**3GPP TSG RAN WG1#112bis-e R1-23xxxxx**

**Online, April 17th – April 26th, 2023**

**Agenda Item: 7.2**

**Source: Qualcomm (Moderator)**

**Title: Email discussion on issue CA-1 of channel access of Rel.17 FR2-2**

**Document for: Discussion, Decision**

# Introduction

This document summarizes the email discussion for the following thread:

[112bis-e-R17-FR2\_2-01] Email discussion on Rel-17 FR2\_2 maintenance for channel access mechanism issue CA-1 (from RAN1#112) by April 20 – Jing (Qualcomm)

# Issue CA-1

This issue is about Type 1 LBT to Type 2 or Type 3 LBT upgrade when back in gNB COT for FR2-2 unlicensed operation in R17. The following proposals are collected in the submitted papers

Discussion CA-1

On Type 1 LBT to Type 2 or Type 3 LBT upgrade when back in gNB COT for FR2-2 unlicensed operation in R17

* Alt 1: Type 1 LBT to Type 2 LBT upgrade when back in gNB COT for FR2-2 unlicensed operation in R17, if UE supports Type 2 LBT. Otherwise, if UE does not support Type 2 LBT, Type 1 LBT upgrade when back in gNB COT is not supported
	+ Support: Oppo [4], CATT [6], Qualcomm [13]
	+ Draft CR in [5] (TP CA-1-oppo)
	+ Draft CR in [7] (TP CA-1-CATT)
* Alt 2: Assume UE is aware of local regulation, and UE determines if Type 2 LBT is needed to share the gNB COT
	+ Support: ZTE [8], Nokia [10], HW [15]
	+ Draft CR in [9] (TP CA-1-ZTE)
	+ Draft CR in [11] (TP CA-1-Nokia)
	+ Draft CR in [15] (TP CA-1-HW)
* Alt 3: Concludes to not support the Type 1 LBT to Type 2 or Type 3 LBT in R17
	+ Support: Qualcomm [13]
* Alt 4:
	+ channel access procedures can be used only if Type 2 has been configured as a table entry by any of the higher layer parameters *ul-AccessConfigListDCI-0-1* *ul-AccessConfigListDCI-0-2* or *ul-AccessConfigListDCI-1-1 or ul-AccessConfigListDCI-1-2.*
	+ Type 3 channel access procedures can be used only if Type 3 has been configured as a table entry by any of the higher layer parameters *ul-AccessConfigListDCI-0-1* *ul-AccessConfigListDCI-0-2* or *ul-AccessConfigListDCI-1-1 or ul-AccessConfigListDCI-1-2*
	+ Support: LGE [12], Qualcomm [13]
	+ Draft CR in [12] (TP CA-1-LGE)
* Alt 5: reuse ra-ChannelAccess-r17 to control if Type 1 LBT can be upgraded to Type 2 or Type 3 LBT
	+ Suport: vivo[1], Wilus [16]
	+ Draft CR in [2] (TP CA-1-vivo)
	+ Draft CR in [16] (TP cA-1-Wilus)

TP CA-1-oppo

4.4.4 Channel access procedures in an initiated channel occupancy

If a gNB/UE initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB/UE may transmit a DL/UL transmission(s) that is followed by a UL/DL transmission(s) within the maximum *Channel Occupancy Time* described in Clause 4.4.1. The followings are applicable to the UL/DL transmission(s):

- The transmission bandwidth(s) corresponding to the UL/DL transmission(s) shall be within the DL/UL bandwidth part(s) where in the channel occupancy is initiated:

- Regardless of the duration of the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel is more than a threshold that is determined by the gNB and is at least $8μs$, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.2. Otherwise, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3.

If a gNB initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a DL transmission(s) on the channel within the maximum *Channel Occupancy Time* described in Clause 4.4.1 on the channel after the DL transmission(s) initiating the channel occupancy. The followings are applicable to the DL transmission(s):

- Regardless of the duration of the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB, the DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB is more than a threshold that is determined by the gNB and is at least $8μs$, the DL transmission(s) occurs following the procedures described in Clause 4.4.2.

If a gNB shares a channel occupancy initiated by a UE using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a transmission on the channel that follows a scheduled UL transmission or a configured PUSCH transmission by the UE if the following conditions are satisfied:

- The DL transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.

When a UE is provided *cg-COT-SharingList-r17* by higher layers, the UE is configured with a table wherein each row is given by higher layer parameter *CG-COT-Sharing-r17*. One row of the table is configured for indicating that the channel occupancy sharing is not available and other rows of the table each provides a channel occupancy sharing information. In this case, each configured grant PUSCH transmission includes 'COT sharing information' in CG-UCI as described in [10] that indicates a row index to the table.

If a gNB shares a channel occupancy initiated by a UE using configured grant PUSCH transmission and the UE is configured by *cg-COT-SharingList-r17*, the gNB may transmit a transmission that follows the configured grant PUSCH transmission by the UE if the following conditions are satisfied:

- If the gNB determines that the 'COT sharing information' in CG-UCI in slot *n* indicates a row index that corresponds to a *CG-COT-Sharing-r17* that provides channel occupancy sharing information, the gNB can share the UE channel occupancy starting from slot $n+O$, where $O=$ *offset-r17* slots, for a duration of $D=$*duration -r17* slots where *duration-r17*, and *offset-r17* are higher layer parameters provided by *CG-COT-Sharing-r17*.

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

- The UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 2 channel access procedures as described in clause 4.4.2 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy.

TP CA-1-CATT

4.4 Channel access procedures for frequency range 2-2

4.4.8 Channel access procedures upon detection of a DCI format 2\_0

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

* The UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 2 channel access procedures as described in clause 4.4.2 for its corresponding UL transmissions within the determined duration in time and determined location in frequency domain of the remaining channel occupancy if a UE indicates the capability of Type 2 channel access. In this case, if the UL transmissions are PUSCH transmissions on configured resources, the UE may assume the channel occupancy is shared with the gNB.

TP CA-1-ZTE

4.4 Channel access procedures for frequency range 2-2

<Unchanged part is omitted>

4.4.X Channel access procedures upon detection of a common DCI

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

The UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 2 channel access procedures as described in Clause 4.4.2 or Type 3 channel access procedures as described in Clause 4.4.3 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy. If Type 2 channel access procedure is allowed by regulation, the UE can use Type 2 channel access for UL transmission. Otherwise, UE can use Type 3 channel access for UL transmission.

TP CA-1-Nokia

4.4 Channel access procedures for frequency range 2-2

**<Unchanged parts omitted>**

When a UE is scheduled by a DCI to transmit a UL transmission(s), the scheduling DCI may indicate the corresponding channel access procedures for the UL transmission(s) as described in [10]. The UE determines based on the DCI if Type 1, or Type 2, or Type 3 channel access procedures described in Clause 4.4.1, Clause 4.4.2 and Clause 4.4.3, respectively, is applicable. If the UE determines that the scheduled UL transmission(s) occur within the channel occupancy initiated by the gNB, it may transmit the UL transmission(s) following the procedures described in Clause 4.4.4, irrespective of the channel access type determined based on the DCI.

TP CA-1-LGE

4.4.4 Channel access procedures in an initiated or a shared channel occupancy

If a gNB/UE initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB/UE may transmit a DL/UL transmission(s) that is followed by a UL/DL transmission(s) within the maximum *Channel Occupancy Time* described in Clause 4.4.1. The followings are applicable to the UL/DL transmission(s):

- The transmission bandwidth(s) corresponding to the UL/DL transmission(s) shall be within the DL/UL bandwidth part(s) where in the channel occupancy is initiated:

- Regardless of the duration of the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel is more than a threshold that is determined by the gNB and is at least $8μs$, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.2. Otherwise, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3.

If a gNB initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a DL transmission(s) on the channel within the maximum *Channel Occupancy Time* described in Clause 4.4.1 on the channel after the DL transmission(s) initiating the channel occupancy. The followings are applicable to the DL transmission(s):

- Regardless of the duration of the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB, the DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB is more than a threshold that is determined by the gNB and is at least $8μs$, the DL transmission(s) occurs following the procedures described in Clause 4.4.2.

If a gNB shares a channel occupancy initiated by a UE using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a transmission on the channel that follows a scheduled UL transmission or a configured PUSCH transmission by the UE if the following conditions are satisfied:

- The DL transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.

When a UE is provided *cg-COT-SharingList-r17* by higher layers, the UE is configured with a table wherein each row is given by higher layer parameter *CG-COT-Sharing-r17*. One row of the table is configured for indicating that the channel occupancy sharing is not available and other rows of the table each provides a channel occupancy sharing information. In this case, each configured grant PUSCH transmission includes 'COT sharing information' in CG-UCI as described in [10] that indicates a row index to the table.

If a gNB shares a channel occupancy initiated by a UE using configured grant PUSCH transmission and the UE is configured by *cg-COT-SharingList-r17*, the gNB may transmit a transmission that follows the configured grant PUSCH transmission by the UE if the following conditions are satisfied:

- If the gNB determines that the 'COT sharing information' in CG-UCI in slot *n* indicates a row index that corresponds to a *CG-COT-Sharing-r17* that provides channel occupancy sharing information, the gNB can share the UE channel occupancy starting from slot $n+O$, where $O=$ *offset-r17* slots, for a duration of $D=$*duration -r17* slots where *duration-r17*, and *offset-r17* are higher layer parameters provided by *CG-COT-Sharing-r17*.

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

- the UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 2 channel access procedures as described in clause 4.4.2, if configured among the entries provided by any of the higher layer parameters *ul-AccessConfigListDCI-0-1* or *ul-AccessConfigListDCI-1-1,* for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy.

- Otherwise, the UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 3 channel access procedures as described in clause 4.4.3, if configured among the entries provided by any of the higher layer parameters *ul-AccessConfigListDCI-0-1* or *ul-AccessConfigListDCI-1-1,* for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy.

TP CA-1-HW

4.4.4 Channel access procedures in an initiated channel occupancy

If a gNB/UE initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB/UE may transmit a DL/UL transmission(s) that is followed by a UL/DL transmission(s) within the maximum *Channel Occupancy Time* described in Clause 4.4.1. The followings are applicable to the UL/DL transmission(s):

- The transmission bandwidth(s) corresponding to the UL/DL transmission(s) shall be within the DL/UL bandwidth part(s) where in the channel occupancy is initiated:

- Regardless of the duration of the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel is more than a threshold that is determined by the gNB and is at least $8μs$, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.2. Otherwise, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3.

If a gNB initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a DL transmission(s) on the channel within the maximum *Channel Occupancy Time* described in Clause 4.4.1 on the channel after the DL transmission(s) initiating the channel occupancy. The followings are applicable to the DL transmission(s):

- Regardless of the duration of the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB, the DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB is more than a threshold that is determined by the gNB and is at least $8μs$, the DL transmission(s) occurs following the procedures described in Clause 4.4.2.

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

- The UE may switch from the channel access procedures described in clause 4.4.1 to the channel access procedures described in clause 4.4.3 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy if the use of the procedures described in clause 4.4.3 is allowed by regulations. Otherwise, the UE may switch to the procedures described in clause 4.4.2 if the UE has indicated the corresponding capability.

If a gNB shares a channel occupancy initiated by a UE using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a transmission on the channel that follows a scheduled UL transmission or a configured PUSCH transmission by the UE if the following conditions are satisfied:

- The DL transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.

\*\*\* unchanged text omitted\*\*\*

TP CA-1-vivo

4.4.4 Channel access procedures in an initiated channel occupancy

<Unchanged parts omitted>

If a gNB shares a channel occupancy initiated by a UE using configured grant PUSCH transmission and the UE is configured by *cg-COT-SharingList-r17*, the gNB may transmit a transmission that follows the configured grant PUSCH transmission by the UE if the following conditions are satisfied:

- If the gNB determines that the 'COT sharing information' in CG-UCI in slot *n* indicates a row index that corresponds to a *CG-COT-Sharing-r17* that provides channel occupancy sharing information, the gNB can share the UE channel occupancy starting from slot $n+O$, where $O=$ *offset-r17* slots, for a duration of $D=$*duration -r17* slots where *duration-r17*, and *offset-r17* are higher layer parameters provided by *CG-COT-Sharing-r17*.

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

- If *ra-ChannelAccess-r17* is configured, the UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 2 channel access procedures as described in clause 4.4.2 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy. Otherwise, the UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 3 channel access procedures as described in clause 4.4.3 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy.

<Unchanged parts omitted>

TP CA-1-Wilus

4.4.4 Channel access procedures in an initiated channel occupancy

If a gNB/UE initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB/UE may transmit a DL/UL transmission(s) that is followed by a UL/DL transmission(s) within the maximum *Channel Occupancy Time* described in Clause 4.4.1. The followings are applicable to the UL/DL transmission(s):

- The transmission bandwidth(s) corresponding to the UL/DL transmission(s) shall be within the DL/UL bandwidth part(s) where in the channel occupancy is initiated:

- Regardless of the duration of the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the UL/DL transmission(s) and previous DL/UL transmission(s) on the channel is more than a threshold that is determined by the gNB and is at least $8μs$, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.2. Otherwise, the UL/DL transmission(s) occurs following the procedures described in Clause 4.4.3.

If a gNB initiates a channel occupancy using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a DL transmission(s) on the channel within the maximum *Channel Occupancy Time* described in Clause 4.4.1 on the channel after the DL transmission(s) initiating the channel occupancy. The followings are applicable to the DL transmission(s):

- Regardless of the duration of the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB, the DL transmission(s) occurs following the procedures described in Clause 4.4.3; or

- if the gap between the DL transmission(s) and any previous transmission(s) corresponding to the channel occupancy initiated by the gNB is more than a threshold that is determined by the gNB and is at least $8μs$, the DL transmission(s) occurs following the procedures described in Clause 4.4.2.

If a gNB shares a channel occupancy initiated by a UE using the channel access procedures described in clause 4.4.1 on a channel, the gNB may transmit a transmission on the channel that follows a scheduled UL transmission or a configured PUSCH transmission by the UE if the following conditions are satisfied:

- The DL transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.

When a UE is provided *cg-COT-SharingList-r17* by higher layers, the UE is configured with a table wherein each row is given by higher layer parameter *CG-COT-Sharing-r17*. One row of the table is configured for indicating that the channel occupancy sharing is not available and other rows of the table each provides a channel occupancy sharing information. In this case, each configured grant PUSCH transmission includes 'COT sharing information' in CG-UCI as described in [10] that indicates a row index to the table.

If a gNB shares a channel occupancy initiated by a UE using configured grant PUSCH transmission and the UE is configured by *cg-COT-SharingList-r17*, the gNB may transmit a transmission that follows the configured grant PUSCH transmission by the UE if the following conditions are satisfied:

- If the gNB determines that the 'COT sharing information' in CG-UCI in slot *n* indicates a row index that corresponds to a *CG-COT-Sharing-r17* that provides channel occupancy sharing information, the gNB can share the UE channel occupancy starting from slot $n+O$, where $O=$ *offset-r17* slots, for a duration of $D=$*duration -r17* slots where *duration-r17*, and *offset-r17* are higher layer parameters provided by *CG-COT-Sharing-r17*.

If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:

- The UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 2 channel access procedures as described in clause 4.4.2 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy if the higher layer parameter *ra-ChannelAccess-r17* is configured. Otherwise, the UE may switch from Type 1 channel access procedures as described in clause 4.4.1 to Type 3 channel access procedures as described in clause 4.4.3 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy.

# Discussion

Please provide your view in the following tables for the support AND objection for each alternative (Multiple choices are allowed).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Company | Alt 1 | Alt 2 | Alt 3 | Alt 4 | Alt 5 |
| Qualcomm | Y | N | Y | Y | N |
|  |  |  |  |  |  |

Please provide additional comments below:

|  |  |
| --- | --- |
| Company | Comments |
| Qualcomm | We don’t see a reliable way for UE to know the local regulation. Thus cannot support Alt 2. ra-ChannelAccess-r17 is for the control of a separate feature, and we don’t support sharing RRC control.We are open for Alt 1 or Alt 3. Alt 1 support the functionality is most cases and is preferred. Alt 3 is simpler (do nothing). Alt 4 is also acceptable for us though the spec impact might be larger. |
|  |  |

# References

1. R1-2302466, Discussions on the support of LBT type switching in the shared COT in FR2-2, vivo
2. R1-2302467, Correction on the LBT Type switching in the shared COT, vivo
3. Reserved
4. R1-2302529, Discussion on remaining issue for LBT upgrade within gNB COT, OPPO
5. R1-2302530, Draft CR on resolving issue for LBT upgrade within gNB COT, OPPO
6. R1-2302674, Discussion on LBT update upon detection of DCI format 2\_0 for FR2-2, CATT
7. R1-2302675, Draft CR on LBT update upon detection of DCI format 2\_0 for FR2-2, CATT
8. R1-2302832, Discussion on LBT type update upon detection of DCI format 2-0 for FR2-2, ZTE, Sanechips
9. R1-2302833, Draft CR on LBT type update upon detection of DCI format 2-0 for FR2-2 in TS 37.213, ZTE, Sanechips
10. R1-2303093, Discussion on LBT type upgrade within a gNB COT, Nokia, Nokia Shanghai Bell
11. R1-2303094, Correction on LBT Type determination within a gNB COT, Nokia, Nokia Shanghai Bell
12. R1-2303422, Draft CR on LBT type determination within a COT for FR2-2 in TS 37.213, LG Electronics
13. R1-2303566, Maintenance for channel access for FR2-2, Qualcomm Incorporated
14. Reserved
15. R1-2303796, Corrections to UL LBT Type 1 upgrade within gNB COT in TS37.213, Huawei, HiSilicon
16. R1-2303829, Draft CR on channel access procedure upon detection of a common DCI for FR2-2, WILUS Inc.