TSG-RAN Working Group 1 meeting #11 **TSGR1#10(00)0269**

San Diego (USA), February 28 ~ March 3, 2000

Agenda Item :

Source : Samsung, GBT, LGIC, Lucent

Title : Dual mode CPCH

Document for : Discussion and approval

The only remaining open issue on channel assignment for CPCH is the solution to the channel assignment message error that can cause the False Mobile situation (or Abnormal Operation). In this contribution we present and analyse two solutions to the aforementioned problem. Furthermore, a CR is proposed for the dual mode CPCH where both the channel assignment and the UE channel selection method can be applied.

I. FALSE MOBILE SITUATION CASES

The issue of Abnormal Operation or False Mobile was among the main items of the off-line AdHoc14 meeting on CPCH, that took place two weeks ago. The companies that participated in the discussions were GBT, LGIC, Lucent and Samsung. This contribution outlines the proposed solutions agreed among the participants on the issue of False Mobile.

At first, we would like to give a definition for the False Mobile situation, which is as follows. In Channel Assignment (CA), Abnormal Operation or False Mobile is defined as the situation when a new user A is assigned a specific channel, but due to an error in the CA message (but not in the CD), he reads that he is assigned a different channel, which happens to be occupied by user B. In that case both users A and B will share the same set of codes. If users are transmitting high bit rate data, and user B happens to be near the cell boundary (while user A is closer to the cell's base station), then the base station's processing window might not include its signal. Therefore, user B remains untraceable. In that case the received TPC commands are invalid and user B starts rumpling up its power, causing the interference level to increase. Due to the fact that the base station cannot trace the interference source, it cannot do anything about it, and eventually all users in this part of the cell will increase their transmitting power in order to maintain the targeted C/I. This will cause additional interference and eventually part of the cell will be lost.

From the above scenario, we can divide the False Mobile situation into two cases. One is the in-sync case and the other is the out-of-sync case between frames transmitted from/to UE#1 and UE#2. In the former case (in-sync), it can be assumed that two the UE signals are in the searching window of the UTRAN (this assumption is based on the fact that in real system (e.g., IS-95) the full size searching window is maintained even after locking a specific UE). In the latter case (out-of-sync), it can be assumed that the signal of the second UE (False Mobile) is outside of the receiver's searching window.

For clearer explanation, from this point on it will be assumed that UE#1 is using channel#1 while UE#2 has just been assigned by UTRAN channel#2. However, UE#2, due to wrong detection of its CA message (CD has been detected correctly) "reads" that it has been assigned channel #1.

We can identify two cases in the False Mobile situation:

1. In-sync case

In this case, UE#2 (the False Mobile) enters channel #1 at the same frame boundary as the UE#1. Since UTRAN uses a sliding correlator (to detect RAKE's fingers , both signals from UE#1 and UE#2 will be combined. In this case, even though the data of UE#1 and UE#2 might be "broken", the Abnormal Operation will not occur since the power control of channel #1 will be based on the combined pilot pattern power from both UE#1 and UE#2 (both UE's are using the same pilot pattern, therefore their combined power will increase). As a result UTRAN will send power down command instead of power up command. This is a basic characteristic of soft handover in CDMA systems. Furthermore, UTRAN can identify that channel #2 is empty because there is no received data in that channel and the frame synchronisation confirmation will not be successful. As a result, UTRAN knows that a CA message error has occurred in UE#2 (False Mobile) and therefore it can activate the emergency stop procedure. Consequently, the Abnormal Operation can be stopped.

2. Out-of-sync case

In this case, we assume that UE#2 (False Mobile) enters channel#1 at a different frame boundary from UE#1. Therefore, both the UE and UTRAN can recognise the CA message error. In the UE side, since the pilot pattern is not matched with the one received in the down-link, (because the channel#1's frame boundary is synchronised with UE#1) UE#2 can recognise the out-of-sync from the first frame. At the UTRAN side, in the same manner as in case 1, (the channel#2 is empty even though UTRAN has already assigned it), UTRAN can recognise that a CA message error has occurred.

In any of the two cases, UTRAN can find out that channel#2 is empty. Therefore, UTRAN can activate some actions (e.g., emergency stop) to resolve this situation. Furthermore, the UE can also recognise the CA message error by checking the pilot pattern in out-of-sync case. As a result the UE can release the CPCH channel by its own will.

Yet, the problem might arise from the surrounding UEs, who during the period of 1-2 frames will start increasing their power (due to the C/I degradation), and potentially make part of the cell to be lost. For this reason there are two proposed solutions that can help to prevent the False Mobile situation.

II. SUGGESTED METHODS FOR SOLVING THE FALSE MOBILE SITUATION

Two methods have been suggested for solving the CA message error problem.

1. <u>Use of the "start frame message pattern"</u>. It is located in the unused part of down-link DPCH. It has a specific pattern that indicates the starting frame by UTRAN. Then an UE that enters the CPCH message part checks the start frame message from the UTRAN. If it fails, the UE release the CPCH channel. This method will prevent the false mobile from entering the wrong CPCH channel.

2. Use of the "parallel CA method". In the parallel CA method UTRAN sends two CA's in parallel for assigning one channel. The total power of both (parallel) CAs is same as for the single CA case. For example, CA1 and CA9 will be sent simultaneously for indicating PCPCH#1. If an error occurred, and CA9 is read as CA8, then UE receives (1,8) rather than (1,9). In this situation, the UE will reject the CA message. Therefore, there can be no False Mobile caused due to an error in one CA message (out of the 2) . False Mobile situation can only occur if an UE misread both CA's (e.g. (0,8), (2,10), (3,11),… and so on), therefore the CA message error probability will be reduced dramatically. To sum up, if the CA message error probability is low in the single CA case, that probability will be significantly reduced for the parallel CA's. However, since this method has a trade-off between the number of CAs and the probability of the False Mobile, it is proposed as an optional feature.

III. SIMULATION RESULTS OF THE CA MESSAGE ERROR

Simulation results regarding the channel assignment error probability are shown in Figure 1 for various simulation parameters (vehicular speed, existence on STTD, number of channel paths) with single CA. We can easily see that, in most cases, the probability will be lower than 1e-5 at Ec/Ior = -15dB. Since the operating range for common channels is between –15dB and –10dB, the value of -15dB can be considered as the worst case scenario. When STTD is used and 2-paths, 1e-5 probability can be achieved at –18dB and -21dB for 3km/h and 120km/h vehicular speed, respectively. Furthermore, if we use the parallel CA method, this curve will be shifted to the right in 3dB and will be lowered doubled. For example, in case of STTD, 2-path, and 3km/h mobile at Ec/Ior = -18dB, the error probability is approximately 8e-6 for single CA case, then if we use the parallel CA method, at Ec/Ior = -15dB, the CA message error probability will be approximately 6.4e-11.

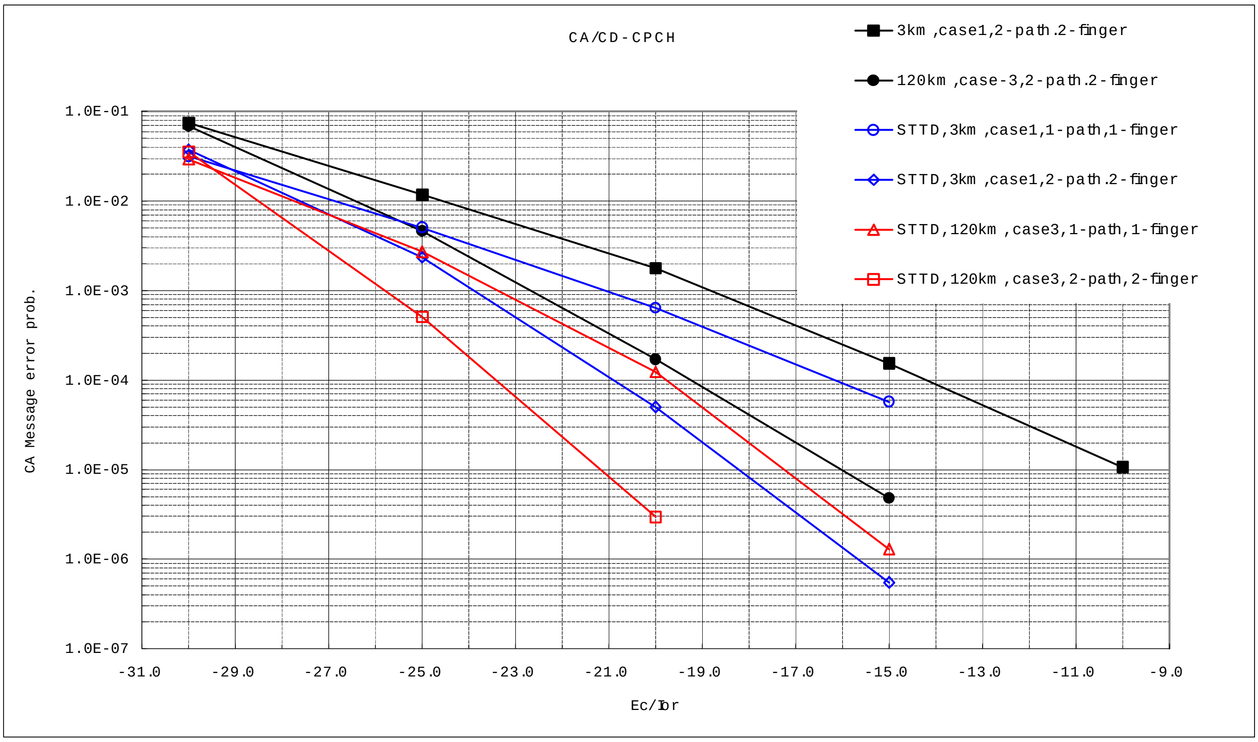

FIGURE 1. THE CHANNEL ASSIGNMENT MESSAGE ERROR FOR VARIOUS SITUATIONS

IV. ROUGH ESTIMATION ON FALSE MOBILE FREQUENCY

Using the rough calculation shown below, an estimate of the False Mobile frequency can be estimated.

1. N CPCH channel assignments for a specific data rate in one access slot frame.
   N times / 20ms = 50 N times/sec

2. Number of seconds per one year: 3600 sec/hour x 24hour/day x 365 day/year = 3.15e7 sec/year
   2-1. Without loss of generality, the assumption of 24 hours shown above might not be appropriate and therefore the total number can be reduced.

3. Total number of CA messages per year = 50 N times/sec x 3.15e7 sec/year = 1.58e9 x N times/year
   3-1. We can assume that N = 5. Furthermore we consider that 3 data rates are supported in CPCH and full AS (access slot) are used for assignments.(We think this case is rare because it means very high load)
   3-2 Then 7.90e9 times/year is a rough estimation of the number of CA messages.

4. The CA message error probability of single CA is approximately 1e-5 when Ec/Ior = -15dB.
   4-1 The value of Ec/Ior = -15dB is relatively low, when we compare the other common channels.

5. We can assume during the Abnormal Operation a 10dB power increase in one frame by random TPC's. By the results of GBT, this probability is approximately 1e-2.

6. The error probability of the first frame indicator maybe 1e-3.

7. Then the probability of Abnormal Operation is 1e-10.

Therefore the frequency of the Abnormal Operation can be estimated as
7.90e9 times/year x 1e-10 = 0.79 times/year.
Furthermore, if the parallel CA method is used, then this value can considerably be lowered.

V. CONCLUSION

We can conclude that the False Mobile (Abnormal Operation) will happen less than one time per year if the single CA case if the "start frame pattern" is used. Furthermore, if the parallel CA is also added, then the False Mobile will occur extremely rarely (*once in a blue moon*). In addition even if the situation arises, UTRAN and/or UE can identify the CA message error as mentioned in section I, and respond accordingly.

3GPP RAN WG1 Meeting #11
San Diego, USA, 28 Feb – 3 Mar 2000

Document R1-00-0269
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.214	**CR**	**069**	Current Version:	3.1.1

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG - RAN #7	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Samsung, GBT, LGIC, Lucent **Date:** 28-Feb-2000

Subject: Dual mode CPCH

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature	X		Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: For dual mode CPCH, the CPCH procedures are changed.

Clauses affected: 6.2 of TS25.214

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

<--------- double-click here for help and instructions on how to create a CR.

7.1 Select a new uplink access slot as next available access slot, i.e. next access slot in the sub-channel group used, as selected in 1

7.2 Randomly selects a new signature from the available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.

7.3 Increase the preamble transmission power by ΔP_0 = Power_Ramp_Step [dB].

7.4 Decrease the Preamble Retransmission Counter by one.

7.5 If the Preamble Retransmission Counter > 0 then repeat from step 6. Otherwise pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.

8 If a negative acquisition indicator corresponding to the selected signature is detected in the downlink access slot corresponding to the selected uplink access slot, pass L1 status ("Nack on AICH received") to the higher layers (MAC) and exit the physical random access procedure.

9 Transmit the random access message three or four uplink access slots after the uplink access slot of the last transmitted preamble depending on the AICH transmission timing parameter. Transmission power of the random access message is modified from that of the last transmitted preamble with the specified offset ΔP_{p-m}.

10 Pass L1 status "RACH message transmitted" to the higher layers and exit the physical random access procedure.

6.1.1 RACH sub-channels

A RACH sub-channel defines a sub-set of the total set of access slots. There are a total of 12 RACH sub-channels. RACH sub-channel #i (i = 0, …, 11) consists of the following access slots:

- Access slot #i transmitted in parallel to P-CCPCH frames for which SFN mod 8 = 0 or SFN mod 8 = 1.
- Every 12^{th} access slot relative to this access slot.

The access slots of different RACH sub-channels are also illustrated in Table 7.

Table 7: The available access slots for different RACH sub-channels

	Sub-channel Number											
SFN modulo 8	0	1	2	3	4	5	6	7	8	9	10	11
0	0	1	2	3	4	5	6	7				
1	12	13	14						8	9	10	11
2				0	1	2	3	4	5	6	7	
3	9	10	11	12	13	14						8
4	6	7					0	1	2	3	4	5
5			8	9	10	11	12	13	14			
6	3	4	5	6	7					0	1	2
7						8	9	10	11	12	13	14

6.2 CPCH Access Procedures

For each CPCH physical channel in a CPCH set allocated to a cell the following physical layer parameters are included in the System Information message:

- UL Access Preamble (AP) scrambling code.
- UL Access Preamble signature set
- The Access preamble slot sub-channels group
- AP- AICH preamble channelization code.
- UL Collision Detection(CD) preamble scrambling code.
- CD Preamble signature set

- CD preamble slot sub-channels group
- CD-AICH preamble channelization code.
- CPCH UL scrambling code.
- CPCH UL channelization code. (variable, data rate dependant)
- DPCCH DL channelization code.([512] chip)

NOTE: There may be some overlap between the AP signature set and CD signature set if they correspond to the same scrambling code.

The following are access, collision detection/resolution and CPCH data transmission parameters:

Power ramp-up, Access and Timing parameters (Physical layer parameters)

1) N_AP_retrans_max = Maximum Number of allowed consecutive access attempts (retransmitted preambles) if there is no AICH response. This is a CPCH parameter and is equivalent to Preamble_Retrans_Max in RACH.

2) $P_{RACH} = P_{CPCH}$ = Initial open loop power level for the first CPCH access preamble sent by the UE.

   [RACH/CPCH parameter]

3) ΔP_0 = Power step size for each successive CPCH access preamble.

   [RACH/CPCH parameter]

4) ΔP_1 = Power step size for each successive RACH/CPCH access preamble in case of negative AICH. A timer is set upon receipt of a negative AICH. This timer is used to determine the period after receipt of a negative AICH when ΔP_1 is used in place of ΔP_0.

   [RACH/CPCH parameter]

5) T_{cpch} = CPCH transmission timing parameter: This parameter is identical to PRACH/AICH transmission timing parameter.

   [RACH/CPCH parameter]

6) $L_{pc\text{-}preamble}$ = Length of power control preamble (0 or 8 slots)

   [CPCH parameter]

~~NOTE: It is FFS if ΔP_0 for the CPCH access may be different from ΔP_0 for the RACH access as defined in section 6.1.~~

The CPCH -access procedure in the physical layer is:

~~1) The UE MAC function selects a CPCH transport channel from the channels available in the assigned CPCH set The CPCH channel selection includes a dynamic persistence algorithm (similar to RACH) for the selected CPCH channel.~~

~~2) The UE MAC function builds a transport block set for the next TTI using transport formats which are assigned to the logical channel with data to transmit. The UE MAC funtion sends this transport block set to the UE PHY function for CPCH access and uplink transmission on the selected CPCH transport channel.~~

1) The identity of the CPCH transport channel and the AP signature which is to be used for this access attempt is supplied by the UE MAC function. MAC requests the PHY to provide the availbility Status of a Transport Format. The Physical layer maps the Transport Format to a set of PCPCH Channels. The physical layer has been provided with a mapping table of Transport Format to each PCPCH.

2) The following events occur based on whether Channel Assignment message is active or not:

2a) When the Channel Assignment message is not active, the UE shall test the value of the most recent transmission of the Status Indicator corresponding to the identified PCPCH channels. If this indicates that the channel is 'not the UE shall abort the access attempt and send a failure message to the MAC layer. The PHY provides the availability information to the MAC.

2b) In case the Channel Assignment message is active, the Status Indicator indicates the maximum available data rate. The UE shall test the value of the Status Indicator. If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. The PHY provides the availability information to the MAC.

3) The UE sets the preamble transmit power to the value $P_{CPCH\_}$ which is supplied by the MAC layer for initial power level for this CPCH access attempt.

4) The UE sets the AP Retransmission Counter to N_AP_Retrans_Max (value TBD).

5) The UE randomly selects a CPCH-AP signature from the signature set for this selected CPCH channel. The random function is TBD.

6) The UE Derives the available CPCH-AP access slots in the next two frames, defined by SFN and SFN+1 in the AP access slot sub-channel group with the help of SFN and table 7 in section 6.1. The UE randomly selects one access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly selects one access slot from the available access slots in the following frame, defined by SFN+1. Random function is TBD

7) ~~The UE transmits the AP using the MAC supplied uplink access slot, signature, and initial preamble transmission power.~~The following events occur based on whether Channel Assignment message is active or not:

7a) When the Channel Assignment message is not active, The UE shall test the value of the most recent transmission of the Status Indicator corresponding to the identified CPCH transport channel. If this indicates that the channel is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE transmits the AP using the UE selected uplink access slot, and the MAC supplied signature and initial preamble transmission power.

7b) In case the Channel Assignment message is active, the Status Indicator indicates the maximum available data rate. The UE shall test the value of the Status Indicator. If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE shall transmit the AP using the UE selected uplink access slot, the MAC supplied signature and initial preamble transmission power.

8) If the UE does not detect the positive or negative acquisition indicator corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE~~:~~ shall test the value of the most recent transmission of the Status Indicator. If the test fails, the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the following steps shall be executed:

   a) Selects the next uplink access slot from among the access slots in the CPCH-AP sub-channel group, as selected in 4.1. There must be a minimum distance of three or four access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter. ~~[NOTE: Use of random function here to select access slot is FFS for RACH and CPCH.]~~

   b) Increases the preamble transmission power with the specified offset ΔP . Power offset ΔP_0 s is used unless the negative AICH timer is running, in which case ΔP_1 is used instead..

   c) Decrease the Preamble Retransmission Counter by one.

   d) If the Preamble Retransmission Counter < 0, the UE aborts the access attempt and sends a failure message to the MAC layer.

9) If the UE detects the AP-AICH_nak (negative acquisition indicator) corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE aborts the access attempt and sends a failure message to the MAC layer. The UE sets the negative AICH timer to indicate use of ΔP_1 use as the preamble power offset until timer expiry

10) Upon reception of AP-AICH, the access segment ends and the contention resolution segment begins. In this segment, the UE randomly selects a CD signautre from the signature set and also select one-CD access slot sub-

channel from the CD sub-channel group supported in the cell.and transmits a CD Preamble, then waits for a CD/CA-AICH from the Node B.

11) If the UE does not receive a CD/CA-AICH in the designated slot, the UE aborts the access attempt and sends a failure message to the MAC layer.

12) If the UE receives a CD/CA-AICH in the designated slot with a signature that does not match the signature used in the CD Preamble, the UE aborts the access attempt and sends a failure message to the MAC layer.

13) 13) If the UE receives a CD/CA-AICH with a matching signature, the following events occur depending on whether the Channel Assignment message is active or not:

13a) When the Channel Assignment message is not active, the UE transmits the power control preamble $\tau_{cd-p-pc-p}$ ms later as measured from initiation of the CD Preamble. . The transmission of the message portion of the burst starts immediately after the power control preamble.

13b) If the channel assignment message is active, the UE determines the assigned PCPCH based on the received value of the CA signature. The UE transmits the power control preamble $\tau_{cd-p-pc-p}$ ms later as measured from initiation of the CD Preamble. The transmission of the message portion of the burst starts immediately after the power control preamble.

14) During CPCH Packet Data transmission, the UE and UTRAN perform inner-loop power control on both the CPCH UL and the DPCCH DL.

15) If the UE detects loss of DPCCH DL during transmission of the power control preamble or the packet data, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.

16) If the UE completes the transmission of the packet data, the UE sends a success message to the MAC layer.

7 Procedures in Packet Data Transfer