TDOC SMG 432/95

HSCSD Meeting

High Speed Circuit Switched Data
Joint SMG1, SMG2, SMG3, SMG4 Workshop

Meeting Report

HSCSD Workshop in Helsinki
9 - 10 May 1995

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1. Introduction

The High Speed Circuit Switched Data (HSCSD) Joint SMG1, SMG2, SMG3, SMG4 Workshop took place on the 9 to 10 May 1995, hosted by Nokia and chaired by Mr Roth.
The aim of the meeting was to pool together expertise from SMG1 (service requirements) and SMG2, SMG3 and SMG4 (protocol specifications) and to meet the following goals:

- To identify the major technical issues to address before the main technical choices are frozen;
- To advise SMG on the subsequent organisation of the work for a timely freezing of the main technical choices.

Results of the discussions will be the basis of subsequent work in the groups in charge of service description, of service requirements (SMG1), of architecture (SMG3) and detailed protocol specifications (SMG2, SMG3 and SMG4).

2. Presentation of the documents

Some of the HSCSD TDocs where there for information only and have not been presented and discussed explicitly (e.g. documents copied from other STCs (TDocs 16, 17, 18, 19)).
Some STC TDocs were used as a basis for the presentations (TDocs 2, 9, 12, 13, 14).

2.1 HSCSD Applications (HSCSD TDoc 1, source: Nokia)

The following HSCSD applications where identified in the presentation:
- Facsimile
- File transfer
- Electronic Mail
- Video
- Distribution oriented services (World Wide Web)
- Alternate services

The question was raised in the presentation if Alternate Services are required and what the thinkable applications would be. There was an agreement, that Alternate services (only with non transparent services) should be defined in the requirement specification.

File transfer was seen to gain a lot from increased data rates.

A transparent fixed rate Video service was felt to be economically justifiable only if it is feasible to use at maximum 2 traffic channels (due to limited radio spectrum).
Good results have been achieved already with 8 and 24 kbit/s data rates (the latter including the voice channel). It was noted that there is a new variable rate video standard, ITU-T H.263, which allows any bit rate up to 64 kbit/s. For video, as for any visual information, higher bit rate always offers better quality and better user satisfaction. (left for further study)

Simultaneous use of data and speech was suggested (cf. GPRS) but might be problematic, e.g. synchronisation of the connections. It was noted that current GSM does not support simultaneous use of two circuit switched connections. (left for further study)

Some kind of stage 1 service description for HSCSD should be developed.

2.2 Requirements for High Speed Data in GSM (HSCSD TDoc 12, source: Vodafone, SMG1 TDoc 167/95)

A Presentation on the requirements for HSCSD was given by Mr. Cox emphasising that radio spectrum is a scarce resource and therefore allocation of 8 traffic channels to a single subscriber for long time applications is not realistic because of the high costs and simply running out of spectrum. It was mentioned that this problem mainly concerns GSM but not so much DCS networks (smaller cells, wider bandwidth).
For transparent services where the data rate is fixed during a call (this applies typically to the facsimile service and view data services) higher data rates than 19200 are not seen as a requirement.

For non transparent services the data rate could be varied many times during a call depending on the demand (e.g. Data transfer to PC during an interactive application), even dropping back to a very low rate, when there is no need for data transfer.
In this context the charging issue would become more complicated because every rate change must be taken into account to allow correct charging. It was suggested to limit the frequency of rate updates, but it may cause additional problems e.g. by slowing down a necessary handover requiring a rate change.

Relation between HSCSD and GPRS
It was discussed whether GPRS and HSCSD can be used by the same applications. For some applications a number of transparent services, as for Packet switched services in general, are not applicable.

2.3 Requirements of HSCSD Draft version 0.1.0 (HSCSD TDoc 2/95)

The requirements document, which was the output of the last SMG1 meeting, was accepted in principle. An updated version will be produced by the rapporteur to reflect the outcome of the Workshop.

2.4 Architectural Aspects of HSCSD Services in GSM (HSCSD TDoc 4/95 source: Nokia)

The main requirement is maximum transparency to BTS equipment when considering architectural changes.

A new combining and splitting functionality is needed in the MSC/IWF and the MS/TAF. This provides the functions of dividing the data into n separate data streams between IWF and TAF. These data streams should be allocated by multiple independent subchannel co-allocation principle for the entire GSM network (Air-, Abis- and A-interfaces). Lower layer standards of all the interfaces between the network elements shall be unchanged to minimise the implementation cost and hardware changes in the equipment.

To simplify the definition and the implementation of HSCSD services in mobiles it is proposed to use consecutive full-rate traffic channels at the Air interface and to limit an HSCSD connection to 8 time slots, i.e. one TRX. Simultaneous handover for all n HSCSD subchannels, i.e. the HSCSD connection is required to allow same mobility as for normal calls. For all the co-allocated traffic channels only one associated control channel (one FACCH and one SACCH) is proposed to be used.

Provision of Flexible Bearer services, where the data rate can be altered, due to lack of radio resource, handover and/or user need is proposed (applicable only to non transparent mode services). The limits for the rate (minimum and maximum) are defined in the call set-up messages.

The approach having only one signalling channel for all the co-allocated traffic channels was accepted. To use the unused control channels for data transmission was felt to be to complex compared to what could be gained.

Contribution has been accepted in principle. See also HSCSD TDoc 3/95.

2.5 Network architecture for HSCSD (HSCSD TDoc 3/95 source: Ericsson)

This contribution proposes to use the 64 kbit/s capacity of the A-Interface connection in a more efficient manner (current A-Interface connection uses only 1/4 of its capacity, i.e. 16 kbit/s)[1].

The changes should not affect the BTS. It should be studied in the relevant STCs and a clear decision should be taken. Big changes to the current A interface are likely to have some repercussions on other network elements and on multivendor networks.

It was also questioned if using flexible bearer service requires the reservation of maximum capacity for the entire duration of the call. The same question was asked concerning alternate services.

The advantages and disadvantages of a centralised interworking function were discussed and they are subject for further study.

As a conclusion on TDocs 3 and 4, more study is needed if up to 4 channels can be multiplexed into one channel on the A-Interface, taking into account possible future Air-interface data rates (e.g. 14.4 kbit/s). The consensus was

[1]This might also be applied in the inter-MSC handover in TUP lines between MSCs.

that only one solution should be chosen to avoid multivendor incompatibilities (cf. HSCSD TDoc 4/95). As for general architectural aspects, they were accepted.

2.6 HSCSD Air Interface Aspects (HSCSD TDoc 5/95 Source Nokia)

The proposed solution by Nokia on mapping HSCSD channel onto physical channels:

- the full rate data channels should be allocated on consecutive time slots of a TDMA frame:
- the frequency hopping sequence should be the same for all subchannels

Channel coding
The simplest choice for the channel coding would be to use the same coding and interleaving scheme as for the TCH/F 9.6 data channel. An alternative would be modified channel coding to allow higher user data rates in the air interface but this would have a direct impact in the BTS.

TCH/F9.6 error performance is good enough in most of the cases, alternatively also TCH/F4.8 (with a more efficient channel coding) could be used if the bit error rate performance is considered inadequate (e.g. near the edge of a cell, thus increasing the usable cell area) Changing the channel coding during the call is not a problem for non transparent protocols, whereas for transparent protocols additional TCH(s) would be required to keep the constant data rate (2*TCH/F9.6 to become 4*TCH/F4.8, both equal to 19.2 kbit/s). To change the coding would require additional signalling.

It could also be possible to use 8 frame interleaving scheme (instead of 19) which would reduce the two way delay (by more than 100 milliseconds) but the bit error rate would increase. The 19 frame interleaving was defined to meet the requirements of transparent data transfer (better BER). For non transparent services the increased bit error rate does not cause severe problems because of the error correcting RLP. Modified interleaving could be an advantage also to current TCH/F9.6 data. It was noted that customers have complained a lot about slow response time, i.e. large delay, of current TCH/F9.6 data services, not actually believing that they are using a 9.6 kbit/s connection.
The channel coding will be discussed in SMG2, as several other items concerning the air interface.

During the discussion it was mentioned that cross phase compatibility must be assessed. It was questioned whether the interleaving depth should be negotiable or fixed for HSCSD. Negotiable interleaving may allow old BTSs to support HSCSD more easily.

Power control and Timing Advance and Radio link measurements
Proposal is to use same power control parameter and radio link measurements parameter for all the subchannels (only one SACCH and FACCH for all subchannels). The advantages are in reduced signalling and simplified RF design. Disadvantages are very small (marginally larger power consumption). Using several SACCHs would allow more consequent neighbour cell measurements e.g. in dual-band networks but having such an advantage only for HSCSD but not for ordinary calls is only a marginal benefit.

Encryption: same encryption for all the channels is proposed to be used.

It was noted that requiring consecutive slots may require intra-carrier or intra-cell handovers to other on-going calls in the cell to make room for a HSCSD call requiring several time slots. This is the major drawback if HSCSD is defined having consecutive time slots.

It was questioned if there is a need for different kinds of MS classes. There was no answer to this at the Workshop.

The general view was that the HSCSD compatible air interface does not create major problems. Some items will be forwarded to SMG2 for confirmation or for further study.

2.7 Future channel coding for HSCSD (HSCSD TDoc 10/95, source: Telia)

Telia proposes to wait until a new channel coding for GPRS has been defined, before a definite decision on channel coding for HSCSD is taken. Some simulations made by Telia have shown that a 1/2 rate code punctured to a 3/4 code together with RLP would have a good performance and would give a data rate of 14.4 kbit/s. It was unclear what interleaving has been used in this simulation.

It was noted that even though higher rates at the air interface may be easily attainable, it may be very difficult to transmit them through the Abis and the A interface. If 14.4 kbit/s data uses the standard RLP frame structure, the Abis and A interface rates will be 18 kbit/s while the current rate is 16 kbit/s.

It was decided that for the time being the proposed approaches would not be used.

2.8 Charging aspects with the HSCSD (HSCSD TDoc 6/95, source: Nokia)

The charging should be based on the air interface resources required for the connection, and as more time slots are needed for an HSCSD call, some mechanisms must be designed to convey this additional information to the charging equipment.

The main point of the paper was that the terminating leg must be paid for, if a HSCSD call is set up for the MT leg. If single numbering scheme is used, it will be impossible to know, whether a HSCSD will be set up or not. Therefore, the calling party cannot be charged for the additional resources that are allocated for the MT leg. The only solution is to charge the receiving party for the additional capacity.

It was confirmed that a mechanism to allow adequate charging information must be provided (either data rate or the used resources in the network) so that accurate charging and AoC is possible. If CMM (channel mode modify) is used to change the data rate during the call, information must be passed to relevant entities in the network.

MT has been covered in this presentation. It was noted that in some Middle East countries the B subscriber is charged for the call, so mechanism already exist for charging for the terminating leg.
Whether data compression should be charged has already been considered by SMG1. They have contacted MoU for advice.

Principles of charging aspects presented in the document were accepted, Information should be brought in to a "stage 0" or stage 1 specification.
SMG 6 should discuss this issues and include the results in the relevant specifications (12.05)

2.9 Aspects on Asymmetric HSCSD (HSCSD TDoc 7/95, source: Nokia)

The need for asymmetric data services (e.g. fax, file transfer, video) was justified by the very asymmetric nature of many data transfer needs even though it is not applied in existing fixed network services, due to the available bandwidth. Even ordinary speech is usually asymmetric (with only one person talking at a time), though during a speech call the asymmetry usually changes several times during a conversation.

The advantages and disadvantages of true asymmetric HSCSD were presented. A true asymmetric connection would require a separate reservation of both uplink and downlink time slots, thus breaking the current pairwise reservation of GSM traffic channels, and requiring additional signalling. The main advantage is that this would allow the reservation of only the required capacity, allowing the saved capacity to be used by other users. Nevertheless, it was argued that it is quite unlikely that the saved capacity could be used by other users as they would have to be in the same cell, and have a bigger requirement for the opposite asymmetry.

Another possibility is what was called pseudo asymmetric HSCSD. During the call set-up an ordinary HSCSD connection would be allocated. Then it would be completely up to the MS to use only the capacity it needs for the uplink. Current RLP is compatible with such a case, i.e. that sometimes a time slot does not contain a frame (cf. DTX). Such a pseudo asymmetric HSCSD connection would be completely transparent to the network that supports a symmetric HSCSD connection. If pseudo asymmetry is required where the uplink has bigger capacity, some changes are required in the BTS, and a negotiation might be required between the MS and the network. However, as in a vast majority of cases the downlink direction can be seen as more important, such a transparent-to-the-network solution allowing easily high downlink rates is very appealing. The only requirement on HSCSD for allowing pseudo asymmetric connections is having a single SACCH channel in a convenient time slot.

The real benefit of a pseudo asymmetric HSCSD is for MS manufacturers. High rates in symmetric HSCSD require rather a complicated RF design in the ME (simultaneous RX and TX requiring separate RX and TX modules). Both true and pseudo asymmetric HSCSD allow them to avoid complexity of the equipment by avoiding or reducing the simultaneous RX and TX operations.

As an additional point the possibility for modified mobility was presented. If the ME sets up a 4 time slot HSCSD connection, and uses 4 downlink and only 1 uplink time slot, it may not be able to perform sufficient neighbour

cell monitoring. The ME has, nevertheless, the IDLE frame, and the unused SACCH frames for some measurements. This reduces the accuracy of the measurements, and is likely to make handovers more difficult. On one hand there is a clear benefit in ME design (2+2 ME may be able to handle also 3+1 or 4+1), on the other hand there may be a drawback for the mobility and user perception of service (a 5+1 ME may not be able to measure in each TDMA frame if only one RF block is used).
There was a consensus to have the asymmetric bearer services to be included in the requirements specifications and that limited mobility should be studied at SMG2.

2.10 GSM High Speed Circuit Switched Data Signalling, Air interface and network infrastructure (HSCSD TDoc 8/95, source: Nokia)

The document presented identifies the places where changes to the signalling would be necessary.
The basic Assumptions for Signalling modifications for the proposed approach are:

- Setup includes required and desired data rates
- In A-bis procedures time slots are handled as separate channels
- New channel update procedure between BSC and MSC
- Service level updating is done with assignment of channel mode modify procedures

The following subjects for further discussion were identified:

- Negotiation and on-line changing of radio channel coding
- How should ME indicate its capabilities (coding, number of time slots it can handle, should it be indicated in the setup message or should a new classmark for the MS be defined)
- Reservation of circuits in A-Interface and between MSCs
- System information broadcasting of HSCSD supporting network

It was discussed if HSCSD broadcasting information is necessary to be broadcasted per BTS: This was not accepted due to the fact that this is not the case for any existing service. But this issue may anyhow be covered by the Phase 2+ Work Item (efficient support of new services in GSM Networks)

In principle the document has been accepted and a list of HSCSD detailed signalling requirements and service types was proposed to be established during the workshop. It is contained in section 3.4

2.11 The synchronisation of the parallel subchannels in the transparent HSCSD bearer service (HSCSD TDoc 13/95 source: Nokia, TDoc SMG4 30/95)

The paper has been presented to SMG 4 already. The paper was accepted as a working assumption.

2.12 Rate adapting of high speed user rates in the transparent HSCSD channels (HSCSD TDoc 14/95, source: Nokia, TDoc SMG4 31/95)

The paper has been presented to SMG 4 already. The paper was accepted as a working assumption.

2.13 Realisation of Multilink Operation in GSM (HSCSD TDoc 9/95 TDoc, source Nokia, SMG4 39/95)

Proposes 3 different RLP modifications to allow HSCSD operation. SMG4 has already studied this paper and was in favour of the 2a proposal which is compatible with asymmetric HSCSD and also reduces the number of simultaneous processes to one. One drawback is the reduction of the user rate to 9.2 kbit/s. It was noted that in reality this is not a problem because current 9.6 kbit/s has 10-20% of overhead capacity for retransmissions. Therefore the proposal offers 9.6 kbit/s in error free conditions and also some capacity for retransmissions without a reduction in throughput. TDoc 11/95 Multilink operation for non-transparent data services.

2.14 Multilink operation for non-transparent data services (HSCSD TDoc 11/95)

This is a modification to TDoc 9, allowing an increased data rate, compared to 9.2 kbit/s.
It was noted that out-of-sequence frames may cause problems for RLP. Current RLP expects to receive the frames in order: if RLP receives frame 7 after frame 5, it assumes that frame 4 is lost. In HSCSD some frames may be delayed but not lost. Thus, allowing a small window for delayed frames may enhance the RLP performance. This was accepted as a subject for further study.

2.15 TAF/TE interface for HSCSD (HSCSD TDoc 15/95, source: Nokia)

TAF/TE interface was not found to be a limiting factor. The PCMCIA interface found in most GSM data implementations supports at least several hundreds of kbit/s. Computer serial port interfaces are mainly hardware limited to either 57 or appr. 110 kbit/s. V.24 in itself does not limit the rate, but V.28 may have some limitations that should be clarified. With special hardware data transfer rates of up to 960 kbit/s can be achieved. IRDA Infrared links offer rates of at least 115 kbit/s, and future standards are likely to offer Mbit/s rates.

The consensus was that the TAF/TE interface is not a problem for HSCSD.

3. Conclusions

3.1 Main Items for the Requirements document:

- 4.8 kbit/s on TCH/F (to be continued by SMG1)
- alternate services: for further study Facsimile (fax group 3: yes), fax , having a combined voice and fax mailbox is one possible candidate for alternate services, facsimile group 4: for further study.
- asymmetric services :yes (only with non transparent services)
- interleaving 8 for 9.6 kbit/s (to be further investigated)
- data rate reduction by the user
- negotiation to TCH/F data service in MT case if MS does not support HSCSD
- new channel coding FS (see GPRS) We do not do this by now but this has to be reconsidered, when a new channel configuration is available for GPRS.

3.2 Architecture

- multiplexing on the A-Interface (other parts may be impacted as well)
- consecutive channels
    - 2 channels
    - 3-8 channels
- Location of the IWF (interworking function)
- alternate services (data followed by data) general modification of existing connection (this is not only an HSCSD issue but could be a new Phase 2+ WI)

3.3 Air interface

Clarify restrictions on mobility (Limitations on mobility to simplify ME hardware design: to be confirmed)
Power control to be continued
Common power control (to be confirmed)

3.4 Signalling Requirements

3.4.1 Service Types(Subscription)

- There should be no distinction between MT and MO service
- HSCSD NT non transparent (flexible service)
- HSCSD T2 (restriction to 2 channels) usually used for lower bit rates for data, video or possibly fax
- not needed (for further study):
    - T3
    - T4
    - ..
    - T8

3.4.2 Service request (MO)

- HSCSD,
    - T or NT
    - # of channels (min, max) [2]
- user rate to the terminating network
- modem types (e.g. V.34)
- data compression

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[2] min and max are the same in case of transparent bearer services

- channel negotiation
- drop back? (could be call modification)
- (channel coding f.f.s)
- (amount of data to be transmitted f.f.s)

3.4.3 Service indication (MT)

- HSCSD
    - NT or T, # of channels (min, max)[3]
- fall back to unchanged MS supporting only FR data

3.5 Interworking scenarios

interworking with PSTN
high speed modems for PSTN are two types:
ITU-T V.17 for high speed facsimile group 3 (max rate 14.4 kbit/s) which will require maximum 2 time slots for fixed rate transparent HSCSD bearer
ITU-T V.34 for high speed generic data connection (max rate 28.8 kbit/s) which is a error correction modem and thus will require max. 3 time slots for flexible rate non transparent HSCSD bearer.

ISDN :
f.f.s

3.6 Class of MSs

SMG1 and SMG 2 should take a look if new MS class(es) should be defined supporting HSCSD

3.7 Quality of Service (QOS)

- Minimise the call setup time (this may not offer much benefit because usually the modem signalling takes a long time compared to call set-up time)

[3] min and max are the same in case of transparent bearer services

4. Work distribution

- SMG1
    - review of the requirement document
    - Service description stage 1 (may be as an annex to existing GSM TS 02.02)
    - specifications: 02.02
- SMG2:
    - clarify restrictions of mobility (measurements)
    - review channel coding (GPRS)
    - confirm power control
    - interleaving of 8 for 9.6 kbit/s to be studied
    - specifications 05.08, 05.05, 05.02, 05.10
- SMG3:
    - Architecture
        - resolve A-Interface multiplexing
        - define Location of IWF
    - specifications
        - 04.0x
        - 08.xx
        - 09.02
        - 09.08
- SMG 4:
    - detailed signalling requirements (together with SMG1) -> SMG 3
    - specifications
        - 03.10
        - 09.07
        - 07.0x
        - 04.2x
- SMG 6:
    - Charging
- SMG9
    - no impact envisaged to the SIM, thus no work required from SMG9

5. Summary

- Basic choices for defining HSCSD are obvious, no major problems foreseen
- A interface architecture must be decided: with or without multiplexing
- Work in STCs can start immediately
- Giving the overall HSCSD responsibility to a certain STC is not necessary

6. Annex A: List of documents

HSCSD TDoc	Title	Source
1	HSCSD Applications	Nokia
2	Requirements of HSCSD, GSM 01.xx, v0.1.0	SMG1
3	HSCSD Architecture (1)	Ericsson
4	HSCSD Architecture (2)	Nokia
5	HSCSD Air Interface Aspects	Nokia
6	Charging Aspects with the HSCSD	Nokia
7	Aspects on Asymmetric HSCSD	Nokia
8	GSM HSCSD Signalling, Air Interface and Network Infrastructure	Nokia
9	Realisation on Multilink Operation in GSM (TDoc SMG4 39/95)	Nokia
10	Future Channel Coding	Telia
11	Multilink Operation for Non-Transparent Data Services	Ericsson
12	Requirements for High Speed Data in GSM (TDoc SMG1 167/95)	Vodafone
13	The synchronisation of the parallel subchannels in the transparent HSCSD bearer service (TDoc SMG4 30/95)	Nokia
14	Rate adapting of high speed user rates in the transparent HSCSD channels (TDoc SMG4 31/95)	Nokia
15	TAF/TE Interface for HSCSD	Nokia
16	Proposed Terms of Reference for the ad-hoc meeting on HSCSD convening 9 to 10 May 1995	SMG3 Chairman
17	Air Interface Physical Layer Implementation of HSCSD Services in GSM (SMG2 TDoc 257/94)	Nokia
18	Multiple Slot Channel for HSCSD (SMG2 264/94)	Ericsson
19	Network Architecture Proposal for Implementation of HSCSD Services in GSM	Nokia

7. Annex B: List of participants

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