**3GPP TSG RAN WG1 Meeting #104bis-e R1-** **2103791**

**April 12th – April 20th, 2021**

**Agenda item: 8.2.6**

**Source: Moderator (Qualcomm Incorporated)**

**Title: Email discussion summary for channel access mechanism for 52.6GHz-71GHz band, ver01**

**Document for: Discussion and Decision**

# Introduction

This paper summarizes the channel access related proposals submitted to agenda item 8.2.6.

# Summary of contributions

The section summarises key proposals and observations from submitted contributions. Discussion points arising from each group of topics are captured separately in subsections.

## ED Threshold computation FFS Items

Agreement:

The baseline ED threshold can be computed as

Where Pout is RF output power (EIRP) and Pmax is the RF output power limit, Pout≤Pmax.

* FFS: Further adjustment on ED threshold based on the sensing beam and the transmission beam (further adjustment should not violate EDT requirements as per regulations)
* FFS: If Pout is max output EIRP of the device or instantaneous output EIRP
* FFS definition of Operating Channel BW
* FFS: Whether ED threshold for NR-U and NR-U coexistence scenarios (eg, at regulation level) can be appropriately relaxed compared with the threshold of coexistence between NR-U and Wi-Fi.
* FFS: EDT when the COT has time varying transmission beams and varying EIRP

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | ***Proposal 3: Reuse the definition in EN 302 567, Pout is the mean EIRP during a transmission burst.*** |
| AT&T |  |
| CAICT |  |
| CATT | **Proposal 3: Adjustment value should be considered for the baseline ED threshold.**  **Proposal 4: For adjustment value on baseline EDT, at least beamforming gain difference between the transmission beam and sensing beam should be considered.** |
| Charter Comm. | Proposal 1a) In the EDT definition, Pout is defined as the instantaneous output EIRP.  Proposal 1b) The EDT operating channel BW is determined based on the LBT bandwidth.  Proposal 1c) Support relaxation of ED threshold for NR-U and NR-U coexistence scenarios (e.g, at regulation level). |
| Convida Wireless |  |
| Ericsson | Proposal 1 Pout corresponds to the maximum of the mean output power EIRPs of the transmissions or transmission bursts in a COT that may contain varying transmission beams and EIRPs.  Proposal 2ED threshold is defined as in the agreement from RAN1#104e. Further adjustment on ED threshold based on the transmission and sensing beamforming gains could be up to implementation while not violating EDT requirements as per regulations.  Proposal 3Pmax should be fixed at 40 dBm in the EDT equation for products in this band as stipulated by the regulations. |
| Fujitsu |  |
| FUTUREWEI | Proposal 1: The EDT value used for a COT initiation should correspond to a Pout that is the maximum RF output power (EIRP) used for the transmissions during that COT. |
| Huawei HiSilicon | Proposal 1: For operation in NR-U-60, the term ‘Operating Channel Bandwidth’ in the agreed baseline EDT formula is defined as the ‘LBT Bandwidth’ or the ‘bandwidth on which a channel access procedure is performed in shared spectrum’.  Proposal 2: For operation in NR-U-60, clarify the definition of Pout in the agreed baseline EDT formula as the mean or maximum output power (EIRP) of the potential transmission burst following the CCA check by the device.  Proposal 3: For operation in NR-U-60, the agreed baseline EDT formula should be adjusted such that, for a given RF output power (EIRP), the EDT proportionally increases with the effective beamforming gain of the potential following transmission(s) by the device.  ***Proposal 4: For operation in NR-U-60, when LBT is used, adopt the following formula to capture the potential adjustment to the baseline EDT formula based on the transmit beamforming gain:***   * + ***GTX is the effective transmit antenna gain at the potential transmitter [dBi]***   + ***GTX,max is the maximum effective transmit antenna gain considered for the deployment [dBi]***   + ***a is a scaling factor such that 0≤ a≤ 1*** |
| Intel Corporation | Proposal 4: Within the formulation to calculate the ED threshold, Pout is defined as the maximum output EIRP for the specific channel that a device intends to acquire.  Proposal 5: When operating in unlicensed 60 GHz band, the ED threshold calculation shall account for the sensing beam used to perform the LBT procedure.  Proposal 6: In case the network is able to assess the absence of any other incumbent technology, the ED threshold value that a device may use during the LBT procedure is up to the gNB and may be configured via higher layer signaling. |
| InterDigital Inc. | Proposal 10: Adapt EDT to account for beamforming gain of the sensing beam.  Proposal 11: The Operating Channel BW used in the EDT formula is equivalent to the LBT BW. |
| ITRI |  |
| Lenovo Motorola Mobility |  |
| LG Electronics | Proposal #13: The ED threshold provided by the ETSI 302 567 can be enhanced considering the following points:l  The size of LBT bandwidthl  Transmit power of beam(s) in the COTl  The beam correspondence capability/requirement of UE. |
| MediaTek Inc. |  |
| NEC | Proposal 1: The energy detection threshold adaptation for beam based channel access procedure should take into account the antenna gain and mapping between transmission beam(s) and sensing beam(s). |
| Nokia Nokia Shanghai Bell | Proposal 6: Further adjustment of EDT based on the sensing and transmission beams is not specified.  Proposal 7: Pout in EDT determination is the mean EIRP of following transmission burst.  Proposal 8: The operating channel bandwidth in EDT determination equals to the LBT bandwidth |
| NTT DOCOMO INC. | Proposal 1:   For detailed aspects for EDT determination,   On whether to consider the transmission beam, it depends on whether Pout can consider the directivity gain or not.   On whether to consider the sensing beam, it depends on the variety of beams to be supported/used for the sensing beam.   On the definition of “Operating Channel BW”, it implies “the bandwidth used for the associated LBT”.   Leaving it as it is, or clarifying it as “the bandwidth used for the associated LBT” should be considered   Scenario-dependent EDT determination is not necessary in Rel-17 NR 52.6 - 71 GHz   EDT when the COT has time varying transmission beams should be discussed after defining LBT mechanism for initiating the COT with TDMed multiple transmissions. |
| OPPO | **Proposal 4: the EDT value should be adjusted: smaller value is applied when sensing beam is narrower.**  **Proposal 5: the definition of the operating channel BW is equal to the LBT bandwidth.** |
| Panasonic |  |
| Qualcomm |  |
| Samsung | **Proposal 5: ED threshold should depend on:**   * **Whether other technology sharing the channel is absent or not on a long-term basis;** * **LBT bandwidth (which is operation channel bandwidth in regulation);** * **Beam parameters including beamforming gain and/or beam direction for transmission and/or receiving.** |
| Sony |  |
| Spreadtrum Comm. | ***Proposal 5: The formula of ED threshold should consider the LBT bandwidth and beamforming gain.*** |
| vivo | **Proposal 1: The ED threshold for CCA check should take into account the impact of beamforming gain of the directional LBT beams.**  **Proposal 2: The maximum instantaneous output EIRP of the beams involved in a COT is used to calculate the EDT.**  **Proposal 3: The LBT bandwidth should be used as the operating channel bandwidth for EDT evaluation.** |
| WILUS Inc. |  |
| Xiaomi |  |
| ZTE Sanechips | Proposal 13: Considering mismatch between LBT sensing beam and transmission beam, the ED threshold provided by the ETSI BRAN 302 567 can be modified to consider mismatching between LBT sensing beam and transmission beam.  Proposal 14: For NR-U and NR-U coexistence scenarios, its ED threshold can be considered to be appropriately relaxed compared with the threshold of coexistence between NR-U and Wi-Fi.  Proposal 15: Study and evaluate the impact of LBT and the limitation of COT length on the procedure of beam failure detection. |

### First round discussion

The baseline ED threshold can be computed as

Where Pout is RF output power (EIRP) and Pmax is the RF output power limit, Pout≤Pmax.

Discussion point 2.1.1-1:

For definition of Pout in EDT, down-select one of following alternatives.

* Alt 1: Pout is the maximum EIRP during a COT.
  + Support: Apple, Ericsson, FUTUREWEI, Huawei, LGE, Nokia, vivo, Charter
* Alt 2: Pout is the maximum EIRP the node can transmit
  + Support: Intel(?)
* Alt 3: Pout is the mean EIRP during a COT
  + Support: Apple

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## LBT Bandwidth FFS Items

Agreement:

For LBT for single carrier transmission, consider the following alternatives

* Alt SC.1. gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)
* Alt SC.2. gNB/UE performs LBT over the transmission bandwidth (from the lowest RB to the highest RB used for the transmission)
* Alt SC.3. Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth

For LBT for multi-carrier transmission in intra-band CA, consider the following alternatives

* Alt CA.1. gNB/UE performs multiple LBT, one for each channel bandwidth separately
* Alt CA.2. gNB/UE performs single LBT over all CCs
* Alt CA.3. gNB/UE performs multiple LBT, one for each CC over the transmission bandwidth (from the lowest RB in to the highest RB used for the transmission in the CC)
* Alt CA.4. gNB/UE performs LBT over the transmission bandwidth over all CCs (from the lowest RB in the lowest CC to the highest RB in the highest CC used for the transmission)
* Alt CA.5. Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth in each CC

Note: supporting more than one alternative for at least multi-carrier transmission in intra-band CA is not precluded.

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | Proposal 5: LBT bandwidth is channel bandwidth for single carrier.  Proposal 6: For multi-carrier, gNB/UE perform multiple LBT, one for each channel bandwidth separately. |
| AT&T |  |
| CAICT | ***Proposal 1: For LBT for single carrier transmission, Alt SC.2 should be supported and the way to reduce the complexity of UE monitoring needs to be considered.***  ***Proposal 2: For LBT for multi-carrier transmission, Alt SC.3 should be supported.*** |
| CATT | **Proposal 5：For single carrier transmission, LBT bandwidth shall equal to the transmission bandwidth, which is from the lowest RB to the highest RB used for the transmission.**  **Proposal 6: Alt CA.3 (gNB/UE performs multiple LBT, one for each CC over the transmission bandwidth) should be supported for multi-carrier transmission in intra-band CA.** |
| Charter Comm. | Proposal 2: For single-channel LBT, Alt SC.3 may be a reasonable compromise wherein a certain minimum unit of LBT bandwidth is pre-defined, for e.g., 400 MHz. |
| Convida Wireless | Proposal 10: The LBT indication and channel occupation time should be studied when the channel BW for NR-U from 52.6 GHz to 71 GHz is smaller than WiFi 802.11 ad/ay channel BW. |
|  | Proposal 4 Support Alt SC1/Alt CA1 or Alt SC2/Alt CA3 for LBT in single carrier and multi-carrier operation |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon | ***Proposal 8: For a single-carrier transmission in NR-U-60, support performing a single LBT over the channel/BWP bandwidth, i.e. Alt SC.1 in the agreement made in the previous meeting RAN1#104-e.***  ***Proposal 9: For a multi-carrier transmission in intra-band CA in NR-U-60, support both performing a single LBT over all CCs, and performing multiple LBTs, one for each channel bandwidth separately, i.e., Alt CA.2 and Alt CA.1, respectively, in the agreement made in the previous meeting RAN1#104-e.*** |
| Intel Corporation | Proposal 7: In single carrier transmission, a gNB/UE performs LBT over the channel bandwidth.  Proposal 8: For carrier aggregation, a gNB/UE performs multiple LBTs and one over each channel bandwidth. |
| InterDigital Inc. | Proposal 12: For single-carrier transmission, support Alt SC.3.  Proposal 13: For multi-carrier transmission, support Alt CA.1.  Proposal 14: Support a set of LBT BWs and LBT is performed in each CC on one or more adjacent LBT BWs that covers at least the transmission BW. |
| ITRI |  |
| Lenovo Motorola Mobility | Proposal 2: For NR unlicensed bands between 52.6 GHz and 71 GHz, for LBT based channel access mechanism, there is no need to specify the nominal bandwidth in 3GPP and it is up to devices’ implementation on how to meet the OCB requirements.  Proposal 3: For NR unlicensed bands between 52.6 GHz and 71 GHz, for LBT based channel access mechanism:  -          For single carrier transmission defining a unit of LBT bandwidth where gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth  -          For multi-carrier transmission in intra-band CA, support defining a unit of LBT bandwidth where gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth in each CC  -          Defined LBT bandwidth value is fixed for both cases |
| LG Electronics | Proposal #4: Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth. |
| MediaTek Inc. |  |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Proposal 11:*** *For single carrier transmission, both Alt SC.1 and Alt SC.3 can be considered for LBT on 60GHz unlicensed band due to different characteristic and usage scenario of the alternatives. However, before making final decisions, the details of channelization (numerology) should be agreed first.*  ***Proposal 12:*** *For multi-carrier transmission in intra-band CA, both Alt CA.1 and Alt CA.5 can be considered for LBT on 60GHz unlicensed band.* |
| NTT DOCOMO INC. |  |
| OPPO | **Proposal 1: Take NRU R16 framework as a baseline for LBT bandwidth definition, i.e.**   * **For LBT performed by UE, the LBT bandwidth is equal to the active UL BWP, unless the network configures smaller bandwidth granularity as LBT bandwidth.** * **For LBT performed by gNB, the LBT bandwidth is equal to usable channel bandwidth, unless the network configures smaller bandwidth granularity as LBT bandwidth.** |
| Panasonic |  |
| Qualcomm | Proposal 1: For single carrier LBT, support both Alt SC.1 and Alt SC.3 as implementation choices, as long as the aggregated LBT bandwidth covers the transmission bandwidth. FFS how to indicate the aggregated LBT bandwidth from the COT initiating node to the COT sharing node.  Proposal 2: For multi-carrier transmission in intra-band CA, support Alt-CA.1, Alt-CA-2, and Alt CA.5 as implementation choices, as long as the aggregated LBT bandwidth covers the transmission bandwidth.  Proposal 3: Consider specifying the maximum number of LBT-Bandwidth units a UE can sense as a UE capability. |
| Samsung | **Proposal 2: Support Alt SC.1, CA.1, and CA.2 as the first preference, and SC.3 and CA.5 as the second preference.** |
| Sony |  |
| Spreadtrum Comm. | ***Proposal 1: Regarding LBT bandwidth, at least Alt SC.1 and Alt CA.1 should be supported.***   * ***For single carrier transmission, at least gNB/UE should perform LBT over the channel bandwidth (or BWP bandwidth)*** * ***For multi-carrier transmission, at least gNB/UE should perform multiple LBT, one for each channel bandwidth separately*** |
| vivo | Proposal 4: For single carrier transmission, gNB performs multi-channel LBT in all the LBT units to be transmitted in, and the UE performs wideband LBT over the active BWP or over all the LBT units to be transmitted in.  Proposal 5: Down-select the LBT schemes for multi-carrier transmission in intra-band CA after the LBT scheme for single carrier is determined. |
| WILUS Inc. |  Proposal 1: We support  o Alt SC.3 for LBT on single carrier transmission.  o At least Alt CA.1 or Alt CA.5 for LBT on multi-carrier transmission in intra-band CA. |
| Xiaomi | ***Proposal 1: Support Alt SC.3*** ***for LBT for single carrier transmission, and Alt CA.5 for multi-carrier transmission in intra-band CA***. |
| ZTE Sanechips | Proposal 1: Alt SC.3 that “Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth” and Alt CA.5 that “Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth in each CC”should be considered to be supported, considering channel access probability and spectrum utilization and friendly and fair coexistence between the same systems or different systems.  Proposal 2: If Alt SC.3 and Alt CA.5 are supported, it is not necessary to separately define LBT bandwidth for single carrier and multi-carrier cases, just a LBT bandwidth unit needs to be defined.  Proposal 3: In order to avoid ambiguity about the understanding of nominal bandwidth and resolve the problem of unclear the conclusion for the OCB requirement, it is necessary to introduce a clear the definition of nominal bandwidth.  Proposal 4: The nominal bandwidth can be defined as follows:  • Nominal bandwidths for the purpose of OCB requirements at the UE are the channel BWs for transmission supported by the UE from the set of channel BWs (carrier BWs) to be defined in 38.101.  • Nominal bandwidths for the purpose of OCB requirements at the gNB are the channel BWs for transmission supported by the gNB from the set of channel BWs (carrier BWs) to be defined in 38.104. |

### First round discussion

From the papers submitted, we collected the support for different alternatives as follows:

For LBT for single carrier transmission:

* Alt SC.1. gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)
  + Support: vivo, Spreadtrum, Samsung, Qualcomm, OPPO, Nokia, Intel, Huawei, Ericssson, Apple
* Alt SC.2. gNB/UE performs LBT over the transmission bandwidth (from the lowest RB to the highest RB used for the transmission)
  + Support: Ericssson, CATT, CAICT
* Alt SC.3. Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth
  + Support: ZTE, Xiaomi, WILUS. Qualcomm, OPPO, Nokia, LGE, Lenovo, InterDigital, Charter

For LBT for multi-carrier transmission in intra-band CA,

* Alt CA.1. gNB/UE performs multiple LBT, one for each channel bandwidth separately
  + Support: WILUS, Spreadtrum, Samsung, Qualcomm, Nokia, InterDigital, Intel, Huawei, Ericssson, Apple
* Alt CA.2. gNB/UE performs single LBT over all CCs
  + Support: Samsung, Qualcomm, Huawei
* Alt CA.3. gNB/UE performs multiple LBT, one for each CC over the transmission bandwidth (from the lowest RB in to the highest RB used for the transmission in the CC)
  + Support: Ericsson, CATT , CAICT
* Alt CA.4. gNB/UE performs LBT over the transmission bandwidth over all CCs (from the lowest RB in the lowest CC to the highest RB in the highest CC used for the transmission)
  + Support:
* Alt CA.5. Define a unit of LBT bandwidth and gNB/UE performs LBT in all the LBT units (to be transmitted in) in the channel bandwidth in each CC
  + Support: ZTE, WILUS, Qualcomm, Nokia, Lenovo, InterDigital

Discussion point 2.2.1-1

Discuss the following approaches:

* Approach 1: Down-select the above alternatives
* Approach 2: Support multiple or all of the alternatives, but leave how to perform LBT to implementation, as long as the (combined) LBT bandwidth covers the transmission bandwidth

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## Sensing Structures FFS Items

Agreement:

For energy measurement in 8us deferral period, down-select from the following:

* Alt 1. Two energy measurements are required
* Alt 2. One measurement is required
* Alt 3. Extend the 8us to 10us and perform two measurements, one in each 5us segment

For energy measurement in 5us observation slot, perform single measurement

* FFS minimum duration of the measurement
* FFS location of the measurement

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | Proposal 9: Within 5us slot, 802.11ad sensing structure can be used as the starting point. Sensing time and accuracy requirement need further study.  Proposal 10: Only one sensing is required in 8us initial sensing period. Reuse the same 5us slot structure. |
| AT&T |  |
| CAICT | ***Proposal 3: One measurement for energy measurement in 8us deferral period is proposed.***  ***Proposal 4: the minimum duration of one measurement in 5us observation slot equals the length of one symbol length for 480kHz and the measurement is in the middle of 5us observation slot.*** |
| CATT | **Proposal 11: Considering LBT for multi-beam operation, deferral period should be extended to 10us for multi-bean operation.** |
| Charter Comm. |  |
| Convida Wireless |  |
| Ericsson | Proposal 17 For energy measurement in 8 µs deferral period, Alt2 is preferred.  Proposal 18 For energy measurement in 5 µs, the duration can be implementation dependent.  Proposal 19 For the location of the energy measurement in 5us, it can be implementation dependent. |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon | ***Proposal 6: For operation in NR-U-60, when LBT is used, the 5us observation slot contains a measurement duration X us starting after Y us from the slot start such that Y+X<4us, where X<3us and 0us<Y<1us.***  ***Proposal 7: For operation in NR-U-60, when LBT is used, support one energy measurement in the 8us deferral period, i.e., Alt 2 in the agreement made in RAN1#104-e.***   * ***Td consists of a Tf duration immediately followed by a 5us slot duration, and Tf=3us does not include any measurement duration.*** |
| Intel Corporation | **Proposal 1: Alt-1 is supported and the 8us observation period is divided into two slots of 3 and 5us, respectively.** |
| InterDigital Inc. |  |
| ITRI |  |
| Lenovo Motorola Mobility |  |
| LG Electronics |  |
| MediaTek Inc. |  |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Proposal 9:*** *We prefer Alt. 1, two energy measurements, for the deferral period.*  ***Proposal 10:*** *The location of the energy measurement within the 5 us observation slot is left for implementation.* |
| NTT DOCOMO INC. |  |
| OPPO | **Proposal 2: two energy measurements are required during a 8us deferral period.**  **Proposal 3: a minimum measurement duration of 2us at the start of a 5us sensing slot can be considered.** |
| Panasonic |  |
| Qualcomm | Proposal 15: Consider the use of two energy measurements for deferral period and \*one\* for contention slot.  Proposal 16: Consider deployment bandwidth dependence on the minimum sensing duration requirement. |
| Samsung |  |
| Sony |  |
| Spreadtrum Comm. | ***Proposal 6: Two energy measurements are required for 8us deferral period.***  ***Proposal 7: The duration of the measurement should be 3us for 5us observation slot.*** |
| vivo |  |
| WILUS Inc. |  |
| Xiaomi |  |
| ZTE Sanechips | Observation 8: For 8us deferral period, two energy measurements are performed in 3us observation slot and 5us observation slot, respectively.  Observation 9: Single energy measurement is performed in 5us observation slot.  "Observation 10:   The location of energy measurement can be anywhere in each observation slot.   The length of energy measurement can be further discussed." |

### First round discussion

Discussion point 2.3.1-1:

For energy measurement in 8us deferral period:

* Alt 1. Two energy measurements are required
  + Support: ZTE, Spreadtrum, Qualcomm, OPPO, Nokia, Intel
* Alt 2. One measurement is required
  + Support: Huawei, Ericsson, CAICT, Apple
* Alt 3. Extend the 8us to 10us and perform two measurements, one in each 5us segment
  + Support: CATT,

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## COT Sharing

Agreement:

On maximum gap within a COT to allow COT sharing without LBT, down-select from

* Alt 1. No maximum gap defined. A later transmission can share the COT without LBT with any gap within the maximum COT duration
* Alt 2. Define a maximum gap X, such that a later transmission can share the COT without LBT only if the later transmission starts within X from the end of the earlier transmission
  + FFS: Value for X
* Alt 3. Define a maximum gap Y, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, an one-shot LBT is needed to share the COT
  + FFS: Value for Y
  + FFS:  How to define the one-shot LBT
* FFS location of the measurement

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | Proposal 11: Regulation does not define max gap duration in COT sharing without LBT. Since any gap is counted into 5ms COT, no gap limitation needs to be specified. |
| AT&T |  |
| CAICT | ***Proposal 5: Alt.3 should be supported for COT sharing.*** |
| CATT |  |
| Charter Comm. | Proposal 3: For COT sharing, support Alt 1. No maximum gap defined. A later transmission can share the COT without LBT with any gap within the maximum COT duration. |
| Convida Wireless |  |
| Ericsson | Proposal 15 Support Alt 1 for gaps in COT sharing. |
| Fujitsu |  |
| FUTUREWEI | Proposal 7: Support Alt 3: Define a maximum gap Y, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, a one-shot LBT is needed to share the COT  • Where Y (for all SCS) may be the time duration of 3 symbols (@120 kHz SCS  • Where One-shot LBT duration (for all SCS): the time duration of 1 symbol @ 120kHz SCS |
| Huawei HiSilicon | ***Proposal 15: For COT sharing without LBT in NR-U-60, no maximum gap is defined and a later transmission from a responding device can share the COT without LBT irrespective to the gap duration within the MCOT.***   * ***Any gap duration should be counted in the COT duration***   ***Proposal 16: Support introducing CAT2 LBT for 60GHz unlicensed band operation (Alt 2 in the agreement made in RAN1#104-e).***   * ***Support only use cases related to COT initiation, i.e., starting transmission on a secondary channel in Type B multi-channel access, and energy measurement and reporting of Rx-assistance information by the receiver in Rx-assisted LBT.*** |
| Intel Corporation |  |
| InterDigital Inc. | ***Proposal 15****: When COT sharing, a UE determines what LBT to use based on the gap duration between the upcoming transmission and a previous transmission on the same beam.* |
| ITRI |  |
| Lenovo Motorola Mobility | Proposal 15: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, define a maximum gap Y, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, one-shot LBT is needed to share the COT  Proposal 16: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, COT sharing between the initiating device and responding device should be supported with at least Cat 2 LBT:  -          If the responding device is capable of beam correspondence and it is expected to use only any of the Rx beam(s) as Tx beam(s) for its transmission that have been used to receive at least one of the transmissions from the initiating device within the same COT  -          If the responding device determines at least one suitable beam on which it is allowed to transmit within the same COT, where the suitable beam can be determined as follows:  o    UE can be configured with a mapping table for determining suitable transmit beams for UL transmissions based on the receive beam(s) which the UE used to receive the prior DL transmissions in the same COT  Proposal 17: For NR unlicensed bands between 52.6 GHz and 71 GHz with directional LBT based channel access mechanism, multiple COT sharing indicators and their corresponding association to different beams can be signaled in a group common DCI and the association of COT sharing indicator to transmission is semi-statically signaled. |
| LG Electronics |  |
| MediaTek Inc. |  |
| NEC | Proposal 2: A maximum gap Y should be defined, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, an one-shot LBT is needed to share the COT. |
| Nokia Nokia Shanghai Bell | ***Proposal 22:*** *On maximum gap within a COT to allow COT sharing without LBT, we support either Alt. 1 or Alt. 2*  ***Proposal 23:*** *In case of Alt.2 for COT sharing without LBT, the maximum time gap X is at least longer that PDSCH processing time and PUSCH preparation time.* |
| NTT DOCOMO INC. |  |
| OPPO | **Proposal 8: Define a maximum gap Y, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, an one-shot LBT is needed to share the COT. The value of Y is 8us or 13us.** |
| Panasonic |  |
| Qualcomm | Proposal 9: Support Alt 1 (no maximum gap defined), but if Cat 2 LBT define, optionally allow the initiating device to trigger the responding device to use Cat 2 LBT to sense the channel before starting COT sharing transmissions. |
| Samsung |  |
| Sony |  |
| Spreadtrum Comm. | ***Proposal 8: Regarding COT sharing, no maximum gap is needed.*** |
| vivo | **Proposal 6: No maximum gap is defined for COT sharing. A later transmission can share the COT without LBT with any gap within the maximum COT duration.** |
| WILUS Inc. | ü  *Proposal 2: We support Alt-1 since it seems no need to define a maximum gap for COT sharing within the maximum COT duration from the ETSI regulation perspectives.* |
| Xiaomi | Proposal 7: Support Alt.3 on maximum gap within a COT to allow COT sharing without LBT. |
| ZTE Sanechips |  |

### First round discussion

On maximum gap within a COT to allow COT sharing without LBT

* Alt 1. No maximum gap defined. A later transmission can share the COT without LBT with any gap within the maximum COT duration
  + Support: Apple, Charter, Ericsson, Huawei, Nokia, Qualcomm, Spreadtrum, Vivo, WILUS,
* Alt 2. Define a maximum gap X, such that a later transmission can share the COT without LBT only if the later transmission starts within X from the end of the earlier transmission
  + Support: Nokia
* Alt 3. Define a maximum gap Y, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, an one-shot LBT is needed to share the COT
  + Support: CAICT, FUTUREWEI, InterDigital, Lenovo, NEC, OPPO, Xiaomi,

Discussion point: 2.4.1-1:

Further down-select between Alt1 and Alt3.

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## Cat 2 LBT

Agreement:

For Cat 2 LBT, down-select from the following alternatives

* Alt 1: Do not introduce Cat 2 LBT for 60GHz unlicensed band operation
* Alt 2: Introduce Cat 2 LBT for 60GHz unlicensed band operation

Agreement:

If Cat 2 LBT is introduced, the following use cases can be further studied:

* Resume transmission after a gap Y:  Cat 2 LBT may be used to resume transmission by the initiating device within the COT after a gap Y (FFS the value of Y)
* COT sharing: Cat 2 LBT may be used before transmission by a responding node sharing a COT
* Multi-Beam LBT:  Cat 2 LBT may be used before switching to a new transmission beam (not used in earlier part of the COT) in a COT with TDM beams, or resume a previously used transmission beam after a gap Z (FFS the value of Z)
* Rx-Assistance:  Cat 2 LBT may be used for sensing at the receiver as a responding device for Rx-Assistance measurements and associated signalling

Other use cases not precluded.

FFS if Cat 2 LBT is mandated for each use case or not.

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| **Company** | | **Key Proposals/Observations/Positions** |
| Apple | | Proposal 12: No CAT-2 LBT needs to be defined for COT sharing. |
| AT&T | |  |
| CAICT | | ***Proposal 6: Cat2 LBT should be supported.*** |
| CATT | |  |
| Charter Comm. | | Proposal 4: Do not introduce Cat 2 LBT for 60GHz unlicensed band operation. |
| Convida Wireless | |  |
| Ericsson | | Proposal 14 Do not support CAT2 LBT in 60 GHz unlicensed band. |
| Fujitsu | |  |
| FUTUREWEI | | Proposal 6: Support Alt 2: Introduce Cat 2 LBT for 60GHz unlicensed band operation. |
| Huawei HiSilicon | |  |
| Intel Corporation | | Proposal 11: Cat-2 LBT is introduced for 60 GHz unlicensed band operation. |
| InterDigital Inc. | |  |
| ITRI | |  |
| Lenovo Motorola Mobility | |  |
| LG Electronics | | Proposal #9: Type 2 (e.g., 2A/2B/2C) channel access procedure can be introduced for the use cases such as COT sharing, multi-beam LBT, and Rx-Assistance and the maximum gap Y between the transmissions within the COT can be defined for above 52.6 GHz. |
| MediaTek Inc. | | **Proposal 8: Whether to introduce cat 2 LBT or not can be determined by discussing its applicability in the potential use cases first.** |
| NEC | | Proposal 3: Cat 2 LBT for 60 GHz unlicensed band operation should be introduced. |
| Nokia Nokia Shanghai Bell | | ***Proposal 3****: Decide on Cat-2 LBT support separately for gNB and UE.*  ***Proposal 4****: Do not support Cat-2 LBT at the UE side.*  ***Proposal 5****: Do not support Cat-2 LBT at the gNB side unless required for SSB transmission.*  ***Proposal 15:*** *One-shot LBT within COT is not required before gNB beam switch between SSBs* |
| NTT DOCOMO INC. | Proposal 3: Cat 2 LBT, i.e., LBT with fixed sensing duration, should be introduced for 60 GHz unlicensed band operation, at least to support COT sharing.   Other use cases can be studied further | |
| OPPO | | **Proposal 9: introduce Cat-2 LBT with a sensing duration of 13us, which further consists of an 8us duration followed by a 5us sensing slot.** |
| Panasonic | |  |
| Qualcomm | | Proposal 7: If any Cat 2 LBT procedure before beam switch is considered, let it be optional/configured and not mandatory.  Proposal 8: Consider defining Cat 2 LBT as a sensing/measurement. Consider the use of such Cat 2 LBT sensing as an optional/configured and triggered component of LBT procedures in all the 4 use-cases above and for Multi-channel medium access. |
| Samsung | | **Proposal 3: Support the following types of channel access procedures for 60 GHz unlicensed band:**   * **Type 1 channel access procedure without CWS adaptation;** * **Type 2 channel access procedure with zero and positive fixed sensing duration.** |
| Sony | | **Proposal 4: Support fixed Contention Window. ·           gNB’s contention windows size is left to network implementation. ·           UE’s contention window size is configured by network.**  Proposal 5: Introduce Cat 2 LBT for 60 GHz unlicensed band operation |
| Spreadtrum Comm. | | ***Proposal 9: Cat 2 LBT should be supported for 60GHz unlicensed band operation.***  ***Proposal 10: Cat 2 LBT may be used in case of Multi-Beam LBT or Receiver-Assistance.*** |
| vivo | | **Proposal 7: The Cat 2 LBT can be used before switching to a new beam in a COT with TDM beams, before response with assistant information at the receiver, and in the Type B multi-channel access scheme.**  **Proposal 8: If Cat 2 LBT is introduced, both Type A and Type B multi-channel channel access can be supported.** |
| WILUS Inc. | | ü  Proposal 4: We support Alt-2 to introduce Cat 2 LBT for 60GHz unlicensed band operation. |
| Xiaomi | | Proposal 2: COT sharing/ resuming and receiver assisted LBT should be discussed and determined first, then we can decide whether or not to introduce Cat 2 LBT. |
| ZTE Sanechips | |  |

### First round discussion

Discussion point 2.5.1-1:

On the support of Cat 2 LBT”

* Alt 1: Do not introduce Cat 2 LBT for 60GHz unlicensed band operation
  + Support: Apple, Charter, Ericsson, Nokia,
* Alt 2: Introduce Cat 2 LBT for 60GHz unlicensed band operation
  + Support: FUTUREWEI, Intel, LGE, NEC, DOCOMO, OPPO, Qualcomm, Samsung, Sony, Spreadtrum, Vivo, WILUS,

Other: By Use case: MediaTek, Xiaomi

Seems more discussions are needed

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## Rx Assistance

Agreement:

For receiver to provide assistance, channel sensing and reporting need to be performed. The following set of tools can be considered for further discussion

* Alt 1. Legacy RSSI measurement and reporting with possible enhancements
* Alt 2. AP-CSI report with possible enhancements
* Alt 3. LBT at receiver
  + Alt 3.1 eCCA
  + Alt 3.2 Cat2 LBT

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | Proposal 14: Consider AP-CSI enhancement for inter-cell interference coordination. |
| AT&T | Proposal 3:  • Receiver assistance in Rel. 17 is limited to measurement enhancements  • Message based schemes similar to RTS/CTS signalling can be addressed in a later release targeting Class B scenarios  • Hand shaking is not supported  • Transmission should be allowed before the receiver assistance is received  • Receiver assistance can equally be useful, and should be allowed, for the no-LBT mode of transmissions  • Receiver assistance is a fast, low complexity feedback mechanism to convey to the transmitter the interference environment at the receiver |
| CAICT |  |
| CATT | **Proposal 12：The receiver assistance information can be designed base on the A-CSI feedback framework.** |
| Charter Comm. |  |
| Convida Wireless |  |
| Ericsson | |  | | --- | | Proposal 12 Support Alt 1 and 2. New receiver assistance mechanisms such as Alt 3 requires further studies and clarifications with all overheads and processing delays considered. | | Proposal 13 If any enhancements to better support receiver assisted channel access are to be specified at all, it should be based on CSI reporting enhancement as currently being discussed in the URLLC WI, with potential enhancements to the CSI report type and the CSI processing timeline. | |
| Fujitsu | **Proposal 3: To support that gNB determines whether to transmit a PDSCH based on UE’s assistance information, LBT at receiver (Alt 3) is preferred.** |
| FUTUREWEI | Proposal 8: For receiver assisted LBT, support NR CSI-IM based reporting for the clear channel assessment at the receiver.  Proposal 9: For receiver assisted LBT, the receiver shall report the resource map availability prior to the transmission. The RSSI measurement definition may be extended to assess the resource availability, where the resources, type of measurement (for instance Cat2 LBT) shall be provided by the transmitter. |
| Huawei HiSilicon | ***Observation 3：Receiver-only directional LBT saves the LBT overhead associated with the transmitter-side LBT of the receiver-assisted LBT mechanism and provides an efficient tradeoff as it aims at increasing the spatial reuse while mitigating the hidden node issue.***  ***Proposal 17：For operation in the 60 GHz band, receiver-side LBT should be supported (Alt 3 in the agreement made in the RAN1#104-e).***  ***Observation 5: When No-LBT is used in regions where LBT is not mandated by regulations, the hidden node issue would still persist.***  ***Observation 6: Compared to No-LBT, substantial coverage gains are achieved using Receiver-assisted LBT/Receiver-only LBT in the indoor scenario, especially at medium and high traffic load.***   * ***Even higher gains are realized when wider beams are used for directional transmissions***   ***Observation 7: For Receiver-assisted LBT/Receiver-only LBT, if a high EDT\_Rx threshold is used, the DL cell-edge performance degrades if only CTS/idle indication is fed back when interference level is lower than the EDT\_Rx threshold.*** |
| Intel Corporation | **Observation 2: Receiver-aided LBT is able to mitigate the issues introduced by directional LBT and offers a mean to better assess the correct level of interference at the receiver.** |
| InterDigital Inc. | |  | | --- | | ***Observation 4****: In a beam-based environment, LBT (omni-directional or directional) can fail to detect hidden nodes if the interference is only in the direction of the receiving node.* | | ***Proposal 4****: Receiver based LBT should be considered for both omni-directional and directional LBT.* | | ***Proposal 5****: Receiver based directional LBT is supported.* | | ***Proposal 6****: A single receiver based directional LBT process can be performed on a beam whose parameters are determined from the parameters of the Rx beam of one or more associated transmissions.* | | ***Proposal 7****: Enhance legacy RSSI measurements and AP-CSI reporting to enable beam-based receiver assisted channel sensing and reporting.* | | ***Proposal 8****: The UE receives configuration and indication of the channel access mechanism to use (omni-directional, directional, receiver based, no LBT) from the gNB..* | | ***Proposal 9****: The UE can select a channel access mechanism as a function of measurements (e.g. RSRP) or prior LBT performance.* | |
| ITRI |  |
| Lenovo Motorola Mobility | Observation 3: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, in order to adopt ATPC as potential channel access mechanism, receiver feedback such as long-term sensing would be needed  Observation 4: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, depending on the configuration, a collision on CG resources can cause systematic collisions between corresponding subsequent retransmissions causing transmission failure of affected packets.  Observation 5: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, when directional LBT is applied, then performing LBT only at the transmitted side may not guarantee an interference-free reception due to hidden nodes to the transmitter  Proposal 25: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, only class A receiver assistance should be supported where the assistance information is sent only to the transmitter.  Proposal 28: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, for receiver to provide assistance, channel sensing and reporting need to be performed and eCCA should be supported as follows:  -          Signaling mechanism similar to RTS/CTS should be considered for receiver assistance  o    Short transmission using control channels (such as with 1-bit) or reference signals for before the actual transmission could be supported |
| LG Electronics | Proposal #7: For receiver to provide assistance, adopt Alt 1 (i.e., legacy RSSI measurement and reporting with possible enhancements). |
| MediaTek Inc. | **Proposal 7:Among candidate mechanisms to obtain assistant information from receiver in receiver-assisted LBT, at least RSSI should not be considered.** |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Proposal 25****. Employ RSSI measurements and CSI reporting as a part of the receiver assistance.*  ***Proposal 26****. Wait for the URLLC discussion to conclude on aperiodic CSI on PUCCH feature.*  ***Proposal 27:*** *Any Rx assistance scheme should be configurable per UE, so that it could be used only with UEs frequently detecting high interference.*  ***Proposal 28:*** *For any new Rx assistance schemes, UE processing time similar to PDSCH processing time (N1) or CSI computation time (N2/Z1Z2) should be considered when providing Rx assistance.*  ***Proposal 29:*** *Rx assistance should not be limited to the beginning of COT only.* |
| NTT DOCOMO INC. | Proposal 4: For Rx assistance, support Alt 1 (Legacy RSSI measurement and reporting with possible enhancements) and/or Alt 2 (AP-CSI report with possible enhancements):   Alt 1 with enhancements to consider beam-related aspects should be a starting point at least for the support of long-term Rx-assistance   Alt 2 should also be considered if the need of short-term Rx-assistance is observed |
| OPPO | **Proposal 12: RTS-like signal can be carried in a PDCCH and CTS-like signal can be carried in a PUCCH.** |
| Panasonic |  |
| Qualcomm | Proposal 10: Any LBT based Rx-Assistance procedure should be made optional/configurable on a per UE link basis.  Proposal 11: Support enhanced RSSI reporting for Rx-Assistance, enhancements include at least L1-RSSI reporting.  Proposal 12: Study further LBT sensing at the receiver with a conditional response from the receiver for Rx-Assistance. Consider the use of CAT 2 LBT for LBT-sensing for Rx-Assistance |
| Samsung | **Proposal 8: Support dynamic RX-assistant channel access mechanism with handshake between transmitter and receiver, e.g. wherein the channel access request is based on DCI and channel access response is based on UCI in a downlink scenario.** |
| Sony | Proposal 9: Receiver assisted LBT should be supported in 60 GHz unlicensed operation. |
| Spreadtrum Comm. | ***Proposal 4: Regarding receiver assisted LBT, at least the method of Legacy RSSI measurement and reporting with possible enhancements (Alt 1) and the method of AP-CSI report with possible enhancements (Alt 2) should be supported for further study.***  ***Proposal 10: Cat 2 LBT may be used in case of Multi-Beam LBT or Receiver-Assistance*** |
| vivo | **Proposal 9: LBT at receiver is supported and Cat 2 LBT can be applied.**  **Proposal 10: The assistant information can include the channel state information at the receiver, such as the LBT results, AP-CSI report.**  **Proposal 11: The transmitter request triggering UE to send assistant information should be studied.**  **Proposal 12: Each transmitter request monitoring occasion corresponds to a receiver feedback transmission opportunity.** |
| WILUS Inc. |  |
| Xiaomi | |  | | --- | | ***Proposal 8: Conditions about whether to enable/disable receiver assisted LBT can be studied.*** | | ***Proposal 9: How to design a receiver assisted LBT with a simpler flow and little spec impact should be considered.*** | | ***Proposal 10:*** ***For receiver to provide assistance, the Rx side can report its detected interference level periodically to Tx. And Tx can determine whether to occupy the channel based on the interference level values previously received from Rx side.*** | |
| ZTE Sanechips | Proposal 12: For receiver assisted channel access and interference management,   If existing L1 and L3 measurement mechanism is supported to obtain assistance information, some enhancements may need to be considered for using the measurement results timely and effectively to guide the subsequent transmission.   If LBT is supported to obtain assistance information, assistance information can be considered to be obtained within COT in addition to the beginning of COT.   If Cat2 LBT is used for receiver, then Cat4 LBT should be used for transmitter to initiate a COT.t |

### First round discussion

Discussion point 2.6.1-1

On receiver assisted channel access:

* Alt 1. Legacy RSSI measurement and reporting with possible enhancements
  + Support: LGE, MediaTek, Nokia, DOCOMO, Spreadtrum,
* Alt 2. AP-CSI report with possible enhancements
  + Support: Apple, CATT, Ericsson, FUTUREWEI, Inter-digital, Nokia, DOCOMO
* Alt 3. LBT at receiver
  + Support: Fujitsu, Huawei, Vivo ZTE
  + Alt 3.1 eCCA
    - Support:
  + Alt 3.2 Cat2 LBT
    - Support: Vivo ZTE

Seems more discussions are needed:

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## Multi-Beam COT and SSB

Agreement:

For a COT with MU-MIMO (SDM) transmission, further consider the follow alternatives (down-select or support both)

* Alt 1: Single LBT sensing at the start of the COT with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold
* Alt 2: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT

Agreement:

Within a COT with TDM of beams with beam switching, down-select one or more of the following LBT operations

* Alt 1: Single LBT sensing with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold
  + FFS: Details on the definition of "cover"
* Alt 2: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT
* Alt 3: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT with additional requirement on Cat 2 LBT before beam switch

Agreement:

* SSB transmission with LBT is supported, at least when the conditions for contention exempt short control signalling based SSB transmission is not met
  + Note the channel access for SSB with LBT may not be different from a normal COT with multiple beams
  + FFS: If any difference from a multi-beam COT LBT needs to be introduced

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple |  |
| AT&T |  |
| CAICT | ***Proposal 7: Both single LBT sensing with wide beam and independent per-beam LBT sensing should be supported for COT with MU-MIMO transmission.***  ***Proposal 8: Three alternatives for LBT within a COT with TDM of beams with beam switching should be supported.*** |
| CATT | **Proposal 8：Consider supporting both of single LBT sensing with wide beam and per-beam LBT sensing at the start of COT.**  **Proposal 9:**  **When the beams transmitted within the COT are spatially dispersive, additional LBT before beam switching can be provisioned.**  **Proposal 10: Multi-beam energy detection in one observation slot should be supported to improve the efficiency of the multi-beam LBT.**  **Proposal 11: Considering LBT for multi-beam operation, deferral period should be extended to 10us for multi-bean operation.** |
| Charter Comm. |  |
| Convida Wireless | Proposal 3: For a COT with MU-MIMO (SDM) transmission, support both single LBT sensing at the start of the COT with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold and independent per-beam LBT sensing at the start of COT performed for beams used in the COT.  Proposal 4: Within a COT with TDM of beams with beam switching, support both single LBT sensing with wide beam ‘cover’ all beams and independent per-beam LBT sensing at the start of COT performed for beams used in the COT. Further discuss independent per-beam LBT sensing at the start of COT for beams used in the COT with additional requirement on Cat 2 LBT before beam switch.  Proposal 8: Enhancement of beam operation for unlicensed bands should be investigated to mitigate interference and optimize system performance due to hidden node for NR up to 71 GHz. |
| Ericsson | Proposal 10 For time domain multiplexing of DL/UL transmissions in multiple beams when LBT mode is used, support Alt 1 where the definition of “cover” at least supports omni-directional or quasi-omni-directional LBT at the beginning of the COT, and no LBT for the following beams in the COT. |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon | ***Proposal 13: For initiating a COT with SDM or TDM of different beams, support multiple per-beam LBTs, i.e. Alt 2 in the agreements of RAN1#104-e.***  ***Proposal 14: For initiating a COT with SDM or TDM of different beams, support one LBT beam covering all transmission beams (Alt 1 in the agreements of RAN1#104-e) as a fallback mechanism when the one-to-one correspondence between the LBT beams and transmission beams cannot be established.***   * ***FFS how to specify the spatial relationship of a wide LBT beam covering all the transmission beams.***   ***Observation 1: (Quasi-)omni-directional simplifies the implementation but could lead to an ‘over protection’ problem and thus reduction of spatial reuse.***  ***Observation 2: Directional LBT potentially improves the channel access probability and enhances the spatial reuse. However, when performed at the transmitter side, the hidden node problem could be more severe due to limited sensing direction.*** |
| Intel Corporation | Proposal 16: When directional sensing is performed, and multiple concurrent COTs are acquired, these should be independently treated unless LBT measurements have overlapping beams. In this case, RAN1 should define some rules on how to handle these cases. |
| InterDigital Inc. | ***Proposal 16****: Independent per-beam LBT sensing at the start of a COT is performed for all beams used in the COT for a COT with MU-MIMO (SDM) transmission or TDM of beams with beam switching.* |
| ITRI | Proposal 2: Independent per-beam LBT sensing should be supported for 60 GHz NR-U. |
| Lenovo Motorola Mobility | Proposal 8: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, for a COT with MU-MIMO +C183:C193(SDM) transmission, all of the following should be supported:  -          Single LBT sensing at the start of the COT with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold  -          Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT  Proposal 9: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, within a COT with TDM of beams with beam switching, all of the following should be supported:  -          Single LBT sensing with wide beam covering all beams to be used in the COT with appropriate ED threshold, where covering implies that the coverage region of wide beam contains the coverage region of all the beams  -          Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT  -          Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT with additional requirement on Cat 2 LBT before beam switch  Proposal 10: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, when multiple DL/UL transmissions are scheduled on multiple beams in TDM in same COT, then LBT can be performed at the beginning of the transmissions and also in the middle of same COT, if needed, which is depending upon following gaps:  -          Maximum allowed gap between the first symbol of the following scheduled transmission on a given beam and the last symbol of the transmitted (same) beam  -          Or if there is no previous transmission on the same beam within a COT, then the maximum allowed gap between the between the first symbol of the following scheduled transmission on a given beam and the time instance when Cat 4 LBT was successful on a beam covering the transmit beam  Proposal 11: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, when multiple DL/UL transmissions are scheduled on multiple beams in TDM and if directional LBT is performed on multiple beams with Cat 4 LBT, then multiple COTs should be initiated corresponding to each of the sensing beam  Proposal 29: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, potential enhancements related to periodic transmission of DRS such as SSB/PBCH/CORESET#0 are needed including:  -          performing directional LBT prior to the transmission of SSB according to the ssb-PositionsInBurst  -          directional LBT on multiple beams at the same time at the beginning of the DRS window  -          Cat 2 LBT (depending on the gap) before actual transmission |
| LG Electronics | "Proposal #8: If the directional CCA procedure is introduced the followings points can be considered:l  How to perform the CCA procedure for multiple-beam sweeping transmissionl  How to define CWS management (e.g., per-direction or across-direction management)l  How to manage the back-off counter value" |
| MediaTek Inc. | **Proposal 6:Both LBT for independent beams or LBT using single sensing beam should be supported for SDM/TDM transmissions.** |
| NEC | Proposal 4: For a COT with SDM transmission, both single LBT sensing with wide beam and independent per-beam LBT should be supported.  "Proposal 5: Within a COT with TDM of beams with beam switching, the following LBT operations should be supported:  • Single LBT sensing with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold.  • Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT with additional requirement on LBT for a gap greater than maximum gap (if any)." |
| Nokia Nokia Shanghai Bell | ***Proposal 15:*** *One-shot LBT within COT is not required before gNB beam switch between SSBs*  ***Proposal 16:*** *High CAPC with short contention window of [3] CCAs is supported for SSB transmission.*  ***Proposal 17:*** *Use of short control signal contention exemption and use of LBT is periodically cycled over the SSBs, evenly distributing the channel access uncertainty over the SSBs.*  ***Proposal 19:*** *For a COT with MU-MIMO (SDM) transmission, support both Alt 1 and Alt 2*  ***Proposal 20:*** *Within a COT with TDM of beams with beam switching, support both Alt 1and Alt 2 for LBT operations.*  ***Proposal 21:*** *CCA check procedure allows the use of both single and multiple LBT beams for the sensing of the intended transmission directions.* |
| NTT DOCOMO INC. | Proposal 5:   For LBT initiating a COT with SDMed multiple transmissions, support a single LBT at the start of COT, covering all the SDMed beams.   For LBT initiating a COT with TDMed multiple transmissions, support independent per-beam LBT at the start of COT. |
| OPPO | **Proposal 10: At least support single LBT sensing at the start of the COT with wide beam covering all transmission beams in the COT.** |
| Panasonic | Proposal 1: Support both Alt 1 (single wide beam LBT sensing) and Alt 2 (independent per-beam LBT sensing) at the start of COT with SDM of beams.  Proposal 2: For a COT with TDM of beams, support both Alt-1 and Alt-2 in the previous agreement at the start of COT. Whether or not additional Cat 2 LBT is required before beam switching within the COT depends on the gap of no transmission of the next beam direction. |
| Qualcomm | Proposal 5: For SDM transmission, support both single LBT sensing with wide beam covers all beams used in the COT and independent per beam sensing.  Proposal 6: For a COT with TDM of beams, support both Alt 1 (single LBT sensing with wide beam covers all beams) and ALT 2 (independent LBT sensing to be performed at the start of the COT).  Proposal 18: SSB burst transmission could be regarded as a Multi-Beam TDM COT, with support for both pre-burst single LBT with wide sensing and per beam independent LBT performed at the start of the COT. |
| Samsung | **Proposal 7:**   * **Support channel access mechanism with directional channel sensing.** * **Support directional channel sensing in multi-beam operation:**   + **For multi-beam SDM scenario, both Alt 1 and Alt 2 can be supported.**   + **For multi-beam TDM scenario, Alt 1 can be supported as baseline, and selection between Alt 2 and Alt 3 depends on whether sensing is required for switching beams within a COT.**   + **The details of per-beam LBT sensing and its associated per-beam transmission for both SDM and TDM scenarios should be further investigated.** |
| Sony | Proposal 7: For a COT with MU-MIMO (SDM) transmission, both Alt 1 (Single LBT sensing at the start of the COT with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold) and Alt 2 (Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT) should be supported.  Proposal 8: Within a COT with TDM of beams with beam switching, both Alt 1 (single LBT sensing with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold) and Alt 2 (independent per-beam LBT sensing at the start of COT is performed for beams used in the COT) should be supported.  Observation 4: If per-beam LBT sensing is introduced, per beam COT indication may need to be needed. |
| Spreadtrum Comm. | ***Proposal 10: Cat 2 LBT may be used in case of Multi-Beam LBT or Receiver-Assistance*** |
| vivo | **Proposal 13: For a COT with MU-MIMO (SDM) transmission, independent per-beam LBT sensing is used at the start of the COT.**  **Proposal 14: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT with additional requirement on Cat 2 LBT before beam switch.** |
| WILUS Inc. |  |
| Xiaomi | Proposal 11: Multi-beam transmission should be studied to fully take advantage of spatial diversity.  Proposal 12: Support independent per-beam LBT sensing at the start of COT for a COT with TDM of beams with beam switching. |
| ZTE Sanechips | Proposal 10: Considering transmission opportunity and utilization of resource, multiple per-beam LBT that cover multiple transmission beams used in COT can be considered to be performed at the start of COT, if directional LBT is supported.  Proposal 11: Considering transmission opportunity and unnecessary interference to other device that is going to transmit transmission, Alt-3 that “Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT with additional requirement on Cat 2 LBT before beam switch” can be considered for the transmission with multiple beams in time domain multiplexing, if directional LBT is supported. |

### First round discussion

For a COT with MU-MIMO (SDM) transmission

* Alt 1: Single LBT sensing at the start of the COT with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold
  + Support: NTT DOCOMO, OPPO
* Alt 2: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT
  + Support: Huawei, Intel, InterDigital, ITRI, Vivo, Xiaomi
* Alt 3: Support both Alt 1 and Alt 2
  + Support: CAICT, CATT, Convida, Lenovo, MediaTek, NEC, Nokia, Qualcomm, Samsung, Sony

Discussion point 2.7.1-1:

For “independent per-beam LBT”, can we further clarify from proposing companies the independent per-beam LBT is performed in TDM fashion or simultaneously?

* Alt A: The per-beam LBT for different beams is performed one after another in time domain
* Alt B: The per-beam LBT for different beams is performed simultaneously
* Alt C: Both

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Within a COT with TDM of beams with beam switching

* Alt 1: Single LBT sensing with wide beam ‘cover’ all beams to be used in the COT with appropriate ED threshold
  + Support: Ericsson, OPPO
* Alt 2: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT
  + Support: DOCOMO, Xiaomi
* Alt 3: Independent per-beam LBT sensing at the start of COT is performed for beams used in the COT with additional requirement on Cat 2 LBT before beam switch
  + Support: CAICT, Vivo
* Alt 4: Support both Alt1 and Alt 2
  + Support: Convida, MediaTech, Nokia, Qualcomm, Samsung, Sony
* Alt 5: Support Alt1 and Alt 3
  + Support: CAICT, CATT, Lenovo, NEC, Samsung (if beam switching requires LBT)

Discussion point 2.7.1-2:

For “independent per-beam LBT sensing” in Alt 2 and Alt 3, can we further clarify from proposing companies the independent per-beam LBT is performed in TDM fashion or simultaneously?

* Alt A: The per-beam LBT for different beams is performed one after another in time domain
* Alt B: The per-beam LBT for different beams is performed simultaneously
* Alt C: Both

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## Multi-Channel channel access

Agreement:

Define Type A and Type B multi-channel channel access as:

* Type A: Perform independent eCCA for each channel
* Type B: Identify a primary channel and perform eCCA on the primary channel, while perform Cat 2 LBT for other channels in the last observation slot

Down-selection between

* Alt1: Support Type A multi-channel channel access only
* Alt2: Support both Type A and Type B multi-channel channel access.

Note: How eCCA is performed on each channel, and the BW of the channels over which eCCAs are performed are separately discussed

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple |  |
| AT&T |  |
| CAICT | ***Proposal 9: Support both Type A and Type B multi-channel channel access.*** |
| CATT | **Proposal 7: Multi-channel access procedure in Rel-16 NR-U could be reused for up to 71GHz operation.** |
| Charter Comm. |  |
| Convida Wireless |  |
| Ericsson | |  | | --- | | Proposal 5 Support Alt1 in the agreement that allows only Type A multi-channel access from 37.213. | | Proposal 6 Do not support Type B multi-channel access for NR operation in 52.6 GHz to 71 GHz. | |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon | ***Proposal 10: For multi-channel access in NR-U-60, support both Type A and Type B procedures, i.e., Alt2 in the agreement made in the previous meeting RAN1#104-e.*** |
| Intel Corporation |  |
| InterDigital Inc. |  |
| ITRI |  |
| Lenovo Motorola Mobility |  |
| LG Electronics |  |
| MediaTek Inc. |  |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Proposal 13:*** *NR-U at 60 GHz supports Type A multiple-channel channel access as the baseline operation on 60GHz unlicensed band. The need for Type B multi-channel LBT requires further discussion* |
| NTT DOCOMO INC. |  |
| OPPO |  |
| Panasonic |  |
| Qualcomm | Proposal 17: Support Alt 2 for Multi-Channel LBT. For Type B multi-channel access, introduce Cat 2 LBT for non-primary channels. |
| Samsung |  |
| Sony |  |
| Spreadtrum Comm. |  |
| vivo | **Proposal 15: If Cat 2 LBT is introduced, both Type A and Type B multi-channel channel access can be supported.** |
| WILUS Inc. | ü  Proposal 5: At least Type A multi-channel access which performs independent eCCA for each channel should be supported. For support of the Type B multi-channel access, it should be further discussed after the decision by depending on support of Cat-2 LBT including definition of Cat-2 LBT. |
| Xiaomi |  |
| ZTE Sanechips |  |

### First round discussion

For multi-channel channel access:

* Alt1: Support Type A multi-channel channel access only
  + Support: Ericsson, Nokia (Further discussion),
* Alt2: Support both Type A and Type B multi-channel channel access.
  + Support: CAICT, CATT, Huawei-HiSilicon, Qualcomm (non primary channel) , WILUS (Further discussion)

Discussion point 2.8.1-1

More discussion needed. Would like other companies to provide their view.

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## Directional LBT

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | |  | | --- | | ***Proposal 1: Sensing beam and transmission beam difference should be adjusted in the Pout calculation.*** | | ***Proposal 2: Perform directional or omni-directional LBT at the beginning of COT with the sensing beam(s) that covers all TDM beams and with no LBT before each beam switching in the middle of COT*** | |  | | ***Proposal 4: 3GPP specify relative relationship between all applicable sensing beams and the transmission beam. The acquired COT should be associated with the corresponding Pout including beam direction and EIRP.*** | |
| AT&T | Proposal 1: Directional LBT is defined as a complete beam sweep with Cat. 4 LBT followed by Cat. 2 LBT before actually transmitting on any spatial direction deemed idle during the complete beam sweep  • Complete, in this context, means all beams the transmitter intends to use during the COT  Proposal 2: The relationship between sensing and transmitting beams should be specified.  • ED threshold adaptation mechanisms can be considered |
| CAICT |  |
| CATT |  |
| Charter Comm. |  |
| Convida Wireless | Proposal 1: Both omni-directional LBT and directional LBT should be supported for frequency range of 52.6GHz to 71GHz. |
| Ericsson | |  | | --- | | Proposal 8 Support omni-directional LBT or quasi-omni-directional LBT as the baseline LBT procedure for 60 GHz band. | | Proposal 9 When LBT mode is used, relationship between sensing and transmission beam(s) is left to implementation while not violating the regional regulations. |   Proposal 10 For time domain multiplexing of DL/UL transmissions in multiple beams when LBT mode is used, support Alt 1 where the definition of “cover” at least supports omni-directional or quasi-omni-directional LBT at the beginning of the COT, and no LBT for the following beams in the COT. |
| Fujitsu |  |
| FUTUREWEI | Proposal 2: UE shall support spatial domain relations for receive and transmit beams for beyond 52.6GHz to 71 GHz band.  Observation 1: The energy detection threshold shall be adjusted to account for the difference between the transmit antenna characteristics used for transmission and the sensing antenna characteristics when the sensing antenna is different than the transmit antenna.  Proposal 4: The EDT value should be adjusted with the difference between the maximum Pout for the transmission and an equivalent transmit power EIRP, Pout\_eq, obtained when sensing antenna is used as transmit antenna. |
| Huawei HiSilicon | ***Proposal 5: For operation in NR-U-60, when LBT is used, the sensing beamforming gain of the LBT beam is deducted from the detected energy level when comparing it to the EDT.***  ***Proposal 11: For operation in the 60 GHz band, specify the spatial relation between the LBT beam and the transmission beam(s).***  ***Proposal 12: For a COT with a single transmission beam, the spatial domain sensing filter for the LBT beam at the beginning of the COT can be configured to be the same as the spatial domain filter for the transmission during the COT.***  ***Observation 1: (Quasi-)omni-directional simplifies the implementation but could lead to an ‘over protection’ problem and thus reduction of spatial reuse.***  ***Observation 2: Directional LBT potentially improves the channel access probability and enhances the spatial reuse. However, when performed at the transmitter side, the hidden node problem could be more severe due to limited sensing direction.*** |
| Intel Corporation | |  | | --- | | **Observation 1: Omni-directional LBT may act in many cases overprotectively and may prevent from fully exploiting spatial reuse under highly directional transmissions. This issue may be mitigated through directional LBT. However, directional sensing exacerbates the well-known hidden node issue, and leads to scenarios where the system could suffer from deafness.** | | **Proposal 13: Both omni-directional and directional LBT are supported. When directional LBT is used, a receiver-aided LBT should complement its CCA procedure.** | | **Proposal 14: RAN1 to define some relationship between the received beams used for LBT measurements, and the transmit beam to be used after LBT success. Further details of how the relationship is defined is FFS in RAN1.** | | **Proposal 17: RAN1 should further study how to efficiently allow beam-pairing due to LBT success.** | | **Proposal 18: A device should perform directional sensing at the beginning of the COT with sensing beam(s) that covers all transmit beams or the first transmission beam, and additional directional LBT with sensing beam that covers the transmission beam(s) .** | |
| InterDigital Inc. | Observation 1: Omni-directional LBT in unlicensed spectrum from 52.6GHz to 71GHz can under-represent interference in the direction of the associated transmission and over-represent interference in other directions.  Observation 2: Dynamic scenarios with some level of mobility increases the likelihood of transmitter-receiver pairs interfering with each other even when using narrowbeams.  Observation 3: Directional LBT provides benefits over no LBT at least for medium to high loads and especially for tail UEs, while reducing the drawbacks associated with omni-directional LBT.  Proposal 1: Directional LBT is specified in Rel-17.  Proposal 2: The relationship between the LBT beam and the transmission beam should be specified.  Proposal 3: A single directional LBT process can be performed on a beam whose parameters are determined from the parameters of the Tx beam of one or more associated transmissions. |
| ITRI | Proposal 1: In order to avoid resource wastage and hidden node problem, the LBT beam should be the same as the transmission beam. |
| Lenovo Motorola Mobility | Observation 1: For NR unlicensed bands between 52.6 GHz and 71 GHz, for LBT based channel access mechanism, if only omni-directional LBT is supported, then the exposed node problem could result in reduce spatial reuse.  Observation 2: For NR unlicensed bands between 52.6 GHz and 71 GHz, with directional LBT based channel access mechanism, LBT failure on a beam could require a beam update procedure and that results in increased latency.  Proposal 4: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz with LBT based channel access mechanism, direction LBT operation should be supported  Proposal 5: For NR unlicensed bands between 52.6 GHz and 71 GHz, with directional LBT based channel access mechanism, configuration and/or indication of multiple sensing beams to UE should be supported for beam-based UL transmission  Proposal 6: For NR unlicensed bands between 52.6 GHz and 71 GHz, with directional LBT based channel access mechanism, explicit mapping between sensing beam(s) and UL transmit beam should be supported, where the sensing beams may or may not be same as the transmit beam  Proposal 7: For NR unlicensed bands between 52.6 GHz and 71 GHz, with directional LBT based channel access mechanism, for UL transmissions on CG resources, time-based autonomous switching of UL Tx beam should be supported, where the switching can be based on a timer within which the UE is expected to receiver HARQ-ACK feedback |
| LG Electronics | Proposal #6: The directional CCA and the receiver assisted LBT can be beneficial to increase cell coverage and spatial reuse, and whether or not the receiver assisted LBT can have an impact on specification except for indicating LBT type to responder should be first investigated.  Proposal #10: It should be discussed how to indicate the direction of LBT (e.g., omni-directional LBT or directional LBT) and the type of LBT (e.g., Type 1 or Type 2A/2B/2C channel access procedure in NR-U) when scheduling a UL transmission inside or outside of a channel occupancy.  Proposal #11: The relationship between the LBT beam with a specific direction to acquire the COT and the transmission beam(s) allowed to transmit in that COT should be defined considering the relationship between the CCA range of the LBT beam and the interference range of the transmission beam(s).  Proposal #12: It would be beneficial for coexistence that channel occupancy acquired by directional LBT is shared only for DL and UL signals/channels having spatial QCL relationship. |
| MediaTek Inc. | **Proposal 5:The calculation of ED threshold should be discussed after the relation between sensing beam and transmission beam is determined.** |
| NEC | Proposal 1: The energy detection threshold adaptation for beam based channel access procedure should take into account the antenna gain and mapping between transmission beam(s) and sensing beam(s). |
| Nokia Nokia Shanghai Bell | ***Observation 3:*** *The feasibility and possible limitations of the true omnidirectional ED sensing for prospective gNBs operating in 60 GHz unlicensed band are not clear.*  ***Proposal 18:*** *Leave the choice of the beam width for the LBT operation to the vendor-specific implementations. Vendors can use different beamforming techniques for their LBT procedures, as long as global or region and deployment specific requirements (i.e., ETSI EN 302 567) are fulfilled.*  ***Observation 4:*** *Generic requirements may be considered, e.g., that the beam(s) used in the LBT contain the transmission direction(s) intended to be used during the COT. However, that should be done in RAN4, not in RAN1.* |
| NTT DOCOMO INC. |  |
| OPPO |  |
| Panasonic |  |
| Qualcomm | Observation 2: For the same interference caused, the measured values under directional and omni-directional sensing are starkly different due to increased beamforming gain under directional sensing  Observation 3: Directional sensing matching transmission beam provides a tighter match between sensing and interference footprint.  Observation 4: Especially for UEs, omni-directional sensing may pick up ‘spurious’ energy from transmissions that do not fall in the interference footprint. Directional sensing naturally avoids those transmissions.  Proposal 4: Consider use of ED adjustment when sensing and transmission beams are different before comparison with ED Threshold. |
| Samsung | **Proposal 7:**   * **Support channel access mechanism with directional channel sensing.** * **Support directional channel sensing in multi-beam operation:**   + **For multi-beam SDM scenario, both Alt 1 and Alt 2 can be supported.**   + **For multi-beam TDM scenario, Alt 1 can be supported as baseline, and selection between Alt 2 and Alt 3 depends on whether sensing is required for switching beams within a COT.**   + **The details of per-beam LBT sensing and its associated per-beam transmission for both SDM and TDM scenarios should be further investigated.** |
| Sony | Proposal 6: Directional LBT should be supported in 60 GHz unlicensed operation. |
| Spreadtrum Comm. | ***Proposal 2: The directional LBT should be supported in 60GHz unlicensed band.***  ***Proposal 3: The relationship between all the LBT beams and the transmission beam should be defined and at least LBT beam “covers” the transmission beam.*** |
| vivo |  |
| WILUS Inc. |  |
| Xiaomi | ***Observation 1: Omni-directional LBT is more suitable for broadcasted channels and groupcasted channels, and directional LBT is more suitable for unicast channels and receiver assisted LBT.*** |
| ZTE Sanechips | Proposal 9: If directional LBT is supported, it is necessary to further define the relationship between LBT sensing beam and transmission beam:   Under the assumption of channel reciprocity between transmission beam and LBT sensing beam, LBT sensing beam and transmission beam are actually equivalent.   Without the assumption of channel reciprocity between transmission beam and LBT sensing beam, when LBT sensing beam (e.g., reception beam) is wider than the transmission beam and/or partially overlapping with each other, certain method need to be further considered, e.g., introduce an additional factor to reflect the difference of transmission beam and reception beam, or directly consider transmission beam as LBT sensing beam.t |

### First round discussion

Discussion point 2.9.1-1:

Continue discussion from previous meeting

* 3GPP specification defines the relative relationship between all applicable sensing beams and the transmission beam, at least sensing beam “covers” the transmission beam~~,~~ 
  + FFS: How to define the relationship
  + FFS: What is the exact definition of sensing beam “covers” the transmission beam.
  + FFS: Whether or not there is RAN1 specification impact, and if no RAN1 impact, whether or not it can be left to RAN4 to introduce a testing requirement

In the last meeting, Ericsson has concerns on if this relationship needs to be specified in 3GPP specs.

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## No LBT

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | Proposal 13: Consider using omni and directional RSSI and channel occupancy for long term sensing. |
| AT&T |  |
| CAICT |  |
| CATT | **Proposal 1: Both Cell-specific and UE-specific indication should be supported to indicate LBT/No-LBT mode for UE.**  **Proposal 2: DCI format 1\_0 scrambled by SI-RNTI could be used as Cell-specific LBT/No-LBT mode indication.** |
| Charter Comm. |  |
| Convida Wireless | Proposal 2: Adaptation between LBT modes and LBT sub-modes for optimizing system performance should be considered. |
| Ericsson | Proposal 20 Support Alt.1 and Atl.2 in the Proposal 2.2.7-1 in [8].  “*Proposal 2.2.7-1:*  *For regions where LBT is not mandated, gNB should indicate to the UE this gNB-UE connection is operating in LBT mode or no-LBT mode. Further discussion whether one or both of the following alternatives can be used for indication:*   * *Alt.1. Cell specific (common for all UEs in a cell) as part of system information or dedicated RRC signaling or both* * *Alt 2. UE specific (can be different for different Ues in a cell) as part of UE-specific RRC configuration* * *FFS: Whether the indication of the decision on applying LBT mode or no-LBT mode is per beam (can be different for different Ues in different beams or can be different for different beam pairs between gNB and the UE) or per cell (can be different for different cells for a UE in carrier aggregation)* * *FFS: Whether a gNB and its UE(s) can have different mode”* |
| Fujitsu |  |
| FUTUREWEI | Proposal 1: For regions where LBT is not mandatory, no-LBT mode can be applied and switching between LBT mode and no-LBT mode can be supported. No other condition is needed.  Proposal 2: For indication of LBT mode and no-LBT mode, cell specific (common for all Ues in a cell) indication as part of system information and dedicated RRC signaling should be supported.  • For additional flexibility, UE specific (can be different for different Ues in a cell) indication as part of dedicated RRC signaling can be supported. |
| Huawei HiSilicon | ***Proposal 18：For operation in the 60 GHz band, in regions where LBT is not mandated, a gNB/UE can initiate a channel occupancy access using a channel access mechanism without LBT if it is used in conjunction with an interference mitigation scheme.***   * ***Interference mitigation schemes such as ATPC or DFS would be implemented as specified by the region-specific regulations and do not need to be specified by 3GPP.***   ***Proposal 19: For operation in the 60 GHz band, in regions where LBT is not mandated, support switching between channel access with LBT and channel access without LBT in a equire cell by gNB configuration.***  ***Proposal 20: For operation in the 60 GHz band, in regions where LBT is not mandated, the serving cell may enable Rx-side LBT using a higher layer configuration to mitigate high levels of interference experienced from hidden nodes.***  ***Observation 4: When network allows enabling/disabling the LBT mode through cell-specific gNB configuration, coexistence issues would arise as the performance in the cells operating with LBT mode would be adversely impacted by the No-LBT mode operation in the neighboring cells.***  ***Proposal 21: For operation in the 60 GHz band, in regions where LBT is not mandated, MCOT limits should be applied for a channel occupancy initiated without LBT.*** |
| Intel Corporation | |  | | --- | | **Proposal 9: gNB indicates whether LBT or no-LBT procedure should be used via both system information and UE-specific RRC configuration.** | | **Proposal 10: A switching mechanism between LBT and no-LBT is defined, but it is up to gNB’s control.** |   Proposal 12: It is up to the gNB on whether to mandate or not the use of LBT before attempting any transmission from any device within an initiating device’s acquired COT. |
| InterDigital Inc. |  |
| ITRI |  |
| Lenovo Motorola Mobility | Observation 6: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, long-term channel sensing could be useful for both LBT and no-LBT based channel access mechanism:  -          For LBT based channel access mechanism, long-term sensing at the UE could be utilized for receiver assistance LBT at the gNB  -          For no LBT based channel access mechanisms, long-term sensing could provide interference statistics in terms of potential interference from WiFi as well as interference from other NR operators  Proposal 19: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, ATPC could be adopted as one of the channel access mechanism, at least for regions where LBT is mandated by regulatory requirements  Proposal 21: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, switching between LBT and no-LBT based channel access mechanism should be supported for regions where LBT is not mandated.  Proposal 22: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, different implicit and/or explicit methods for switching between LBT and no-LBT mode should be considered.  Proposal 23: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, receiver assistance should be supported for both LBT and no-LBT based channel access mechanisms to avoid potential interference at the receiver.  Proposal 26: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, long term sensing should be supported for both LBT based and no-LBT based channel access mechanism to consider potential interference.  Observation 7: Currently, there is no mechanism is support long-term sensing including interference measurements from WiFi or other NR operators at the UE and corresponding reporting.  Proposal 27: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, for receiver to provide assistance, channel sensing and reporting need to be performed and following enhancements to legacy RSSI measurements should be supported:  -          for long term sensing to measure interference statistics from WiFi systems or other NR operators, a new category of ZP CSI-RS should be supported where the UE is not expected to receive any channel/signal (including NZP CSI-RS for interference measurement) and only measure potential interference from WiFi nodes or other NR operators and report back corresponding measurements. |
| LG Electronics | Proposal #1: The channel access mechanism can be switched from LBT mode to no-LBT mode based on timer operation when receiving the information of the local regulation from the gNB (by cell specific or UE specific signaling) and satisfying certain conditions such as a low interference environment. |
| MediaTek Inc. | **Proposal 1:Both cell-specific and UE-specific method should be supported for gNB to indicate UE operating in LBT or no LBT mode.**  **Proposal 2:In addition to indicating UE to operate in LBT or no LBT mode, switching between different LBT schemes (e.g., from omni-directional to directional LBT or from directional LBT to receiver-assisted LBT) should be considered.** |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Observation 5:*** *Use of LBT does not provide significant increase of median throughput compared to no-LBT mode*  ***Observation 6:*** *Use of LBT introduces reduction of throughput for cell edge Ues*  ***Observation 7:*** *Simulation results do not show any gain due to introduction of additional Cat-2 LBT at gNB beam switch during COT.*  ***Proposal 24:*** *Ues without LBT functionality are supported.*  ***Observation 8****: Channel access mechanism without LBT should fulfil the expected equirement of EN 303 722 but also possibly EN 303 753.*  ***Observation 9****: NR for 60 GHz band shall be able to fulfil the EN 303 722 requirements for spectrum sharing based on automatic transmit power control and/or automatic link adaptation. Needed specification changes, if any, are to be considered along with EN 303 722 progress.*  ***Proposal 30:*** *Channel access mechanism (i.e. whether or not LBT is in use) is part of the cell configuration.*  ***Proposal 31:*** *Signalling supporting flexible selection of channel access mechanism (LBT or no-LBT) per gNB beam is considered further.*  ***Proposal 32****: Leave any additional conditions/mechanisms/restriction/fallback modes on the no-LBT channel access mode for gNB implementation.* |
| NTT DOCOMO INC. |  |
| OPPO | **Proposal 7: network can signal to the UE whether the LBT is requested or not, the signaling can be cell-specific.** |
| Panasonic |  |
| Qualcomm | Proposal 19: Support provision for sensing and measurement gaps for discovery of aggressors and victims in a No-LBT deployment  Proposal 20: For No-LBT deployments, consider specification of optional good neighbor procedures, such as away time, to break persistent beam collisions for better coexistence. |
| Samsung | **Proposal 1: Support LBT mode and no-LBT mode per node in a cell.**   * **Ues in a cell can operate in same or different mode;** * **UE can operate in same or different mode from its serving gNB;** * **gNB determines its operation mode up to implementation;** * **gNB indicates both gNB’s and UE’s operation mode to its serving UE in both cell-specific (e.g. system information and RRC parameter) and UE-specific/UE-group-specific (e.g. RRC parameter) manners.**   **Proposal 9: Support RSSI measurement outside the active BWP and in non-serving cell.** |
| Sony | Observation 1: In EU, no-LBT mode cannot be operated at least under the ‘C1’ mode for indoor and outdoor deployment.  Observation 2: No-LBT mode works in the uncongested environment.  Observation 3: Congestion could be measured by average RSSI and channel occupancy which have already been introduced in NR-U.  Proposal 2: No-LBT mode is configured by the network based on measurement results of RSSI and channel occupancy. |
| Spreadtrum Comm. |  |
| Vivo | **Proposal 16: Both cell-specific and UE-specific indication of the channel access mode should be supported. Per-beam based channel access mode indication is not necessary.**  **Proposal 17: The channel access mode can be selected based on the channel occupancy time, channel access rate, transmission priority, service requirement, or feedback information from the receiver, etc.** |
| WILUS Inc. |  |
| Xiaomi | |  | | --- | | ***Proposal 3: Whether No-LBT*** ***channel access mechanism is allowed can be broadcasted by gNB or be informed by message from core network.*** | | ***Proposal 4: At least the energy/interference detection threshold for determining whether No-LBT is applicable should be defined in specification.*** | | ***Proposal 5: Switching between LBT and No-LBT channel access should be studied. The following three alternatives can be considered,*** | | ***Alt 1, gNB self-determines the applied channel access mechanism for both itself and UEs.*** | | ***Alt 2, Both gNB and UE self-determines the applied channel access mechanism for itself.*** | | ***Alt 3,*** ***gNB self-determines the applied channel access mechanism for itself, and gNB determines for UEs based on request.*** | | ***Proposal 6: How to prevent long time continuous channel occupying for Tx using No-LBT should be further studied.*** | |
| ZTE Sanechips | "Proposal 6: No LBT can be considered to be used in the following cases:  • COT sharing case.  o Support Alt 3: Define a maximum gap Y, such that a later transmission can share the COT without LBT only if the later transmission starts within Y from the end of the earlier transmission. If the later transmission starts after Y from the end of the earlier transmission, a one-shot LBT is needed to share the COT.  • Specific areas such as ITU region 2 and 3.  • Interference controlled environment.  • The transmission beams of nodes of different operators in the same system (e.g., NR-U) have little interference with each other."  Observation 5: No LBT should be workable only if some interference elimination mechanisms are applied on top of it. If no LBT is supported, the spec impact of introducing such enhancement should be further studied and evaluated.  Proposal 7: Similar restriction as defined in Type 2C channel access procedure in TS 37.213 can also introduced in above 52.6GHz NR-U frequency band but the length of a transmission can be relaxed.  Proposal 8: Conditions for No LBT fallback to LBT should be further studied, e.g., based on the interference level or correctly decoding rate. |

### First round discussion

The following discussion points are continuation from the previous meeting. Seems more discussions are needed.

Discussion point 2.10.1-1:

For regions where LBT is not mandated, gNB should indicate to the UE this gNB-UE connection is operating in LBT mode or no-LBT mode. Further discussion whether one or both of the following alternatives can be used for indication:

* Alt.1. Cell specific (common for all UEs in a cell) as part of system information or dedicated RRC signaling or both
* Alt 2. UE specific (can be different for different UEs in a cell) as part of UE-specific RRC configuration
* FFS: Whether the indication of the decision on applying LBT mode or no-LBT mode is per beam (can be different for different UEs in different beams or can be different for different beam pairs between gNB and the UE) or per cell (can be different for different cells for a UE in carrier aggregation)
* FFS: Whether a gNB and its UE(s) can have different mode

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Discussion point 2.10.1-2:

For regions where LBT is not mandated, shall we introduce additional conditions for no-LBT to be used, or leave it for gNB implementation. The condition can be based on DFS, long term sensing, etc

* Alt 1: Up to gNB implementation: Apple, vivo, FW, QC, Ericsson, Samsung, Intel, Fujitsu, CATT, Nokia, DCM (based on RSSI and CO), Sony (based on RSSI and CO), Spreadtrum, OPPO, NEC, IDC, Oppo, NEC, Charter
  + Also define mechanism to assist gNB identify issues: QC, Samsung
* Alt 2: Introduce conditions for no-LBT to be used: LGE (low interference detection), Xiaomi (energy/interference detection), Lenovo (long term sensing, HARQ feedback), ZTE (use case, length of transmission, etc), HW(?)

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Discussion point 2.10.1-3:

For regions where LBT is not mandated when no-LBT is used, what are the good neighbor procedures, if any that can be useful?

* Shall we design ATPC-like mechanism to be used in no-LBT mode
* Shall we design DFS-like mechanism to be used in no-LBT mode
* Shall we design long term sensing type mechanism to be used in no-LBT mode
* Shall we design duty-cycle or away time restriction mechanism to be used in no-LBT mode
* Shall we design transmit power restriction mechanism to be used in no-LBT mode

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Discussion point 2.10.1-4:

For regions where LBT is not mandated, when operating in no-LBT mode, shall we further define mechanism for the system to fall back to LBT mode

* Yes (define mechanism): Apple (long term sensing and feedback, and RRC signalling), vivo, LGE (timer and HARQ feedback), Xiaomi, Lenovo, ZTE (interference level, decoding rate), DCM (RSSI/CO), HW, Spreadtrum (RSSI/CO)
* No (gNB implementation): FW, QC (define procedures to switch), Ericsson, Samsung, Intel (define mechanism, but not usage), Fujitsu, CATT, Nokia, OPPO, IDC, Charter

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## Short Control Signaling and Contention Exempt Transmission

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple | Proposal 7: For DL, at least SSB should be considered as short control signaling. For UL, at least PRACH should be considered as short control signaling. Other signal such as CSI-RS and SRS can be further discussed.  Proposal 8: Transmission of SSB/PRACH within an acquired COT after LBT success is not counted into 10% limitation within 100ms observation period. |
| AT&T |  |
| CAICT |  |
| CATT |  |
| Charter Comm. |  |
| Convida Wireless |  |
| Ericsson | |  | | --- | | Proposal 7Consistent with EN 302 567, a node can access the channel without LBT for control signal/channel transmissions, the total duration of which shall not exceed 10 ms within an observation period of 100 ms. The following signals/channels shall be classified as short control signaling transmissions: | | 1Discovery burst (as defined in Rel-16) | | 2msg1 and msg3 for the 4 step RACH and MsgA for the 2-step RACH |   3FFS: Other control transmissions not multiplexed with user data (subject to gNB configuration) |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon | ***Proposal 22: For operation in the 60 GHz band, in regions where LBT is mandated, support transmission of short control signalling without LBT, and with a duty cycle 10 % within an observation period of 100 ms.***   * ***Short control signaling is defined as a*** ***short transmission burst that contains control information without any user plane data.*** |
| Intel Corporation | Proposal 19: SSB transmission with no LBT is supported at least for 960 kHz and type0-PDCCH.  Observation 2: For 120 kHz, 480kHz, and 960 kHz PRACH transmission, UE does not exceed total transmission duration of 10 msec for PRACH within a 100 msec observation period.  Proposal 20: Consider applying short control signal exemption to PRACH transmission by the UE. |
| InterDigital Inc. |  |
| ITRI |  |
| Lenovo Motorola Mobility |  |
| LG Electronics | Proposal #3: The contention exempt short control signalling can be supported in NR above 52.6 GHz at least for the transmission(s) initiated by gNB with only SS/PBCH or with SS/PBCH multiplexing with non-unicast information (e.g., SIB1, CSI-RS), where the transmission(s) duration is not exceed 10ms within an observation period of 100ms. |
| MediaTek Inc. |  |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Observation 2:*** *EN 302 567, v2.2.0 allows for Short Control Signalling transmissions for up to 10% of time within an observation period of 100 ms*.  ***Proposal 14:*** *NR-U design for 60 GHz bands supports transmission of DL and UL control and management signals as short control signalling without LBT. Details are FFS.*  ***Proposal 17:*** *Use of short control signal contention exemption and use of LBT is periodically cycled over the SSBs, evenly distributing the channel access uncertainty over the SSBs.* |
| NTT DOCOMO INC. | Proposal 6: SSB in DL and PRACH in UL should be considered as Short Control Signalling, as long as the limits required in the regulation are ensured |
| OPPO | **Proposal 11: PUCCH carrying HARQ-ACK information and SSB burst belong to short control signaling; while the duty cycle limitation should be met.** |
| Panasonic |  |
| Qualcomm | Proposal 13: Under the restrictions of duty cycle for short control signaling, allow SS/PBCH, PDCCH, CSI-RS and PRS for contention exempt transmission  Proposal 14: Under the restrictions of duty cycle for short control signaling, allow PRACH, msg1, msg3, msgA, SRS, PUCCH and PUSCH without user plane data for contention exempt transmission |
| Samsung | **Proposal 6: For “short control signal”:**   * **any periodic transmission with high priority can be part of “short control signal”, including discovery burst, non-unicast information, PRACH, PDCCH, PUCCH, and RS.** * **support limitation on the transmission duration and duty cycle to use “short control signal”, wherein the transmission duration and duty cycle are defined from the channel occupancy point of view.** |
| Sony | **Proposal 3: Contention exempt short control signalling should be adopted at least for SSB and PRACH transmission** |
| Spreadtrum Comm. |  |
| vivo |  |
| WILUS Inc. |  |
| Xiaomi |  |
| ZTE Sanechips | Observation 1: On 10ms limitation of Short Control Signalling, it is recommended that “Understanding1: a cumulative sum of all transmitted symbols for SCS transmission is used to evaluate whether to meet 10ms limitation” should be considered.  "Observation 2:   For 120 kHz SCS SS/PBCH, transmitted 64 SS/PBCH with 20ms SS/PBCH period exceeds 10ms limitation within a 100ms observation period required for short control signalling.   For larger SCS (e.g., 240/480/960kHz) SS/PBCH, transmitted 64 SS/PBCH with 20ms SS/PBCH period does not exceed 10ms limitation within a 100ms observation period required for short control signalling."  Observation 3: Based on the Understanding1: a cumulative sum of all transmitted symbols for SCS transmission is used to evaluate whether to meet 10ms limitation, Msg1 or Msg3 or MsgA can be considered to apply Contention Exempt Short Control Signaling rules.  Observation 4: For the case of the transmission of DL/UL channels/signals considered as Short Control Signalling is in a COT initiated by gNB or UE, it is suggested that such transmission should not be counted into 10ms limitation within the 100ms observation period.  Proposal 5: SS/PBCH other than 120kHz SCS and Msg1 or Msg3 or MsgA can be considered using Contention Exempt Short Control Signaling rules. |

### First round discussion

Discussion point 2.11.1-1: (Continue from previous meeting)

* Contention Exempt Short Control Signaling rules can be applicable to the transmission of SS/PBCH.
  + FFS what are the other DL signals and channels that can be multiplexed with SS/PBCH transmission under Contention Exempt Short Control Signaling rule
  + FFS: whether this can be applied to all supported SCS or specific SCS.
  + Note restriction for short control signalling transmissions apply (10% over 100ms)
* FFS: Other DL signals/channels can be transmitted with Contention Exempt Short Control Signaling rule, such as PDCCH, broadcast PDSCH, PDSCH without user plain data, CSI-RS, PRS, etc

Discussion point 2.11.1-2: (Continue from previous meeting):

* Contention Exempt Short Control Signaling rules apply to the transmission of msg1 or msg3 for the 4 step RACH and MsgA for the 2-step RACH for all supported SCS.
  + Note restriction for short control signalling transmissions apply (10% over 100ms)
  + FFS: If the 10% over 100ms restriction is applicable to all available msg1/msg3/msgA resources configured in a cell, or msg1/msg3/msgA transmission from one UE perspective
* FFS: Other UL signals/channels can be transmitted with Contention Exempt Short Control Signaling rule, such as SRS, PUCCH, PUSCH without user plain data, etc

Discussion point 2.11.1-3:

Alt 1. Usage restriction on short control signalling is enforced by gNB implementation

* Apple, FW, Qualcomm, Ericsson, Samsung, Intel, LGE, NEC, Xiaomi, Nokia (at least DL), ZTE, Spreadtrum, OPPO, Charter

Alt 2. Introduce additional mechanism to explicitly restrict the short control signalling usage. FFS how.

* Vivo, ZTE, HW

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## CWS and CAPC

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple |  |
| AT&T |  |
| CAICT |  |
| CATT |  |
| Charter Comm. |  |
| Convida Wireless |  |
| Ericsson | Proposal 16CAPC, CWS adjustment can be implementation dependent. |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon |  |
| Intel Corporation | |  | | --- | | **Proposal 2: For operation unlicensed 60 GHz band, when LBT is used within the COT, the principle of the type 1 channel access procedure defined for the sub-6 GHz band should be reused, and the channel access parameters should be modified in accordance with numerologies provided by the ETSI BRAN Harmonized Standard.** | | **Proposal 3: The procedure specified in NR-U related to the CWS adjustment should be considered for operation in unlicensed 60 GHz band. RAN1 should further discuss and identify the values Zmin and Zmax.** | |
| InterDigital Inc. |  |
| ITRI |  |
| Lenovo Motorola Mobility | Proposal 18: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, CWS adjustment should be applied for each beam in an independent manner depending upon the corresponding CAPC (when Cat 4 LBT is done for each beam and COT is initiated for each of the beams), where the CWS adjustment for a transmit beam (TCI state) of a data channel can be based on the ACK/NACK feedback for the corresponding data channel with the same transmit beam (TCI state) |
| LG Electronics | Proposal #5: Introduce channel access priority class and the contention window adjustment mechanisms when LBT is used in NR above 52.6 GHz, similar to Rel-16 NR-U. |
| MediaTek Inc. | **Proposal 9: For channel access mechanism, at least channel access priority class should be considered to prioritize different traffic.**  **Proposal 10: Current CAPC table can be a starting point for 52.6 – 71 GHz.** |
| NEC |  |
| Nokia Nokia Shanghai Bell | ***Observation 1:*** *We do not see a need for contention window adjustment mechanism for mitigating channel access collisions.*  ***Proposal 1:*** *LBT procedure uses fixed contention window size for random back-off. The size of the fixed contention window is FFS.*  ***Proposal 2:*** *At most two CAPCs are supported.* |
| NTT DOCOMO INC. |  |
| OPPO |  |
| Panasonic |  |
| Qualcomm |  |
| Samsung | **Proposal 4: No need to define CAPC for 60 GHz unlicensed band.** |
| Sony | **Proposal 4: Support fixed Contention Window. ·           gNB’s contention windows size is left to network implementation. ·           UE’s contention window size is configured by network.** |
| Spreadtrum Comm. |  |
| vivo |  |
| WILUS Inc. | ü  *Proposal 3: We propose to introduce CAPC, CWS and CWS adjustment mechanism for 60GHz band, with Rel.16 NR-U as baseline.t* |
| Xiaomi |  |
| ZTE Sanechips | Observation 6: CWs adjustment can be considered to be introduced, which is beneficial in some highly congested scenarios and to friendly and fair coexistence with Wi-Fi.  Observation 7: Current CCA check procedure in EN 302 567 can be regarded as “Cat 4” rather than “Cat3”. |

### First round discussion

The following discussion points are continuation from the previous meeting. More discussion needed

Discussion point 2.12.1-1:

* Alt 1. Not introduce CAPC 60GHz band
  + Support: Ericsson, Samsung,
* Alt 2. Introduce CAPC for 60GHz band, with Rel.16 NR-U as baseline.
  + Support: Intel, Lenovo, LG, WILUS, ZTE, Nokia (Max 2) , MediaTek

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Discussion point 2.12.1-2:

* Alt 1. Not introduce CWS, and CWS adjustment for 60GHz band
  + Support: Ericsson, Samsung,,
* Alt 2. Introduce CWS and CWS adjustment mechanism for 60GHz band, with Rel.16 NR-U as baseline.
  + Support: Intel, Lenovo, LG, WILUS, ZTE

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## Other

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| **Company** | **Key Proposals/Observations/Positions** |
| Apple |  |
| AT&T |  |
| CAICT |  |
| CATT |  |
| Charter Comm. |  |
| Convida Wireless | Proposal 9: Increasing the number of SSB candidate positions to above 64 to increase transmission opportunities to cope with LBT failure should be considered. |
| Ericsson |  |
| Fujitsu |  |
| FUTUREWEI |  |
| Huawei HiSilicon |  |
| Intel Corporation |  |
| InterDigital Inc. |  |
| ITRI | Proposal 3: PDCCH monitoring enhancement for M-TRP operation should be supported for 60 GHz NR-U.  Proposal 4: Configuring multiple SRIs for a CG transmission should be supported for 60 GHz NR-U. |
| Lenovo Motorola Mobility | Proposal 13: For NR operation in unlicensed bands between 52.6 GHz and 71 GHz, then following potential enhancements related to periodic transmissions of RS such as P-TRS should be specified to deal with LBT failure:  -          Termination of periodic RS transmission on beams where consecutive LBT failures are encountered  -          Dynamic switching of the QCL assumption (beams) for periodic RS transmission where consecutive LBT failures are encountered, where:  o    Multiple QCL assumptions (multiple beams) can be configured to the RS resource and beam switch can be triggered once the continuous number of LBT failures reach a certain threshold value  Proposal 14: For NR unlicensed bands between 52.6 GHz and 71 GHz with directional LBT based channel access mechanism, within a COT, PDCCH monitoring is not supported in the CORESETs corresponding to other COTs (PDCCH monitoring restricted to monitoring corresponding to only one COT at a time) |
| LG Electronics | "Proposal #2: Adopt the definition of a discovery burst described in TS 37.213 for NR above 52.6GHz-       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 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)." |
| MediaTek Inc. | **Proposal 11: Choose which ETSI EN HS to follow.** |
| NEC |  |
| Nokia Nokia Shanghai Bell |  |
| NTT DOCOMO INC. |  |
| OPPO |  |
| Panasonic |  |
| Qualcomm |  |
| Samsung |  |
| Sony | **Channelization**: Proposal 1: NR devices support 2.16 GHz bandwidth in 60GHz spectrum as one of the nominal channel bandwidths. |
| Spreadtrum Comm. |  |
| vivo |  |
| WILUS Inc. |  |
| Xiaomi |  |
| ZTE Sanechips |  |

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