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Technical Specification

Digital cellular telecommunications system (Phase 2+); High Speed Circuit Switched Data (HSCSD) - Stage 2 (GSM 03.34 version 5.1.0 Release 1996)

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Contents

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Foreword

This Technical Specification (TS) has been produced by the Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI).

This TS specifies the Stage 2 description of High Speed Circuit Switched Data (HSCSD) within the digital cellular telecommunications system (Phase 2+).

The contents of this TS are subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of this TS it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 5.x.y

where:

5 indicates GSM Phase 2+ Release 1996

x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated in the specification.

1 Scope

This Technical Specification (TS) contains the stage 2 service description for a High Speed Circuit Switched Data (HSCSD) on GSM.

In analogy with CCITT Recommendations I.130 [6] (refer to annex A) and with reference of CCITT Recommendations VI.1 Q.65 [7] (Stage 2 of the method for characterization of services supported by an ISDN), the second stage of the HSCSD is defined as follows.

Stage 2 identifies the functional capabilities and information flows needed to support the service as described in High Speed Circuit Switched Data (HSCSD) - Stage 1, GSM 02.34 [9]. Furthermore, it identifies various possible physical locations for the functional capabilities. The output of Stage 2, which is signalling system independent, is used as an input to Stage 3, the design of signalling system and switching Recommendations.

2 Normative references

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] GSM 01.04 (ETR 350): "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 05.02 (ETS 300 908): "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[3] GSM 04.08 (ETS 300 940): "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[4] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile-services Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[5] GSM 04.22 (ETS 300 946): "Digital cellular telecommunications system (Phase 2+); Radio Link Protocol (RLP) for data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[6] CCITT Recommendation I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[7] CCITT Recommendation Q.65: "Stage 2 of the method for the characterization of services supported by an ISDN".

[8] ITU-T Recommendation I.460 "Multiplexing, rate adaptation and support of existing interfaces".

[9] GSM 02.34: "Digital cellular telecommunications system (Phase 2+); High Speed Circuit Switched Data (HSCSD) - Stage 1".

[10] GSM 03.20 (ETS 300 929): "Digital cellular telecommunications system (Phase 2+); Security related network functions".

[11] GSM 04.21 (ETS 300 945): "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Mobile Station - Base Station System (MS - BSS) Interface".

[12] GSM 08.20: "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[13] GSM 07.02: (ETS 300 914): "Digital cellular telecommunications system (Phase 2+); Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[14] GSM 07.03: (ETS 300 915): "Digital cellular telecommunications system (Phase 2+); Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[15] GSM 05.08 (ETS 300 911): "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

3 Definitions and abbreviations

HSCSD: High Speed Circuit Switched Data.

HSCSD configuration: A multislot configuration consisting of one or several full rate traffic channels for data transmission.

HSCSD channel: A full rate traffic channel belonging to a HSCSD configuration.

main channel: The only channel in a HSCSD configuration carrying an FACCH.

symmetric configuration: A configuration consisting of bi-directional channels.

asymmetric configuration: A configuration consisting of bi-directional channels and at least one uni-directional channel.

For further GSM abbreviations see GSM 01.04 [1].

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. 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.

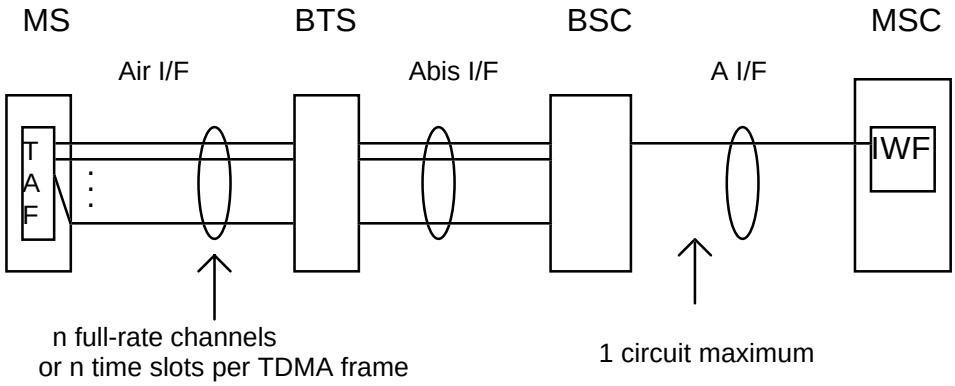


Figure 1: Network architecture for supporting HSCSD

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, 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. 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. This modification of channel requirements and/or wanted air interface user rate 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 and asymmetric. 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.

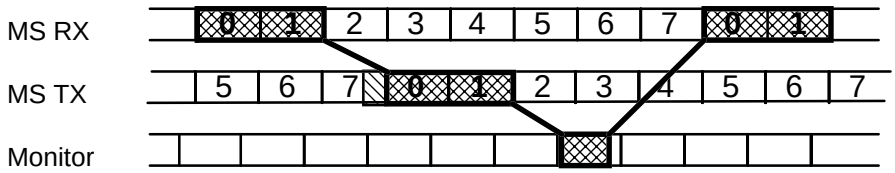


Figure 2: Double slot operation in the air interface

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].

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. The change between different TCH/F channel codings can be provided with RR Channel Mode Modify or Configuration Change procedure.

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 (T/NT)
- maximum number of traffic channels, Max TCH/F (T/NT)
- User Initiated Modification Indication, UIMI (T/NT) and
- wanted Air Interface User Rate, AIUR (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.

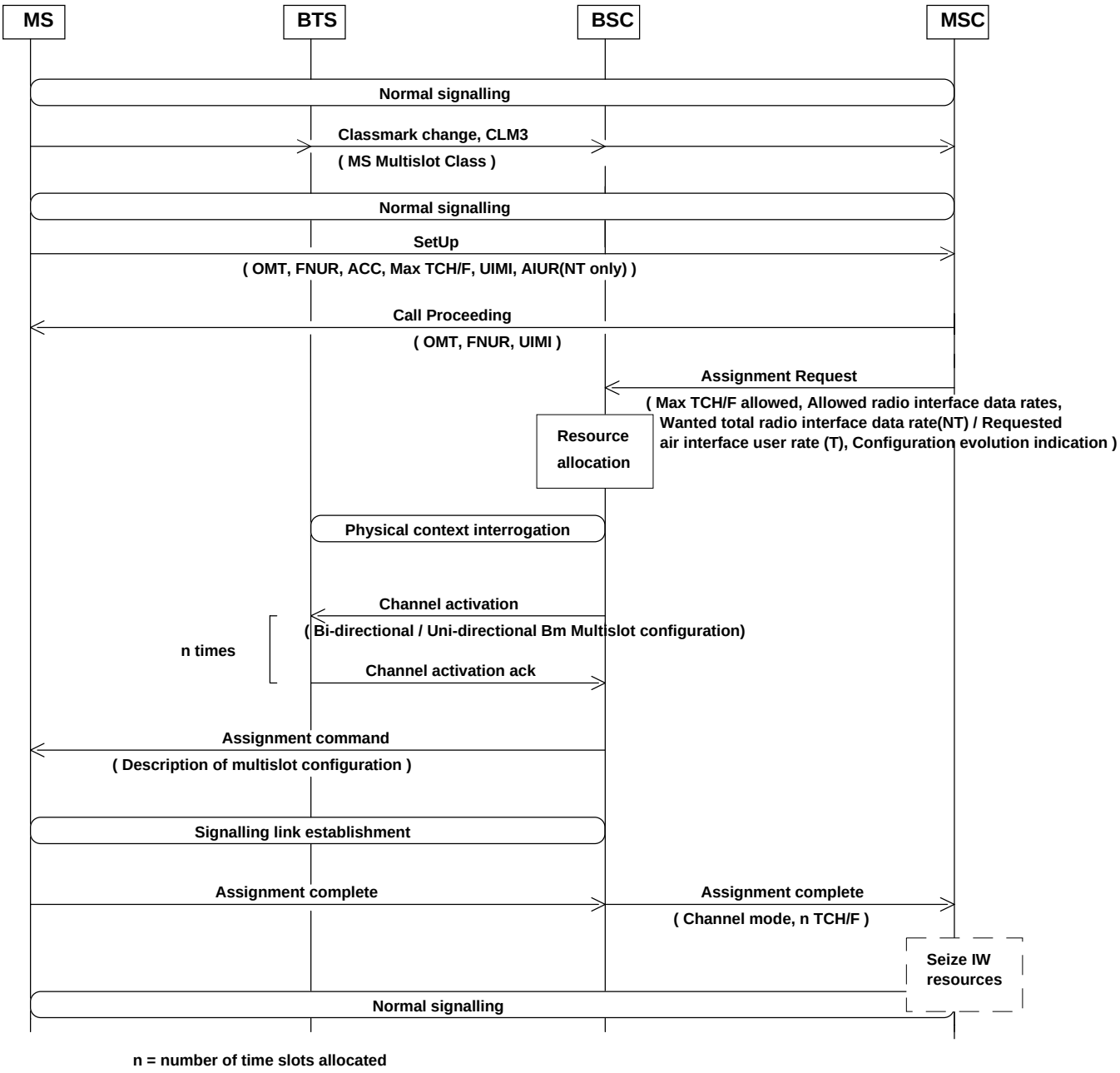


Figure 3: Mobile originated call establishment

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.

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 (T/NT)
- maximum number of traffic channels, Max TCH/F (T/NT)
- User Initiated Modification Indication, UIMI (T/NT) and
- wanted Air Interface User Rate, AIUR (NT).

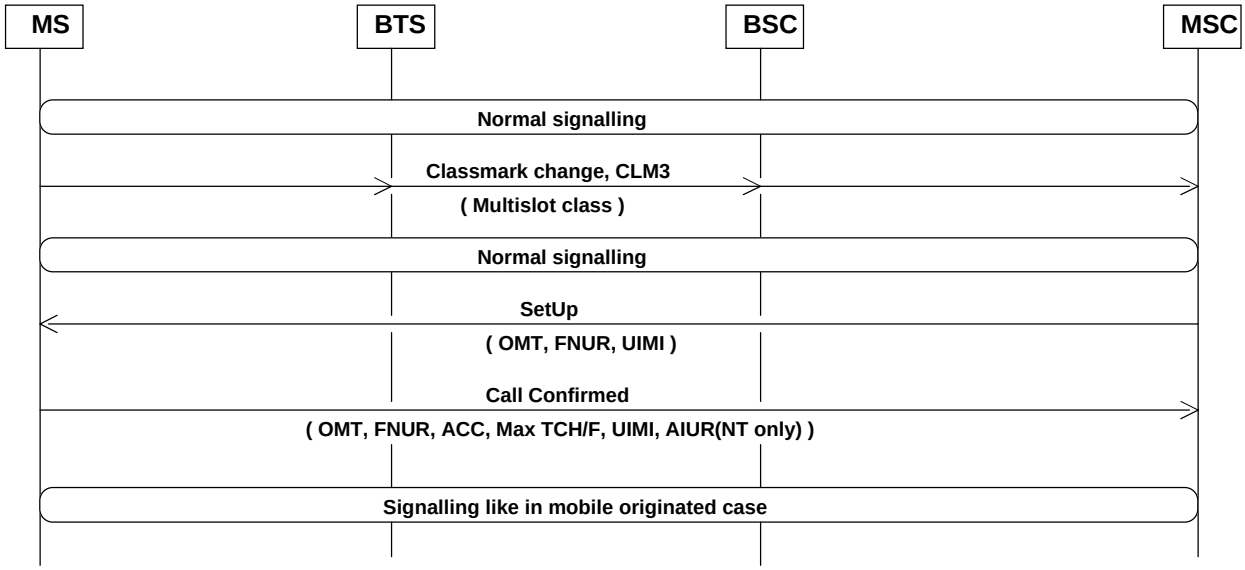


Figure 4: Mobile terminated call establishment

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.

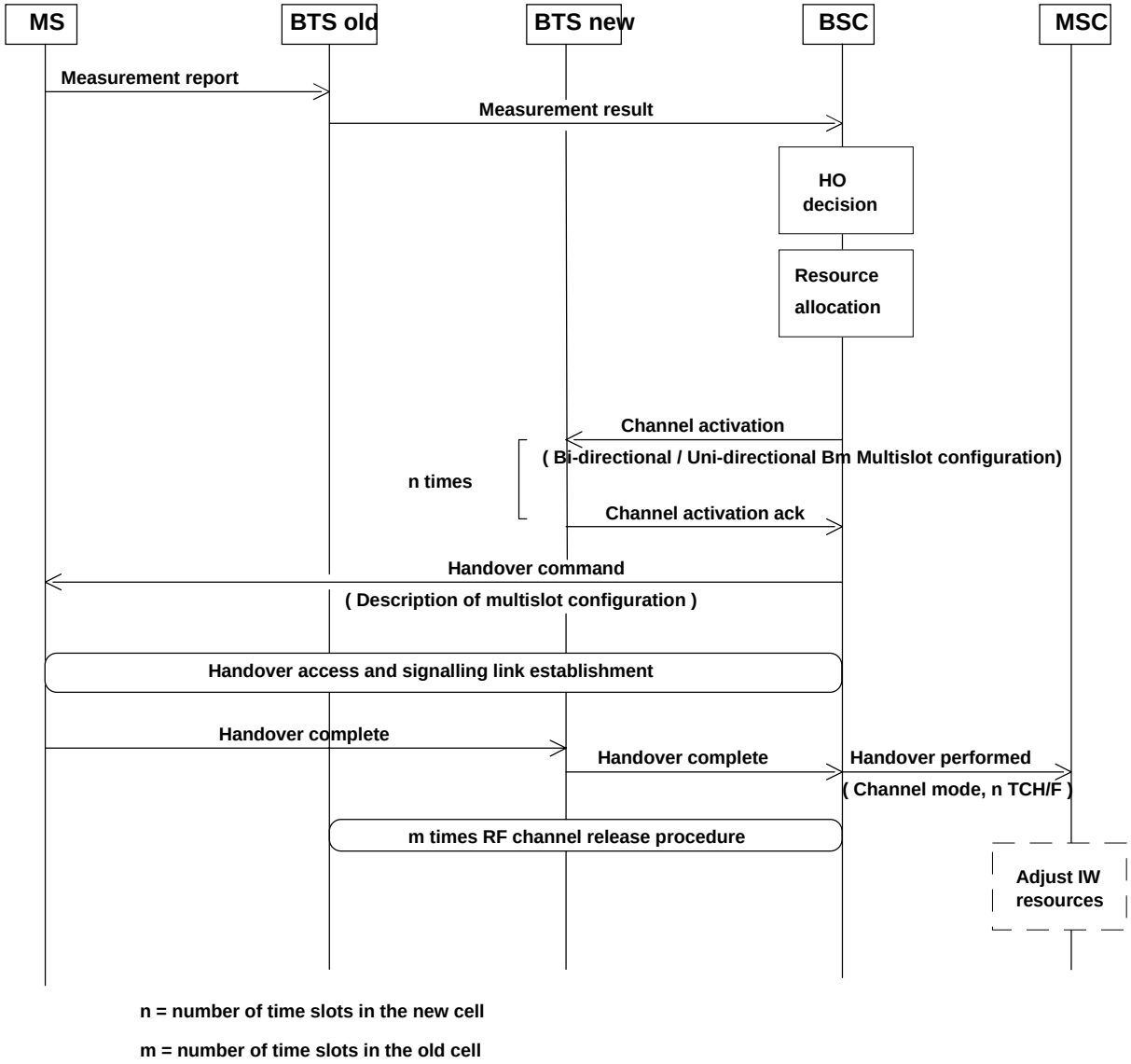


Figure 5: Intra BSC handover

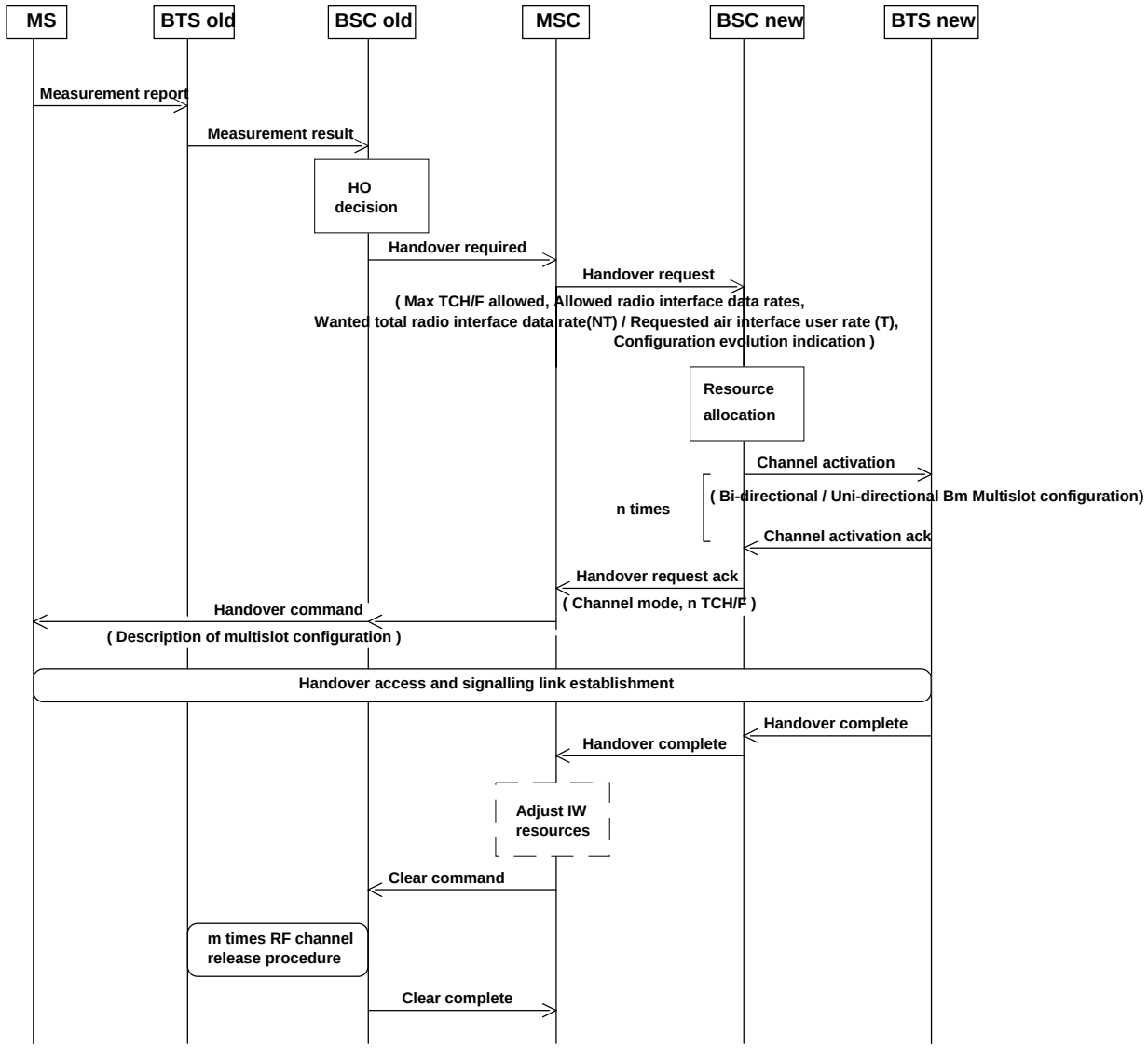
For a non-transparent call, the HSCSD configuration may be modified during an intra BSS handover within the maximum number of TCH/F and channel codings acceptable for the user and allowed by the network.

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.



n = number of time slots in the new cell

m = number of time slots in the old cell

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

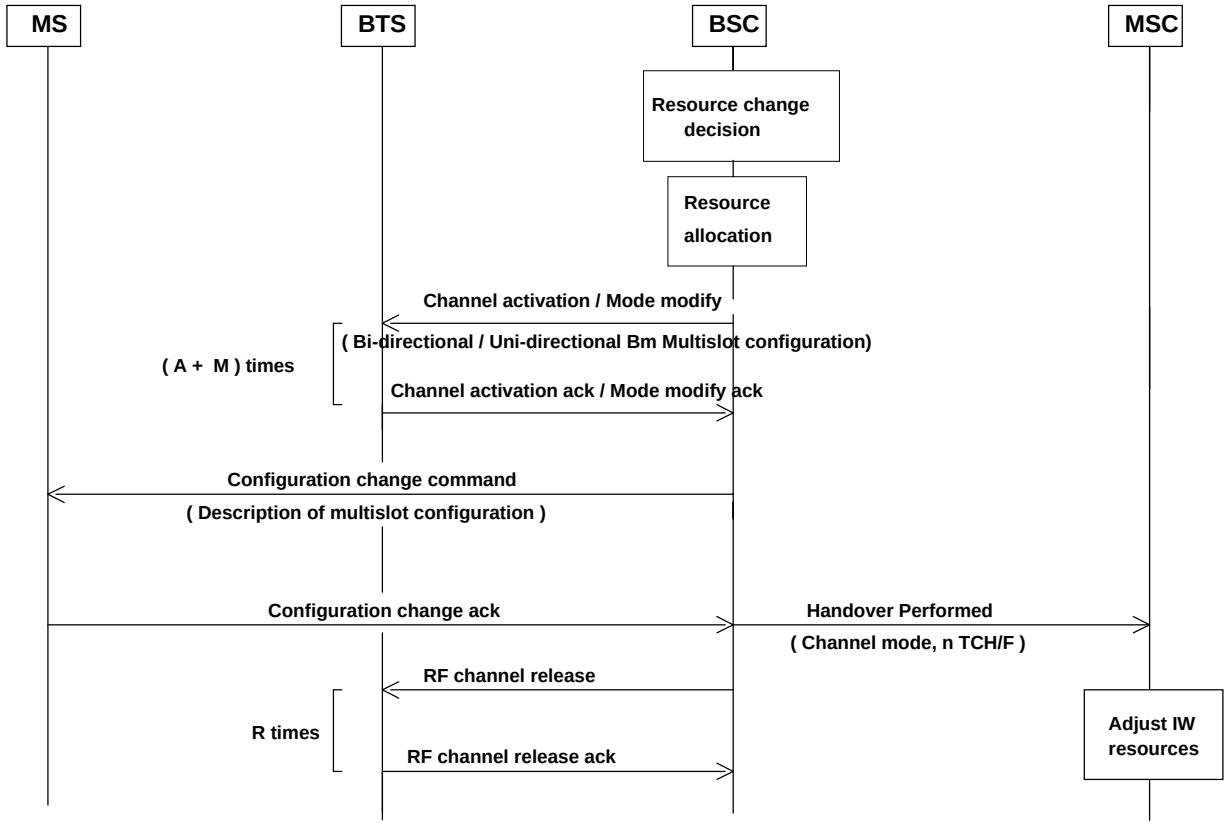
Resource upgrading means allocating more channels to the HSCSD configuration. Similarly, in resource downgrading channels are released.

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.



A = number of time slots added to the connection

R = number of time slots released from the connection

M = number of time slots modified

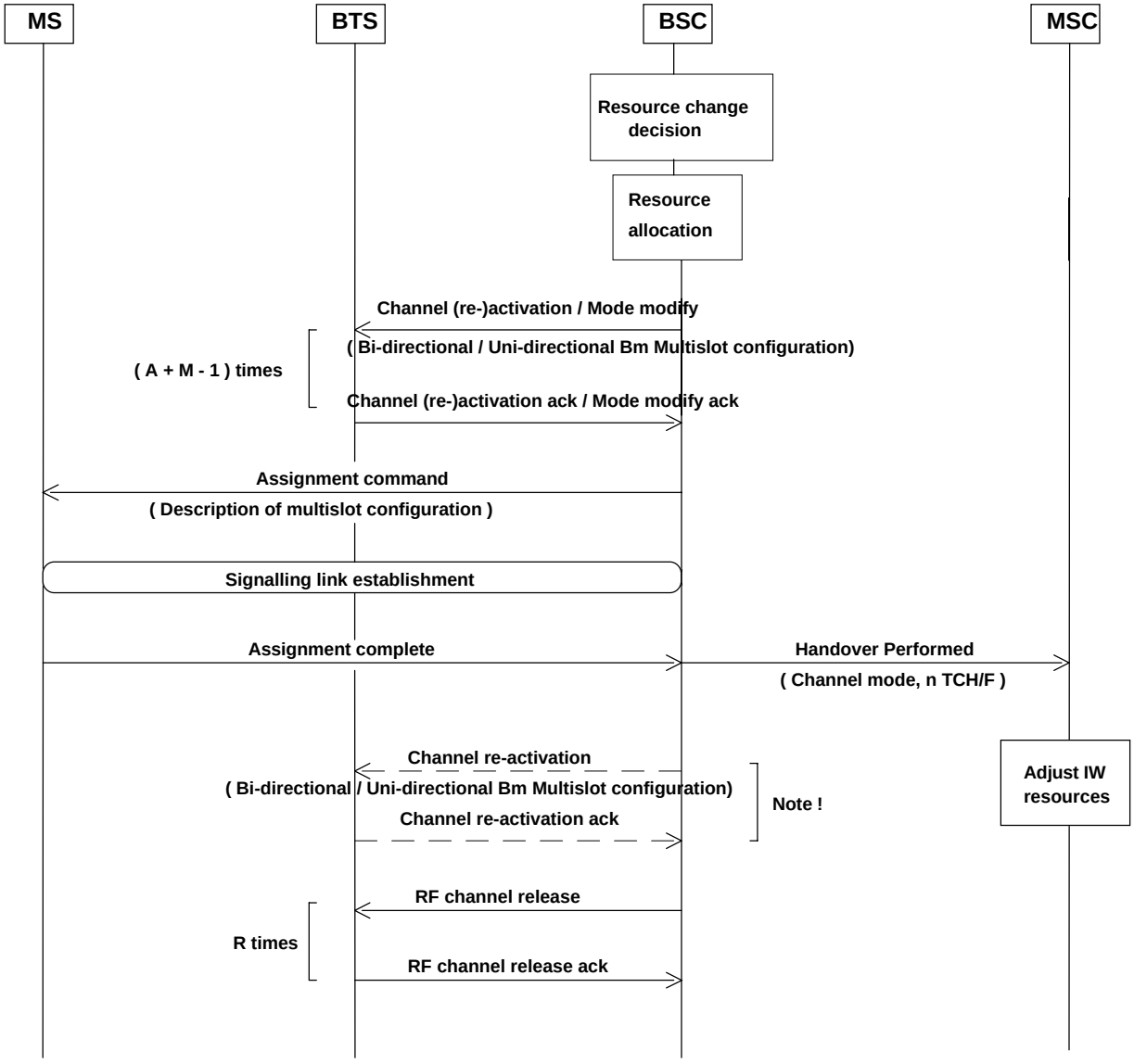
n = number of time slots after upgrading/downgrading

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. 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.

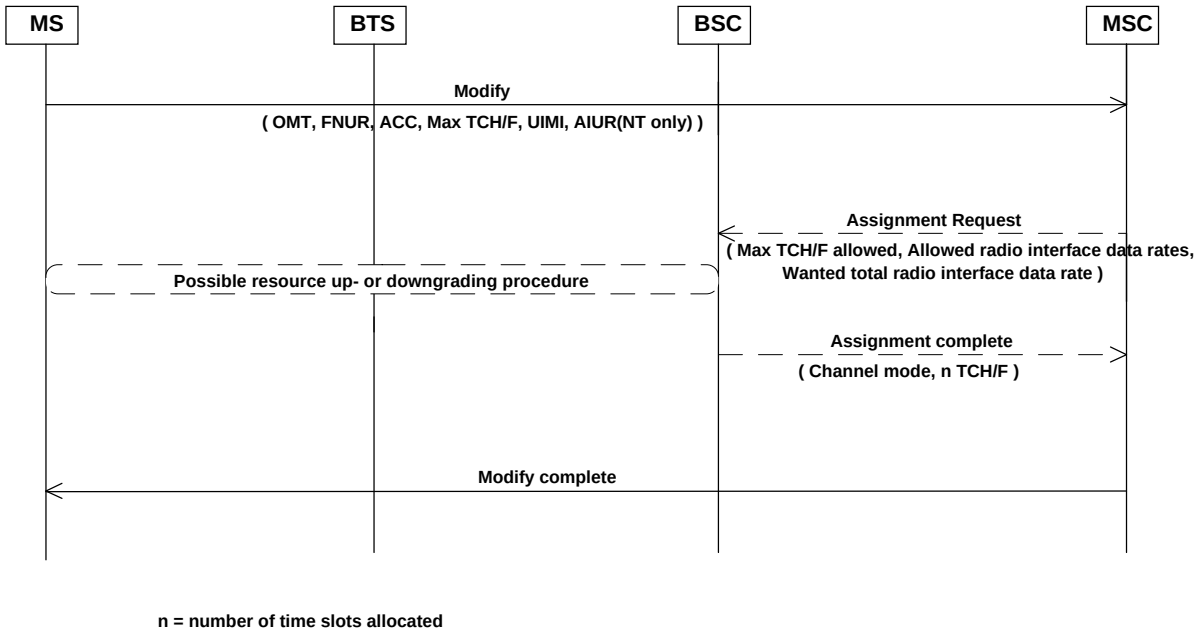


Figure 9: User initiated service level up- and downgrading

5.2.5 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.

5.3 Transparent data transmission

5.3.1 Numbering of data substreams

In transparent data transmission the V.110 data frames on the HSCSD channels carry data substream numbers to retain the order of transmission over GSM, between the split/combine functions. Between these functions a channel internal multiframing is also used in order to increase the tolerance against inter channel transmission delays. Depending on the location of the access point to external networks the split/combine functionality is located in the BSS or in the IWF on the network side, and at the mobile station.

A detailed description of the numbering scheme is given in GSM 04.21 [12].

5.3.2 Padding

HSCSD also supports user rates which are not multiples of rates provided by one TCH/F.

If the selected user rate requires n TCH/F channels but is less than the total rate that can be achieved with these n TCH/F then in the first n-1 channels the data frames carry user data on all D bits. In the n th channel the unneeded D bits of the V.110 frames are padded with fill bits.

5.4 Non-Transparent data transmission

5.4.1 HSCSD RLP

Non-transparent mode of HSCSD is realized by modifying the RLP and L2R functions to support multiple parallel TCH/Fs instead of only one TCH/F (figure 11). In addition the RLP frame numbering is increased to accommodate the enlarged data transmission rate.

The detailed specification of the RLP is given in GSM 04.22 [5], and L2R is defined in GSM 07.02 [13] and GSM 07.03 [14].

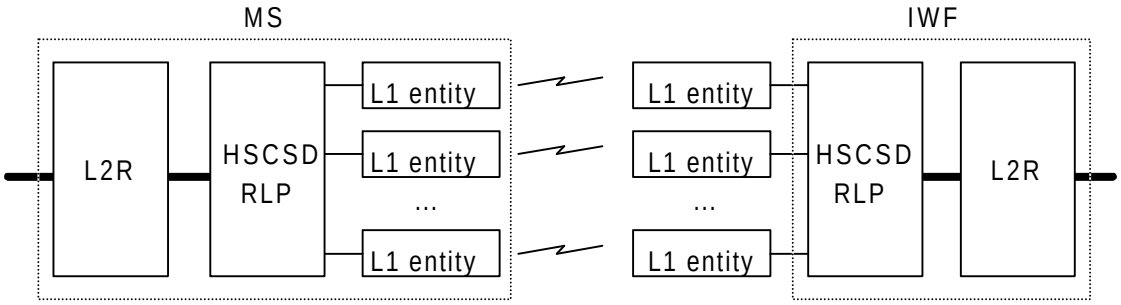


Figure 11: The HSCSD concept in non-transparent mode

5.5 Interworking

Interworking of HSCSD will be arranged to all the services to which interworking is provided in the existing GSM-system; these services are PSTN, ISDN, CSPDN and PSPDN.

5.6 Subscription aspects and storage of subscriber data

The HSCSD uses general bearer services defined in 02 series specifications. No HSCSD related subscriber data is stored in HLR or VLR.

6 Charging

6.1 General principles

The A party is liable for the usage of all TCH/F in her PLMN. The B party may have to pay for one or more TCH/F in her PLMN. In case the originating or terminating subscriber is in the PSTN there is no additional charge for them.

6.2 Call forwardings

The A party is liable for the leg A-B. The B party who forwards the call to the forwarded-to subscriber (C party) is liable for the primary (basic) channel on the leg B-C. Forwarded-to (C party) is liable for the usage of one or more TCH/F in her PLMN.

6.3 AoC and toll ticketing

MSC will send the modified e-parameters to the MS, both in MO and in MT calls, every time the charging rate will change. This can happen when:

- the coding on the air interface channel is changed;

- the number of TCH/F allocated is increased or decreased;

during an existing HSCSD data call and when AoC supplementary service is activated.

Appropriate information concerning these changes have to also be included in the charging record (toll ticket).

Annex A (informative): Change History

SPEC	SMG#	CR	PHASE	VERS	NEW_VERS	SUBJECT
03.34	s21	new	2+	2.0.0	5.0.0	GSM 03.34 HSCSD Stage 2
03.34	s26	A001	R96	5.0.1	5.1.0	Number of TCH Allocation Requirement for HSCSD

History

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