TSG RAN Meeting #26 **RP-040438**
Vouliagmeni Athens, Greece, 08 - 10 December 2004

Title **For information - draft MBMS changes for TS25.402**
Source **TSG RAN WG3**
Agenda Item **8.4**

RAN3 Tdoc	Spec	curr. Vers.	new Vers.	CR	Rev	Cat	Rel	Title	Work item
R3-041735	25.402	6.0.0	-	-	-	-	Rel-6	Draft MBMS changes for TS 25.402	MBMS-RAN

3GPP TSG-RAN3 Meeting #45 **_Tdoc_ ⌘ R3-041735**
Shin-Yokohama, Japan, 15th – 19th November 2004

CR-Form-v7.1

CHANGE REQUEST

⌘	25.402	CR	XXX	⌘ rev	-	⌘	Current version:	6.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects:	UICC apps⌘	[ ]	ME	[ ]	Radio Access Network	X	Core Network	[ ]

Title:	⌘	Draft MBMS changes to 25.402		
Source:	⌘	RAN WG3		
Work item code:	⌘	MBMS-RAN	**_Date:_** ⌘	30/11/2004
Category:	⌘	B	**_Release:_** ⌘	REL-6
		Use one of the following categories: **_F_** *(correction)* **_A_** *(corresponds to a correction in an earlier release)* **_B_** *(addition of feature),* **_C_** *(functional modification of feature)* **_D_** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *Ph2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)* *Rel-7 (Release 7)*

Reason for change:	⌘	Allow setup of synchronised MBMS transport channels
Summary of change:	⌘	One reference is added Some MBMS related abbreviations are added Minor changes to the definition of [FDD – Chip Offset] Introduction of MBMS Frame Offset [FDD – SCCPCH Frame Offset] Introduction of MBMS OFFSET "MOFF" Introduction of new MBMS related descriptive chapter
Consequences if not approved:	⌘	Combining methods in UE might work very inefficiently.

Clauses affected:	⌘	2, 3.3, 5 and new chapter 11				
		Y	**N**			
Other specs affected:	⌘	X		Other core specifications	⌘	TS25.401 TS25.410 TS25.413 TS25.420 TS25.430 TS25.423 TS25.433
			X	Test specifications		
			X	O&M Specifications		

Other comments:	⌘	This CR will be part of a bunch of CRs, introducing MBMS.

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References

……Text omitted

[26] 3GPP TS 25.346: “Introduction of MBMS in the Radio Access Network”

3.3 Abbreviations

……Text omitted

UMTS	Universal Mobile Telecommunications System
USCH	Uplink Shared CHannel
UTRAN	UMTS Terrestrial Radio Access Network
MBMS	Multimedia Broadcast Multicast Service
MCCH	MBMS point-to-multipoint Control Channel
MTCH	MBMS point-to-multipoint Traffic Channel
p-t-p	Point-to-Point
p-t-m	Point-to-Multipoint

5 Synchronisation Counters and Parameters

This clause defines counters and parameters used in the different UTRAN synchronisation procedures.
The parameters used only by FDD has been indicated with the notation [FDD – parameter].

BFN Node B Frame Number counter. This is the Node B common frame number counter. [FDD -BFN is optionally frequency-locked to a Network synchronisation reference]. Range: 0 .. 4095 frames.

RFN RNC Frame Number counter. This is the RNC node common frame number counter. RFN is optionally frequency-locked to a Network synchronisation reference. Range: 0 .. 4095 frames.

SFN Cell System Frame Number counter. SFN is sent on BCH. SFN is used for paging groups and system information scheduling etc.
In FDD SFN = BFN adjusted with T_cell.
In TDD, if Inter Node B synchronisation port is used, SFN is locked to the BFN (i.e. SFN mod 256 = BFN mod 256).
Range: 0 .. 4095 frames.

CFN Connection Frame Number (counter). CFN is the frame counter used for the L2/transport channel synchronisation between UE and UTRAN. A CFN value is associated to each TBS and it is passed together with it through the MAC-L1 SAP. CFN provides a common frame reference (at L2) to be used e.g. for synchronised transport channel reconfiguration (see [2] and [3]).

The duration of the CFN cycle is longer than the maximum allowed transport delay between MAC and L1 (in UTRAN side, between SRNC and Node B, because the L1 functions that handle the transport channel synchronisation are in the Node B). Range: 0 .. 255 frames. When used for PCH the range is 0 .. 4095 frames.

Frame Offset Frame Offset is a radio link specific L1 parameter used to map the CFN, used in the transport channel, into the SFN that defines the specific radio frame for the transmission on the air interface.

At the L1/L2 interaction, the mapping is performed as:

- SFN mod 256 = (CFN + Frame Offset) mod 256 (from L2 to L1) (5.1);

- CFN = (SFN - Frame Offset) mod 256 (from L1 to L2) (5.2).

The resolution of all three parameters is 1 frame. Frame Offset and CFN have the same range (0…255) and only the 8 least significant bits of the SFN are used. The operations above are modulo 256.

In the UTRAN, the Frame Offset parameter is calculated by the SRNC and provided to the Node B.

OFF The parameter OFF is calculated by the UE and reported to the UTRAN only when the UTRAN has requested the UE to send this parameter. In the neighbouring cell list, the UTRAN indicates for each cell if the Frame Offset is already known by the UTRAN or shall be measured and reported by the UE.

OFF has a resolution of 1 frame and a range of 0 .. 255.

Five different cases are discerned related to the determination of the OFF value by the UE:

1. The UE changes from common channel state to dedicated channel state: 1 RL. In this case OFF is zero.

2. [FDD -The UE changes from common channel state to dedicated channel state: several RL's.
   OFF is in this case defined as being the difference between SFN of the candidate cells and the SFN of the camping cell. Again the UE sets OFF to zero for the cell to which the UE sends an UL RRC message (cell #1). For cells #2 to n, the UE sets OFF to the difference between the SFN of cell#2,n and the SFN of cell#1.
   This could be seen as if a virtual dedicated physical channel (DPCH) already is aligned with cell #1].

3. The UE adds another RL or moves to another cell in dedicated channel state. OFF is in this case defined as being the time difference between the CFN and the SFN of the cell in which the RL is to be added. In case this difference cannot be measured, a value as in [FDD - 13] [TDD - 14] shall be reported instead.

4. The UE is coming from another RAN and goes to dedicated channel state: 1 RL. This case is identical to case 1).

5. [FDD - The UE is coming from another RAN or another frequency in the same RAN and goes to dedicated channel state: several RL's.
   This case is identical to case 2), with one exception: OFF will not be zero for the cell to which the UE sends an UL RRC message (the measurement information will be received via the CN in this case) but for a reference cell selected by the UE. All other reported OFF values will be relative to the SFN of this selected reference cell].

[FDD – $DOFF_{FDD}$] The $DOFF_{FDD}$ (FDD Default DPCH Offset value) is used to define Frame Offset and Chip Offset at first RL setup. The resolution should be good enough to spread out load over Iub and load in Node B (based on certain load distributing algorithms). In addition it is used to spread out the location of Pilot Symbol in order to reduce the peak DL power since Pilot symbol is always transmitting at the fixed location within a slot (the largest number of chips for one symbol is 512 chips).

The SRNC sends a $DOFF_{FDD}$ parameter to the UE when the new RL will make the UE change its state (from Cell_FACH state or other when coming from another RAN) to Cell_DCH state.

Resolution: 512 chips; Range:0 .. 599 (< 80 ms).

[TDD – $DOFF_{TDD}$] The $DOFF_{TDD}$ (TDD Default DPCH Offset value) is used to define Frame Offset at first RL setup, in order to spread out load over /Iur and load in Node B (based on certain load distributing algorithms).

The SRNC sends a $DOFF_{TDD}$ parameter to the UE when the new RL will make the UE change its state (from Cell_FACH state or other when coming from another RAN) to the Cell_DCH state.

Resolution: 1 frame; Range: 0 .. 7 frames.

[FDD – MOFF] MOFF is a parameter, which shows the time offset of given transport channel at air interface relative to P-CCPCH of reference cell.
Range: 0 .. (38400*4096-256) chips.

[FDD – Chip Offset] The Chip Offset is used as offset for the DL DPCH relative to the PCCPCH timing.

In case of MBMS, this parameter is used as offset for S-CCPCH relative to P-CCPCH timing.

The Chip Offset parameter has a resolution of 1 chip and a range of 0 .. 38399 (< 10 ms).

The Chip Offset parameter is calculated by the SRNC and provided to the Node B.

Frame Offset + Chip Offset (sent via NBAP) are in Node B rounded together to closest
256 chip boundary. The 256 chip boundary is used regardless of the used spreading factor, also when the spreading factor is 512. The rounded value (which is calculated in Node B) controls the DL DPCH respectively S-CCPCH air-interface timing.

The "Frame Offset + Chip Offset" 256 chip boundary rounding rules for Node B to consider for each DL DPCH are:

1. IF (Frame Offset x 38 400 + Chip Offset) modulo 256 [chips] = {1..127} THEN round (Frame Offset x 38 400 + Chip Offset) modulo 256 frames down to closest 256 chip boundary.

2. IF (Frame Offset x 38 400 + Chip Offset) modulo 256 [chips] = {128..255} THEN round (Frame Offset x 38 400 + Chip Offset) modulo 256 frames up to closest 256 chip boundary.

3. IF (Frame Offset x 38 400 + Chip Offset) modulo 256 [chips] = 0 THEN "Frame Offset x 38 400 + Chip Offset" is already on a 256 chip boundary.

[FDD – SCCPCH Frame Offset]

SCCPCH Frame offset relates to Offset of S-CCPCH of a given cell relative to P-CCPCH of reference cell .
Range: Range: 0..4095 frames.

[FDD – DPCH Frame Offset]

The DPCH Frame Offset is used as offset for the DL DPCH relative to the PCCPCH timing at both the Node B and the UE. The DPCH Frame Offset parameter has a resolution of 256 chips and a range of 0 .. 38144 chips (< 10 ms).

The DPCH Frame Offset is equivalent to Chip Offset rounded to the closest 256 chip boundary. It is calculated by the SRNC and sent to the UE by the SRNC for each radio link in the active set.

The DPCH Frame Offset controls the DL DPCH air-interface timing. It enables the DL DPCHs for radio links in the Active Set to be received at the UE at approximately the same time, which can then be soft combined during soft handover.

[FDD –Tm] The reported Tm parameter has a resolution of 1 chip and a range of 0 .. 38399. The Tm shall always be sent by the UE.

Five different cases are discerned related to the determination of the Tm value by the UE:

1. The UE changes from common channel state to dedicated channel state: 1 RL.
   In this case the Tm will be zero.

2. The UE changes from common channel state to dedicated channel state: several RL's.
   Tm is in this case defined as being the time difference between the received PCCPCH path of the source cell and the received PCCPCH paths of the other target cells. Again the UE sets Tm to zero for the cell to which the UE sends an UL RRC message (cell #1). For cells #2 to n, the UE sets Tm to the time difference of the PCCPCH reception timing of cell#2,n from the PCCPCH reception timing of cell#1.

3. The UE adds another RL in dedicated channel state (macro-diversity).
   Tm is in this case defined as being the time difference between "$T_{UETX} – T_o$" and the earliest received PCCPCH path of the target cell. T_{UETX} is the time when the UE transmits an uplink DPCCH frame, hence "$T_{UETX} – T_o$" is the nominal arrival time for the first path of a received DPCH.

4. The UE is coming from another RAN and goes to dedicated channel state: 1 RL.
   This case is identical to case 1.

5. The UE is coming from another RAN or another frequency in the same RAN and goes to dedicated channel state: several RL's.
   This case is identical to case 2, with one exception: Tm will not be zero for the cell to which the UE sends an UL RRC message (the measurement information will be received via the CN in this case) but for a reference cell selected by the UE. All other reported Tm values will be relative to the timing of the PCCPCH in this cell.

[FDD – T_cell] T_cell represents the Timing delay used for defining the start of SCH, CPICH and the DL Scrambling Code(s) in a cell relative BFN. The main purpose is to avoid having overlapping SCHs in different cells belonging to the same Node B. A SCH burst is
256 chips long. SFN in a cell is delayed T_cell relative BFN.

Resolution: 256 chips. Range: 0 .. 9 x 256 chips.

T1 RNC specific frame number (RFN) that indicates the time when RNC sends the DL NODE SYNCHRONISATION control frame through the SAP to the transport layer.

Resolution: 0.125 ms; Range: 0 .. 40959.875 ms.

T2 Node B specific frame number (BFN) that indicates the time when Node B receives the correspondent DL NODE SYNCHRONISATION control frame through the SAP from the transport layer.

Resolution: 0.125 ms; Range: 0 .. 40959.875 ms.

T3	Node B specific frame number (BFN) that indicates the time when Node B sends the UL NODE SYNCHRONISATION control frame through the SAP to the transport layer. Resolution: 0.125 ms; Range: 0 .. 40959.875 ms.
T4	RNC specific frame number (RFN) that indicates the time when RNC receives the UL NODE SYNCHRONISATION control frame. Used in RNC locally. Not standardised over Iub.
TOAWS	TOAWS (Time of Arrival Window Startpoint) is the window startpoint. DL DATA FRAMES are expected to be received after this window startpoint. TOAWS is defined with a positive value relative Time of Arrival Window Endpoint (TOAWE) (see Figure 10). A data frame arriving before TOAWS gives a TIMING ADJUSTMENT control frame response. The resolution is 1 ms, the range is: {0 .. CFN length/2 –1 ms}.
TOAWE	TOAWE (Time of Arrival Window Endpoint) is the window endpoint. DL DATA FRAMES are expected to be received before this window endpoint (see Figure 10). TOAWE is defined with a positive value relative Latest Time of Arrival (LTOA). A data frame arriving after TOAWE gives a TIMING ADJUSTMENT control frame response. The resolution is 1 ms, the range is: {0 .. CFN length –1 ms}.
LTOA	LTOA (Latest Time of Arrival) is the latest time instant a Node B can receive a data frame and still be able to process it. Data frames received after LTOA can not be processed (discarded). LTOA is defined internally in Node B to be a processing time before the data frame is sent in air-interface. The processing time (Tproc) could be vendor and service dependent. LTOA is the reference for TOAWE (see Figure 14).
TOA	TOA (Time of Arrival) is the time difference between the TOAWE and when a data frame is received. A positive TOA means that data frames are received before TOAWE, a negative TOA means that data frames are received after TOAWE. Data frames that are received after TOAWE but before LTOA are processed by Node B. TOA has a resolution of 125 µs. TOA is positive when data frames are received before TOAWE (see Figure 12). The range is: {0 .. +CFN length/2 –125 µs}. TOA is negative when data frames are received after TOAWE. The range is: {–125 µs .. –CFN length/2}.

11 MBMS related Transport Channel Synchronisation

11.1 General

Point-to-multipoint transmission is used to transfer MBMS specific control/user plane information between the network and several UEs in RRC Connected or Idle Mode. In ptm mode, FACH is used as a transport channel for MTCH and MCCH. SCCPCH is used as a physical channel for FACH carrying MTCH or MCCH.

11.2 FDD MBMS related Transport Channel Synchronisation

For FDD the synchronisation of MBMS related transport channels could be achieved by following steps:

1. Node synchronisation (as described in chapter 6)
   After carrying out this procedure, RNC is able to calculate BFN assuming that the DL and UL propagation delay have the same value. Since, for every cell the timing delay of cell (Tcell) is known to

CRNC, the CRNC is further able to calculate for every cell the three parameters Frame offset, chip offset and also the Round Trip Delay (RTD: delay between RNC and Node B).

2. Calculations for Alignment of Air Interface Transmission
At the beginning of these calculations, CRNC has as a result of earlier performed Node synchronisation the timing relation between RNC and every Node B. Additionally CRNC knows the value of parameter T_cell for every cell. This includes the information about offset between SFNs of two cells and also offset between RFN and BFNs. Having this information, CRNC is able to calculate the parameters for MBMS related transport channels (control/data) in several cells in such a way, that these transport channels are time aliened. This time alignment of MBMS transport channels in different cells enables various combining methods and eases the requirement on UE capabilities. This mechanism is described below (see also figure 1) :

The offset between BFNs of two given Node Bs can be calculated:
BFN(X)_BFN(Y)_time_difference [chips] = (RFN_BFN_Offset_X - RFN_BFN_Offset_Y) * 38400 (11.1)

And the offset between SFNs of two given cells is given by:

SFN(m)_SFN(n)_time_difference [chips] = (RFN_BFN_Offset_m*3840 + TCell_m) - (RFN_BFN_Offset_n*3840 + TCell_n) (11.2)

For a transport channel in a given cell x, the time difference between P-CCPCH and S-CCPCH is given by:

MOFF_x [chips] = SCCPCH_Frame_Offset * 38400 + FDD_SCCPCH_Offset * 256 (11.3)
The Range is: (0.. 157 286 144)= [0.. (4096 * 38400 - 256)]

The timing relation between two transmission channels in different cells x and Y can be generally described by:

MOFF_x [chips] = SFN_X-SFN_Y_time_difference + MOFF_Y) mod 157286400 (11.4)
Note: The mode operation is used to keep the offset within the allowed range (wrap around)!

One gets further:
MOFF_Y [chips] = (157286400 + MOFF_X - SFN_X-SFN_Y_time_difference) mod 157286400 (11.5)

Replacing the offset between two SFNs by equation (11.2) results in:

MOFF_Y [chips] = (157286400 + MOFF_X – (RFN_BFN_Offset_Y*38400) - TCell_2 + RFN_BFN_Offset_X*38400 + TCell_X) mod 157286400 = A (11.6)

Finally the farme offset and chip offset of S-CCPCH (transport channel in cell y) relative to P-CCPCH of reference cell can be calculated by the following operations:

FDD_SCCPCH_Frame_Offset = A div 38400 (11.7)
FDD_SCCPCH_Offset = A mod 38400 (11.8)

For every trasport channel the equation (11.9) is valid:

MOFF = (FDD_SCCPCH_Frame_Offset * 38400) + FDD_SCCPCH_Offset (11.9)

RNC calculates according to (11.7) and (11.8) the Frame Offset and Chip Offset and uses this information to calculate the respective CFN for the common transport channel frame protocol.

By doing this procedure for every cell in the cell group, time aliened transmission channels through out the cell group is achieved.

11.3 TDD MBMS related Transport Channel Synchronisation

For TDD the synchronisation of MBMS related transport channels could be achieved using methods similar to those described in section 6.1.2 which are used to achieve Inter Node B Node Synchronisation.