Technical Document

GSM DATA SERVICES

MESSAGE SEQUENCE CHARTS

RA1´

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1.2 Abbreviations

AGCH Access Grant Channel

1.3 Terms

Entity	Program which executes the functions of a layer
Message:	A message is a data unit which is transferred between the entities of the same layer (peer-to-peer) of the mobile and infrastructure side. Message is used as a synonym to protocol data unit (PDU). A message may contain several information elements.
Primitive:	A primitive is a data unit which is transferred between layers on one component (mobile station or infrastructure). The primitive has an operation code which identifies the primitive and its parameters.
Service Access Point:	A Service Access Point is a data interface between two layers on one component (mobile station or infrastructure).

2 Overview

The GSM specifications are normative when used to describe the functionality of interfaces, but the stacks and

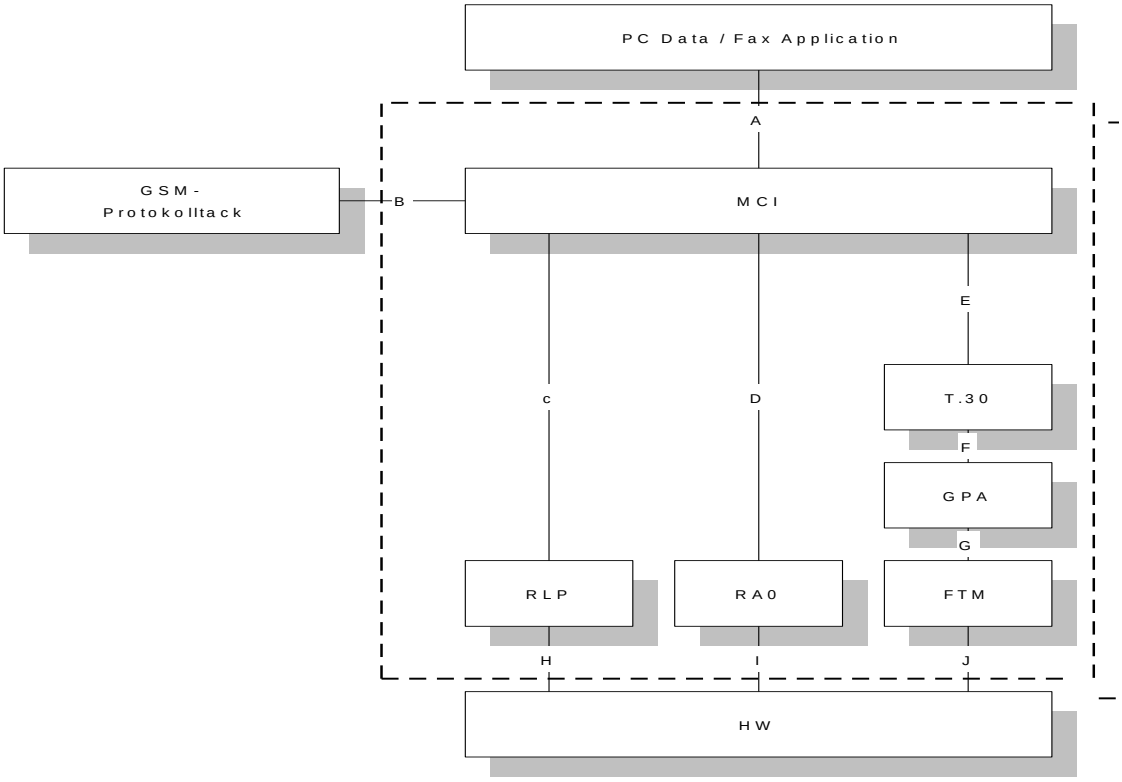


Figure 1: Data Services protocol architecture

This document describes the services offered by the radio link protocol.

3 Introduction

3.1 Frame Formats

The channel codec requests in regular times data from the rate adaption function RA1´.

- For 9600 bit/s 60 bit CCITT V.110 frames are send to the channel codec.
- For 4800 bit/s 60 bit CCITT V.110 frames are send to the channel codec.
- For 2400 bit/s 36 bit CCITT V.110 frames are send to the channel codec.

The number of blocks send to channel codec depends on the time interval and the baudrate:

	Time Interval			
Baudrate	5 ms	10 ms	20 ms	Type of Frame
9600 bit/s	1	2	4	60 bit V.110
4800 bit/s	-	1	2	60 bit V.110
2400 bit/s	-	1	2	36 bit V.110

If the channel codec requests all 10 ms data at 9600 bit/s the rate adaption function RA1´ sends 100 times per second two 60 bit V.110 frames. This is an air interface rate of 12000 bit/s. The data inside one 60 bit V.110 frame is 48 bits. So 100 * 2 * 48 data bits are send per second. This is equal to the baudrate of 9600 bits/s.
Using longer intervals reduces communication between rate adaption function RA1´ and channel codec but prolongs the reaction time for in-band flow control (status bits).
If the number of stored bits for sending to channel codec is lower than a threshold the rate adaption function RA1´ requests new data from it´s source (RLP, RA0 or fax adapter).
The following frame formats are defined:

9600 bit/s and 4800 bit/s (60 bit CCITT V.110 frames)

Offset	7	6	5	4	3	2	1	0
0	D7	S1	D6	D5	D4	D3	D2	D1
1	D14	D13	x	D12	D11	D10	D9	D8
2	D21	D20	D19	S3	D18	D17	D16	D15
3	E7	E6	E5	E4	S4	D24	D23	D22
4	D31	S6	D30	D29	D28	D27	D26	D25
5	D38	D37	x	D36	D35	D34	D33	D32
6	D45	D44	D43	S8	D42	D41	D40	D39
7	0	0	0	0	S9	D48	D47	D46

2400 bit/s (blocks of 36 bit CCITT V.110 frames)

Offset	7	6	5	4	3	2	1	0
0	x	D6	D5	D4	S1	D3	D2	D1
1	S4	D12	D11	D10	S3	D9	D8	D7
2	S6	D15	D14	D13	E7	E6	E5	E4
3	S8	D21	D20	D19	x	D18	D17	D16
4	0	0	0	0	S9	D24	D23	D22

3.2 Extension Bits

The extension bits E4, E5, E6and E7 are inserted in each V.110 frames. E4, E5 and E6 are used as clocking bits and E7 is the multiframe bit.
Synchronous data signals received by the MT from the DTE at the MS or by IWF from the modem on the PSTN may not be synchronized to the PLMN. The following method shall be used to enable transfer of those data signals and the corresponding bit timing information via the V.110 frames. Such a situation would exist where the signals received from the modem at the IWF require its own clock or where the signals received from the DTE at the MS employs ist own network independent clock.
The transmitting end of the GSM PLMN connection shall establish a multiframe structure utilising bit E7 consisting of four frames by setting E7 in every fourth frame to binary 0. This structure is identical to all user rates. The frame synchronization will be achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the GSM PLMN connection can be easily recognized and applied based on the code words (in c1, c2, c3, c4 and c5) positioned in bits E4, E5 and E6 of two consecutive V.110 frames as depicted in the next figure. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe.

Frame	E4	E5	E6	E7
Multiframe 0a	c1	c2	1	0
Multiframe 1a	c3	c4	c5	1
Multiframe 0b	c1	c2	1	1
Multiframe 1b	c3	c4	c5	1

Once multiframe synchronization is achieved, each code word is independently evaluated to determine the compensation needed, if any. The compensation is carried out after reception of multiframe 1a or 1b.

The V.110 transmitter will use the following 5-bit code words, as shown in the next figure, to indicate the four possible states of compensation required for network independent clocking.

	c1	c2	c3	c4	c5
No compensation	1	1	1	1	1
Negative compensation	1	0	0	1	0
Positive compensation of a zero	0	1	0	0	1
Positive compensation of one	0	0	1	0	0

When negative compensation is indicated, one less user data bit than normal is transported in the accected frame (multiframe 1a or multiframe 1b). A negative compensation shall cause the receiver to delete the user data bit occupied by bit position D25, since the transmitter sets this to binary 1 and does not utilize this position for user data. At those user data rates where the user data bit repeated, all copies of D25 shall be discarded.
When a positive compensation is indicated, one additional user data bit is transferred by meand of the code word. At the receiver, a positive compensation will cause a user data bit of binary 0 or 1, as indicated by the code word, to be inserted between the user data bits carried in bit positions D24 and D25 (in multiframe 1a or 1b) of the V.110 frame.
When no compensation is necessary or when NIC is applied, the values of E4, E5, E6 and E7 on the four multi frame scheme is

Frame	E4	E5	E6	E7
Multiframe 0a	1	1	1	0
Multiframe 1a	1	1	1	1
Multiframe 0b	1	1	1	1
Multiframe 1b	1	1	1	1

When NIC is not applicable the MS and the IWF shall disregard the received value of bits E4, E5, E6 and E7 in the data transmission phase. NIC is not applicable in the following cases:

- transparent asynchronous bearer services
- the facsimile teleservices in transparent mode
- every transparent bearer services when interworking with an UDI information transfer capability

3.3 Status Bits

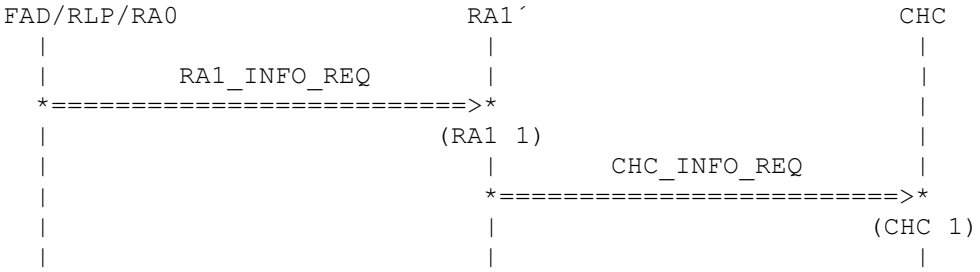
The bits S and X are used to convey channel status information associated with the data bits in the data transfer state. The S-Bits are put in two groups SA and SB to carry the condition of two interchange circuits. The X-bit is used to control the condition of circuit 106.
For the S and X bits, a binary zero corresponds to ON condition, a binary one to the OFF condition. The status SA corresponds with S1, S3, S6 and S8. Status SB is defined by S4 and S9. The following figure shows the use of SA, SB and X and the corresponding flow control signals:

Terminal Equipment	Interworking Function	Terminal Equipment
DTR	SA	DSR
RTS	SB	DCD
CTS	X	CTS

The mobile station uses DTR to signal that is is ready for operation. The RTS signal is used to indicate that the mobile station will send data. The CTS signal is used to indicate whether it is possible to receive data or not.
The interworking function uses DSR to indicate that the other party is connected. DCD is used to indicate that data will be send to the mobile station. CTS is used by the interworking function to indicate that it is ready for receiving data.

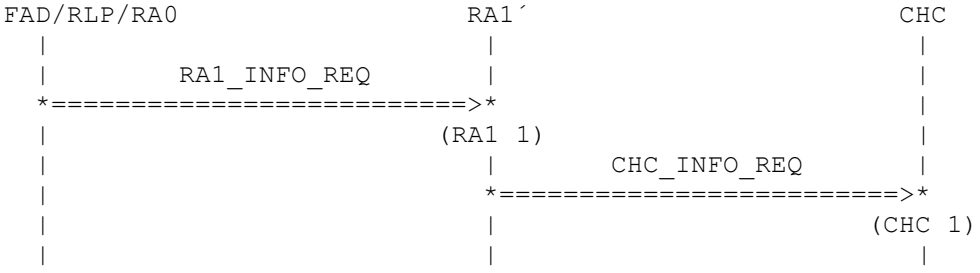
4 Common Procedures

4.1 Activation / Deactivation



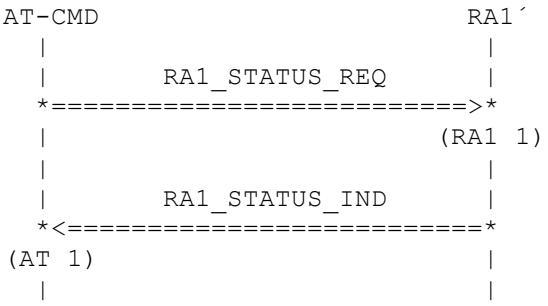
(RA1 1)
The rate adaption function 1´ is activated or deactivated.
(CHC 1)
The information is forwarded to the channel codec.

4.2 Setting of Baudrate



(RA1 1)
A new speed rate is defined.
(CHC 1)
The information is forwarded to the channel codec.

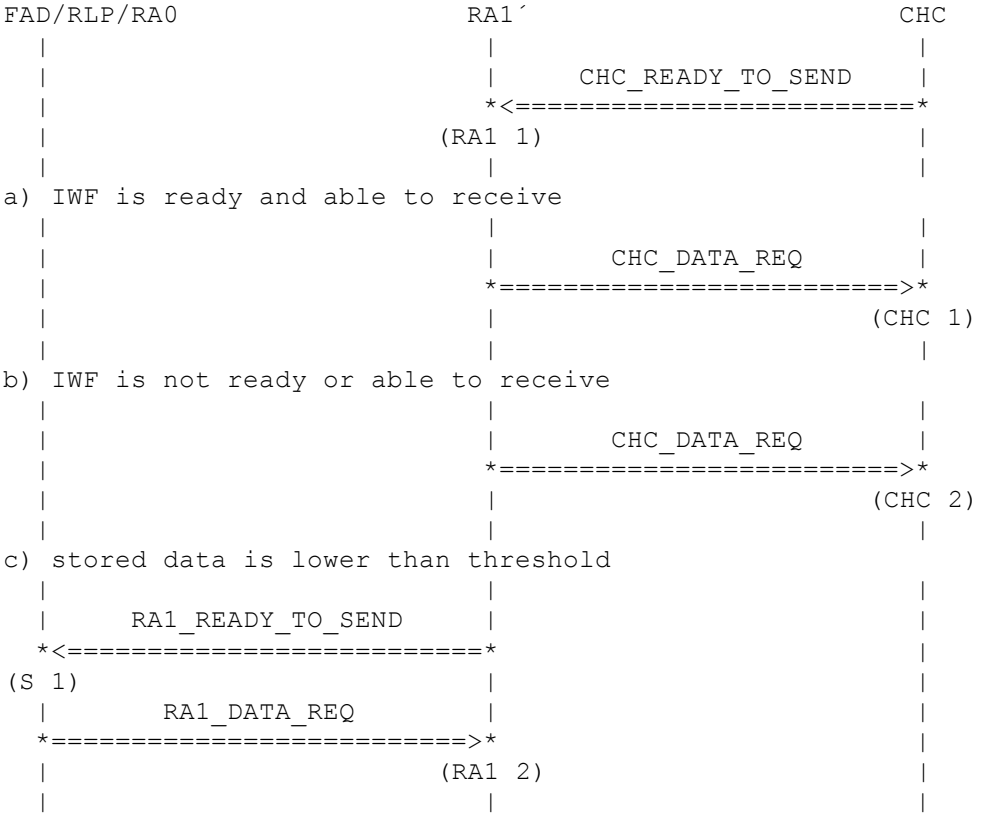
4.3 Status Change



(RA1 1)
The AT command interpreter indicates a change of status. This results in change of setting in S and X bits in the following V.110 frames.
(AT 1)
After receiving information with V.100 frames the status bits have changed. The new status is signalled to the AT command interpreter.

5 Transmission of data

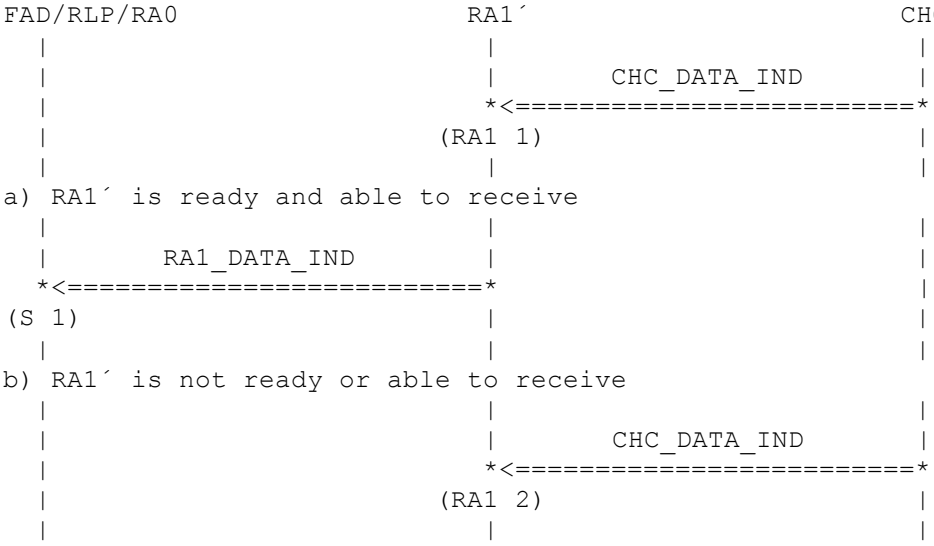
Transmission of data is only processed, when the rate adaption function RA1´ is activated.



(RA1 1)
The channel codec requests new data.
(CHC 1)
From previous received V.110 frames it is detected that the interworking function is not able to receive data. Rate adaption function RA1´ retransmits the last sended V.110 frame to the interworking function to avoid loss of synchronisation and to forward it´s own status.
(CHC 2)
From previous received V.110 frames it is detected that the interworking function is able to receive data. Rate adaption function RA1´ builds the next frame(s) and sends it to the channel coded.
(S 1)
If the remaining number of bits is lower than a configurable threshold value, the rate adaption function RA1´ requests new data from it´s source. This is the FAD, RLP or RA0.
(RA1 2)
New data is stored at rate adaption function 1´.

6 Reception of data

Reception of data is only processed, when the rate adaption function RA1´ is activated.



(RA1 1)
The channel codec sends V.110 frames to the rate adaption function RA1´. The status and extension bits are extracted.
(S 1)
If the rate adaption function is able to receive data, the data is forwarded to the source. The source is the fax adapter, the radio link protocol or the rate adaption function 0.
(RA1 2)
The channel codec sends V.110 frames to the rate adaption function RA1´. The status and extension bits are extracted. If the rate adaption function is unable to receive data, the data is erased.

Appendices

A. Acronyms

DS-WCDMA Direct Sequence/Spread Wideband Code Division Multiple Access

B. Glossary

International Mobile Telecommunication 2000 (IMT-2000/ITU-2000) Formerly referred to as FPLMTS (Future Public Land-Mobile Telephone System), this is the ITU's specification/family of standards for 3G. This initiative provides a global infrastructure through both satellite and terrestrial systems, for fixed and mobile phone users. The family of standards is a framework comprising a mix/blend of systems providing global roaming. <URL: http://www.imt-2000.org/>