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BSS-MSC Layer 3 Specification

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1. Reason for changes

Only pagenumbering/layout/etc. has been changed since the previously distributed version.

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PREFATORY NOTE

ETSI has constituted stable and consistent documents which give specifications for the implementation of the European Cellular Telecommunications System. Historically, these documents have been identified as "GSM recommendations".

Some of these recommendations may subsequently become Interim European Telecommunications Standards (I-ETSs) or European Telecommunications Standards (ETSs), whilst some continue with the status of ETSI-GSM Technical Specifications. These ETSI-GSM Technical Specifications are for editorial reasons still referred to as GSM recommendations in some current GSM documents.

The numbering and version control system is the same for ETSI-GSM Technical Specifications as for "GSM recommendations".

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1. SCOPE

This recommendation specifies the layer 3 procedures used on the BSS to MSC interface for control of GSM services.

For the purposes of call control and mobility management, messages are not interpreted at the base station system (BSS) which acts as a relay function. These messages and procedures are documented in recommendation GSM 04.08, the only relevant issues covering these messages in this recommendation are those concerned with error conditions at the interface, and the headers that are required for the correct addressing of the messages. This is specified in more detail in recommendation GSM 08.06.

The functional split between MSC and BSS is defined in recommendation GSM 08.02 and states that the BSS is responsible for local radio resource allocation and in order to support this the required procedures between BSS and MSC are defined in detail in this recommendation.

Recommendation GSM 08.02 also states that the BSS is responsible for scheduling all CCCH/BCCH messages and therefore some procedures for providing to the BSS the necessary information to be passed on these channels for individual calls (ie paging) are defined in this recommendation, but the scheduling is not discussed.

This interface and consequently these layer 3 procedures are designed to support BSSs supporting one or more cells.

2. APPLICATION TO INTERFACE STRUCTURES

The underlying transport mechanism defined to carry signalling information between BSS and MSC is the message transfer part , and the signalling connection control part of signalling system No.7

The MTP and SCCP is used to support communication between the MSC and two conceptual entities within the BSS, these are:

- the BSS operation and maintenance application part (BSSOMAP).

- the BSS application part (BSSAP).

The BSS application part is split into two sub application parts, these are ; the BSS management application part (BSSMAP), and the direct transfer application part (DTAP).

Distribution of messages between the two sub application parts is described in recommendation GSM 08.06.

Figure 1 is a diagrammatical representation of these conceptual entities. It should be noted that this is not intended to imply a particular implementation and is only for the purposes of specifying the interface.

Differentiation between BSSAP and BSSOMAP is by addressing mechanisms within the SCCP, using subsystem number see recommendation GSM 08.06.

2.1. The BSS operation and maintenance application part

If operation and maintenance messages are transferred by means of this interface then they shall use SCCP messages. The application protocol being defined in the 12 series of recommendations. The routing and addressing to support this is provided by the SCCP and allows the MSC and the O&M centre to be addressed directly by the BSS using for example two E164 numbers. The operator may also use an X.25 connection for the transfer of O&M messages between the BSS and the OMC. This option is not further discussed in this recommendation.

2.2. The Direct Transfer Application Part

The direct transfer application part , (DTAP) is used to transfer call control and mobility management messages to and from the MS. The DTAP information in these messages is not interpreted by the BSS at all. Recommendation GSM 08.06 contains more detail relating to the handling of DTAP messages at the BSS, the multiplexing of the messages onto the relevant signalling channels of the radio interface, and the use of the SCCP services.

Messages received from the MS are identified as to be sent by DTAP by the protocol discriminator as described in recommendation GSM 04.08, except for initial messages (see section 3.1.16). The majority of radio interface messages are transferred across the BSS MSC interface by the DTAP, the exceptions being messages belonging to the RR protocol

2.3. The BSS management application part

The BSSMAP supports all procedures between MSC and BSS that require interpretation and processing of information related to single calls, and resource management.

Some of the BSSMAP procedures result in, or are triggered by, Radio Resource (RR) management messages defined in recommendation GSM 04.08. The BSSMAP procedures are described in section 3.

3. THE BSS MANAGEMENT APPLICATION PART

3.1. Procedures for the BSSMAP

This section describes the procedures used in the BSS management application part. There are the following main procedures:

Assignment *	fig 2
Blocking #	fig 10
Resource indication #	fig 12
Reset #	fig 11
Handover required indication *	fig 4
Handover resource allocation *	fig 5
Handover execution *	fig 3
Handover Candidate Enquiry #	fig 13
Release *	figs 6 and 7
Paging #	fig 15

Paging #	fig 15
Flow Control #	fig 14
Classmark update *	fig 9
Cipher mode control *	fig 25
Trace invocation *	
Initial MS message *	
Queuing Indication *	
Data link control SAPI not equal to 0 *	fig 26
Reset circuit #	

These procedures are documented separately and are intended to be used by the operators/manufacturers to build up complete call sequences, in a flexible manner. Any sequences given where more than one procedure is shown concatenated are only for illustrative purposes.

Each of the above procedures is qualified by either an asterisk (*) or a hash symbol (#). This signifies whether the procedure is considered as global (#) and concerns a complete cell (or BSS), or concerns a single dedicated radio resource on the radio interface (*).

Messages used to support global procedures are sent using the connectionless services of the SCCP.

Messages used to support dedicated procedures are sent using the connection oriented services of the SCCP, on the connection which has been set up to support that call or transaction. The establishment of SCCP connections is detailed in 08.06.

In the description of each procedure that follows it is explicitly stated whether a particular procedure is global or not, and hence the type of SCCP service used to support the service is defined.

In the following descriptions where dedicated resource procedures are described, only a single instance of the procedure is described, many instances of the procedure can exist simultaneously.

3.1.1. Assignment

The purpose of the assignment task is to ensure that the correct dedicated radio resource can be allocated or reallocated to a mobile that requires it. However, the initial random access by the MS and "immediate assignment" to a DCCH is handled autonomously by the BSS without reference to the MSC.

3.1.1.1. Successful operation

The initial conditions are assumed to be that the mobile is in contact with the fixed infrastructure of a PLMN by means of a dedicated radio (and possibly terrestrial) resource, and that the MSC has analysed any relevant call control information and wishes to allocate or `reallocate` to the mobile a radio (and possibly a terrestrial) resource on the cell to which the MS is tuned.

The MSC is the entity that carries out the necessary analysis on the call control information received from the mobile or fixed network customer.

On the basis of this analysis a resource request is made to the appropriate BSS by sending it an ASSignment REQuest message. This message contains details of the resource that is required, for instance speech rate, channel type, data adaption, priority level etc, it also includes the terrestrial channel that should be used between the MSC and BSS, a full description of the message is given in section 3.2.1.1.

This request is addressed to the BSSMAP and is analysed within the BSS. Based on this analysis, which is not defined further in this recommendation the BSS chooses an appropriate radio resource, and allocates the appropriate resources for transcoding, rate adaptation etc. On the terrestrial route connecting the BSS and MSC, certain TCHs can be used for different combinations of bearer capabilities. The MSC holds this information as route data and on this basis should only ever ask for resource from the BSS that it knows can be supplied on the nominated TCH. The BSS will construct and send the appropriate radio assignment messages if required (ie if the radio resource has to be changed) as described in 04.08 and start timer T10. The assignment request message includes additional information to allow the BSS to construct the necessary layer 3 radio messages.

The management of priority levels is implementation dependent, under operator control.

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

The highest defined priority value is used for indicating that the assignment has to be performed unconditionally and immediately. This may cause the release or forced handover of a lower priority call if no free resource is immediately available.

In addition, for test calls, there is also the option for the MSC to overrule the channel choice of the BSS by including the specific channel to be used as an optional field in the assignment request message.

The radio assignment procedure on the radio path is described in recommendation GSM 04.08. When the BSS is satisfied that the radio assignment procedure has been successfully accomplished (eg by receipt of assignment complete) it will return an ASSignment COMplete message over the BSS MSC interface. This will implicitly release the old dedicated resource at the BSS.

If the assignment did not require a change of radio resource, and consequently no 04.08 radio assignment procedure had been invoked, then the assignment complete message shall be returned to the MSC as soon as the requested resources have been allocated within the BSS.

3.1.1.2. Assignment Failure

The following failure conditions may occur:

The BSS may not be able to use the terrestrial resource that the MSC has indicated in which case a ASSignment FaiLuRe message will be returned. The appropriate failure cause will be included in the message (cause value : requested transcoding\rate adaption unavailable, or requested terrestrial resource unavailable).

The BSS may not receive an ASSignment COMPlete message from the MS in which case the timer T10 will expire. In this case an ASSignment FaiLuRe message is returned to the MSC and the procedure is terminated (cause value: radio interface message failure).

If the radio channel assignment fails for any other reason then an ASSignment FaiLuRe message will be returned to the MSC, the procedure will terminate, and the associated references concerning the old dedicated resource should be maintained until explicitly released by the MSC. It should be noted that if the MS fails to assign after receiving an ASSIGNMENT COMMAND and returns to the old channels as detailed in Recommendation GSM 04.08, then the ASSIGNMENT FAILURE received from the MS will cause an ASSIGNMENT FAILURE to be returned to the MSC (cause value: Radio interface failure, reversion to old channel). The assignment failure message contains a cause field which will be set to the nearest appropriate value. Possible cause values are equipment failure,no radio resource

If a terrestrial circuit has not been allocated then the assignment failure message will indicate to the MSC that the terrestrial circuit involved is still considered by the BSS to be idle, no explicit clearing sequence is therefore needed.

All messages concerned with an assignment are sent using the connection oriented mode of the SCCP.

3.1.1.3. Abnormal Conditions

If the BSS receives an assignment request message calling up a terrestrial circuit that is already assigned to another call then an assignment failure message will be returned with a cause setting of: terrestrial circuit already allocated, no action will be taken on the radio interface.

If the BSS receives an ASSignment REQuest message for a terrestrial circuit which has been blocked by a global blocking message then an assignment failure message shall be sent (cause value: requested terrestrial resource unavailable) and the global blocking message repeated.

If an ASSignment REQuest message is received calling up a radio resource (ie the MSC is defining the radio channel) which is in use, then an ASS FAIL message is returned to the MSC with the cause: No radio resources available.

3.1.2. Blocking

As described in section 3.1.1. the assignment procedure depends upon the MSC choosing the terrestrial resource to be used. The MSC therefore needs to be informed of any terrestrial circuits that are out of service at the BSS. This is performed by using a simple blocking/unblocking procedure. The blocking messages used to support this procedure are sent as global messages (ie using connectionless mode), each message refers to a single terrestrial circuit accessed through the BSS MSC interface. The circuit is identified by its circuit identity code.

3.1.2.1. Successful Operation

The procedure operates as follows:

Initial conditions are assumed to be that all circuits are unblocked.

Receipt of a BLOck message at the MSC from the BSS will indicate to the MSC that the identified circuit is unavailable for reselection, if a call is in progress on the identified terrestrial circuit then it will be unaffected by this procedure, the circuit will however be "camp on blocked". A BLock Acknowledge message will be returned to the BSS by the MSC to acknowledge receipt of the

blocking message and to indicate that any necessary action has been taken. The blocking message has a cause element in it indicating the reason for the blocking, allowable values are: no radio resource available, O and M intervention, equipment failure.

The resource involved will be assumed to be blocked by the MSC until either an unblock or reset message is received relevant to that resource.

If the BSS wishes to unblock a blocked circuit and return it to service then it will generate an unblock message.

If an unblock message is received at the MSC for a blocked resource then the resource will be marked as available for service and an UnBlock Acknowledge will be returned to the BSS.

Figure 10 shows an overview of the blocking procedure.

It should be noted that this is a unidirectional procedure and that the MSC, does not therefore send block messages towards the BSS. If the MSC wishes to take a terrestrial circuit out of service this is achieved by local blocking within the MSC.

A BSS may block a terrestrial circuit because:

- Operation and maintenance intervention makes the circuit unavailable for use (cause value: operation and maintenance intervention).

- An equipment failure makes the circuit unavailable (Cause value equipment failure).

- Radio resource is not accessible from the terrestrial circuit (Cause value: no radio resource available).

3.1.2.2. Abnormal Conditions

If a blocking/unblocking acknowledgement is not received for a block/unblock message within T1 seconds then the message will be repeated. If this occurs a second time the circuit will be marked as blocked, and the situation must then be resolved internally in the BSS or by O&M procedures.

If an ASSignment REQuest message is received for a circuit which is marked at the BSS as blocked then an ASSignment failure will be sent and a block message will be sent to the MSC.

3.1.3. Resource Indication

The purpose of the resource indication task is :

- To inform the MSC of the amount of radio resource that is spare at the BSS and available for traffic carrying purposes. This cannot easily be derived from the traffic that the MSC is carrying because some half rate channels may be isolated. The MSC may take this information into account for the external handover decision.

3.1.3.1. Successful operation

The procedure relates to a single cell (this being relevant to the case of multi cell BSSs).

The MSC sets the way the BSS transfers the resource information to the BSS by sending a Resource Information Request Message to the BSS. This message shall contain a Resource Indication Method parameter which can be set to one of the following values :

i) (Spontaneous indication expected) : The BSS shall send Resource Indication messages to the MSC spontaneously everytime some conditions defined by O&M are met in the BSS for the considered cell (e.g. traffic thresholds, or time interval between two messages). The BSS stays in this mode until the receipt of a new resource information request for the same cell, or a reset occurs;

ii) (One single indication expected) : The BSS shall immediately return a single Resource Indication message immediately, and then cease any resource information transfer related to the cell until the receipt of either a new resource information request or a reset;

iii) (Periodic indication expected) : The BSS shall return a Resource Indication message immediately, and then periodically, with a period set by MSC* until the receipt of either a new resource information request for the same cell or a reset.

* (The period shall equal the value of the periodicity parameter times 100 ms).

iv) (No indication expected) : The BSS to MSC transfer of resource information related to the cell is disabled until the receipt of either a new resource information request for the same cell or a reset.

The default mode is iv) ; after receipt of a reset, this mode is set for all the cells of a BSS.

The transfer of resource information related to a given cell from the BSS to the MCS occurs when the Resource Indication Method parameter is set to one of the values i) to iii) in the BSS. The BSS sends Resource Indication messages to the MSC, under the conditions explained above.

For each idle channel the level of interference will be averaged over a period of Intave. (Intave is a parameter set by O&M command on a per cell basis). This averaging will be immediately before the transmission of the resource indication message. The result of this averaging will be used to classify the average interference level on the idle channels into five interference bands.

The resource indication element contains two pieces of information for each of the five interference bands :

- The number of half rate TChs available in that band.

- The number of full rate TChs available in that band.

The levels of the five bands are defined by O&M

3.1.4. Reset

3.1.4.1. Global reset procedure

The purpose of the reset procedures is to initialise the BSS and MSC in the event of a failure. The procedure is a global procedure applying to a whole BSS, and therefore all messages relating to the reset procedure are sent as global messages using the connectionless mode.

If only a limited part of the MSC or BSS has suffered a failure then clearing procedures can be used to clear only those affected calls.

3.1.4.1.1. Reset At The BSS

In the event of a failure at the BSS which has resulted in the loss of transaction reference information, a RESet message is sent to the MSC. This message is used by the MSC to release affected calls and erase all affected references, and to put all circuits into the idle state.

After a guard period of T2 seconds a reset acknowledge is returned to the BSS indicating that all references have been cleared.

3.1.4.1.2. Reset at the MSC

In the event of a failure at the MSC which has resulted in the loss of transaction reference information, a RESet message is sent to the BSS. This message is used by the BSS to release affected calls and erase all affected references.

Upon receipt of a reset message from the MSC the BSS shall send block messages for all circuits that were previously blocked, the MSC shall respond to these with blocking acknowledgements as described in para 3.1.2

After a guard period of T13 seconds a reset acknowledge is returned to the MSC, indicating that all MSs which were involved in a call are no longer transmitting and that all references at the BSS have been cleared.

3.1.4.1.3. Abnormal Conditions

3.1.4.1.3.1. Abnormal Condition at the BSS

If the BSS sends a reset message to the MSC and receives no reset acknowledge message within a period T4 then it shall repeat the entire reset procedure.

3.1.4.1.3.2. Abnormal Condition at the MSC

If the MSC sends a Reset message to the BSS and receives no Reset Acknowledge message within a period T16 then it shall repeat the reset procedure.

3.1.4.2. Reset Circuit.

The purpose of the reset circuit procedure is to restore the information in MSC/BSS in case of a failure which has affected only a small part of the equipment, in case the SCCP-connection has been released during the failure.

3.1.4.2.1. Reset Circuit at the BSS.

If a circuit has to be put to idle at the BSS due to an abnormal SCCP-connection release, a reset circuit message will be sent to the MSC. When the MSC receives this message, it clears the possible call and puts the circuit to the idle state. A reset circuit acknowledge message is returned to the BSS.

Timer T12 is used at the BSS to supervise the reset circuit procedure. If the timer elapses before a response is returned to the BSS, the message is repeated.

3.1.4.2.2. Reset Circuit at the MSC

If a circuit has to be put to idle at the MSC due to an abnormal SCCP-connection release, a reset, a reset circuit message, will be sent to the BSS. When the BSS receives a reset circuit message, it shall respond with a reset circuit acknowledge message in case the circuit can be put to idle. If the circuit is blocked at the BSS at reception of the reset message, a blocking message shall be returned to the MSC.The MSC shall then respond with a blocking acknowledge message, as described in paragraph 3.1.2.

Timer T12 is used at the MSC to supervise the reset circuit procedure.If the Timer elapses before a response (reset circuit acknowledge or blocking) the reset circuit procedure is repeated.

3.1.4.2.3. Abnormal conditions.

If timer T12 elapses at the MSC or BSS before a response is returned, the reset circuit procedures shall be repeated.

3.1.5. External Handover

The details of the radio information as far as handover is concerned are given in GSM Recommendation GSM 04.08. The relevant network information is given in GSM Recommendation GSM 03.09.

Using this protocol the BSS should support handover transitions to and from all combinations of the following:

From:	To:
DCCh	DCCh
Full Rate TCh	Full Rate TCh
Half Rate TCh	Half Rate TCh

In this specification three procedures are defined which can be used for handover. They are:

Handover Required Indication
Handover Resource Allocation
Handover Execution

(Fig 16 shows an example of a complete handover procedure)

(The use of a scanning receiver at the target BSS is not supported in this version of this interface).

The handover procedures are specified in the following sections:

3.1.5.1. Handover Required Indication

The handover required indication procedure allows an BSS to request that a handover be carried out for a particular mobile, currently allocated a dedicated resource. This is done by generating a HANdover REQuired message from the BSS to the MSC. If so required by the BSS the MSC informs the BSS if the handover cannot be carried out. This is done by a Handover Required Reject Message. The HANdover REQuired message relates to a particular dedicated resource on the radio interface, either DCCh or TCh, and is sent using the BSSAP connection already set up for that transaction. The BSS therefore continually monitors all radio information, and compares it with parameters such that if the transmission quality of a given parameter (or set of parameters) passes a predetermined threshold (set by O&M) then a handover required message is generated towards the MSC.

3.1.5.1.1. Generation of the HANdover REQuired Message

The handover required message contains the following information:

Message type
Cause for handover
Response request
Preferred list of target cells
Radio environment information

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.

The cause for handover is set as appropriate, eg uplink quality poor, or for traffic reasons indicated from the MSC.

The response request indicates, if present, that the BSS requires an indication if the Handover Required message does not result in a handover.

The preferred list of target cells is a parameter controlled field. It is mandatory for BSSs to be able to produce this field. The number of preferred cells is given in order of predicted best performance. The number of preferred cells indicated in this field will be "n" where n is a parameter set by O&M (it shall be possible to set n in the range 0 to 16). If n cells cannot be identified then an appropriate coding shall be given in order to fill out the field. It is mandatory for the MSC to be able to receive this field, and interpret it if the operator chooses to use it, however its use is controlled by the operator by setting the value of n.

The algorithm by which the BSS produces this list is not addressed in this recommendation.

The radio environment information is a parameter controlled field. It is mandatory for the BSS to be able to produce this field. It describes the performance of the current radio channel to which the MS is tuned, and the reported perception of surrounding cells that the MS is reporting. This information is preprocessed as described in section 3.2.2. This field contains measurements for "m" surrounding cells where "m" is equal to the specified maximum number of measurements that the MS is able to provide (refer to 05 series and 04.08) or to zero if this field is not required. If m surrounding cells cannot be identified by the MS then the fields are coded as appropriate. It is mandatory for the BSS to be able to generate this field under control of the parameter m, and it is optional for the MSC to be able to interpret this field. The interpretation of this field at the MSC when this function is supported is not further defined here.

If m = 0 then neither current channel information, nor the surrounding BSS information is included.

The handover required indication message shall be repeated by the BSS with a periodicity of T7 between messages (set by O&M command) until:

- A handover command message is received, or;

- A reset message is received, or;

- The reason for the original handover required message disappears eg the MS transmission improves,or;

- All communication is lost with the MS as defined in recommendation GSM 04.08, and the transaction is abandoned, or;

- The transaction ends, eg call clearing.

3.1.5.2. Handover Resource allocation

This procedure has been defined to allow the MSC to request resources from an 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 mobile on the channel which it indicates to the MSC. In order to support this procedure a BSSAP SCCP connection is set up to the BSS, this connection is then used to support all BSSAP messages related to this dedicated resource.

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 BSS from which it requires radio resource. This message contains an indication of the type of channel required, and the terrestrial resource that will be used if the request is for a traffic channel.

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

The management of priority levels 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.

If a radio resource becomes available before queueing timer expiry (T_{qho}),this will be reflected back to the MSC in a handover request acknowledgement message. The BSS shall then take all necessary action to allow an MS to access the radio resource that it has chosen, this is detailed in the 05 series of recommendations. If the radio resource is a traffic channel then the BSS shall at this point switch it through to the terrestrial resource indicated in the handover request, and the necessary transcoding/rate adaption/encryption equipment enabled as detailed in Recommendation GSM 04.08.

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

The MSC receives the handover request acknowledge containing the appropriate channel, and the radio interface HANDOVER COMMAND message to send to the MS.

When the MS accesses the radio resource then:

- The BSS checks the handover reference number to ensure that it is the same as expected, and hence that there is a high probability that the correct MS has been captured (if the handover reference is not as expected then the BSS shall wait for an access by the correct MS).

- If the handover reference number is as expected, the BSS shall send a HANDOVER DETECT message. When the MS is successfully in communication with the network, ie the HANDOVER COMPLETE message has been received from the MS, then the BSS will immediately send a handover complete message to the MSC. This terminates the procedure at the BSS. The dedicated radio resource and connected terrestrial resource shall remain assigned until either the MSC instructs the BSS to release the resource or a reset occurs.

If either:

- a clear command is received from the MSC
- a reset is received from the MSC

before an MS with the correct handover reference accesses the BSS then

3.1.5.2.2. Handover Resource Allocation Failure

The following failure conditions of this procedure may occur:

- The BSS may not be able to use the terrestrial channel that the MSC has indicated in which case a Handover FaiLuRe message will be returned. The appropriate failure cause will be included in the message, the cause value will be set to: requested terrestrial resource unavailable.

included in the message, the cause value will be set to: requested terrestrial resource unavailable.

- The BSS may not be able to support the call type that has been indicated in the handover request. In this case a handover failure message shall be returned to the MSC with the appropriate failure cause set.

All messages concerned with an handover are sent using the connection oriented mode of the SCCP.

The generation of the handover failure message terminate the procedure and allows all references to be released.

3.1.5.2.3. Abnormal conditions

If a handover resource request message is received relating to a connection on which a handover resource request message has already been received, then the later message will be discarded.

3.1.5.3. Handover execution

Handover execution in the context of the BSS/MSC interface is the process whereby an MSC instructs an MS to tune to a new dedicated radio resource which may be on a different cell.

3.1.5.3.1. Operation of the procedure

The correct operation of the procedure is as follows:

A handover command is generated by the MSC and transmitted to the BSS on which the concerned MS is currently supported by the BSSAP connection. At the BSS the handover command is received and a timer T8 is started. A handover command message is then sent by the BSS, to the concerned MS. The message contains a handover reference number, previously allocated by the target BSS.

The MSC always terminates this procedure by use of a clear sequence.

3.1.5.3.2. Handover Failure

If a handover failure message with the cause value "radio interface failure, reversion to old channel" is received from the MS on the old channel then a handover failure message is sent to the MSC.

The procedure at the target BSS is terminated by the MSC using a clear sequence.

3.1.5.3.3. Abnormal Conditions

Whilst this procedure is in operation any messages received at the BSS concerning assignment, handover resource allocation relating to this call should be discarded.

Whilst this procedure is in operation the BSS should not attempt to invoke any other procedure related to this call eg handover required indication.

If at the BSS a clear command message from the MSC or a handover

failure message from the MS is not received before the expiry of T8 then the procedure shall be terminated, and the radio resource released for other calls ie by sending a clear request message to the MSC , this allows for a MS to return to the old dedicated resource. The terrestrial resource shall remain assigned until a clear command is received from the MSC.

3.1.6. Internal Intra-Cell Handover Procedure

The definition of internal intra cell handover is given in section 5.

It is optional that an BSS support internal intra-cell handover. However if it is supported, it should be as follows.

It should be possible to inhibit internal intra-cell handover at an BSS that supports it by operation and maintenance command.

Internal intra-cell handover occurs between channels on the same cell. It is decided and executed autonomously by the BSS, so that no message is generated at the BSS-MSC interface, until the completion of the handover execution, when a handover performed message is sent.

The decision process in the BSS is based on the internally available radio and resource parameters.

The relevant radio interface layer 3 procedures (dedicated channel assignment) are described in Recommendation GSM 04.08.

3.1.7. Internal Inter-Cell Handover Procedure

The definition of internal inter-cell handover is given in section 5.

It should be possible to inhibit internal inter-cell handover at an BSS that supports it by operation and maintenance command.

Multi cell BSSs would normally be expected to support internal inter cell handover, however it is optional that they do so. However if it is supported, it should be as follows.

Internal inter-cell handover occurs between channels pertaining to different cells of the same BSS. It is decided and executed

autonomously by the BSS, so that no message is generated at the BSS-MSC interface, until the completion of the handover execution, when a handover performed message is sent.

The decision process in the BSS is based on the internally available radio and resource parameters.

The relevant radio interface layer 3 procedures (for handover) are described in Recommendation GSM 04.08.

3.1.8. Handover Candidate Enquiry

The purpose of this procedure is to allow the MSC to ascertain if it is possible to handover any MSs that are currently being served by a particular cell to another nominated cell. The procedure uses global messages, and is relevant to an individual cell.

3.1.8.1. Successful Operation

The procedure operates as follows:

The MSC sends a handover candidate enquiry message to an BSS. The message indicates that the MSC wishes the BSS to identify handover candidates in a particular cell, that can be handed over to other nominated cells. The maximum number of candidates is also indicated to the BSS.

For each candidate the BSS will generate a single handover required message, using the appropriate SCCP connection. If the BSS was already generating handover required messages for that MS then it will continue to so, however the cause element of the next handover required message will indicate that the message is generated in response to a handover candidate enquiry message.

When the last handover required message has been sent,the BSS also sends a handover candidate response message giving the number of candidates identified, and terminating the procedure.

Only one handover enquiry procedure may be invoked on any given cell at any one time.

3.1.8.2. Abnormal conditions

If at the BSS a handover candidate enquiry message is received when a handover candidate enquiry procedure has already been invoked then the new handover candidate enquiry shall be discarded.

3.1.9. Release of Radio Resource And Terrestrial Resource.

3.1.9.1. Release Due To Transaction Completion

The release of an assigned radio resource at the end of a transaction will take place as follows:

Release negotiation will take place directly between the MS and MSC using transparent messages via the DTAP in the BSS (see rec 04.08). The MSC will then send a BSSMAP clear command, indicating that the radio resource should be released.

When the BSS receives the clear command the guard timer defined in recommendation GSM 04.08 is started and clearing on the radio interface initiated. On receipt of clear complete, the MSC releases any assigned terrestrial resources.

A clear complete message is sent to the MSC after receipt of the clear command up to the point where radio channel release is complete, or guard timer expires.

3.1.9.2. Release due to BSS generated reason

If a radio channel release is required because of a BSS generated reason (eg operation and maintenance intervention, equipment failure,) then, the BSS shall generate a clear request message towards the MSC. This messages shall include a cause field, indicating the reason for the failure.

If transmission from the MS is lost for more than the guard period defined in recommendation GSM 04.08 then a clear request shall be sent to the MSC.

On receipt of a CLEAR REQUEST the MSC shall initiate the release as defined above with a CLEAR COMMAND. On receipt of this message the BSS shall, if the resources are not already internally released, release the resources in the normal way. The procedure is always terminated with a CLEAR COMPLETE to the MSC

3.1.9.3. Release due to successful handover

If a radio channel release is required because of a handover being successfully completed on another BSS, then the resources at the old BSS are released by the MSC using the clearing sequence with a cause value; handover successful.

3.1.10. Paging

Paging messages for all mobiles shall be sent via the BSSMAP as a connectionless message. These will include the IMSI of the mobile to allow derivation of the paging population number. This type of paging message will then be stored and a corresponding paging message transmitted over the radio interface at the appropriate time.

It should be noted that each paging message on the MSC-BSS interface relates to only one MS and therefore the BSS has to pack the pages into the relevant 04.08 paging message.

If a paging response message is received then the relevant connection is set up towards the MSC as described in recommendation GSM 08.06 and the page response message is passed to the MSC in a complete layer 3 info message.

A single paging message across the BSS to MSC interface can contain a list of cells in which the page is to be broadcast.This is of use in multi cell BSSs.

3.1.11. Trace Invokation

The purpose of the invocation procedure is to inform the receiving entity that it should begin producing a trace record on this particular transaction.

The trace is invoked by the MSC sending a trace message to the BSS or vice versa. Included in the "trace invocation command" is a trace number, used to tag the trace record to allow simpler construction of the total record by the entity which combines trace records. The trace number is assumed to be allocated by the OMC.

The message is not acknowledged and is sent as a connection oriented message on the connection on which a trace is required.

3.1.12. Flow Control

These procedures are defined to give some degree of flow control. At the BSS processor overload and CCCH scheduler overload are catered for, and at the MSC processor overload is catered for.

3.1.12.1. Philosophy

The philosophy used is to stem the traffic at source with known effect on the service. The algorithm used is :

- On receipt of the first overload message or signalling point congested information, the traffic is reduced by one step. At the same time, timers T5 and T6 are started. During T5 all received overload messages or signalling point congested information are ignored in order not to reduce the traffic too rapidly. Reception of an overload message or signalling point congested information after expiry of T5 but still during T6 , will decrease the traffic load by one more step, and restart T5 and T6.

This step by step reduction of traffic is continued until maximum reduction is obtained by arriving at the last step. If T6 expires (ie no overload message or signalling point congested information is received during T6) the traffic will be increased by one step and T6 will be started, unless full load has been resumed.

The number of steps and the method of reducing the load is considered to be an implementation specific function.

There may be other traffic control mechanisms from O and M activities occurring simultaneously.

3.1.12.2. Processor Overload at the MSC

The MSC can indicate to the BSS that it is in a congested state by sending an overload message. This is sent as a connectionless global message.

At the BSS receipt of this message causes the reduction of random access traffic using the method in 3.1.12.1.

For example, the amount of random access traffic could be reduced by using the access control class in the system information message of Recommendation GSM 04.08.

3.1.12.3. Processor/CCCH overload at the BSS

If the CCCH scheduler at the BSS is overloaded (queue passed a predefined threshold) then the BSS sends an overload message to the MSC with the appropriate cause (value :CCCH overload) and indicating the cell in question.

If the BSS processing is overloaded then the BSS sends an overload message with the cause setting :processor overload.

The MSC originated traffic is reduced in accordance with the method of 3.1.12.1.

3.1.12.4. Message throughput congestion

If the lower layers of the protocol become congested then it is assumed that the MTP congestion indication will take place (see recommendation GSM 08.06) and the source of the traffic will receive primitives from the transport protocols resulting in them reducing the generated load.

A suitable method to achieve this reduction could be based on that given in section 3.1.12.1.

3.1.13. Classmark Updating Procedure

At any point when an SCCP connection has been established for BSSAP messages, the BSS must be able to sent to the MSC a classmark update message if one is received from the MS. This message contains information on several transmission parameters relevant to the MS in communication with the network.

This message is sent as an BSSAP message over the appropriate SCCP connection

This procedure will normally only be used where the power class of the MS changes whilst the MS has a dedicated resource.

3.1.14. Cipher Mode Control

The Cipher mode control procedure allows the MSC to pass cipher mode information to the BSS to select and load the user data and signalling encryption device with the appropriate key.

This is achieved by sending the BSS a cipher mode command message. Receipt of the message at the BSS will implicitly also invoke the encryption device, and shall cause the start of stream ciphering as described in recommendations 04.08 and 03.20, and the generation of cipher mode command message via the radio interface.

The cipher mode command and cipher mode complete messages are sent as connection oriented messages via the appropriate SCCP connection.

Receipt of the cipher mode complete (or other correctly deciphered layer 2 frame) from the air interface is used internally within the BSS to achieve air interface ciphering synchronisation (see Recommendation GSM 04.08). When this has been achieved a cipher mode complete message is returned to the MSC.

3.1.15. Abnormal Conditions General

If a user-out-of-service information or signalling-point-inaccessible information is received by the BSSAP or BSSOMAP no new attempt to establish SCCP connections towards the affected point code will be started until the corresponding user-in-service information or signalling-point-accessible information is received.

OPTIONALLY

When a user-out-of-service information or signalling-point-inaccessible is received by the BSS a timer will be started. When the timer expires all the SCCP connections towards the affected point code will be released. When the user-in-service or signalling-point-accessible is received, the timer is stopped.

If for any reason an SCCP connection is released, the optional timer expires or a connection refusal is received while any of the BSSAP procedures are being performed or while a dedicated resource is still allocated the following actions are taken:

At BSS:

The radio resources associated with the SCCP connection are cleared by an appropriate radio procedure

Any BSS procedure relating to that connection is abandoned

The resources allocated to the call associated to the connection are released

At MSC:

The call associated with the SCCP connection is cleared as soon as possible.

At the BSS, communication over assigned radio channels shall be assumed to be continuing until either the SCCP connection is lost, a clearing sequence is received, or no signal is received from an MS for longer than the guard time defined in recommendation GSM 04.08. If the BSS recognises that a call has terminated then a clear request should be generated.

If a 2Mbits/s system fails and one of the standard alarms is received, no action is taken at the BSS on the calls associated with the traffic channels involved.

At the MSC, calls should be cleared if either subscriber clears, or if the BSS sends a clear request message. Clearing of affected calls by the MSC may take place after loss of the traffic channels for a period defined by the operator.

For the procedures controlled by the MSC, and in particular procedurees where the MSC sends a request for resources at the BSS and waits for an acknowledge, the implementation in the MSC must provide means for avoiding deadlock situations at the BSS as e.g. hanging resources.

3.1.16. Initial MS message

When the SCCP connection establishment is performed by the BSS, the intitial L3 message received from the MS (piggybacked on the SABM frame) is processed as follows:

The BSS shall analyse the message to a level which allows the extraction by the BSS of the classmark field. However, the entire initial message (e.g. CM service request, page response, reestablishment request, Loc update request) is also passed to the MSC, using a "complete layer 3 information" message. The contents of the MS to BS message other than the classmark field are not analysed by the BSS.

3.1.17. Queueing Indication

The purpose of the queuing indication message is to inform the MSC about a delay in the allocation of the necessary dedicated radio resources. The procedure is only relevant if the system is using a queuing procedure for traffic channels in the BSS, (§3.1.17.1) and/or for handover of traffic channels (§3.1.17.2)

3.1.17.1. Operation of the procedure in case of assignment procedure

After the assignment request message without having the necessary TCH available the assignment request shall be put into a queue; the queuing indication shall be returned to the MSC and the timer T11 shall be started. The timer value T11 specifies the maximum queuing delay and is determined by the operator.

The procedure shall be terminated with a successful or unsuccessful assignment of the required traffic channel by sending an assignment complete or an assignment failure, respectively, to the MSC.

If the timer T11 expires the assignment request shall be removed from the queue and a clear request message shall be sent to the MSC, with the cause "no radio resource available"

3.1.17.2. Operation of the procedure in case of hand-over resource allocation procedure

After the handover request message without having the necessary TCH available the handover request shall be put into a queue; the queuing indication shall be returned to the MSC and the timer T_{qho} shall be started. The timer value T_{qho} specifies the maximum queuing delay and is determined by the operator.

The procedure shall be terminated with a successful or unsuccessful reservation of the required traffic channel by sending a handover request acknowledge or a handover failure,

respectively, to the MSC, with the cause no radio resource available.

If the timer T_{qho} expires the handover request shall be removed from the queue and a handover failure message shall be sent to the MSC.

3.1.18. Data Link Control SAPI not Equal to 0

The air interface can support data links with the SAPI not equal to 0. In order to control these data links from the network certain explicit commands are required between the MSC and the BSS.

It should be noted that these procedures do not relate to the control of data links with a SAPI value of "0".

3.1.18.1. Data link set up across the air interface

This section deals with the impact of data link establishment (SAPI not equal to "0") on the MSC to BSS interface.

3.1.18.1.1. MS to MSC direction

In the MS to MSC direction the receipt of a layer 3 message via a data link where SAPI does not equal 0 at the BSS will be transferred to the MSC as a DTAP message with the DLCI octet set appropriately.

3.1.18.1.2. MSC to MS Direction

Receipt of a layer 3 (DTAP) message from the MSC with the DLCI not set to 0 will cause one of the following actions:

- the triggering of a data link set up to support the message transfer across the air interface if no suitable link exists;
- the transmission of the message to the MS if a suitable link has already been established;
- the sending of a BSSMAP SAPI "n" reject message to the MSC if for any reason the data link cannot be established a cause field is included, allowable causes are processor overload, BSS not equipped, MS not equipped. In this case no additional SAPI "n" clear command is required a the release is implicit.

3.1.18.2. Data link release

Data link release for links with SAPI not equal to 0 is achieved by using a bi-directional clearing procedure which identifies the SAPI to be released.

3.1.18.2.1. Operation of the release procedure

Across the BSS to MSC interface the BSS or MSC will command the release of the SAPI "n" data link by sending a "SAPI "n" clear command" message, this is a BSSMAP message. The receiving entity will release any resources specifically associated with that SAPI and respond with a "SAPI "n" clear complete" message.

3.2. Message Formats and Coding

This section defines the codings and formats of the messages required for the BSSMAP.

For each message there is in section 3.2.1 a table listing the signalling elements in their order of appearance in the message (mandatory before optional).

There is no general rule for the order of signalling elements : it happens that the same elements appear in various orders depending on the message.

All of the messages that are included in BSSMAP are concerned with radio resource management. The following messages are concerned;

Message name	reference
ASSignment REQuest	3.2.1.1.
ASSignment COMplete	3.2.1.2.
ASSignment FAILure	3.2.1.3.
BLOck	3.2.1.4.
BLocking Acknowledge	3.2.1.5.
CLeaR CoMmanD	3.2.1.21.
CLeaR COMplete	3.2.1.22.
CLeaR REQuest	3.2.1.20.
UnBLOck	3.2.1.6.
UnBLocking Ack	3.2.1.7.
HaNDover CaNDidate ENQuiry	3.2.1.14.
HaNDover CaNDidate RESponse	3.2.1.15.
HaNDover REQuest	3.2.1.8.
HaNDover ReQuireD	3.2.1.9.
HaNDover ReQuireD Reject	3.2.1.37.
HaNDover ReQuest ACKnowledge	3.2.1.10.
HaNDover COMmand	3.2.1.11.
HaNDover CoMPlete	3.2.1.12.
HaNDover FaiLuRe	3.2.1.16.
HaNDover PerForMed	3.2.1.25.
HaNDover DETect	3.2.1.40.
RESource REQuest	3.2.1.17.
ReSeT	3.2.1.23.
ReSeT ACK	3.2.1.24.
RESource indication	3.2.1.18.
Paging	3.2.1.19.
Overload	3.2.1.26.
Trace invocation	3.2.1.27.
Classmark update	3.2.1.29.
Cipher Mode Command	3.2.1.30.
Cipher Mode Complete	3.2.1.31.
Complete layer 3 information	3.2.1.32.
Queuing indication	3.2.1.33.
SAPI "n" reject	3.2.1.34.
SAPI "n" clear command	3.2.1.35.
SAPI "n" clear complete	3.2.1.36.
Reset circuit	3.2.1.38.
Reset circuit acknowledge	3.2.1.39.

3.2.1. Message Contents

3.2.1.1. ASSIGNMENT REQUEST (MSC to BSS)

This message is sent from the MSC to the BSS in order to request the BSS to assign radio resource, the attributes of which are defined within the message.

The message will also include the terrestrial circuit to be used.

An optional field can be included in this massages that the radio channel to be used for the call is determined by the MSC rather than the BSS, (this allows for O & M procedures to force the use of a particular resource).

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
Layer 3 header information	3.2.2.9	MSC-BSS	M	4
Priority	3.2.2.18	MSC-BSS	O	3
Circuit identity code	3.2.2.2	MSC-BSS	O*	3
Radio channel identity	3.2.2.3	MSC-BSS	O	5-38
Downlink DTX flag	3.2.2.26	MSC-BSS	O**	2
Interference band to be used	3.2.2.21	MSC-BSS	O	2

* This element is not included when terrestrial resource is not required (eg when a DCCH is assigned for signalling purposes only).

** This element is included in the case of a speech TCH where DTX is applied in the downlink direction, and only in this case.

3.2.1.2. ASSIGNMENT COMPLETE

The assignment complete message is sent from BSS to MSC and indicates that the requested assignment has been completed correctly.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message Type	3.2.2.1	BSS-MSC	M	1
RR Cause	3.2.2.22	BSS-MSC	O	2
Radio channel identity*	3.2.2.3	BSS-MSC	O*	5-38
Cell identifier	3.2.2.17	BSS-MSC	O**	5-10

* Optional inclusion for O&M purposes

** The cell identifier is used to indicate a new cell, if during the assignment the serving cell has changed

3.2.1.3. ASSIGNMENT FAILURE

The assignment failure is sent in the BSS to MSC direction. It indicates that there has been a failure in the assignment process at the BSS and that the assignment procedure has been aborted.

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
RR Cause	3.2.2.22	BSS-MSC	O	2

Allowable cause values; radio interface message failure ,operation and maintenance intervention ,equipment failure,no radio resource available,requested terrestrial resource unavailable, requested transcoding/rate adaption unavailable,terrestial resource already allocated, radio interface failure - reversion to old channel.

3.2.1.4. BLOCK

This message is sent from the BSS to the MSC to indicate that a particular terrestrial resource (ie a particular timeslot within a 2Mbit system) must be blocked at the MSC, and cannot therefore be used for traffic.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Circuit identity code	3.2.2.2	BSS-MSC	M	3
Cause	3.2.2.5	BSS-MSC	M	3-4

Allowable cause values : no radio resource available, operation and maintenance intervention, equipment failure,

3.2.1.5. BLOCKING ACKNOWLEDGE

This message is sent from MSC to BSS to acknowledge the receipt of an earlier block message, and to indicate that the circuit concerned has been removed from service.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Circuit identity code	3.2.2.2	MSC-BSS	M	3

3.2.1.6. UNBLOCK

This message is sent from the BSS to the MSC to indicate that a particular terrestrial resource (ie a particular timeslot within a 2Mbit system) may be returned to service at the MSC, and can therefore be used for traffic.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Circuit identity code	3.2.2.2	BSS-MSC	M	3

3.2.1.7. UNBLOCKING ACKNOWLEDGE

This message is sent from MSC to BSS to acknowledge the receipt of an earlier unblock message, and to indicate that the circuit concerned has been returned to service.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Circuit identity code	3.2.2.2	MSC-BSS	M	3

3.2.1.8. HANDOVER REQUEST

This message is sent from the MSC to the BSS to indicate that the a mobile 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	3-20
Classmark information 1 or Classmark information 2	3.2.2.30 3.2.2.19	MSC-BSS MSC-BSS	M# M#	2 4
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
Radio channel identity	3.2.2.3	MSC-BSS	O*	5-38
Downlink DTX flag	3.2.2.26	MSC-BSS	O***	2
Cell identifier (target)	3.2.2.17	MSC-BSS	O**	3-10
Interference band to be used	3.2.2.21	MSC-BSS	O	2

* Optional inclusion for O&M purposes

** Only required for multi cell BSSs.

*** This element is included in the case of a speech TCH where DTX is applied in the downlink direction, and only in this case.

\# One of these two elements is sent.

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.

This message includes the measurement results relevant to this

communication.

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	O	2n+3 to 7n+3
Current radio environment	3.2.2.14	BSS-MSC	O	15-n
Environment of BS "n"	3.2.2.15	BSS-MSC	O	7-n

Allowable cause values are : Uplink quality, uplink strength, downlink quality, downlink strength, distance, better cell, response to MSC invocation, O and M intervention + national options

3.2.1.10. HANDOVER REQUEST ACKNOWLEDGE

This message is sent from BSS to MSC and indicates that the request to support a handover at the target BSS can be supported by the BSS, and also to which radio channel the MS should be directed.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Layer 3 Information *	3.2.2.24	BSS-MSC	M	9-56

* This information field carries a radio interface HANDOVER COMMAND message

3.2.1.11. HANDOVER COMMAND

This message is sent from the MSC to the BSS, and contains the target channel to which the MS should retune.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message Type	3.2.2.1	MSC-BSS	M	1
Layer 3 Information *	3.2.2.24	MSC-BSS	M	9-56

* This information field carries a radio interface HANDOVER COMMAND message

3.2.1.12. HANDOVER COMPLETE

This message is sent from BSS to MSC.

It indicates that the correct MS has successfully accessed the target cell.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
RR Cause	3.2.2.22	BSS-MSC	O	2

3.2.1.14. HANDOVER CANDIDATE ENQUIRE

This message is sent from MSC to BSS, using the connectionless services of the SCCP.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Number of MSs	3.2.2.8	MSC-BSS	M	2
Cell identifier list	3.2.2.27	MSC-BSS	M	2n+3 to 7n+3
Cell identifier	3.2.2.17	MSC-BSS	O*	3-10

* only required for multi cell BSSs.

3.2.1.15. HANDOVER CANDIDATE RESPONSE

This message is sent from BSS to MSC in response to receipt of a handover candidate enquire message. It contains the number of mobiles for which handover required messages have been sent.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Number of MSs	3.2.2.8	BSS-MSC	M	2
Cell identifier	3.2.2.17	BSS-MSC	O*	3-10

* *only required for multi-cell BSSs*

3.2.1.16. HANDOVER FAILURE

This message is sent from BSS to MSC. It indicates to the MSC that there has been a failure in the resource allocation process on handover, and that the handover has been aborted.

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
RR Cause	3.2.2.22	BSS-MSC	O	2

Allowable cause values : as for assignment failure.

3.2.1.17. RESOURCE REQUEST

This Message is sent from MSC to BSS and requests the current spare resource [on a particular cell].

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Periodicity	3.2.2.12	MSC-BSS	M	2
Resource Indication Method	3.2.2.29	MSC-BSS	M	2
Cell Identifier	3.2.2.17	MSC-BSS	O*	3-10

* Only required for multi cell BSSs.

3.2.1.18. RESOURCE INDICATION

This message is sent from BSS to MSC in response to a resource request message, the message includes an explicit indication of the cell concerned.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Resource available	3.2.2.4	BSS-MSC	M	21
Cell Identifier	3.2.2.17	BSS-MSC	O*	3-10

* This element is only required for multi cell BSSs.

3.2.1.19. PAGING

This message is sent from MSC to BSS and contains sufficient information to allow the paging message to be transmitted by the correct cells at the correct time.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
IMSI	3.2.2.6	MSC-BSS	M	3-10
TMSI	3.2.2.7	MSC-BSS	O**	3-6
Cell Identifier list	3.2.2.27	MSC-BSS	O*	3 to 3+7n

* This element is only required for multi-cell BSSs. More than one cell identifier element may be included to allow the paging of several cells within a BSS on receipt of a single paging message from the MSC.

** The element is omitted in the exceptional case where the IMSI is used instead of the TMSI as a paging address at the radio interface.

3.2.1.20. CLEAR REQUEST

This message is sent from the BSS to the MSC to indicate to the MSC that the BSS wishes to release the associated dedicated resource.

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

Allowable cause values: radio interface message failure,operation and maintenance intervention,equipment failure, ciphering algorithm not supported, protocol error between BSC and MSC.

3.2.1.21. CLEAR COMMAND

This message is sent from MSC to BSS to instruct the BSS to release the associated dedicated resource.

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	MSC-BSS	M	1
Layer 3 header information	3.2.2.9	MSC-BSS	M	4
Cause	3.2.2.5	MSC-BSS	M	3-4

Allowable cause values: call control, operation and maintenance intervention, equipment failure, handover successful, protocol error between BSC and MSC.

3.2.1.22. CLEAR COMPLETE

This message is sent from the BSS to the MSC to inform the MSC that the associated dedicated resource has been successfully cleared.

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

3.2.1.23. RESET

This message can be sent either from BSS to MSC or MSC to BSS. It indicates to the receiving entity that the transmitting entity has suffered a failure and has lost memory of the calls in progress, calls set up, and associated references.

This message is sent as a connectionless message.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
Cause	3.2.2.5	Both	M	3-4

Allowable cause values:Operation and maintenance intervention, equipment failure.

3.2.1.24. RESET ACKNOWLEDGE

This message can be sent either from BSS to MSC or MSC to BSS. It indicates to the receiving entity that the transmitting entity has cleared all calls and reset all references, and is ready to resume service.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1

3.2.1.25. HANDOVER PERFORMED

This message is sent from the BSS to the MSC in order to indicate that the BSS has performed an internal handover.

The cell identifier and (if required for O and M reasons) optionally the new channel identity is included.

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
Cell identifier	3.2.2.17	BSS-MSC	O*	3-10
Radio channel identity	3.2.2.3	BSS-MSC	O**	5-38

Cause values as for the handover required message, except response to MSC invocation.

* Only required for multi cell BSSs.

** Optional inclusion for O and M purposes.

3.2.1.26. OVERLOAD

This message is sent from BSS to MSC or MSC to BSS. When sent from BSS to MSC it indicates either processor overload of the whole BSS (cell identifier field not present) or overload of a CCCH downlink in which case the relevant cell is identified for multi cell BSSs.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
Cause	3.2.2.5	Both	M	3-4
Cell identifier	3.2.2.17	BSS-MSC	O*	3-10

* Only required for multi cell BSSs.

Cause values : Processor overload, CCCH overload, O&M intervention.

3.2.1.27. TRACE INVOCATION

This message is sent from MSC to BSS or from BSS to MSC in order to start production of a trace record at the receiving entity.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
Trace number	3.2.2.23	Both	M	3

3.2.1.29. CLASSMARK UPDATE

This message is sent from a BSS to an MSC via the relevant SCCP connection associated with that MS transaction. It updates the classmark parameters for the concerned MS.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Classmark information type 2	3.2.2.19	BSS-MSC	M	4

3.2.1.30. CIPHER MODE COMMAND

This message is sent from an MSC to an BSS via the relevant SCCP connection associated with that MS transaction. It updates the encryption parameters for the concerned MS.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Layer 3 header information	3.2.2.9	MSC-BSS	M	4
Encryption information	3.2.2.10	MSC-BSS	M	3-20

3.2.1.31. CIPHER MODE COMPLETE

This message is sent from BSS to MSC via the relevant SCCP connection. It indicates that a successful cipher synchronisation has been achieved across the air interface.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1

3.2.1.32. COMPLETE LAYER 3 INFORMATION

The message is sent from BSS to MSC as described in 3.1.16 (on receipt of the intitial layer3 message on a dedicated channel, e.g. Page response, Location Update Request, Re-est Req, CM service request)

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
Cell Identifier	3.2.2.17	BSS-MSC	M	3-10
Layer 3 information	3.2.2.24	BSS-MSC	M	3-n

3.2.1.33. QUEUEING INDICATION

The message is sent from BSS to MSC in order to indicate a delay in the assignment of the required TCH.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1

3.2.1.34. SAPI "n" REJECT

The message is sent from BSS to MSC in order to indicate that a message with a SAPI value other than "0" has been rejected.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1
DLCI	3.2.2.25	BSS-MSC	M	2
Cause	3.2.2.5	BSS-MSC	M	3-4

Allowed cause values are : O&M intervention, processor overload, BSS not equiped, MS not equipped.

3.2.1.35. SAPI "n" CLEAR COMMAND

The message is sent from BSS to MSC or vice versa in order to instruct the receiving entity to release resources concerned with SAPI "n".

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
DLCI	3.2.2.25	Both	M	2

3.2.1.36. SAPI "n" CLEAR COMPLETE

The message is sent from BSS to MSC or vice cersa in order to indicate that the transmitting entity has released all resources concerned with SAPI "n".

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
DLCI	3.2.2.25	Both	M	2

3.2.1.37. HANDOVER REQUIRED REJECT

This message is sent from MSC to BSS. It indicates to the BSS that the Handover Required message has not resulted in handover.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	MSC-BSS	M	1
Cause	3.2.2.5	MSC-BSS	M	3-4

Allowed cause values: equipment failure, no radio resource available, requested terrestrial resource unavailable, requested transcoding/rate adaptation unavailable, O&M intervention

3.2.1.38. RESET CIRCUIT

The message is sent from either from BSS to MSC or from MSC to BSS. It indicates to the receiving entity that the state of the circuit indicated in the message is unknown, due to a failure.

This message is sent as a connectionless message.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
Circuit identity code	3.2.2.2	Both	M	3
Cause	3.2.2.5	Both	M	3-4

Allowed cause values are as for the RESET message.

3.2.1.39. RESET CIRCUIT ACKNOWLEDGE

The message is sent either from BSS to MSC or from MSC to BSS. It indicates to the receiving entity that the transmitting entity has cleared a possible call using the circuit, and is ready to resume service.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	Both	M	1
Circuit Identity	3.2.2.2	Both	M	3

3.2.1.40. HANDOVER DETECT

This message is sent from BSS to MSC.
It indicates that the correct MS has successfully accessed the target cell.

INFORMATION ELEMENT	REFERENCE	DIRECTION	TYPE	LEN
Message type	3.2.2.1	BSS-MSC	M	1

3.2.2. SIGNALLING ELEMENT CODINGS

This paragraph contains the codings of the signalling elements used.

The following conventions are assumed for the sequence of transmission of bits and bytes:

■ Each bit position is marked as 1 to 8. Bit 1 is the least significant bit and is transmitted first.

■ In a message octets are identified by number, octet 1 is transmitted first, then octet 2 etc.

For variable length fields a length indicator is included, this indicates the number of octets following in the element.

All information elements are mandatory unless otherwise specified. The information Element Identifier shall always be included.

All spare bits are set to 0.

The elements used and their codings are :

Element Identifier Coding	Element name	Reference
0000 0000	Spare	
0000 0001	Circuit identity code	3.2.2.2.
0000 0010	Radio channel identity	3.2.2.3.
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 1110	Number of MSs	3.2.2.8.
0000 1111	Spare	
0001 0000	Current radio environment	3.2.2.14.
0001 0001	Environment of BS "n"	3.2.2.15.
0001 0010	Classmark information type 2	3.2.2.19.
0001 0100	Interference band to be used	3.2.2.21.
0001 0101	RR Cause	3.2.2.22.
0001 0110	Trace number	3.2.2.23.
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.

3.2.2.1. MESSAGE TYPE

Message type uniquely identifies the message being sent. It is a single octet element, mandatory in all messages.

Bit 8 is reserved for future extension of the codeset. All unassigned codes are spare.

8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Reserved.
ASSIGNMENT MESSAGES	
0 0 0 0 0 0 0 1	Assignment Request
0 0 0 0 0 0 1 0	Assignment complete
0 0 0 0 0 0 1 1	Assignment failure
HANDOVER MESSAGES	
0 0 0 1 0 0 0 0	Handover request
0 0 0 1 0 0 0 1	Handover required
0 0 0 1 0 0 1 0	Handover request acknowledge
0 0 0 1 0 0 1 1	Handover command
0 0 0 1 0 1 0 0	Handover complete
0 0 0 1 0 1 1 0	Handover failure
0 0 0 1 0 1 1 1	Handover performed
0 0 0 1 1 0 0 0	Handover candidate enquire
0 0 0 1 1 0 0 1	Handover candidate response
0 0 0 1 1 0 1 0	Handover required reject
0 0 0 1 1 0 1 1	Handover detect
RELEASE MESSAGES	
0 0 1 0 0 0 0 0	Clear command
0 0 1 0 0 0 0 1	Clear complete
0 0 1 0 0 0 1 0	Clear request
0 0 1 0 0 0 1 1	SAPI "n" clear command
0 0 1 0 0 1 0 0	SAPI "n" clear complete
0 0 1 0 0 1 0 1	SAPI"n" reject
GENERAL MESSAGES	
0 0 1 1 0 0 0 0	Reset
0 0 1 1 0 0 0 1	Reset Acknowledge
0 0 1 1 0 0 1 0	Overload
0 0 1 1 0 0 1 1	Trace invocation
0 0 1 1 0 1 0 0	Reset Circuit
0 0 1 1 0 1 0 1	Reset Circuit acknowledge
TERRESTRIAL RESOURCE MESSAGES	
0 1 0 0 0 0 0 0	Block
0 1 0 0 0 0 0 1	Blocking acknowledge
0 1 0 0 0 0 1 0	Unblock
0 1 0 0 0 0 1 1	Unblocking acknowledge
RADIO RESOURCE MESSAGES	
0 1 0 1 0 0 0 0	Resource request
0 1 0 1 0 0 0 1	Resource indication
0 1 0 1 0 0 1 0	Paging
0 1 0 1 0 0 1 1	Cipher mode command
0 1 0 1 0 1 0 0	Classmark update
0 1 0 1 0 1 0 1	Cipher Mode Complete
0 1 0 1 0 1 1 0	Queing Indication
0 1 0 1 0 1 1 1	Complete layer 3 information

3.2.2.2. Circuit Identity code

This element defines the terrestrial channel over which the call will pass.

If a 2048kbits/s digital path is used then the circuit identification code contains in the 5 least significant bits a binary representation of the actual number of the timeslot which is assigned to the circuit. The remaining bits in the CIC are used where necessary, to identify one among several systems interconnecting an originating and destination point.

The element is 2 octets in length:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
a	b	c	d	e	f	g	h	octet 2
i	j	k	X	X	X	X	X	octet 3

a-k defines the PCM multiplex in use.

XXXXX define the actual timeslot in use.

The circuit identity code defines the PCM multiplex and timeslot in use at the MSC. In cases where remultiplexing takes place between the MSC and BSS a translation may be necessary at the BSS.

3.2.2.3. RADIO CHANNEL IDENTITY

The element is coded as:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
04.08 "Channel description"								octet 3
04.08 "Frequency channel sequence"								octet 4
04.08 "Mobile allocation"								octet 5 *
04.08 "Starting time"								octet 6

An * means that the whole of the 04.08 element including the element identifier and length should be included.

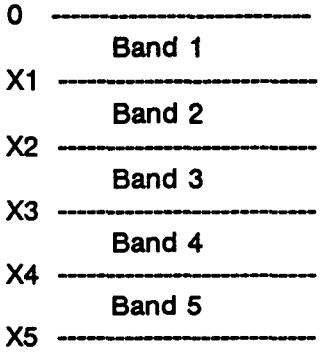
Only those elements required are included. For details refer to 04.08.

3.2.2.4. RESOURCE AVAILABLE

This element gives the number of full and half rate channels available on any given cell at the time of construction of the message.

It defines these parameters in terms of the number of channels available in five interference bands, the boundaries of these bands being set by O and M as follows:

Interference level :



The element is coded as follows :

8 7 6 5 4 3 2 1	
Element identifier	octet 1
Number of full rate channels available in band 1	octet 2 octet 3
Number of half rate channels available in band 1	octet 4 octet 5
:	: :
Number of full rate channels available in band 5	octet 18 octet 19
Number of half rate channels available in band 5	octet 20 octet 21

Octets (2,3,4,5,) are then repeated for each of the other interference bands giving a total message length of 21 octets.

Octets 2 and 3 give a 16 bit binary representation of the number of full rate channels available for service but not currently assigned.

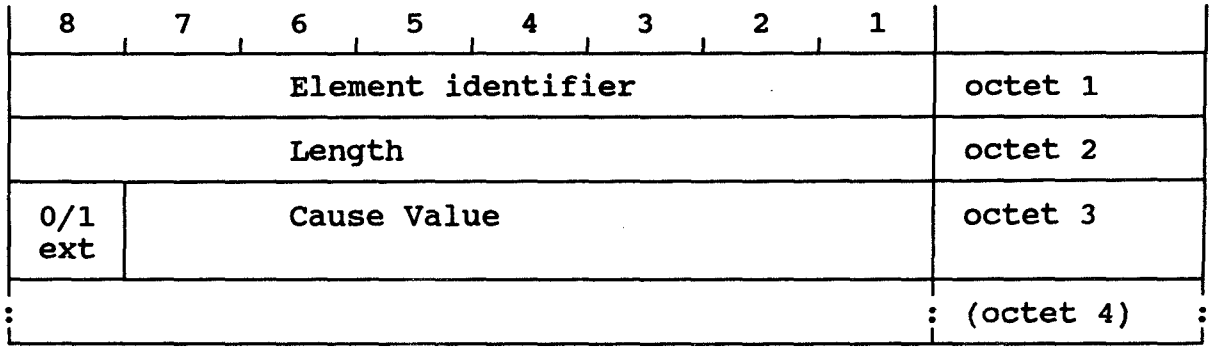
Octets 4 and 5 give a 16 bit binary representation of the number of half rate channels available for service but not currently assigned. This will include half rate channels already counted in octets 2 and 3, if these correspond to full rate channels that can be used as half rate channels.

(eg. If there is a spare half rate channel and a spare full rate channel that can be used as two half rate channels, then the full rate count will be 1 and the half rate count will be 3)

3.2.2.5. CAUSE

The cause element is used to indicate the reason for a particular event to have occurred and is coded as shown below.

The cause value is a single octet element if the extension bit (bit 8) is set to 0. If it is set to 1 then the cause value is a 2 octet field. If the value of the first octet of the cause field is 1XXX 0000 then the second octet is reserved for national applications, (XXX will still indicate the class).



The length indicator is a binary representation of the length of the following element.

Cause Value:

Class (000) : Normal event
Class (001) : Normal event
Class (010) : Resource unavailable
Class (011) : Service or option not available
Class (100) : Service or option not implemented
Class (101) : invalid message (eg parameter out of range)
Class (110) : protocol error
Class (111) : interworking

Cause value		Cause Number	
Class	Value		
7 6 5	4 3 2 1		
0 0 0	0 0 0 0		Radio interface message failure
0 0 0	0 0 0 1		Radio interface failure
0 0 0	0 0 1 0		Uplink quality
0 0 0	0 0 1 1		Uplink strength
0 0 0	0 1 0 0		Downlink quality
0 0 0	0 1 0 1		Downlink strength
0 0 0	0 1 1 0		Distance
0 0 0	0 1 1 1		O and M intervention
0 0 0	1 0 0 0		Response to MSC invocation
0 0 0	1 0 0 1		Call control
0 0 0	1 0 1 0		Radio interface failure, reversion to old channel
0 0 0	1 0 1 1		Handover successful
0 0 0	1 1 0 0		Better Cell
0 0 1	0 0 0 0		}Reserved for international use
0 0 1	0 1 1 1		}
0 0 1	1 0 0 0		}Reserved for national use
0 0 1	1 1 1 1		}
0 1 0	0 0 0 0		Equipment failure
0 1 0	0 0 0 1		No radio resource available
0 1 0	0 0 1 0		Requested terrestrial resource unavailab
0 1 0	0 0 1 1		CCCH overload
0 1 0	0 1 0 0		Processor overload

Cause value		Cause Number	
Class	Value		
0 1 0	0 1 0 1		BSS not equipped
0 1 0	0 1 1 0		MS not equipped
0 1 0	0 1 1 1		}Reserved for international use
0 1 0	1 0 1 0		}
0 1 0	1 0 1 0		}Reserved for national use
0 1 0	1 1 1 1		}
0 1 1	0 0 0 0		Requested transcoding/rate adaption unavailable
0 1 1	0 0 0 1		}Reserved for international use
0 1 1	1 1 1 1		}
1 0 0	0 0 0 0		Ciphering algorithm not supported
1 0 0	0 0 0 1		}Reserved for international use
1 0 0	0 1 1 1		}
1 0 0	0 1 1 1		}Reserved for national use
1 0 0	1 1 1 1		}
1 0 1	0 0 0 0		Terrestrial circuit already allocated
1 0 1	0 0 0 1		}Reserved for international use
1 0 1	0 1 1 1		}
1 0 1	1 0 0 0		}Reserved for national use
1 0 1	1 1 1 1		}
1 1 0	0 0 0 0		Protocol Error between BSC and MSC
1 1 0	0 0 0 1		}Reserved for international use
1 1 0	0 1 1 1		}
1 1 0	1 0 0 0		}Reserved for national use
1 1 0	1 1 1 1		}
1 1 1	0 0 0 0		}Reserved for international use
1 1 1	0 1 1 1		}
1 1 1	1 0 0 0		}Reserved for national use
1 1 1	1 1 1 1		}

3.2.2.6. IMSI

The IMSI is coded as a sequence of BCD digits, compressed two into each octet. This is a variable length element, and included a length indicator. The end of the element is indicated by a code 15, if this does not equate to an integral number of octets in the message then a filler nibble will be added as shown.

The element coding is:

8 7 6 5 4 3 2 1	
Element identifier	octet 1
Length	octet 2
Rest of element coded as in GSM 04.08, not including GSM 04.08 element identifier or GSM 04.08 octet length value	octet 3 - n

3.2.2.7. TMSI

The TMSI is a variable length element, and therefore contains a length indicator. The TMSI is an unstructured number of up to 4 octets in length, it is however an integral number of octets.

The coding is:

8 7 6 5 4 3 2 1	
Element identifier	octet 1
Length	octet 2
TMSI	octet 3 - n

The length octet is of minimum value 1 and maximum value 4.

The TMSI field is unstructured.

3.2.2.8. NUMBER OF MSs

This is a fixed length element which indicates the number of handover candidates that will be sent to the MSC.

The coding is:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Number of handover candidates								octet 2

Octet 2 is a binary indication of the number of handover candidates. Bit 1 is the least significant bit.

3.2.2.9. LAYER 3 HEADER INFORMATION

This element is used to supply the BSS with information that needs to be included in the header of layer 3 messages over the radio interface.

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
Protocol discriminator								octet 3
Transaction identifier								octet 4

The length indicator is a binary indication of the number of octets following in the element.

The transaction identifier and protocol discriminator fields are coded as defined in recommendation GSM 04.08. The protocol discriminator occupies bit 1 to 4 in octet 3 of Layer 3 header information, the Transaction identifier occupies bit 1 to 4 in octet 4 of the Layer 3 header information.

3.2.2.10. ENCRYPTION INFORMATION

This element contains the user data encryption information used to control any encryption equipment at the BSS.

It is a variable length element.

It is coded as follows:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
Algorithm identifier								octet 3
Key								octet 4 - n

The length indicator (octet 2) is a binary number indicating the absolute length of the contents after the length indicator octet.

The algorithm identifier is caters the possible future introduction of different user data encryption algorithms. It is coded as;

```
0000 0000 .. Spare
0000 0001 .. No encryption required
0000 0010 .. GSM user data encryption version 1.
0000 0011 .. Reserved for future international use.
1111 1111 ..
```

The key shall be an integral number of octets. Its length is given as the value of the length indicator minus 1.

3.2.2.11. CHANNEL TYPE

This element contains all of the information that the BSS requires to determine the radio resource that is required.

It is coded as follows:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
Speech or data indicator								octet 3
Channel rate and type								octet 4
Speech encoding algorithm / data rate + tranparency indicator								octet 5

The speech or data octet is coded as follows:

```
0000 0000   Spare
0000 0001   Speech
0000 0010   Data
0000 0011   Signalling
```

For values 0000 0001 and 0000 0010 a dedicated terrestrial resource is also required, for value 0000 0011 a dedicated terrestrial resource is not required.

The channel rate is coded as follows:

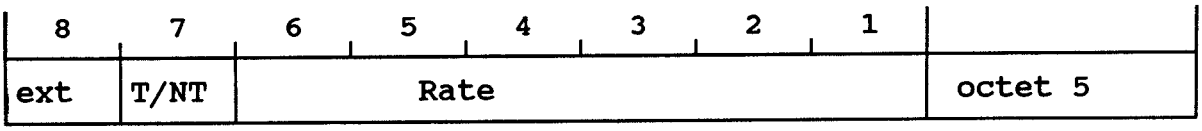
```
0000 0000   Spare
0000 0001   SDCCH

0000 0010   Reserved for future use
0000 0111

0000 1000   Full rate TCH channel Bm
0000 1001   Half rate TCH channel Lm
0000 1010   Reserved for future international use
1111 1111
```

It describes the radio channel type and rate.The "speech encoding algorithm/transparency indicator"is coded as follows:

If octet 3 indicates that the call is a speech call or signalling (eg DCCH) then octet 5 is coded as follows:

```
0000 0000   No resources required
0000 0001   GSM speech algorithm version 1
0000 0010   Spare reserved for future international use
1111 1111
```

If octet 3 indicates that the call is a data call then octet 5 shall be coded as follows:




```
Bit 8 :  reserved for extension.
Bit 7 :  0 Transparent service
         1 Non-transparent service.
Bits 6-1 indicate the data rate;
  00 0000 spare
  00 0001 Reserved for international use
  00 1000
  01 0000 9.6kbits/s
  01 0001 4.8kbits/s
  01 0010 2.4kbits/s
  01 0011 1.2Kbits/s
  01 0100 600 bits/s
  01 0101 1200/75 bit/s (1200 network-to-MS)
                        (  75 MS-to-network)
```

Note: For data services, the information in the CHANNEL TYPE message is used to set the "E-bits" and map the "D-bits" (as described in GSM 04.21 and 08.20) and to select the correct channel coding.

3.2.2.12. PERIODICITY

This element defines the periodicity of a particular procedure. It is fixed length, 2 octets.

The coding is as follows:

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

The coding of the periodicity parameter is :

0000 0001 Period 1111 1111

Where the period, when not equal to zero, is the binary value of octet 2 * 100ms (ie 100ms to 25,500 ms).

3.2.2.13. [Spare]

3.2.2.14. CURRENT RADIO ENVIRONMENT

The current radio environment element is of variable length and will contain the following fields:

8 7 6 5 4 3 2 1	
Element identifier	octet 1
Length	octet 2
Hreqave	octet 3
Hreqt	octet 4
Uplink signal strength Full	*
Uplink signal strength Sub	*
Downlink signal strength Full	*
Downlink signal strength Sub	*
Hreqave	
Hreqt	
Uplink signal quality	*
Downlink signal quality	*
Hreqave	
Hreqt	
Distance	*
Hreqave	
Uplink power level	
Downlink power level	

The length indicator is a binary number indicating the length of the remaining element.

All of the parameters that are marked with an asterisk will be coded as follows:

Two parameters are defined per cell, Hreqave and Hreqt for each of the parameter pairs, up/down link signal strength, up/down link signal quality, and distance.

Hreqave: defines the period over which an average is produced, in terms of the number of SACCH blocks containing measurement results.

Hreqt : is the number of averaged results that are concatenated.

Both of these parameters are included in the message as single octet binary numbers, before each of the measurement averages that have been produced using them.

E.g.,assume that for a particular parameter (eg uplink signal strength) the received values are UplinkSST

Where "T" indicates that this is the result at time "T".

Then if for example

```
Hreqave = 4
HreqT   = 3
```

The element coding will be :

Average 1	*	(1)
Average 2	*	(3)
Average 3	*	(5)

Each of the average fields are single octet fields calculated in the following way:

$$\text{Average 1} = \frac{\sum_{T}^{T-3} \text{UplinkSST}}{4}$$

$$\text{Average 2} = \frac{\sum_{T-4}^{T-7} \text{UplinkSST}}{4}$$

$$\text{Average 3} = \frac{\sum_{T-8}^{T-11} \text{UplinkSST}}{4}$$

Each of the elements marked is coded as above.

The BSS shall be able to support this function for:

```
     0 < Hreqave < 32
and  0 < Hreqt   < 32
```

Where Hreqave*Hreqt < 32

The values that are averaged are all single octet values defined as follows:

Distance:

6 bit number defined in the 05 series of recommendations giving the adaptive frame alignment value, the result will occupy the least six significant bits of the octet.

Downlink Signal Strength Full:

6 bit number defined in the 05 series of recommendations, the result will occupy the least six significant bits of the octet. Bit 7 indicates with a "1" that DTX was used by the MS transmitter during the average period or part thereof.

Downlink signal strength Sub:

6 bit number defined in the 05 series of recommendations, the result will occupy the least six significant bits of the octet.

Downlink Signal quality :

Two 3 bit numbers, RXQUAL-FULL(bits 6,5,4) and RXQUAL-SUB(bits 3,2,1) as defined in the 05 series of recommendations, the result will occupy the least six significant bits of the octet. Bit 7 indicates with a "1" that DTX was used by the BS transmitter during the averaging period or part thereof.

Uplink Signal Strength Full:

6 bit number coded as defined in the 05 series of recommendations, indicating the received signal level at the transceiver, the result will occupy the least six significant bits of the octet. Bit 7 indicates with a "1" that DTX was used by the BS transmitter during the averaging period or part thereof.

Uplink Signal Strength Sub:

6 bit number coded as defined in the 05 series of recommendations, indicating the received signal level at the transceiver on a subset of slots. The result will occupy the six least significant bits of the octet.

Uplink Signal quality :

Two 3 bit numbers, RXQUAL-FULL(bits 6,5,4) and RXQUAL-SUB(bits 3,2,1) as defined in the 05 series of recommendations indicating the received signal quality at the transceiver, the result will occupy the least six significant bits of the octet. Improved measurement algorithms are for discussion between operators and manufacturers. Bit 7 indicates with a "1" that DTX was used by the BS transmitter during the averaging period or part thereof.

The field marked uplink power level indicates the power level of the uplink at the end of the averaging period, it is coded identically to that described in section 3.2.2.13 octet (2).

The field marked downlink power level indicates the power level of the downlink at the end of the averaging period, it represents the output power of the relevant transceiver(s) at the end of the averaging period.

3.2.2.15. ENVIRONMENT OF BS "n"

This is a variable length element, the length element defining the number of following octets.

It is coded as follows:

8 7 6 5 4 3 2 1	
Element identifier	octet 1
Length	octet 2
Hreqave	octet 3
Hreqt	octet 4
Number of BSs	octet 5
BSIC 1	octet 6
Freq 1	octet 7
Average 1	octet 8 - (7+Hreqt)
:	:
BSIC n	
Freq n	
Average n	

The values of Hreqt and Hreqave are defined by O and M for each cell for the averaging of reported measurements. The values of Hreqave and Hreqt used for this averaging process can be different from those used in section 3.2.2.14.

Octets 6,7 and (8 to 7+Hreqt) are repeated for each BS that is reported from the MS.

In the BSIC octet, the six low order bits give the BSIC of a cell as defined for the BSIC-NCELL field of the Measurement Result information element of Recommendation GSM 04.08. Bits 8 and 7 are reserved. In the FREQ octet, the five low-order bits give the BCCH frequency of a cell as defined for the BCCH-FREQ-NCELL field of the Measurement Result information element of Rec. GSM 04.08. Bits 6-8 are reserved.

Each average is calculated as described in section 3.2.2.14. using the 6 bit input values received from the MS (see recommendation GSM 05.08). If a BSIC+FREQ combination is not reported by an MS in all Measurement Reports during the averaging period, it shall be assumed that the measured value is 0 for Measurement reports in which it was not reported.

3.2.2.17. CELL IDENTIFIER

This element uniquely identifies a cell within a BSS and is of variable length containing the following fields:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
Cell identification discriminator								octet 3
Cell identification 1								octet 4 - 10

The coding of octet 2 is a binary number indicating the length of the remaining element. The length depends on the Cell identification discriminator (octet 3).

The coding of octet 3 is a binary number indicating if the whole or a part of Cell Global Identification, CGI, according to Recommendation GSM 03.03 is used for cell identification in octet 4-n. Octet 3 is coded as follows:

0000 0000 The whole Cell Global Identification, CGI, is used to identify the cell.
0000 0001 Location Area Code, LAC, and Cell Identity, CI, is used to identify the cell.
0000 0010 Cell Identity, CI, is used to identify the cell.
0000 0011 No cell is associated with the transaction.

The coding of octet 4-n depends on the Cell identification discriminator (octet 3). Below the coding is shown for each Cell identification discriminator :

The Cell identification discriminator = 0000 0000

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	0	0	octet 3
MCC dig 2				MCC dig 1				octet 4
1	1	1	1	MCC dig 3				octet 5
MNC dig 2				MNC dig 1				octet 6
LAC								octet 7
LAC cont.								octet 8
CI value								octet 9
CI value cont								octet 10

The octets 4-8 are coded as shown in Table 10.9/GSM 04.08.

The octets 9-10 are coded as shown in Table 10.7/GSM 04.08.

The Cell identification discriminator = 0000 0001

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	0	1	octet 3
LAC								octet 4
LAC cont.								octet 5
CI value								octet 6
CI value cont								octet 7

The Cell identification discriminator = 0000 0010

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	1	0	octet 3
CI value								octet 4
CI value cont								octet 5

The octet 4-5 are coded as shown in Table 10.7/GSM 04.08.

The Cell identification discriminator = 0000 0011

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	1	1	octet 3

3.2.2.18. PRIORITY

This element indicates the priority of the request. It is coded as follows:

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

Octet 2 is a binary indication of the length of the rest of the element.

Octet 3 is coded as follows:

8	7	6	5	4	3	2	1	
spare		priority level				qa	pe	octet 3

Bits 7 and 8 are spare, set to 0 priority level:

```
     6 5 4 3
     0 0 0 0  spare
     0 0 0 1  priority level  1 = highest priority
     0 0 1 0  priority level  2 = second highest priority
     : : : :
     1 1 1 0  priority level 14 = lowest priority
     1 1 1 1  priority not used

qa = queueing allowed indicator
     0        queueing not allowed
     1        queueing allowed

pe = preemption allowed indicator
     0        preemption  not allowed
     1        preemption  allowed
```

3.2.2.19. CLASSMARK INFORMATION TYPE 2

The classmark information type 2 defines certain attributes of the mobile station equipment in use on a particular transaction.

It is coded as follows:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
Classmark								octet 3 - 4

Octet 2 is a binary indication of the length of the remainder of the element in octets.

The classmark octets 3 and 4 are coded in the same way as the equivalent octets in the classmark 2 element of 04.08.

3.2.2.20. [Spare]

3.2.2.21. INTERFERENCE BAND TO BE USED

This fixed length element is coded as follows:

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Band to be used								octet 2

Octet 2 is coded as :

Bits 876 - Spare
Bits 54321 - A bit map indicating which interference bands are acceptable, the LSB represents the least level of interference.

3.2.2.22. RR CAUSE

This fixed length element is passed from the air interface to the MSC transparently, when received in a Recommendation GSM 04.08 message.

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

Octet 2 is coded as the equivalent field from Recommendation GSM 04.08.

3.2.2.23. TRACE NUMBER

A fixed length element giving a 16 bit binary reference number.

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Trace number								octet 2 - 3

Octet 2 and 3 are the 16 bit binary reference number.

3.2.2.24. LAYER 3 INFORMATION

This is a variable length element used to pass layer three messages from the air interface to the MSC unchanged. It differs from the DTAP message because the BSS analyses part of the message as it passes through the BSS, it is not therefore a transparent message as such.

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
Layer 3 information								octet 3 - n

Octet 1 identifies the element. Octet 2 gives the length of the following layer 3 information.

Octets 3 to n are the unchanged layer 3 information form the air interface, as defined in recommendation GSM 04.08.

3.2.2.25. DLCI

This is a fixed length element indicating the channel on which the SAPI value over the air interface that the transaction concerns.

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

Octet 2 is coded as the DLCI octet described in 08.06, with bits C2 and C1 being spare.

3.2.2.26. DOWNLINK DTX FLAG

A fixed length element indicating whether the DTX function in the BSS is to be disabled on a particular radio channel.

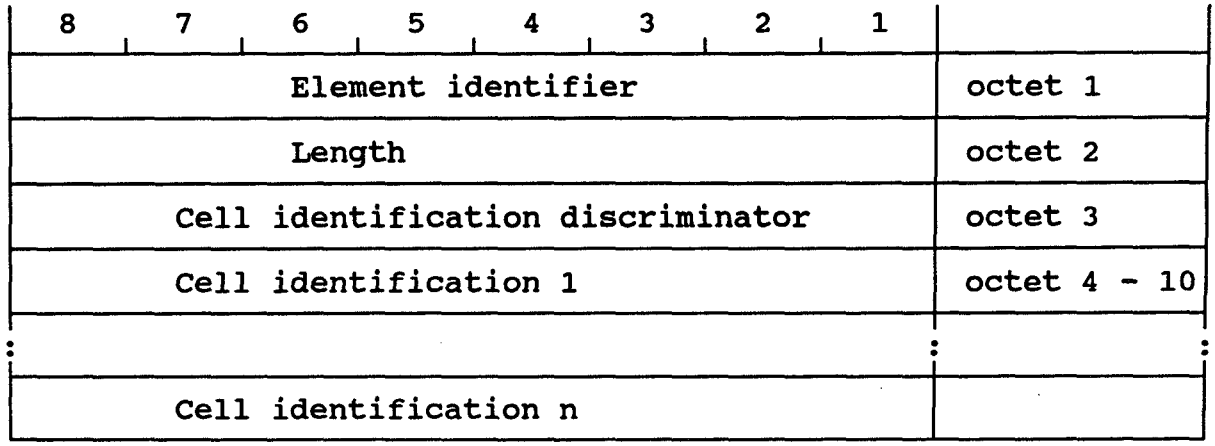
8	7	6	5	4	3	2	1	
Element identifier								octet 1
Downlink DTX flag								octet 2

The Downlink DTX Flag is coded as follows:

- bits 8 to 2 are spare;
- bit 1 is set to one if the DTX is disabled in the downlink direction; it is set to 0 otherwise.

3.2.2.27. CELL IDENTIFIER LIST

This element uniquely identifies cells within a BSS and is of variable length containing the following fields :



The coding of octet 2 is a binary number indicating the Length of the remaining element. The Length depends on the Cell identification discriminator (octet 3) as well as the number of cells to be identified.

The coding of octet 3 is a binary number indicating if the whole or a part of Cell Global identification, CGI, according to GSM 03.03 is used for cell identification of the cells in the list. Octet 3 is coded as follows :

0000 0000 The whole Cell Global Identification, CGI, is used to identify the cells.
0000 0001 Location Area Code, LAC, and Cell Identify, CI, is used to identify the cells.
0000 0010 Cell Identity, CI, is used to identify the cells.

0000 0011 No cell is associated with the transaction.

0000 0100 Location Area Identification, LAI, is used to identify all cells within a Location Area.
0000 0101 Location Area Code, LAC, is used to identify all cells within a location area.
0000 0110 All cells on the BSS are identified.

Values 0000 0100, 0000 0101 and 0000 0110 are only applicable for page message.

The coding of octet 4-n depends on the Cell identification discriminator (octet 3). Below the coding is shown for each Cell identification discriminator :

The Cell identification discriminator = 0000 0000

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	0	0	octet 3
MCC dig 2				MCC dig 1				octet 4
1	1	1	1	MCC dig 3				octet 5
MNC dig 2				MNC dig 1				octet 6
LAC								octet 7
LAC cont.								octet 8
CI value								octet 9
CI value cont								octet 10

The octets 4-8 are coded as shown in Table 10.9/GSM 04.08.

The octets 9-10 are coded as shown in Table 10.7/GSM 04.08.

The Cell identification discriminator = 0000 0001

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	0	1	octet 3
LAC								octet 4
LAC cont.								octet 5
CI value								octet 6
CI value cont								octet 7

The octets 4-5 are coded as shown in Table 10.9/GSM 04.08.

The octets 6-7 are coded as shown in Table 10.7/GSM 04.08.

The Cell identification discriminator = 0000 0010

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	1	0	octet 3
CI value								octet 4
CI value cont								octet 5

The octet 4-5 are coded as shown in Table 10.7/GSM 04.08.

The Cell identification discriminator = 0000 0011

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	0	1	1	octet 3

The Cell identification discriminator = 0000 0100

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	1	0	0	octet 3
MCC dig 2				MCC dig 1				octet 4
1	1	1	1	MCC dig 3				octet 5
MNC dig 2				MNC dig 1				octet 6
LAC								octet 7
LAC cont.								octet 8

The octets 4-8 are coded as shown in Table 10.9/GSM 04.08.

The Cell identification discriminator = 0000 0101

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	1	0	1	octet 3
LAC								octet 4
LAC cont.								octet 5

The octets 4-5 are coded as shown in Table 10.9/GSM 04.08.

The Cell identification discriminator = 0000 0110

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Length								octet 2
0	0	0	0	0	1	1	0	octet 3

3.2.2.28. RESPONSE REQUEST

The presence of this element indicates that a Handover Required Reject message is required by the BSS, if the Handover Required message does not result in a handover.

The element has a fixed length of one octet:

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

3.2.2.29. RESOURCE INDICATION METHOD

This element defines the way the BSS shall transfer the resource information related to a cell to the MSC. The coding is as follows :

8	7	6	5	4	3	2	1	
Element identifier								octet 1
Resource indication method								octet 2

The coding of the Resource Indication parameter is :

0000 0000 the method i) of section 3.1.3.1 is selected,
0000 0001 the method ii) of section 3.1.3.1 is selected,
0000 0010 the method iii) of section 3.1.3.1 is selected,
0000 0011 the method iv) of section 3.1.3.1 is selected.

Bits 8 to 3 are spare.

3.2.2.30. CLASSMARK INFORMATION TYPE 1

The classmark information type 1 defines certain attributes of the mobile station equipment in use on a particular transaction.

It is coded as follows:

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

The classmark octet 2 is coded in the same way as the equivalent octet in the classmark 1 element of 04.08.

3.2.3. List of Timers in the BSSMAP Procedures

Timer	Title	Time
T1	Time to receipt of blocking ack.	O&M
T2	Reset guard period at the MSC	O&M
T3	Resource indication periodicity	O&M
T4	Time to return of reset acknowledge	O&M
T5	Overload timer see 3.1.12.1	O&M
T6	Overload timer see 3.1.12.1	O&M
T7	Handover required periodicity	O&M
T8	Time to receipt of successful handover information	O&M
T10	Time to return of ASSignment COMPlete or Assignment Failure from MS (Note 1)	O&M
T11	Maximum allowed queuing time	O&M
T12	Time to receipt of Reset Circuit Acknowledge	O&M
T13	Reset guard period at the BSS	O&M
T16	Time to return of Reset Acknowledge at the MSC	O&M
T_{qho}	Maximum allowed queueing time for handover	O&M

Note 1: T10 is not the same as T3107 as defined in GSM 04.08

3.3. SDL Representation Of The Procedures At The BSS

The SDL diagrams may be inserted at a later stage after updating and carefully checking of consistency with the main text.

4. Broadcast INFORMATION CONTROL CHANNEL

Information that is transferred in the Broadcast Control Channel is stored locally at the BSS. The scheduling of this information on the BCCH is controlled autonomously by the BSS.

The set of information that is transmitted in the BCCH is derived locally or downloaded to the BSS via the BSS operation and maintenance application part.

5. VOCABULARY

This paragraph contains definition of terms:

BSS
Base Station System. This is the equipment which is accessed through the interface defined in the 08 series of recommendations. It contains the functionality described in 08.02, and supports one or more cells. See Rec. GSM 01.04.

BSSAP

The base station system application part, this is the subsystem that contains the process dealing with radio resource control and management known as the base station system management application part (BSSMAP) and transparent transfer of call control and mobility management information known as the direct transfer application part (DTAP). The BSSAPs at the BSS and the MSC are connected by means of SCCP connections.

DTAP

The DTAP, direct transfer application is a process which allows the direct transfer of messages between individual MSs and the MSC with no interpretation of layer 3 information at the BSS.

BSSMAP

Base station system management application part. This is the process within the BSS that controls radio resources in response to instructions from the MSC.

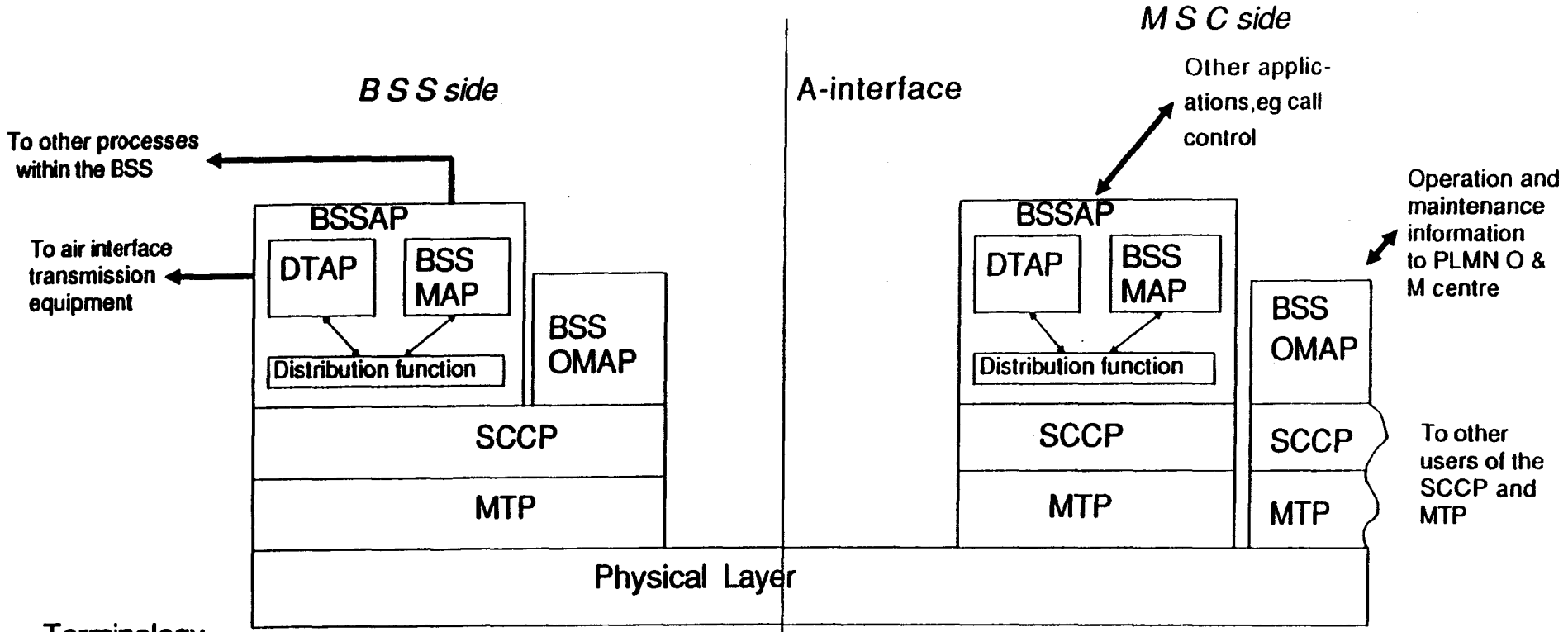
INTERNAL HANDOVER

An internal handover is a handover which takes place between channels on a cell or cells controlled by a single BSS. This handover operates without reference to the MSC (although the MSC will be informed on completion). Handovers of this type in one cell are called internal intra cell handovers and between cells are called internal inter cell handovers.

Handovers between channels on the same cell or between cells on the same BSS which are controlled by the MSC are external handovers and use identical procedures to those for inter-BSS handovers.

6. LIST OF DIAGRAMS

FIGURE 1
SIGNALLING PROTOCOL REFERENCE MODEL



Terminology

DTAP ; direct transfer application part
BSSMAP : BSS management application part
BSS OMAP : Operation and maintenance application part
SCCP : signalling connection control part
MTP : message transfer part
BSS : Base station system
MSC : Mobile services switching centre

Note: X.25 can be used for transferring O and M information

BSSMAP ELEMENTARY PROCEDURES ON THE BSS/MSC INTERFACE

PROCEDURES RELATING TO A SINGLE DEDICATED RESOURCE

ASSIGNMENT

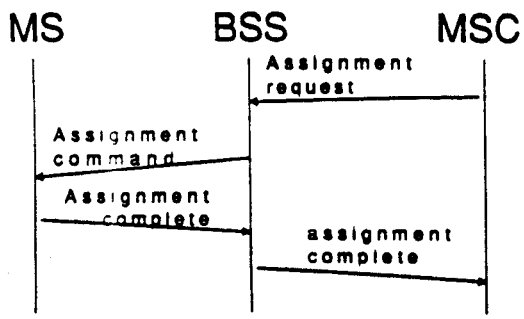


FIG 2

HANDOVER EXECUTION

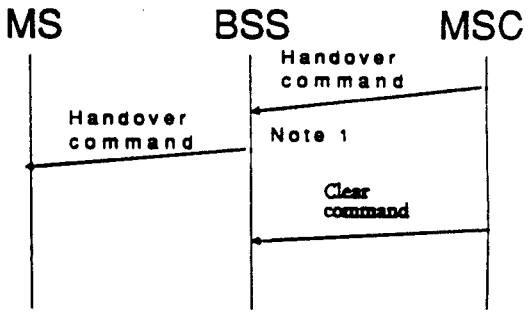


FIG 3

Note 1 : A timer T8 is started to protect the overall procedure

HANDOVER REQUIRED INDICATION

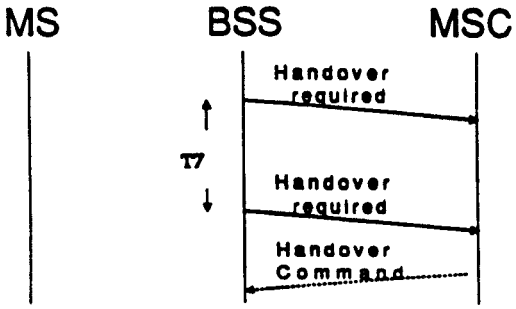


FIG 4

HANDOVER RESOURCE ALLOCATION

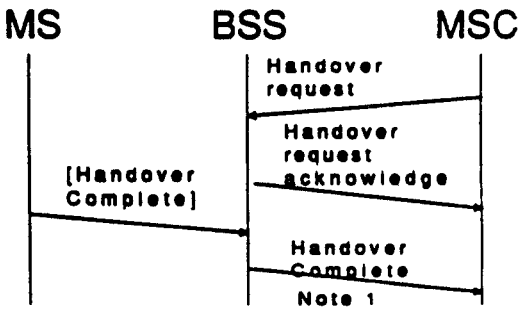


FIG 5

Note 1: The instant of generation of the handover complete is described in the text of recommendation 08.08

BSSMAP ELEMENTARY PROCEDURES ON THE BSS/MSC INTERFACE

PROCEDURES RELATING TO A SINGLE DEDICATED RESOURCE

RELEASE

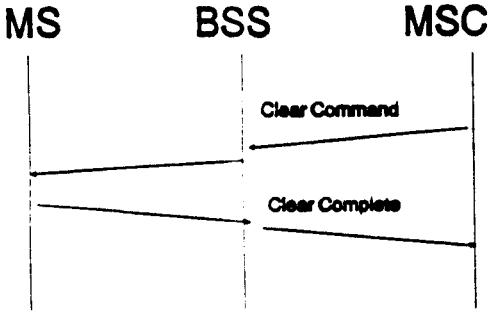


FIG 6

RELEASE DUE TO REASON AT THE BSS

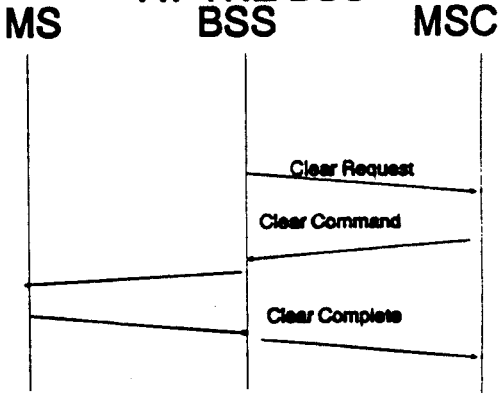


FIG 7

CLASSMARK UPDATING

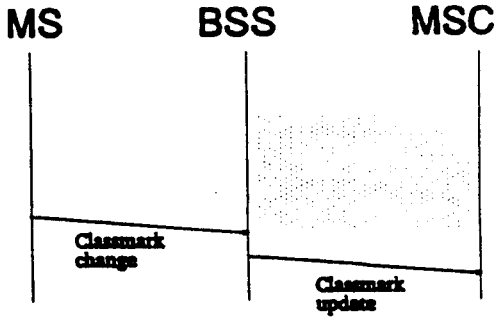


FIG 9

BSSMAP ELEMENTARY PROCEDURES ON THE BSS/MSC INTERFACE

GLOBAL PROCEDURES USING CONNECTIONLESS SCCP SERVICES

BLOCKING OF TERRESTRIAL CIRCUITS

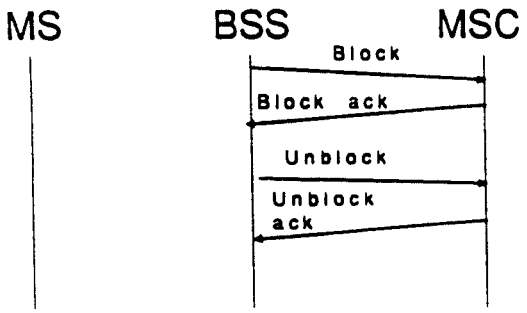


FIG 10

RESET

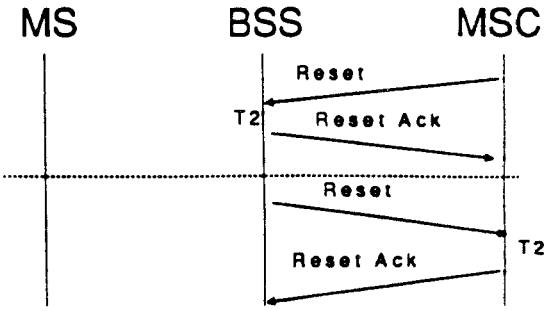


FIG 11

RESOURCE INDICATION

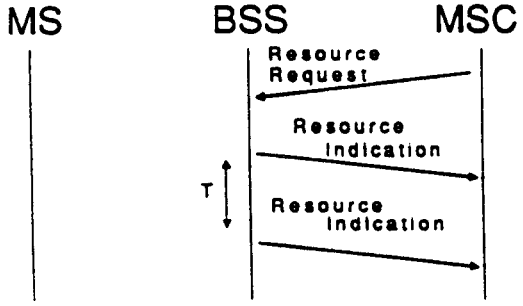


FIG 12

H/O CANDIDATE ENQUIRY

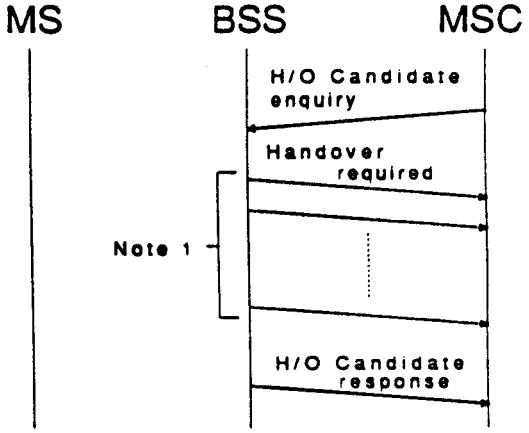


FIG 13

Note 1 : Receipt of the handover candidate enquiry message causes the generation of a handover required message for each candidate MS. These are sent as connection orie messages. When all handover req messages have been generated a global handover candidate respor message is returned.

FLOW CONTROL

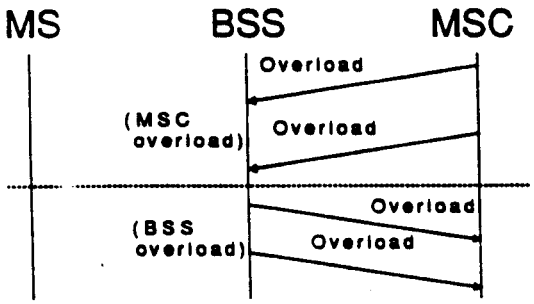


FIG 14

PAGING

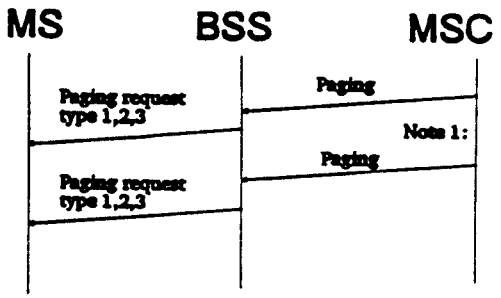
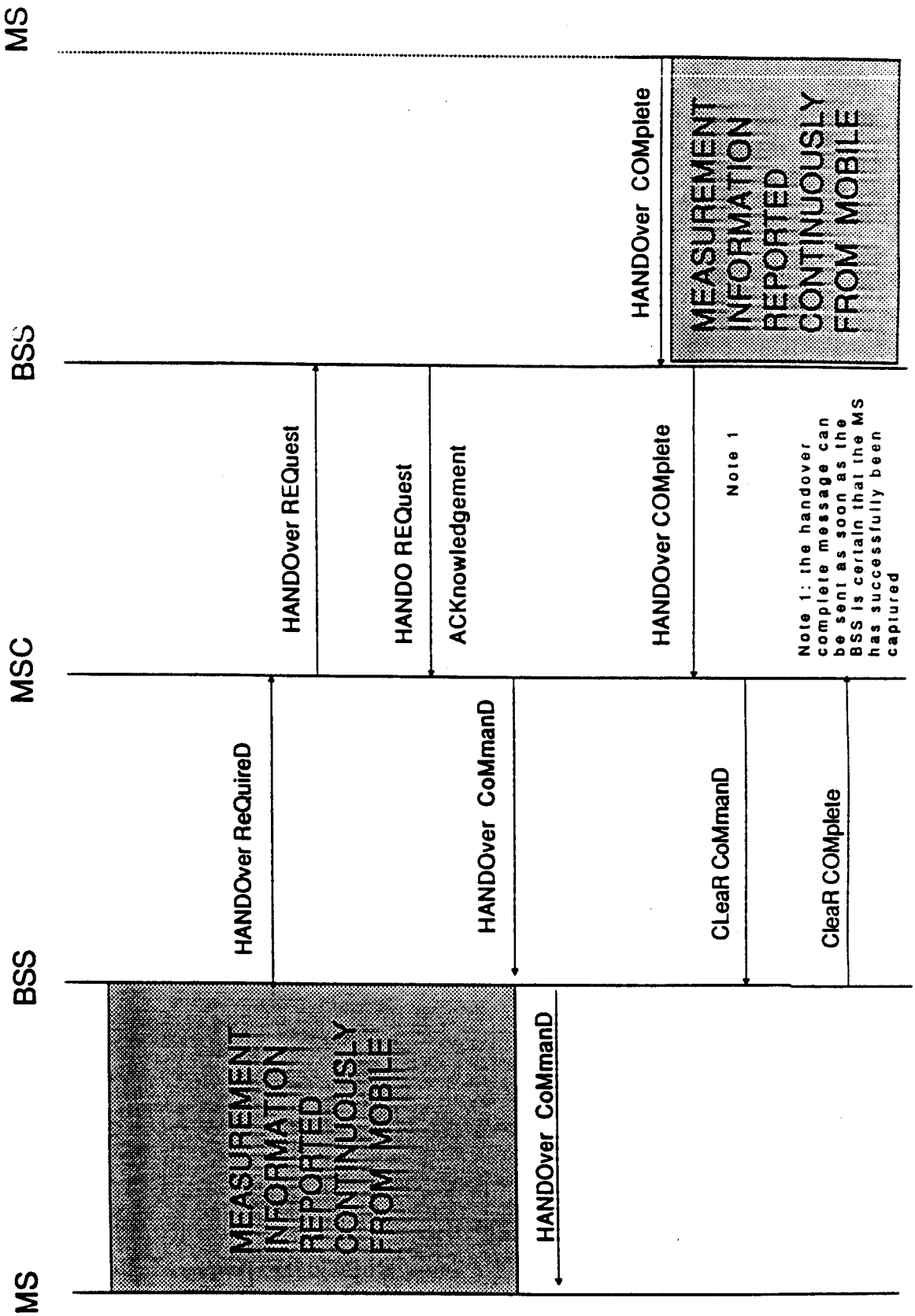


FIG 15

FIG 16: OVERVIEW OF THE HANDOVER PROCEDURE
BETWEEN TWO BSS'S ON THE
SAME MSC



E SSMAP ELEMENTARY PROCEDURES ON THE BSS/MSC INTERFACE

PROCEDURES RELATING TO A SINGLE DEDICATED RESOURCE

CIPHER MODE CONTROL

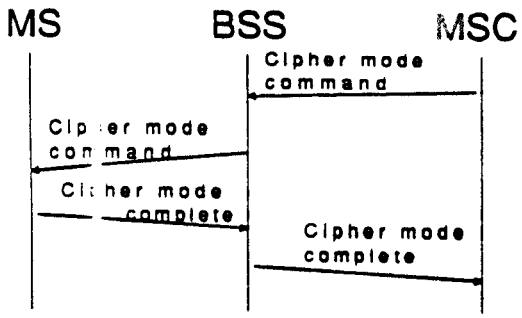


FIG 25

SAPI "n" REJECTION

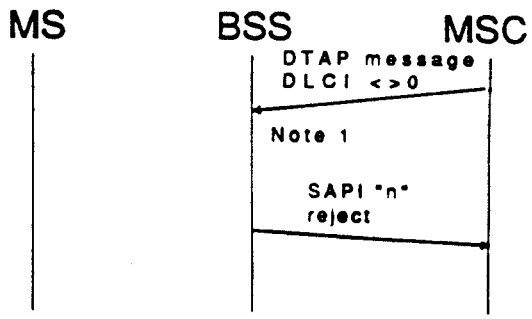


FIG 26a

Note 1 : The BSS or MS is not equipped for the SAPI requested

SAPI "n" RELEASE FROM MSC

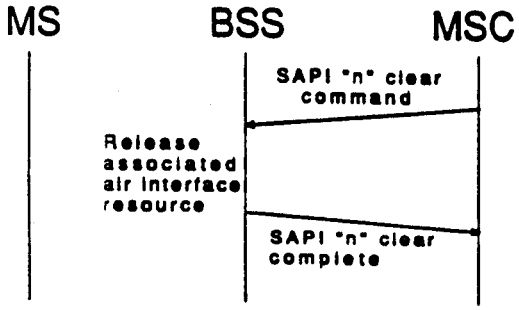


FIG 26b

SAPI "n" RELEASE FROM BSS

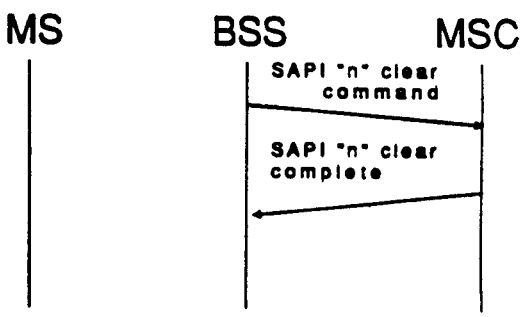


FIG 26c