**3GPP TSG RAN WG1 Meeting #105-e R1-210xxxx**

**e-Meeting, May 10th – 27th, 2021**

**Agenda item: 7.2.2**

**Source: Moderator (Nokia)**

**Title: FL summary for channel access signals procedures for NR-U**

**Document for: Discussion and Decision**

# Introduction

This paper summarizes the CR proposals for channel access procedures for NR-U.

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| Issue # | Area of proposal | Contributions |
| CA-1 | China-specific aspects related to CCA time and gaps | [1], [2] |

# Summary of issues

## Issue CA-1: China-specific aspects related to CCA time and gaps

In [1] and [2], it is proposed modify the CCA time and the requirement for gap duration with no-LBT for both dynamic and semi-static channel access. The changes relate to three parts of 37.213:

* Type 1 Channel Access for both DL and UL
* Multi-channel Access Procedure for both DL and UL
* Semi-static channel access

**Type 1 Channel Access (37.213, Section 4.1.1 and 4.2.1.1;**

[**R1-2104271**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2104271.zip)

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| ==============================End of TP#3 for TS 37.213 v16.5.0====================  4.1.1 Type 1 DL channel access procedures  <Unchanged parts are omitted>  The eNB/gNB may transmit a transmission after first sensing the channel to be idle during the sensing slot durations of a defer duration and after the counter is zero in step 4. The counter is adjusted by sensing the channel for additional sensing slot duration(s) according to the steps below:  1) set , where is a random number uniformly distributed between 0 and , and go to step 4;  2) if and the eNB/gNB chooses to decrement the counter, set ;  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 , stop; else, go to step 2.  5) sense the channel until either a busy sensing slot is detected within an additional defer duration or all the sensing slots of the additional defer duration 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 , 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 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 immediately before this transmission. If the channel has not been sensed to be idle in a sensing slot duration 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 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 .  The defer duration consists of duration immediately followed by consecutive sensing slot durations , and includes an idle sensing slot duration at start of . The duration unless longer sensing duration is required (e.g. by level of regulation), in which case .  <Unchanged parts are omitted>  4.2.1.1 Type 1 UL channel access procedure  <Unchanged parts are omitted>  A UE may transmit the transmission using Type 1 channel access procedure after first sensing the channel to be idle during the slot durations of a defer duration , and after the counter is zero in step 4. The counter is adjusted by sensing the channel for additional slot duration(s) according to the steps described below.  1) set , where is a random number uniformly distributed between 0 and , and go to step 4;  2) if and the UE chooses to decrement the counter, set ;  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 , stop; else, go to step 2.  5) sense the channel until either a busy slot is detected within an additional defer duration or all the slots of the additional defer duration are detected to be idle;  6) if the channel is sensed to be idle during all the slot durations of the additional defer duration , go to step 4; else, go to step 5;  If a UE has not transmitted a UL transmission on a channel on which UL transmission(s) are performed after step 4 in the procedure above, the UE may transmit a transmission on the channel, if the channel is sensed to be idle at least in a sensing slot duration when the UE is ready to transmit the transmission and if the channel has been sensed to be idle during all the slot durations of a defer duration immediately before the transmission. If the channel has not been sensed to be idle in a sensing slot duration when the UE first senses the channel after it is ready to transmit, or if the channel has not been sensed to be idle during any of the sensing slot durations of a defer duration immediately before the intended transmission, the UE proceeds to step 1 after sensing the channel to be idle during the slot durations of a defer duration .  The defer duration consists of duration immediately followed by consecutive slot durations where each slot duration is , and includes an idle slot duration at start of . The duration unless longer sensing duration is required (e.g. by level of regulation), in which case .  <Unchanged parts are omitted>  ==============================End of TP#3 for TS 37.213 v16.5.0=================== |

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| ============= Start of TP#1 for TS 37.213 v16.5.0 [2] ============ 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  - Transmission(s) initiated by a gNB including unicast PDSCH with user plane data, or unicast PDSCH with user plane data and unicast PDCCH scheduling user plane data, 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 larger than or the transmission causes the discovery burst duty cycle to exceed .  The eNB/gNB may transmit a transmission after first sensing the channel to be idle during the sensing slot durations of a defer duration and after the counter is zero in step 4. The counter is adjusted by sensing the channel for additional sensing slot duration(s) according to the steps below:  1) set , where is a random number uniformly distributed between 0 and , and go to step 4;  2) if and the eNB/gNB chooses to decrement the counter, set ;  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 , stop; else, go to step 2.  5) sense the channel until either a busy sensing slot is detected within an additional defer duration or all the sensing slots of the additional defer duration 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 , go to step 4; else, go to step 5;  ============= Unchanged parts are omitted ===============  The defer duration consists of duration immediately followed by consecutive sensing slot durations , and includes an idle sensing slot duration at start of . In China, the duration Tf = 18us.  ============= Unchanged parts are omitted =============== 4.2.1.1 Type 1 UL channel access procedure This clause describes channel access procedures by a UE where the time duration spanned by the sensing slots that are sensed to be idle before a UL transmission(s) is random. The clause is applicable to the following transmissions:  - PUSCH/SRS transmission(s) scheduled or configured by eNB/gNB, or  - PUCCH transmission(s) scheduled or configured by gNB, or  - Transmission(s) related to random access procedure.  A UE may transmit the transmission using Type 1 channel access procedure after first sensing the channel to be idle during the slot durations of a defer duration , and after the counter is zero in step 4. The counter is adjusted by sensing the channel for additional slot duration(s) according to the steps described below.  1) set , where is a random number uniformly distributed between 0 and , and go to step 4;  2) if and the UE chooses to decrement the counter, set ;  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 , stop; else, go to step 2.  5) sense the channel until either a busy slot is detected within an additional defer duration or all the slots of the additional defer duration are detected to be idle;  6) if the channel is sensed to be idle during all the slot durations of the additional defer duration , go to step 4; else, go to step 5;  ============= Unchanged parts are omitted ===============  The defer duration consists of duration immediately followed by consecutive slot durations where each slot duration is , and includes an idle sensing slot duration at start of . In China, the duration Tf = 18us.  ============= Unchanged parts are omitted =============== |

**Multi-channel Access Procedure (37.213, Section 4.1.6.2 and 4.2.1.0.4);**

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| ==============================Start of TP#4 for TS 37.213 v16.5.0===================  4.1.6.2 Type B multi-channel access procedure  A channel is selected by the eNB/gNB as follows:  - the eNB/gNB selects by uniformly randomly choosing from before each transmission on multiple channels , or  - the eNB/gNB selects no more frequently than once every 1 second,  where is a set of channels on which the eNB/gNB intends to transmit, , and is the number of channels on which the eNB intends to transmit.  To transmit on channel  - the eNB/gNB shall perform channel access on channel according to the procedures described in clause 4.1.1 with the modifications described in clause 4.1.6.2.1 or 4.1.6.2.2.  To transmit on channel ,  - for each channel , the eNB/gNB shall sense the channel for at least a sensing interval immediately before the transmitting on channel , and the eNB/gNB may transmit on carrier immediately after sensing the channel to be idle for at least the sensing interval . The channel is considered to be idle for if the channel is sensed to be idle during all the time durations in which such idle sensing is performed on the channel in given interval . The sensing interval unless longer sensing interval is required (e.g. by level of regulation), in which case .  The eNB/gNB shall not transmit a transmission on a channel , , for a period exceeding as given in Table 4.1.1-1, where the value of is determined using the channel access parameters used for channel .  For the procedures in this clause, the channel frequencies of the set of channels selected by gNB, is a subset of one of the sets of channel frequencies defined in [6].  <Unchanged parts are omitted>  4.2.1.0.4 Channel access procedures for UL multi-channel transmission(s)  If a UE  - is scheduled to transmit on a set of channels , and if Type 1 channel access procedure is indicated by the UL scheduling grants for the UL transmissions on the set of channels , and if the UL transmissions are scheduled to start transmissions at the same time on all channels in the set of channels , or  - intends to perform an uplink transmission on configured resources on the set of channels with Type 1 channel access procedure, and if UL transmissions are configured to start transmissions on the same time all channels in the set of channels , and  if the channel frequencies of set of channels is a subset of one of the sets of channel frequencies defined in clause 5.7.4 in [2]  - the UE may transmit on channel immediately after sensing the channel to be idle for at least a sensing interval ,  - if the sensing is performed on channel immediately before the UE transmission on channel , , and  - if the UE has accessed channel using Type 1 channel access procedure as described in clause 4.2.1.1,  - where channel is selected by the UE uniformly randomly from the set of channels before performing Type 1 channel access procedure on any channel in the set of channels , and  - where the channel is considered to be idle for if the channel is sensed to be idle during all the time durations in which such idle sensing is performed on the channel in given interval ; the sensing interval unless longer sensing interval is required (e.g. by level of regulation), in which case ,  - if a UE is configured without intra-cell guard band(s) on a UL bandwidthpart as described in clause 7 in [8], the UE may not transmit on a channel within the bandwidth of the carrier, if the UE fails to access any of the channels of the UL bandwidthpart.  - otherwise, the UE may not transmit on channel within the bandwidth of a carrier, if the UE fails to access any of the channels, of the carrier bandwidth, on which the UE is scheduled or configured by UL resources.  <Unchanged parts are omitted>  ==============================End of TP#4 for TS 37.213 v16.5.0=================== |
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| 4.1.6.2 Type B multi-channel access procedure A channel is selected by the eNB/gNB as follows:  - the eNB/gNB selects by uniformly randomly choosing from before each transmission on multiple channels , or  - the eNB/gNB selects no more frequently than once every 1 second,  where is a set of channels on which the eNB/gNB intends to transmit, , and is the number of channels on which the eNB intends to transmit.  To transmit on channel  - the eNB/gNB shall perform channel access on channel according to the procedures described in clause 4.1.1 with the modifications described in clause 4.1.6.2.1 or 4.1.6.2.2.  To transmit on channel ,  - for each channel , the eNB/gNB shall sense the channel for at least a sensing interval immediately before the transmitting on channel , and the eNB/gNB may transmit on carrier immediately after sensing the channel to be idle for at least the sensing interval . The channel is considered to be idle for if the channel is sensed to be idle during all the time durations in which such idle sensing is performed on the channel in given interval . In China, at least a sensing interval Tmc=27us.  ============= Unchanged parts are omitted =============== 4.2.1.0.4 Channel access procedures for UL multi-channel transmission(s) ============= Unchanged parts are omitted ===============  if the channel frequencies of set of channels is a subset of one of the sets of channel frequencies defined in clause 5.7.4 in [2]  - the UE may transmit on channel using Type 2 channel access procedure as described in clause 4.2.1.2.  - if Type 2 channel access procedure is performed on channel immediately before the UE transmission on channel , , and  - if the UE has accessed channel using Type 1 channel access procedure as described in clause 4.2.1.1,  - where channel is selected by the UE uniformly randomly from the set of channels before performing Type 1 channel access procedure on any channel in the set of channels .  - if a UE is configured without intra-cell guard band(s) on a UL bandwidthpart as described in clause 7 in [8], the UE may not transmit on a channel within the bandwidth of the carrier, if the UE fails to access any of the channels of the UL bandwidthpart.  - otherwise, the UE may not transmit on channel within the bandwidth of a carrier, if the UE fails to access any of the channels, of the carrier bandwidth, on which the UE is scheduled or configured by UL resources.  In China, the sensing interval Tmc used in Type 2 channel access procedure is replaced from 25us to 27us.  ============= End of TP#1 for TS 37.213 ============ |

**Semi-Static Channel Access (Section 4.3 of 37.213)**

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| ===========Start of TP#1 for TS 37.213 v16.5.0===========  4.3 Channel access procedures for semi-static channel occupancy  Channel assess procedures based on semi-static channel occupancy as described in this Clause, are intended for environments where the absence of other technologies is guaranteed e.g., by level of regulations, private premises policies, etc. If a gNB provides UE(s) with higher layer parameters *ChannelAccessMode-r16 ='semistatic'* by SIB1 or dedicated configuration, a periodic channel occupancy can be initiated by the gNB every within every two consecutive radio frames, starting from the even indexed radio frame at with a maximum channel occupancy time , where *period* in , is a higher layer parameter provided in *SemiStaticChannelAccessConfig* and *.* For determining a *Channel Occupancy Time* based on semi-static channel access procedures, duration of any transmission gap within is counted in the channel occupancy time.  In the following procedures in this clause, when a gNB or UE performs sensing for evaluating a channel availability, the sensing is performed at least during a sensing slot duration . The corresponding adjustment for performing sensing by a gNB or a UE is described in clauses 4.1.5 and 4.2.3, respectively.  A channel occupancy initiated by a gNB and shared with UE(s) satisfies thefollowing:  - The gNB shall transmit a DL transmission burst starting at the beginning of the channel occupancy time immediately after sensing the channel to be idle for at least a sensing slot duration . If the channel is sensed to be busy, the gNB shall not perform any transmission during the current period.  - The gNB may transmit a DL transmission burst(s) within the channel occupancy time immediately after sensing the channel to be idle for at least a sensing slot duration if the gap between the DL transmission burst(s) and any previous transmission burst is more than .  - The gNB may transmit DL transmission burst(s) after UL transmission burst(s) within the channel occupancy time without sensing the channel if the gap between the DL and UL transmission bursts is at most  - A UE may transmit UL transmission burst(s) after detection of a DL transmission burst(s) within the channel occupancy time as follows:  - If the gap between the UL and DL transmission bursts is at most , the UE may transmit UL transmission burst(s) after a DL transmission burst(s) within the channel occupancy time without sensing the channel.  - If the gap between the UL and DL transmission bursts is more than , the UE may transmit UL transmission burst(s) after a DL transmission burst(s) within the channel occupancy time after sensing the channel to be idle for at least a sensing slot duration within a interval ending immediately before transmission.  - A UE may be indicated by the gNB to transmit UL transmission burst(s) within the channel occupancy time without sensing the channel or after sensing the channel to be idle for at least a sensing slot duration within a interval ending immediately before transmission.  - The gNB and UEs shall not transmit any transmissions in a set of consecutive symbols for a duration of at least before the start of the next period.  The sensing slot duration unless longer sensing duration is required (e.g. by level of regulation), in which case .  If a UE fails to access the channel(s) prior to an intended UL transmission to a gNB, Layer 1 notifies higher layers about the channel access failure.  ===========End of TP#1 for TS 37.213 v16.5.0=========== |

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| =====================Start of TP#2 for TS 38.212 v16.5.0===================  <Unchanged parts are omitted>  **Table 7.3.1.1.1-4A: Channel access type & CP extension if *ChannelAccessMode-r16* = "*semistatic*" is provided**   |  |  |  | | --- | --- | --- | | **Bit field mapped to index** | **Channel Access Type** | **The CP extension T\_"ext" index defined in Clause 5.3.1 of [4, TS 38.211]** | | 0 | No sensing as defined in Clause 4.3 in TS 37.213 | 0 | | 1 | No sensing as defined in Clause 4.3 in TS 37.213 | 2 | | 2 | Sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | | 3 | - | - |   <Unchanged parts are omitted>  =====================End of TP#2 for TS 38.212 v16.5.0=================== |

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| ============= Start of TP #2 for TS 37.213 v16.5.0 [2] ============ 4.3 Channel access procedures for semi-static channel occupancy ============= Unchanged parts are omitted ===============  In the following procedures in this clause, when a gNB or UE performs sensing for evaluating a channel availability, the sensing is performed at least during a sensing slot duration . The corresponding adjustment for performing sensing by a gNB or a UE is described in clauses 4.1.5 and 4.2.3, respectively.  A channel occupancy initiated by a gNB and shared with UE(s) satisfies thefollowing:  - The gNB shall transmit a DL transmission burst starting at the beginning of the channel occupancy time immediately after sensing the channel to be idle for at least a sensing slot duration . If the channel is sensed to be busy, the gNB shall not perform any transmission during the current period.  - The gNB may transmit a DL transmission burst(s) within the channel occupancy time immediately after sensing the channel to be idle for at least a sensing slot duration if the gap between the DL transmission burst(s) and any previous transmission burst is more than except in China, the gap between the DL transmission burst(s) and previous DL transmission burst is more than 18us.  - The gNB may transmit DL transmission burst(s) after UL transmission burst(s) within the channel occupancy time without sensing the channel if the gap between the DL and UL transmission bursts is at most except in China, the gNB may transmit DL transmission burst(s) within the channel occupancy time without sensing the channel if the gap between the DL transmission burst(s) and previous transmission burst is at most 18us.  - A UE may transmit UL transmission burst(s) after detection of a DL transmission burst(s) within the channel occupancy time as follows:  - If the gap between the UL and DL transmission bursts is at most , the UE may transmit UL transmission burst(s) after a DL transmission burst(s) within the channel occupancy time without sensing the channel. However, in China, if the gap between the UL transmission bursts is at most 18us, the UE may transmit UL transmission burst after an earlier UL transmission burst within the channel occupancy time without sensing the channel.  - If the gap between the UL and DL transmission bursts is more than , the UE may transmit UL transmission burst(s) after a DL transmission burst(s) within the channel occupancy time after sensing the channel to be idle for at least a sensing slot duration within a interval ending immediately before transmission. However, in China, if the gap between the UL transmission bursts is more than 18us, the UE may transmit UL transmission burst after an earlier UL transmission burst within the channel occupancy time after sensing the channel to be idle for at least a sensing slot duration within a interval ending immediately before transmission.  - A UE may be indicated by the gNB to transmit UL transmission burst(s) within the channel occupancy time without sensing the channel or after sensing the channel to be idle for at least a sensing slot duration within a interval ending immediately before transmission.  - The gNB and UEs shall not transmit any transmissions in a set of consecutive symbols for a duration of at least before the start of the next period.  If a UE fails to access the channel(s) prior to an intended UL transmission to a gNB, Layer 1 notifies higher layers about the channel access failure.  ============= End of TP#2 for TS 37.213 ============ |

# References

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| 1 | [**R1-2104271**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2104271.zip) | Maintenance on channel access and HARQ procedures for NR Unlicensed | Huawei, HiSilicon |
| 2 | [**R1-2104832**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2104832.zip) | Maintenance of channel access for NR-U | ZTE, Sanechips |