TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) *TSGR2#3(99)208*
Yokohama 13th to 16th April 1999

Agenda Item: **4.2**

Source: **Editor**

Title: **Draft Version of 3GPP TSG RAN WG2 TR R2.02 V0.0.2: on "Radio Resource Management Strategies**"

Document for: **Discussion**

During the last meeting of 3GPP TSG RAN WG2, based on RAN decision, a new TR R2.02 on "RRM Strategies" was created, and a Scope and Index was agreed for the new document.
In particular it was decided to check RAN documentation in order to include in the R2.02 all parts related to RRM issues; moreover it was decided to start an e-mail discussion on the Radio Resource Management issue.

As a result of these decisions CSELT, as Editor of the document, identified parts of the various RAN WGs documents which could be included in the R2.02; the editor of the relevant documents were informed and then a proposed draft version of R2.02 was circulated through the reflector to initiate the correspondence discussion.

Starting from comments emerged on the e-mail discussion and taking into account other possible parts to be included in the TR R2.02 a second draft version of TR R2.02 was circulated on the mail reflector.

Finally taking into account the comments received on the second draft version, version 0.0.2 of the document TR R2.02 was created and presented to the WG2 meeting in Yokohama.

TR RAN R2.02 V0.0.2 (1999-04)

Technical Report

3rd Generation Partnership Project (3GPP);
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Contents

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Pursuant to the 3GPP Interim IPR Policy, no investigation, including IPR searches, has been carried out by 3GPP . No guarantee can be given as to the existence of other IPRs not referenced in the [tbd.] , which are, or may be, or may become, essential to the present document.

[Editor's note: This section needs to be reviewed. It is assumed here than a 3GPP IPR report will be available in the near future.]

Foreword

This Technical Recommendation has been produced by the 3rd Generation Partnership Project, Technical Specification Group RAN.
The contents of this TR may be subject to continuing work within the 3GPP and may change following formal TSG approval. Should the TSG modify the contents of this TR, it will be re-released with an identifying change of release date and an increase in version number as follows:

Version m.t.e

where:

m indicates [major version number]

x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated into the specification.

1. Scope

The present document shall describe RRM strategies supported by UTRAN specifications and typical algorithms.

2. 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, the latest version applies.
- A non-specific reference to an TS shall also be taken to refer to later versions published as an EN with the same number.

[1] 3GPP Homepage: www.3GPP.org
[2] S2.01, Radio Interface Protocol Architecture
[3] S2.02, Layer 1; General requirements
[4] S2.03, UE States and Procedures in Connected Mode

[5] S2.04, Description of procedures in idle Mode
[6] S2.22, Description of RLC protocol
[7] S2.31, Description of RRC protocol
[8] S2.40, Description of principles for error handling and message description
[9] ETSI UMTS 25.XX: "Vocabulary for the UTRAN"
[10] S1.25, Measurements TDD

3. Definitions, abbreviations and symbols

3.1 Definitions

See [9] for a definition of fundamental concepts and vocabulary.

3.2 Abbreviations

ARQ	Automatic Repeat Request
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
C-	Control-
CC	Call Control
CCCH	Common Control Channel
CCH	Control Channel
CCTrCH	Coded Composite Transport Channel
CN	Core Network
CRC	Cyclic Redundancy Check
DC	Dedicated Control (SAP)
DCA	Dynamic Channel Allocation
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DRNC	Drift Radio Network Controller
DSCH	Downlink Shared Channel
DTCH	Dedicated Traffic Channel
FACH	Forward Link Access Channel
FAUSCH	Fast Uplink Signalling Channel
FCS	Frame Check Sequence
FDD	Frequency Division Duplex
GC	General Control (SAP)
HO	Handover
ITU	International Telecommunication Union
kbps	kilo-bits per second
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)
LAC	Link Access Control
LAI	Location Area Identity
MAC	Medium Access Control
MM	Mobility Management
Nt	Notification (SAP)

OCCCH	ODMA Common Control Channel
ODCCH	ODMA Dedicated Control Channel
ODCH	ODMA Dedicated Channel
ODMA	Opportunity Driven Multiple Access
ORACH	ODMA Random Access Channel
ODTCH	ODMA Dedicated Traffic Channel
PCCH	Paging Control Channel
PCH	Paging Channel
PDU	Protocol Data Unit
PHY	Physical layer
PhyCH	Physical Channels
RACH	Random Access Channel
RLC	Radio Link Control
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RNTI	Radio Network Temporary Identity
RRC	Radio Resource Control
SAP	Service Access Point
SCCH	Synchronization Control Channel
SCH	Synchronization Channel
SDU	Service Data Unit
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
TCH	Traffic Channel
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TMSI	Temporary Mobile Subscriber Identity
TPC	Transmit Power Control
U-	User-
UE	User Equipment
UE_R	User Equipment with ODMA relay operation enabled
UL	Uplink
UMTS	Universal Mobile Telecommunications System
URA	UTRAN Registration Area
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

3.3 Symbols

4. General Description of Radio resource Management

5. Idle Mode Tasks

5.1 Overview

When a multi-mode UE is switched on, it attempts to make contact with a public land mobile network (PLMN) using a certain radio access mode. The choice of radio access mode, for instance UTRA, GSM or GPRS may be done automatically or manually.

The particular PLMN to be contacted may be selected either automatically or manually.

The UE looks for a suitable cell of the chosen PLMN and chooses that cell to provide available services, and tunes to its control channel. This choosing is known as "camping on the cell". The UE will then register its presence in the registration area of the chosen cell if necessary, by means of a location registration procedure.

If the UE finds a more suitable cell, it reselects onto that alternative cell of the selected PLMN and camps on that cell. If the new cell is in a different registration area, location registration is performed.

If necessary, the UE will look for more suitable cells on other PLMNs at regular time intervals, which is referred to as PLMN-reselection. Particularly, in the home country of the UE, the UE will try to get back to its Home PLMN.

If the UE loses coverage of a PLMN, either a new PLMN is selected automatically (automatic mode), or an indication of which PLMNs are available is given to the user, so that a manual selection can be made (manual mode).

Registration is not performed by UE's only capable of services that need no registration.

The purpose of camping on a cell in idle mode is fourfold:

a) It enables the UE to receive system information from the PLMN.

b) When registered and if the UE wishes to initiate a call, it can do this by initially accessing the network on the control channel of the cell on which it is camped.

c) If the PLMN receives a call for the registered UE, it knows (in most cases) the registration area of the cell in which the UE is camped. It can then send a "paging" message for the UE on control channels of all the cells in the registration area. The UE will then receive the paging message because it is tuned to the control channel of a cell in that registration area and the UE can respond on that control channel.

d) It enables the UE to receive cell broadcast messages

If the UE is unable to find a suitable cell to camp on, or the USIM is not inserted, or if the location registration failed, it attempts to camp on a cell irrespective of the PLMN identity, and enters a "limited service" state in which it can only attempt to make emergency calls.

The idle mode tasks can be subdivided into four processes:

- Radio access mode selection and reselection; *[FFS]*
- PLMN selection and reselection;
- Cell selection and reselection;
- Location registration.

The relationship between these processes is illustrated in the Figure 11~~Figure 11~~.

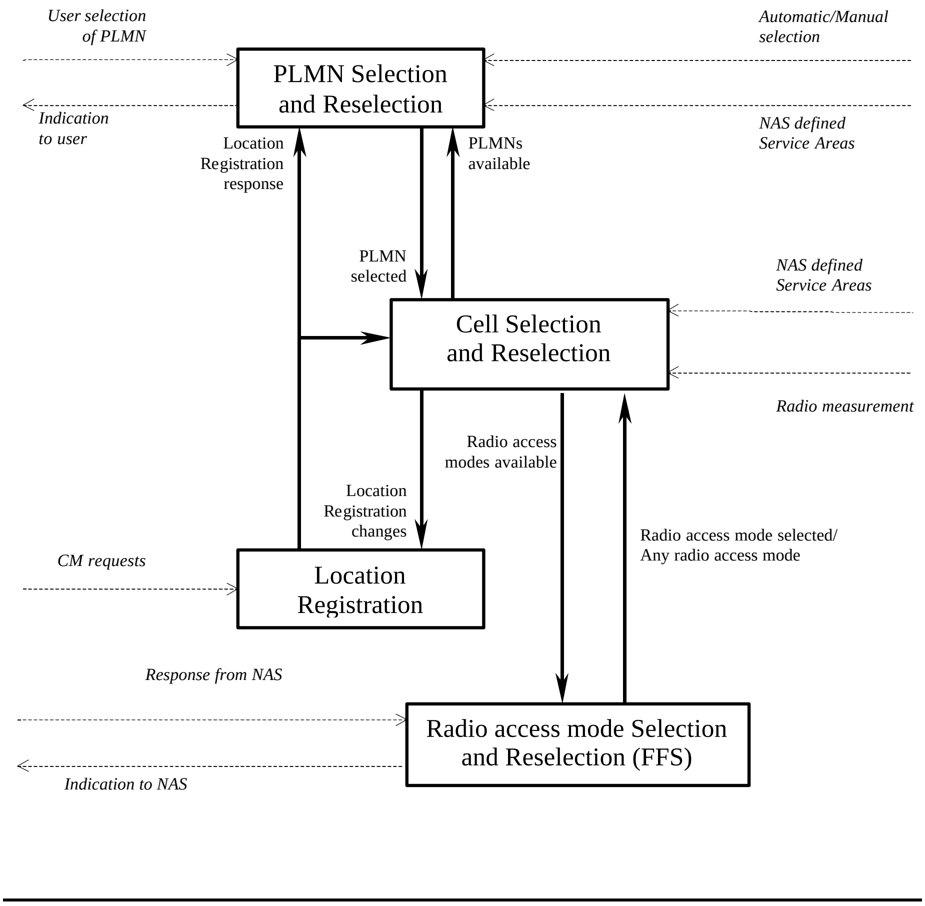

Figure 1~~1~~. Overall Idle Mode process.

[Note: The idle mode process for radio access mode selection/reselection and the impact of NAS defined service areas is FFS.]

[Note: Whether it is possible to be active in more than one radio access mode at the time is FFS.]

5.2 Functional division between AS and NAS in Idle mode

Table 11~~Table 11~~ presents the functional division between UE non-access stratum (NAS) and UE access stratum (AS) in idle mode.

Idle Mode Process	**UE Non-Access Stratum**	**UE Access Stratum**

PLMN Selection and Reselection	Maintain a list of PLMNs in priority order. Request AS to select a cell either belonging to the PLMN having the highest priority (in automatic mode) or belonging to the manually selected PLMN. In automatic mode, if a PLMN with higher priority is found, request AS to select a cell belonging to that PLMN.	Report available PLMNs to NAS on request from NAS or autonomously.
Cell Selection	Control cell selection by for example, maintaining lists of forbidden registration areas and a list of NAS defined service areas in priority order.	Perform measurements needed to support cell selection. Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS. Search for a suitable cell belonging to the PLMN requested by NAS. The cells are identified with PLMN identity in the system information. Respond to NAS whether such cell is found or not. If such a cell is found, the cell is selected to camp on.
Cell Reselection	Control cell reselection by for example, maintaining lists of forbidden registration areas and a list of NAS defined service areas in priority order.	Perform measurements needed to support cell reselection. Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS. Change cell if a more suitable cell is found. Perform ODMA probing in an ODMA Relay Node.
Location registration	Register the UE as active after power on. Register the UE's presence in a registration area, for instance regularly or when entering a new registration area.	Report registration area information to NAS.

	Deregister UE when shutting down.

Table 1~~1~~. Functional division between AS and NAS in idle mode.

5.3 Service type in Idle mode

This chapter provides some definitions regarding the level of service that may be provided by the UTRAN to an UE in Idle mode.

The action of camping on a cell is generally presented as mandatory to receive some service from the cell. This notion of service should be distinguished in 3 categories, so that the network may eventually not provide all kind of services in every cells for UE in idle mode:

- Emergency calls
- Normal services (for public use)
- Operator related services

Furthermore, the cells can be categorised according to services they can offer:

acceptable cell:

An "acceptable cell" is a cell on which the UE may camp on to originate emergency calls. Such a cell fulfills the following requirements, which is the minimum set of requirements to initiate an emergency call in a UTRAN network:

- the cell may or may not belong to the allowable PLMN list stored on the USIM
- the path loss between the UE and the radio site is below a threshold which is set by the operator
- the cell is not reserved for operator use only

high priority suitable cell:

A "high priority suitable cell" is a cell on which the UE may camp on. Such a cell fulfill the following requirements:

- the cell belongs to the selected PLMN
- the path loss between the UE and the radio site is below a threshold which is set by the operator
- the cell is not barred or reserved for operator use only
- the cell priority is provided by the network on the BCCH.

low priority suitable cell:

An UE may only camp on this cell if no other high priority suitable cells are available. This may be used as an example for the support of multilayered networks

barred cell:

An UE cannot camp on this kind of cell for standard services, but may eventually initiate an emergency call from this cell if no other suitable cell is available, either low or high priority.

This type of cell may be used by operators for traffic load balancing, as an example.

Whether or not the cell is barred, is provided by the network on the BCCH.

"operator only" cell:

The aim of this type of cells is to allow the operator using and test newly deployed cells without being disturbed by normal traffic. UE cannot camp on this cell, or initiate an emergency call from this cell, except for some classes of UE. The clearance for accessing to initiate a call within such a cell is part of the information stored on the USIM.

Whether or not the cell is reserved for operator use only, is provided by the network on the BCCH.

Table 222~~Table 22~~ quickly summarizes all the different cases above as well as the level of service provided by UTRAN, as seen from the UE in Idle mode.

	acceptable cell	high priority suitable cell	low priority suitable cell	barred cell	operator only cell
emergency	Y	Y	Y	Y	N
standard	N	Y	Y (backup)	N	N
operator	N	Y	Y	N	Y

Table 2~~2~~2. Summary of service provided by UTRAN.

5.4 Criteria for Cell Selection and Reselection

5.4.1 Cell Selection Monitoring Frequency or Cell Set

5.4.2 Cell Re-Selection Monitoring Frequency or Cell Set

5.5 Location Registration

When first camped on a suitable cell after power on, the non-access stratum will register the UE as active and present in the registration area of the chosen cell, if necessary.

The non-access stratum will register the UE’s presence in a registration area, for instance regularly and when entering a new registration area.

The access stratum will inform the non-access stratum in which NAS defined service area(s) the UE is located, for instance regularly and when entering a new NAS defined service area.

Prior to power off, the non-access stratum will deregister the UE, if necessary.

5.6 Broadcast information receiving

5.6.1 System Information

The following information are broadcast by UTRAN on the BCH in each cell:

- PLMN identity
- Registration Area Identity
- LSA IDs. There may be several LSA IDs broadcast, since a cell may belong to several LSAs.
- cell priority (high | low)
- access allowed (standard | barred | operator only | LSA exclusive)
- minimum received level
- maximum UE transmit power
- neighbouring cells with corresponding scrambling code
- ...

[Note: This list is not exhaustive due to the fact that some information related to L1 aspects may be further needed. Details are FFS.]

[Editor's note: The complete list of BCH parameters will be listed in the RRC protocol specification.]

5.6.2 Cell Broadcast

6. RRC Connection Mobility

6.1 General Description of Connected Mode

The connected mode is entered when the RRC connection is established. The UE is assigned a radio network temporary identity (RNTI) to be used as UE identity on common transport channels.

The UE leaves the connected mode and returns to idle mode when the RRC connection is released or at RRC connection failure.

Within connected mode the level of UE connection to UTRAN is determined by the quality of service requirements of the active radio access bearers and the characteristics of the traffic on those bearers.

The UE-UTRAN interface is designed to support a large number of UE:s using packet data services. Due to limitations, such as air interface capacity, UE power consumption and network h/w availability, the dedicated resources cannot be allocated to all of the packet service users at all times.

The UE state in the connected mode defines the level of activity associated to the UE. The key parameters of each state are the required activity and resources within the state and the required signalling prior to the data transmission. The state of the UE shall at least be dependent on the application requirement and the period of inactivity.

Packet Services can be supported also using the FAUSCH, by means of which a dedicated transport channel can be allocated for data transmission.

[Editor's note: The FAUSCH transport channel is still under discussion in the L1 Expert Group. If the corresponding physical channel is not approved, then the FAUSCH Transport Channel will be removed]

The different levels of UE connection to UTRAN are listed below:

- No signalling connection exists
  The UE is in idle mode and has no relation to UTRAN, only to CN. For data transfer, a signalling connection has to be established.

- Signalling connection exists
  When at least one signalling connection exists, the UE is in connected mode and there is normally an RRC connection between UE and UTRAN. The UE position can be known on different levels:

  - UTRAN Registration Area (URA) level
    The UE position is known on URA level. The URA is a set of cells

  - Cell level
    The UE position is known on cell level. Different transport channel types can be used for data transfer:
    - Common transport channels (RACH/FACH)
    - Dedicated transport channels (DCH) (FAUSCH can be used to allocate a dedicated transport channel for data transmission.)

Assuming that there exists an RRC connection, there are two basic families of RRC connection mobility procedures, URA updating and handover. Different families of RRC connection mobility procedures are used in different levels of UE connection (cell level and URA level):

- URA updating is a family of procedures that updates the UTRAN registration are of a UE when an RRC connection exists and the position of the UE is known on URA level in the UTRAN.

- Handover is a family of procedures that adds or removes one or several radio links between one UE and UTRAN when an RRC connection exists and the position of the UE is known on cell level in the UTRAN.

6.1.1 Handover

6.1.1.1 Strategy

The handover strategy employed by the network for radio link control determines the handover decision that will be made based on the measurement results reported by the UE/RNC and various parameters set for each cell. Network directed handover might also occur for reasons other than radio link control, e.g. to control traffic distribution between cells. The network operator will determine the exact handover strategies.. Possible types of Handover are as follows:

- Handover 3G -3G:
- FDD soft/softer handover;
- FDD inter-frequency hard handover;
- FDD/TDD Handover;
- TDD/FDD Handover;
- TDD/TDD Handover;
- Handover 3G - 2G:
- Handover to GSM

6.1.1.2 Causes

The following is a non-exhaustive list for causes for the initiation of a handover process.

- Uplink quality
- Uplink signal strength
- Downlink quality
- Downlink signal strength
- Distance
- Change of service
- Better cell
- O&M intervention
- Directed retry
- Traffic
- Pre-emption

6.1.1.3 Cell Set for the Handover Preparation

6.1.1.4 Hard Handover

6.1.1.4.1 Hard Handover (FDD and TDD Hard)

The NW RRC determines the need for hard handover based on received measurement reports or load control algorithms. For inter-frequency handover the measurements are assumed to be performed in slotted mode.

The NW RRC first configures the NW L1 to activate the new radio links. The NW L1 begins transmission and reception on the new links immediately. The NW RRC then sends the UE RRC a HANDOVER COMMAND message. The message indicates the radio resources that should be used for the new radio link. The UE RRC configures the UE L1 to terminate reception on the old radio link and begin reception on the new radio link.

After the UE L1 has achieved downlink synchronisation on the new frequency, a L2 link is established and the UE RRC sends a HANDOVER COMPLETE message to the NW RRC. After having received the L3 acknowledgement, the NW RRC configures the NW L1 to terminate reception and transmission on the old radio link.

[Note 1: Whether it should be possible to setup several radio links immediately on the new frequency is FFS.]

[Note 2: The suspension and resuming of the CC and MM signalling during handover is FFS.]

6.1.1.4.2 Hard handover (between FDD and TDD)

6.1.1.5 Soft Handover

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).

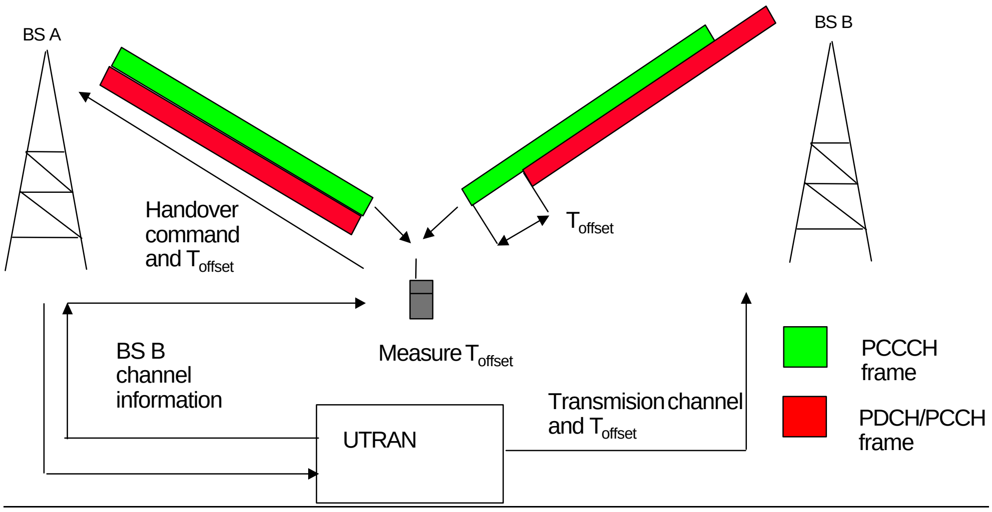

Figure 2. Making transmissions capable to be combined in the Rake receiver from timing point of view.

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>

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.
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.
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.
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.
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.

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.

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.

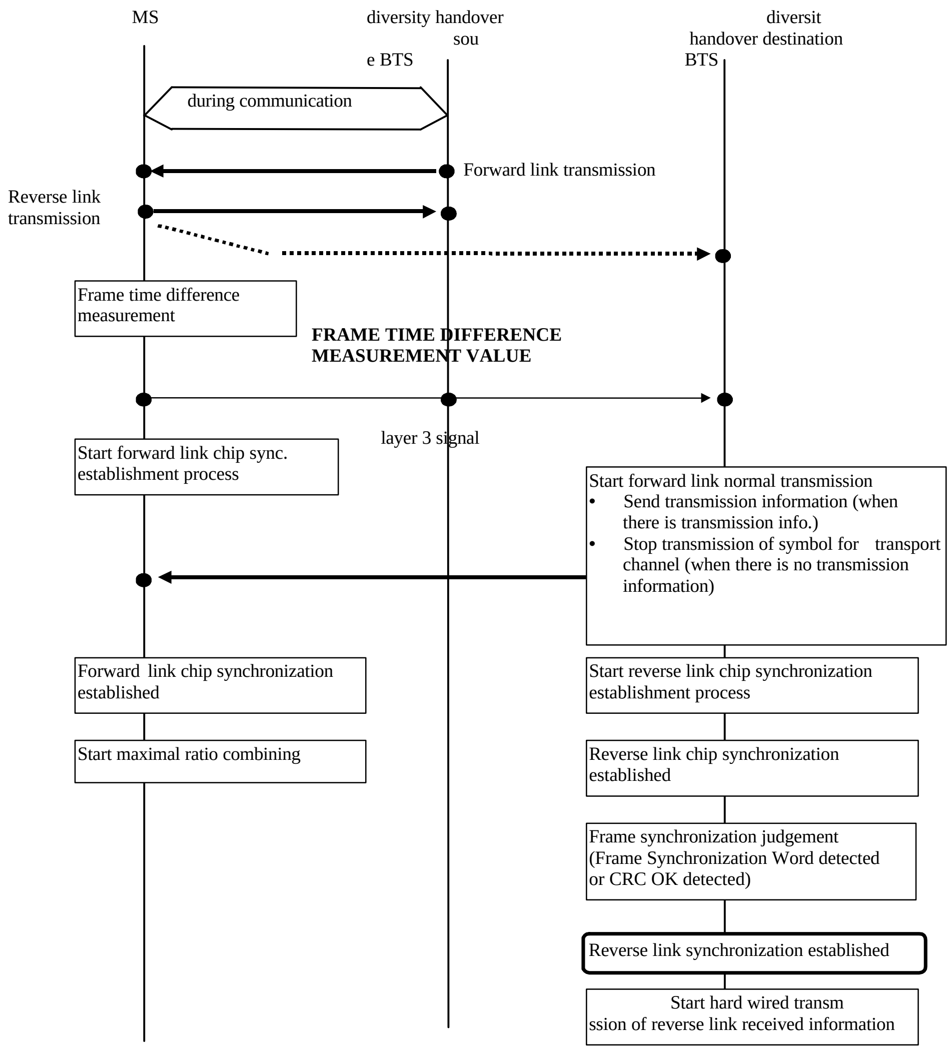

Fig. 3.2.6-4 Synchronisation Establishment Flow Upon Intra/Inter-cell Diversity Handover

6.1.1.6 Inter System Handover

6.1.1.6.1 Handover 3G to 2G

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/FDD-GSM dual mode UEs 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 FDD channels use similar 120 ms multi-frame structure. Similar timing can be naturally done with UTRA TDD mode as well.

A UE can do the measurements by using idle periods in the downlink transmission, where such idle periods are created by using the downlink slotted mode as defined in reference [2]. In addition to downlink slotted frames for measurements, the UTRAN will provide uplink slotted frames to allow the UE to GSM cells on frequencies closed to the FDD uplink band. The slotted mode is under the control of the UTRAN, and the UTRAN should communicate to the UE which frame is slotted. .

Alternatively independent measurements not relying on the slotted mode, but using a dual receiver approach can be performed, where the GSM receiver branch can operate independently of the UTRA FDD receiver branch.

For smooth inter-operation between the systems, information needs to be exchanged between the systems, in order to allow the UTRAN to notify the UE of the existing GSM frequencies in the area (see section 6.1.1.2.1.4). Further more integrated operation is needed for the actual handover where the current service is maintained, taking naturally into account the lower data rate capabilities in GSM when compared to UTRA maximum data rates reaching all the way to 2 Mbits/s.

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 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 low-cost constraint excludes the dual receiver approach.

For smooth inter-operation, inter-system information exchanges are needed in order to allow The UTRAN to notify the UE of the existing GSM frequencies in the area and vice versa. Further more integrated operation is needed for the actual handover where the current service is maintained, taking naturally into account the lower data rate capabilities in GSM when compared to UMTS maximum data rates reaching all the way to 2 Mbits/s.

Basic requirements to correctly perform a handover in GSM are described in GSM 05.08 “Radio subsystem link control”.

6.1.2 Radio Link Management

6.1.2.1 Radio Link Addition (FDD soft-add)

[Note: TDD soft-add is an option supported on the condition that L1 supports it]

Radio link addition is triggered in the network RRC layer by measurement reports sent by the UE. The NW RRC first configures the new radio link on the physical layer in Node B. Transmission and reception begin immediately. The NW RRC then sends an RRC ACTIVE SET UPDATE message to the UE RRC. The UE RRC configures layer 1 to begin reception.

After confirmation from the physical layer in UE an ACTIVE SET UPDATE COMPLETE message is sent to the RNC-RRC.

6.1.2.2 Radio Link Removal (FDD soft-drop)

[Note: TDD soft-drop is an option supported on the condition that L1 supports it]

Radio link removal is triggered by an algorithm in the network RRC layer by measurement reports sent by the UE. Radio link removal may also be triggered in the NW due to load control algorithms. The radio link is first deactivated by the UE and then in the NW.

The NW RRC sends an ACTIVE SET UPDATE message to the UE RRC. The UE RRC requests UE L1 to terminate reception of the radio link(s) to be removed. After this the UE RRC acknowledges radio link removal with an ACTIVE SET UPDATE COMPLETE message to the NW RRC. The NW RRC proceeds to request the NW L1 in both Node B and the RNC to release the radio link.

6.1.2.3 Combined radio link addition and removal

The NW RRC determines the need for radio link replacement based on received measurement reports or load control algorithms.

When radio links are to be replaced, the NW RRC first configures the NW L1 to activate the radio link(s) that are being added. The NW RRC then sends an ACTIVE SET UPDATE message to the UE RRC, which configures the UE L1 to terminate reception on the removed radio link(s) and begin reception on the added radio link(s).

If the UE active set is full, the replacement has to be performed in the order defined in Figure 28 Section 7.3.6 in S2.03. If UE has only one radio link, then the replacement must be done in reverse order (first add, then remove). *Note: The present assumption is that the order of the replacement can be left to the UE.*

The UE RRC acknowledges the replacement with an ACTIVE SET UPDATE COMPLETE message. The NW RRC then configures the NW L1 to terminate reception and transmission on the removed radio link.

6.1.3 Cell Update

The cell update procedure is a forward handover procedure. It is triggered by the cell re-selection function in the UE, which notifies which cell the UE should switch to. The UE reads the broadcast information of the new cell. Subsequently, the UE RRC layer sends a CELL UPDATE REQUEST message to the UTRAN RRC via the MAC SAP for the CCCH logical channel and the RACH transport channel. The RACH transmission includes the current RNTI.

[Editor’s Note: The logical channel to be used and the routing of the message are FFS]

Upon reception of the CELL UPDATE REQUEST, the UTRAN registers the change of cell and replies with a CELL UPDATE CONFIRM message transmitted on the CCCH/FACH to the UE. The message includes the current RNTI and may also include a new RNTI.*[Detailed Examples of this type of procedures are reported in Section 7.3.2 of 3GPP TSG RAN WG2 S2.03]*

6.1.4 URA Updating

When cell re-selection is triggered, the UE abandons the radio link in the old cell and establishes a radio link to the new cell. The URA update procedure is triggered when the UE reads the broadcast information of the new cell and recognises that a URA update is required. After that, the UE RRC layer sends a URA UPDATE REQUEST on the CCCH to the UE MAC layer, which transfers the message on the RACH to UTRAN. The RACH transmission includes the current RNTI.

[Editor’s Note: The logical channel to be used and the routing of the message are FFS]

Upon reception of the URA UPDATE REQUEST, the UTRAN registers the change of URA. Then the UTRAN RRC layer requests the UTRAN MAC layer to send a URA UPDATE CONFIRM message on the FACH to the UE. The message includes the current RNTI and may also include a new RNTI.

7. Admission Control

8. Radio Access Bearer Control

8.1 Radio Access Bearer Control – Overview of Procedures

8.1.1 Configurable parameters

The following layer 1, MAC and RLC parameters should be able to configure by RRC. The list is not complete.
Radio access bearer parameters, e.g.
RLC parameters per RLC link (radio access bearer), which may include e.g. PDU size and timeout values. Used by RLC.
Multiplexing priority per DCCH/DTCH. Used by MAC in case of MAC multiplexing of logical channels.
Transport channel parameters, e.g.
Scheduling priority per transport channel. Used by MAC in case of layer 1multiplexing of transport channels.
Transport format set (TFS) per transport channel. Used by MAC and L1.
Transport format combination set (TFCS) per UE. Used by MAC and L1.
Allowed subset of TFCS per UE. Used by MAC.
Physical channel parameters, which may include e.g. carrier frequency and codes. Used by L1.

8.1.2 Typical configuration cases

The table below gives a proposal which main combination cases of parameter configuration that shall be supported, in terms of which parameters that shall be able to configure simultaneously (by one procedure). Note that the "Transport channel type switching" is not a parameter as such, it only indicates that switching of transport channel type may take place for that combination case.

Parameter		Layer	A	B	C	D	E
Radio access bearer parameters	RLC parameters	RLC	X				
	Logical channel multiplexing priority	MAC	X				
Transport channel parameters	Transport channel scheduling priority	MAC	X				
	TFS	L1+MAC	X	X			
	TFCS	L1+MAC	X	X			
	Subset of TFCS	MAC					X
	Transport channel type switching	MAC	X	X	X		
Physical channel parameters		L1	X	X	X	X	

Table 3~~3~~. Typical configuration cases. An "X" indicates that the parameter can (but need not) be configured.

Case A is typically when a radio access bearer is established or released, or when the QoS of an existing radio access bearer or the signalling link need to be changed (the necessity of change of QoS is FFS).

Case B is when the traffic volume of a radio access bearer has changed so the TFS used on the DCH need to be changed, which may in turn affect any assigned set of physical channels. Another example is to make the UE use a new transport channel and at the same time supplying the TFS for that channel.

Case C is when the traffic volume of one radio access bearer has changed so that the used transport channel type is changed from e.g. RACH/FACH to DCH/DCH, which includes the assignment or release of a set of physical channels.

Case D is e.g. the change of used DL channelization code, when a DCH is currently used. No transport channel type switching take place.

Case E is a temporary restriction and/or a release of restriction for usage of the TFCS by the UE (total uplink rate).

8.1.3 RRC Elementary Procedures

8.1.3.1 Category 1: Radio Access Bearer Configuration

The first category of procedures includes Case A and are characterized by:
Are executed upon request by higher layers and the parameter configuration is based on QoS
Affects L1, MAC and RLC.
There are three RRC procedures included in this category:

- **Radio Access Bearer Establishment.** This procedure establishes a new radio access bearer. The establishment includes, based on QoS, assignment of RLC parameters, multiplexing priority for the DTCH, scheduling priority for DCH, TFS for DCH and update of TFCS. It may also include assignment of a physical channel(s) and change of the used transport channel types / RRC state.

- **Radio Access Bearer Release.** This procedure releases a radio access bearer. The RLC entity for the radio access bearer is released. The procedure may also release a DCH, which affects the TFCS. It may include release of physical channel(s) and change of the used transport channel types / RRC state.

- **Bearer Reconfiguration.** This procedure reconfigures parameters for a radio access bearer or the signalling link to reflect a change in QoS. It may include change of RLC parameters, change of multiplexing priority for DTCH/DCCH, change of DCH scheduling priority, change of TFS for DCH, change of TFCS, assignment or release of physical channel(s) and change of used transport channel types. *[Note: The necessity of this procedure is FFS.]*

8.1.3.2 Category 2: Transport Channel Configuration

The second category of procedures includes Case B and are characterized by:
Configuration of TFS for a transport channel and reconfiguration of TFCS is done, but sometimes also physical channel parameters.
Affects L1 and MAC.
Switching of used transport channel(s) may take place.
There is one RRC procedure included in this category:
Transport Channel Reconfiguration. This procedure reconfigures parameters related to a transport channel such as the TFS. The procedure also assigns a TFCS and may change physical channel parameters to reflect a reconfiguration of a transport channel in use. *[Note: It is expected that the configuration of TFS/TFCS needs to be done more seldom than the assignment of physical channel. A "pre-configuration" of TFS/TFCS of a transport channel not in use can be done by this procedure, to be used after transport channel type switching when the physical channel is assigned.]*

8.1.3.3 Category 3: Physical Channel Configuration

The third category of procedures includes the cases C and D and are characterized by:
May assign or release a physical channel for the UE (which may result in transport channel type switching)
May make a combined release and assignment (replacement) of a physical channel in use (which does not result in transport channel type switching / change of RRC state).

Affects mainly L1, and only the transport channel type switching part of MAC.
The transport format sets (TFS and TFCS) are not assigned by this type of procedure. However, the UE can be directed to a transport channel, which TFS is already assigned to the UE.
There is one RRC procedure included in this category:

- **Physical Channel Reconfiguration.** This procedure may assign, replace or release a set of physical channels used by an UE. As a result of this, it may also change the used transport channel type (RRC state). For example, when the first physical channel is assigned the UE enters the DCH/DCH state. When the last physical channel is released the UE leaves the DCH/DCH state and enters a state (and transport channel type) indicated by the network. A special case of using this procedure is to change the DL channelization code of a dedicated physical channel. *[Note: The procedure does not change the active set, in the downlink the same number of physical channels are added or replaced for each radio link.]*

8.1.3.4 Category 4: Transport Format Combination Restriction

The fourth category of procedures includes Case E and are characterized by:
Does only control MAC by means of the transport format combinations that may be used within the set without affecting L1.
There is one RRC procedure included in this category:
Transport format combination control. The network uses this procedure towards an UE, to control the used transport format combinations in the uplink within the transport format combination set.

9. Dynamic Channel Allocation

9.1 DCA (FDD)

9.1.1 Radio Resource Allocation Tasks (RACH/FACH and RACH+FAUSCH/FACH)

In the RACH / FACH substate the UE will monitor an FACH. It is enabled to transmit uplink control signals and it may be able to transmit small data packets on the RACH. The network can assign the UE stransport channel parameters (e.g. transport format sets) in advance, to be used when a DCH is used. When the physical channel for DCH is assigned, the transport channel type is switched to DCH and the assigned TFS can be used.

When there is either user or control data to transmit, a selection procedure determines whether the data should be transmitted on a common transport channel, or if a dedicated transport channel should be allocated. The selection should be dynamic and depend on traffic parameters (amount of data, packet burst frequency).

9.1.2 Radio Resource Allocation tasks (DCH/DCH and DCH/DCH+DSCH)

For the DCH, several physical channel allocation strategies may be applied. The allocations can be either permanent (needing a DCH release message) or based on time or amount-of-data.

Resource allocation can be done separately for each packet burst with fast signalling on the DCH. Transition out of the Control only state is either triggered by user capacity allocation or by timeout (no data transaction requests received within a specified time period).

For each radio frame the UE and the network indicate the current data rate (in uplink and downlink respectively) using the transport format combination indicator (TFCI). If the configured set of combinations (i.e. transport format set for one transport channel) are found to be insufficient to retain the QoS requirements for a transport channel, the network initiates a reconfiguration of the transport format set (TFS) for that transport channel. This reconfiguration can be done during or in between data transmission. Further, the network can reconfigure the physical channel allowing an increase or decrease of the peak data rate.

For the uplink data transmission, the UE reports the observed traffic volume to the network in order for the network to re-evaluate the current allocation of resources. This report contains e.g. the amount of data to be transmitted or the buffer status in the UE.

If during data transfer the UE is unable to transmit at the requested output power when using the peak allocated capacity, the UE shall reduce transmission rate within the current 10 ms radio frame in order to maintain the closed-loop power control.

9.2 DCA (TDD)

9.2.1 Channel Allocation

<not covered in ARIB TDD>

For the UTRA-TDD mode a physical channel is characterised by a combination of its carrier frequency, time slot, and spreading code as explained in the chapter on the physical channel structure

Channel allocation covers both :

- resource allocation to cells (slow DCA)

resource allocation to bearer services (fast DCA)

9.2.1.1 Resource allocation to cells (slow DCA)

<not covered in ARIB TDD>

Channel allocation to cells follows the rules below:

- A reuse one cluster is used in the frequency domain. In terms of an interference-free DCA strategy a timeslot-to-cell assignment is performed, resulting in a time slot clustering. A reuse one cluster in frequency domain does not need frequency planning. If there is more than one carrier available for a single operator also other frequency reuse patters >1 are possible.
- Any specific time slot within the TDD frame is available either for uplink or downlink transmission . UL/DL resources allocation is thus able to adapt itself to time varying asymmetric traffic.
- In order to accommodate the traffic load in the various cells the assignment of the timeslots (both UL and DL) to the cells is dynamically (on a coarse time scale) rearranged (slow DCA) taking into account that strongly interfering cells use different timeslots. Thus resources allocated to adjacent cells may also overlap depending on the interference situation.
- Due to idle periods between successive received and transmitted bursts, UEs can provide the network with interference measurements in time slots different from the one currently used. The availability of such information enables the operator to implement the DCA algorithm suited to the network.
- For instance, the prioritized assignment of time slots based on interference measurements results in a clustering in the time domain and in parallel takes into account the demands on locally different traffic loads within the network.

9.2.1.2 Resource allocation to bearer services (fast DCA)

<not covered in ARIB TDD>

Fast channel allocation refers to the allocation of one or multiple physical channels to any bearer service Resource units (RUs) are acquired (and released) according to a cell-related preference list derived from the slow DCA scheme.

1. The following principles hold for fast channel allocation:The basic RU used for channel allocation is one code / timeslot / (frequency).

2. Multirate services are achieved by pooling of resource units. This can be made both in the code domain (pooling of multiple codes within one timeslot = **multicode** operation) and time domain (pooling of multiple timeslots within one frame = **multislot** operation). Additionally, any combination of both is possible.
3. Since the maximal number of codes per time slot in UL/DL depends on several physical circumstances like , channel characteristics, environments, etc. (see description of physical layer) and whether additional techniques to further enhance capacity are applied (for example smart antennas),. the DCA algorithm has to be independent of this number. Additionally, time-hopping can be used to average inter-cell interference in case of low-medium bit rate users.
   - 4. Channel allocation differentiates between RT and NRT bearer services:RT services: Channels remain allocated for the whole duration the bearer service is established . The allocated resources may change because of a channel reallocation procedure (e.g. VBR).
   - NRT services: Channels are allocated for the period of the transmission of a dedicated data packet only UDD channel allocation is performed using 'best effort strategy', i.e. resources available for NRT services are distributed to all admitted NRT services with pending transmission requests. The number of channels allocated for any NRT service is variable and depends at least on the number of current available resources and the number of NRT services attempting for packet transmission simultaneously. Additionally, prioritisation of admitted NRT services is possible.

5. Channel reallocation procedures (intra-cell handover) can be triggered for many reasons:

- To cope with varying interference conditions.
- In case of high rate RT services (i.e. services requiring multiple resource units) a 'channel reshuffling procedure' is required to prevent a fragmentation of the allocated codes over to many timeslots. This is achieved by freeing the least loaded timeslots (timeslots with minimum used codes) by performing a channel reallocation procedure.
- When using smart antennas, channel reallocation is useful to keep spatially separated the different users in the same timeslot.

9.2.2 Measurements Reports from UE to the UTRAN

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- While in active mode the DCA needs measurements for the reshuffling procedure (intra-cell handover). The specification of the measurements to be performed is contained in Section 7.4 in [10]. In this section the relevant measurement reports are presented:

- Pathloss of a sub-set of cells (pathloss is quantized in N_{PL} [e.g. 128] intervals ; [max. number of cells is 30].
- Inter-cell interference measurements of all DL time slots requested by the UTRAN (interference is quantized in N_{ICI} [e.g. 32] intervals, due to asymmetry up to 14 time slots are possible)
- BER of serving link (quantized in N_{BER} [e.g. 16] intervals)
- Transmission power of the UE on serving link (separated in N_{TX} [e.g. 64] intervals)
- DTX flag link
- ffs
- Further measurements and reports can be requested by the UTRAN.

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.

10. Power Management

11. Radio Link Surveillance

12. History

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