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Technical Report

3rd Generation Partnership Project; Technical Specification Group (TSG) RAN3; Transcoder Free Operation (Release 4)

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Contents

Foreword

This Technical Specification 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:

Version x.y.z

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.

1 Scope

The present document provides the current status of the work item "Transcoder Free Operation" within 3GPP TSG RAN WG3.

The purpose of this Rel4 Work Task is to define necessary enhancements of specifications under RAN WG3 control to support the procedures specified within the parent Building Block "Out of Band Transcoder Control".

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] "Out of Band Transcoder Control", Work Item Description, TSG CN#9, submitted as NP-000529

[2] "Transcoder Free Operation", Work Item Description, TSG RAN#9, submitted as RP-000507

[3] UMTS 23.153: "3rd Generation Partnership Project (3GPP) Technical Specification Group Core Network; Out of Band Transcoder Control - Stage 2"

[4] UMTS 23.205: "3rd Generation Partnership Project (3GPP) Technical Specification Group Core Network; Bearer Independent CS Core Network; Stage 2"

[5] UMTS 21.401: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Overall Description"

[6] UMTS 25.410: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Iu Interface: General Aspects and Principles"

[7] UMTS 25.413: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Iu interface RANAP signalling"

[8] UMTS 25.415: "3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network; UTRAN Iu Interface User Plane Protocols"

[9] UMTS 21.905: "3rd Generation Partnership Project (3GPP) Technical Specification Group Services and System Aspects; Vocabulary for 3GPP specifications"

[10] Status Report of TrFO Workshop to TSG#09, TSG CN#9, submitted as NP-000516

[11] ITU-T H.248: "Media Gateway Control Protocol"

[12] "Report of an Adhoc meeting (2000-10-16 evening, during TrFO WS#4) on *TrFO & Initialisation and Maximum Rate Procedures during Call Setup and SRNS Relocation in case of Mobile to Mobile Call*", Document for WS between R3/S4/N4 on TrFO during RAN3#16, submitted as TRFO_IU_014^

[13] 3GPP TS 29.415: "3rd Generation Partnership Project; Technical Specification Group Core Network; CN Nb interface user plane protocols".

[14] 3GPP TS 29.232: "3rd Generation Partnership Project; Technical Specification Group Core Network; Media Gateway Controller (MGC) – Media Gateway (MGW) interface; Stage 3"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

3.2 Symbols

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

3.3 Abbreviations

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

ACS	Active Codec Set
CN	Core Network
CS	circuit switched
DL	Downlink
DTX	Discontinuous Transmission
Iu FP	Iu framing protocol
IN	Intelligent Network
MGW	Media Gateway
OoBTC	Out of Band Transcoder Control
RFCI	RAB Subflow Combination Indicator
RNC	Radio Network Controller
SDU	Service Data Unit
SS	Supplementary Service
TICC	Transport Independent Call Control
TrFO	Transcoder Free Operation
UE	User Equipment
UL	Uplink

4 Introduction

Figure 4/1 illustrates the architecture for Rel4 for a UMTS to UMTS TrFO connection from a system wide point of view.

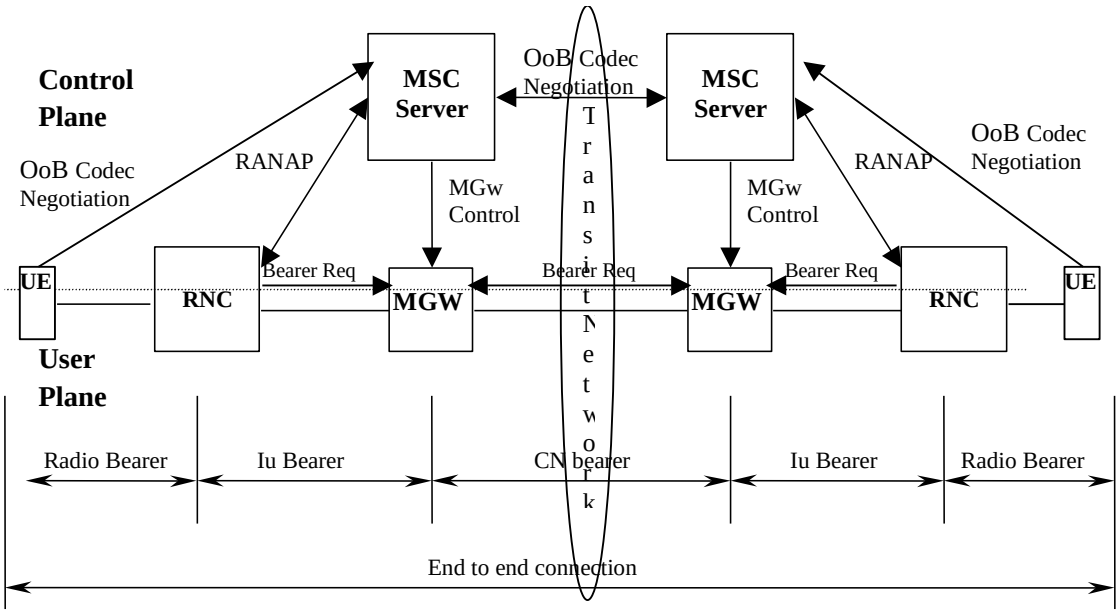

Figure 4/1. Basic Architecture for UMTS to UMTS TrFO Connection [3].

OoBTC is required to establish Transcoder Free Operation. Out of Band Transcoder Control (OoBTC) is the term used for the capability of a network to negotiate codec types and codec modes for a call with out-of-band signalling procedures.

In [3] these procedures are specified to take place at the call setup phase or possibly later if there is a need to re-negotiate the codec due to e.g. SS interworking. OoBTC is performed between serving core network nodes taking into account transcoding capabilities of all involved parties, i.e. UEs and MGWs under the control of their serving nodes. OoBTC relies on the mechanisms and the architecture defined for an bearer independent circuit switched core network, as specified in [4].

The general principle of Transcoder Free Operation is to enable the support mode operation of the framing protocol defined within [8] not only on the Iu interface but to allow an end to end operation of the support mode procedures on Iu and CN bearers. It shall be possible that the end to end operation of the UP support mode is possible between network nodes that permanently terminate the Iu FP protocol, e.g. between two RNCs in case of a mobile to mobile call or an RNC and a gateway CN node in case of a mobile to fixed call, i.e. it shall not be limited to Figure 4/1.

This principle is enabled due to the agreement during the TrFO workshop to use the Iu UP protocol as a framing protocol within the circuit-switched AAL2/ATM and IP core network for compressed speech and CS data services. (see [10])

Note, that TSG CN WG3, responsible for the definitions of the Nb interface, communicated that the term “Iu UP” is not applicable for the Nb interface. Consequently, instead of using the terms “Iu UP” and “Iu UP protocol”, “Iu framing” and “Iu framing protocol” will be used throughout this TR when applicable, according to wording agreements reached within TSG CN WG4.

Figure 4/2 outlines a network configuration during a mobile to mobile call setup involving certain network entities (RNCs, MGWs, MSC-Servers) and respective protocol entities (RANAP, Iu framing protocol terminations (Iu-UP, Nb-UP) and Transport Independent Call Control (TICC)). Call Contexts, containing terminations (see [11]) with properties that shall be defined within [8] are involved as well (T1-T4).

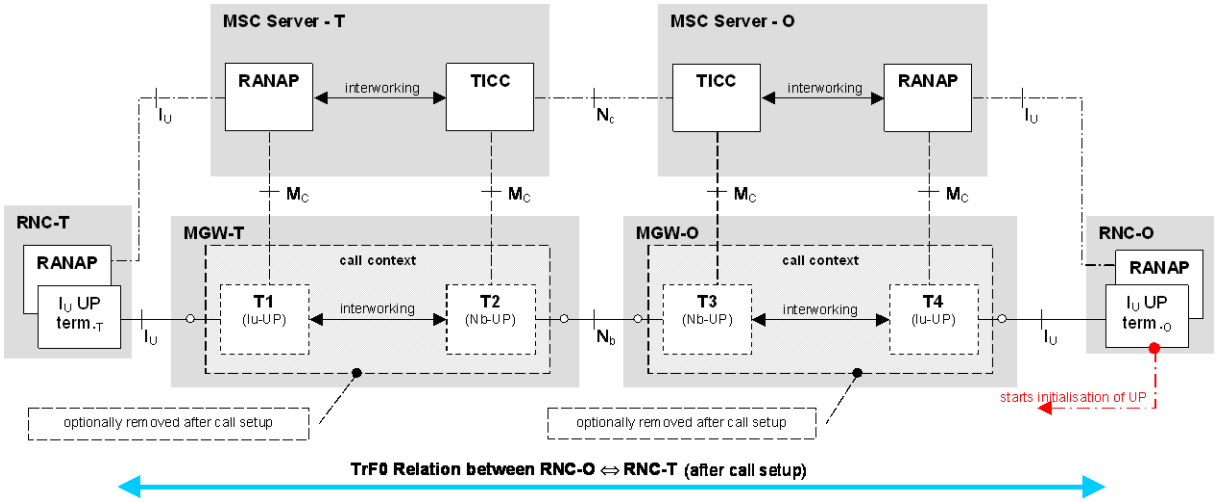

Figure 4/2. Configuration during Call Setup of a Mobile to Mobile Call [3].

5 Requirements

This section contains the requirements for supporting Transcoder Free Operation.

5.1 General Requirements

- The general requirement is to allow end-to-end communication between mobile users or between a mobile and a fixed user without inserting a transcoding equipment into the communication path, as far as possible.
- It shall be possible to define the protocols in a way the support mode operation within the call context in a MGW may revert to transparent mode (i.e. without the requirement to permanently scan Iu UP specific control frames) to allow reduction of processing time and HW equipment.

6 Study Area

6.1 RAB establishment and UP initialisation

This section introduces RAB assignment and UP initialisation in the light of TrFO. In principle R'99 concepts shall be re-used with some modifications.

6.1.1 Initial UP initialisation

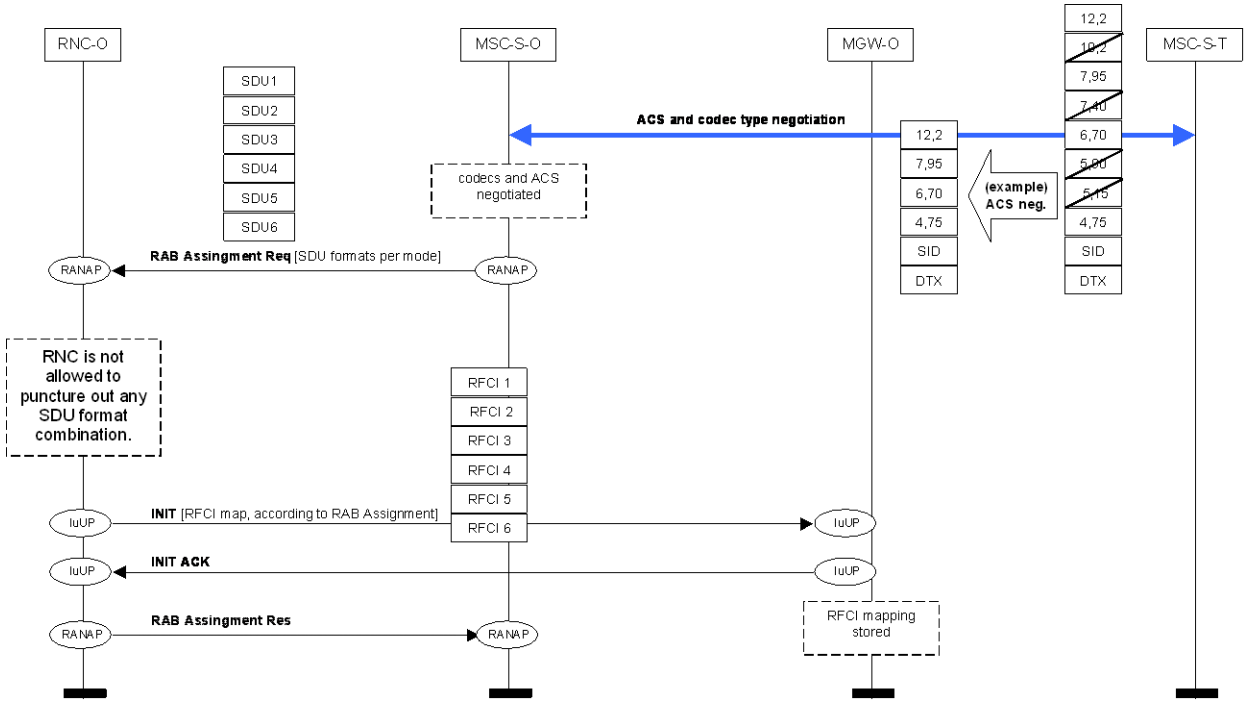

Figure 6/1. Initialisation procedure in conjunction with codec negotiation and RAB Assignment.

Figure 6/1 outlines issues that represent additional functionality compared to R'99 as follows:

Codec negotiation has to be performed at the very start of the setup-phase. Involved parties: MSC-Servers, that serve the calling/called UE and the served Ues. The UEs only report their capabilities. Codec negotiation implies negotiation of the codec type and active codec set (ACS). (See [3] for further details, outside RAN3 scope.) TrFO specific RAB assignment and UP initialisation may take place after codec negotiation, if TrFO was found possible.

RNC shall accept the number of subflow combinations contained within the RAB ASSIGNMENT REQUEST message. Internal handling of mode restriction will be performed via maximum rate control. (Note: Codec negotiation should be able to avoid unnecessary large number of requested RFCs in RAB Assignment).

When the MSC requests for a RAB to be assigned, it shall always define at least one speech mode SDU (lowest rate), DTX SDU and no data SDU as non-rate controllable. Other SDU formats for higher rates shall be defined as rate controllable.

The RNC shall not indicate RABs as successfully established within the RAB ASSIGNMENT RESPONSE message before the UPs of the respective Iu bearers have been successfully initialised.

6.1.2 Iu framing protocol initialisation throughout the CN

The Iu framing protocol is established throughout the CN in forward direction, i.e. from the originating node (that could be a border GW node, as outlined within Figure 6/2 or an originating RNC) onwards. The initialisation process of the UP will stop at the terminating MGW. The terminating RNC will start the UP initialisation as well, as already defined within R'99.

As outlined within Figure 6/2, the initialisation procedure shall be always acknowledged between peer Iu framing protocol entities.

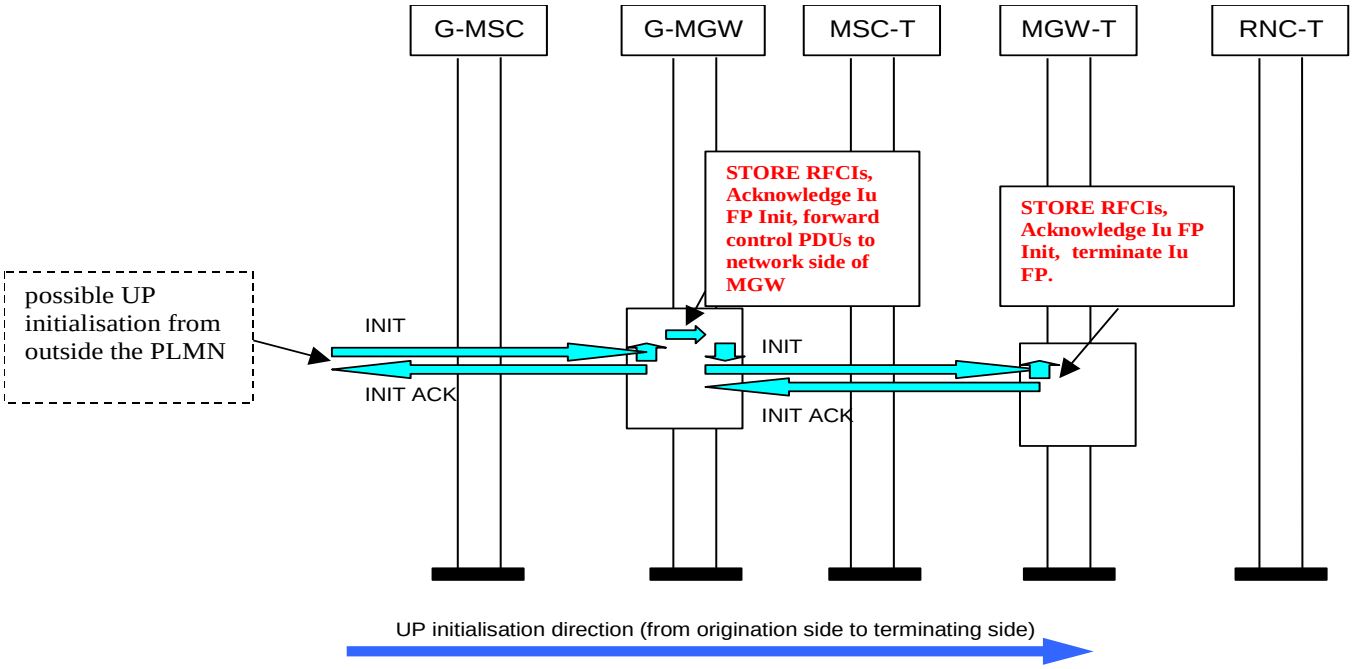

Figure 6/2. Iu framing protocol establishment up to the terminating MGW.

The RFCI parameters shall always be stored for that Iu FP termination that received the Iu framing initialisation.

6.1.3 UP re-initialisation

In [3], two situations are described that may be responsible for re-initialising the user plane for already established RAB's:

1) re-initialising due to service interworking (supplementary services, IN, etc., see chapter 5.8 and 6.3 in [3]).

2) re-initialising due to RFCI value correction.

ad 1.) Re-initialising due to service interworking may be necessary if, e.g. due to IN the call is extended to another CN node that cannot support the already negotiated codec. Codec modification has to be performed, which generally leads to re-initialising the UP. This case can be already handled by Iu framing protocol version 1 protocol means as it always requires interacting with the RANAP protocol, i.e. a RAB modification.

ad 2.) RFCI value correction occurs if an RNC representing the terminating access node initialises its Iu UP differently from the already initialised TrFO links (the originating Iu section and the links between CN nodes) (see section 5.4.3 in [3]). To enable TrFO operation that does not require any frame manipulation within the intermediate nodes (MGW(s)), the RFCI set applied for all TrFO links needs to be identical. To align the RFCI set on the terminating Iu section, the Iu framing protocol is required to allow the initialisation procedure to be re-invoked by the CN.

6.1.4 Removal of Iu framing protocol terminations after call setup

If a MGW has two terminations with Iu UP package connected to the same context and both RFCI sets match then the MGW (e.g. T1& T2 and T3&T4 in Figure 4/2) may remove the Iu framing protocol terminations, i.e no monitoring of the Iu frames will be performed, provided that the terminations are connected through. The resulting user plane configuration (according to Figure 4/2) can be found in Figure 6/3 below:

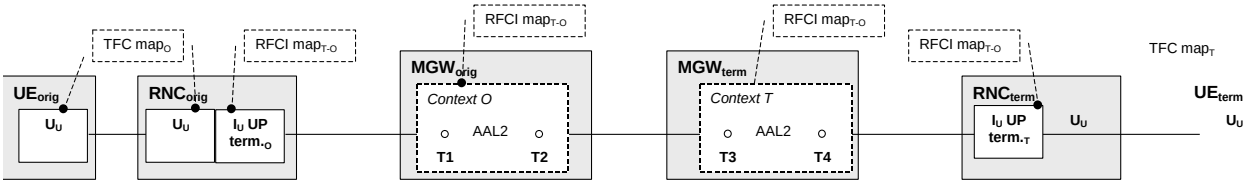

Figure 6/3. Optional removal of Iu UP protocol terminations within MGWs.

6.2 Inband Rate Control

This section outlines required changes for the rate control procedure in the light of TrFO.

6.2.1 Distributed and Maximum Rate Control

Inband rate control shall only allow the RNCs to set the maximum codec mode (maximum bitrate) from the set of codec modes that have been negotiated out of band. This procedure is called Maximum Rate Control. In TrFO maximum rate control shall be supported by the peer Iu FP protocol entities. The maximum rate control procedures need to be defined within the Iu UP protocol [8].

The final maximum rate results from a rate control request from one side and the maximum rate supported at the side that receives the rate control request; the lower rate of these two is selected. This is known as Distributed Rate Decision. Figure 6/3 outlines the principle.

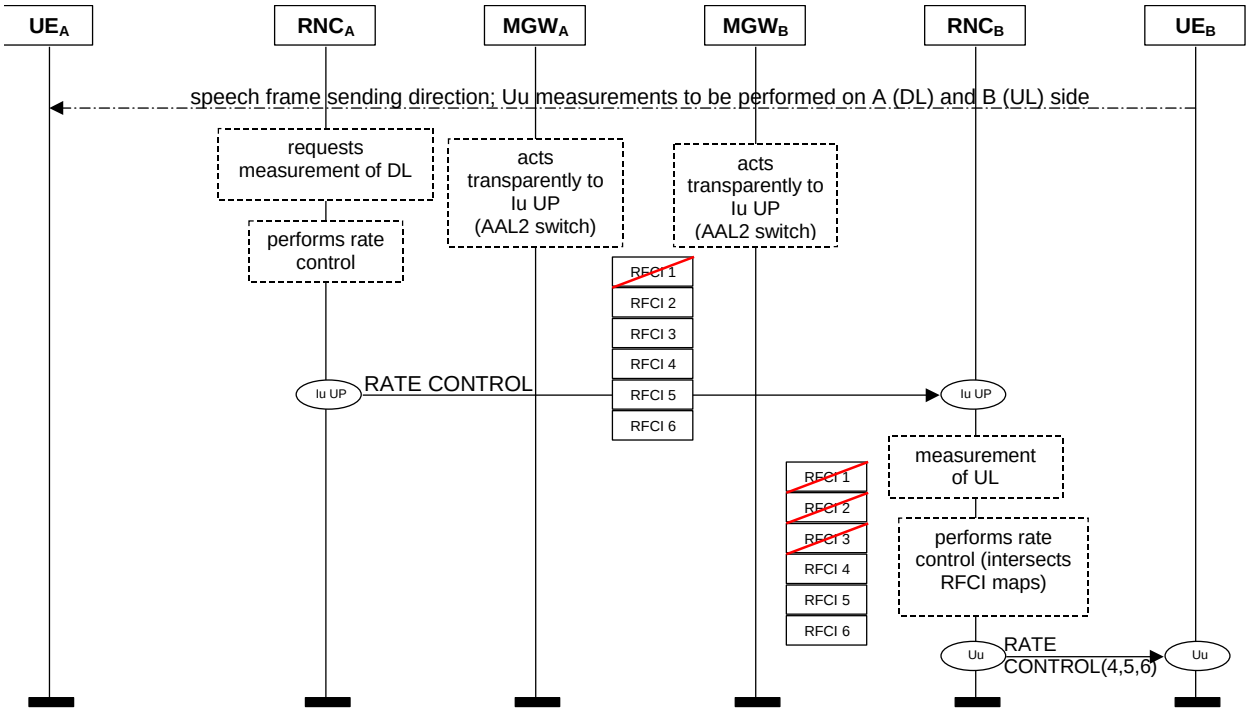

Figure 6/4. Distributed - and Maximum Rate Control Principle.

Note: in Figure 6/4 RFCI's are ordered according to their bitrate, i.e. "RFCI 1" corresponds to the highest bitrate.

Evaluating the appropriate codec mode for sending speech frames from UE_B to UE_A, two measurement processes are involved: UL for UE_B and DL for UE_A. RNC_A requests UE_A's DL measurement and performs the appropriate rate control action (if necessary). It is not allowed to puncture out any mode of the ACS with a bitrate below the maximum

allowed just evaluated. RNC_B performs UL measurement for UE_B as well and might, if the UL quality is worse, reduce the maximum rate. The resulting maximum rate will be sent to UE_B, which is now able to sent speech frames of that mode, that fits in the radio conditions on both air interfaces.

Whereas in R'99 a peer Iu framing protocol entity performing rate control is allowed to indicate any mode-vector within the rate control frame, it is not allowed in Rel4 to puncture out any mode below a certain rate, to avoid non-matching mode vectors in the peer Iu framing protocol entity that receives the rate control frame.

6.2.2 Immediate Rate Control

At SRNS relocation the new RNC shall send a rate control frame at Relocation Detect indicating its current maximum rate, it will receive in the acknowledgement the current maximum rate from the far end. This procedure is called Immediate Rate Control. Again the distributed rate decision means both RNCs will operate within a common limit.

Note, that the Rate Control procedure, that has to be issued immediately after the reception of the relocation execution trigger shall be the first rate control frame sent from the target RNC to indicate the MGW to start relaying control frames received from the new Iu leg.

Figure 6/5 outlines this principle.

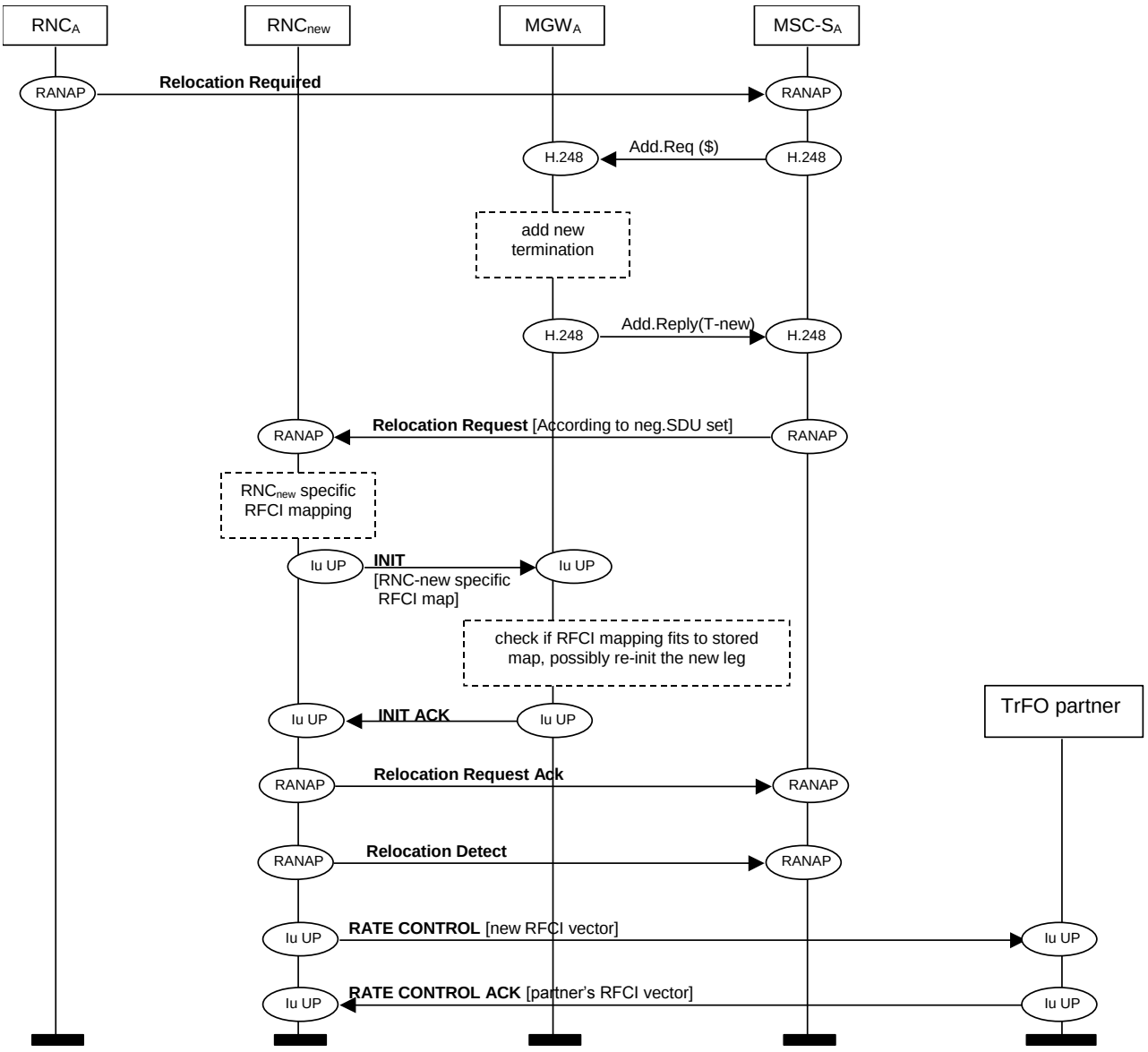

Figure 6/5. Immediate Rate Control.

6.3 Required behaviour of an Iu framing protocol entity

The following list contains required behaviour of an Iu framing protocol entity as given within [13] as far as applicable to technical specifications under the responsibility of 3GPP TSG RAN WG3.

- The MGW shall be able to initiate and respond to the UP control procedures (PDU type 14 frames) independently of the Stream Mode during the call establishment phase, i.e. when not in TrFO.
- During TrFO operation the MGW shall be able to forward UP control procedures (PDU type 14 frames) received at one termination to the other termination.
- As outlined within Figure 6/2, the initialisation procedure shall always be acknowledged between peer Iu framing protocol entities.
- The RFCI parameters shall always be stored for that UP termination that received the UP initialisation.
- If a MGW has two terminations in the same context defined as supporting UP package, then on receipt of an Initialisation procedure from one side it shall forward the UP initialisation procedure on to the peer MGW. This procedure shall be performed independently of the through-connection of the terminations in the context, but is dependent on the bearer connection from the other termination to its peer MGW being established.
- "RFCI Value Correction" may be delayed if terminations are not connected-through, triggered by connection modification otherwise it shall be performed immediately, this is an implementation option.
- If "RFCI Matching" is not performed the MGW shall map the indexes for UP frames from one side to the RFCI indexes from the other side.
- - If an MGW has two terminations which support the UP package connected to the same context and both RFCI sets match then the MGW may pass frames transparently through the UP entities; no monitoring of the frames is performed, provided that the terminations are through-connected. The "UP Relay Function" may then also be bypassed.
- If a H.248 procedure is received when a MGW removed the Iu FP entities (but Iu FP is defined as support mode) that requires interpretation or interaction with the Iu FP then the MGW shall again perform monitoring or termination of the Iu FP protocol.

6.4 Communication of Iu FP entities with upper layers

According to the requirements, outlined in section 6.3, it shall be possible to relay PDU type 14 frames between Iu FP entities. The primitives used for communication with the upper layers needs to contain the whole protocol information. This is necessary not only for the initialisation procedure, but for all procedures described within [8] to support the option not to remove the Iu framing protocol entities after call setup.

7 Selected Solution

In principle all the proposed solutions were accepted as described in section 6. The list below contains important issues worth to be emphasised and the outcome of the only controversial discussion regarding the acknowledgement of the rate control frame.

- It was agreed to increase the version of the Iu UP protocol to "2".
- It was agreed, that the Rate Control procedure always foresees an acknowledgement. The acknowledgement always contains the current rate control vector of the peer. This was not only seen to be necessary in relation to the immediate rate control procedure but also as an enhancement to Rel 99.
- It was also agreed to include a section about the principle of the "distributed rate decision" within the informative Annex of [8].

8 Specification Impact and Associated Change Requests

The necessary CRs to the relevant specifications are attached to the zip- file. Find a list below:

Prepared changes for 3GPP TS 25.413

R3-010980, CR271 "Changes on RANAP due to WI TrFO"

Prepared changes for 3GPP TS 25.415

R3-010981, CR057 "RNL-SAP Primitives necessary for TrFO"

R3-010982, CR058 "TrFO impacts on Rate Control"

R3-010983, CR059 "General changes for WI TrFO"

R3-010984, CR060 "TrFO Impacts on Iu UP initialisation"

9 Communication with other WGs

9.1 Communication with TSG CN WG3

TSG CN WG3 proposed (among other issues) in R3-003142 "Reply to LS on Proposed enhancements to Mc specification"

- not apply the term Iu UP protocol for framing protocols used on CN internal interfaces. This has been taken into account within several contributions prepared for the stage 2 description of TrFO in [3]. The wording has been changed to "Iu framing" resp. "Iu framing protocol".
- to provide a 3GPP TS "29.415, Core Network Nb User Plane protocols" that differs only in certain places from 3GPP TS 25.415.

In R3-003277 "Proposed LS on Working Assumptions made by N3 for the new TS 29.415 "Core Network Nb User Plane protocols"" TSG RAN WG3 stated not to be in favour of the solution given by CN3.

- RAN WG3 explained that consistency between Iu and Nb UP protocols is a pre-condition of TrFO to work. Therefore RAN WG3 proposed that the newly created TS 29.415 shall only contain the applicability of TS 25.415 on the Nb interface.

In R3-010623, which was sent from a joint CN3 & CN4 workshop, "Answer LS on Working Assumptions made by N3 for the new TS 29.415 "Core Network Nb User Plane protocols" it was stated that

- during TrFO operation it is crucial to be able to pass additional information to the upper layer.
- a further alignment between 25.415 and 29.415 in the sense to have only one UP specification would be beneficial.

In R3-011090, RAN3 answered CN3 and CN4 that

- RAN3 has already foreseen additional information to be passed between the UP protocol layer an the upper layer(s).
- RAN3 agreed that the most convenient way to proceed is to keeps the hierarchical structure of the specifications as it is

Annex A:
Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
03/2001	11	RP-010139	-	-	Approved at TSG RAN #11 and placed under Change Control	2.0.0	4.0.0