

**3<sup>rd</sup> Generation Partnership Project;  
Technical Specification Group Radio Access Network;  
Evolved Universal Terrestrial Radio Access (E-UTRA);  
Physical layer procedures  
(Release 8)**



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

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

Keywords

---

UMTS, radio, layer 1

**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.

© 2008, 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 .....	7
3.1 Symbols.....	7
3.2 Abbreviations .....	7
4 Synchronisation procedures.....	8
4.1 Cell search .....	8
4.2 Timing synchronisation.....	8
4.2.1 Radio link monitoring.....	8
4.2.2 Inter-cell synchronisation .....	8
4.2.3 Transmission timing adjustments .....	8
5 Power control.....	9
5.1 Uplink power control.....	9
5.1.1 Physical uplink shared channel.....	9
5.1.1.1 UE behaviour .....	9
5.1.1.2 Power headroom .....	12
5.1.2 Physical uplink control channel.....	12
5.1.2.1 UE behaviour .....	12
5.1.3 Sounding Reference Symbol .....	14
5.1.3.1 UE behaviour .....	14
5.2 Downlink power allocation .....	14
5.2.1 eNodeB Relative Narrowband TX Power restrictions.....	15
6 Random access procedure .....	16
6.1 Physical non-synchronized random access procedure .....	16
6.1.1 Timing.....	16
6.2 Random Access Response Grant .....	17
7 Physical downlink shared channel related procedures .....	18
7.1 UE procedure for receiving the physical downlink shared channel.....	18
7.1.1 Single-antenna port.....	21
7.1.2 Transmit diversity .....	21
7.1.3 Open-loop spatial multiplexing.....	21
7.1.4 Closed-loop spatial multiplexing .....	22
7.1.5 Multi-user MIMO.....	22
7.1.6 Resource allocation .....	22
7.1.6.1 Resource allocation type 0 .....	22
7.1.6.2 Resource allocation type 1 .....	23
7.1.6.3 Resource allocation type 2 .....	23
7.1.7 Modulation order and transport block size determination .....	25
7.1.7.1 Modulation order determination .....	25
7.1.7.2 Transport block size determination.....	26
7.1.7.2.1 Transport blocks not mapped to two-layer spatial multiplexing.....	26
7.1.7.2.2 Transport blocks mapped to two-layer spatial multiplexing.....	32
7.1.7.2.3 Transport blocks mapped for DCI Format 1C .....	33
7.2 UE procedure for reporting channel quality indication (CQI), precoding matrix indicator (PMI) and rank indication (RI) .....	33
7.2.1 Aperiodic CQI/PMI/RI Reporting using PUSCH.....	36
7.2.2 Periodic CQI/PMI/RI Reporting using PUCCH.....	40
7.2.3 Channel quality indicator (CQI) definition.....	46
7.2.4 Precoding Matrix Indicator (PMI) definition .....	48
7.3 UE procedure for reporting ACK/NACK .....	48

8	Physical uplink shared channel related procedures .....	51
8.1	Resource Allocation for PDCCH DCI Format 0 .....	53
8.2	UE sounding procedure .....	54
8.2.1	Sounding definition .....	56
8.3	UE ACK/NACK procedure .....	56
8.4	UE PUSCH Hopping procedure .....	57
8.4.1	Type 1 PUSCH Hopping .....	58
8.4.2	Type 2 PUSCH Hopping .....	58
8.5	UE Reference Symbol procedure .....	59
8.6	Modulation order, redundancy version and transport block size determination .....	59
8.6.1	Modulation order and redundancy version determination .....	59
8.6.2	Transport block size determination .....	60
8.6.3	Control information MCS offset determination .....	60
8.7	UE Transmit Antenna Selection .....	62
9	Physical downlink control channel procedures .....	63
9.1	UE procedure for determining physical downlink control channel assignment .....	63
9.1.1	PDCCH Assignment Procedure .....	63
9.1.2	PHICH Assignment Procedure .....	64
9.2	PDCCH validation for semi-persistent scheduling .....	65
10	Physical uplink control channel procedures .....	66
10.1	UE procedure for determining physical uplink control channel assignment .....	66
10.2	Uplink ACK/NACK timing .....	71
<b>Annex A (informative): Change history .....</b>		<b>72</b>

---

# Foreword

This Technical Specification (TS) has been produced by the 3<sup>rd</sup> 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 this 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.