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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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Scope

is technical report captures the results of the work on the work item "Hybrid ARQ Type II/III". This includes hnical solutions and their comparison. The report covers impacts on all RAN WGs.

References

e following documents contain provisions which, through reference in this text, constitute provisions of the present cument.

- 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.

[<seq>] <doctype> <#>[([up to and including]{yyyy[-mm]|V<a[.b[.c]]>}[onwards])]: "<Title>".

[1] 3G TS 25.123: "Example 1, using sequence field".

[2] 3G TR 29.456 (V3.1.0): "Example 2, using fixed text".

Definitions, symbols and abbreviations

1 Definitions

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

finition format

efined term>: <definition>.

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

.2 Symbols

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

mbol format

<symbol> <Explanation>

.3 Abbreviations

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

breviation format

<ACRONYM> <Explanation>

Background and Introduction

5 Overview of Hybrid ARQ Type II/III

5.1 General Mechanism

There are different variants of hybrid ARQ methods. The terms hybrid ARQ type I, type II, and type III are used according to the following definition:

Type I hybrid ARQ

The ARQ method used in current 3GPP specifications is referred to as HARQ type I. In this basic HARQ type I the CRC is added and the data is encoded with a forward error correction (FEC) code. In the receiver the FEC code is decoded and the quality of the packet is checked (CRC check). If there are errors in the packet, a retransmission of the packet (RLC-PDU) is requested. The erroneous packet is discarded and retransmissions use the same coding as the first transmission.

Type II hybrid ARQ

The type II HARQ is a so-called Incremental Redundancy ARQ scheme. This means that an RLC-PDU that is to be retransmitted is not discarded but is combined with some incremental redundancy information provided by the transmitter for subsequent decoding.
For type II HARQ the retransmissions are typically not identical with the original transmission. The retransmitted part carries additional redundancy information for error correction purposes. This additional redundancy is combined with the previously received packet and the resulting code word with a higher coding gain is decoded. In hybrid ARQ type II, the retransmitted amount of redundancy is different for each retransmission, and retransmissions can in general only be decoded after combination with previous transmissions.
Type II hybrid ARQ requires that when RLC-PDU are transferred their sequence numbers are signalled with a better error protection than the data part of the RLC-PDU. This is because several versions of the RLC-PDU may need to be combined in the physical layer before it can be decoded and any identifier contained within the RLC-PDU detected.

Type III hybrid ARQ

Like type II hybrid ARQ, type III hybrid ARQ also belongs to the incremental redundancy ARQ schemes. This means that retransmissions concerning one RLC-PDU are not discarded but kept at the receiver for combination with additional information before decoding.
With type II hybrid ARQ, retransmissions containing additional incremental code bits sent for a RLC-PDU, which was initially received with errors, are in general not self decodable. In situations where the transmitted RLC-PDU can be severely damaged, for example, due to interference, it is desirable to have a scheme where any additional information sent is self decodable. In type III HARQ each retransmission is self-decodable. Thus, the data can be recovered from the retransmitted packet without combining if it is transmitted with sufficient quality.

Type III places similar requirements on the signalling protocol for external RLC-PDU identification and on the physical layer as type II hybrid ARQ.

Two subcases of hybrid ARQ type III can be distinguished:

- with multiple redundancy versions
  Different versions of a RLC-PDU are created. Different puncture bits are used in each version. If transmission of the first fails then the second version is sent. Transmission of further versions or repeat transmissions of the already transmitted versions may be made and combined.

- with one redundancy version
  In this subcase of HARQ type III, the same FEC coding is used for each retransmission, similar to the operation of HARQ type I. However, the erroneous packets are stored in the receiver and combined with retransmissions of the packet. This is a kind of incremental redundancy coding scheme in the form of a repetition code.

Hybrid ARQ Type II/III in UTRAN Layer 2 and Layer 3

Protocol Architecture

ection gives a general overview of function split for HARQ type II/III in the UE, the Node B, the Controlling or RNC, and the Serving RNC in the UL and DL direction.

llowing major functions are shown in table 1 and table 2:

TX buffering: The buffering of data which should be (re)transmitted at the transmitting side.

Parameter setting for Redundancy Version selection: It is selected with which redundancy version a certain (re-)transmission of a PDU is done.

RX soft decision buffering for combining: Buffering of the received initial and retransmitted data for the combining at the receiver side.

RX buffering for RLC-SDU reassembly: Buffering of the RLC-PDUs to reassemble them to RLC-SDUs.

Combining of retransmissions: Combining of the initially transmitted and retransmitted data for error correction.

	UE	Node B	CRNC / DRNC	SRNC
ffering	RLC	-	-	-
ieter setting for dancy Version ion	RLC	-	-	-
ft decision buffering nbining	-	Layer 1	-	-
ffering for DU reassembly	-	-	-	RLC
ining of smissions	-	Layer 1	-	-

ble 1: Function split for hybrid ARQ type II/III in the UE, NodeB, CRNC/DRNC, and SRNC in UL direction

	UE	Node B	CRNC / DRNC	SRNC
ffering	-	-	-	RLC
ieter setting for dancy Version ion	-	-	-	RLC
ft decision buffering nbining	Layer 1	-	-	-
ffering for DU reassembly	RLC	-	-	-
ining of smissions	Layer 1	-	-	-

ble 2:-Function split for hybrid ARQ type II/III in the UE, NodeB, CRNC/DRNC, and SRNC in DL direction

rform the HARQ type II / III operation the physical layer requires additional side information, e.g. sequence r, redundancy version, and logical channel identification. The setting of these parameters should be under l of RLC. A coordinated data flow of user data and side information from RLC to MAC and L1 is required (see

figure 1). The physical layer can encode the data and the side information separately, and map them on ones or possibly even different physical channels. At the receiver the buffering and recombining of the data is performed.

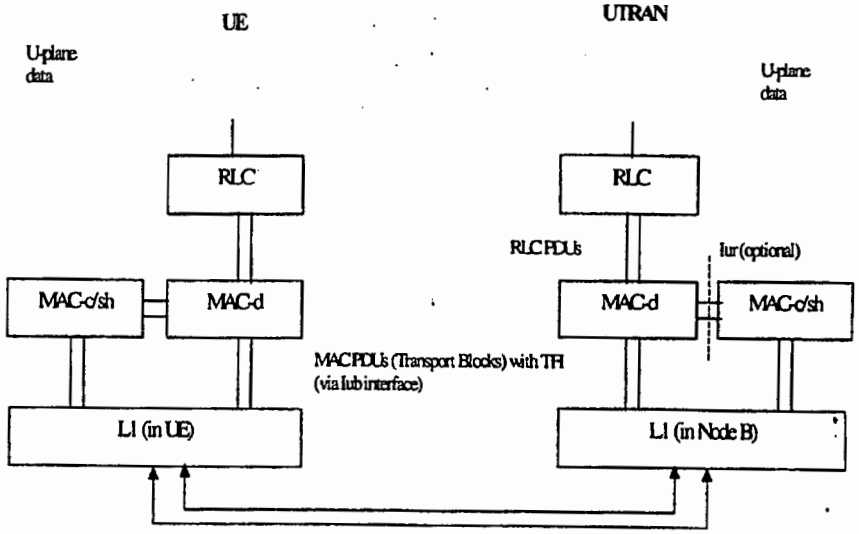

Figure 1 Protocol stack overview for hybrid ARQ type II/III.

Dotted lines visualise the transport of necessary side information for hybrid ARQ type II/III operation between RLC and the Physical Layer. Solid lines show the transport of user data.

Two different models for handling the additional requirements for hybrid ARQ type II/III in Layer 2 and Layer 3 have been proposed and are described in this report.

Case A: One logical channel is used for the transfer of user data and side information between RLC and MAC, and one transport channel is used for the transfer of user data and side information between MAC and physical layer.

Case B: Two separate logical channels are used for the transfer of user data and side information between RLC and MAC, and two separate transport channels are used for the transfer of user data and side information between MAC and physical layer.

6.2 Usage of logical channels and transport channels

6.2.1 Usage of logical channels and transport channels with Case A

The necessary side information for hybrid ARQ type II/III operation is included in the same logical channel as the RLC PDU data. This logical channel can be mapped to the following transport channels:

a) DTCH can be mapped onto the DCH.

b) DTCH can be mapped onto the DSCH

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