

# ETSI TS 137 213 V17.6.0 (2023-07)



LTE;  
5G;

## Physical layer procedures for shared spectrum channel access (3GPP TS 37.213 version 17.6.0 Release 17)

[ETSI TS 137 213 V17.6.0 \(2023-07\)](https://standards.iteh.ai/catalog/standards/sist/eef36683-9481-4299-8b55-172724dd12fa/etsi-ts-137-213-v17-6-0-2023-07)

<https://standards.iteh.ai/catalog/standards/sist/eef36683-9481-4299-8b55-172724dd12fa/etsi-ts-137-213-v17-6-0-2023-07>



---

**Reference**RTS/TSGR-0137213vh60

---

**Keywords**5G,LTE

---

**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

---

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° w061004871

---

**Important notice**

---

The present document can be downloaded from:

<https://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at [www.etsi.org/deliver](http://www.etsi.org/deliver).

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://standards-portal.etsi.org/People/CommitteeSupportStaff.aspx> 4299-8b55-

If you find a security vulnerability in the present document, please report it through our

Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

---

**Notice of disclaimer & limitation of liability**

---

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

---

**Copyright Notification**

---

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2023.  
All rights reserved.

---

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

---

# Legal Notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under <https://webapp.etsi.org/key/queryform.asp>.

---

# Modal verbs terminology

In the present document **"shall"**, **"shall not"**, **"should"**, **"should not"**, **"may"**, **"need not"**, **"will"**, **"will not"**, **"can"** and **"cannot"** are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

**"must"** and **"must not"** are **NOT** allowed in ETSI deliverables except when used in direct citation.

# Contents

Intellectual Property Rights .....	2
Legal Notice .....	2
Modal verbs terminology.....	2
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 Channel access procedure .....	7
4.0 General .....	7
4.1 Downlink channel access procedures .....	8
4.1.1 Type 1 DL channel access procedures .....	8
4.1.1.1 Regional limitations on channel occupancy time .....	9
4.1.2 Type 2 DL channel access procedures .....	9
4.1.2.1 Type 2A DL channel access procedures .....	10
4.1.2.2 Type 2B DL channel access procedures.....	10
4.1.2.3 Type 2C DL channel access procedures.....	10
4.1.3 DL channel access procedures in a shared channel occupancy.....	10
4.1.4 Contention window adjustment procedures .....	11
4.1.4.1 Contention window adjustment procedures for transmissions by eNB .....	11
4.1.4.2 Contention window adjustment procedures for DL transmissions by gNB .....	12
4.1.4.3 Common procedures for CWS adjustments for DL transmissions.....	13
4.1.5 Energy detection threshold adaptation procedures .....	13
4.1.6 Channel access procedures for transmission(s) on multiple channels .....	14
4.1.6.1 Type A multi-channel access procedures .....	14
4.1.6.1.1 Type A1 multi-channel access procedures .....	14
4.1.6.1.2 Type A2 multi-channel access procedures .....	14
4.1.6.2 Type B multi-channel access procedure.....	14
4.1.6.2.1 Type B1 multi-channel access procedure .....	15
4.1.6.2.2 Type B2 multi-channel access procedure .....	15
4.2 Uplink channel access procedures.....	15
4.2.1 Channel access procedures for uplink transmission(s) .....	16
4.2.1.0 Channel access procedures and UL related signaling .....	17
4.2.1.0.0 Channel access procedures upon detection of a common DCI.....	17
4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) .....	18
4.2.1.0.2 Conditions for maintaining Type 1 UL channel access procedures.....	19
4.2.1.0.3 Conditions for indicating Type 2 channel access procedures .....	20
4.2.1.0.4 Channel access procedures for UL multi-channel transmission(s).....	20
4.2.1.1 Type 1 UL channel access procedure.....	21
4.2.1.2 Type 2 UL channel access procedure.....	22
4.2.1.2.1 Type 2A UL channel access procedure .....	22
4.2.1.2.2 Type 2B UL channel access procedure.....	22
4.2.1.2.3 Type 2C UL channel access procedure.....	22
4.2.2 Contention window adjustment procedures .....	22
4.2.2.1 Contention window adjustment procedures for UL transmissions scheduled/configured by eNB .....	22
4.2.2.2 Contention window adjustment procedures for UL transmissions scheduled/configured by gNB .....	24
4.2.2.3 Common procedures for CWS adjustments for UL transmissions.....	25
4.2.3 Energy detection threshold adaptation procedure .....	25
4.2.3.1 Default maximum energy detection threshold computation procedure.....	25
4.3 Channel access procedures for semi-static channel occupancy .....	26
4.3.1 Channel access procedures to initiate a channel occupancy .....	26
4.3.1.1 Channel occupancy initiated only by gNB .....	27

4.3.1.2	Channel occupancy initiated by gNB or UE .....	27
4.3.1.2.1	Channel occupancy initiated by gNB and sensing procedures .....	27
4.3.1.2.2	Channel occupancy initiated by UE and sensing procedures .....	28
4.3.1.2.3	Association with initiated channel occupancy for configured UL transmissions .....	28
4.3.1.2.4	Association with initiated channel occupancy for scheduled UL transmissions .....	30
4.3.1.2.4.1	Intra-period scheduled UL transmissions.....	30
4.3.1.2.4.2	Cross-period scheduled UL transmissions .....	30
4.3.2	Channel access related procedures for UL transmissions .....	31
4.3.3	Channel access procedures for transmission(s) on multiple channels .....	32
4.4	Channel access procedures for frequency range 2-2 .....	32
4.4.1	Type 1 channel access procedures .....	34
4.4.2	Type 2 channel access procedures .....	35
4.4.3	Type 3 channel access procedures .....	35
4.4.4	Channel access procedures in an initiated channel occupancy .....	35
4.4.5	Exempted transmissions from sensing.....	36
4.4.6	Channel access procedures for transmission(s) on multiple channels or beams .....	36
4.4.7	Energy detection threshold adaptation procedures .....	36
<b>Annex X (informative):</b>	<b>Change history .....</b>	<b>37</b>
History .....		40

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ETSI TS 137 213 V17.6.0 (2023-07)

<https://standards.iteh.ai/catalog/standards/sist/eef36683-9481-4299-8b55-172724dd12fa/etsi-ts-137-213-v17-6-0-2023-07>

---

# 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.

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

ETSI TS 137 213 V17.6.0 (2023-07)

<https://standards.iteh.ai/catalog/standards/sist/eef36683-9481-4299-8b55-172724dd12fa/etsi-ts-137-213-v17-6-0-2023-07>

---

# 1 Scope

The present document specifies and establishes the characteristics of the physical layer procedures for shared spectrum channel.

---

## 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] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
  - [2] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".
  - [3] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".
  - [4] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".
  - [5] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".
  - [6] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".
  - [7] 3GPP TS 38.213: "NR; Physical layer procedures for control".
  - [8] 3GPP TS 38.214: "NR; Physical layer procedures for data".
  - [9] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".
  - [10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
  - [11] 3GPP TS 38.211: "NR; Physical channels and Modulations".
- 

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

### 3.2 Symbols

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

$CW_p$                       Contention window for a given priority class

$CW_{\max,p}$	Maximum contention window for a given priority class
$CW_{\min,p}$	Minimum contention window for a given priority class
$T_{\text{mcot},p}$	Maximum channel occupancy time for a given priority class
$T_{\text{ulmcot},p}$	Maximum Uplink channel occupancy time for a given priority class
$X_{\text{Thresh}}$	Energy detection threshold
$X_{\text{Thresh\_max}}$	Maximum energy detection threshold

### 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AUL-DFI	Autonomous UL Downlink feedback indication
CAPC	Channel access priority class
COT	Channel Occupancy Time
LAA	Licensed Assisted Access
MCOT	Maximum Channel Occupancy Time

## 4 Channel access procedure

### 4.0 General

Unless otherwise noted, the definitions below are applicable for the following terminologies used in this specification:

- A channel refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum.
- A channel access procedure is a procedure based on sensing that evaluates the availability of a channel for performing transmissions. The basic unit for sensing is a sensing slot with a duration  $T_{sl} = 9\mu\text{s}$ . The sensing slot duration  $T_{sl}$  is considered to be idle if an eNB/gNB or a UE senses the channel during the sensing slot duration, and determines that the detected power for at least  $4\mu\text{s}$  within the sensing slot duration is less than energy detection threshold  $X_{\text{Thresh}}$ . Otherwise, the sensing slot duration  $T_{sl}$  is considered to be busy.
- A *channel occupancy* refers to transmission(s) on channel(s) by eNB/gNB/UE(s) after performing the corresponding channel access procedures in this clause.
- A *Channel Occupancy Time* refers to the total time for which eNB/gNB/UE and any eNB/gNB/UE(s) sharing the channel occupancy perform transmission(s) on a channel after an eNB/gNB/UE performs the corresponding channel access procedures described in this clause. For determining a *Channel Occupancy Time*, if a transmission gap is less than or equal to  $25\mu\text{s}$ , the gap duration is counted in the channel occupancy time. A channel occupancy time can be shared for transmission between an eNB/gNB and the corresponding UE(s).
- A *DL transmission burst* is defined as a set of transmissions from an eNB/gNB without any gaps greater than  $16\mu\text{s}$ . Transmissions from an eNB/gNB separated by a gap of more than  $16\mu\text{s}$  are considered as separate DL transmission bursts. An eNB/gNB can transmit transmission(s) after a gap within a *DL transmission burst* without sensing the corresponding channel(s) for availability.
- A *UL transmission burst* is defined as a set of transmissions from a UE without any gaps greater than  $16\mu\text{s}$ . Transmissions from a UE separated by a gap of more than  $16\mu\text{s}$  are considered as separate UL transmission bursts. A UE can transmit transmission(s) after a gap within a *UL transmission burst* without sensing the corresponding channel(s) for availability.
- A *discovery burst* refers to a DL transmission burst including a set of signal(s) and/or channel(s) confined within a window and associated with a duty cycle. The *discovery burst* can be any of the following:



- Transmission(s) initiated by an eNB that includes a primary synchronization signal (PSS), secondary synchronization signal (SSS) and cell-specific reference signal(s)(CRS) and may include non-zero power CSI reference signals (CSI-RS).
- Transmission(s) initiated by a gNB that includes at least an SS/PBCH block consisting of a primary synchronization signal (PSS), secondary synchronization signal (SSS), physical broadcast channel (PBCH) with associated demodulation reference signal (DM-RS) and may also include CORESET for PDCCH scheduling PDSCH with SIB1, and PDSCH carrying SIB1 and/or non-zero power CSI reference signals (CSI-RS).

## 4.1 Downlink channel access procedures

An eNB operating LAA SCell(s) on channel(s) and a gNB performing transmission(s) on channel(s) shall perform the channel access procedures described in this clause for accessing the channel(s) on which the transmission(s) are performed.

In this clause,  $X_{Thresh}$  for sensing is adjusted as described in clause 4.1.5 when applicable.

A gNB performs channel access procedures in this clause unless the higher layer parameter *channelAccessMode-r16* is provided and *channelAccessMode-r16* = 'semiStatic'.

### 4.1.1 Type 1 DL channel access procedures

This clause describes channel access procedures to be performed by an eNB/gNB where the time duration spanned by the sensing slots that are sensed to be idle before a downlink transmission(s) is random. The clause is applicable to the following transmissions:

- Transmission(s) initiated by an eNB including PDSCH/PDCCH/EPDCCH, or
- Any transmission(s) initiated by a gNB.

The eNB/gNB may transmit a transmission after first sensing the channel to be idle during the sensing slot durations of a defer duration  $T_d$  and after the counter  $N$  is zero in step 4. The counter  $N$  is adjusted by sensing the channel for additional sensing slot duration(s) according to the steps below:

- 1) set  $N = N_{init}$ , where  $N_{init}$  is a random number uniformly distributed between 0 and  $CW_p$ , and go to step 4;
- 2) if  $N > 0$  and the eNB/gNB chooses to decrement the counter, set  $N = N - 1$ ;
- 3) sense the channel for an additional sensing slot duration, and if the additional sensing slot duration is idle, go to step 4; else, go to step 5;
- 4) if  $N = 0$ , stop; else, go to step 2.
- 5) sense the channel until either a busy sensing slot is detected within an additional defer duration  $T_d$  or all the sensing slots of the additional defer duration  $T_d$  are detected to be idle;
- 6) if the channel is sensed to be idle during all the sensing slot durations of the additional defer duration  $T_d$ , go to step 4; else, go to step 5;

If an eNB/gNB has not transmitted a transmission after step 4 in the procedure above, the eNB/gNB may transmit a transmission on the channel, if the channel is sensed to be idle at least in a sensing slot duration  $T_{sl}$  when the eNB/gNB is ready to transmit and if the channel has been sensed to be idle during all the sensing slot durations of a defer duration  $T_d$  immediately before this transmission. If the channel has not been sensed to be idle in a sensing slot duration  $T_{sl}$  when the eNB/gNB first senses the channel after it is ready to transmit or if the channel has been sensed to be not idle during any of the sensing slot durations of a defer duration  $T_d$  immediately before this intended transmission, the eNB/gNB proceeds to step 1 after sensing the channel to be idle during the sensing slot durations of a defer duration  $T_d$ .

The defer duration  $T_d$  consists of duration  $T_f = 16\mu s$  immediately followed by  $m_p$  consecutive sensing slot durations  $T_{sl}$ , and  $T_f$  includes an idle sensing slot duration  $T_{sl}$  at start of  $T_f$ .

$CW_{min,p} \leq CW_p \leq CW_{max,p}$  is the contention window.  $CW_p$  adjustment is described in clause 4.1.4.

$CW_{min,p}$  and  $CW_{max,p}$  are chosen before step 1 of the procedure above.

$m_p$ ,  $CW_{min,p}$ , and  $CW_{max,p}$  are based on a channel access priority class  $p$  associated with the eNB/gNB transmission, as shown in Table 4.1.1-1.

An eNB/gNB shall not transmit on a channel for a *Channel Occupancy Time* that exceeds  $T_{m\ cot,p}$  where the channel access procedures are performed based on a channel access priority class  $p$  associated with the eNB/gNB transmissions, as given in Table 4.1.1-1.

If an eNB/gNB transmits discovery burst(s) as described in clause 4.1.2 when  $N > 0$  in the procedure above, the eNB/gNB shall not decrement  $N$  during the sensing slot duration(s) overlapping with discovery burst(s).

A gNB may use any channel access priority class for performing the procedures above to transmit transmission(s) including discovery burst(s) satisfying the conditions described in this clause.

A gNB shall use a channel access priority class applicable to the unicast user plane data multiplexed in PDSCH for performing the procedures above to transmit transmission(s) including unicast PDSCH with user plane data.

For  $p = 3$  and  $p = 4$ , if the absence of any other technology sharing the channel can be guaranteed on a long term basis (e.g. by level of regulation),  $T_{m\ cot,p} = 10\text{ms}$ , otherwise,  $T_{m\ cot,p} = 8\text{ms}$ .

**Table 4.1.1-1: Channel Access Priority Class (CAPC)**

Channel Access Priority Class ( $p$ )	$m_p$	$CW_{min,p}$	$CW_{max,p}$	$T_{m\ cot,p}$	allowed $CW_p$ sizes
1	1	3	7	2 ms	{3,7}
2	1	7	15	3 ms	{7,15}
3	3	15	63	8 or 10 ms	{15,31,63}
4	7	15	1023	8 or 10 ms	{15,31,63,127,255,511,1023}

ETSI TS 137 213 V17.6.0 (2023-07)

<https://standards.iteh.ai/catalog/standards/sist/eef36683-9481-4299-8b55-1727240121a/etsi-ts-137-213-v17-6-0-2023-07>

#### 4.1.1.1 Regional limitations on channel occupancy time

In Japan, if an eNB/gNB has transmitted a transmission after  $N = 0$  in step 4 of the procedure above, the eNB/gNB may transmit the next continuous transmission, for duration of maximum  $T_j = 4\text{ms}$ , immediately after sensing the channel to be idle for at least a sensing interval of  $T_{js} = 34\mu\text{s}$  and if the total sensing and transmission time is not more than  $1000 \cdot T_{m\ cot} + \left\lceil \frac{T_{m\ cot}}{T_j} - 1 \right\rceil \cdot T_{js} \mu\text{s}$ . The sensing interval  $T_{js}$  consists of duration  $T_f = 16\mu\text{s}$  immediately followed by two sensing slots and  $T_f$  includes an idle sensing slot at start of  $T_f$ . The channel is considered to be idle for  $T_{js}$  if it is sensed to be idle during the sensing slot durations of  $T_{js}$ .

#### 4.1.2 Type 2 DL channel access procedures

This clause describes channel access procedures to be performed by an eNB/gNB where the time duration spanned by sensing slots that are sensed to be idle before a downlink transmission(s) is deterministic.

If an eNB performs Type 2 DL channel access procedures, it follows the procedures described in clause 4.1.2.1.

Type 2A channel access procedures as described in clause 4.1.2.1 are only applicable to the following transmission(s) performed by an eNB/gNB:

- Transmission(s) initiated by an eNB including discovery burst and not including PDSCH where the transmission(s) duration is at most  $1\text{ms}$ , or
- Transmission(s) initiated by a gNB with only discovery burst or with discovery burst multiplexed with non-unicast information, where the transmission(s) duration is at most  $1\text{ms}$ , and the discovery burst duty cycle is at most  $1/20$ , or

- Transmission(s) by an eNB/ gNB following transmission(s) by a UE after a gap of  $25\mu\text{s}$  in a shared channel occupancy as described in clause 4.1.3.

Type 2B or Type 2C DL channel access procedures as described in clause 4.1.2.2 and 4.1.2.3, respectively, are applicable to the transmission(s) performed by a gNB following transmission(s) by a UE after a gap of  $16\mu\text{s}$  or up to  $16\mu\text{s}$ , respectively, in a shared channel occupancy as described in clause 4.1.3.

#### 4.1.2.1 Type 2A DL channel access procedures

An eNB/gNB may transmit a DL transmission immediately after sensing the channel to be idle for at least a sensing interval  $T_{\text{short\_dl}} = 25\mu\text{s}$ .  $T_{\text{short\_dl}}$  consists of a duration  $T_f = 16\mu\text{s}$  immediately followed by one sensing slot and  $T_f$  includes a sensing slot at start of  $T_f$ . The channel is considered to be idle for  $T_{\text{short\_dl}}$  if both sensing slots of  $T_{\text{short\_dl}}$  are sensed to be idle.

#### 4.1.2.2 Type 2B DL channel access procedures

A gNB may transmit a DL transmission immediately after sensing the channel to be idle within a duration of  $T_f = 16\mu\text{s}$ .  $T_f$  includes a sensing slot that occurs within the last  $9\mu\text{s}$  of  $T_f$ . The channel is considered to be idle within the duration  $T_f$  if the channel is sensed to be idle for a total of at least  $5\mu\text{s}$  with at least  $4\mu\text{s}$  of sensing occurring in the sensing slot.

#### 4.1.2.3 Type 2C DL channel access procedures

When a gNB follows the procedures in this clause for transmission of a DL transmission, the gNB does not sense the channel before transmission of the DL transmission. The duration of the corresponding DL transmission is at most  $584\mu\text{s}$ .

### 4.1.3 DL channel access procedures in a shared channel occupancy

For the case where an eNB shares a channel occupancy initiated by a UE, the eNB may transmit a transmission that follows an autonomous PUSCH transmission by the UE as follows:

- If 'COT sharing indication' in AUL-UCI in subframe  $n$  indicates '1', an eNB may transmit a transmission in subframe  $n + X$ , where  $X$  is subframeOffsetCOT-Sharing, including PDCCH but not including PDSCH on the same channel immediately after performing Type 2A DL channel access procedures in clause 4.1.2.1, if the duration of the PDCCH is less than or equal to duration of two OFDM symbols and it shall contain at least AUL-DFI or UL grant to the UE from which the PUSCH transmission indicating COT sharing was received.

If a gNB shares a channel occupancy initiated by a UE using the channel access procedures described in clause 4.2.1.1 on a channel, the gNB may transmit a transmission that follows a UL transmission on scheduled resources or a PUSCH transmission on configured resources by the UE after a gap as follows:

- The transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.
- If the higher layer parameters *ul-toDL-COT-SharingED-Threshold-r16* is not provided, the transmission shall not include any unicast transmissions with user plane data and the transmission duration is not more than the duration of 2, 4 and 8 symbols for subcarrier spacing of 15, 30 and 60 kHz of the corresponding channel, respectively.
- If the gap is up to  $16\mu\text{s}$ , the gNB can transmit the transmission on the channel after performing Type 2C DL channel access as described in clause 4.1.2.3.
- If the gap is  $25\mu\text{s}$  or  $16\mu\text{s}$ , the gNB can transmit the transmission on the channel after performing Type 2A or Type 2B DL channel access procedures as described in clause 4.1.2.1 and 4.1.2.2, respectively.

For the case where a gNB shares a channel occupancy initiated by a UE with configured grant PUSCH transmission, the gNB may transmit a transmission that follows the configured grant PUSCH transmission by the UE as follows:

- If the higher layer parameter *ul-toDL-COT-SharingED-Threshold-r16* is provided, the UE is configured by *cg-COT-SharingList-r16* where *cg-COT-SharingList-r16* provides a table configured by higher layer. Each row of the table provides a channel occupancy sharing information given by higher layer parameter *CG-COT-Sharing-r16*. One row of the table is configured for indicating that the channel occupancy sharing is not available.
- If the 'COT sharing information' in CG-UCI detected in slot  $n$  indicates a row index that corresponds to a *CG-COT-Sharing-r16* that provides channel occupancy sharing information, the gNB can share the UE channel occupancy assuming a channel access priority class  $p = \text{channelAccessPriority-r16}$ , starting from slot  $n+O$ , where  $O = \text{offset-r16}$  slots, for a duration of  $D = \text{duration-r16}$  slots where *duration-r16*, *offset-r16*, and *channelAccessPriority-r16* are higher layer parameters provided by *CG-COT-Sharing-r16*.
- If the higher layer parameter *ul-toDL-COT-SharingED-Threshold-r16* is not provided, and if 'COT sharing information' in CG-UCI indicates '1', the gNB can share the UE channel occupancy and start the DL transmission  $X = \text{cg-COT-SharingOffset-r16} * 14$  symbols from the end of the slot where CG-UCI is detected, where *cg-COT-SharingOffset-r16* is provided by higher layer. The transmission shall not include any unicast transmissions with user plane data and the transmission duration is not more than the duration of 2, 4 and 8 symbols for subcarrier spacing of 15, 30 and 60 kHz of the corresponding channel, respectively.

For the case where a gNB uses channel access procedures as described in clause 4.1.1 to initiate a transmission and shares the corresponding channel occupancy with a UE that transmits a transmission as described in clause 4.2.1.2, the gNB may transmit a transmission within its channel occupancy that follows the UE's transmission if any gap between any two transmissions in the gNB channel occupancy is at most  $25\mu\text{s}$ . In this case the following applies:

- If the gap is  $25\mu\text{s}$  or  $16\mu\text{s}$ , the gNB can transmit the transmission on the channel after performing Type 2A or 2B DL channel access procedures as described in clause 4.1.2.1 and 4.1.2.2, respectively.
- If the gap is up to  $16\mu\text{s}$ , the gNB can transmit the transmission on the channel after performing Type 2C DL channel access as described in clause 4.1.2.3.

#### 4.1.4 Contention window adjustment procedures

If an eNB/gNB transmits transmissions including PDSCH that are associated with channel access priority class  $p$  on a channel, the eNB/gNB maintains the contention window value  $CW_p$  and adjusts  $CW_p$  before step 1 of the procedure described in clause 4.1.1 for those transmissions as described in this clause.

##### 4.1.4.1 Contention window adjustment procedures for transmissions by eNB

If an eNB transmits transmissions including PDSCH that are associated with channel access priority class  $p$  on a channel, the eNB maintains the contention window value  $CW_p$  and adjusts  $CW_p$  before step 1 of the procedure described in clause 4.1.1 for those transmissions using the following steps:

- 1) for every priority class  $p \in \{1,2,3,4\}$  set  $CW_p = CW_{\min,p}$
- 2) if at least  $Z = 80\%$  of HARQ-ACK values corresponding to PDSCH transmission(s) in reference subframe  $k$  are determined as NACK, increase  $CW_p$  for every priority class  $p \in \{1,2,3,4\}$  to the next higher allowed value and remain in step 2; otherwise, go to step 1.

Reference subframe  $k$  is the starting subframe of the most recent transmission on the channel made by the eNB, for which at least some HARQ-ACK feedback is expected to be available.

The eNB shall adjust the value of  $CW_p$  for every priority class  $p \in \{1,2,3,4\}$  based on a given reference subframe  $k$  only once.

For determining  $Z$ ,

- if the eNB transmission(s) for which HARQ-ACK feedback is available start in the second slot of subframe  $k$ , HARQ-ACK values corresponding to PDSCH transmission(s) in subframe  $k + 1$  are also used in addition to the HARQ-ACK values corresponding to PDSCH transmission(s) in subframe  $k$ .
- if the HARQ-ACK values correspond to PDSCH transmission(s) on an LAA SCell that are assigned by (E)PDCCH transmitted on the same LAA SCell,

- if no HARQ-ACK feedback is detected for a PDSCH transmission by the eNB, or if the eNB detects 'DTX', 'NACK/DTX' or 'any' state, it is counted as NACK.
- if the HARQ-ACK values correspond to PDSCH transmission(s) on an LAA SCell that are assigned by (E)PDCCH transmitted on another serving cell,
  - if the HARQ-ACK feedback for a PDSCH transmission is detected by the eNB, 'NACK/DTX' or 'any' state is counted as NACK, and 'DTX' state is ignored.
  - if no HARQ-ACK feedback is detected for a PDSCH transmission by the eNB
    - if PUCCH format 1b with channel selection is expected to be used by the UE, 'NACK/DTX' state corresponding to 'no transmission' as described in Clauses 10.1.2.2.1, 10.1.3.1 and 10.1.3.2.1 is counted as NACK, and 'DTX' state corresponding to 'no transmission' is ignored in [4].
    - Otherwise, the HARQ-ACK for the PDSCH transmission is ignored.
- if a PDSCH transmission has two codewords, the HARQ-ACK value of each codeword is considered separately
- bundled HARQ-ACK across M subframes is considered as M HARQ-ACK responses.

If the eNB transmits transmissions including PDCCH/EPDCCH with DCI format 0A/0B/4A/4B and not including PDSCH that are associated with channel access priority class  $p$  on a channel starting from time  $t_0$ , the eNB maintains the contention window value  $CW_p$  and adjusts  $CW_p$  before step 1 of the procedure described in clause 4.1.1 for those transmissions using the following steps:

- 1) for every priority class  $p \in \{1,2,3,4\}$  set  $CW_p = CW_{min,p}$
- 2) if less than 10% of the UL transport blocks scheduled by the eNB using Type 2 channel access procedure (described in clause 4.2.1.2) in the time interval between  $t_0$  and  $t_0 + T_{CO}$  have been received successfully, increase  $CW_p$  for every priority class  $p \in \{1,2,3,4\}$  to the next higher allowed value and remain in step 2; otherwise, go to step 1.

$T_{CO}$  is computed as described in clause 4.2.1.0.3.

#### 4.1.4.2 Contention window adjustment procedures for DL transmissions by gNB

If a gNB transmits transmissions including PDSCH that are associated with channel access priority class  $p$  on a channel, the gNB maintains the contention window value  $CW_p$  and adjusts  $CW_p$  before step 1 of the procedure described in clause 4.1.1 for those transmissions using the following steps:

- 1) For every priority class  $p \in \{1,2,3,4\}$ , set  $CW_p = CW_{min,p}$ .
- 2) If HARQ-ACK feedback is available after the last update of  $CW_p$ , go to step 3. Otherwise, if the gNB transmission after procedure described in clause 4.1.1 does not include a retransmission or would be transmitted within a duration  $T_w$  from the end of the *reference duration* corresponding to the earliest DL channel occupancy after the last update of  $CW_p$ , go to step 5; otherwise go to step 4.
- 3) The HARQ-ACK feedback(s) corresponding to PDSCH(s) in the reference duration for the latest DL channel occupancy for which HARQ-ACK feedback is available is used as follows:
  - a. If at least one HARQ-ACK feedback is 'ACK' for PDSCH(s) with transport block based feedback or at least 10% of HARQ-ACK feedbacks is 'ACK' for PDSCH CBGs transmitted at least partially on the channel with code block group based feedback, go to step 1; otherwise go to step 4.
- 4) Increase  $CW_p$  for every priority class  $p \in \{1,2,3,4\}$  to the next higher allowed value.
- 5) For every priority class  $p \in \{1,2,3,4\}$ , maintain  $CW_p$  as it is; go to step 2.

The *reference duration* and duration  $T_w$  in the procedure above are defined as follows:

- The *reference duration* corresponding to a channel occupancy initiated by the gNB including transmission of PDSCH(s) is defined in this clause as a duration starting from the beginning of the channel occupancy until the end of the first slot where at least one unicast PDSCH is transmitted over all the resources allocated for the