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Header Removal in GERAN

1. INTRODUCTION

A key requirement in GERAN standardization work has been the ability to provide optimized speech using already existing channel coding schemes. Voice over IP can be provided under such constraint only by removing the RTP/UDP/IP protocol headers from the voice packet before sending them over the radio interface. Equivalently, in the uplink direction the RTP/UDP/IP headers are inserted to the voice frames on the network side. This function is called header removal/header generation and it is done on PDCP layer of GERAN.

In order to generate the header information on the network side some information needs to be carried from the MS to the network during the call set-up. This has to be done because GERAN is initially not aware of MS's IP address, IP port number etc information that is inserted into RTP/UDP/IP header fields.

This document shows how the signalling related to header removal can be done and briefly describes how header removal/generation can be done. The proposed scheme utilizes the existing RAB assignment, Relocation and Radio Bearer Setup procedures and requires only modification of the message contents.

2. INITIAL SETUP IN GERAN

The PDP context activation (for voice) contains an indication that allows the SGSN to choose RAB parameters in such a fashion, which gives GERAN unambiguous information on, whether header removal can (will) be used. For this purpose indication of the codec should be added into RAB parameters (or the choice of RAB QoS parameters should be such that would unambiguously identify the speech codec version). The information for address generation is assumed to come from the terminal as a part of the RRC signaling.

The initial setup of optimized voice bearer goes as follows:

- The outcome of SIP codec negotiation (as defined in 23.228) should allow terminal to send and receive "simultaneously" with AMR over GERAN.

- The terminal starts secondary PDP context activation.

- The codec info (or payload type) is given to GERAN via Iu with other QoS parameters. The same info must be communicated to target GERAN controller in inter GERAN HO. This can be done inside Source RNC to Target RNC Transparent Container.

- The decision on header adaptation method in GERAN is communicated to terminal: "use header removal".

- The terminal completes setup. This includes sending all the necessary info needed for regeneration (IP-addresses, IP port numbers etc.)

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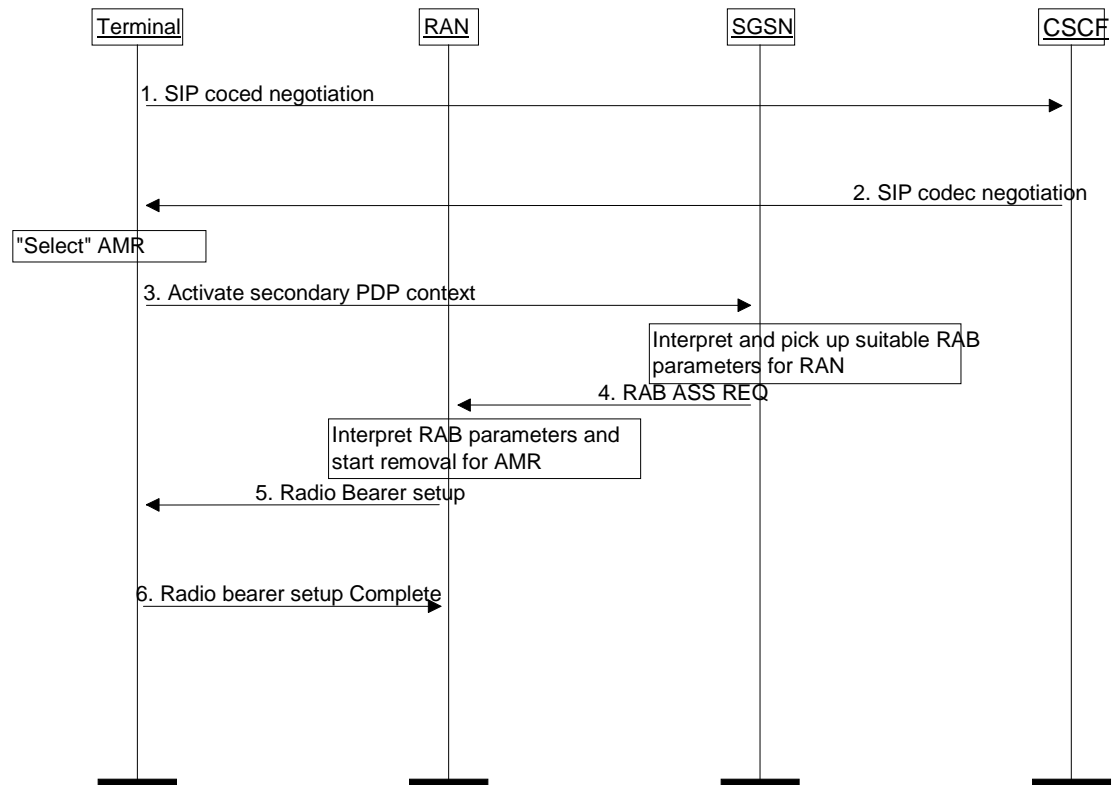Figure 1. Initial setup for optimized voice bearer

3. HEADER REMOVAL SIGNALING ON RRC LAYER

It is up to GERAN RRC to decide whether header removal shall be used. As described in the previous section the decision is made based on RAB parameters. It is assumed that the RAB in question carries only one media i.e. the speech.

3.1 Radio Bearer setup

When a radio bearer is set up between the MS and GERAN different protocol layers are configured. Radio bearer setup procedure consists of Radio Bearer Setup and Radio Bearer Setup Complete messages.
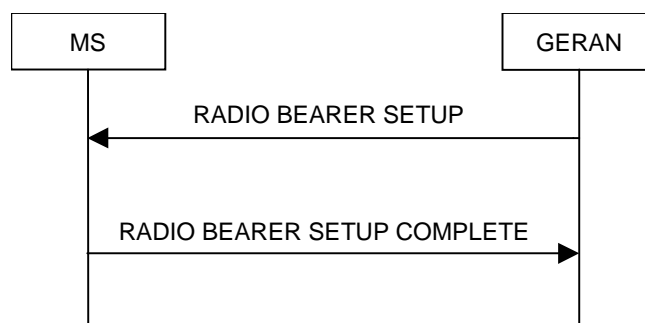

Figure 2 Radio Bearer Establishment

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3.2 RTP/UDP/IP information transfer between MS and GERAN

GERAN does not have information required for RTP/UDP/IP header generation before that information is provided from the mobile station. There are two ways to convey the information. It can be transferred as a part of PDP context activation to the CN and given in the RAB assignment to GERAN. Second option is using RRC signalling.

3.2.1 RTP/UDP/IP information transfer using RRC signalling

In case of optimized IP speech service, RRC will include in the Radio Bearer setup message an indication that header removal shall be used. This indication could be added for example into the optional PDCP info information element of the Radio Bearer Setup message (see appendix A).

When the MS discovers this indication in the RB setup message it shall include a specific container in the Radio Bearer Setup Complete message (see appendix C). On the network side header removal function shall be configured based on this information.

4. HEADER REMOVAL / HEADER GENERATION

4.1 Header Removal

The RTP/UDP/IP protocol headers are removed from the voice packet and the plain voice frame (PDCP-No-Header PDU) is given to RLC (transparent) for transmission over the radio.

4.2 Header Generation

Received voice frames are encapsulated into RTP/UDP/IP protocols by the network. Most of the field values remain constant throughout the connection and can be filled using simple lookup table. However, RTP sequence number changes for each packet and for this reason the header generation function must track the packets while generating the headers. Furthermore, RTP time stamp must be generated based on local clock.

4.3 RTCP

Current assumption is that RTCP packets will not be transmitted over the air interface.

4.4 Handover

During the handover the network should guarantee continuation in RTP sequence number and time stamp values. For this reason the state of the header generation function must be communicated from source RAN to target RAN during the PDCP relocation. This information can be included in the RANAP Relocation Information field of the Relocation Commit message on Iur-g interface. Handover between GERAN and UTRAN is FFS.

5. CONCLUSIONS

In this document a concept for header removal has been presented. The proposed mechanism for initial signaling utilizes existing RAB assignment and Radio Bearer Setup mechanisms with straightforward modifications of message contents. It is assumed that RTCP packets will not be transmitted over the air interface. With this assumption the header removal function/generation becomes relatively simple. Another important issue is how RTP sequence number and timestamp values are communicated between source and

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target RANs during the relocation. It is assumed that this information can be included into existing RANAP and RNSAP messages, mainly Relocation Commit message.

APPENDIX A PDCP INFO IE

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Support for lossless SRNS relocation	CV-*LosslessCriteria*		Boolean	TRUE means support
Max PDCP SN	CV *Lossless*		Integer (255, 65535)	Maximum PDCP sequence number. Default value is 65535.
PDCP PDU header	MD		Enumerated (present, absent)	Whether a PDCP PDU header is existent or not. Default value is "present"
Header compression information	OP	1 to <maxPDCPAlgoType>		
>CHOICE *algorithm type*	MP			7 spare values needed, criticality: reject
>>RFC2507				Header compression according to IETF standard RFC2507
>>>F_MAX_PERIOD	MD		Integer (1..65535)	Largest number of compressed non-TCP headers that may be sent without sending a full header. Default value is 256.
>>>F_MAX_TIME	MD		Integer (1..255)	Compressed headers may not be sent more than F_MAX_TIME seconds after sending last full header. Default value is 5.
>>>MAX_HEADER	MD		Integer (60..65535)	The largest header size in octets that may be compressed. Default value is 168.
>>>TCP_SPACE	MD		Integer (3..255)	Maximum CID value for TCP connections. Default value is 15.
>>>NON_TCP_SPACE	MD		Integer (3..65535)	Maximum CID value for non-TCP connections. Default value is 15.
>>>EXPECT_REORDERING	MD		Enumerated (reordering not expected, reordering expected)	Whether the algorithm shall reorder PDCP SDUs or not. Default value is "reordering not expected".
Header Removal	OP		Binary	0=not used 1=used

Condition	Explanation
LosslessCriteria	This IE is present only if the IE "RLC mode" is "Acknowledged" and the IE "In-sequence delivery " is "True".
Lossless	This IE shall be present if the IE "Support for lossless SRNS relocation" Is TRUE, otherwise it shall be absent.

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APPENDIX B: RADIO BEARER SETUP

This message is sent by GERAN to the MS to establish new radio bearer(s). The message could contain a request for header removal info.

Logical channel: PDTCH or main DCCH

Direction: GERAN → MS

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Message Type	M		Message Type	
MS Information Elements				
Integrity check info	C		Integrity check info	IE shall be set to the used signalling radio bearer identity when the encoded RRC message is used as the MESSAGE parameter in the integrity protection algorithm
Integrity protection mode info	O		Integrity protection mode info	At least 2 spare values, Criticality: reject, are needed. The IE is mandatory if the IE "Integrity protection mode command" has the value "start ", otherwise it is not needed in the message. The IE is only present if the IE "Integrity protection mode command" has the value "modify"
Ciphering mode info	O		Ciphering mode info	This information element contains the ciphering specific security mode control information. 14 spare values needed. Criticality: criticality reject is needed.
Starting time	M		44.18-10.5.2.38 Starting time procedures	[Note: replaces the Activation Time that is used in UTRAN.]
New G-RNTI	O		G-RNTI	The G-RNTI (GERAN Radio Network Temporary Identity) is allocated to an MS having a RRC connection and identifies the MS within GERAN
CN Information Elements				
CN Information info	O		CN Information info	Identifies the type of core network domain. Enumerated (CS domain, PS domain)
GERAN mobility information elements				
GRA identity			GRA identity	
RB Information Elements				
Signalling RB information to setup list [Note: SRBs are FFS in GERAN]		1 to <maxSRBsetup>		For each signalling radio bearer established
>Signalling RB information to setup	M			
RAB information to setup list	O	1 to <maxRABsetup>		For each RAB established
>RAB information for setup	M			

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Information Element/Group name	Need	Multi	Type and reference	Semantics description
RB information to be affected list	O	1 to <maxRB>		
>RB information to be affected	M			
Quality target parameters	FFS			[Note: QoS parameters are FFS]
PhyCH information elements				
Logical channel parameters				
>TCH				
>>channel type			Channel description 10.5.2.5-44.018 [FFS	The **Channel type** field (5 bit) shall be ignored by the receiver and all bits treated as spare. For backward compatibility reasons, the sender shall set the spare bits to binary '00001'
>>TN			Channel description 10.5.2.5-44.018 [FFS]	The **TN** field (3 bit) is the binary representation of the timeslot number as defined in GSM 05.10. Range: 0 to 7
>>TSC			Channel description 10.5.2.5-44.018 [FFS]	The **TSC** field (3 bit) is the binary representation of the training sequence code as defined in 3GPP TS 45.002
>>> ARFCN			Channel description 10.5.2.5-44.018 [FFS]	The **ARFCN** field (10 bit) is the binary representation of the absolute RF channel number, see 3GPP TS 45.005. Range: 0 to 1023.
>>*Indirect encoding of hopping RF channel configuration*				
>>> MAIO			Channel description 10.5.2.5-44.018 [FFS]	The **MAIO** field (6 bit) is the binary representation of the mobile allocation index offset, see 3GPP TS 45.002. Range: 0 to 63.
>>>MA_NUMBER_IND			Channel description 10.5.2.5-44.018 [FFS]	The **MA_NUMBER_IND** field (1 bit) is the binary representation of the MA_NUMBER to use as reference to a GPRS mobile allocation
>>>> CHANGE_MARK_1			Channel description 10.5.2.5-44.018 [FFS]	The C**HANGE_MARK_1** field (2 bit) is the binary representation of the allowed value of the SI *change mark* associated with the GPRS mobile allocation to which the MA_NUMBER refers. Range: 0 to 3.
>PDTCH				
>>EGPRS window size				This field is encoded as the EGPRS window size IE in the PACKET UPLINK ASSIGNMENT message in GSM 04.60

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Information Element/Group name	Need	Multi	Type and reference	Semantics description
>>Packet Timing Advance IE				This field is encoded as the Packet Timing Advance IE in the PACKET DOWNLINK ASSIGNMENT message in GSM 04.60.
>>>P0, BTS_PWR_CTRL_MODE and PR_MODE fields				These fields are optional downlink power control parameters and are encoded as in the PACKET UPLINK ASSIGNMENT message in GSM 04.60.
>>Power Control Parameters IE				This field is encoded as the Power Control Parameters IE in the PACKET DOWNLINK ASSIGNMENT message in GSM 04.60.
>>DOWNLINK_ TFI_ASSIGNMENT				(5 bit field) If present, this field is encoded as the DOWNLINK_TFI_ASSIGNME NT information element in the PACKET DOWNLINK ASSIGNMENT message in GSM 04.60. This information element, if present, assigns the TFI to the mobile station to identify to DL TBF described message.??
>>MEASUREMENT_INTER-VAL (5 bit field)				If present, this field is encoded as the MEASUREMENT_INTERVAL field in the PACKET DOWNLINK ASSIGNMENT message in GSM 04.60. This information field indicates the number of block periods from start of the one assigned measurement period to the beginning of the next measurement period.
>>LINK_QUALITY_MEASUR E-MENT_MODE (2 bit field)				This field is encoded as the LINK_QUALITY_MEASU REMENT_MODE in the PACKET DOWNLINNK ASSIGNMENT message in GSM 04.60. This field determines the measurements to be included within the EGPRS Timeslot Link Quality Measurements IE
TCH rate			Enumerated (full, half, quater)	43.051-Annex A
PDTCH rate			Enumerated (full, half)	43.051-Annex. A
Choice of modulation scheme				Modulation schemes used for RB : GMSK or 8PSK. 43.051 Annex A

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Information Element/Group name	Need	Multi	Type and reference	Semantics description
Interl. scheme				Indication of interlv. Scheme.-43.051-Annex A
Choice of coding scheme				coding scheme used for RB. 43.051-Annex A

APPENDIX C: RADIO BEARER SETUP COMPLETE

This message is sent by MS to confirm the establishment of the radio bearer. In case GERAN ordered that header removal shall be used MS shall include a container for the header removal specific information.

Logical channel: PDTCH or main DCCH

Direction: MS → GERAN

Information Element/Group name	Need	Multi	Type and reference	Semantics description
Message Type	M		Message Type	
MS information elements				
Integrity check info	C		Integrity check info	
Uplink integrity protection activation info	O		Integrity protection activation info	
RB Information elements				
Radio bearer uplink ciphering activation time info			RB activation time info	
PDCP container for header removal	O		HR info	