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*Technical Specification*

## **3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; High Speed Circuit Switched Data (HSCSD); Stage 1 (Release 16)**



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# Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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x the first digit:

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

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

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# 1 Scope

The present document specifies the Stage 1 description of High Speed Circuit Switched Data (HSCSD). HSCSD is a feature that introduce General Bearer Services and a multislot mechanism is used for user rates that can be achieved with one or more TCH/F. Multislot also defines a flexible use of air interface resources which makes efficient and flexible use of higher user rates feasible.

The Multislot mechanism is only applicable to GERAN.

At UTRAN radio access parameters used for GBS user data are specified at TS 23.107.

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 22.002: "Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)".
- [3] 3GPP TS 22.004: "General on supplementary services".
- [4] 3GPP TS 405.002: " Multiplexing and multiple access on the radio path".

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# 3 Abbreviations and definitions

## 3.1 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AIUR	Air Interface User Rate
EDGE	Enhanced Data rates for GSM Evolution
FNUR	Fixed Network User Rate
GBS	General Bearer Services
GERAN	GSM/EDGE radio access network
HSCSD	High Speed Circuit Switched Data
MO	Mobile Originated
MT	Mobile Terminated
NT	Non Transparent
T	Transparent
UE	User Equipment (same as MS in GSM specifications)

Additional abbreviations can be found in TS 22.905 [1].

## 3.2 Definitions

For the purposes of the present document, the following terms and definitions apply:

**Fixed Network User Rate:** user rate between IWF and the fixed network.

**Air Interface User Rate:** user rate between Mobile Termination and IWF. For T services it is the maximum possible AIUR not including padding. For NT services it is the maximum possible AIUR.

**maximum possible GERAN AIUR:** highest possible GERAN AIUR that the multiple TCH/F can provide, e.g. 2 TCH/F using TCH/F9.6 provides a maximum possible AIUR of 19,2 kbit/s.

**padding:** fill bits needed to adapt the maximum possible AIUR supported by a given number of TCH/F with a given channel coding to a FNUR that is lower than the maximum possible AIUR.

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## 4 Description

### 4.1 General

HSCSD is a feature that introduce General Bearer Services (GBS) and a multislot mechanism is used for user rates that can be achieved with one or more TCH/F. HSCSD also defines mechanisms for the use of air interface resources which makes efficient and flexible use of higher user rates feasible. The Multislot mechanism is only applicable to GERAN.

### 4.2 Applicability

GBS shall provide flexible ways of supporting GSM Phase 2, T and NT data services and new data services at the higher rates. Data compression shall be applicable to NT GBS. Supplementary Services applicable to the General Bearer Services are specified at TS 22.004, [3].

### 4.3 General Bearer Services

The General Bearer Services are defined in TS 22.002 [2].

The General Bearer Services (GBS) consist of two Bearer Services, and they are as follows:

- asynchronous;
- synchronous.

### 4.4 Parameters to be indicated and negotiated

#### 4.4.1 Call set-up

The parameters to be indicated, and negotiated, if applicable, during the call set-up shall include:

- FNUR;
- GERAN Channel coding(s) acceptable (for the call);
- maximum number of GERAN TCH/F (that the mobile user can accept);
- wanted AIUR (desired rate that the mobile user wants the network to allocate). The wanted AIUR is applicable to NT services only;
- indication if the user initiated modification is required, and if so, the network resource needs;
- channel coding asymmetry indication.

Some of the parameters are only utilised by GERAN. When UTRAN radio access bearer is allocated the values are ignored.

The GERAN channel coding(s) acceptable shall be indicated by the mobile at call set-up and is not negotiable. It indicates the GERAN channel coding(s) that may be chosen by the network for the call.

The maximum number of GERAN TCH/F shall be indicated at call set-up. It enables the mobile user to limit the number of GERAN TCH/F used and thus to control an essential parameter for charging. It sets the upper limit of number of TCH/F that the network may allocate to the mobile.

The wanted AIUR (applicable to NT services only) indicates the AIUR that the mobile user wants and which the network shall try to reach but which it is not allowed to exceed. The exception where the network is allowed to exceed the wanted AIUR is when the network can achieve the GERAN AIUR with a lower number of TCH/F, e.g. wanted GERAN AIUR indicated by the mobile is 14,4 kbit/s, GERAN channel codings acceptable are both TCH/F9.6 and TCH/F4.8 and maximum number of TCH/F are 3, then the network shall choose 2 x 9,6 over 3 x 4,8 if a channel coding of TCH/F9.6 is available on two TCH/F.

If the user wishes to make use of the user initiated modification procedure, this shall be indicated at the call set-up.

It shall be possible to reserve a different FNUR than the AIUR.

Channel coding asymmetry indication is only applicable to NT calls where the user has indicated acceptance for channel coding(s) based on enhanced modulation. In this case the user may indicate preference for channel coding symmetry, downlink biased channel coding asymmetry, or uplink biased channel coding asymmetry. The channel coding asymmetry indication is only applicable in direction UE to network.

#### 4.4.1.1 T services

The ME or the network may propose to modify the FNUR. The calling entity may accept or release the call. Autobauding is not allowed.

The AIUR is always equal to the FNUR.

Fax Group 3 can make use of HSCSD.

The GERAN channel coding selected must be one of the channel coding(s) indicated in the channel coding(s) acceptable parameter, the number of TCH/F selected shall not exceed the maximum number of TCH/F parameter, and the combination of the two shall result in an AIUR that is equal to the FNUR.

#### 4.4.1.2 NT services

The ME or the network may propose to modify the FNUR. The calling entity may accept or release the call. Autobauding is allowed.

The wanted AIUR is indicated by the mobile at call set-up.

### 4.4.2 Network initiated modification

#### 4.4.2.1 T services

For transparent calls the radio resource parameters must remain within limits that allow the transparent call to maintain its characteristics of fixed end to end throughput and delay. This means that in GERAN the channel coding and the number of TCH/F used may change during the call as long as a channel coding indicated in the channel coding(s) acceptable parameter is used, the maximum number of TCH/F is not exceeded and the AIUR is kept constant.

#### 4.4.2.2 NT services

For NT calls the network may modify the number of TCH/F and the channel coding used at GERAN and thus also the AIUR during the call as long as the maximum number of TCH/F, and the channel coding(s) acceptable are all respected. The network shall try to reach the wanted GERAN AIUR indicated, as long as the resource situation allows it.



### 4.4.3 User initiated modification

The in-call modification feature shall be supported in case of alternate services.

#### 4.4.3.1 T services

The user initiated modification is not applicable to T services.

#### 4.4.3.2 NT services

The user may indicate a change of the parameters maximum number of GERAN TCH/F, wanted AIUR, and channel coding asymmetry. No other parameters may be modified.

The user initiated modification is only applicable to the data phase of alternate services.

## 4.5 Air Interface Resource Allocation

### 4.5.1 Minimum GERAN Air Interface Resource Allocation and Allocation Increment

Air interface resources shall be allocated to HSCSD calls at TCH/F increments. The minimum air interface resource allocation for HSCSD calls shall be one TCH/F.

### 4.5.2 Flexible Air Interface Resource Allocation

Flexible air interface resource allocation enables:

- the network to allocate dynamically resources related to the air interface usage according to the network operator's strategy, within the limits negotiated at the call set-up or during a user initiated modification.

## 4.6 Symmetric and asymmetric connections

### 4.6.1 Symmetric connections

For symmetric connections, air interface resources are allocated symmetrically.

### 4.6.2 Asymmetric connections

There are two types of asymmetry, asymmetric air interface connection and channel coding asymmetry. Asymmetric air interface connection implies that more time slots are used in the downlink than in the uplink at GERAN. Channel coding asymmetry implies that one channel coding is used in the uplink and another channel coding is used in the downlink at GERAN.

#### 4.6.2.1 Asymmetric air interface connection

The provision of the asymmetric air interface connections allows simple ME (of Type 1, Reference TS 405.002, [4]) to receive at higher AIUR than otherwise would be possible with a symmetric connection.

Asymmetric air interface connections that are a subset of the symmetric HSCSD, and support different user rates at uplink and downlink, shall be provided.

Asymmetric air interface connections are only applicable to the downlink-biased asymmetry, i.e., where the ME is receiving at a higher rate than it is transmitting.

Asymmetric air interface connections shall only be applicable to NT GBS.

#### 4.6.2.2 Channel coding asymmetry

Channel coding asymmetry may be set up by the network in three cases:

- if the UE only supports enhanced modulation in the downlink;
- if the UE supports enhanced modulation in both links, but the user indicates preference for uplink or downlink biased channel coding asymmetry;
- if the UE supports enhanced modulation in both links, and the user indicates preference for channel coding symmetry, but the link conditions justifies different channel codings in up- and downlink.

In the case when preference of uplink or downlink biased channel coding asymmetry is indicated by the user, and a asymmetric channel coding connection is set up based on this indication, the network shall always assign a TCH/F14.4 channel at GERAN on the unbiased link.

Channel coding asymmetry shall only be applicable to NT services applying the GERAN channel codings TCH/F14.4, TCH/F28.8 and TCH/F43.2.

In case a symmetric channel coding connection is set up, the link adaptation mechanism may change a symmetric channel coding connection to an asymmetric channel coding connection.

#### 4.6.3 Network choice of connection symmetry

When the network has a choice of allocating either a symmetric or an asymmetric air interface connection it shall proceed as follows:

- in the case where the wanted AIUR is smaller than or equal to the AIUR supported symmetrically by the ME, or asymmetric air interface connection is not supported by the network, then a symmetric air interface connection is established;
- in the case where the wanted AIUR exceeds the AIUR supported symmetrically by the ME, the network shall assign the maximum AIUR supported by the ME in the down-link at GERAN, upper-bounded by the maximum number of TCH/F indicated by the mobile user, and the number of TCH/F supported by the network, maintaining the minimum of one TCH/F.

### 4.7 User Equipment/Mobile Equipment requirements

The general UE capabilities is applicable to HSCSD.

A ME that supports multislot mechanism shall support one or more of the GERAN channel types TCH/F at or above 4,8 kbit/s.

Given that the ME supports a certain GERAN channel coding, the network shall be able to assume that the ME can support this channel coding in any multislot configuration allowed by its multislot class (Reference TS 45.002, [4]).

### 4.8 Mobility Management

HSCSD shall be provided for within the existing supported Mobility Management.

### 4.9 Roaming

Roaming shall be possible.

## 4.10 Quality of Service

### 4.10.1 Bit error rate

#### 4.10.1.1 GERAN TCH/F Bit Error Rate

The bit error rate performance of each TCH/F of a multiple TCH/F HSCSD call shall be the same as that of a single TCH/F data call for the same channel coding.

#### 4.10.1.2 Overall GBS Bit Error Rate

Any increase in the bit error rate caused by the splitting and combining of multiple GERAN TCH/F shall be kept to a minimum.

### 4.10.2 GERAN Radio resource management

The multislot mechanism shall be provided for within the existing Radio Resource management control functions, including the relevant handover types. The handover shall be simultaneous for all air interface timeslots making up the call.

The multislot mechanism shall be provided with full mobility.

### 4.10.3 Call set-up delay

Any increase in call set-up delay of the GBS calls compared to GSM Phase 2 data services shall be kept to a minimum.

### 4.10.4 End-to-end delay

Any increase in end-to-end delay of the GBS calls compared to GSM Phase 2 data services shall be kept to a minimum.

### 4.10.5 Throughput

The throughput for GBS T calls shall remain constant for the duration of the call except for the interruption of transmission at handover.

### 4.10.6 Network planning and interference levels

The impact of multislot mechanism on network planning and interference levels shall be kept to a minimum.

## 4.11 Mapping of FNUR to GERAN TCH/F for T services

For some FNUR padding is required to adapt the maximum possible AIUR to the FNUR.

## 4.12 Mapping of GERAN AIUR to GERAN TCH/F for NT services

The following table indicates the mapping of AIUR to the number of TCH/F for NT services.

**Table 1: Mapping of AIUR to TCH/F for NT services**

AIUR	TCH/F4.8	TCH/F9.6	TCH/F14.4	TCH/F28.8	TCH/F43.2
4,8 kbit/s	1	N/A	N/A	N/A	N/A
9,6 kbit/s	2	1	N/A	N/A	N/A
14,4 kbit/s	3	N/A	1	N/A	N/A
19,2 kbit/s	4	2	N/A	N/A	N/A
28,8 kbit/s	N/A	3	2	1	N/A
38,4 kbit/s	N/A	4	N/A	N/A	N/A
43,2 kbit/s	N/A	N/A	3	N/A	1
57,6 kbit/s	N/A	N/A	4	2	N/A
N/A	Not applicable.				

For Fixed Network User Rates (FRUR) see TS 22.002 [2].

NOTE: GERAN TCH/F28.8 and GERAN TCH/F43.2 require EDGE capability.

## 4.13 GBS MMI aspects

It shall be possible to configure the parameters negotiated and indicated at GBS call set-up and during user initiated modification.

## 4.14 GBS Subscription aspects

HSCSD is not subscribed to. Users wanting to use multislot mechanism must subscribe to the General Bearer Services.

## 4.15 GBS charging aspects

To allow accurate charging of multislot calls, a record of start and stop timestamps versus the number of TCH/F, for each change in TCH/F allocation, shall be provided.

NOTE: For MO multislot calls, the A party is liable for the use of all the TCH/F in her PLMN.

For MT multislot calls, the B party may have to pay for one or more of the TCH/F in her PLMN.

In case the originating or terminating subscriber is a fixed network subscriber, there should be no additional charge (in respect of the changing allocation of GERAN TCH/F) for the originating or terminating fixed network subscriber.

## 4.16 O and M aspects

For GBS call, there are several new and modified parameters compared to GSM Phase 2 data calls.

For GBS, the air interface resource allocation may change several times during the call (network initiated and user initiated changes). It shall be possible to limit the frequency of changes per call, separately for network initiated and user initiated changes.

Multislot calls can occupy multiple TCH/F. It shall dynamically be possible to limit the maximum number of GERAN TCH/F allowed for GBS calls per cell.

## 4.17 Multislot security aspects

Authentication and ciphering are applicable to multislot calls with no or minimal reduction in the security of the air interface.

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## 5 Exceptional procedures or unsuccessful outcome

When a GBS call is offered to an entity (either ME or network) unable to support the offered GBS call, it shall be possible, within the limitations of the service, to revert the call:

- to an GBS call the entity can support; or
- at GERAN to a GSM Phase 2 data service.

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## 6 Interworking requirements

### 6.1 Service interworking

#### 6.1.1 Interworking with supplementary services

Supplementary Services that are applicable to the General Bearer Services can be used (Reference TS 22.004, [3]).

#### 6.1.2 Interworking with other services

The simultaneous use of multislot mechanism and SMS MO/PP, and multislot mechanism and SMS MT/PP services shall be possible.

### 6.2 Network interworking

Interworking should be possible to all networks which are covered by GSM Phase 2 bearer services:

- PSTN;
- ISDN.

## Annex A (informative): Change history

Change history											
TSG SA#	SA Doc.	SA1 Doc	Spec	CR	Rev	Rel	Cat	Subject/Comment	Old	New	Work Item
SP-04			02.34					Transferred to 3GPP SA1 at ETSI SMG#29	8.1.0	3.0.0	
SP-05	SP-99479	S1-99615	22.034	001		R99	D	Editorial changes for alignment	3.0.0	3.1.0	
SP-05	SP-99448	S1-99706	22.034	002		R99	B	Channel coding asymmetry for ECSD	3.0.0	3.1.0	
SP-07	SP-000057	S1-000052	22.034	003		R99	C	CR on HSCSD changes for 3GPP	3.1.0	3.2.0	
April 2000								Editorial correction to title (Release 1999, not Release 2000)	3.2.0	3.2.1	
SP-11	SP-010065	S1-010258	22.004			Rel-4		Transferred to 3GPP Release 4	3.2.1	4.0.0	
SP-16	SP-020239	S1-020890	22.034	004		Rel-4	F	CR to 22.034 Correction of terminology and references	4.0.0	4.1.0	Correct
SP-16	SP-020267	S1-021043	22.034			Rel-5		Updated from Rel-4 to Rel5	4.1.0	5.0.0	
SP-26	SP-040744	S1-040997	22.034			Rel-6		Updated from Rel-5 to Rel-6	5.0.0	6.0.0	
SP-36			22.034			Rel-7		Updated from Rel-6 to Rel-7	6.0.0	7.0.0	
SP-42	-	-				Rel-8		Updated from Rel-7 to Rel-8	7.0.0	8.0.0	
SP-46	-	-	-	-	-	-		Updated to Rel-9 by MCC	7.0.0	9.0.0	
2011-03	-	-	-	-	-	-	-	Update to Rel-10 version (MCC)	9.0.0	10.0.0	
2012-09	-	-	-	-	-	-	-	Update to Rel-11 version (MCC)	10.0.0	11.0.0	
2014-10	-	-	-	-	-	-	-	Update to Rel-12 version (MCC)	11.0.0	12.0.0	
2015-12								Update to Rel-13 version (MCC)	12.0.0	13.0.0	
2017-03	-	-	-	-	-	-	-	Updated to Rel-14 by MCC	13.0.0	14.0.0	
2018-06	-	-	-	-	-	-	-	Updated to Rel-15 by MCC	14.0.0	15.0.0	
SP-88e	-	-	-	-	-	-	-	Updated to Rel-16 by MCC	15.0.0	16.0.0	