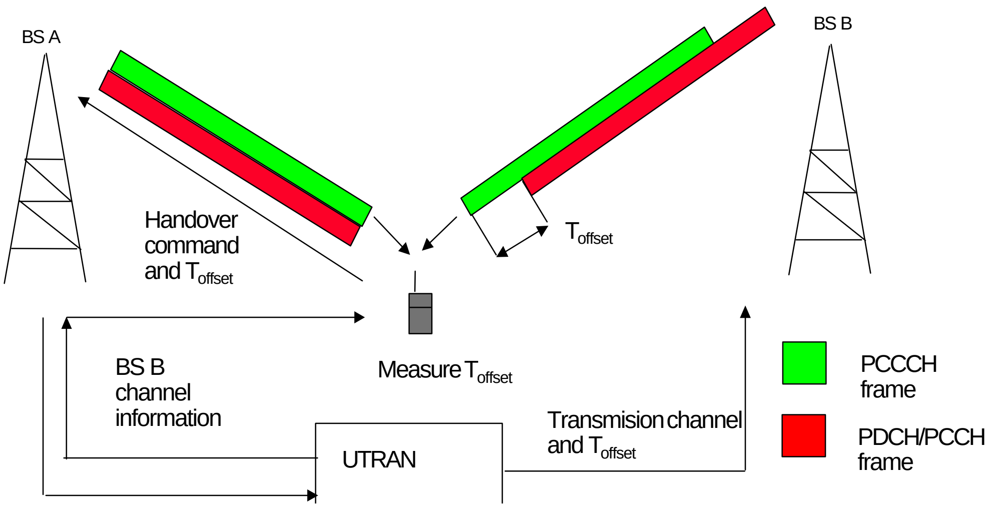

Figure 3. Making transmissions capable to be combined in the Rake receiver from timing point of view.

At the start of diversity handover, the reverse link dedicated physical channel transmitted by the MS, and the forward link dedicated physical channel transmitted by the diversity handover source BTS will have their radio frame number and scrambling code phase counted up continuously as usual, and they will not change at all. Naturally, the continuity of the user information mounted on them will also be guaranteed, and will not cause any interruption.

<Editor's note : text from ARIB, volume 3, agreed for inclusion by 3GPP RAN WG1#2>

The synchronization timing upon starting diversity handover are presented in Fig. 3.2.5-4. The synchronisation establishment flow upon intra/inter-cell diversity handover is described in Fig. 3.2.6-4.

(a) The MS measures the frame time difference of the radio frame at the same frame number between the reverse link dedicated physical channel and the perch channel transmitted at the handover destination BTS. These measurements shall be notified to the network. The measured value is the time difference of the frame timing of the reverse link dedicated physical channel against the frame timing of the perch channel.
The values shall always be positive values in chip units, and the range shall be 0 ~"reverse link scrambling code cycle-1" chip.

(b) The MS notifies the frame time difference measurement values as layer 3 signals to the BSC via the diversity handover source BTS with the DCH of the reverse link dedicated physical channel.

(c) The BSC notifies the frame time difference measurement result, together with the frame offset and slot offset set up upon originating/ terminating call connection, to the diversity handover destination BTS with layer 3 signals. Furthermore, the BSC notifies radio parameters such as the spreading codes used at the handover destination BTS etc., to the MS via the handover source BTS.

(d) The MS starts the chip synchronisation establishment process of forward link channel from the handover destination BTS with the notified radio parameters. The reverse link channels being transmitted shall continue transmission without any operations performed.

(e) The handover destination BTS receives the notification of the above frame time difference frame offset, and slot offset. Utilising these informations, the BTS starts the transmission of forward link dedicated physical channels and starts the synchronization establishment process of reverse link dedicated physical channel transmitted by the MS. See chapter 3.2.5.1 for the specific transmission timing of forward link dedicated physical channels, and the reception timing of reverse link dedicated physical channel. As soon as chip synchronisation and frame synchronisation using Frame Synchronization Word are established, hard wired transmission shall be started.

(f) Based on the handover destination perch channel reception timing, the MS establishes chip synchronisation of forward link channel from handover destination BTS. As soon as chip synchronisation is established, maximal ratio combining with the forward link channel from handover source BTS shall be started.

(See also Appendix D)

Fig. 4 Synchronisation Establishment Flow Upon Intra/Inter-cell Diversity Handover

11 History

V.0.0.1	19.03.1999	First version created by the editor by merging S1.15 version 0.0.1 and S1.25 version 0.0.1
V.0.0.2	23.03.99	Second version incorporating agreed text proposals contained in R1-99166 and R1-99167 which were agreed by TSG RAN WG1 #3 with editorial modifications.
V.0.1.0	26.03.1999	Version 0.0.2 was approved by WG1#3 with editorial modifications.
V.0.1.1	20.04.1999	Version 0.1.1 incorporates changes approved at RAN WG1#4, based on R1-99335, R1-99505 and-99519
V.2.0.0	20.04.1999	Version 2.0.0

The editor for 3GPP RAN S1.31 (Physical layer measurements) is

Evelyne Le Strat
Nortel Networks
Tel : +33 1 39 44 53 39, Fax : +33 1 39 44 50 12, e-mail: elestrat@nortelnetworks.com

This document is written in Microsoft Word 97.