ETSI TS 137 213 V15.3.0 (2020-04)

TECHNICAL SPECIFICATION

LTE;
5G;
Physical layer procedures for shared spectrum channel access
(3GPP TS 37.213 version 15.3.0 Release 15)

A GLOBAL INITIATIVE

Reference
RTS/TSGR-0137213vf30

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 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://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.

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://portal.etsi.org/People/CommiteeSupportStaff.aspx

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is 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 IPR Policy, no investigation, 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.

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 http://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

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.

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".

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
$T_{m\cot,p}$	Maximum channel occupancy time for a given priority class
$T_{ulm\cot,p}$	Maximum Uplink channel occupancy time for a given priority class
X_{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
COT	Channel Occupancy Time
LAA	Licensed Assisted Access
MCOT	Maximum Channel Occupancy Time

4 Channel access procedure

4.1 Downlink channel access procedures

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

4.1.1 Channel access procedure for transmission(s) including PDSCH/PDCCH/EPDCCH

The eNB may transmit a transmission including PDSCH/PDCCH/EPDCCH on a carrier on which LAA Scell(s) transmission(s) are performed , after first sensing the channel to be idle during the 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 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 chooses to decrement the counter, set $N = N - 1$;

3) sense the channel for an additional slot duration, and if the additional 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 slot is detected within an additional defer duration T_d or all the 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 slot durations of the additional defer duration T_d , go to step 4; else, go to step 5;

If an eNB has not transmitted a transmission including PDSCH/PDCCH/EPDCCH on a carrier on which LAA Scell(s) transmission(s) are performed after step 4 in the procedure above, the eNB may transmit a transmission including PDSCH/PDCCH/EPDCCH on the carrier, if the channel is sensed to be idle at least in a slot duration T_{sl} when the eNB is ready to transmit PDSCH/PDCCH/EPDCCH and if the channel has been sensed to be idle during all the slot durations of a defer duration T_d immediately before this transmission. If the channel has not been sensed to be idle in a slot duration T_{sl} when the eNB 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 slot durations of a defer duration T_d immediately before this intended transmission, the eNB proceeds to step 1 after sensing the channel to be idle during the slot durations of a defer duration T_d .

The defer duration T_d consists of duration $T_f = 16us$ immediately followed by m_p consecutive slot durations where each slot duration is $T_{sl} = 9us$, and T_f includes an idle slot duration T_{sl} at start of T_f ;

A slot duration T_{sl} is considered to be idle if the eNB senses the channel during the slot duration, and the power detected by the eNB for at least $4us$ within the slot duration is less than energy detection threshold X_{Thresh}. Otherwise, the slot duration T_{sl} is considered to be busy.

$CW_{\min,p} \le CW_p \le CW_{\max,p}$ 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 channel access priority class associated with the eNB transmission, as shown in Table 4.1.1-1.

X_{Thresh} adjustment is described in clause 4.1. 5

If the eNB transmits discovery signal transmission(s) not including PDSCH/PDCCH/EPDCCH when $N > 0$ in the procedure above, the eNB shall not decrement N during the slot duration(s) overlapping with discovery signal transmission.

The eNB shall not continuously transmit on a carrier on which the LAA Scell(s) transmission(s) are performed, for a period exceeding $T_{m\cot,p}$ as given in Table 4.1.1-1.

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

Table 4.1.1-1: Channel Access Priority Class

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}

For LAA operation in Japan, if the eNB has transmitted a transmission after $N = 0$ in step 4 of the procedure above, the eNB may transmit the next continuous transmission, for duration of maximum T_j =4 ms, immediately after sensing the channel to be idle for at least a sensing interval of T_{js} =34us and if the total sensing and transmission time is not more than $1000 \cdot T_{mcot} + \lceil T_{mcot} / T_j - 1 \rceil \cdot T_{js}$ μsec. T_{js} consists of duration $T_f = 16us$ immediately followed by two slot durations $T_{sl} = 9us$ each and T_f includes an idle slot duration T_{sl} at start of T_f. The channel is considered to be idle for T_{js} if it is sensed to be idle during the during the slot durations of T_{js}.

4.1.2 Channel access procedure for transmissions including discovery signal transmission(s) and not including PDSCH

An eNB may transmit a transmission including discovery signal but not including PDSCH on a carrier on which LAA Scell(s) transmission(s) are performed immediately after sensing the channel to be idle for at least a sensing interval $T_{\text{drs}} = 25us$ and if the duration of the transmission is less than 1 ms. T_{drs} consists of a duration $T_f = 16us$ immediately followed by one slot duration $T_{sl} = 9us$ and T_f includes an idle slot duration T_{sl} at start of T_f. The channel is considered to be idle for T_{drs} if it is sensed to be idle during the slot durations of T_{drs}.

4.1.3 Channel access procedure for transmissions including PDCCH and not including PDSCH

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 carrier immediately after sensing the channel to be idle for at least a sensing interval $T_{\text{pdcch}} = 25us$, if the duration of the PDCCH is less than or equal to two OFDM symbols length and it shall contain at least AUL-DFI or UL grant to the UE from which the PUSCH transmission indicating COT sharing was received. T_{pdcch} consists of a duration $T_f = 16us$ immediately followed by one slot duration $T_{sl} = 9us$ and T_f includes an idle slot duration T_{sl} at start of T_f. The channel is considered to be idle for T_{pdcch} if it is sensed to be idle during the slot durations of T_{pdcch}.

4.1.4 Contention window adjustment procedure

If the eNB transmits transmissions including PDSCH that are associated with channel access priority class p on a carrier, 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 carrier 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.

If $CW_p = CW_{\max,p}$, the next higher allowed value for adjusting CW_p is $CW_{\max,p}$.

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.

where T_{CO} is computed as described in clause 4.2.1.

If the $CW_p = CW_{\max,p}$ is consecutively used K times for generation of N_{init}, CW_p is reset to $CW_{\min,p}$ only for that priority class p for which $CW_p = CW_{\max,p}$ is consecutively used K times for generation of N_{init}. K is selected by eNB from the set of values {1, 2, …,8} for each priority class $p \in \{1,2,3,4\}$.

4.1.5 Energy detection threshold adaptation procedure

An eNB accessing a carrier on which LAA Scell(s) transmission(s) are performed, shall set the energy detection threshold (X_{Thresh}) to be less than or equal to the maximum energy detection threshold $X_{\text{Thresh\_max}}$.

$X_{\text{Thresh\_max}}$ is determined as follows:

- If the absence of any other technology sharing the carrier can be guaranteed on a long term basis (e.g. by level of regulation) then:
  - $X_{\text{Thresh\_max}} = \min \begin{Bmatrix} T_{\max} + 10\,dB, \\ X_r \end{Bmatrix}$
    - X_r is Maximum energy detection threshold defined by regulatory requirements in dBm when such requirements are defined, otherwise $X_r = T_{\max} + 10\,dB$
- Otherwise,