3GPP TR 23.807 V0.3.0 (2005-11)

Technical Report

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Feasibility Study of enhancement of radio performances for VoIMS; Report on Technical Options and Conclusions (Release 7)

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Contents

Foreword

This Technical Report has been produced by the 3rd 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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where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- 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.

Introduction

There is interest on future usage of VoIMS compared to CS service. Operators are interested in optimising the current VoIMS bearer performances.

During the WI on RAB support enhancements and the study of VoIMS bearer performances , it has been shown that voice over PS domain in Release 6 on a dedicated channel, with ROHC compression and without Unequal Error Protection (UEP), will remain 20% to 30% less efficient compared to circuit-switched voice with UEP.

UEP is one of the methods which can be used to enhance radio performances. Header Removal (HR) is also in the scope of this study.

For Voice over IMS service, the introduction of such enhancement may bring architectural changes that have to be studied, in particular the way to provide the RAN with information allowing it to apply UEP.

1 Scope

The present document describes architecture changes for Voice over IMS service to allow enhancement of radio performances in RAN. This work focuses on the PS domain with the assumption that voice services are supported in this domain.

Two radio optimization methods have been identified to provide radio optimisation for VoIMS: Unequal Error Protection (UEP) and Header Removal (HR). With the information currently available in RNC, RNC cannot use these optimisation methods. More study is then needed to describe which additional information are needed by RNC and how these information can be provided to RNC.

Radio optimisations for the SIP signalling are out of the scope of this TR. The study will focus on the bearer optimisation for user data.

Radio optimisations with no architecture impact outside the UTRAN are out of the scope of this TR.

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 41.001: "GSM Release specifications".

3 Definitions, symbols and abbreviations

Delete from the above heading those words which are not applicable.

Subclause numbering depends on applicability and should be renumbered accordingly.

3.1 Definitions

For the purposes of the present document, the [following] terms and definitions [given in ... and the following] apply.

Definition format

***<defined term>**: <definition>.*

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

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

Symbol format

<symbol> <Explanation>

3.3 Abbreviations

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

HR Header Removal
UEP Unequal Error Protection

4 Architecture Baseline

[Editors Note: This clause describes the starting point for the architecture enhancement]

For 3GPP IMS voice service, user data stream can consists of:

- IMS signalling stream
- RTCP stream
- RTP speech stream

All these streams can be transported over the same UMTS bearer (the same PDP Context/RAB) or over different ones. The TR study should consider the different possibilities.

As described in 3GPP TS 26.236, for 3GPP IMS voice service, the RTP payload carries the speech data coded with AMR or AMR-WB codec with following RTP limitations:

- the bandwidth efficient operation shall be used,
- only one speech frame shall be encapsulated in each RTP packet,
- the multi-channel session shall not be used,
- interleaving shall not be used,
- internal CRC shall not be used.

3GPP may introduce codecs other than AMR and WB-AMR in the future.

5 UEP Solutions

5.1 Introduction

In CS Domain, Unequal Error Protection is performed as following:

For UTRAN or GERAN Iu mode, the codecs as such are not known by the UTRAN. Instead RAB subflows have been defined to enable Unequal Error Protection and Rate Control.
Each RAB Subflow correspond to a specific class of bits in a codec frame (Class A, B or C in AMR) and is associated with SDU Error Ratio and Residual Bit Error Ratio. All the RAB subflow belonging to a RAB are mapped to "coordinated DCHs" in the UTRAN, which are synchronised.
A "RAB Subflow Combination" fully defines a codec mode with class A, B and C bits. For example there are 3 RAB subflows for 12.2 kbit/s AMR.
The list of RAB Subflow Combinations defines all the codecs for UEP and all codec modes for Rate Control. This list corresponds to the codecs and codec modes supported by both the transcoders in the CN and codecs in the UE.
Similar information is needed in PS domain.

For GERAN A/Gb mode, the codecs should be known as such: the GERAN BTS has to know how a codec frame is made of, and each time a new codec is added, BTS software has to be changed. A list of codecs supported by the MS should be provided to GERAN. For AMR, the list of modes (12.2, 10.2, ..., 4.75) supported by the MS should also be provided.

In PS Domain, Unequal Error Protection consists in the following actions:

- Differentiate and separate the most and the least important speech bits of the AMR codec frame (set of Class A, B and C bits of the received AMR frames in the RTP payload). For voice over CS Domain, this is done in the Core Network (the Media Gateway).
- Apply different protection level for each of these subflows (and for the packet header) and send them over the radio interface. This is done by the UTRAN.

5.2 Which entity differentiates and separates speech bits of the AMR frame

When there is no encryption at the application layer, all information needed to allow RNC to discriminate the AMR codec and codec mode in use are available in the DL IP Packet itself (the codec is available in the RTP Header and the codec mode is available in RTP payload Table of Content). As a consequence, the RNC only needs to know the AMR frame payload structure associated to each codec mode negotiated. This is provided by OAM configuration or via signalling. Some additional information such as the Payload Type indicating the codec if negotiated by the UE at SIP layer or which SDU Error Ratio and Residual Bit Error Ratio has to be applied may need to be provided to the RNC.

The RNC differentiates and separates the most and the least important speech bits of the AMR codec frame.

- During an IMS multimedia session establishment, the end-points negotiate codecs and codec modes to be used during the IMS multimedia session (AMR and WB-AMR).
- At the end of the IMS multimedia session negotiation or after SIP re-negotiation where codec can be changed, a UE supporting UEP feature provides the RNC with information indicating relationship between the expected speech frame payload structures and the RTP Payload length (while keeping the RNC agnostic of Codec negotiated).

Note: The relationship between the expected speech frame payload structure and the RTP Payload length may not be valid if the restrictions defined in TS 26.236 (ver. 6.4.0) for RTP payload in conversational speech are relaxed, or the restrictions are not followed (e.g. if there is more than one speech frame per RTP packet). RTP payload for AMR and WB-AMR is defined in RFC 3267 with additional clarification provided in RFC 3550 and 3551. The impact of a dynamic change in RTP payload structure proposed as an option in these RFCs is FFS.

- Information needed by the RNC to apply UEP can be Payload Type, mapping table between AMR payload structure in use and RTP payload length and which SDU Error Ratio and Residual Bit Error Ratio has to be applied on each class of AMR bits.

  All these information are called in the following “Media parameters”.

- During the VoIP session life, the RNC differentiates each set of bits in the received packet and separates the speech bits by using this information.
- The UTRAN applies different error protection level to each identified part of the speech frame.

5.2.1 Should the CN be aware of the Media parameters

In CS domain, the Core Network is teleservice-centric, i.e. the UE requests for "AMR speech service" and the CN translates this request into a RAB Assignment Request with appropriate RAB subflows.

In PS domain, the request from the UE is different: the UE only requests for an end-to-end bearer via a PDP Context Activation procedure. In the PS-CN (SGSN and GGSN) establishes a GTP tunnel with the appropriate QoS for the whole PDP context (RAB): it is not possible to have a separate tunnel for each RAB subflow, since they have to be synchronized. All the RAB subflows have the same QoS requirements (latency, residual error ratio, SDU bit error rate).

Moreover, there is no particular need for SGSN and GGSN to be aware of RAB subflows as UEP is a radio technique to provide spectrum efficiency.

Therefore, neither the SGSN nor the GGSN need to be aware of media parameters.

5.2.2 How can "media parameters" be sent to RAN during IMS multimedia session establishment

The signalling solution should:

- Be independent from the radio access technology (GERAN, UTRAN)
- Be independent from the media handling functions carried out in RAN in order to use the same mechanism un-modified even though for future "specific" media handling in RAN.
- Allow UTRAN to carry out header compression / UEP … without UTRAN having to know the codec used for the media.
- SGSN, GGSN shall not have to know which codec is being used.
- Neither RAN, nor SGSN-GGSN shall have to understand IMS signalling. This method shall work for other services than IMS.
- Cope with GERAN specific needs of knowing the codec…..

Three possible methods are described below to show how RAN-specific media parameters can be sent to RAN with neither SGSN/GGSN nor UTRAN knowing the codecs:

1- Direct transfer from UE to RAN of the "media parameters"

2- Transfer of the media parameters for RAN in QoS parameter of 24.008 Activate PDP Context Request message and of RANAP

3- Transparent Transfer of the "media parameters" between UE and RAN via the SGSN

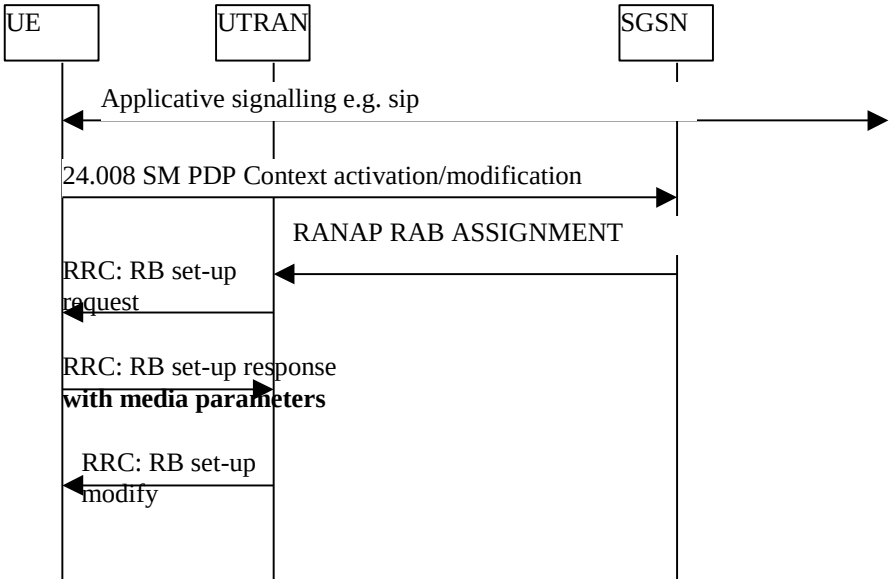
5.2.2.1 Direct transfer from UE to RAN of "media parameters"

This section describes a solution in which the "media parameters" are not sent by the CN at RAB Assignment but directly from the UE to the RAN.

The "media parameters" could be sent directly on radio from UE to RAN within the answer to the Radio Bearer Setup Request.

After codec negotiation at application (e.g. SIP) level the process to establish the radio bearer would be the following:

- UE maps the media component definition onto PDP context to be established and activates the relevant PDP context without media parameters for RAN
- SGSN upon reception of the 24.008 SM message requests from RAN the RANAP RAB assignment
- RAN requests from UE the activation of the radio bearer (RB) using relevant RRC message
- UE answers back with indication of " media parameters" to be associated with the radio bearer
- RAN has to change the RB according to this information.



But this solution raises synchronization issues: the RB is first (step 1-3) established without knowing "media parameters" (e.g.the Header compression/UEP parameters). Then (step 4-5) RAN discovers that RB parameters need to be changed. As an example, application to the RB of Header compression algorithm may imply that the throughput of the radio bearer has to be downgraded afterwards from the throughput required by a non compressed bearer down to the throughput of a compressed bearer. Hence this solution shall be avoided.

5.2.2.2 Transfer of "media parameters" in QoS parameter of 24.008 Activate PDP Context Request message and of RANAP

To illustrate this method, the case of the subflow definition for UEP has been used. This method should be adapted for other parameters such as parameters for header removal / compression…

How the solution would work:

In the Activate PDP Context Request message, it is possible to modify the *Requested QoS* IE, which is composed of following parameters, extracted from TS24.008 section 10.5.6.5, in order to allow several subflows. It would be the responsibility of the UE to build that message from the parameters negotiated with the remote user via SIP/SDP protocol.

8	7	6	5	4	3	2	1	
Quality of service IEI								octet 1
Length of quality of service IE								Octet 2
0 0 spare			**Delay class**			**Reliability class**		octet 3
Peak throughput				**0 spare**		**Precedence class**		octet 4
0 0 0 spare			**Mean throughput**					octet 5
Traffic Class			**Delivery order**			**Delivery of erroneous SDU**		Octet 6
Maximum SDU size								Octet 7
Maximum bit rate for uplink								Octet 8
Maximum bit rate for downlink								Octet 9
Residual BER				**SDU error ratio**				Octet 10
Transfer delay						**Traffic Handling priority**		Octet 11
Guaranteed bit rate for uplink								Octet 12
Guaranteed bit rate for downlink								Octet 13

For UEP in the RAN, there is also the need to define one set of Residual Bit Error Rate and SDU Error Ratio IEs per subflow in an additional set of parameters. Furthermore, the SDU Format Information Parameter IE (one per RAB subflow combination) is also needed for the definition of the subflows. All other parameters are common to all subflows as specified in current 24.008 and RANAP specification.

It can be noticed that, in Activate PDP Context Request message, there is only one *Residual Bit Error Rate* IE and one *SDU Error Ratio* IE, which is not on a per subflow basis: anyhow these general parameters are needed to determine the QoS required for the segment RNC-SGSN-GGSN.

Considering other features such as header removal (for GERAN) for which other parameters such as "is header removal allowed for this RAB" are also needed, it seems hard to pack all of theses parameters into the QoS IE of 24.008 and RANAP.

Drawbacks of this solution are:

1. This method might not be generic enough to allow the transfer of other parameters than the subflow definition for UEP (e.g. parameters for header removal / header compression).

1. This method implies to bother GGSN with information per subflow as the QoS IE is normally transferred to the GGSN within Gn messages.

2. This method implies to add lots of parameters in the QoS IE. Considering that the QoS IE is stored in the CDR, this would render the GPRS CDR much longer.

5.2.2.3 Transparent Transfer of the "media parameters"

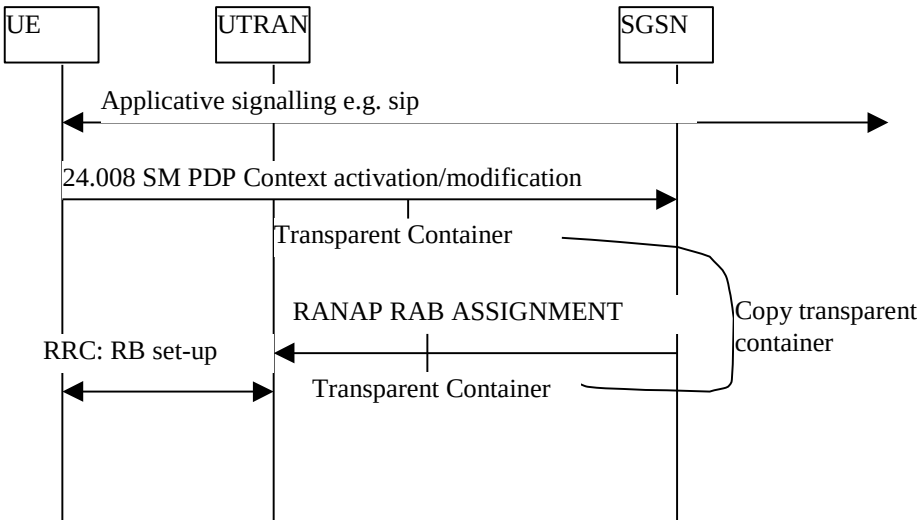
In order

1- not to modify GPRS QoS definition and not to propagate the media parameters for RAN up to GGSN,

2- to provide an unified way for UE to send to the RAN (UTRAN, GERAN) the media (handling) parameters needed by media (handling) features provided by RAN: UEP, RoHC; Header removal). Such parameters are e.g.

- "may/should header removal apply to this bearer"
- "may/should header compression apply to this bearer"
- parameters needed for UEP support: (codec definition in GERAN case, sub-flow definition in UTRAN case),

the "media parameters" are transferred from UE to RAN via a transparent container attached to the PDP context activation / modification sent by UE to SGSN and transparently copied from this message to another transparent container in the associated RANAP RAB ASSIGNEMENT request message.



For the transfer of these parameters between source RNC / BSS and target BSS / RNC at Hand-Over / SRNS relocation, a possible solution could be that independently from the current Radio Access Technology (GERAN / UTRAN) used at PDP context activation, the UE sends the media parameters for RAN both for GERAN and UTRAN technologies allowing further Hand-Over / SRNS relocation / directed retry without any further exchange of these parameters between the UE and the network.

This solution avoids the drawbacks listed in the above alternative solutions and is future proof:

- It does not raise any synchronization issue
- It does not imply to propagate media parameters for RAN up to GGSN

It provides a common solution for different radio access technologies (UTRAN, GERAN) and for different functions such as UEP, Header stripping and Header Compression.

6 HR Solutions

- The Header Removal function for an RTP media stream requires the following sub-functions:The Header Stripper function removes the IP/UDP and RTP headers of a media stream and sends the payload frames over a link.
- The Header Reconstructor function receives the media frames from a link and reconstructs the IP/UDP and RTP headers. The Header Reconstructor function needs to be provided with the information necessary to correctly reconstruct the IP, UDP and RTP headers.

In UMTS, the header stripper and the header reconstructor functions should be located both in the UE and in the RNC, similarly to the header compression functions.

Editor's Note: An HR solution may require a mechanism to perform relocation of the header removal context between RNCs during SRNS relocation. This is FFS.

Editor's note: Whether RTP sequence numbers need to be transmitted over the radio link is FFS.

Editor's Note: The impact of RTP Payload type changes needs to be studied.

7 Conclusion

Annex A:
Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2005 07	SA2#47				TR skeleton	-	0.0.0
2005-07	SA2#47				Agreed Tdoc implemented: S2-051841 on architecture baseline and S2-051842 on which entity differentiates and separates speech bits of the AMR frame	0.0.0	0.1.0
2005-10	SA2#48				Agreed Tdoc implemented: S2-052355 on Header removal and S2-052357 on UEP with no encryption	0.1.0	0.2.0
2005-11	SA2#48				Agreed Tdoc implemented: S2-052907 and S2-052908	0.2.0	0.3.0