

**3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Multiplexing and channel coding
(Release 8)**



The present document has been developed within the 3rd Generation Partnership Project (3GPPTM) and may be further elaborated for the purposes of 3GPP.

The present document has not been subject to any approval process by the 3GPP Organizational Partners and shall not be implemented.

Keywords

<keyword[, keyword]>

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>

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© 2009, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TTA, TTC).
All rights reserved.

UMTS™ is a Trade Mark of ETSI registered for the benefit of its members
3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners
LTE™ is a Trade Mark of ETSI currently being registered for the benefit of its Members and of the 3GPP Organizational Partners
GSM® and the GSM logo are registered and owned by the GSM Association

Contents

| | |
|---|----|
| Foreword | 5 |
| 1 Scope | 6 |
| 2 References | 6 |
| 3 Definitions, symbols and abbreviations | 6 |
| 3.1 Definitions | 6 |
| 3.2 Symbols | 6 |
| 3.3 Abbreviations..... | 7 |
| 4 Mapping to physical channels | 7 |
| 4.1 Uplink | 7 |
| 4.2 Downlink | 8 |
| 5 Channel coding, multiplexing and interleaving | 8 |
| 5.1 Generic procedures | 8 |
| 5.1.1 CRC calculation | 8 |
| 5.1.2 Code block segmentation and code block CRC attachment | 9 |
| 5.1.3 Channel coding..... | 10 |
| 5.1.3.1 Tail biting convolutional coding..... | 11 |
| 5.1.3.2 Turbo coding | 12 |
| 5.1.3.2.1 Turbo encoder | 12 |
| 5.1.3.2.2 Trellis termination for turbo encoder | 13 |
| 5.1.3.2.3 Turbo code internal interleaver | 13 |
| 5.1.4 Rate matching..... | 15 |
| 5.1.4.1 Rate matching for turbo coded transport channels | 15 |
| 5.1.4.1.1 Sub-block interleaver | 15 |
| 5.1.4.1.2 Bit collection, selection and transmission | 16 |
| 5.1.4.2 Rate matching for convolutionally coded transport channels and control information | 18 |
| 5.1.4.2.1 Sub-block interleaver | 18 |
| 5.1.4.2.2 Bit collection, selection and transmission | 19 |
| 5.1.5 Code block concatenation | 20 |
| 5.2 Uplink transport channels and control information | 20 |
| 5.2.1 Random access channel..... | 20 |
| 5.2.2 Uplink shared channel..... | 20 |
| 5.2.2.1 Transport block CRC attachment | 21 |
| 5.2.2.2 Code block segmentation and code block CRC attachment | 22 |
| 5.2.2.3 Channel coding of UL-SCH | 22 |
| 5.2.2.4 Rate matching..... | 22 |
| 5.2.2.5 Code block concatenation..... | 22 |
| 5.2.2.6 Channel coding of control information..... | 22 |
| 5.2.2.6.1 Channel quality information formats for wideband CQI reports | 27 |
| 5.2.2.6.2 Channel quality information formats for higher layer configured subband CQI reports | 28 |
| 5.2.2.6.3 Channel quality information formats for UE selected subband CQI reports | 29 |
| 5.2.2.6.4 Channel coding for CQI/PMI information in PUSCH | 30 |
| 5.2.2.7 Data and control multiplexing | 31 |
| 5.2.2.8 Channel interleaver..... | 32 |
| 5.2.3 Uplink control information on PUCCH | 34 |
| 5.2.3.1 Channel coding for UCI HARQ-ACK..... | 34 |
| 5.2.3.2 Channel coding for UCI scheduling request..... | 34 |
| 5.2.3.3 Channel coding for UCI channel quality information | 35 |
| 5.2.3.3.1 Channel quality information formats for wideband reports | 35 |
| 5.2.3.3.2 Channel quality information formats for UE-selected sub-band reports..... | 36 |
| 5.2.3.4 Channel coding for UCI channel quality information and HARQ-ACK..... | 37 |
| 5.2.4 Uplink control information on PUSCH without UL-SCH data..... | 38 |
| 5.2.4.1 Channel coding of control information..... | 38 |
| 5.2.4.2 Control information mapping | 39 |
| 5.2.4.3 Channel interleaver..... | 39 |

| | | |
|------------|--|----|
| 5.3 | Downlink transport channels and control information..... | 39 |
| 5.3.1 | Broadcast channel | 39 |
| 5.3.1.1 | Transport block CRC attachment | 40 |
| 5.3.1.2 | Channel coding | 40 |
| 5.3.1.3 | Rate matching..... | 41 |
| 5.3.2 | Downlink shared channel, Paging channel and Multicast channel..... | 41 |
| 5.3.2.1 | Transport block CRC attachment | 42 |
| 5.3.2.2 | Code block segmentation and code block CRC attachment | 42 |
| 5.3.2.3 | Channel coding..... | 42 |
| 5.3.2.4 | Rate matching..... | 42 |
| 5.3.2.5 | Code block concatenation..... | 42 |
| 5.3.3 | Downlink control information..... | 43 |
| 5.3.3.1 | DCI formats..... | 43 |
| 5.3.3.1.1 | Format 0..... | 43 |
| 5.3.3.1.2 | Format 1 | 44 |
| 5.3.3.1.3 | Format 1A..... | 45 |
| 5.3.3.1.3A | Format 1B..... | 47 |
| 5.3.3.1.4 | Format 1C..... | 48 |
| 5.3.3.1.4A | Format 1D..... | 48 |
| 5.3.3.1.5 | Format 2..... | 49 |
| 5.3.3.1.5A | Format 2A..... | 53 |
| 5.3.3.1.6 | Format 3..... | 55 |
| 5.3.3.1.7 | Format 3A..... | 55 |
| 5.3.3.2 | CRC attachment..... | 56 |
| 5.3.3.3 | Channel coding..... | 56 |
| 5.3.3.4 | Rate matching..... | 56 |
| 5.3.4 | Control format indicator..... | 56 |
| 5.3.4.1 | Channel coding..... | 57 |
| 5.3.5 | HARQ indicator | 57 |
| 5.3.5.1 | Channel coding..... | 57 |

| | | |
|-------------------------------|-----------------------------|-----------|
| Annex A (informative): | Change history | 59 |
|-------------------------------|-----------------------------|-----------|

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.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.