3GPP TR 21.877V0.76.0 (2002-02)

Technical Report

**3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Radio optimisation impacts on PS architecture;
(Release 6)**

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3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis

Valbonne - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

http://www.3gpp.org

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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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.

1 Scope

The present document provides an overview of the architecture impacts related to the provision of radio optimisation methods for services over PS domain for both GERAN (A/Gb mode and Iu mode) and UTRAN (Iu mode).

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: "3G Vocabulary".

3 Definitions, symbols and abbreviations

For the purposes of the present document, the terms and definitions given in [1] and the following apply.

3.1 Definitions

In the document, the terminology GERAN will be used for GERAN A/Gb or Iu modes and UTRAN will be used for UTRAN Iu mode.

3.2 Symbols

3.3 Abbreviations

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

UEP Unequal Error Protection

Other abbreviations used in the present document are listed in 3GPP TR 21.905 [1].

4 Introduction

The objective of this TR is to study the architectural impacts of radio optimisation methods that can be provided for services such as IMS that require the transport of real time traffic over PS domain. Details of radio optimisations methods are not studied in the present TR, only the impacts identified on the architecture are covered. This TR does not consider radio optimisation methods that have no identified impact on the architecture.

This TR should cover impacts on the architecture for both GERAN and UTRAN cases when radio optimisation method applies.

Different radio optimisation methods are studied when they impact the architecture. As an example, for IM conversational services, some radio optimization such as Unequal Error Protection could be provided for PS multimedia services but the introduction of UEP needs some architecture enhancement that have to be identified.

Currently, the following radio optimisation methods having architecture impacts have been identified:

- For both UTRAN and GERAN cases:

UEP (Unequal Error Protection)

- For UTRAN case only:
- For GERAN case only:

For each of these identified radio optimisation methods, this TR should identify the architecture impacts to be solved and the way to solve these concerns.

The following should be defined as goals for the TR:

- A common solution for GERAN and UTRAN is intended to minimize overall functionality.
- The solution should be based, when possible, on already specified functionality

5 Scenarios

This sub-clause details the scenarios considered within this technical report. The scenarios apply to GERAN and UTRAN equally. Table X details the scenarios considered in terms of the data streams present. Each row represents a possible scenario. For each scenario the potential Radio Optimisations to be considered are identified.

		IMS Signallingg	Speech (RTP)	Speech (RTCP)	Audio (RTP)	Audio (RTCP)	Video (RTP)	Video (RTCP)	Text (RTP)	Text (RTCP)	Data	
1	Speech	X	X	X	-	-	-	-	-	-	O	
2	Audio	X	-	-	X	X	-	-	-	-	O	
3	Video	X	-	-	-	-	X	X	-	-	O	
4	Text	X	-	-	-	-	-	-	X	X	O	
5	Speech, Video	X	X	X	-	-	X	X	-	-	O	
6	Speech, Text	X	X	X	-	-	-	-	X	X	O	
7	Video, Text	X	-	-	-	-	X	X	X	X	O	
8	Speech, Video, Text	X	X	X	-	-	X	X	X	X	O	
9	Audio	X	-	-	X	X	-	-	-	-	O	
10	Audio, Video	X	-	-	X	X	X	X	-	-	O	
11	Audio, Text	X	-	-	X	X	-	-	X	X	O	
12	Audio, Video, Text	X	-	-	X	X	X	X	X	X	O	

X = stream included in scenario

- = stream not included in scenario

O = stream optionally included in scenario

Speech (RTP) = AMR or AMR-WB over RTP

Audio (RTP) = Other audio codec (e.g. G.722) over RTP

Video (RTP) = H.263 or MPEG-4 or other video codec over RTP

Text (RTP) = T.140 over RTP

6 Transport option approaches

This sub-clause details the transport options considered within this technical report. The scenarios apply to GERAN and UTRAN equally.

The transport options are represented in Table Y below. For each scenario, and each transport option, the PDP Contexts required are numbered, and the number of the Context in which each stream appears entered in the appropriate column on the table.

Three factors affect possible Transport Options:

1 Whether IMS signalling has a dedicated PDP Context, or whether it is carried on a general PDP Context (i.e. a PDP Context also used for other services). Carrying IMS signalling on a general PDP Context implies that the 'other Data' stream is present (to carry, at least, IMS signalling)

2 Whether RTP and RTCP are multiplexed on the same PDP Context

3 Whether each media stream is multiplexed on the same PDP Context as another, or as the IMS signalling or other data services.

Speech, Audio and Video have specific QoS requirements which mean it would not be appropriate to multiplex these. Therefore the cases where the speech, audio and video media are multiplexed with other data are not considered. However, it may be possible to multiplex the T.140 traffic onto the same PDP Context as other data traffic.

From the above, the possible transport options are summarised in the following table:

Transport Option	Signalling	RTCP	Media
A	Separate	Combined with RTP	Separate
B	Separate	Combined with RTP	T.140 combined with data
C	Separate	Separate	Separate
D	Combined with data	Combined with RTP	Separate
E	Combined with data	Combined with RTP	T.140 combined with data
F	Combined with data	Separate	Separate

The following table captures the mapping of data streams to PDP Contexts for each scenario and each transport option. Only scenarios where a potential radio optimisation has been identified in Table X are considered.

Scenario		Transport Format	IMS Signallingg	Speech (RTP)	Speech (RTCP)	Audio (RTP)	Audio (RTCP)	Video (RTP)	Video (RTCP)	Text (RTP)	Text (RTCP)	Data	Number of PDP Contexts
1	Speech	A, B	1	2	2	-	-	-	-	-	-	3	3
		C	1	2	3	-	-	-	-	-	-	4	4
		D, E	1	2	2	-	-	-	-	-	-	1	2
		F	1	2	3	-	-	-	-	-	-	1	3
5	Speech, Video	A, B	1	2	2	-	-	3	3	-	-	4	4
		C	1	2	3	-	-	4	5	-	-	6	6
		D, E	1	2	2	-	-	3	3	-	-	1	3
		F	1	2	3	-	-	4	5	-	-	1	5
6	Speech, Text	A	1	2	2	-	-	-	-	3	3	4	4
		B	1	2	2	-	-	-	-	3	3	3	3
		C	1	2	3	-	-	-	-	4	5	6	6
		D	1	2	2	-	-	-	-	3	3	1	3
		E	1	2	2	-	-	-	-	1	1	1	2
		F	1	2	3	-	-	-	-	4	5	1	5
8	Speech, Video, Text	A	1	2	2	-	-	3	3	4	4	5	5
		B	1	2	2	-	-	3	3	4	4	4	4
		C	1	2	3	-	-	4	5	6	7	8	8
		D	1	2	2	-	-	3	3	4	4	1	4
		E	1	2	2	-	-	3	3	1	1	1	3
		F	1	2	3	-	-	4	5	6	7	1	7

7 Radio Optimisation Mechanisms

7.1 Support of UEP

7.1.1 Description of the UEP feature and identification of the open point(s) on the architecture

7.1.1.1 Description of UEP

For CS voice calls, Unequal Error Protection allows to differentiate the most and least important speech bits in order to apply different level of protection for different set of bits over the radio interface. This UEP function brings a better radio optimisation for voice service. For the same reason, Unequal Error Protection could be studied for IMS multimedia conversational services.

7.1.1.2 Expected UEP gains for IMS multimedia conversational services

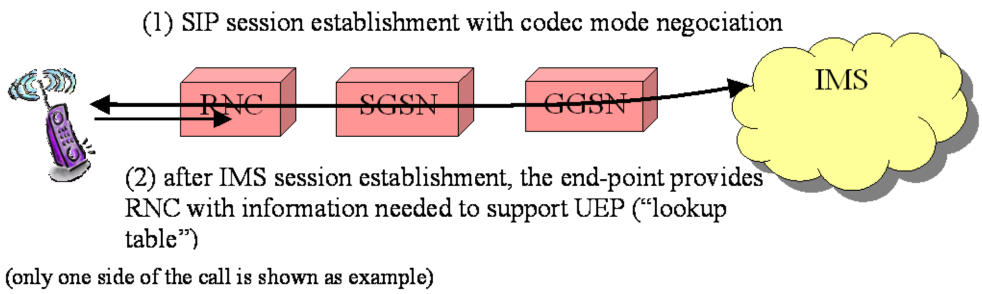
editor note: the goal of this section is to summarize gains estimated for UEP

7.1.2 UEP for VoIP services using AMR-NB or AMR-WB codecs

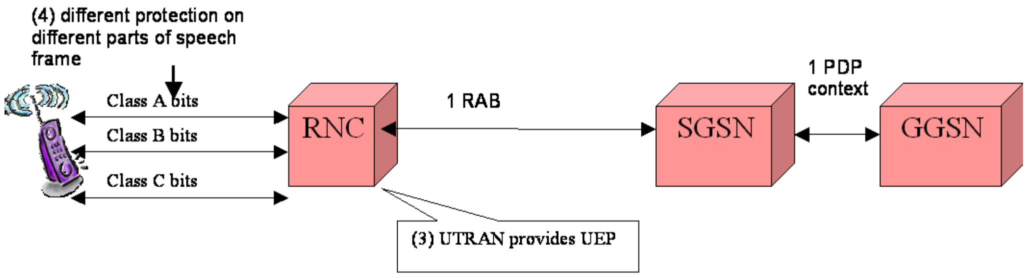
7.1.2.1 Proposal 1

To allow the RNC to provide UEP for VoIP service, an approach similar to the one used for CS domain is proposed:

- During an IMS multimedia session establishment, the end-points negotiate codecs and codec modes to be used during the IMS multimedia session. NB-AMR and WB-AMR are the codecs to be used for VoIP.
- After the codec negotiation of the IMS multimedia session both end-points know the agreed codecs and codec modes and the end-points are aware of which AMR Payload structures are expected in case of VoIP.
- At the end of the IMS multimedia session negotiation, the end-points provides the RNC with the information indicating the expected speech frame payload structures.



- During the VoIP session life:
  - The RNC compared each speech frame with the “lookup table”.
  - then the RNC applies different error protection level to each identified part of the speech frame with no difference compared to what it does for UEP in CS domain.



- In case the end-point changes the codec via a new SIP negotiation, the end-point provides the new information relative to the new negotiated codecs and codec modes to the RNC.

The following points have to be clarified:

- what exact information are needed by the RNC
- the way the UE provides the information to the RNC

7.1.2.2 Conclusion

7.2 Support for Rate Control

Rate control is used for voice in cellular mobile system in order to allow the cellular mobile system to react to the changing radio conditions, which are influenced by at least the issues such as behaviour of the application and users, the radio environment, the total number of users in a cell, the location of the users within a cell. The rate control mechanism has resulted in an increase in capacity of the network under heavily loaded conditions, while allowing a high voice quality under normal operating conditions.

In the current standards for applications/services using packet delivery over the PS domain, there is no rate control mechanism allowing the radio network to control applications to adapt to changing radio conditions.

For human to content based services, rate control provides benefits in terms of allowing the radio network to influence applications to react to the network conditions allowing for the possibilities to increasing the perceived end-user experience and the support increased number of concurrent users.

8 Possible solutions to provide (multi)media RAB specific handling parameters to RAN

There is a need to communicate to RAN "specific" RAN handling parameters of (multi)media RABs. These parameters could correspond e.g. to (WB)AMR Multi-mode Codec Control or to any other (future) mechanisms that one day 3gpp could decide to standardise (Unequal Error Protection (UEP),…)

Three possible methods are described to show how these specific media parameters can be sent to RAN:

- Direct transfer from UE to RAN of the "media parameters for RAN"
- Transfer of the media parameters for RAN in QoS parameter of 24.008 Activate PDP Context Request message and of RANAP
- Transparent Transfer of the "media parameters for RAN" via the SGSN

8.1 Requirements on the solution

The recommended solution shall:

1. Be independent of the radio access technology (GERAN, UTRAN)
2. Be independent of the media handling functions carried out in RAN in order to use the same mechanism un-modified even though in the future other "specific" handling of the multimedia media were specified in the RAN.

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3. Allow UTRAN to carry out Multi-mode Codec Control, without UTRAN having to know the codec used for the media

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4. SGSN, GGSN shall not have to know which codec is being used

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5. Work for other services than IMS. Neither RAN, nor SGSN-GGSN shall have to understand IMS signalling.

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8.2 Direct transfer from UE to RAN of "media parameters for RAN"

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This section describes a solution in which the "media parameters for RAN" are not sent by the CN at RAB Assignment, but only afterwards. The "media parameters for RAN" could be sent directly on radio from UE to RAN within the answer to the RB (Radio Bearer) establishment request. In this solution no specific information for ""media parameters for RAN" is neither transferred on 24.008 SM (PDP context activation…) nor on RANAP (RAB Assignment).

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

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

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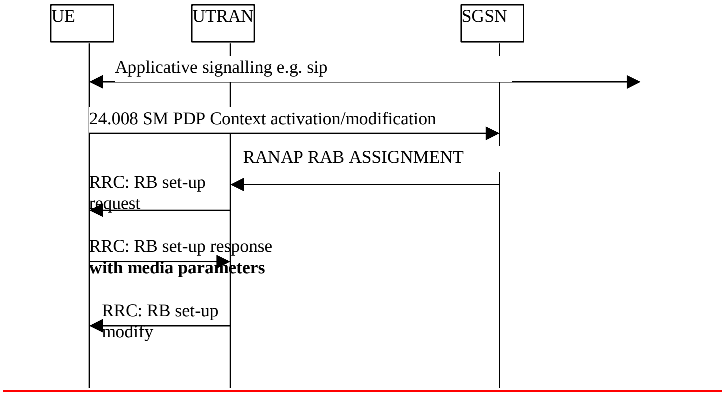

This solution raises synchronization issues: the RB is first (step 1-3) established without knowing "media parameters for RAN" (e.g. Multi-mode Codec Control parameters). Then afterwards (step 4-5) RAN discovers that RB parameters need to be changed. As an example, application to the RB of (multi)media RAB specific handling 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.

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

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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

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

To illustrate this method, the case of the subflow definition for (WB)AMR Multi-mode Codec Control is used. This method should be adapted for other media handling feature in UTRAN

8.3.1 Example: subflow definition for (WB)AMR Multi-mode Codec Control

In order to allow the definition of several flows each one corresponding to a codec mode. It is the responsibility of the UE to build the *Requested QoS* IE as part of the Activate PDP Context Request message from the parameters negotiated with the remote user via SIP/SDP protocol.

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.
- If Multi-mode Codec Control applies in the RAN, there would also be the need to define one set of Maximum SDU size and guaranteed bit rate per codec flow in an additional set of parameters.
- Furthermore, in the case where UEP were defined, the SDU Format Information Parameter IE (one per RAB subflow combination) is also needed for the definition of the subflows within a codec flow.

8.3.2 Discussion of the solution

- This solution might not be generic enough to allow the transfer of parameters for different type of media handling requirements such as subflow definition for Multi-mode Codec Control, parameters for UEP, etc. It seems hard to cram all of theses parameters into the QoS IE of 24.008 and RANAP.
- This solution implies to bother GGSN with information per codec flow as the QoS IE is normally transferred to the GGSN within Gn messages.
- This solution has advantages with regards to charging since QoS IE is stored in the CDR. However, the GPRS CDRs need to accommodate a much longer QoS IE.
- This solution may impose including the specific media handling parameters in the QoS received from HLR. Considering that QoS parameters received by SGSN from UE are compared with QoS value received from HLR. The same rules may apply to the specific media handling parameters.
- The solution is not backward compatible with a R5 SGSN independently of the fact that the SGSN compares or not the Requested QoS with the QoS received from HLR. If they do not need to be compared, then this would imply that a R5 SGSN would anyhow have to be modified in order to pass to RAN these QoS parameters (it does not understand) without comparing them with any network or subscriber profile. If they need to be compared then again SGSN needs to be changed.

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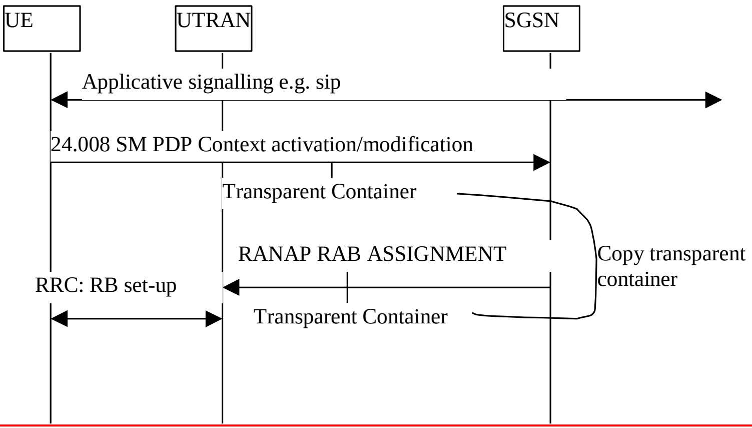
8.4 Transparent Transfer of the "media parameters for RAN"

In this solution the 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.



8.4.1 Discussion of the solution

- This solution does not modify GPRS QoS definition
- This solution does not propagate the media parameters for RAN (e.g. subflow definition) up to GGSN
- This solution provides a unified way for UE to send to the RAN (UTRAN, GERAN) the specific media (handling) parameters needed.
- How charging can be applied for this specific RAN handling is FFS.
- 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 of 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.

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Annex

Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
22/02/02				0.1.0	Output version from TSG SA2#23		
12/04/02				0.2.0	Output version from TSG SA2#23 taking into account S2-020854		
12/05/02 1				0.3.0	Output version from TSG SA2#24 taking into account S2-021003; S2-021486		
07/08/02				0.4.0	Output version from TSG SA2#25 taking into account S2-021717; S2-021718		
13/09/02				0.5.0	Output version from TSG SA2#26 taking into account S2-022582rev1		
03/12/02				0.6.0	Ouput version from TSG SA2#27 taking into account S2-023643		
17/02/03				0.7.0	Ouput version from TSG SA2#29 taking into account S2-030322		

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