Agenda Item: 9.1

Source: **Ericsson**

Title: IU Downlink Rate Control procedure description for 25.415 (Iu UP protocol)

Document for: Decision

1. Introduction

At the last Iu SWG meeting in Sophia Antipolis, it was agreed in principle to introduce Downlink Rate Control procedure over Iu in the Iu UP specification 25.415.

This contribution proposes text in respect with the procedure, primitives modificationsand function impacts. The coding of the rate control procedure is specified in a companion contribution ([2]). The protocol state changes are shown in [3].

It was also mentionned at the last meeting that clarification shall be brought as to maximum rate control or exact rate control shall be performed and it any rates of a rate controllable RAB can be controlled by the RNC.

This contribution proposes to specify that:

1. An indication shall be appended to every SDU size information (i.e. rate) in the RAB attributes to indicate whether that rate can be controlled by the RNC or not. Indeed, certain rates such as the DTX modes for a speech RAB (no data, SID frame, SID first) are totally controlled by the encoder and the rate control function in the RNC cannot alter or prevent those rates to be used. Having this indication of the RAB attributes level permits to keep independance between UTRAN and the service using the RAB.

2. Rate control shall be signalled over Iu so that it can allow maximum rate control. It can be so that the originating RNC does not permit to go beyond a certain rate in a given cell (i.e. maximum rate). However links in between the RNC and the source coding device can be impaired by data corruption (e.g. satellite link), thus forcing to the source coding device to select a more robust and lower rate than the maximum rate pointed at by the RNC. Therefore maximum rate control shall be possible to indicate over IU

3. Rate Control shall be signalled over Iu so that it can allow exact rate control. Indeed in a TFO or TrFO situation the rate can vary very rapidly according to the e.g. GSM path loss variations (theoritically every 40 ms), which may compromise the relocation of the Iu UP. Therefore it shall be possible, similar to GSM, to block the rate (except the non-rate controllable rates such as DTX) at a certain level during the relocation and resume the dynamic rate variations once the relocation is performed.

It is therefore proposed to signal uplink in the appropriate PDU Type, a bitmap indicating which RFCI are permitted to be used in the downlink upon recpetion of the rate control procedure request.

It is not necessary to positively or negatively acknowledge the rate control procedure, since the RNC that initiates the rate control change will detect whether the order has been correctly interpreted and could in the negative case reiterate the rate control command to the source coding device.

The proposal is designed so that the RNC may receive a rate control command (downlink rate control command received <u>downlink</u>). This case would correspond to a TrFO or TFO case. The order would have to be turned into the appropriate radio interface protocol action to signal to the UE the rate that RNC has selected for Uplink transfer among the permitted rates received from the TFO/TrFO partner. The exact details of this case are however left for further contribution tackling the TFO and TrFO handling completely.

2. Iu Downlink Rate Control Procedure

Successful operation

The purpose of the rate control procedure is to signal in the uplink direction to the peer Iu UP protocol layer the permitted rate(s) over Iu in the downlink direction.

The rate control procedure over Iu UP is controlled by the entity controlling the rate control over UTRAN i.e. SRNC.

The Iu downlink rate control procedure is invoked whenever the SRNC decides that the set of downlink permitted rates over Iu shall be modified. This set can be made of only one permitted rate among the rates that are permitted for rate control or several rates among the rates that can be rate controlled by the SRNC.

The rates that can be controlled by the SRNC are indicated to the Iu UP at establishment in addition to the rates that cannot be controlled by the RNC e.g. such as DTX rates for certain RABs.

The procedure can only be invoked when the Iu UP protocol layer is in the "Transfer of user data" state.

The procedure can be signalled at any time in the "Transfer of user data" state.

The Procedure control function upon request of upper layer prepares the RFCI bitmap of downlink permitted rates.

The frame handler function calculates the frame CRC, formats the frame header into the appropriate PDU Type and sends the Iu UP frame PDU to the lower layers for trasnfer across the Iu interface.

After sending the rate control frame, the Iu UP protocol layer remains in the "Transfer of User Data" state.

Upon reception of a rate control frame, the Iu UP protocol layer checks the consistency of the Iu UP frame as follows:

- The Frame handler checks the consistency of the frame header and associated CRC. If correct, the frame handler passes procedure control part to the procedure control functions.

- The procedure control functions check that the new downlink permitted rate(s) are consistent with the RFCI set received at initialisation. They also verify that non-rate controllable rates are still permitted. If the whole rate control information is correct, the procedure control functions passes the rate control information to the NAS Data Streams specific functions.

- The NAS data streams specific functions forward to the rate control information in a Iu-UP-Status indication primitive.

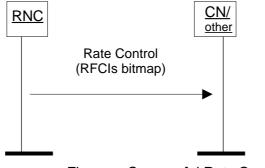The Iu UP protocol layer remains in the "Transfer of User Data" state.

Figure x. Successful Rate Control

Unsuccessful operation

If the Iu UP in the SRNC detects that the rate control command has not been correctly interpreted or received (e.g. the downlink rate is outside the set of permitted downlink rate), the Iu UP shall repeat the rate control procedure with the same rate control information as initially. The Iu UP protocol remains in the "Transfer of User Data" state. If after "m" repetitions, the error situation persists, the Iu UP informs the upper layers. The Iu UP protocol layer remains in the "Transfer of User Data" state.

If the Iu UP protocol layer receives a rate control frame that is badly formatted or corrupted, it shall ignore the rate control frame. The Iu UP protocol remains in the "Transfer of User Data" state.
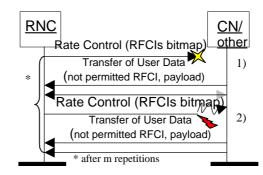

Figure x. Unsuccessful Transfers of rate control: 1) Frame loss 2) Corrupted Frame

3. Primitives modifications

Extracted from 25.415 V1.0.2:

Table 1. Iu UP protocol layer service primitives towards the upper layer at the RNL SAP

Primitive	Type	Parameters	Comments
Iu-UP-DATA	Request	Iu-UP-payload	
		Iu-UP-control	RFCI
	Indication	Iu-UP-payload	
		Iu-UP-control	RFCI
Iu-UP-Status	Indication	Iu-UP-Procedure-Control	Abnormal Event
			Initialisation
			RFCI bitmap Request (Note 2)
			Abnormal Event
			Time Alignment (FFS Note 3)
	Request	Iu-UP-Procedure-Control	Abnormal Event
			RFCI bitmap Request (Note 1)
Iu-UP-UNIT-DATA	Request	Iu-UP-payload	
	Indication	Iu-UP-payload	

Iu-UP-DATA-REQUEST

Note 1: This information is related to rate control.
Iu-UP-DATA-INDICATION

This primitive may also include a request for a RFC change. This corresponds to the case where a change of RFC needs to be applied to the frames sent in the opposite direction.

Note 2: This information is related to rate control.
Iu-UP-STATUS-REQUEST

This primitive is used to pass down to the Iu UP, the rate control information necessary for changing the permitted downlink rate(s) over Iu. The rate control information consists of the RFCI bitmap.

Note: The usage of this primitive is to be defined.
Iu-UP-STATUS-INDICATION

This primitive is used to report to the upper layer entity that a fault has been detected. The information concerning that fault is characterised by the Abnormal event information passed to the upper layer.

This primitive is also used in the context of the initialisation control procedure to pass to the upper Iu DS layer e.g. the RFC set and the associated RFCIs to be used in the communication phase.

This primitive is used to indicate to the upper layers the set of permitted rate(s) in the downlink direction over Iu. The set of permitted rate(s) is represented by the RFCI bitmap.

4. Procedure Control Functions modifications

Extracted from 25.415 V1.0.2:

- **Rate Control**: is the procedure which controls over Iu ~~~~UP the set of permitted down-link~~maximum rate~~ rates among the rates that can be controlled by UTRAN. The set of rates is represented by an RFCI bitmap.~~RAB Formats~~ **(to update)** ~~negotiated for the established RAB service.~~ The function controlling this procedure interacts with functions outside of the Iu UP protocol layer.

5. Proposal

It is proposed to include these modifications into [1].

6. References

[1] UMTS 25.415, Iu Interface CN-RAN User Plane Protocols, Source: Editor

[2] R3-99B52, Frame Coding of PDU Type 15 for support mode for predefined SDU size, Source: Ericsson

[3] R3-99B53, Protocol States for Iu User Plane, Source: Ericsson