ETSI TR 129 994 V12.0.0 (2014-10)

TECHNICAL REPORT

**Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
LTE;
Recommended infrastructure measures to overcome specific
Mobile Station (MS) and User Equipment (UE) faults
(3GPP TR 29.994 version 12.0.0 Release 12)**

Reference
RTR/TSGC-0129994vc00

Keywords
GSM,LTE,UMTS

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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where:

x   the first digit:

   1   presented to TSG for information;

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   3   or greater indicates TSG approved document under change control.

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

z   the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document clarifies recommended measures which may be adopted by 3GPP infrastructure utilising GSM or GERAN as access network to enable inter-working to be obtained between network and various User Equipment (UE) implementations of the 3GPP specification. The objective is to obtain compatibility without changing the consolidated set of specifications. The present document describes the recommended changes to the infrastructure to cater for specific faults within some types of UE.

The lifetime of the herein described measures together with their potential impact on optimal network performance is out of the scope of the present document.

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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   3GPP TR 21.905: " Vocabulary for 3GPP Specifications".

[2]   3GPP TS 04.08 (Phase 1): "Mobile radio interface layer 3 specification Part 1: Generic".

[3]   3GPP TS 04.08 (Phase 2): "Mobile radio interface layer 3 specification".

[4]   3GPP TS 04.08 (Phase 2+): "Mobile radio interface layer 3 specification".

[5]   3GPP TS 05.05 (Phase 2): "Radio Performance Aspects.

[6]   3GPP TS 05.05 (Phase 2+): "Radio Performance Aspects.

[7]   3GPP TS 24.007: "Mobile radio interface signalling layer 3 General aspects".

[8]   3GPP TS 24.008: "Mobile radio interface layer 3 specification Core Network Protocols-Stage 3".

[9]   3GPP TS 23.107: "Quality of Service, Concept and Architecture".

[10]   3GPP TS 44.018: "Mobile radio interface layer 3 specification, Radio Resource Control (RRC) protocol".

3 Abbreviations

Abbreviations used in the present document are listed in 3GPP TR 21.905 [1].

4 General

In the implementation of the standard it has been found that some aspects of the specifications have been mis-interpreted by some MS manufacturers. These MSs require specific implementations of the Phase 1 standard in the infrastructure, to provide completely compatible interworking.

It has been assumed throughout this TR that Phase 2 and later infrastructure will interwork with Phase 1 MSs in the same way as Phase 1 infrastructure.

The remainder of this TR describes how to overcome the possible impacts of the above factors. Descriptions given are limited to specific implementations which are permissible for the Phase of the infrastructure.

5 Specific implementation on the radio interface

This clause deals with the choice of specific infrastructure implementation options of the protocols at the radio interface. The protocols concerned are defined in 3GPP TS 04.08 Phase 1 [2], Phase 2 [3] and Phase 2+ [4]. The corresponding protocol definitions for R99 and later releases are in 3GPP TS 24.007 [7] and 3GPP TS 24.008 [8].

5.1 Handovers and "Synchronisation Indication"

5.1.1 Justification

In the HANDOVER COMMAND message there is a mandatory part consisting of nine octets followed by several optional information elements. The first optional information element is Synchronisation Indication which is a type 1 Information Element (IE) and as such is coded, with IE Identifier (IEI), on one octet. Other optional IE follow the Synchronisation Indication IE and are used to:

- indicate the frequency hopping sequence to use on the new channel;

- indicate the channel mode for the new channel;

- indicate a start time.

Some types of MS do not correctly decode these following information elements if the Synchronisation Indication information element is omitted.

5.1.2 Solution

To ensure correct operation the infrastructure should always send the Synchronisation Indication IE to a Phase 1 MS.

> NOTE: In a few cases this will force an extra layer 2 segment to be sent to the MS.

5.2 "Directed Retry" type Handovers

5.2.1 Justification

In the HANDOVER COMMAND message there is an optional Channel Mode Information Element. When this information element is included in the handover command the MS should go to the new channel mode when it hands over to the new channel. This information element may be used for "directed retry" type handovers where a cell has an MS on a control channel but has no available traffic channel for the MS to use. The network may then choose to handover the MS to a new cell with traffic channel (TCH) capacity and change the channel mode at the same time.

Some MSs appear to accept the handover command, from Stand-alone Dedicated Control Channel (SDCCH) to TCH with speech mode, and make the required channel and mode change but do not through connect the speech path.

5.2.2 Solution

To ensure correct operation, of these MSs, the infrastructure should always initiate a channel mode change procedure according to 3GPP TS 04.08 (Phase 1) [2] clause 3.4.6 once the MS has arrived at the new channel following a handover of a Phase 1 MS involving a channel mode change to full rate speech.

The additional channel mode change procedure shall only be performed for a directed retry handover to a full rate speech channel, and not for a data channel. First this will save performance in these cases, and secondly some MS"s will release the call with this additional and unnecessary channel mode change procedure in case of fax or data calls.

For internal intra-Base Station System (BSS) handovers, this decision to initiate channel mode modify is taken by the BSS concerned. For external intra-BSS and inter-BSS handovers, the new BSS must know that there has been a change of mode from the previous BSS and that therefore a channel mode change procedure must be executed. The communication of this information is achieved by using the "current channel" element in the HANDOVER REQUEST and HANDOVER REQUIRED message as described in the Annex A.

In the case of external handover, the following will ensure correct operation with mobiles suffering from fault 5.2.1:

    i)   The change described in Annex A shall be implemented by the MSC and BSS concerned.

    ii)   The new BSS, after receiving a HANDOVER REQUEST containing a current channel IE indicating "signalling only", and a channel type indicating full rate speech, shall behave as specified in 3GPP TS 08.08 and additionally, upon reception of the HANDOVER COMPLETE message, initiate a channel mode change procedure according to 3GPP TS 04.08 with the new mode indicating speech.

If the new BSS receives a HANDOVER REQUEST without the current channel IE but containing a cause value "directed retry", and a channel type indicating full rate speech, it shall also behave as ii) above.

    NOTE: The performance of MSs not experiencing this problem has been checked for a sizeable subset of the MSs available in Phase 1, but it has not been possible to check all versions of all MSs.

5.3   Cell broadcast and frequency hopping

5.3.1   Justification

In the SYSTEM INFORMATION TYPE 4 message there is an optional Information Element "CBCH Channel Description" used when a cell broadcast channel is configured in the network.

Some Types of GSM 900 MSs may not obtain service whilst within reception range of a cell from any network having the CBCH configured with frequency hopping: i.e. the Hopping channel bit set to 1 in the "CBCH Channel description" information element.

5.3.2   Solution

To enable operation from the affected MS, the infrastructure could configure the CBCH on a non hopping channel:

-    In combined type of configuration: the CBCH would be distributed on the SDCCH/4 with BCCH

-    In non-combined type of configuration, two types of solution are considered:

    -    Type 1 CBCH distributed on a non hopping SDCCH broadcasted on TSx of C0 (x=1,2,3)

    -    Type 2 CBCH distributed on a non hopping SDCCH broadcasted on TS0 of Cx (x≠0)

5.4   Handling of Phase 2 and Phase 2+ BCCH Messages

5.4.1   Justification

Some types of Phase 1 GSM 900 MSs could fail to offer full services whilst System Information messages other than those specified in GSM 900 Phase 1 are broadcast with a L2-Pseudo Length value greater than 1.

5.4.2   Solution

In order to provide service to these existing GSM 900 MS and not disturb Phase 2 MS, the following restrictions and changes should be implemented in the P-GSM 900 band of the network.

For System Information 2ter, the value 0 of the L2 Pseudo Length shall be used instead of 18.

The System Information 2bis shall not be used in the P-GSM 900 band of the network.

Therefore, the EXT-IND bit in System Information 2 in the P-GSM 900 Band of the network shall not be set to 1.

5.5 Handling of Phase 2 and Phase 2+ SACCH Messages

5.5.1 Justification

Some types of Phase 1 MSs may experience performance degradation if the network sends System Information Messages other than those specified in Phase 1.

5.5.2 Solution

In order not to degrade the performance of these Phase 1 mobile stations it is recommended:

> any new messages that are not defined in Phase 1 shall not be sent to a Phase 1 MS, e.g System Information 5bis and 5ter to a Phase 1 P GSM 900 mobile station and System Information 5ter to a Phase 1 DCS 1800 mobile station.

5.6 Handling of assignment message using Mobile Allocation IE including ARFCN=0

5.6.1 Justification

Some type of Phase 2 and Phase 2+ MSs may not access the assigned channel correctly if the network sends an assigning message (Immediate Assignment, Assignment Command or Handover Command) that uses the Mobile Allocation IE to specify an RF hopping channel that includes ARFCN=0 in the hopping sequence.

5.6.2 Solution

To enable operation of all MSs, the infrastructure can avoid using RF hopping channels that include ARFCN=0 in the hopping sequence. When assigning a channel at RR connection establishment (Immediate Assignment), this solution should be used.

When a channel resource is assigned, using either the Assignment Command or the Handover Command message, the infrastructure may use the Frequency List or the Frequency Short List IEs in the assigning message to specify an RF hopping channel that includes ARFCN=0 in the hopping sequence.

5.7 Hopping sequence generation including ARFCN=0

5.7.1 Justification

Some type of Phase 2 and Phase 2+ MSs may not access the assigned channel correctly if the network assigns an RF hopping channel that includes ARFCN=0 in the hopping sequence.

5.7.2 Solution

To enable operation of all MSs, the infrastructure can avoid using RF hopping channels that include ARFCN=0 in the hopping sequence.

5.8 QoS IE length between R97 and R99 implementations

5.8.1 Justification

Quality of Service was initially defined in R97 specifications as a type 4 TLV coded IE but with fixed length of 5 octets.

Subsequently the length of the IE was extended to maximum 13 octets in R99 and further on to 14 octets in Rel-5.

Some types of R97 MS do not accept new length for this IE which used to be fixed in R97 reference version. Such MS will diagnose an erroneous mandatory IE and consequently reject the PDU containing the IE and send back SM status with cause #96.

This means that such a R97 MS can not support GPRS procedures for PDP context activation or PDP context modification in R99 network.

5.8.2 Solution

To enable operation of all MSs, the infrastructure may adapt the length of the QoS IE it sends to MS according to the served MS by sending only the first 5 QoS octets to pre-R99 GSM mobiles. This can be done either based on the MS Classmark revision level or alternatively the infrastructure may check how many octets were received from the MS in the QoS IE.

> NOTE 1: The mapping between the information in the original R97/98 part of QoS and later extension part is defined in 3GPP TS 23.107.

> NOTE 2: This subclause was added to the present document in 3GPP TSGN #16.

5.9 MS unable to handle the LOCATION UPDATING ACCEPT, ATTACH ACCEPT and ROUTING AREA UPDATE ACCEPT messages when the EPLMN Lists IE is included

5.9.1 Justification

The concept of EPLMN was initially defined in the R99 specifications and to provide the EPLMN list to an MS a type 4 TLV coded IE was added to the LOCATION UPDATING ACCEPT, ATTACH ACCEPT and ROUTING AREA UPDATE ACCEPT messages.

Some types of R97/R98 MS are not able to handle these messages when the EPLMN List IE is included. Such MS ignore the messages and continually repeats the registration procedure. Consequently they never successfully register on the network and as a result fail to provide any service to the subscriber.

This means that such a R97/R98 MS can not provide any service in a network applying the EPLMN functionality.

5.9.2 Solution

To enable operation of the affected MSs, the infrastructure may adapt the contents of the LOCATION UPDATING ACCEPT, ATTACH ACCEPT and ROUTING AREA UPDATE ACCEPT message it sends to an MS by excluding the EPLMN List IE added in the R99 version of the specifications. This can be done based on the MS Revision Level Indicator.

> NOTE 1: This subclause was added to the present document in 3GPP TSGN #25.

5.10 MS unable to handle messages when the truncation function is used

5.10.1 Justification

The concept of truncation of rest octet information elements (see 3GPP TS 44.018 [10]) was introduced in the R99 version of specifications and allows the handling of situations when the number of octets in the rest octets information element is not enough to contain the complete set of components. These components can be truncated by the sender, i.e. the infrastructure, to fit into the rest octets information element. The truncation function was added to the PAGING REQUEST TYPE 1, PAGING REQUEST TYPE 2 messages and the SYSTEM INFORMATION TYPE 4 sent on BCCH. When the truncation function is used with the PAGING REQUEST TYPE 1 or PAGING REQUEST TYPE 2 messages, the receiver, i.e. the MS, assumes bits "L" for the missing components (see 3GPP TS 44.018 [10]).

The MS that implements release version of specifications prior to R99 is not able to handle correctly the messages in which the truncation function is used. Such MS ignores the received message since the message contains mandatory information element with semantically incorrect contents.

The MS that implements the R99 or onwards version of specifications is able to decode and act on a correctly truncated message.

However, paging can be used to address more than one MS by means of using a single paging message as specified by 3GPP TS 44.018 [10]. Additionally, the system information impacts all MSes located in a specific area. The MSes addressed can be of different release version of 3GPP specifications. Therefore, it cannot be guaranteed that a message addressing several MSes of different release versions of the 3GPP specifications is handled correctly by all the addressed mobile stations.

5.10.2 Solution

To enable operation of the affected MS, it is advised that the infrastructure adapts the contents of any message addressing several MSes by means of excluding the use of the truncation function.

NOTE: This subclause was added to the present document in 3GPP TSG CT #33.

5.11 Roaming restrictions issues with reject cause #13 and #15

5.11.1 Justification

Upon reception of a location updating reject cause #13 (Roaming not allowed in this Location Area) or #15 (no suitable cells in this Location Area), the LAI, TMSI, ciphering key sequence number and RAI, P-TMSI, P-TMSI signature and GPRS ciphering key sequence number are not deleted in the MS, as per CR 24.008-521r4 (R99) and the Rel-4 and Rel-5 mirror CRs.

During an inter-VLR or inter-SGSN location update, the roaming restriction checks that may lead to reject the location updating request with the cause #13 or #15 are normally performed after the HLR update (e.g. ARD and national roaming checks), i.e. the MSC/VLR or SGSN address stored in the HLR is that of the MSC/VLR or SGSN controlling the not allowed location area.

During an intra-VLR or intra-SGSN location update, the VLR or SGSN sets the 'LA not allowed' or 'RA not allowed' flag when rejecting the location updating request.

The 3GPP standard was found ambiguous on whether the UE would initiate immediately a new location updating request when it comes back to its previous (allowed) location area, i.e. when it moves to a registration area that has the same identity as the one stored in the MS while being in the ROAMING NOT ALLOWED update state.

If it does not, mobile terminated calls or mobile terminated PS activity (e.g. SMS) can no longer be delivered to the MS until the next mobile originated activity or periodic location update is initiated.

A new security context (CKSN/KSI, Kc/CK-IK) may also have been received by the MS during the authentication procedure with the MSC/VLR or SGSN controlling the not allowed location area. If the MS is roaming to a VLR3/LA3

(allowed) after having roamed from the VLR1/LA1 (allowed) to VLR2/LA2 (not allowed), then the MS initiates a location updating request towards the VLR3:

- with the old TMSI1/LA1, which refers to a wrong previous VLR and possibly a wrong VLR1 context (VLR1 receives a Cancel Location when the MS tried to register in VLR2/LA2 and TMSI1 may have been re-allocated to another UE), leading to a wrong TMSI1-IMSI mapping.

- with the KSI/CKSN received from the VLR2 if an authentication was performed by VLR2. If the VLR3 re-uses the current security context (Kc, CKSN)/(KSI, CK, IK) obtained from VLR1, it will not correspond to the security context stored in the UE and ciphering will fail.

5.11.2   Solution

It was clarified from 3GPP Rel-8 onwards, as per CR 23.122 – 122 (Rel-8), that a MS shall initiate a location updating request if it detects that it has entered a registration area that has the same identity as the one stored in the MS, while being in the ROAMING NOT ALLOWED update state, and the LAI or the PLMN identity is not contained in any of the lists of "forbidden LAs for roaming", "forbidden LAs for regional provision of service", "forbidden PLMNs for GPRS service" or "forbidden PLMNs" respectively.

To enable normal operation of the affected MSs in the CS domain, the MSC/VLR may allocate a TMSI within the restricted location area before it rejects the location area with the reject cause #13 or #15, as per CR 23.012 – 29 (Rel-8). This forces the mobile station to initiate immediately a new location updating request when moving back to the location area stored in the MS; this also avoids the risk of wrong TMSI-IMSI mapping and ciphering failure.
This solution is not applicable to the PS domain since a P-TMSI reallocation procedure is not allowed during a Routing Area Update procedure.

NOTE: This subclause was added to the present document in 3GPP CT#42.

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6   Use of VAD/DTX in conjunction with frequency hopping for a speech call

6.1   Scope

The chapter six of this Technical Report is to identify limitations in the specification for phase 1 reflected in performance degradation in phase 1 terminal equipment. This report identifies possible ways of improving the service offered to subscribers using phase 1 terminals whilst using the two features - downlink DTX and frequency hopping at the same time.

6.2   General

The specification of acoustic performance of the MS when downlink DTX is implemented is in 3GPP TS 05.05 which restricts the MS performance to 1 undetected bad frame in 10s when in the presence of random RF. In reality the MS does not experience random RF exclusively when downlink DTX is implemented.

There is a SIlence Descriptor (SID) frame sent on eight bursts every 104 bursts. Due to the interleaving scheme, half of the bits of the frame preceding the SID and half of the bits of the frame following the SID are sent and there is no specific requirement covering what is sent for these bits but in most cases it is every other bit of a correctly coded frame. The MS receives these bits

In addition, when the ARFCN used is C0, dummy bursts are sent when there is neither speech nor signalling to be transmitted.

Finally, when frequency hopping is used as well as downlink DTX, the MS may receive random RF on some TDMA frames and dummy bursts on others (C0).

It is possible for the MS to receive combinations of transmitted bits at high confidence and random RF at low confidence. In some cases the MS can then decode the frame as good when in fact it was never intended to have been transmitted and the resultant bad frame can give a very annoying acoustic effect known as banjo noise. The occurance

of these noises, even if no more frequent than one in 10s, is worse than one would expect from a high quality cellular system.

The three following sections refer to ways of improving the system performance for MS approved according to the existing phase 1 specification. Section 6.3 identifies some "normal" operation configurations which would improve undetected bad frame performance for MS"s with the above fault (banjo noise), section 6.4 describes aspects for possible changed network implementation, section 6.5 relates the results of tests performed using combinations of the implementations described in section 6.4 and whether that combination was effective or not.

6.3 Implementation options to reduce the occurance of undetected bad frames by utilising normal system features

This section deals with a variety of options to improve the system performance which are implementable by normal system operational choices. These options typically improve matters in specific configurations and are not universal solutions for all configurations. It may be possible that some networks do not permit such configuration.

6.3.1 Number of frequency hopping channels

The number of undetected bad frames is related to the probability of getting sufficient dummy bursts transmitted to make a false good frame decision. The number of dummy bursts received depends on the number of ARFCN in the hopping list. Hence frequency hopping on 3 ARFCN gives better audio performance than frequency hopping on 2, likewise hopping on 4 ARFCN gives better performance than hopping on 3.

In tests of the comparison between hopping on 2 ARFCN and hopping on 3, some MS have been found to improve to approximately one tenth of the occurance of bad frames, while others have improved from a slightly annoying level when hopping on 2 ARFCN, to give no audible disruption when hopping on 3. Not all MS have been tested and it is believed that the improvement for some MS may be less noticeable.

This solution is obviously not trivial to implement in a frequency plan, but could also be used to enable frequency hopping on cells which naturally have 3 or more ARFCN operational whilst selecting a solution for other parts of the network and operational scenarios.

6.3.2 Frequency hopping type

When utilising pseudo-random frequency hopping, it is possible to get more dummy bursts in a speech frame than when utilising cyclic frequency hopping. As an alternative to random frequency hopping, cyclic hopping may be used. It will minimise the banjo noise effect experienced by the faulty mobiles. This will however be done at the expense of a possible degradation of performance during speech activity period for all mobiles due to the absence of interferer diversity.

In tests of the comparison between pseudo-random frequency hopping and cyclic frequency hopping, some phones were found to improve with the use of cyclic hopping to approximately one third of the occurance of bad frames when using pseudo-random hopping, while others have improved from a slightly annoying level to give no audible disruption. Not all phones have been tested for this.

6.3.3 Continuous SID frames on C0

At some times, a network implementing downlink DTX may hold a call on C0. In this case it would be possible for the network to send dummy bursts when it has nothing else to send. This is likely to cause a high level of unwanted noises for some MS. An alternative would be to send continuous SID frames in which case there should be no undesired effects.

6.4 Implementation options to reduce the occurance of undetected bad frames by changing normal system operation

This section deals with implementation options which improve the audio quality of the faulty mobiles, suffering from banjo noise, by making changes to the network equipment. The solutions give varying performance improvements but not all solutions would be possible on all networks.

6.4.1 Changing the training sequence of the dummy burst to a new (ninth) training sequence

If a different training sequence code is used for all dummy bursts forming part of the TCH on C0, the MS will have difficulty training to the dummy burst frames and this would cause the bits to be received as low confidence. This would then give a performance rather more like that for random RF input and should then meet the 05.05 requirement.

6.4.2 Using an alternative training sequence out of the eight assigned

This option is similar in concept and performance to the one described in section 6.4.1. The advantage is that it may be usable in some networks where it is not easily possible to add a ninth training sequence. The following table gives a list of training sequence codes for the TCH and the preferred choice of training sequence code for the dummy burst.

Training sequence code for TCH	Training sequence code for dummy bursts on C0
0	2
1	5
2	0
3	4
4	5
5	2
6	3
7	5

6.4.3 Setting the stealing flag for the bits transmitted which are not intended to be part of the TCH

When bits are transmitted which are not intended for reception in the TCH path, such as dummy bursts and the half burst before and after a discrete, wanted frame, it would be possible to set the stealing flag for these bits and so bias the decision of the majority vote on stealing flags in favour of routing the frame as control information rather than speech information. The channel protection on the control channel is much greater and the chance of getting an undetected bad control channel frame is very low.

6.4.4 Sending partial SID frames on C0

It has been observed that improvements in the undetected bad frame rate are seen when the BTS sends partial SID frames on the otherwise unused TCH bursts on C0. This is because the high confidence bits are correctly coded for the relevant speech frame and the normal design of the MS receiver is expected to cope with such errors. This proposal works best for DCS 1800 because very early GSM models are not represented in DCS 1800.

6.5 Tested Combinations

This section identifies tests that have been performed and the results that have been obtained. The reporting of result is limited to acceptable or not acceptable and a brief additional comment is sometimes made. If the result is deemed to be acceptable, most products which suffer from the described problem have been improved to a point where extraneous noises are significantly reduced to virtually nothing and no product has got worse. No solution completely corrected all products but significant improvements have been achieved if the result is deemed acceptable.

6.5.1 "Normal" system

Test configuration:

Sent on C0:
Dummy bursts using training sequence from TCH.

Stealing flag on C0:
Set to 0

Half burst filling bits:
Partial SID information from the SID frame otherwise scheduled for transmission.

Half burst stealing flags:
Set to 0

Result:

Unacceptable; Several products exhibit frequent noises from undetected bad frames.

6.5.2 New training sequence

Test configuration:

Sent on C0:
Dummy bursts using new (ninth) training sequence.

Stealing flag on C0:
Set to 0

Half burst filling bits:
Partial SID information from the SID frame otherwise scheduled for transmission.

Half burst stealing flags:
Set to 0

Result:

Acceptable.

6.5.3 Alternative training sequence from the eight assigned

Test configuration:

Sent on C0:
Dummy bursts using alternative training sequence according to table in 6.4.2.

Stealing flag on C0:
Set to 0

Half burst filling bits:
Partial SID information not necessarily related to the SID frame otherwise scheduled for transmission.

Half burst stealing flags:
Set to 0

Result:

Acceptable.

6.5.4 Setting stealing flag for unintentionally transmitted bits

Test configuration:

Sent on C0:
    Partial SID information from the two SID frames otherwise scheduled for transmission.

Stealing flag on C0:
    Set to 1

Half burst filling bits:
    Partial SID information from the SID frame otherwise scheduled for transmission.

Half burst stealing flags:
    Set to 1

Result:

Acceptable.

6.5.5 Setting stealing flag for unintentionally transmitted bits and modifying training sequence for Dummy Bursts

Test configuration:

Sent on C0:
    Dummy bursts using new (ninth) training sequence.

Stealing flag on C0:
    Set to 1

Half burst filling bits:
    Dummy burst mixed bits

Half burst stealing flags:
    Set to 1

Result:

Acceptable; This configuration gave marginally the best performance of all tested.

6.5.6 Sending partial SID information on C0

Test configuration:

Sent on C0:
    Part SID frames

Stealing flag on C0:
    Set to 0

Half burst filling bits:
    Partial SID information from the SID frame otherwise scheduled for transmission.

Half burst stealing flags:
    Set to 0

Result:

Acceptable for DCS 1800.

Annex A:
Amendment Request 08.08 - 021 R4: Information on channel in use in HO REQUEST

NOTE: This Annex A reflects the Amendment Request 08.08 - 021 R4 which was approved by SMG#15 and is part of the 3GPP TS 08.08 version 4.9.0.

A.3.1.5.1.1   Generation of the HANDOVER REQUIRED message

Generation of the HANDOVER REQUIRED message can be for the following reasons:

- The BSS has detected that a radio reason exists for a handover to occur.

- The MSC has initiated a handover candidate enquiry procedure, and this MS is currently a candidate.

- A cell change is required at call setup due to congestion, e.g. directed retry.

The HANDOVER REQUIRED message contains the following information elements:

- Message Type;

- Cause;

- Cell Identifier List (preferred).

It should also contain the "Current channel" information element.

Sec. 3.2.1.9. gives coding details of the above message.

The "Cause" field indicates the reason for the HANDOVER REQUIRED message e.g. "uplink quality poor" or "response to MSC invocation" in the case of traffic reasons indicated by the MSC.

If present the "Response Request" Information Element indicates, that the BSS requires an indication if the HANDOVER REQUIRED message does not result in a HANDOVER COMMAND message.

If the BSS wants to change the CIC due to a channel change, the BSS sends a HANDOVER REQUIRED message with the cause "switch circuit pool" and the "circuit pool list" information element. The "circuit pool list" information element will allow the BSS to indicate to the MSC from which circuit pool or pools the new CIC should be chosen.

The "Cell Identifier List (preferred)" shall identify "n" preferred cells. The identified cells are given in order of preference. The algorithm by which the BSS produces this list is Operator dependent and is not addressed in this Technical Specification. The "n" number of preferred cells is a parameter set by O&M and shall range from 1 to 16. If "n" number of cells cannot be identified, then only as many as are available shall be encoded and sent (as specified in section 3.2.2.27).

It is mandatory for the BSS to be able to produce this "Cell Identifier List (preferred)". The sending of this list is controlled by the O&M parameter "n". It is mandatory for the MSC to be able to receive and interpret this Information Element.

The HANDOVER REQUIRED message shall be updated and repeated by the BSS with a periodicity of T7 until:

- A HANDOVER COMMAND message is received from the MSC, or;

- A RESET message is received, or;

- The reason for the original HANDOVER REQUIRED message disappears e.g. the MS transmission improves, or;

- All communication is lost with the MS as defined in Technical Specification 3GPP TS 04.08, and the transaction is abandoned, or;

- The transaction ends, e.g., call clearing.

A.3.1.5.2 Handover Resource allocation

This procedure has been defined to allow the MSC to request resources from a BSS in a manner similar to that used for the assignment case. However it does not result in the transmission of any messages over the radio interface, only in the reservation of the resource identified at the BSS, which awaits access of a MS on the reserved channel. These reserved resources are then indicated back to the MSC.

In order to support this procedure the MSC sets up a BSSAP SCCP connection to the BSS. This connection is then used to support all BSSAP messages related to this dedicated resource.

A.3.1.5.2.1 Operation of the procedure

The correct operation of the handover resource allocation procedure is as follows:

The MSC sends a HANDOVER REQUEST message to the new BSS (note 1) from which it requires radio resources. This message contains details of the resource that is required. If the requested resource is for speech or data it also indicates the terrestrial resource that shall be used between the MSC and the BSS. The type of channel required can be different from the type of channel in use, e.g. in the case of directed retry. The description of the resource can either specify it completely, or give the BSS some freedom in the selection. The message may also specify the channel in use.

On receipt of this message the new BSS shall choose a suitable idle radio resource.

The management of priority levels - relating to the Information Element "Priority" within the HANDOVER REQUEST message - is implementation dependent, under operator control.

If queueing is managed, new requests which cannot be served immediately are put in the queueing file according to the indicated priority levels.

(Refer to section 3.1.17 for Queuing Procedure)

As a further operator option, the preemption indicators may (alone or along with the priority levels) be used to manage the preemption process, which may lead to the forced release or forced handover of lower priority connections.

However, the preemption indicators (refer to section 3.2.2.18), if given in the HANDOVER REQUEST, shall be treated on a per connection basis as follows:

- the last received "Preemption Vulnerability" indicator and priority levels shall prevail.

- if the "Preemption Capability" bit is set to 1, then this allocation request can trigger the running of the preemption procedure.

- if the "Preemption Capability" bit is set to 0, then this allocation request cannot trigger the preemption procedure.

- if the "Preemption Vulnerability" bit is set to 1, then this connection is vulnerable and shall be included in the preemption process or procedure and as such may be subject to forced release or forced handover.

- if the "Preemption Vulnerability" bit is set to 0, then this connection is not vulnerable to preemption and shall not be included in the preemption process and as such may not be subject to forced release or forced handover.

- if no Priority Information Element has been received, both "Preemption Capability" and "Preemption Vulnerability" bits shall be regarded as set to 0.

If a radio resource is available then this will be reflected back to the MSC in a HANDOVER REQUEST ACKNOWLEDGE message. The HANDOVER REQUEST ACKNOWLEDGE message sent by the new BSS shall contain the radio interface message HANDOVER COMMAND within its "Layer 3 Information" Information Element. This "Layer 3 Information" (which is in fact the RR-Layer 3 HANDOVER COMMAND) is transferred by the controlling MSC to the old BSS using the BSSMAP message HANDOVER COMMAND also within the Information Element "Layer 3 Information" of that BSSMAP message. The old BSS then sends to the MS over the radio interface the RR-Layer 3 HANDOVER COMMAND message. Information about the appropriate new channels and a handover reference number chosen by the new BSS are contained in the HANDOVER COMMAND. Knowledge of the channel in use at the old BSS allows the new BSS to minimize the size of the HANDOVER COMMAND message (i.e. to decide whether the mode of the first channel IE need not be included in the HANDOVER COMMAND).

NOTE: The new BSS and the old BSS may be the same.

When several circuit pools are present on the BSS MSC interface, the "circuit pool" information field shall be included in the HANDOVER REQUEST ACKNOWLEDGE. The "circuit pool" field will indicate to the MSC the circuit pool of the CIC given in the HANDOVER REQUEST message.

The sending of the HANDOVER REQUEST ACKNOWLEDGE by the new BSS to the MSC ends the Handover Resource Allocation procedure. The Handover Execution procedure can now proceed and this is given in section 3.1.5.3.

The new BSS shall then take all necessary action to allow the MS to access the radio resource that the new BSS has chosen, this is detailed in the 3GPP TS 05 series of Technical Specifications. If the radio resource is a traffic channel then the new BSS shall at this point switch it through to the terrestrial resource indicated in the HANDOVER REQUEST message, and the necessary transcoding/rate adaption/encryption equipment enabled as detailed in 3GPP TS 04.08.

The optimum procedure for switching through to the target cell at the MSC is not defined in these Technical Specifications.

A.3.2.1.8   HANDOVER REQUEST

This message is sent from the MSC to the BSS via the relevant SCCP connection to indicate that the MS is to be handed over to that BSS.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Channel type	3.2.2.11	MSC-BSS	M	5
Encryption information	3.2.2.10	MSC-BSS	M	3-n
Classmark information 1 or	3.2.2.30	MSC-BSS	M#	2
Classmark information 2	3.2.2.19	MSC-BSS	M#	4-5
Cell identifier (serving)	3.2.2.17	MSC-BSS	M	5-10
Priority	3.2.2.18	MSC-BSS	O	3
Circuit identity code	3.2.2.2	MSC-BSS	O##	3
Downlink DTX flag	3.2.2.26	MSC-BSS	O*	2
Cell identifier (target)	3.2.2.17	MSC-BSS	M	3-10
Interference band to be used	3.2.2.21	MSC-BSS	O	2
Cause	3.2.2.5	MSC-BSS	O	3-4
Classmark information 3	3.2.2.20	MSC-BSS	O**	3-14
Current channel	3.2.2.49	MSC-BSS	O§	2

* This element may be included in the case of a speech TCH, and only in this case. If not included, this has no impact on the DTX function in the BSS.

** This element is included if the MSC has received such information.

\# One of these two elements is sent.

\## This element is included when the channel type Information Element indicates speech or data, and only in those cases.

§ This element is included at least when the message is sent as a reaction to reception of a HANDOVER REQUIRED message containing a "Current channel" information element. In this case it shall be equal to the received element.

Typical Cause values are:

        uplink quality,
        uplink strength,
        downlink quality,
        downlink strength
        distance,
        better cell,
        response to MSC invocation
        O and M intervention,

directed retry,
switch circuit pool.

A.3.2.1.9 HANDOVER REQUIRED

This message is sent from the BSS to the MSC to indicate that for a given MS which already has a dedicated radio resource assigned, a handover is required for the reason given by the cause element.

The message is sent via the BSSAP SCCP connection associated with the dedicated resource.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Cause	3.2.2.5	BSS-MSC	M	3-4
Response request	3.2.2.28	BSS-MSC	O	1
Cell identifier list (preferred)	3.2.2.27	BSS-MSC	M	2n+3 to 7n+3
Circuit pool list	3.2.2.46	BSS-MSC	O*	V
Current channel	3.2.2.49	BSS-MSC	O**	2

* Shall be included when cause "switch circuit pool".

** This information element should always be included.

Typical Cause values are:
uplink quality,
uplink strength,
downlink quality,
downlink strength,
distance,
better cell,
response to MSC invocation,
O&M intervention,
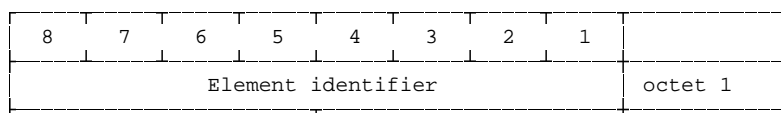directed retry,
switch circuit pool.

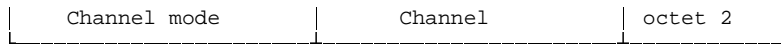| Element Identifier Coding	Element name	Reference
0000 0001	Circuit identity code	3.2.2.2.
0000 0010	Reserved	*
0000 0011	Resource available	3.2.2.4.
0000 0100	Cause	3.2.2.5.
0000 0101	Cell identifier	3.2.2.17.
0000 0110	Priority	3.2.2.18.
0000 0111	Layer 3 header information	3.2.2.9.
0000 1000	IMSI	3.2.2.6.
0000 1001	TMSI	3.2.2.7.
0000 1010	Encryption information	3.2.2.10.
0000 1011	Channel type	3.2.2.11.
0000 1100	Periodicity	3.2.2.12.
0000 1101	Extended resource indicator	3.2.2.13.
0000 1110	Number of MSs	3.2.2.8.
0000 1111	Reserved	*
0001 0000	Reserved	*
0001 0001	Reserved	*
0001 0010	Classmark information type 2	3.2.2.19.
0001 0011	Classmark information type 3	3.2.2.20.
0001 0100	Interference band to be used	3.2.2.21.
0001 0101	RR Cause	3.2.2.22.
0001 0110	Reserved	*
0001 0111	Layer 3 information	3.2.2.24.
0001 1000	DLCI	3.2.2.25.
0001 1001	Downlink DTX flag	3.2.2.26.
0001 1010	Cell identifier list	3.2.2.27.
0001 1011	Response request	3.2.2.28.
0001 1100	Resource indication method	3.2.2.29.
0001 1101	Classmark information type 1	3.2.2.30.
0001 1110	Circuit identity code list	3.2.2.31.
0001 1111	Diagnostic	3.2.2.32.
0010 0000	Layer 3 message contents	3.2.2.35.
0010 0001	Chosen channel	3.2.2.33.
0010 0010	Total resource accessible	3.2.2.14.
0010 0011	Cipher response mode	3.2.2.34.
0010 0100	Channel needed	3.2.2.36.
0010 0101	Trace type	3.2.2.37.
0010 0110	TriggerId	3.2.2.38.
0010 0111	Trace reference	3.2.2.39.
0010 1000	TransactionId	3.2.2.40.
0010 1001	Mobile identity	3.2.2.41.
0010 1010	OMCId	3.2.2.42.
0010 1011	Forward indicator	3.2.2.43.
0010 1100	Chosen encryption algorithm	3.2.2.44.
0010 1101	Circuit pool	3.2.2.45.
0010 1110	Circuit pool list	3.2.2.46.
0010 1111	Time indication	3.2.2.47.
0011 0000	Resource situation	3.2.2.48.
0011 0001	Current channel	3.2.2.49.

* Information Element codes marked as "reserved are reserved for use by previous versions of this interface specification.

A.3.2.2.49 CURRENT CHANNEL

This Information Element contains a description of the channel allocated to the MS.

It is coded as follows:

8	7	6	5	4	3	2	1	
Element identifier								octet 1

Channel mode	Channel	octet 2

The channel mode field is coded as follows:

Bit 8765
    0000   signalling only
    0001   speech (full rate or half rate)
    0011   data, 12.0 kbit/s radio interface rate
    0100   data, 6.0 kbit/s radio interface rate
    0101   data, 3.6 kbit/s radio interface rate

All other values are reserved.

The channel field is coded as follows:

Bit 4321
    0001   SDCCH
    1000   Full rate TCH
    1001   Half rate TCH

All other values are reserved.

Annex B:
Change History

Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
					Change history		
					09.94/29.994		
	SMG#15		001		Dircted retry by external handover	4.0.0	4.0.1
			002		Dircted retry handover for fax and data		
	SMG#16		003		Editorials on chapter 6	4.1.0	4.2.0
			004		Editorials on section 5.2.2		
	SMG#19		A005	3	Guidelines for the support of MSs affected by frequency hopping on CBCH	4.2.0	4.3.0
			A006	1	Scope of GSM 09.94		
	SMG#20				upgrade to Ph2+	4.3.0	5.0.0
	SMG#27				upgrade to Ph2+ R97	5.0.0	6.0.0
	SMG#30				withdrawn	5.0.0	-
	SMG#30				withdrawn	6.0.0	-
	SMG#23		A007	1	Handling of new phase 2 BCCH and SACCH messages by phase 1 MS	4.3.0	4.4.0
	SMG#30		A008		Change of Title, Scope and References Clauses 1 to 5)	4.4.0	4.5.0
			A009		Frequency Hopping using ARFCN=0		
Jun 2002	CN#16	conversion to 29.994				09.94	29.994
		NP-020222	A016	2	QoS IE length	4.5.0	5.0.0
Nov 2002					Editorial revision due to changing the title from TS to TR, and to introduce 3GPP were missing in the specification numbers.	5.0.0	5.0.1
Sept 2004	CN#25	NP-040386	A018	2	Incorrect handling, by MS, of registration acceptance messages that include R99 and later IEs	5.0.1	6.0.0
Sept 2006	CT-33	CP-060506	A020	2	Incorrect handling, by the MS, of messages in which truncation is used	6.0.0	7.0.0
Dec 2008	CT-42	CP-080873	0021	2	Roaming restrictions issues with cause #13 or #15	7.0.0	8.0.0
Dec 2009	CT-46				Upgrade to Rel-9	8.0.0	9.0.0
Mar 2011	CT-51				Upgrade to Rel-10	9.0.0	10.0.0
Sept 2012	CT-57				Upgrade to Rel-11	10.0.0	11.0.0
Sept 2014	CT-65				Upgrade to Rel-12	11.0.0	12.0.0

History

Document history		
V12.0.0	October 2014	Publication