3GPP TSG_CN#7 **NP-000090**

ETSI SMG3 Plenary Meeting #7,

Madrid, Spain

13th – 15th March 2000

Agenda item: **5.1.3**

Source: **TSG_N WG1**

Title: **CRs to 3G Work Item EDGE**

Introduction:

This document contains **"2"** CRs on **Work Item EDGE,** that have been agreed by **TSG_N WG1,** and are forwarded to **TSG_N Plenary** meeting #7 for approval.

Tdoc	Spec	CR	Rev	CAT	Rel.	Old Ver	New Ver	Subject
N1-000177	23.034	CR 003	2	B	R99	3.1.1	3.2.0	Modifications to Stage 2 service description due to EDGE
N1-000444	24.008	CR049	4	B	R99	3.2.1	3.3.0	Support of 400 and 850 MHz band"

3GPP TSG-CN-WG1, Meeting #10
11 - 14.January. 2000
Abiko, Japan

Tdoc N1-000177

CHANGE REQUEST

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23.034	CR	003r2	Current Version:	3.1.1

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

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

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

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

Source:	CN1		**Date:**	21.01.99		
Subject:	Modifications to Stage 2 service description due to EDGE					
Work item:	EDGE					

Category: *(only one category shall be marked with an X)*			**Release:**	
F	Correction		Phase 2	
A	Corresponds to a correction in an earlier release		Release 96	
B	Addition of feature	X	Release 97	
C	Functional modification of feature		Release 98	
D	Editorial modification		Release 99	X
			Release 00	

Reason for change:	Additions and changes for HSCSD service description due to EDGE
Clauses affected:	4. Main concepts; 5.1 Air Interface; 5.2.1.1 Mobile originated call establishment, Figure 3: Mobile originated call establishment; 5.2.1.2 Mobile terminated call establishment, Figure 4: Mobile terminated call establishment; new section 5.2.5 Link Adaptation for ECSD;

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

Other comments:	The contents of this CR is almost identical to CR 03.34 A004r4 (Tdoc 3A99-141), which was agreed in SMG3 WPA meeting January 1999. Furthermore the CR was agreed in STC SMG3 Plenary Meeting January 1999 (Tdoc 3P99-094). In SMG3 plenary it was put on hold to wait for the complete bundle. However, the CR wasn't implemented into the specification before GSM TS 03.34 was transferred to 3GPP. The only difference between this CR and CR 03.34 A004r4 is the chapter "5.2.5 Link adaptation for ECSD", which has been reworded to address Ericsson's proposal for link adaptation in tdoc N1-000051.


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4 Main concepts

The air interface user rate in the original GSM data transmission is limited to 9.6 kbps with the 12 kbps air interface rate. The HSCSD described in this TS Stage 2 description allows higher air interface user rates to be used for transparent and non-transparent data services.

NOTE: In this document the term "air interface user rate" corresponds to the transfer rate in radio interface for user data and "air interface rate" includes additional data related to transmission protocols.

HSCSD is a feature enabling the co-allocation of multiple full rate traffic channels (TCH/F) into a HSCSD configuration. The aim of HSCSD is to provide a mixture of services with different air interface user rates by a single physical layer structure. Further improvements in data rates are achieved through enhancement of the radio interface (modulation and coding schemes), which allows higher bit rates per one GSM time slot. The available capacity of a HSCSD configuration is several times the capacity of a TCH/F, leading to a significant enhancement in the air interface data transfer rate.

Figure 1 represents the network architecture to support GSM HSCSD based on the concept of multiple independent channels in one HSCSD configuration. In case when enhanced modulation is used the number of time slots in the radio interface may not correspond to the number of data streams in the network side, for example a 28.8 kbps service may be offered through one air interface time slot, but it requires two 14.4 (16 kbps) Abis channels. Another example is bit transparent 56/64 kbps service where two air interface time slots of 32 kbps are multiplexed onto one 64 kbps data stream on the network side.

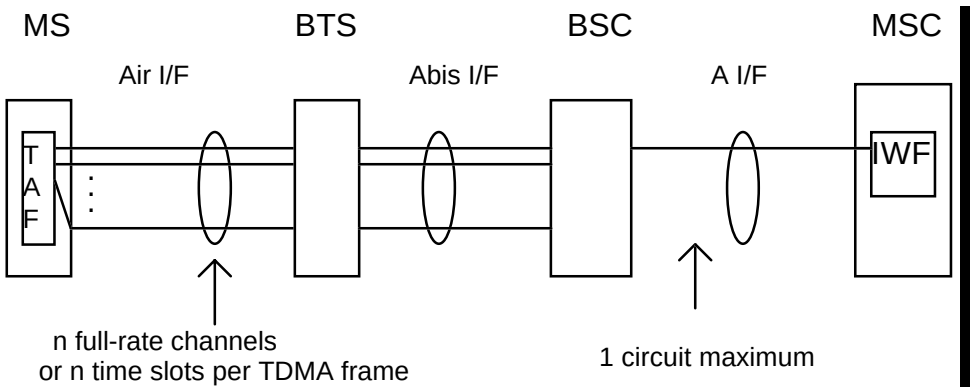


Figure 1: Network architecture for supporting HSCSD

~~In the above concept all lower layer standards for all interfaces between the network elements shall remain identical to those specified in Phase 2.~~ A new functionality is introduced at the network and MS to provide the functions of combining and splitting the data into separate data streams which will then be transferred via n channels at the radio interface, where n = 1, 2, 3, ... 8. Once split, the data streams shall be carried by the n full rate traffic channels, called HSCSD channels, as if they were independent of each other, for the purpose of data relay and radio interface L1 error control, until to the point in the network where they are combined. However, logically the n full rate traffic channels at the radio interface belong to the same HSCSD configuration, and therefore they shall be controlled as one radio link by the network for the purpose of cellular operations, e.g. handover. This requires a new functionality in BSS.

The different user data substreams carried on the radio channels (one substream being the data flow over a single TCH) shall be mapped over the A interface, and vice versa, following the rules defined in GSM 04.08 [3] and GSM 08.20 [8].

On the A and E interfaces, the use of resources is restricted to one 64 kbps circuit by multiplexing the data streams into one A interface circuit (see ITU-T Recommendation I.460 [8]).

4.1 HSCSD service aspects

At call setup a user indicates a maximum number of TCH/F, acceptable channel codings (including extensions to acceptable channel codings for ECSD channel codings), possible other modem type, and fixed network user rate values.

For non-transparent HSCSD connection, in addition, wanted air interface user rate is indicated and the network resource needs, if user wishes to make use of the user initiated modification of the maximum number of TCH/F and/or wanted air interface user rate (user initiated service level up- and downgrading described in subclause 5.2.4) during the call. In case the indicated acceptable channel coding(s) implies that enhanced modulation is possible, the user may indicate a preference for channel coding asymmetry, i.e. downlink biased channel coding asymmetry, uplink biased channel coding asymmetry or channel coding symmetry. Together these parameters describe the HSCSD characteristics and network uses them to allocate an appropriate HSCSD connection.

For both transparent and non-transparent HSCSD connections the call can be established with any number of TCH/F from one up to the maximum number of TCH/F, i.e. the minimum channel requirement is always one TCH/F.

If the wanted air interface user rate requirement cannot be met using a symmetric configuration, an asymmetric configuration can be chosen. The network shall in this case give priority to fulfilling the air interface user rate requirement in downlink direction.

For non-transparent HSCSD connection the network can use dynamic allocation of resources, i.e. TCH/F, as long as the configuration is not in contradiction with the limiting values defined by the MS and the mobile equipment is capable of handling the allocated channel configuration. For transparent HSCSD connection the dynamic resource allocation is applicable, if the air interface user rate is kept constant. The change of channel configuration within the limits of minimum and maximum channel requirements is done with resource upgrading and resource downgrading procedures (described in subclause 5.2.3) during the call.

The MS may request a service level up- or downgrading during the call, if so negotiated in the beginning of the call. In the user initiated modification procedure, the user can modify the channel coding asymmetry preference when enhanced modulation is indicated. This modification of channel requirements and/or wanted air interface user rate and/or channel coding asymmetry preference is applicable to non-transparent HSCSD connections only.

5 HSCSD architecture and transmission

5.1 Air interface

The HSCSD configuration is a multislot configuration using the TCH/F data channel mapping described in GSM 05.02 [2].

Two types of HSCSD configurations exist, symmetric configuration and asymmetric configuration . For both types of configurations the channels may be allocated on either consecutive or non-consecutive time slots taking into account the restrictions defined by the classmark.

An example of the HSCSD operation with two consecutive time slots is shown in figure 2.

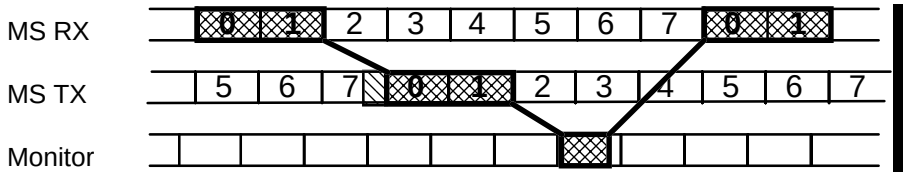


Figure 2: Double slot operation in the air interface

A symmetric HSCSD configuration consists of a bi-directional FACCH and co-allocated bi-directional TCH/F and SACCH channels. An asymmetric HSCSD configuration consists of a bi-direction FACCH and co-allocated uni-directional or bi-directional TCH/F and SACCH channels. A bi-directional channel is a channel on which the data is transferred in both uplink and downlink directions. On uni-directional channels for HSCSD the data is transferred in downlink direction, only.

In both symmetric and asymmetric HSCSD configurations one bi-directional channel, the main channel, carries a FACCH used for all the signalling not carried on the SACCH(s).

For HSCSD configuration all SACCHs are synchronized so that idle frames for each time slot coincide.

The classification of mobile stations used for HSCSD shall be based on Multislot classes, described in detail in GSM 05.02 [2]. Further classification shall be based on the Mobile Station Classmark depending on the supported modulations.

The same frequency hopping sequence and training sequence is used for all the channels in the HSCSD configuration.

~~The same coding scheme as specified for the TCH/F9.6 and TCH/F4.8 data channels is used. Using a different radio interface channel coding may be considered at the later stage.~~ The same channel coding is used for all the channels in the HSCSD configuration, though in the enhanced modulation mode, for non-transparent services, it is possible to have one channel coding used in the downlink and another channel coding used in the uplink. Different channel codings for up- and downlink could be applied in three cases, see 22.034:

a) If the mobile station only supports enhanced modulation in the downlink direction;

b) If the mobile station supports enhanced modulation in both directions, but the user indicates preference for uplink or downlink biased channel coding asymmetry;

c) If the mobile station supports enhanced modulation in both directions, and the user indicates preference for channel coding symmetry, but the link conditions justifies different channel coding in uplink or downlink

For Mobile Stations supporting 8-PSK modulation additional channel codings shall apply. The change between different TCH/F channel codings can be provided with RR Channel Mode Modify or Configuration Change procedure. It shall be possible to change between channel codings of different modulation schemes.

In symmetric HSCSD configuration individual signal level and quality reporting for each HSCSD channel is applied.

For an asymmetric HSCSD configuration individual signal level and quality reporting is used for those channels, which have uplink SACCH associated with them. The quality measurements reported on the main channel are based on the worst quality measured among the main and the uni-directional downlink time slots used.

In both symmetric and asymmetric HSCSD configuration the neighbouring cell measurement reports are copied on every uplink channel used. See GSM 05.08 [15] for more detail on signal level and quality reporting.

Separate ciphering keys are used for each HSCSD channels. The ciphering keys used on different channels are derived from the Kc. See GSM 03.20 [10] for more details.

5.2 Functions and information flows

The procedures discussed in this subclause follow the procedures described in detail in GSM 08.08 [4] and 04.08 [3]. Modifications are referred with text in brackets and conditional procedures with dashed line. Normal signalling or signalling presented earlier in the document is drawn with ovals.

5.2.1 Call establishment procedures

5.2.1.1 Mobile originated call establishment

Figure 3 depicts the procedures for a successful HSCSD call establishment in mobile originated case.

The Multislot class is sent from MS to network using the early classmark sending.

At the call setup the mobile station sends a set of parameters describing the HSCSD characteristics to the network. These parameters and their presence in the Setup message in transparent (T) and non-transparent (NT) calls are as follows:

- Other Modem Type, OMT (T/NT)
- Fixed Network User Rate, FNUR (T/NT)
- Acceptable Channel Codings, ACC (including ACC ext.) (T/NT)
- maximum number of traffic channels, Max TCH/F (T/NT)

- User Initiated Modification Indication, UIMI (NT)- wanted Air Interface User Rate, AIUR (NT).and
- channel coding ASYMmetry indication, ASYM (NT)

In reply the network responds in Call Proceeding with the Other Modem Type, OMT, Fixed Network User Rate, FNUR, and User Initiated Modification Indication, UIMI (NT only), parameters it is prepared to give to the mobile station.

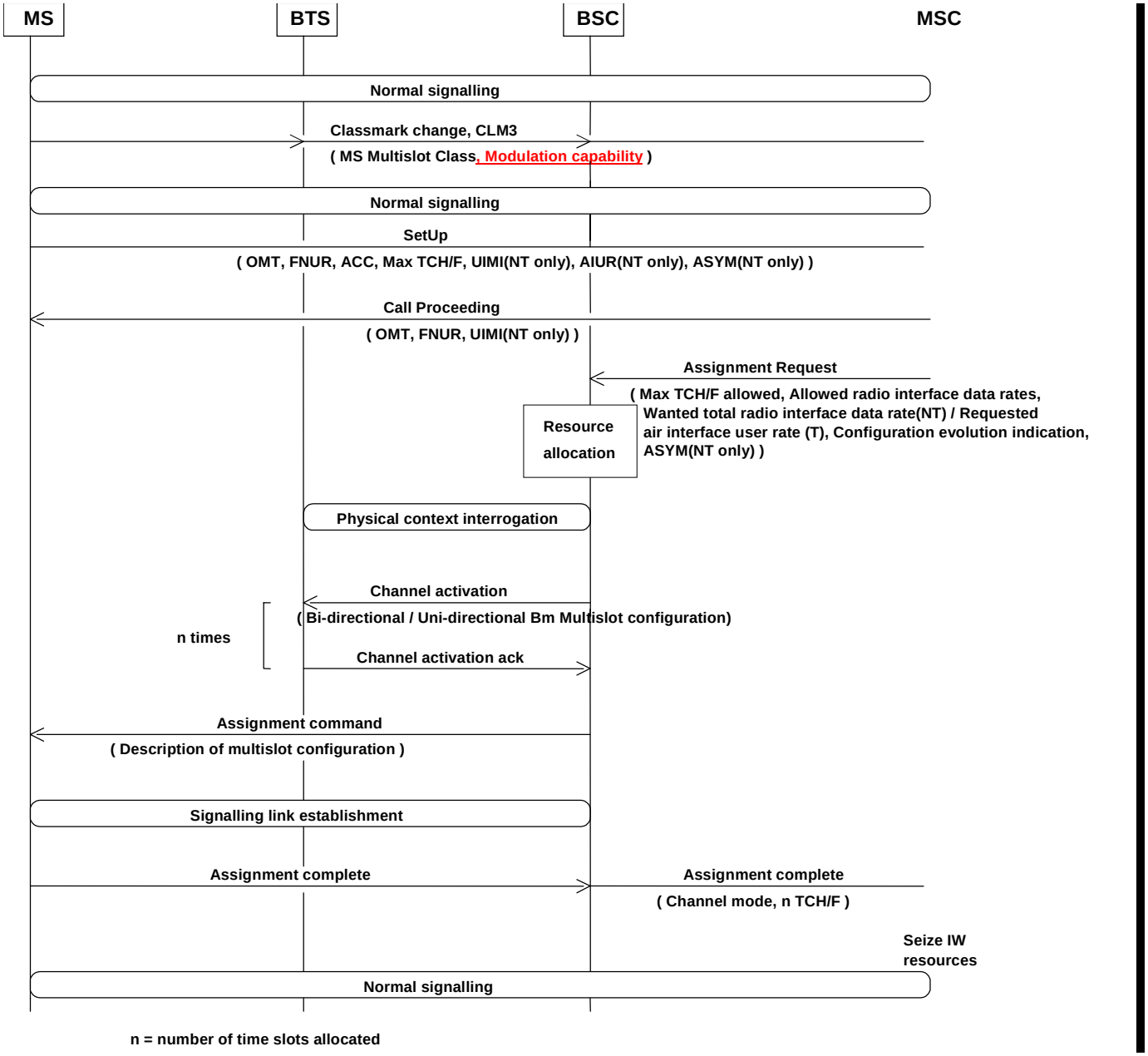


Figure 3: Mobile originated call establishment

The MSC requests the BSC to allocate the channel configuration using parameters derived from the HSCSD related parameters agreed in the setup phase. Based on these parameters and operator preferences the BSC then allocates a suitable number of channels and a suitable channel coding for the connection.

The following rule for the channel allocation apply:

The BSS shall try to reach but not exceed, with one exception, the wanted AIUR. The exception is the case when the chosen configuration can reach the wanted AIUR with lower number of TCH/F, e.g. in case AIUR=14.4 kbit/s, max

number of TCH/F=3, ACC=TCH/F4.8 and TCH/F9.6, the network shall choose 2x9.6 over 3x4.8 if the TCH/F9.6 is available in the cell.

A separate channel activation is applied for each of the HSCSD channels before the selected channel configuration with information of the channel coding is forwarded to the mobile station. When the preference for downlink or uplink biased channel coding asymmetry is indicated by the user, and an asymmetric channel coding connection is set up based on this indication, the BSC shall always assign a TCH/F14.4 channel on the unbiased link of the connection.

At assignment completion, the BSS informs the MSC of the chosen HSCSD configuration and the MSC may seize the IW resources accordingly.

5.2.1.2 Mobile terminated call establishment

Figure 4 depicts the procedures for a successful HSCSD call establishment in mobile terminated case.

At the call setup the network sends the Other Modem Type,OMT, Fixed Network User Rate,FNUR, and User Initiated Modification Indication,UIMI (NT only), parameters to the mobile station.

In reply the mobile station responds to the network with the set of parameters describing the HSCSD characteristics. These parameters and their presence in the Call Confirmed message in transparent (T) and non-transparent (NT) calls are as follows:

- wanted Other Modem Type, OMT (T/NT)
- wanted Fixed Network User Rate, FNUR (T/NT)
- Acceptable Channel Codings, ACC (including ACC ext.) (T/NT)
- maximum number of traffic channels, Max TCH/F (T/NT)
- User Initiated Modification Indication, UIMI (NT)
- wanted Air Interface User Rate, AIUR (NT).and
- channel coding ASYMmetry indication, ASYM (NT)

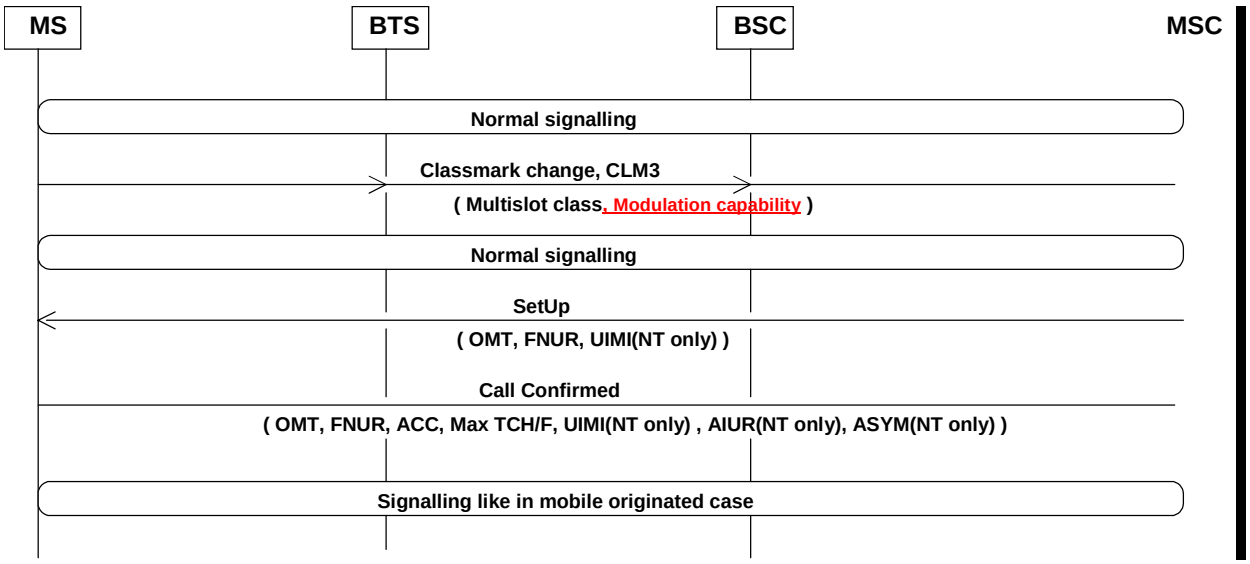


Figure 4: Mobile terminated call establishment

The MSC requests the BSC to allocate the channel configuration using parameters derived from the HSCSD related parameters agreed in the setup phase. Based on these parameters and operator preferences the BSC then allocates a suitable number of channels and a suitable channel coding for the connection.

The same channel allocation rules as in mobile originated case apply.

The same channel activation rules as in mobile originated case apply.

At assignment completion, the BSS informs the MSC of the chosen HSCSD configuration and the MSC may seize the IW resources accordingly.

5.2.2 Handover procedures

5.2.2.1 Intra BSC handover

Figure 5 depicts the procedures for a successful HSCSD intra BSC handover.

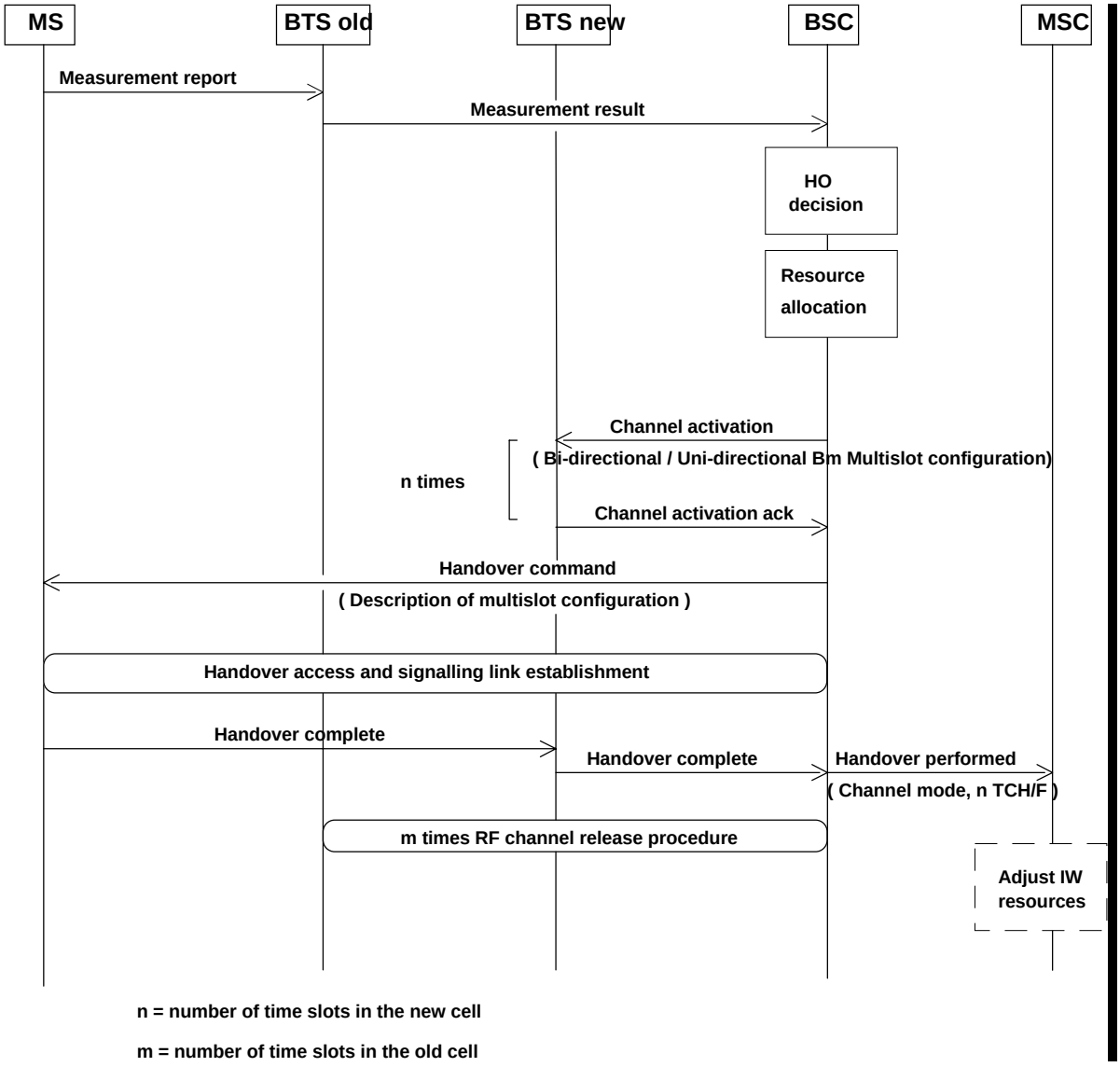


Figure 5: Intra BSC handover

For a non-transparent call, the HSCSD configuration may be modified during an intra BSS handover within the maximum number of TCH/F and channel codings acceptable for the user and allowed by the network.

The same allocation and activation rules as in call establishment apply.

At handover completion, the BSC signals to the MSC the new HSCSD configuration and the MSC may adjust the IW resources accordingly.

5.2.2.2 Inter BSC, intra-MSC handover

Figure 6 depicts the procedures for a successful HSCSD inter BSC handover.

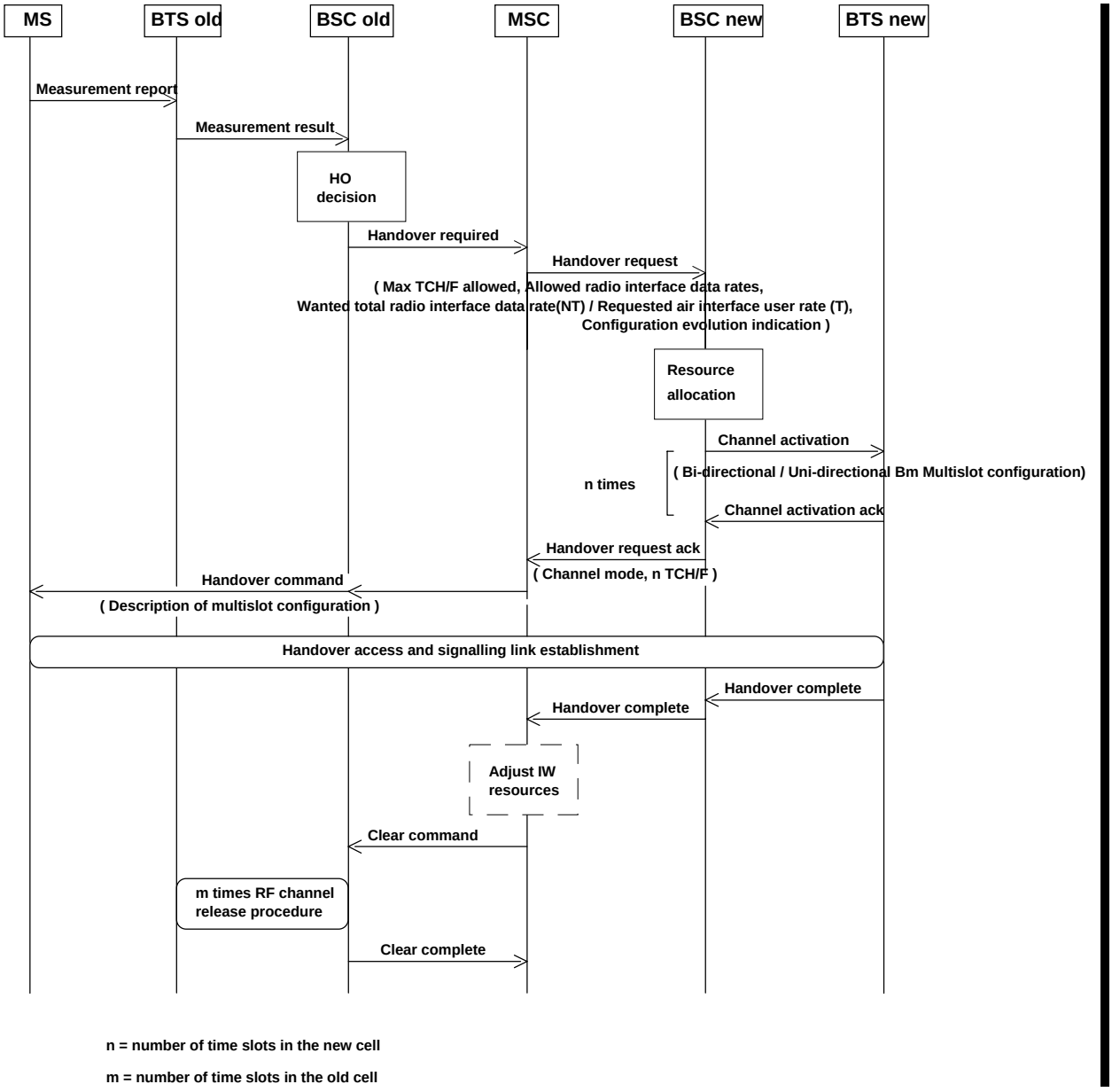


Figure 6: Inter BSC intra MSC handover

In inter BSS handover the MSC requests the new BSS to allocate a channel configuration using parameters derived from the HSCSD related parameters agreed earlier during the call. Based on these parameters and operator preferences the BSC then allocates a suitable number of TCH/F and a suitable channel coding for the connection.

For a non-transparent call, the HSCSD configuration may be modified during an intra BSS handover within the maximum number of TCH/F and channel codings acceptable for the user and allowed by the network.

The same channel allocation and activation rules as in call establishment apply.

The BSC informs the MSC of the chosen HSCSD configuration and at handover completion the MSC may adjusts the IW resources accordingly.

5.2.2.3 Inter MSC handover

In inter MSC handover the requested channel configuration is forwarded to a BSS within the new MSC using MAP protocol between MSCs. Procedures similar to those in inter BSS handover case can be applied in order to establish the HSCSD connection in a new cell.

5.2.3 Resource upgrading, downgrading and configuration change

Resource upgrading means allocating more channels to the HSCSD configuration. Similarly, in resource downgrading channels are released.

Both of these procedures are initiated by the network and they are used in non-transparent calls to alter the channel resources between one TCH/F and the maximum number of TCH/F allowed. For transparent connection the alteration of resources is also applicable required that the AIUR for the connection remains constant.

Figure 7 depicts the procedures for a successful resource upgrading and downgrading for an ongoing HSCSD call, in case the position of the main TCH/F remains unchanged.

A separate channel activation for the new HSCSD channels is carried out and the earlier activated HSCSD channels may be modified, before RR Configuration change procedure is used for forwarding the new channel configuration to the mobile station. Similarly, the Configuration change procedure can be used in both transparent and non-transparent calls for reordering the channels in a call without changing the number of TCH/Fs allocated.

At resource modification completion, the BSC signals to the MSC the new HSCSD configuration and the MSC may adjusts the IW resources accordingly.

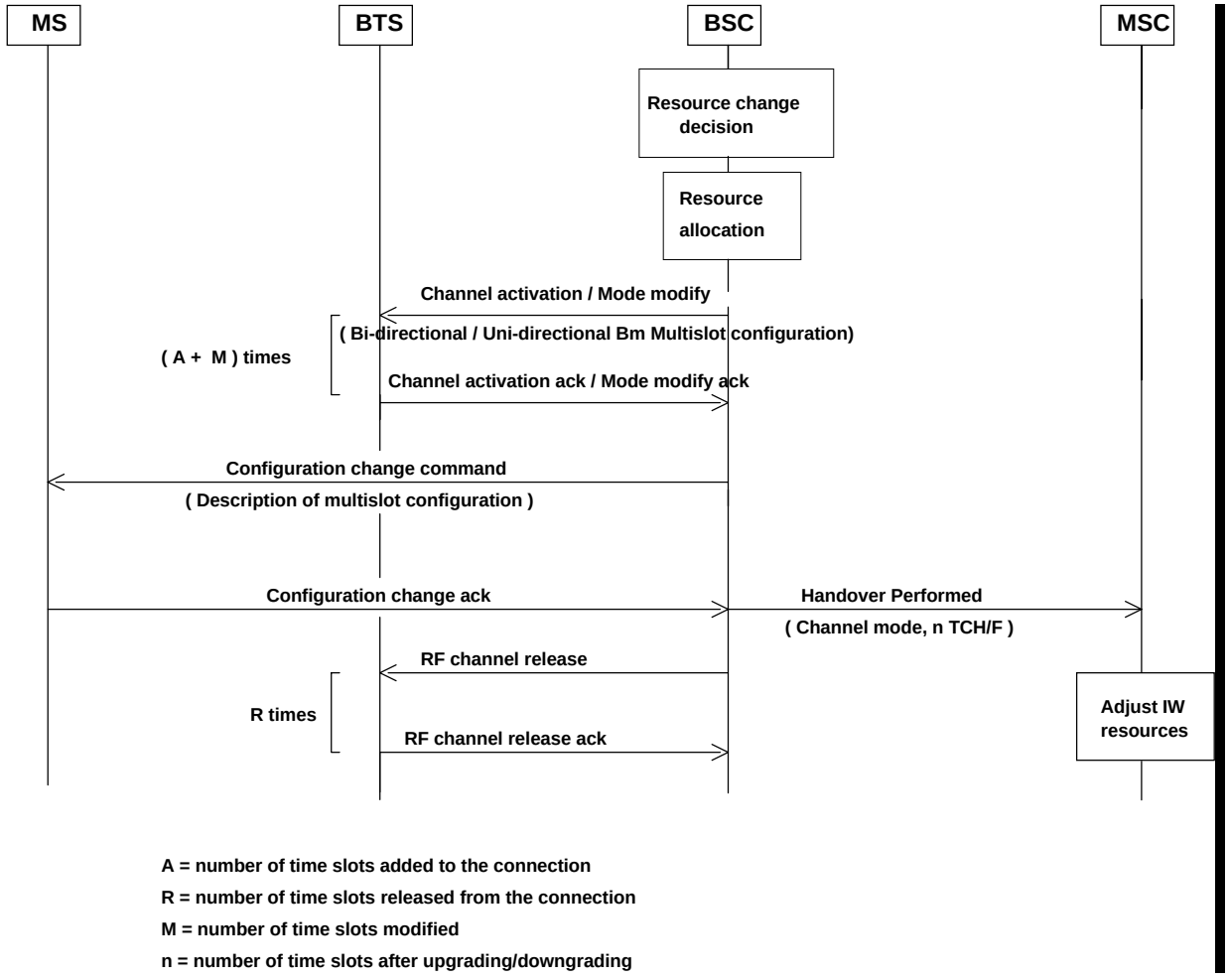
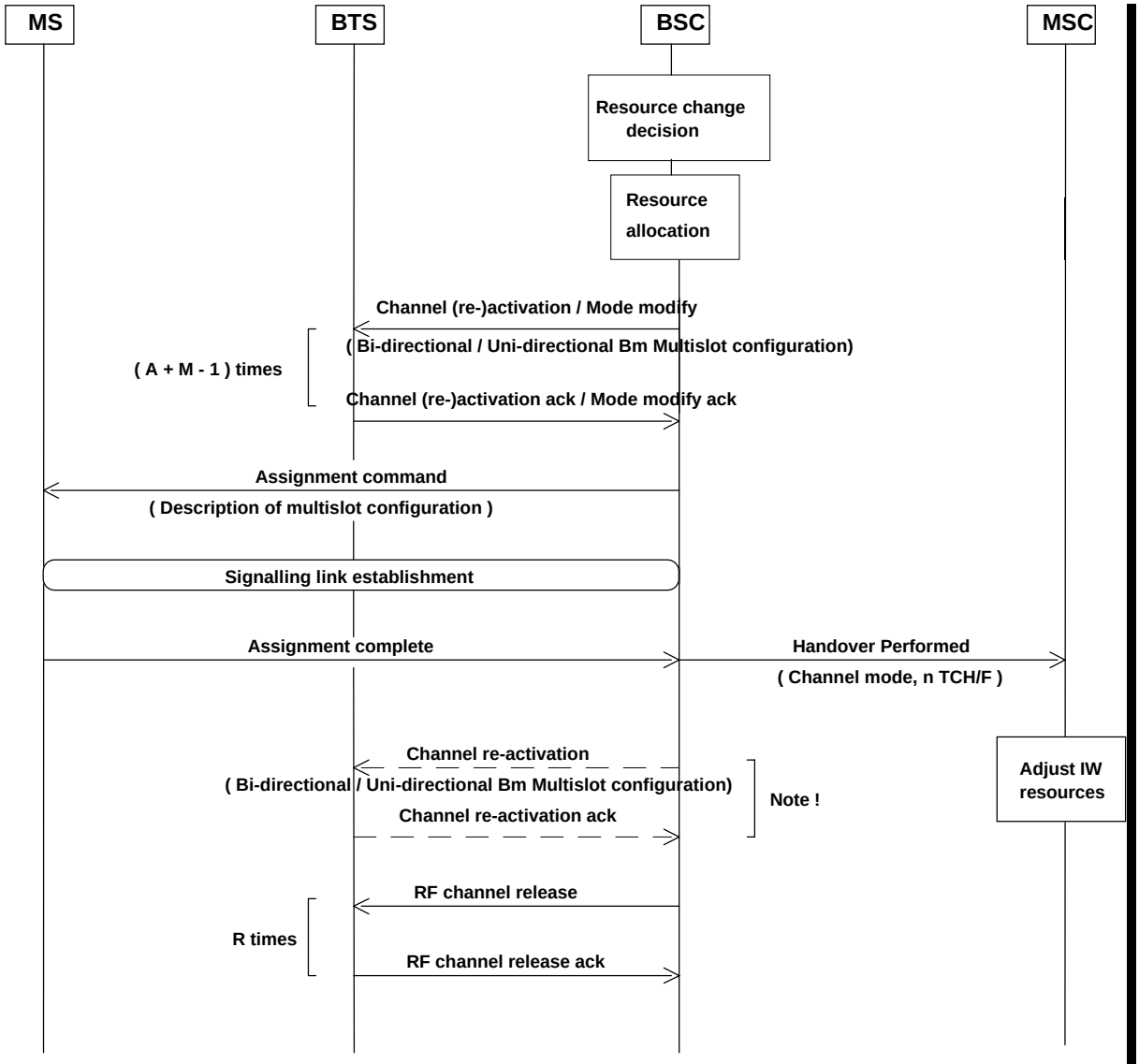


Figure 7: Resource upgrading and downgrading, the position of the main channel unchanged

Figure 8 depicts the procedures for a successful resource upgrading and downgrading for an ongoing HSCSD call in case the position of the main channel is changed.

A separate channel activation for the new HSCSD channels, is carried out and the earlier activated HSCSD channels may be modified or, in case of the new main channel, reactivated, before RR Assignment procedure is used for forwarding the new channel configuration to the mobile station. Similarly, the Assignment procedure can be used in both transparent and non-transparent calls for reordering the channels in a call without changing the number of TCH/Fs allocated.

At resource modification completion, the BSC signals to the MSC the new HSCSD configuration and the MSC may adjusts the IW resources accordingly.



NOTE: Deactivates the old signalling link by modifying the old main channel. The old main can not be modified before a new main has been established. If the time slot for the old main is not used in the new HSCSD configuration, RF channel release is used instead.

A = number of time slots added to the HSCSD connection

R = number of time slots released from the HSCSD connection

M = number of time slots modified or re-activated

n = number of time slots after upgrading/downgrading

Figure 8: Resource upgrading and downgrading, the position of the main channel changed

5.2.4 User initiated service level up- and downgrading

Figure 9 depicts the procedures for a successful user initiated service level up- and downgrading for on-going HSCSD call.

During a HSCSD call the user may request, if so indicated in the call setup, the network to change the current maximum number of traffic channels and air interface user rate parameters and/or channel coding asymmetry preference. This is done by using the CC User initiated service level up- and downgrading procedure.

If network allows the modification, the resulting new parameters are forwarded to BSC and the radio interface resources may be adjusted accordingly. The resource upgrading or downgrading is done separately from the change in HSCSD parameters. However, if a contradiction between the new parameters and the used air interface resources exists, the resource downgrading may be needed before the network acknowledges the new parameters.

The user initiated service level up- and downgrading is applicable in non-transparent mode connections, only.

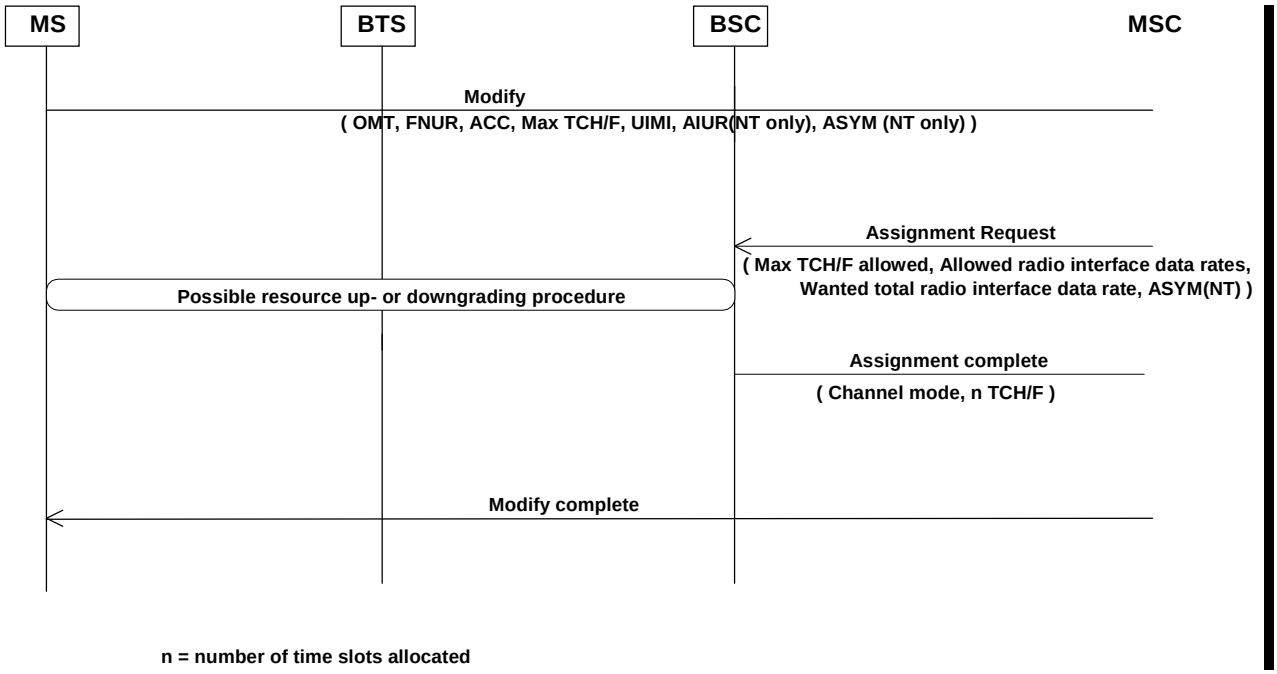


Figure 9: User initiated service level up- and downgrading

5.2.5 Link adaptation for ECSD

Link adaptation for ECSD particularly in high data rate call becomes essential in order to provide good enough service over large coverage areas. Signalling for link adaptation between channel coding schemes in 8-PSK modulation and between GMSK and 8-PSK coding schemes is done using existing signalling mechanisms, i.e. RR Channel Mode Modify procedure, intracell handover, etc. In performing link adaption between 8-PSK modulated channels , the normal Channel Mode (or the assignment or the intra-cell HO procedure) should be used and in case of link adaptation between 8-PSK modulated channels and GMSK modulated channels the assignment procedure or the intra-cell handover should be used.

5.2.65 Start of ciphering

In order to start ciphering, the RR Encryption procedure is controlled by the main signalling link, only. The encryption information for secondary HSCSD channel is forwarded to the corresponding TCH/F in initial channel activation or later in the channel reactivation or Mode modify message.

The change of ciphering modes for separate channels within the HSCSD connection might not be perfectly synchronized.

3GPP CN WG 1 Meeting # 11
Umea, Sweden, 28 February – 3 March, 2000

Document N1-000444
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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24.008	CR	A049 rev4	Current Version:	3.2.1

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

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

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

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

Source: CN1 **Date:** Feb. 28, 2000

Subject: Support of 400 and 850 MHz band

Work item: EDGE Compact and support for EGPRS in ANSI-136 networks

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

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

Reason for change: Inclusion of 400 and 850 MHz band in MS Radio Access Capability

Clauses affected: 9.4.1, 9.4.14, 10.5.5.12a

Other specs Affected:

Other 3G core specifications		→ List of CRs:	
Other GSM core specifications	X	→ List of CRs:	05.01-A022r1, 05.05-A116r1
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

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***** First modified section *****

9.4.1 Attach request

This message is sent by the MS to the network in order to perform a GPRS or combined GPRS attach. See table 9.4.1/TS 24.008.

Message type: ATTACH REQUEST

Significance: dual

Direction: MS to network

Table 9.4.1/TS 24.008: ATTACH REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	Protocol discriminator	Protocol discriminator 10.2	M	V	1/2
	Skip indicator	Skip indicator 10.3.1	M	V	½
	Attach request message identity	Message type 10.4	M	V	1
	MS network capability	MS network capability 10.5.5.12	M	LV	2
	Attach type	Attach type 10.5.5.2	M	V	½
	GPRS ciphering key sequence number	Ciphering key sequence number 10.5.1.2	M	V	½
	DRX parameter	DRX parameter 10.5.5.6	M	V	2
	P-TMSI or IMSI	Mobile identity 10.5.1.4	M	LV	6 - 9
	Old routing area identification	Routing area identification 10.5.5.15	M	V	6
	MS Radio Access capability	MS Radio Access capability 10.5.5.12a	M	LV	6 - 52~~31~~
19	Old P-TMSI signature	P-TMSI signature 10.5.5.8	O	TV	4
17	Requested READY timer value	GPRS Timer 10.5.7.3	O	TV	2
9-	TMSI status	TMSI status 10.5.5.4	O	TV	1

***** Next modified section *****

9.4.14 Routing area update request

This message is sent by the MS to the network either to request an update of its location file or to request an IMSI attach for non-GPRS services. See table 9.4.14/TS 24.008.

Message type: ROUTING AREA UPDATE REQUEST

Significance: dual

Direction: MS to network

Table 9.4.14/TS 24.008: ROUTING AREA UPDATE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	Protocol discriminator	Protocol discriminator 10.2	M	V	1/2
	Skip indicator	Skip indicator 10.3.1	M	V	1/2
	Routing area update request message identity	Message type 10.4	M	V	1
	Update type	Update type 10.5.5.18	M	V	1/2
	GPRS ciphering key sequence number	Ciphering key sequence number 10.5.1.2	M	V	1/2
	Old routing area identification	Routing area identification 10.5.5.15	M	V	6
	MS Radio Access capability	MS Radio Access capability 10.5.5.12a	M	LV	6 ~~-~~52 ~~31~~
19	Old P-TMSI signature	P-TMSI signature 10.5.5.8	O	TV	4
17	Requested READY timer value	GPRS Timer 10.5.7.3	O	TV	2
27	DRX parameter	DRX parameter 10.5.5.6	O	TV	3
9-	TMSI status	TMSI status 10.5.5.4	O	TV	1
18	P-TMSI	Mobile identity 10.5.1.4	O	TLV	7

***** Next modified section *****

10.5.5.12a MS Radio Access capability

The purpose of the *MS RA capability* information element is to provide the radio part of the network with information concerning radio aspects of the mobile station. The contents might affect the manner in which the network handles the operation of the mobile station.

The *MS RA capability* is a type 4 information element, , with a maximum length of ~~32~~ 52 octets.

The value part of a *MS RA capability* information element is coded a shown table 10.5.146/TS 24.008.

– SEMANTIC RULE : Among the three Access Type Technologies GSM 900-P, GSM 900-E and GSM 900-R only one shall be present.

– ~~–~~The MS shall ~~never~~ indicate supported ~~more than 4~~ Access Technology Types, ~~. NOTE:~~ e.g., [~~400~~450, 480, 900, 1800, UMTS] or [~~800~~850, 1900] MHz bands during a single MM procedure.

~~–~~Error handling : If a received Access Technology Type is unknown to the receiver, it shall ignore all the corresponding fields;

– If within a known Access Technology Type a receiver recognizes an unknown field it shall ignore it.

– See more details about error handling of MS radio access capability in TS GSM 08.18.

- Due to shared radio frequency channel numbers between 1800 and 1900, the mobile should provide the relevant MS Radio Access capability for either ~~900/~~1800 band~~(s)~~ OR 1900 band, not both.

Table 10.5.146/TS 24.008 : *Mobile Station Radio Access Capability* Information Element

< MS Radio Access capability IE > ::=
<**MS Radio Access capability IEI** : 00100100 >
<**Length of MS RA capability**: <octet>> -- *length in octets of MS RA capability value part and spare bits*
<**MS RA capability value part** : < MS RA capability value part struct >>
<spare bits>**; -- *may be used for future enhancements*

<MS RA capability value part struct >::= --*recursive structure allows any number of Access technologies*

< **Access Technology Type**: bit (4) >
< **Access capabilities** : <Access capabilities struct> >
{ 0 | 1 <MS RA capability value part struct> } ;

< Access capabilities struct > ::=
< **Length** : bit (7) > -- length in bits of Content and spare bits
<Access capabilities : <Content>>
<spare bits>** ; -- expands to the indicated length
-- may be used for future enhancements

< Content > ::=
< **RF Power Capability** : bit (3) >
{ 0 | 1 <**A5 bits** : <A5 bits> > } -- *zero means that the same values apply for parameters as in the immediately preceeding Access capabilities field within this IE*
-- *The presence of the A5 bits is mandatory in the 1st Access capabilities struct within this IE.*
< **ES IND** : bit >
< **PS** : bit >
< **VGCS** : bit >
< **VBS** : bit >
{ 0 | 1 < **Multislot capability** : Multislot capability struct > } ; -- *zero means that the same values for multislot parameters as given in an earlier Access capabilities field within this IE apply also here*
{ 0 | 1 < **8PSK Power Capability** : bit(2) >} – *'1' also means 8PSK modulation capability in uplink.*
-- error: struct too short, assume features do not exist
-- error: struct too long, ignore data and jump to next Access technolgy

Table 10.5.146/TS 24.008 (continued): *Mobile Station Radio Access Capability* Information Element

< Multislot capability struct > ::=
{ 0 | 1 < **HSCSD multislot class** : bit (5) > }
{ 0 | 1 < **GPRS multislot class** : bit (5) > < **GPRS Extended Dynamic Allocation Capability** : bit > }
{ 0 | 1 < **SMS_VALUE** : bit (4) > < **SM_VALUE** : bit (4) > } ;
{ 0 | 1 < **ECSD multislot class** : bit (5) > }
{ 0 | 1 < **EGPRS multislot class** : bit (5) > < **EGPRS Extended Dynamic Allocation Capability** : bit > };

<A5 bits> ::= < A5/1 : bit> <A5/2 : bit> <A5/3 : bit> <A5/4 : bit> <A5/5 : bit> <A5/6 : bit> <A5/7 : bit>; -- bits for circuit mode ciphering algorithms

Access Technology Type
This field indicates the access technology type to be associated with the following access capabilities.

Bits
4 3 2 1
0 0 0 0 GSM P
0 0 0 1 GSM E --*note that GSM E covers GSM P*
0 0 1 0 GSM R --*note that GSM R covers GSM E and GSM P*
0 0 1 1 GSM 1800
0 1 0 0 GSM 1900
0 1 0 1 GSM 450
0 1 1 0 GSM 480
0 1 1 1 GSM 850
All other values are treated as unknown by the receiver.

RF Power Capability
This field is coded as radio capability in Classmark 3 for the indicated band: it contains the binary coding of he power class associated (see GSM 05.05 paragraph 4.1 output power and paragraph 4.1.1 Mobile Station).

8PSK Power Capability
This field is coded according to the definition in GSM 05.05. The presence of this field indicates also 8PSK modulation capability in uplink.

A5/1
0 encryption algorithm A5/1 not available
1 encryption algorithm A5/1 available
A5/2
0 encryption algorithm A5/2 not available
1 encryption algorithm A5/2 available
A5/3
0 encryption algorithm A5/3 not available
1 encryption algorithm A5/3 available
A5/4
0 encryption algorithm A5/4 not available
1 encryption algorithm A5/4 available
A5/5
0 encryption algorithm A5/5 not available
1 encryption algorithm A5/5 available
A5/6
0 encryption algorithm A5/6 not available
1 encryption algorithm A5/6 available
A5/7
0 encryption algorithm A5/7 not available
1 encryption algorithm A5/7 available

ES IND – (Controlled early Classmark Sending)
0 "controlled early Classmark Sending" option is not implemented
1 "controlled early Classmark Sending" option is implemented

PS – (Pseudo Synchronisation)
0 PS capability not present
1 PS capability present

VGCS – (Voice Group Call Service)
0 no VGCS capability or no notifications wanted
1 VGCS capability and notifications wanted.

Table 10.5.146/TS 24.008 (concluded): *Mobile Station Radio Access Capability* Information Element

VBS – (Voice Broadcast Service)
0 no VBS capability or no notifications wanted
1 VBS capability and notifications wanted

HSCSD Multi Slot Class
The Multi Slot Class field is coded as the binary representation of the multislot class defined in TS GSM 05.02.
Range 1 to 18, all other values are reserved.

GPRS Multi Slot Class
The GPRS Multi Slot Class field is coded as the binary representation of the multislot class defined in TS GSM 05.02.

ECSD Multi Slot Class
The presence of this field indicates ECSD capability. Whether the MS is capable of 8-PSK modulation in uplink is indicated by the presence of 8-PSK Power Capability field. The Multi Slot Class field is coded as the binary representation of the multislot class defined in TS GSM 05.02.
Range 1 to 18, all other values are reserved.

EGPRS Multi Slot Class
The presence of this field indicates EGPRS capability. Whether the MS is capable of 8-PSK modulation in uplink is indicated by the presence of 8-PSK Power Capability field. The EGPRS Multi Slot Class field is coded as the binary representation of the multislot class defined in TS GSM 05.02.

GPRS Extended Dynamic Allocation Capability
0 Extended Dynamic Allocation Capability for GPRS is not implemented
1 Extended Dynamic Allocation Capability for GPRS is implemented
EGPRS Extended Dynamic Allocation Capability
0 Extended Dynamic Allocation Capability for EGPRS is not implemented
1 Extended Dynamic Allocation Capability for EGPRS is implemented

SMS_VALUE (Switch-Measure-Switch) (4 bit field)
The SMS field indicates the time needed for the mobile station to switch from one radio channel to another, perform a neighbor cell power measurement, and the switch from that radio channel to another radio channel.

Bits
4 3 2 1

0 0 0 0 1/4 timeslot (~144 microseconds)
0 0 0 1 2/4 timeslot (~288 microseconds)
0 0 1 0 3/4 timeslot (~433 microseconds)
. . .
1 1 1 1 16/4 timeslot (~2307 microseconds)

(SM_VALUE) Switch-Measure (4 bit field)
The SM field indicates the time needed for the mobile station to switch from one radio channel to another and perform a neighbour cell power measurement.

Bits
4 3 2 1
0 0 0 0 1/4 timeslot (~144 microseconds)
0 0 0 1 2/4 timeslot (~288 microseconds)
0 0 1 0 3/4 timeslot (~433 microseconds)
. . .
1 1 1 1 16/4 timeslot (~2307 microseconds)