3GPP TSG-RAN WG1 Meeting #106-e Tdoc R1- 2108301

E-meeting, August 16th – 27th, 2021

Agenda Item: 8.3.2

Source: Moderator (Ericsson)

Title: Summary#1 - Enhancements for IIOT/URLLC on Unlicensed Band

Document for: Discussion, Decision

# 1 Introduction

This document summarizes the discussions in input contributions and during RAN1#106-e under the following email thread assigned by RAN1 Chair:

[106-e-NR-R17-IIoT-URLLC-03] Email discussion on unlicensed band URLLC/IIoT – Sorour (Ericsson)

* 1st check point: August 19
* 2nd check point: August 25
* 3rd check point: August 27

# 2 Discussion topics

## 2.1 Indication of Channels access parameters in DCI

During the last meeting, determination of ownership of a COT for a scheduled UL transmission was extensively discussed and led to the following agreement (to select Alt-a) where states that a COT-ownership for a scheduled UL transmission is provided by scheduling DCI.

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| Agreement:In semi-static channel access mode when a UE can operate as initiating device,* To determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT:
* Determination based on the content in the scheduling DCI
	+ FFS on whether the corresponding field(s) can be absent in DCI
		- If absent, determination based on the rules applied for configured UL transmissions is applied
	+ FFS whether/how to handle the case when the gNB schedules an UL transmission in the next gNB’s FFP period
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However, it was not agreed **“How” the COT ownership would be indicated in a scheduling DCI.**

The discussion in the last meeting on the solutions for the remaining design issue showed the inter-dependency between different aspects should be taken into account as summarized in the Moderator summary and described below:

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| **Clarification notes:*** In the following, for convenience, when it is mentioned “LBT fields in DCI”, it is referred to ChannelAccess-CPext-CAPC or ChannelAccess-CPext, in Rel-16 DCI.

**Summary of Rel-16 status:*** In Rel-16:
	+ In fall-back DCI (0\_0/1\_0), LBT fields for both LBE and FBE are always present (2-bits field)
	+ In non-fallback DCI 0\_1/1\_1, LBT fields for both LBE and FBE are present.
		- FBE: Always present (2-bits)
		- LBE: Configurable field size: DCI 0\_1 (0, 1, 2, 3 or 4 bits) and DCI 1\_1 (0, 1, 2, 3, 4, 5 or 6 bits)
	+ In non-fall back DCI 0\_2/1\_2, LBT fields for neither LBE or FBE is present.

**Summary of main design questions for Rel-17:**1. **How to indicate COT-initiator in scheduling DCI (0\_0/1\_0, 0\_1/1\_1, 0\_2/1\_2)?**
	1. Using LBT fields in DCI? Or other methods?
	2. An always present field or configurable to be absent
2. **Can the LBT fields in Rel-16 DCI 0\_1/1\_1 to be included in Rel-17 DCI 0\_2/1\_2 for FBE?**
3. **Can the LBT fields in Rel-16 DCI 0\_1/1\_1 to be included in Rel-17 DCI 0\_2/1\_2 for LBE?**
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**On using channel access field to indicate COT initiator**

* Common view among companies that the DCI content for determining COT-initiator should be based on channel access field. However, there is different view among companies if this field should be always present in a scheduling DCI.

**On presence/absence of COT initiator indication in DCI**

* Always present in DCI:
	+ Companies supporting this approach prefer to maintain the same procedures/functionality as Rel-16 and not to change the corresponding behaviour based on configuration of DCI format. The proponents are of the view that additional complexity is not worth the saving of 2-bits in DCI.
* Can be absent in DCI
	+ Companies supporting this approach are of the view that reducing DCI overhead by 2-bits is beneficial for URLLC operation, and in particular is aligned with the design principle for DCI X\_2 that should be respected. With respect to complexity concern for different UE behaviours in case of presence or absence of the field, the proponents’ view is that the UE should support both behaviours to accommodate both configured and scheduled UL transmissions anyway.

**On extension of Rel-16 channel access fields to DCI X\_2 for FBE/LBE**

* It seems all the companies in favour of extending the channel access field to DCI X\_2 for semi-static channel access mode with different views on its size as explained above (configurability to 0 or 2 bits).
* However, the views are different with respect to dynamic channel access mode. The proponents of extension support unified framework and consistent operation with minimum specification impact while the opponents consider that including is not align with the design principle for compact DCI and the enhancement is out of WID scope.

**On content of channel access field for FBE**

* Few companies proposed changes to Rel-16 table to determine the FBE channel access parameters for FBE where some example alternatives are shown below.
	+ Alt-1 and Alt-2 maintain indication of CP, as opposed to Alt-3. It is claimed in Alt-3 that indication of CP extension is not critical as LBE and can be skipped.
	+ On No sensing:
		- In Alt-1 is only feasible in case of sharing gNB COT.
		- In Alt-2, the baseline is based on UE-initiated COT if validated, otherwise gNB initiated COT.
		- In Alt-3, it can be either based on sharing gNB COT or UE-initiated COT.
* **Alt-1 (Apple):**

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| Bit field mapped to index | Channel Access Type  | The CP extension T\_"ext" index defined in Clause 5.3.1 of [4, TS 38.211] | gNB’s COT or UE-initiated COT |
| 0 | No sensing as defined in Clause 4.3 in TS 37.213 | 0 | gNB’s COT |
| 1 | No sensing as defined in Clause 4.3 in TS 37.213 | 2 | gNB’s COT |
| 2 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | gNB’s COT |
| 3 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | UE-initiated COT |

* **Alt-2 (Intel):**

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| Bit field mapped to index | Channel Access Type  | The CP extension T\_"ext" index defined in Clause 5.3.1 of [4, TS 38.211] | gNB’s COT or UE-initiated COT |
| 0 | No sensing as defined in Clause 4.3 in TS 37.213 | 0 | UE-initiated COT if condition A, otherwise gNB’s COT |
| 1 | No sensing as defined in Clause 4.3 in TS 37.213 | 2 | UE-initiated COT if condition A, otherwise gNB’s COT |
| 2 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | gNB’s COT |
| 3 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | UE-initiated COT |

Condition A: the UE has previously received explicit indication to operate as initiating device within a specific u-FFP, it was able to succeed LBT, and the time-domain resources for the current UL burst fall within the same u-FFP

* **Alt-3 (Ericsson)**

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| Bit field mapped to index | Channel Access Type  | gNB’s COT or UE-initiated COT |
| 0 | No sensing  | gNB’s COT |
| 1 | No sensing  | UE-initiated COT |
| 2 | 9us sensing  | gNB’s COT |
| 3 | 9us sensing  | UE-initiated COT |

## 2.1.1 Discussion – 1st round

**Proposals and summary of views:**

**Proposal 1-1:**

* In semi-static channel access mode, the content in a scheduling DCI that indicates the assumption on the COT-initiator for the scheduled transmission is determined based on the channel access field in the DCI.
	+ **Common view**

**Proposed Conclusion 1-1:**

* In semi-static channel access mode,
* The channel access field in Rel-16 DCI 0\_1 and 1\_1 is included in Rel-17 DCI 0\_2 and 1\_2, respectively.
	+ **Supported by: Intel, QC, Nokia/NSB, Ericsson, Samsung, Apple, MTK, FW, Sharp, Sony?, CATT?, Pana, Vivo, WILUS, DCM, ETRI, NEC, ZTE. HW/HiSi?**

**Proposal 1-2:**

* In semi-static channel access mode, the size of channel access field in a scheduling DCI with format 0\_0/1\_0, 0\_1/1\_1, 0\_2/1\_2 is:
	+ A) 2-bits
		- **Supported by: Intel, QC, Nokia/NSB, Ericsson, Samsung, Apple, MTK, FW, Sharp, Sony?, CATT?, Pana**
	+ B) 0 or 2-bits by configuration
		- **Supported by: Vivo, WILUS, DCM, ETRI, NEC, ZTE, Pana, HW/HiSi?**
			* B1) 0 or 2 bits by configuration for DCI format 0\_0/1\_0, 0\_1/1\_1, 0\_2/1\_2
			* B2) 0 or 2 bits by configuration for DCI format 0\_2/1\_2, 2-bits other formats

**Proposal 1-3:**

In dynamic channel access mode,

* Option 1: The channel access field in Rel-16 DCI 0\_1 and 1\_1 is included in Rel-17 DCI 0\_2 and 1\_2, respectively.
	+ **Supported by: LG, Nokia/NSB, Ericsson, Pana, WILUS**
* Option 2: The channel access field in Rel-16 DCI 0\_1 and 1\_1 is NOT included in Rel-17 DCI 0\_2 and 1\_2, respectively.
	+ **Supported by: HW/HiSi, MTK**

**Proposal 1-4:**

* In semi-static channel access mode, determine the interpretation of 2-bits channel access field in a DCI scheduling a UL transmission by further studying at least the following:
	+ Whether no sensing is only applicable in case of sharing the gNB COT
	+ Whether no sensing is based on UE-initiated COT if validated, and gNB initiated COT otherwise.
	+ Whether no sensing is applicable to both gNB initiated COT and UE initiated COT.
	+ Whether it is needed to indicate CP extension
	+ …

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| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2**: Do you agree with the following assessment and categorization by moderator? If not, please suggest for improvement.
	+ Moderator understanding is Proposal 1-1 reflects companies view. Given that assessment of the moderator is correct, Proposed conclusion 1-1 would be the direct consequence of agreeing to Proposal 1-1 since DCI 0\_2/1\_2 format is a scheduling DCI for UL transmission. Therefore, by agreeing to Proposal 1-1, for clarity one can draw conclusion 1-1. Please note that the split in views on configurability of the channel access fields is reflected in Proposal 1-2.
* **Q3:** It is not clear to moderator that proponents of Proposal 1-2B prefer B1 or B2. Can you please clarify whether B1 or B2 is preferred?
* **Q4:** Proposal 1-4 is considered as a starting point for discussion. Please share your views how to proceed to solve the signalling and update the proposal, accordingly.
* **Q5:** Please share any other comments if needed.
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| **Company** | **Comment** |
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## 2.2 Cross-FFP scheduling

With respect to cross-FFP scheduling, the validity of indicated COT-initiator is remained to be resolved as highlighted in the follwong agreements.

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| Agreement:In semi-static channel access mode when a UE can operate as initiating device,* To determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT:
* Determination based on the content in the scheduling DCI
	+ FFS on whether the corresponding field(s) can be absent in DCI
		- If absent, determination based on the rules applied for configured UL transmissions is applied
	+ FFS whether/how to handle the case when the gNB schedules an UL transmission in the next gNB’s FFP period

Agreement**:*** In semi-static channel access mode, the gNB can schedule by a DCI UL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI.
	+ The UL transmission can occur only if the corresponding channel access requirements are met.
		- FFS on details.

Agreement**:*** In semi-static channel access mode, the gNB can schedule by a DCI DL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI.
	+ The DL transmission can occur only if the corresponding channel access requirements are met.
		- FFS on details.
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As the agreements show, cross-FFP scheduling is supported. However, it is remained to clairfy how to interpret the indicated COT-initiaor for a DL or UL scheuled transmission.

**On UE behavior for scheduled UL transmission**

Companies epxress different views in that regard, specially with respect to UL transmission. The view are summarized by the aternatvies below.

* Alt-1: The shceudled UL is assumed to be based on UE-initiaited COT irrepective of the indicated COT ownersip.
* Alt-2: The rules for configured UL tranmission is applied for the scheduled UL transmisison irrespective of the indicated COT ownership.
* Alt-3: The UE follows the indicated COT ownership. If the COT ownership is not validated the transmission is dropped.
* Alt-4: If gNB-initiated COT is indicated and validated by UE, the UE follows the indicated COT ownership. Otherwise, the UE assumes UE initiated COT.

One can observe a common factor in the defined behaviour between Alt-1 and Al-t2 is that for cross-FFP scheduling, UE ignores the indicated COT ownership assumptions. However, in Alt-3 and Alt-4, the indicated assumption is respected and UE determines whehter the assumption is valid. If it is not valid, ether the UE drops the transmission (Alt-3) or in case a gNB COT sharing is indicated it is not validated, the UE changes the assumption to the UE-initiated COT instead (Alt-4). Note that for validtion of gNB COT, some companies (e.g. Samsung, Sony) discussed the common/group signalling as well.

**On UE behavior for scheduled DL transmission**

Few companies epxress different with respect to DL transmission. The view are summarized by the aternatvies below.

* + Alt-1: If the gNB is unable to validate the assumption on COT initiator in the DCI for the scheduled DL transmission(s), the gNB would cancel the scheduled DL transmission(s) and the UE would not detect the DL transmission.
	+ Alt-2:Study how the UE determines the COT initiator associated to the DL transmission resource.

## 2.2.1 Discussion – 1st round

**Proposals and summary of views:**

**Proposal 2-1:**

* In semi-static channel access mode, when the gNB schedules by a DCI a UL transmission in a later g-FFP that is different from the g-FFP that carries the scheduling DCI, select one of the following alternatives
* Alt-1: The shceudled UL is assumed to be based on UE-initiaited COT irrepective of the indicated COT ownersip.
	+ **Supported by: Intel, WILUS**
* Alt-2: The COT determination rules for configured UL tranmission is applied for the scheduled UL transmisison irrespective of the indicated COT ownership.
	+ **Supported by: IDC, FGI, Asia Pacific, vivo, HW/HiSi, ZTE**
* Alt-3: The UE follows the indicated COT ownership. If the COT ownership is not validated the transmission is dropped.
	+ **Supported by: Spreadtrum, Ericsson, Apple, FW, Sharp, LG?, HW/HiSi, Samsung**
* Alt-4: If gNB-initiated COT is indicated and validated by UE, the UE follows the indicated COT ownership. Otherwise, the UE assumes UE initiated COT.
	+ **Supported by: ZTE, Sony, Nokia/NSB**

**Proposal 2-2:**

* In semi-static channel access mode, when the gNB schedules by a DCI DL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI,
	+ Alt-1: If the gNB is unable to validate the assumption on COT initiator in the DCI for the scheduled DL transmission(s), the gNB would cancel the scheduled DL transmission(s) and the UE would not detect the DL transmission.
		- **Supported by: Spreadtrum Ericsson, Intel**
	+ Alt-2:Study how the UE determines the COT initiator associated to the DL transmission.
		- **Supported by: IDC, Nokia/NSB**

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| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2**: Please provide your view with respect to the alternatives above and provide suggestions for progress and update the proposal if possible.
* **Q3:** Please share any other comments if needed.
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| **Company** | **Comment** |
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## 2.3 UE-to-gNB COT sharing

When a DL transmission is intended based on sharing a COT that is initiated by a UE, few aspects are remained to be clarfied whihc we discuss in this section.

**On content and duration of DL and transmisison gap**

* Few companies disucssed that the stringent conditions on DL transmisisons based on UE-initiated COT is not applicable to FBE mode. A DL transmisison burst that is confined within the UE FFP before idle period and includes at least transmisison intended to the initiating UE, is allowed. If the gap betweem UL and DL is less or more than 16us, it not affecting the duration of the DL transmisison.

**On ED threshold adjutment**

* Few companies, e.g. Intel and HW/HiSi motivated relaxation in ED threshold in Rel-17 and FBE operation mode as compared to Rel-16. Intel provides a detailed explanaton of Rel-16 behaviour and justifies that the UE EDT should be solely based on UE transmit power. HW/HiSi largely shares the same view, however reserves some consideration if the gNB is allowed to share the CO initiated by the UE, without the UE adjusting the EDT, for transmitting unicast user plane data to other UEs as well.

**On indication of COT-initiatior in CG-UCI**

* Few companies, e.g. vivo and IDC discussed that it is necessary that the assumption on the COT-initiaor for the UL CG transmisison is inlucded in the CG UCI when provided, i.e. when *cg-RetransmissionTimer-r16* is enabled and a UE operates as an initiating device. Vivo argues that the COT determination rule for configured UL is subject to ambiguity due to misdetection or mis-alignment between UE and gNB.

## 2.3.1 Discussion – 1st round

**Proposals and summary of views:**

**Proposal 3-1:**

* In semi-static channel access mode, a DL transmission burst based on a UE initiated COT sharing for a UE FFP, can be transmitted to any other UE in the cell than the COT initiating UE if the DL transmission burst at least includes data or control intended for the UE that initiated that FFP.
	+ **Ssupported by: Intel, LG, Ericsson, Spreadtrum**

**Proposal 3-2:**

* When a UE operates as an initiating device, and shares its own FFP with the serving gNB, if the gap between the UL and DL burst is less than 16us, no restriction is imposed on the maximum length of the DL burst
	+ **Supported by: Intel, Ericsson**

**Proposal 3-3:**

* For semi-static channel access when a UE operating as an initiating device acquires its FFP, support gNB sharing of the CO initiated by the UE with a sensing ED threshold that is calculated based on the UE’s transmit power, for DL transmissions including unicast user plane data to the same UE.
	+ FFS: whether the calculation of sensing EDT is applicable for DL transmissions with unicast user plane data to other UEs with a UL-to-DL gap is more than 16us
		- **Supported by: HW/HiSi, Intel (supports FFS)**

**Proposal 3-4:**

* In semi-static channel access mode when a UE operates as an initiating device and the cg-RetransmissionTimer-r16 is enabled and the CG-UCI is piggybacked within a CG PUSCH transmission, the CG-UCI includes the indication of the COT-initiator, i.e. UE-initiated COT or gNB-initiated COT for the CG PUSCH.
	+ **Supported by: vivo, IDC**

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| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2**: Proponents of Proposal 3-3 are kindly requested to provide clarification for better understanding of the proposal, in particular on the condition for DL transmissions. It is not clear whether it is meant that the DL transmission includes only unicast user plane data to the same UE or includes at least unicast user plane data to the same UE.
	+ The proposal can be updated to more accurately reflect the intention. Also, based on clarification, one can use the term “DL transmission burst” if applicable.
* **Q3:** Please share any other comments if needed.
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| **Company** | **Comment** |
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## 2.4 UE initiated COT for Wideband operation

Few companies discussed issue that may need additional consideration for Wideband operation.

**On FFP parameter configuration**

* Nokia suggests considering further study for FFP configuration per channel in Wideband. It is discussed that in case of wideband operation, different 20 MHz channels (and the corresponding RB sets) could in principle have different transmission characteristics, and hence also different FFP configuration. This could be helpful in reducing the access delay, as the latency associated with getting a transmission opportunity can be minimized with time-interlaced FFP stating points. On the other hand, channel specific FFP configuration slightly increases the configuration complexity.

**On alignment of COT-initiator assumption for Wideband operation**

* Few companies e.g. Intel and LG discussed the issue of misalignment between COT-initiator assumption across Wideband. For example, Intel discusses that when a system operates in wideband, the CCA procedure in each LBT bandwidth (BW) may have a different outcome. It is claimed that while in principle a UE may assume that it can operate differently in every LBT BW, this may have several drawbacks. In fact, this may not only complicate the design, but it may induce additional interference among devices, while on the other hand allowing the UE to switch in ad-hoc manner between responding and initiating device operation based on the outcome of the LBT increasing the likelihood of a UE to be able to transmit. It is further argued that given that the targeted scenario of URLLC is within a controlled environment where maintaining a coordination among gNB and UEs and reducing power consumption may be critical, it may be preferred if there may be alignment among the assumptions made by a UE across all LBT BWs.

## 2.4.1 Discussion – 1st round

**Proposals and summary of views:**

**Proposal 4-1:**

* Consider, whether RB set (i.e. 20 MHz channel) specific configuration of UE FFP is supported with wideband operation.
	+ **Supported by: Nokia/NSB**

**Proposal 4-2:**

* Consider to align the assumption of FFP type for multiple RB sets in a carrier/BWP under the unaligned FFP structure between UE and gNB.
	+ **Supported by: LG, Intel**

**Proposal 4-3:**

* When operating on multiple carriers, the assumptions regarding the COT initiator are aligned across all carriers/ LBT BWs. In this case, a UE could assume to operate:
* as an initiating device over all RBs if for at least one LBT BW i) the UE assesses that it shall operate as initiating in that LBT BW or ii) the UE has received indication to the gNB that it shall operate as an initiating device; or
* as a responding device over all RBs, if for each LBT BW i) the UE assesses that it shall operate as a responding device or ii) the UE has received indication from the gNB that it shall operate as responding device.
	+ **Supported by: Intel, LG?**

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| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2:** Please share any other comments if needed.
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## 2.5 Control of UE-initiated COT

Some of companies have discussed mechanisms to control a COT in a UE-FFP by RRC or dynamically.

In previous meetings companies indicated lack of support for proposals that by RRC UE initiated COT would be disabled for a set of occasions.

With respect to RRC configuration, HW/HiSi proposes to include a parameter in RRC configuration of UE FFP that determines the interval that the UE initiated COT would be applicable.

With respect to dynamically updating the COT assumption, companies suggest enabling this functionality for Rel-17 FBE similarly to Rel-16 LBE.

Among the proposed proposals, few are suggested for discussion next.

## 2.5.1 Discussion – 1st round

**Proposals and summary of views:**

**Proposal 5-1:**

* In semi-static channel access mode, the gNB is allowed to overwrite through scheduling DCI any prior indication regarding the initiator of a COT.
	+ FFS on details, e.g. required processing time when applicable
	+ **Supported by: Intel**

**Proposal 5-2:**

* In semi-static channel access mode when a UE can operate as an initiating device, for a UL transmission, the UE can be dynamically indicated to change its assumption on the associated COT initiator for the UL transmission via DCI format 2\_0.
	+ FFS on details, e.g. required processing time when applicable
	+ **Supported by: DCM**

**Proposal 5-3:**

* On the semi-static configuration of UE-initiated FFP in a given unlicensed channel, the UE should be provided with a parameter to limit its COT to an indicated duration, such that the COT ends before the idle period/CCA of a subsequent frame of that UE FFP.
	+ **Supported by: HW/HiSi**

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| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2:** Please share any other comments if needed.
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## 2.6 UE-initiated COT in Inactive/Idle mode

Companies view on support of UE-initiated COT in inactive/idle mode is still divided.

The proponents of supporting UE-initiated COT for inactive/idle UEs furthermore provides details on signalling and procedures. However, the opponents are not convinced the enhancement is justified or beneficial for URLLC/IIOT applications. Therefore, in order to have constructive discussions, it is helpful to discuss the motivations or the concerns for support of the feature together with the corresponding design consideration.

The proposal below, aims to capture the views with respect to the discussion topic, on high level.From moderator perspective, **it is important to make a decision on this topic this meeting** since in case of support, there will be higher impacts that requires timely consideration.

## 2.6.1 Discussion – 1st round

**Summary of companies view:**

**Proposal 6-1:**

* Select one of the following options:
	+ Option 1: UE-initiated COT for semi-static channel occupancy in IDLE/INACTIVE mode is supported. FFS on details.
		- **Supported by: Intel, QC, vivo, Sony, Nokia/NSB, Ericsson, IDC, Samsung, Apple, WILUS, MTK**
	+ Option 2: UE-initiated COT for semi-static channel occupancy in IDLE/INACTIVE mode is NOT supported.
		- **Supported by: HW/HiSi, Spreadtrum. DCM**

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| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2**: Do you agree with moderator’s recommendation for a decision at this meeting?
* **Q3:** Please provide any additional comments that can help the progress
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| **Company** | **Comment** |
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## 2.7 CG Harmonization for operation on unlicensed band

With respect to CG harmonization, in general there are two overall dimensions:

* 1) CG PUSCH with repetition in unlicensed
	+ Type A PUSCH repetition non-back to back (Rel-15 NR)
	+ Type A PUSCH repetition with back-to-back (Rel-16 NR-U)
	+ Type B PUSCH repetition (Rel-16 URLLC)
* 2) CG PUSCH
	+ Rel-16 NR-U based
	+ Rel-16 URLLC based

**On harmonization on the 1st dimension**

The harmonization on the1st dimension is still under discussion. Basically, there are the following views:

* Alt-1: Do not combine of any of the repetition modes for enhancements
* Alt-2: Do not combine of any of the repetition modes for enhancements and exclude Non-b2b Type A repetition
* Alt-3: Combine Type B and Type A back-2-back
* Alt-4: Combine Type A non-b2b and Type A back-2-back

Since any of the combination/exclusion alternatives (i.e. Alt-2, Alt-3, Alt-4) would impact RRC configurations, a decision or conclusion at this meeting on which alternatives to discuss further is critical. From moderator review, it seems that only Alt-1 and Alt-3 have good support. Therefore, it is constructive that for the remaining of the WI to focus on Alt-1 and Alt-3.

**Moderator observation:**

* Lack of considerable support for exclusion of Non-b2b Type A CG PUSCH repetition (Alt-2 above) or combination of b2b and bob-b2b Type A CG PUSCH repetition (Alt-4 above)

**Moderator recommendation:**

* In the remaining of the WI, do not discuss further Alt-2 and Alt-4. Focus the discussion to conclude whether Alt-3 is supported or not (i.e. Alt-1).

The recommendation is in fact suggests to select an option from the agreement below.

Agreement:

* Select one of the following options (aiming for RAN1#105-e):
	+ Option 1: Do not support PUSCH repetition Type B~~when using~~ based on NR-U Rel-16 ~~based~~ CG for unlicensed band operation.
	+ Option 2: Support enhancements of PUSCH repetition Type B ~~when using~~ based on NR-U Rel-16~~based~~ CG for unlicensed band operation. FFS whether/how to enhance

The companies’ view is split between these two options. Companies supporting Option 2, have provided different approaches on how to implement the combination. However, companies in favour of the Option 1 are not convinced of the need and additional benefits. Either way, due to potential RRc impact a decision at this meeting on the preferred option would be helpful.

**On harmonization on the 2nd dimension**

The harmonization on the2nd dimension was finally concluded in last meeting where the operation based on Rel-16 NR-U or Re-16 URLLC is done based on configuration of *cgRetransmisisonTimer*. There are few remaining aspects that companies have raised to ensure proper operations with or without repetitions. The following summarizes few of these proposals.

* PUSCH segmentation for PUSCH repetition Type-B and idle period (Discussion based on the agreement from last meeting)
* How to treat the orphan symbols for PUSCH repetition Type-B (Discussion based on the agreement from last meeting)

## 2.7.1 Discussion – 1st round

**Summary of companies view:**

**Proposal 7-1:**

Agreement:

* Select one of the following options (aiming for RAN1#105-e):
	+ Option 1: Do not support PUSCH repetition Type B based on NR-U Rel-16  CG for unlicensed band operation.
		- **Supported by: HW/HiSi, vivo, Ericsson, DCM, Nokia/NSB**
	+ Option 2: Support enhancements of PUSCH repetition Type B based on NR-U Rel-16 CG for unlicensed band operation. FFS whether/how to enhance
		- **Supported by: Intel, QC, LG, IDC, Samsung, Apple, OPPO**

**Proposal 7-2:**

* For PUSCH repetition Type B enhancements on unlicensed spectrum, the symbols in an idle period that the UE is not allowed to perform a UL transmission, should be considered as invalid symbols which are not considered for an actual repetition as in Rel-16.
	+ **Supported by: LG, Ericsson, IDC, Samsung, DCM, FGI, Asia Pacific**

**Proposal 7-3:**

* For PUSCH repetition Type B enhancements on unlicensed spectrum, select one of the following options
	+ Option 1: Orphan symbol(s) are dropped as in Rel-16
		- **Supported by: Ericsson, Samsung**
	+ Option 2: Orphan symbol(s) are transmitted if they are between two actual repetitions that are transmitted. FFS on details
		- **Supported by: OPPO, QC (using CP extension), LG, IDC, Apple, DCM, ETRI**

|  |
| --- |
| **Questions:** * **Q1**: Companies are kindly requested to provide any update/correction on the discussion and their corresponding positions with respect to the proposals above.
* **Q2**: Do you agree with moderator’s observation and recommendation for scoping the discussion and decision at this meeting?
* **Q3:** Please provide any additional comments that can help the progress
 |
| **Company** | **Comment** |
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## 2.8 Other issues

Companies discussed other issues where few of them are listed below along with a recommendation from Moderator:

* **Issue#1:** Clarification on the configuration of cg-RetransmissionTimer is per CG or per cell when multiple CGs are configured for an unlicensed carrier (vivo)
	+ **Moderator comment:** It should be per cell to implement RAN1 agreement in previous meeting. However, it seems that is within RAN2 responsibility to ensure configurations are updated properly to reflect Reel-17 agreements.
* **Issue#2:** COT-initiator indication for multi-PUSCH scheduled by a single DCI (CATT)
	+ **Moderator comment:** The issue can be addressed after finalization of discussion in section 2.1. One possible outcome is that the since the indicated COT-initiator is applicable to all PUSCH, every PUSCH follows the same behaviour that to be agreed in section 2.1.
* **Issue#3:** UCI multiplexing and prioritization in CG PUSCH, configuration of PHY-PriorityIndex (Nokia, LG,vivo, ..)
	+ **Moderator comment:** Based on the Rel-16 maintenance and Rel-17 Intra-UE ongoing work, the issues can be postponed when more progress is made. Meanwhile, f there are isolated issues without dependency to ongoing work REl-16/Rel-17 work in Intra-UE multiplexing, it is appreciated the help to initiate the discussion.
* **Other issues:**
	+ Consideration with respect to timeline and processing time (MTK)
	+ Enhancement of Ul cancellation indication mechanism to efficiently handle interlaced frequency resource allocation (Apple)
	+ Disabling UE-initiated COT by RRC for P-CSI and/or SRS (Apple)
	+ Not dropping the beginning of a low priority transmission due to prioritization if it could initiate a UE COT (Len/MOT)
	+ Consideration on SCS and FFP configuration (LG, ETRI,..)
	+ …

## 2.8.1 Discussion – 1st round

|  |
| --- |
| **Questions:*** Please share your view on the issues or recommendations above and provide suggestions on topics that are critical for design and should be prioritized for discussions, even if they are not included in this summary.
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| **Company** | **Comment** |
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# 3 Conclusion

TBD

# 4 References

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| --- | --- | --- | --- |
| 1 | [**R1-2106493**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106493.zip) | Uplink enhancements for URLLC in unlicensed controlled environments | Huawei, HiSilicon |
| 2 | [**R1-2106588**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106588.zip) | Enhancements for unlicensed band URLLC/IIoT | vivo |
| 3 | [**R1-2106680**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106680.zip) | Enhancements for IIoT/URLLC on Unlicensed Band | Ericsson |
| 4 | [**R1-2106699**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106699.zip) | Discussion on enhancements for unlicensed band URLLC/IIoT | Spreadtrum Communications |
| 5 | [**R1-2106736**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106736.zip) | Discussion on unlicensed band URLLC/IIoT | ZTE |
| 6 | [**R1-2106764**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106764.zip) | UL enhancements for IIoT/URLLC in unlicensed controlled environment | Nokia, Nokia Shanghai Bell |
| 7 | [**R1-2106803**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106803.zip) | Considerations on Unlicensed URLLC | Sony |
| 8 | [**R1-2106881**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106881.zip) | Enhancements for unlicensed band URLLC/IIoT | Samsung |
| 9 | [**R1-2106964**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106964.zip) | Discussion on remaining issues on enhancements for unlicensed band URLLC/IIoT | CATT |
| 10 | [**R1-2107013**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107013.zip) | Enhancements for unlicensed band URLLC/IIoT | NEC |
| 11 | [**R1-2107103**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107103.zip) | UE initiated COT for semi-static channel access | FUTUREWEI |
| 12 | [**R1-2107114**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107114.zip) | Enhancements for unlicensed band URLLC/IIoT | Panasonic Corporation |
| 13 | [**R1-2107186**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107186.zip) | Enhancements for unlicensed band URLLC/IIoT | Lenovo, Motorola Mobility |
| 14 | [**R1-2107274**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107274.zip) | Enhancements for unlicensed band URLLC/IIoT | OPPO |
| 15 | [**R1-2107294**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107294.zip) | Enhancements for unlicensed band URLLC/IIoT | FGI, Asia Pacific Telecom |
| 16 | [**R1-2107338**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107338.zip) | Uplink enhancements for URLLC in unlicensed controlled environments | Qualcomm Incorporated |
| 17 | [**R1-2107445**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107445.zip) | Discussion on unlicensed band URLLC/IIOT | LG Electronics |
| 18 | [**R1-2107473**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107473.zip) | Enhancements for unlicensed band URLLC/IIoT | ETRI |
| 19 | [**R1-2107493**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107493.zip) | On the enhancements for unlicensed band URLLC/IIoT | MediaTek Inc. |
| 20 | [**R1-2107585**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107585.zip) | On the Details for Enabling URLLC/IIoT in Unlicensed Band | Intel Corporation |
| 21 | [**R1-2107640**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107640.zip) | Enhancements for unlicensed band URLLC/IIoT | InterDigital, Inc. |
| 22 | [**R1-2107734**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107734.zip) | URLLC uplink enhancements for unlicensed spectrum | Apple |
| 23 | [**R1-2107792**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107792.zip) | Enhancements for unlicensed band URLLC/IIoT | Sharp |
| 24 | [**R1-2107853**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107853.zip) | Discussion on enhancements for unlicensed band URLLC | NTT DOCOMO, INC. |
| 25 | [**R1-2108153**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2108153.zip) | Discussion on enhancement for unlicensed URLLC/IIoT | WILUS Inc. |

# 5 Appendix

## 5.1 List of agreements

### 5.1.1 Agreements in RAN1#102-e

Agreements:

* For semi-static channel access mode,
* If sensing is needed, it is performed immediately before the configured/scheduled transmission opportunity.
* For operation with semi-static channel access, the Rel-16 random starting offsets for UL configured grants with Full BW allocation when UE initiates a COT, is not supported.

Agreements:

* For semi-static channel access mode,
	+ When gNB operates as an initiating device
		- The gNB is not allowed to transmit during the idle period of any FFP associated with the gNB in which the gNB initates a COT
	+ When a UE operates as an initiating device
		- The UE is not allowed to transmit during the idle period of any FFP associated with the UE in which the UE initates a COT
	+ When a UE shares a COT initiated by the gNB during an FFP associated with the gNB
		- The UE is not allowed to transmit during the idle period of that FFP in which the UE shares the COT initiated by the gNB
	+ When the gNB shares a COT initiated by a UE during an FFP associated with the UE
		- The gNB is not allowed to transmit during the idle period of that ~~the~~ FFP in which the gNB shares the COT initiated by the UE
	+ FFS whether/how to support additional restrictions to the idle period

Agreements:

* For semi-static channel access mode, support using the transmission of any scheduled/configured UL channel/signal to initiate a COT by a UE in RRC\_CONNECTED mode
	+ FFS the case when the UE is IDLE/INACTIVE mode

Agreements:

* A UE initiates a COT in an FFP associated with the UE, if the UE transmits a UL transmission burst starting at the beginning of the FFP and ending at any symbol before the FFP’s idle period after a successful CCA of 9us immediately before the UL transmission burst.

Update on 8/26

Agreements:

* At least for FBE, configuration of (*cg-RetransmissionTimer*) should not be mandated when configured grant Type 1 or Type 2 are configured on unlicensed spectrum.

**Conclusion:**

Further study and decide how to harmonize the CG features for Rel-16 URLLC and Rel-16 NR-U. Table 1 in [R1-2005376](file:///C%3A/Users/wanshic/OneDrive%20-%20Qualcomm/Documents/Standards/3GPP%20Standards/Meeting%20Documents/TSGR1_102/Docs/R1-2005376.zip) can be used as a starting point for the corresponding discussion and decision.

Agreements:

* Conditions on the channel access procedures with respect to sensing duration and transmission gap for UE-initiated COT with UE-to-gNB COT sharing is similar as those for gNB initiated COT and gNB-to-UE COT sharing in Rel-16 by exchanging UE and gNB roles.

Agreements:

* UE-to- gNB COT sharing in semi-static channel access mode is supported.
	+ The gNB determines a COT in an FFP associated to a UE, that is initiated by the UE, if the gNB detects a UL transmission from the UE starting from the beginning of the FFP and ending before the idle period of the FFP.
		- FFS details
	+ When the gNB determines a UE has initiated a COT in an FFP associated to the UE, the gNB can transmit within the FFP and before the idle period corresponding to the FFP.
		- FFS whether/how UE to gNB COT sharing when the gap is >16us

Update from 8/28 GTW

Agreements:

For semi-static channel access mode,

o    Start of FFP for UE-initiated COT can be different from the start of FFP for gNB-initiated COT.

o    FFS: FFP Periodicity for UE-initiated COT can be different from the FFP periodicity for gNB-initiated COT.

Agreements:

* For semi-static channel access mode,
* FFP parameters for UE-initiated COT can be provided to the UE by at least dedicated RRC signaling.
	+ FFS on to be provided by SIB-1
* FFS whether the UE FFP periodicity is explicitly configured, or implicitly determined based on other higher layer parameters

### 5.1.2 Agreements in RAN1#103-e

Agreements:

* In semi-static channel access mode, a single FFP (periodicity and offset) is associated to an initiating device (gNB or UE) at a given time which can be used for the purpose of channel occupancy. The FFP configuration that is used for initiating channel occupancy purposes, is such that it shall not be changed for at least 200ms

**Conclusion:**

* For operation on unlicensed channels and irrespective of the adopted LBT mechanism (LBE or FBE), all transmissions in DL and UL are controlled by gNB similarly to licensed channels, and potential collisions or blocking are controlled/mitigated by gNB.

Agreements:

* + UE-to-gNB COT sharing in semi-static channel access mode with a gap > 16us is supported

**Conclusion:**

If a device X at a given time is initiating a COT, the applicable FFP for the device X is the FFP associated with X.

If a device X at a given time is sharing a COT initiated by a device Y, the applicable FFP for the device X is the FFP associated with Y.

Note 1: One of the devices X and Y is a UE and the other is its serving gNB.

Note 2: Whether or not there is additional restriction on idle period is still FFS.

**Agreements:**

Down-select one of the following options (target RAN1#104-e):

* **Option 1:** Both “CG-UCI based procedures” and “CG-DFI based procedures” are enabled or disabled for unlicensed using one RRC parameter i.e. *cg-RetransmissionTimer-r16*.
* **Option 2-a:** “CG-UCI based procedures” and “CG-DFI based procedures” are independently enabled or disabled for unlicensed using respective RRC parameter, i.e. new parameter X and *cg-RetransmissionTimer-r16,* respectively.
* **Option 2-b:** “CG-UCI based procedures” and “CG-DFI based procedures” are independently enabled or disabled for unlicensed using respective RRC parameter, i.e. new parameter X and new parameter Y, respectively, where X and Y are different from *cg-RetransmissionTimer-r16.*
* **Option 3:** CG-UCI based procedures are supported for unlicensed. CG-DFI based procedures are enabled or disabled for unlicensed using one RRC parameter *i.e. cg-RetransmissionTimer-r16*
* Note: Procedures based on CG-UCI rely on UE including CG-UCI in CG PUSCH at least as in Rel-16 where the values of the respective fields of CG-UCI are decided by UE.
* Note: Procedures based on CG-DFI rely on automatic re-transmission on CG configuration and reception of CG downlink feedback information (DFI) in DCI for re-transmissions.

Agreements:

* The gNB configures a UE to initiate semi-static CO in an unlicensed channel(s) only if the gNB configures the UE also with the higher layer parameters of the gNB’s initiating semi-static CO in the same channel(s).
	+ Note: UE initiated FBE configuration is configured per serving cell

Agreements:

In semi-static channel access mode, FFP Period for UE-initiated COT is separately provided from FFP period for gNB-initiated COT.

o    Note: Any value for the period, shall be at least 1ms and at most 10ms.

o    Note: Aim for low complexity operation to handle gNB and UE COT interactions

Agreements:

In semi-static channel access mode, a UE should be able to determine whether a scheduled UL transmission should be transmitted according to shared gNB COT or UE-initiated COT.

* UE determines the initiator of a COT based on at least one of the following alternatives:
	+ Alt 1: Introduce additional bit field in the scheduling DCI
	+ Alt 2: Based on ChannelAccess-CPext field in DCI
	+ Alt. 3: Based on a predetermined rule(s)
	+ Alt. 4: Based on RRC signalling
	+ Alt. 5: Based on MAC CE
	+ FFS other alternatives
* FFS on overriding possibility and/or the assumption
* Note: A scheduled UL transmission cannot be transmitted according to both shared gNB COT and UE-initiated COT.

Agreements:

In semi-static channel access mode:

* When a configured UL transmission is aligned with a UE FFP boundary and ends before the idle period of that UE FFP associated to the UE, down-select one of the following:
	+ Alt-a: If the transmission is confined within a gNB FFP before the idle period of that gNB FFP, and the UE has already determined that gNB is initiated that gNB FFP, UE assumes that the configured UL transmission corresponds to gNB-initiated COT. Otherwise, UE assumes that the configured UL transmission corresponds to UE-initiated COT
	+ Alt-b: The UE assumes that the configured UL transmission corresponds to UE-initiated COT.
	+ Alt-c: The UE assumption on whether the configured UL transmission is allowed to correspond to UE-initiated COT is based on gNB configuration.
* When a configured UL transmission starts after a UE FFP boundary and ends before the idle period of that UE FFP associated to the UE:
	+ If the UE has already initiated the UE FFP, then UE assumes that the configured UL transmission corresponds to UE-initiated COT
	+ Otherwise, If the transmission is confined within a gNB FFP before the idle period of that gNB FFP, and if the UE has already determined that gNB has initiated that gNB FFP, then UE assumes that the configured UL transmission corresponds to gNB-initiated COT.
* FFS on other conditions for determining the corresponding UE or gNB initiated COT
* Note: A configured UL transmission cannot be transmitted according to both shared gNB COT and UE-initiated COT.

### 5.1.3 Agreements in RAN1#104-e

Agreement:

* PUSCH repetition Type B is supported for unlicensed band operation when using NR IIoT Rel-16 based CG
	+ FFS whether/how to enhance

Agreement**:**

* In semi-static channel access mode, UE FFP periodicity is chosen from the following set of values in ms: {1, 2, 2.5, 4, 5,10}.
	+ FFS on other values

Agreement:

* In semi-static channel access mode:
	+ An FFP period for UE-initiated COT is configured as the same, integer multiple of, or inter-factor of the FFP period configured for gNB-initiated COT
	+ FFP period for UE-initiated COT can be configured independently from FFP period of gNB-initiated COT, if the UE indicates the corresponding capability
	+ FFP offset for UE-initiated COT is the starting point of first UE FFP relative to the radio frame X boundary.
		- The offset value range is 0 ≤ offset ＜FFP period of UE-initiated COT
			* FFS on X (e.g. X=0, or X= even index number)

Agreement:

In semi-static channel access mode when a UE can operate as initiating device,

* Select one of the following alternatives to determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT:
* Alt-a: Determination based on the content in the scheduling DCI
	+ FFS on whether the corresponding field(s) can be absent in DCI
		- If absent, determination based on the rules applied for configured UL transmissions is applied
	+ FFS whether/how to handle the case when the gNB schedules an UL transmission in the next gNB’s FFP period
	+ Alt-b: Determination based on the rules applied for a configured UL transmission

Agreement:

In semi-static channel access mode when a UE can operate as UE-initiated COT,

* Select one of the following alternatives to determine whether a configured UL transmission that is aligned with a UE FFP boundary and ends before the idle period of that UE FFP, is based on UE-initiated COT or sharing a gNB-initiated COT:
	+ **Alt-a:** If the transmission is confined within a gNB FFP before the idle period of that gNB FFP, and the UE has already determined that gNB is initiated that gNB FFP, UE assumes that the configured UL transmission corresponds to gNB-initiated COT. Otherwise, UE assumes that the configured UL transmission corresponds to UE-initiated COT
	+ **Alt-b:** The UE assumes that the configured UL transmission corresponds to UE-initiated COT.

Agreement:

* In semi-static channel access mode, sharing a UE initiated COT through the gNB to other intra-cell UEs for UL transmissions, is not supported.

### 5.1.4 Agreements in RAN1#104bis-e

Agreements**:**

* Support explicit RRC configuration for the UE-FFP parameters including period and offset in RRC connected mode.

Agreements**:**

* For semi-static channel access mode, the offset value for configuration of a UE-FFP for a serving cell has a symbol level granularity.

The following agreements were made during the GTW on 16th:

Agreement:

* For semi-static channel access mode, in addition to the agreed set of period values for configuration of a UE-FFP for a serving cell:
	+ Do not support any additional period value

Agreement**:**

* For semi-static channel access mode, the starting point of first UE FFP for a serving cell
	+ is relative to the boundary of the radio frame of even index number (i.e. X=even indexed number in RAN1#104-e agreement).

Agreement**:**

* In semi-static channel access mode, the gNB can schedule by a DCI UL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI.
	+ The UL transmission can occur only if the corresponding channel access requirements are met.
		- FFS on details.

Agreement**:**

* In semi-static channel access mode, the gNB can schedule by a DCI DL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI.
	+ The DL transmission can occur only if the corresponding channel access requirements are met.
		- FFS on details.

Agreement:

* Select one of the following options (aiming for RAN1#105-e):
	+ Option 1: Do not support PUSCH repetition Type B~~when using~~ based on NR-U Rel-16 ~~based~~ CG for unlicensed band operation.
	+ Option 2: Support enhancements of PUSCH repetition Type B ~~when using~~ based on NR-U Rel-16~~based~~ CG for unlicensed band operation. FFS whether/how to enhance

Agreements

* For PUSCH repetition Type B enhancements on unlicensed spectrum, further study whether PUSCH segmentation should take into account the idle period of an FFP.
	+ FFS on details

Agreements

* For PUSCH repetition Type B enhancements on unlicensed spectrum, further study whether orphan symbol(s) are transmitted if they are between two actual repetitions that are transmitted. FFS on details

**Conclusion:**

* In semi-static channel access mode, a UE as an initiating device, is allowed to transmit during the idle period of any FFP associated with the serving gNB if the UE transmission is based on UE initiated COT
	+ Note: the gNB may disallow UL transmission during symbols of the idle period by configuring them either as semi-static DL symbols, or indicating them as DL with SFI.

Agreement:

* Option 2-b and option 3 are not considered further for the agreement in RAN1#103-e regarding CG harmonization

### 5.1.5 Agreements in RAN1#105-e

Agreement:

* Both “CG-UCI based procedures” and “CG-DFI based procedures” are enabled or disabled for unlicensed using one RRC parameter i.e. cg-RetransmissionTimer-r16.
* Note: Procedures based on CG-UCI rely on UE including CG-UCI in CG PUSCH at least as in Rel-16 where the values of the respective fields of CG-UCI are decided by UE.
* Note: Procedures based on CG-DFI rely on automatic re-transmission on CG configuration and reception of CG downlink feedback information (DFI) in DCI for re-transmissions

Agreement:

In semi-static channel access mode when a UE can operate as UE-initiated COT,

* To determine whether a configured UL transmission that is aligned with a UE FFP boundary and ends before the idle period of that UE FFP, is based on UE-initiated COT or sharing a gNB-initiated COT:
	+ If the transmission is confined within a gNB FFP before the idle period of that gNB FFP, and the UE has already determined that gNB is initiated that gNB FFP, UE assumes that the configured UL transmission corresponds to gNB-initiated COT. Otherwise, UE assumes that the configured UL transmission corresponds to UE-initiated COT

Agreement:

In semi-static channel access mode when a UE can operate as initiating device,

* To determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT:
* Determination based on the content in the scheduling DCI
	+ FFS on whether the corresponding field(s) can be absent in DCI
		- If absent, determination based on the rules applied for configured UL transmissions is applied
	+ FFS whether/how to handle the case when the gNB schedules an UL transmission in the next gNB’s FFP period

## 5.2 List of observations and proposals in contributions

R1-2107585 Intel Corporation [On the Details for Enabling URLLC IIoT in Unlicensed Band](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107585%20Intel%20On%20the%20Details%20for%20Enabling%20URLLC%20IIoT%20in%20Unlicensed%20Band.docx)

**Proposal 1**: When a UE operating as initiating device acquires its FFP, in any circumstances the ED threshold used to determine whether the channel is busy or idle is calculated solely based on the UE’s transmit power.

**Proposal 2**: When a UE operates as an initiating device, it is allowed to share its FFP with its associated gNB, and the gNB is allowed both control and data transmissions as long as a DL burst contains at least a transmission per switching point which is dedicated for the UE that initiated that FFP.

**Proposal 3**: When the cg-RetransmissionTimer-r16 is enabled and a UE operates as an initiating device, and the CG-UCI is piggybacked within a PUSCH transmission, the CG-UCI includes at least a bitfield information indicating the length of the shared resources as well as the exact starting symbol from when the gNB may be able to use those resources.

**Proposal 4**: When the cg-RetransmissionTimer-r16 is disabled and a CG UE operates as an initiating device, the same procedure established for DG UEs in Rel.16 is reused.

**Proposal 5**: When a UE operates as an initiating device, and shares its own FFP with the serving gNB, if the gap between the UL and DL burst is less than 16us, no restriction is imposed on the maximum length of the DL burst, , which is left up to the gNB’s scheduling decisions.

**Proposal 6**: For 2-step RACH procedure and for semi-static channel access mode, a UE is allowed to initiate its own FFP at least when transmitting the HARQ-ACK feedback information for msgB.

**Proposal 7**: For 4-step RACH procedure and for semi-static channel access mode, a UE is allowed to initiate its own FFP at least for a msg3 transmission.

**Proposal 8**: UE’s FFP parameters are provided within SIB1.

**Proposal 9**: In semi-static channel access mode, the bitfield carrying Table 7.3.1.1.1-4A of TS 38.212 jointly indicates not only the channel access type and CP extension to use, but also whether a UE should operate as initiating or responding device. In particular:

* The reserved entry within Table 7.3.1.1.1-4A of TS 38.212 is used to indicate that a UE must perform the channel sensing as defined by clause 4.3 in TS 37.213, while operating as initiating device.
* The entry with index 2 is used to indicate that a UE must perform the channel sensing as defined by clause 4.3 in TS 37.213, and in this case as in Rel.16 should be operating as responding device.
* If a UE is indicated no sensing (i.e., index 0 or 1), it would assume that it operates as an initiating device only if the UE has previously received explicit indication to operate as initiating device within a specific u-FFP, it was able to succeed LBT, and the time-domain resources for the current UL burst fall within the same u-FFP. Otherwise, it operates as a responding device.

**Proposal 10**: For semi-static channel access mode, the 2 bits field indicating the CP extension, channel access type and COT initiator, should be included in Rel. 17 DCI 0\_2 and 1\_2, and should be always present.

**Proposal 11**: The bitfields carrying information related to the channel access which have been defined in Rel.16 and included in DCI 0\_1 and 1\_1 should be included in Rel. 17 DCI 0\_2 and 1\_2.

**Proposal 12**: In semi-static channel access mode, early termination or cancellation of a FFP is enabled by allowing the gNB to overwrite through DCI scheduling indication any prior decision regarding the initiator of the COT.

**Proposal 13**: If a gNB operates as an initiating device and schedules an UL transmission outside of its FFP, then the UE must assume that the scheduled UL transmission would need to be performed as if the UE is the initiating device irrespectively from any explicit indication provided by the gNB within the scheduled DCI or any implicit assumptions that the UE may be able to make.

**Proposal 14**: If a gNB operates as an initiating device and schedules via a DCI a DL transmission outside of its FFP, no special considerations are needed in terms of channel access requirements or COT initiator.

**Proposal 15**: When operating on multiple carriers, the assumptions regarding the COT initiator are aligned across all carriers/ LBT BWs. In this case, a UE could assume to operate:

* as an initiating device over all RBs if for at least one LBT BW i) the UE assesses that it shall operate as initiating in that LBT BW or ii) the UE has received indication to the gNB that it shall operate as an initiating device; or
* as a responding device over all RBs, if for each LBT BW i) the UE assesses that it shall operate as a responding device or ii) the UE has received indication from the gNB that it shall operate as responding device.

**Proposal 16**: When the cg-RetransmissionTimer is enabled, the CG-UCI is regarded as high priority and can be multiplexed in a similar manner as HP HARQ-ACK onto a PUSCH.

**Proposal 17**: When the cg-RetransmissionTimer is enabled, if both HP and LP HARQ-ACK are to be multiplexed onto a CG-PUSCH that includes CG-UCI, CG-UCI is jointly encoded with HP HARQ-ACK with same beta offset.

**Observation 1**: Even if Type A is further enhanced for unlicensed operation, LBT overhead may be still unacceptable for URLLC use cases, given that gaps across slots are often unavoidable.

**Proposal 18**: Both the NR-U’s repetition scheme and Type B repetition scheme from Rel.16 URLLC design should be further enhanced, potentially to converge into a single repetition scheme.

**Proposal 19**: Independently on whether cg-RetransmissionTimer is enabled or disabled, multi-TB transmission should be supported to fully utilize the MCOT available.

**Proposal 20**: When the cg-RetransmissionTimer is enabled and segmentation is applied to a PUSCH transmission occurring across a slot boundary, the CG-UCI is included in every actual repetition.

**Observation 2**: When operating in unlicensed spectrum, the orphan symbol deriving from segmentation is highly detrimental for transmissions within either a UE or a gNB’s initiated COT. Therefore, RAN1 should discuss how to prevent a UE from performing an additional LBT due to the occurrence of an orphan symbol.

**Proposal 21**: When the cg-RetransmissionTimer is enabled, DCI 0\_2 should be enhanced to carry the DFI information based on configuration.

R1-2107338 Qualcomm Incorporated [Uplink enhancements for URLLC in unlicensed controlled environments](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107338%20Qualcomm%20Uplink%20enhancements%20for%20URLLC%20in%20unlicensed%20controlled%20environments.docx)

**Proposal 1**: gNB indicates UE to initiate a COT for UL transmission based on ChannelAccess-CPext field in DCI.

**Proposal 2**: gNB indicates UE to initiate a COT for UL transmission in next FFP based on ChannelAccess-CPext field in DCI and define the behavors of UE if gNB’s LTB fails.

**Proposal 3**: UE assumes that the transmission of HARQ ACK/NACK corresponds to UE-initiated COT when gNB does not initiate a COT.

**Proposal 4**: Study the scheme of indication of gNB sharing UE-initiated COT for DL transmission to disable UE sharing the COT.

**Proposal 5**: Study ED thresholds selection when UE share its COT to gNB.

**Observation 1**: Either supporting UE initiated COT in IDLE/INACTIVE mode or allowing PRACH transmission in idle period can provide more chances for the UE to send PRACH.

**Proposal 6**: Study the following alternatives for PRACH transmission in idle mode:

Alt.1: Supporting UE initiated COT by PRACH transmission in idle mode;

Alt.2: Allowing PRACH transmission in idle period of an FFP.

**Proposal 7**: Study the following two alternatives for SSB to PRACH mapping:

Alt.1 Divide PRACH occasions into two groups and SSB is mapped to PRACH occasion per group;

Alt.2: Introduce two PRACH configurations and SSB is mapped to PRACH occasions per PRACH configuration.

**Proposal 8**: Study the following alternatives for MsgA transmission in idle mode:

Alt.1: Supporting UE initiated COT by MsgA transmission in idle mode;

Alt.2: Allowing MsgA transmission in idle period of an FFP.

**Proposal 9**: Study the following for RO-to-PO mapping:

Alt.1: Divide PUSCH occasions into two groups and PRACH occasion is mapped to PUSCH occasion per group;

Alt.2: Introduce two sets of PUSCH configurations and each PUSCH configuration is associated with one PRACH configuration.

**Proposal 10**: For LBE, configuration of (cg-RetransmissionTimer) should be mandated when configured grant Type 1 or Type 2 are configured on unlicensed spectrum.

**Proposal 11**: NR-U CG-PUSCH shall support type A PUSCH repetition introduced in Rel.16 URLLC by reinterpreting the # of repetitions in consecutive slots as the # of repetitions in consecutive transmission occasions.

**Proposal 12**: NR-U CG-PUSCH shall support type B PUSCH repetition introduced in Rel.16 URLLC with the proposal in this contribution.

**Proposal 13**: NR-U CG-PUSCH shall support type B PUSCH repetition introduced in Rel.16 URLLC with the proposal in this contribution.

**Proposal 14**: CP extension can be used to handle the non-transmission of orphan symbol for Tpye B PUSCH repetition

R1-2107445 LG Electronics [Discussion on unlicensed band URLLC IIOT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107445%20LG%20Discussion%20on%20unlicensed%20band%20URLLC%20IIOT.docx)

**Proposal #1**: Consider to support dynamic indication of whether to allow UE-initiated COT for the next FFP based on the transmission of UE (group)-common DCI, at least for the control of potential congestion among multiple UEs in a same FFP.

* Structure of the common DCI signaling (with indication of COT duration and SFI information) designed in Rel-16 NR-U can be reused.

**Proposal #2**: Consider the following aspects for the configuration of UE FFP-u parameters.

The candidate values of the FFP-u starting offset is scaled according to SCS value.

The period and duration of FFP-u could be different for gNB controllability.

**Proposal #3**: Consider to allow the following UE behaviour for the scheduled UL not aligned with FFP-u boundary.

The UE would drop the scheduled UL transmission in case when gNB indicates the UE as the COT initiator for the UL, but the UE didn’t initiate COT for the FFP-u period.

**Proposal #4**: Consider to support the following UE behaviour for the scheduled UL based on cross-FFP scheduling.

The rule to determine COT initiator for the configured UL is applied for the scheduled UL, except for the case where the scheduled UL is aligned with FFP-u boundary and the COT initiator for the UL in DCI is indicated as the UE.

**Proposal #5**: Consider the following for the inclusion of COT initiator indication in DCI formats for consistent UE behaviour with any DCI format.

The COT initiator indication is always present (cannot be absent) in all the DCI formats 0\_0/1\_0 and 0\_1/1\_1 (and/or 0\_2/1\_2).

**Proposal #6**: Consider the following for the LBT indication field in DCI formats 0\_2/1\_2 (if introduced) to avoid gNB scheduling restriction and inconsistent UE behaviour.

The size of LBT indication field is kept same as Rel-16 (i.e., same size as Rel-16 (always 2-bit) for FBE, and same configurable size as Rel-16 for LBE).

**Proposal #7**: Consider to define the FFP including or starting with essential DL/UL transmission occasions (such as SSB or CORESET#0) as default FFP-g.

**Proposal #8**: Consider to align the assumption of FFP type for multiple RB sets in a carrier/BWP under the unaligned FFP structure between UE and gNB.

**Proposal #9**: Consider to configure (limit) the maximum COT duration allowed by the UE within a FFP-u period for gNB control of UE multiplexing.

**Proposal #10**: Consider the following condition in terms of allowing the DL transmission in FFP-u period based on sharing of UE-initiated COT.

The DL can be transmitted to any other UE in the cell than the COT-initiating UE, except for the UE having a configured UL after the DL reception, if the DL transmission at least includes data or control intended for the COT-initiating UE.

**Proposal #11**: Consider the following aspects for the configuration of CG PUSCH.

A same CG type (e.g., Rel-16 NR-U CG type or Rel-16 URLLC CG type) is configured per cell.

How to select a CG PUSCH for the multiplexing of UCI (e.g. HARQ-ACK) needs to be further studied by considering multiple cells configured with different CG type and the UL skipping for NR-U CG due to the collision with HARQ-ACK PUCCH.

**Proposal #12**: Consider to adopt PUSCH repetition type B for NR-U CG resource allocation.

**Proposal #13**: Consider to introduce following three resource allocation parameters replacing existing parameters to support harmonized CG operation.

A RRC parameter for the number of consecutive PUSCH occasions

A RRC parameter for the number of repetition of consecutive PUSCH occasions in slot-level

A RRC parameter for the number of PUSCH occasion used for a TB

**Proposal #14**: Consider not to allow transmission of the configured UL in the idle period of FFP-g located within a FFP-u period even if the UE has initiated COT for the FFP-u, in order to avoid potential UE-to-gNB interference.

**Proposal #15**: Consider to support transmission of the orphan symbol created by PUSCH (repetition type B) segmentation, to avoid unnecessary LBT behaviour as well as undesirable PUSCH dropping (due to LBT failure).

**Proposal #16**: Consider new equation for determining HARQ process ID in order to support multiple TB transmission per periods.

**Proposal #17**: Consider NDI indication with less overhead other than CG-UCI.

R1-2106493 Huawei, HiSilicon [Uplink enhancements for URLLC in unlicensed controlled environments](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106493%20Huawei%20Uplink%20enhancements%20for%20URLLC%20in%20unlicensed%20controlled%20environments.docx)

**Observation 1**: For IIoT/URLLC operation in unlicensed spectrum, transmission of initial access signals/channels is not an adequate use case for UE-initiated CO and it should be rather conducted within the gNB-initiated CO.

**Observation 2**: For IIoT/URLLC operation in unlicensed spectrum, enhancements in RRC\_CONNECTED mode are needed whereas enhancements only useable for IDLE/INACTIVE are not needed.

**Proposal 1**: For IIoT/URLLC operation in unlicensed spectrum, providing the UE with FFP parameters by SIB-1 is not supported.

**Proposal 2**: For IIoT/URLLC operation in unlicensed spectrum, UE-initiated semi-static CO is not supported when the UE is in IDLE/INACTIVE mode.

**Observation 3**: UEs would not be aware of the FFP frame start points of each other on the same channel, avoiding mutual blocking/collisions among these UEs (or interlaced UE groups) through gNB’s semi-static configuration becomes quite intricate.

Configuring an FFP for a second UE or interlaced UE group would trigger reconfiguration of all impacted UL resources for the first operating UE/interlaced UE group

**Observation 4**: For gNB to control the collisions/blocking between UEs on the same channel, the existing mechanism for UL cancellation cannot be applied since it is cell-specific group common signaling and would result in cancelling the UL resources to be used in the subsequent frame for another UE/interlaced UE group.

**Proposal 3**: On the semi-static configuration of UE-initiated FFP in a given unlicensed channel, the UE should be provided with a parameter to limit its COT to an indicated duration, , such that the COT ends before the idle period/CCA of a subsequent frame of that UE FFP.

**Proposal 4**: Extending the Rel-16 channel access fields to the compact DCI formats X\_2 is not supported in Rel-17.

**Proposal 5**: The COT initiator indication field may not be always present in the scheduling DCI, at least considering the case of UL scheduling using compact DCI formats X\_2.

**Proposal 6**: if the scheduling DCI indicates that an UL transmission belongs to gNB COT in the next gNB FFP but gNB fails to initiate that COT, select between the following options

Opt 1: UE disregards the DCI indication and applies the rules applicable to configured UL to determine whether the UL transmission can belong to UE COT. If the UE COT has not been initiated, the gNB cancels the scheduled UL transmission

Opt 2: UE gives up the scheduled UL transmission

**Proposal 7**: Discuss the case in which the scheduling DCI indicates that an UL transmission not aligned with the UE FFP belongs to UE COT in the next UE FFP but the UE fails to initiate that COT.

**Observation 5**: In semi-static channel access mode, the calculation of ED threshold is the same as in dynamic channel access mode. Given the operation is intended for unlicensed controlled environment;

If the gNB shares the CO initiated by the UE, without the UE adjusting the EDT, for transmitting unicast user plane data to the same UE, there would not be much of an impact to intra-operator coexistence.

However, if the gNB is allowed to share the CO initiated by the UE, without the UE adjusting the EDT, for transmitting unicast user plane data to other UEs as well, it would be advantageous for the gNB to often rely on sharing a UE initiated CO, especially without LBT, thus leading to intra-operator coexistence issues.

**Proposal 8**: For semi-static channel access in unlicensed controlled environment, support gNB sharing of the CO initiated by the UE, without the UE adjusting the EDT, for transmissions including unicast user plane data to the same UE.

FFS transmitting unicast user plane data to other UEs as well if the UL-to-DL gap is more than 16us

**Proposal 9**: Support configuration of harq-ProcID-Offset2 for operation in unlicensed spectrum when the cg-RetransmissionTimer-r16 is not configured.

**Observation 6**: Either PUSCH repetition type B, or NR-U multi-slot and multi-PUSCH per slot allocation under PUSCH repetition type A, are suitable for configuring consecutive PUSCH transmissions without gaps.

**Proposal 10**: Combination of Rel-16 PUSCH repetition and NR-U multi-slot allocation is not supported, no further enhancements are needed for PUSCH repetition Type B when using NR IIoT Rel-16 based CG.

**Observation 7**: For UE-initiated semi-static CO using CG, neither URLLC nor NR-U can benefit from the flexibility in starting the CG transmission since the whole FFP would be skipped if LBT fails at the beginning of an FBE frame.

**Observation 8**: Rel-16 URLLC and NR-U CG mechanisms related to HARQ procedures are comparable when operating in an unlicensed controlled environment where LBT failures are unlikely to occur.

**Observation 9**: For supporting IIoT/URLLC transmission with CG in unlicensed controlled environment in Rel-17, there is no need to support a combination of the Rel-16 NR-U and URLLC enhancements.

**Proposal 11**: For harmonizing remaining UL CG enhancements in Rel-16, if the higher-layer parameter cg-RetransmissionTimer-r16 is provided in ConfiguredGrantConfig, NR-U CG enhancements shall be adopted, otherwise, URLLC CG enhancements shall be used instead.

R1-2106588 vivo [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106588%20vivo%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Observation 1**: For CG transmission, Alt-a will cause misunderstanding between the gNB and the UE for the following two cases:

There is misalignment between gNB and UE on the COT initiator in case a configured UL transmission that is NOT confined within a gNB FFP before the idle period of that gNB FFP

UE mis-detects the gNB-initiated COT.

**Proposal 1**: It is necessary to include the COT initiating information in the CG UL transmission to indicate that if the CG UL transmission uses UE-initiated COT.

**Proposal 2**: Support DCI format 0\_2 and DCI format 1\_2 for URLLC on unlicensed band.

**Proposal 3**: The ChannelAccess\_CPext field(s) can be absent in DCI for URLLC in unlicensed band.

**Proposal 4**: In the case that ChannelAccess\_CPext field is not available or cross-FFP scheduling, UE determines whether to initiated a COT

**Proposal 5**: For gNB-to-UE COT sharing detection, the following options can be further considered:

Option 1: explicit gNB-to-UE COT sharing indication in DCI.

Option 2: DL signal detection from dedicated positions.

**Proposal 6**: UE-initiated COT should be supported for IDLE mode UE

**Proposal 7**: Do not support PUSCH repetition Type B when using NR-U Rel-16 based CG for unlicensed band operation.

**Proposal 8**: Clarify the configuration of cg-RetransmissionTimer is per CG or per cell when multiple CGs are configured for an unlicensed carrier.

**Proposal 9**:

Support configuration of phy-PriorityIndex field for CG operation in unlicensed band.

The field of pusch-RepTypeIndicator is NOT configured for operation with shared spectrum channel access for Type 1 CG in case the CG using Rel-16 NR-U mechanism.

**Proposal 10**: It is necessary to enhance the cg-UCI-Multiplexing field to support CG using NR-U like mechanism for URLLC traffic by taking into account intra-UE prioritization/multiplexing.

**Proposal 11**: To ensure the URLLC reliability for CG PUSCH using NR-U mechanism, startingFromRV0 can be used to control whether the RV for initial CG-PUSCH determined by the UE should be 0.

R1-2106736 ZTE [Discussion on unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106736%20ZTE%20Discussion%20on%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: After introducing UE-initiated COT, one mechanism should be provided to let UE determine whether to share the COT based on gNB-to-UE COT sharing.

**Proposal 2**: One option can be applied to the case when the gNB schedules an UL transmission in the next gNB’s FFP period as following:

Option 1: The same predefined rule as for CG UL transmission can be used when the gNB schedules an UL transmission in the next gNB’s FFP period.

Option 2: If the indication of the scheduling DCI indicates sharing a gNB-initiated COT, and the UL transmission scheduled in the next gNB’s FFP period is confined within a gNB FFP before the idle period of that gNB FFP, and the UE has already determined that gNB is initiated that gNB FFP, UE assumes that the scheduled UL transmission corresponds to gNB-initiated COT. Otherwise, UE assumes that the scheduled UL transmission corresponds to UE-initiated COT.

**Proposal 3**: The LBT field in DCI can be used to determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT.

If the LBT field is absent, the same predefined rule as for CG UL transmission can be reused.

The minimal size of LBT field in DCI x\_2 should be configurable to 0 bit for the design principle of compact DCI.

**Proposal 4**: For unlicensed band operation, enhancements of PUSCH repetition Type B based on NR-U Rel-16 CG should be supported.

**Proposal 5**:The use of PUSCH repetition type-B together with NR-U based multi-slot allocations should be considered with potential enhancements.

The consecutive resources are indicated, where the starting symbol of the first repetition, the duration of a repetition and the ending symbol of last repetition are determined by the NR-U rules

Back-to-back repetitions with segmentation across the slot boundary or invalid symbols is supported as in Rel-16 URLLC.

**Proposal 6**: For PUSCH repetition Type B enhancements on unlicensed spectrum,

The idle period of an FFP is treated as invalid symbols.

PUSCH segmentation should consider the idle period of an FFP.

**Proposal 7**: For PUSCH repetition Type B enhancements on unlicensed spectrum, DMRS can be transmitted on the orphan symbol(s) if they are between two actual repetitions that are transmitted.

**Proposal 8**: For the interaction with DL/UL directions for Type 1 CG PUSCH and Type 2 CG PUSCH without the first PUSCH (including all the repetitions), Rel-16 NR-U feature is used with modifying the repetition to actual repetition.

If dynamic SFI is not received and EnableConfiguredUL-r16 is not provided, the actual repetition is not transmitted if it conflicts with a semi-static flexible symbol.

If dynamic SFI is not received but EnableConfiguredUL-r16 is provided, the actual repetition can be transmitted.

**Proposal 9**: For URLLC over unlicensed band, CG-UCI is transmitted per actual repetition.

**Proposal 10**: If PHY priority introduced in Rel-16 is supported in unlicensed band, how to handle the multiplexing and PHY prioritization of CG-UCI and HARQ-ACK codebooks should be considered.

R1-2106803 Sony [Considerations on Unlicensed URLLC](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106803%20Sony%20Considerations%20on%20Unlicensed%20URLLC.docx)

**Observation 1**: If the COT initiator indicator for scheduled UL transmission that starts at the UE’s FFP can be absent in the scheduling DCI, then additional rules need to be defined which leads to extra specification impact.

**Observation 2**: Ambiguity on whether a UL transmission, scheduled in a gNB’s FFP that is different to the gNB’s FFP where the scheduling DCI is transmitted, should be according to gNB’s COT or UE’s COT would be an issue if the UL transmission overlaps a UE’s FFP Idle Period.

**Observation 3**: It is beneficial for flexibility and latency purposes that the gNB is able to schedule another UE when transmitting under a UE initiated COT.

**Observation 4**: Using Dynamic SFI to cancel a UE COT has limited scope since only Flexible symbols can be changed, it prevents other UEs from initiating a COT and it reduces gNB scheduler flexibility.

**Observation 5**: Without a UE-initiated COT, the gNB needs to transmit in an FFP so that Idle Mode UE can perform a PRACH. Such transmissions may introduce interference and deprive UEs in Connected Mode from initiating a COT.

**Observation 6**: The gNB can avoid PUSCH segmentation for a CG-PUSCH repetition by proper configuration of the TO’s.

**Observation 7**: Since gNB can avoid PUSCH segmentation due to slot boundary crossing and collision with DL/invalid symbols, orphan symbols are likely caused by PUSCH segmentation due to a PUSCH repetition overlapping the Idle Period of the COT initiator. Therefore, the orphan symbol would be before or after the Idle Period rather than between two actual PUSCH repetitions.

**Proposal 1**: The COT initiator indicator in a DCI scheduling UL transmission to start at the UE’s FFP cannot be absent if UE initiated COT is configured for a UE.

**Proposal 2**: If the gNB transmits a DCI to schedule an UL transmission in a gNB’s FFP that is different to the gNB’s FFP where the DCI is transmitted, and the DCI indicates that the gNB is the COT initiator for that UL transmission, then the UE monitors for a “COT Confirmation”, at the start of that gNB’s FFP, to determine how to transmit that UL transmission, i.e.:

If UE detects the “COT Confirmation” the UE transmits the UL transmission according to gNB’s COT as indicated in the DCI.

If the UE fails to detect the “COT Confirmation”, the UE would either transmit the UL transmission according to UE’s COT or drop the UL transmission

**Proposal 3**: The “COT Confirmation” can reuse the “co-DurationsPerCellToAddModList” in DCI Format 2\_0 or any GC-DCI that the gNB had configured the UE to monitor at the start of gNB’s FFP.

**Proposal 4**: If the UE fails to detect a “COT Confirmation” for a scheduled UL transmission indicated by the scheduling DCI to be transmitted according to gNB’s COT:

The UE transmits the UL transmission if the UL transmission does not overlap the UE’s FFP Idle Period

The UE drops the UL transmission if the UL transmission overlaps the UE’s FFP Idle Period

**Proposal 5**: Allow the gNB to cancel a UE initiated COT. A COT cancellation indicator can be introduced to dynamically indicate to a UE to cancel its initiated COT.

**Proposal 6**: UE initiated COT for semi-static channel access is supported in Idle Mode.

**Proposal 7**: The UE FFP configuration in Idle Mode is signaled in the SIB.

**Proposal 8**: Support Rel-16 PUSCH repetition Type B for CG-PUSCH in unlicensed band.

**Proposal 9**: A nominal PUSCH repetition that overlaps an Idle Period of the COT initiator is segmented.

**Proposal 10**: Orphan symbols are dropped for PUSCH repetition Type B in unlicensed band operation.

R1-2106764 Nokia, Nokia Shanghai Bell [UL enhancements for IIoT URLLC in unlicensed controlled environment](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106764%20Nokia%20UL%20enhancements%20for%20IIoT%20URLLC%20in%20unlicensed%20controlled%20environment.docx)

**Observation 1**: Back-to-back PUSCH repetitions are already supported with NR-U as part of Type A repetitions.

**Proposal 1**: Non-back-to-back Type A repetitions are not supported in unlicensed band.

**Proposal 2**: Select Option 1: Do not support PUSCH repetition Type B based on NR-U Rel-16 CG for unlicensed band operation.

**Proposal 3**: PHY multiplexing/prioritization introduced in Rel-16 is supported also with NR-U CG. Interaction of CG-UCI and HARQ-ACK codebooks of different priorities is FFS.

On the support for UE-initiated COT for FBE

**Proposal 4**: Consider, whether RB set (i.e. 20 MHz channel) specific configuration of UE FFP is supported with wideband operation.

**Proposal 5**: The field(s) indicating the COT initiator in the scheduling DCI cannot be absent. Channel access related fields in Rel-16 DCI 0\_1 and 1\_1 are included in Rel-17 DCI 0\_2 and 1\_2, respectively, and are supported with both dynamic as well as semi-static channel access.

**Proposal 6**: Discuss further the case where gNB indicates gNB as the COT initiator for the next FFP.

**Proposal 7**: In semi-static channel access mode, when a UE can be COT initiator, and a configured UL transmission is aligned with a UE FFP boundary, and ends before the idle period of that UE FFP:

If the transmission is confined within a gNB FFP before the idle period of that gNB FFP, and the UE has already determined that the gNB has initiated that gNB FFP, the UE assumes that the configured UL transmission corresponds to gNB-initiated COT

if the UE determines that the gNB has NOT initiated that gNB FFP, the UE assumes that the configured UL transmission corresponds to UE-initiated COT.

if the transmission is NOT confined within a gNB FFP before the idle period of that gNB FFP (i.e. the transmission overlaps at least partially with the idle period of that gNB FFP) and the UE has already determined that the gNB has initiated that gNB FFP, the UE only transmits on a subset of the configured UL (time) resources to ensure no transmissions during the idle period of that gNB FFP.

Note: this is a slightly clarified version of the agreement from RAN1 #105-e

**Proposal 8**: Support UE-initiated COT for semi-static channel occupancy in IDLE/INACTIVE mode.

**Proposal 9**: Assuming support of UE-initiated COT for semi-static channel occupancy in IDLE/INACTIVE mode is agreed, FFP parameters for UE-initiated COT also need to be provided to the UE in SIB-1.

**Observation 2**: With semi-static channel occupancy, the mechanism used by a legacy (Rel-16) UE to detect and share a serving gNB COT needs further clarifications if UE-to-gNB COT sharing is supported in Rel-17.

R1-2107186 Lenovo, Motorola Mobility [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107186%20Lenovo%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: UE should not drop from the beginning a first low-priority configured UL transmission initiating a UE-COT that overlaps with a later second high-priority configured UL transmission.

**Proposal 2**: UE should not drop a first low-priority configured UL transmission that overlaps with a later second high-priority configured UL transmission earlier than 16 us before the start of the second high-priority configured UL transmission.

**Proposal 3**: UE-initiated COT for idle/inactive mode UE can be further studied (with lower priority compared to remaining items for RRC-connected mode such as deciding whether semi-static/dynamic COT-initiator control is needed).

**Proposal 4**: In semi-static channel access mode when a UE can operate as an initiating device, further discuss disabling UE-initiated COT by RRC for a UL transmission aligned with a (set of) UE FFP boundary(ies), for cases that gNB implementation cannot achieve such disabling, if any.

**Proposal 5**: Discuss dynamic indication to change UE’s assumption on the associated COT initiator with low priority considering applicability to dynamic scheduling when the transmission overlaps with the idle period of FFP determined from the scheduling DCI.

**Proposal 6**: If UE-initiated COT for idle/inactive UE is supported, a UE can transmit CG-PUSCH in a gNB-FFP, upon receiving a broadcast signal from gNB at the beginning of the gNB-FFP (subject to existing rules such as sensing prior to transmission).

**Proposal 7**: For the case of UE-initiated COT with configured grant PUSCH transmission, the transmit power at the beginning of the acquired FFP can be higher than the transmit power associated with PUSCH transmissions of the configured grant (in transmission occasions other than those of the beginning of the acquired FFP).

**Proposal 8**: For the case of UE-initiated COT with configured grant PUSCH transmission, when a first UL transmission burst is followed by a high priority second UL transmission burst on CG resources and if the gap is more than 16µs between the two transmissions, a CP is extended for the second transmission to keep the effective gap under 16µs

**Observation 1**: Dynamic indication to change UE’s assumption on the associated COT initiator for a dynamically scheduled UL transmission could allow transmission within the idle period of the former FFP as determined based on the scheduling DCI if the scheduled UL transmission overlaps with the idle period.

a timeline needs to be specified for receiving the dynamic indication w.r.t. the scheduling DCI.

**Observation 2**: Dynamic indication to change UE’s assumption on the associated COT initiator for a configured UL transmission seems to have lower importance compared to that for dynamically scheduled UL transmission.

R1-2107114 Panasonic Corporation [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107114%20Panasonic%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: LBT fields in Rel.16 DCI format 0-1/1-1 to be included in Rel.17 DCI format 0-2/1-2 for both FBE and LBE.

**Proposal 2**: LBT fields in DCI is used for COT-initiator in scheduling DCI.

**Proposal 3**: For COT-initiator in scheduling DCI, either Alt.1 or Alt.2 in the following is considered.

Alt.1: Indication always present

The same field size as Rel.16 (always 2 bits) for FBE (i.e., if ChannelAccessMode = “semistatic” is provided for operation in a cell with shared spectrum channel access).

Alt.2: Indication can be configured to be absent

Configurable field size as compared to Rel.16, e.g., 0 or 2 bits.

If absent, determination based on the rules applied for configured UL transmission is applied.

**Proposal 4**: For cross-FFP scheduling DCI, the following alternatives are considered.

Alt.2: Apply the configured grant rule

If the UE has already initiated the UE FFP, then UE assumes that the configured UL transmission corresponds to UE-initiated COT.

Otherwise, if the transmission is confined within a gNB FFP before the idle period of that gNB FFP, and if the UE has already determined that gNB has initiated that gNB FFP, then UE assumes that the configured UL transmission corresponds to gNB-initiated COT.

Alt.3: It’s gNB responsibility, based on existing tools (i.e., it is up to gNB to ensure channel access requirements are met).

**Observation 1**: Multiple starting time offset for configured grant, which is configured as the amount of CP extension, can be reused to support UE-initiated COT.

**Observation 2**: It should be clarified that whether the difference of CP extension is called as the change of FFP or not.

**Observation 3**: If DG PUSCH is used for UE-initiated COT together with CG PUSCH, to support CP extension for multiple starting time offset as in CG PUSCH for DG PUSCH could be considered.

**Observation 4**: If the difference of CP extension is called as the change of FFP, the start of FFP might be always CG PUSCH if DG PUSCH does not have CP extension. If DG PUSCH supports CP extension, the amount of CP extension for DG PUSCH should be same as that configured to CG PUSCH.

**Proposal 5**: Do not support PUSCH repetition Type B based on NR-U Rel.16 CG for unlicensed band operation.

R1-2106680 Ericsson [Enhancements for IIoT URLLC on Unlicensed Band](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106680%20Ericsson%20Enhancements%20for%20IIoT%20URLLC%20on%20Unlicensed%20Band.docx)

**Observation 1**: The options “a-i-1-a, b-i-1 and c-i-1” in the final moderator summary in section 2.3.3 of R1-2106048 are preferred to ensure competitive performance for 3GPP technologies for IIOT/URLLC applications in unlicensed with minimum spec impact and fragmentation.

**Proposal 1**: Support the channel access fields in Rel-16 DCI 0\_1 and 1\_1 to be included in Rel-17 DCI 0\_2 and 1\_2, respectively, as in Rel-16

**Proposal 2**: In semi-static channel access mode when a UE can operate as initiating device, the COT-initiator is indicated by means of the channel access fields in DCI (0\_0/1\_0, 0\_1/1\_1, 0\_2/1\_2) corresponding field(s) in DCI to determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT.

**Proposal 3**: In semi-static channel access mode, CP extension is not indicated in the channel access field in DCI.

**Proposal 4**: In semi-static channel access mode, when the gNB schedules by a DCI UL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI, if the UE is unable to validate the assumption on COT initiator in the DCI for the scheduled UL transmission(s), the UE would cancel the scheduled UL transmission.

**Proposal 5**: In semi-static channel access mode, when the gNB schedules by a DCI DL transmission(s) in a later g-FFP that is different from the g-FFP that carries the scheduling DCI, if the gNB is unable to validate the assumption on COT initiator in the DCI for the scheduled DL transmission(s), the gNB would cancel the scheduled DL transmission(s).

* Note that since the cancelled DL transmission(s) would not be detected by UE, no additional specification is needed.

**Proposal 6**: In semi-static channel access mode, a DL transmission burst based on a UE initiated COT sharing for a UE FFP, can be transmitted to any other UE in the cell than the COT initiating UE if the DL transmission burst at least includes data or control intended for the UE that initiated that FFP .

**Proposal 7**: Do not support PUSCH repetition Type B based on NR-U Rel-16 CG for unlicensed band operation (i.e. Option 1 in corresponding RAN1#104bis).

**Proposal 8**: For PUSCH repetition Type B enhancements on unlicensed spectrum, the symbols in an idle period that the UE is not allowed to perform a UL transmission, should be considered as invalid symbols which are not considered for an actual repetition as in Rel-16.

**Proposal 9**: For PUSCH repetition Type B on unlicensed spectrum, the orphan symbol(s) are dropped as in Rel-16.

**Proposal 10**: Configuration of cg-RetransmissionTimer is optional when configured grant Type 1 or Type 2 are configured on unlicensed spectrum.

**Proposal 11**: For semi-static channel access mode, UE-initiated COT is supported before dedicated RRC and is enabled by SIB-1.

* UE FFP periodicity and offset are implicitly determined based on PRACH configuration corresponding to a PRACH transmission outside the gNB-initiated COT.

R1-2107640 InterDigital, Inc. [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107640%20InterDigital%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: IDLE/INACTIVE mode UEs can initiate COTs in FBE at least for PRACH transmission.

**Proposal 2**: A UE sends an indication of the COT used for a configured transmission (gNB-initiated or UE-initiated).

**Proposal 3**: For an UL transmission scheduled in a subsequent g-FFP, the UE operates based on the rules applied for a configured UL transmission.

**Proposal 4**: For a DL transmission scheduled in a subsequent g-FFP, study how the UE determines the COT initiator associated to the DL transmission resource.

**Proposal 5**: Support enhancements of PUSCH repetition Type B based on NR-U Rel-16 CG for unlicensed band operation (Option 2).

**Proposal 6**: PUSCH Type B repetition is enhanced such that segmentation considers LBT, idle period of an FFP and COT duration.

**Proposal 7**: A nominal PUSCH Type B repetition overlapping a COT boundary is segmented into two actual repetitions.

**Proposal 8**: Allow transmission on orphan symbols. FFS conditions when to transmit on orphan symbols and contents of orphan symbol transmission.

R1-2106881 Samsung [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106881%20Samsung%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Observation 1**: For cross-FFP UL transmission that is aligned with UE FFP, gNB can always indicate UE to initiate COT to ensure channel access condition is met.

**Observation 2**: For cross-FFP UL transmission that is not aligned with UE FFP, UE has to perform COT detection to determine whether channel access condition is met. If the condition is not met, UE has to drop the scheduled UL transmission.

**Observation 3**: Whether to initiate UE COT is based on the scheduling DCI indication, regardless of intra or cross-FFP scheduling.

**Proposal 1**: Support UE-initiated COT for idle UE. UE FFP parameters can be indicated by SIB1 or derived by PRACH configuration.

**Proposal 2**: For a scheduled UL transmission, a UE determines whether the UL transmission should be transmitted based on UE-initiated COT or sharing gNB-initiated COT according to LBT indication by existing bit field ChannelAccess-CPext in the scheduling DCI

If ChannelAccess-CPext indicates ‘3’, the UE initiates COT after 9us LBT right before the UL transmission, otherwise, the UE uses gNB-initiated COT without LBT or 9us LBT within 25us as indicated by gNB.

 ChannelAccess-CPext is always present in all DCI formats including DCI format 0\_2/1\_2.

**Proposal 3**: For gNB-initiated COT detection, the following mechanism can be considered:

A UE assumes gNB has initiated a COT if the UE receives explicit indication in DCI 2\_0.

A UE assumes gNB has initiated a COT if the UE detects DL transmission at the beginning of gNB FFP.

**Proposal 4**: For PUSCH repetition Type B over unlicensed band, to cope with FBE frame structure and LBT operation:

Support segmentation around idle period.

Support additional gaps to avoid LBT blocking from DL signals/channels or LBT blocking between UEs.

No enhancement for orphan symbol.

**Proposal 5**: Support PUSCH repetition Type B combined with NR-U multi-slot allocation. Multi-TB transmission with PUSCH repetition Type B within a period can be supported, if CG-UCI is enabled.

R1-2106699 Spreadtrum Communications [Discussion on enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106699%20Spreadtrum%20Discussion%20on%20enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: Not support semi-static control of UE-initiated COT.

**Proposal 2**: Not support dynamic control of UE-initiated COT.

**Proposal 3**: According to cross-FFP scheduling, legacy assumptions can be reused to decide whether or not meet the channel access requirement.

* For UL Tx, when UE does not detect a DL indicator or burst, UE would drop its UL transmission unless satisfy the condition of its initiating COT.
* For DL reception, when UE does not detect a DL burst, UE can just assume there is no DL transmission or error reception

**Proposal 4**: For UE-to-gNB COT, Option 2 is preferred.

* Option 2: In semi-static channel access mode, a DL transmission based on a UE initiated COT sharing for an FFP, can be transmitted to any other UE in the cell than the COT initiating UE if the DL transmission at least includes data or control intended for the UE that initiated that FFP .

**Proposal 5**: UE in IDLE/INACTIVE mode does not use semi-static channel access mode.

**Proposal 6**: Enhancements of PUSCH repetition Type B in unlicensed band should consider the impact of orphan symbol and gNB’s idle periods if additional constrain is supported.

R1-2107734 Apple [URLLC uplink enhancements for unlicensed spectrum](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107734%20Apple%20URLLC%20uplink%20enhancements%20for%20unlicensed%20spectrum.docx)

**Proposal 1**: The indication to determine whether to share gNB’s COT or use UE-initiated COT is always present in the scheduling DCI.

**Proposal 2**: When the gNB schedules an UL transmission in the next gNB’s FFP period, the UE also follows the indication in the scheduling DCI to determine whether to share gNB’s COT or use UE-initiated COT.

**Proposal 3**: When UE-initiated COT is enabled, the existing fields ChannelAccess-CPext in DCI format 0\_0/1\_0 and ChannelAccess-CPext-CAPC in DCI format 0\_1/1\_1 are re-interpreted as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Bit field mapped to index** | **Channel Access Type**  | **The CP extension T\_"ext" index defined in Clause 5.3.1 of [4, TS 38.211]** | **gNB’s COT or UE-initiated COT** |
| 0 | No sensing as defined in Clause 4.3 in TS 37.213 | 0 | gNB’s COT |
| 1 | No sensing as defined in Clause 4.3 in TS 37.213 | 2 | gNB’s COT |
| 2 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | gNB’s COT |
| 3 | 9us sensing within a 25us interval as defined in Clause 4.3 in TS 37.213 | 0 | UE-initiated COT |

**Proposal 4**: UE-initiated COT is considered enabled once the FFP periodicity and offset are configured for a UE. Introduce a RRC parameter to disable UE-initiated COT for P-CSI and/or SRS.

FFS whether to introduce a RRC parameter to disable UE-initiated COT for each CG configuration, which overrides the per-UE configuration for this CG.

**Proposal 5**: Support UE-initiated COT for PRACH for idle/inactive UEs.

**Proposal 6**: Enhance the UL cancellation indication mechanism to efficiently handle interlaced frequency resource allocation in NR-U UL.

**Proposal 7**: For PUSCH repetition Type B enhancements on unlicensed spectrum, support the flexible start of the transmission and multiple TBs within a period when CG-UCI is enabled.

An additional parameter is configured for each CG configuration to indicate the total number of consecutive transmission occasions within a period.

**Proposal 8**: For PUSCH repetition Type B enhancements on unlicensed spectrum, orphan symbol(s) are transmitted if they are between two actual repetitions that are transmitted.

R1-2108153 WILUS Inc. [Discussion on enhancement for unlicensed URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2108153%20WILUS%20Discussion%20on%20enhancement%20for%20unlicensed%20URLLC%20IIoT.docx)

**Proposal 1**: For Rel-17, regarding the signaling for FBE operation when a UE operates as an initiating device, it should be supported that a gNB provides FFP parameters for UE-initiated COT to the UE by SIB-1, in addition to dedicated RRC signaling like that of a gNB initiated COT in Rel-16 NR-U.

**Proposal 2**: For semi-static channel access mode, it should be allowed to use the transmission of any scheduled/configured UL channel/signal to initiate a COT by a UE regardless of DL transmission burst’s reception within one channel occupancy even for the case when the UE is in IDLE/INACTIVE mode.

**Proposal 3**: If the corresponding field(s) for COT initiator indication is absent in DCI, we propose to have determination of COT initiator for scheduled UL transmission based on the rules which was already agreed to be applied for configured UL transmissions.

**Proposal 4**: For the case of cross-FFP scheduling, we propose that the gNB on cross-FFP scheduling can indicate UE’s initiated COT as default on COT initiator indication or the UE always can assume UE’s initiated COT irrespective of indication for scheduled UL transmission outside a COT initiated by gNB.

**Proposal 5**: We support to have extension of Rel-16 channel access fields to DCI X\_2.

**Proposal 6**: It should be further discussed whether or not to possibly transmit configured-grant PUSCH with repetition at candidate SS/PBCH block positions for the same SS/PBCH block index after the detection of the SS/PBCH block index.

**Proposal 7**: To enhance PUSCH repetition Type-B for URLLC/IIoT in the unlicensed band, it should be further discussed how to handle on LBT gap/switching gap between segmented transmissions of nominal repetition by slot boundary or between non-contiguous PUSCH Type-B repetitions by DL reception (e.g., candidate SS/PBCH blocks, or others).

R1-2107853 NTT DOCOMO, INC. [Discussion on enhancements for unlicensed band URLLC](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107853%20NTT%20Discussion%20on%20enhancements%20for%20unlicensed%20band%20URLLC.docx)

**Proposal 1**:

Support the channel access fields in Rel-16 DCI 0\_1 and 1\_1 to be included in Rel-17 DCI 0\_2 and 1\_2, respectively.

The channel access fields in Rel-17 DCI 0\_2 and 1\_2 can be present or absent by configuration

**Proposal 2**:

In semi-static channel access mode when a UE can operate as initiating device, channel access field is used to determine whether a scheduled UL transmission is based on UE-initiated COT or sharing a gNB-initiated COT

If channel access field is absent, determination based on the rules applied for configured UL transmissions is applied

**Proposal 3**:

Semi-static control of UE-initiated COT, such as disabling UE-initiated COT by RRC for (a part of) UL transmissions or limiting COT duration, is not supported.

**Proposal 4**:

In semi-static channel access mode when a UE can operate as an initiating device, for a UL transmission, the UE can be dynamically indicated to change its assumption on the associated COT initiator for the UL transmission via DCI format 2\_0.

If the UL transmission is once scheduled to use 9us sensing and then indicated to be within gNB-initiated COT via DCI format 2\_0, no sensing is applied to the UL transmission.

**Proposal 5**:

UE in IDLE/INACTIVE mode does not initiate COT, i.e., PRACH is not used to initiate COT in IDLE/INACTIVE mode.

**Proposal 6**:

Do not support PUSCH repetition Type B based on NR-U Rel-16 CG for unlicensed band operation.

**Proposal 7**:

For PUSCH repetition Type B enhancements on unlicensed spectrum, the idle period of the corresponding COT (either g-FFP or u-FFP) should be taken into account for the PUSCH segmentation.

**Proposal 8**:

For PUSCH repetition Type B enhancements on unlicensed spectrum, orphan symbol is transmitted if it is between two actual repetitions that are transmitted for OFDM waveform.

For DFT-s-OFDM waveform, Rel-16 rule (i.e., dropping the orphan symbol) is applied.

R1-2107493 MediaTek Inc. [On the enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107493%20MediaTek%20On%20the%20enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: UE processing time needs to be considered in semi-static channel access mode for configured UL transmission.

**Proposal 2**: For FBE mode, Rel-17 DCI 0\_2/1\_2 to be extended with LBT fields defined in Rel-16 DCI 0\_1/1\_1 using the same DCI field sizes as Rel-16.

**Proposal 3**: Introduce new fields than the LBT fields for COT-initiator indication in scheduling DCI for UL transmission

**Proposal 4**: In FBE mode, support enabling/disabling UE COT-initiating functionality dynamically.

**Proposal 5**: The UE is configured to initiate a COT for PRACH transmission.

* E.g. UEs with high Priority traffic or mixed high/low priority traffic could have this functionality enabled by gNB.

**Proposal 6**: UE-initiated COT carrying PRACH is automatically shared with the gNB without any additional indication.

**Proposal 7**: UE COT-initiating functionality is dynamically enabled/disabled.

**Proposal 8**: UE COT initiation enabling/disabling is determined from the traffic priority.

**Proposal 9**: FFP parameters for UE-initiated COT could be provided by SIB-1.

**Proposal 10**: UE FFP periodicity determined from higher layer parameters but overridden by explicit dedicated signalling.

R1-2107103 FUTUREWEI [UE initiated COT for semi-static channel access](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107103%20FUTUREWEI%20UE%20initiated%20COT%20for%20semi-static%20channel%20access.docx)

**Proposal 1**: The field in DCI that determine whether a scheduled UL transmission is based on UE-initiated COT or shared gNB initiated COT cannot be absent in the FBE mode of operation when UE indicated the support of UE initiated COT.

**Proposal 2**: gNB can schedule an UL transmission later than the end of COT in the current FFP period.

**Proposal 3**: If a UL transmission is scheduled for a future FFP (either in a gNB-FFP or UE-FFP) and that FFP cannot be initiated, the transmission is postponed to the next FFP that can be initiated (by the gNB or UE).

**Proposal 4**: A gNB may cancel UL transmissions pending in future FFP including canceling future UE initiated COT in the future FFPs for instance by canceling the transmission that initiate the COT. Details of cancellations are TBD (DCI, DCI 2\_0, timer, etc).

**Proposal 5**: gNB may indicate UEs to switch between FFP configurations, for instance from UE FFP to gNB FFP during current UE initiated FFP or at future FFP boundaries. Details for signaling TBD.

**Proposal 6**: In case of consistent LBT failures or link failure UE switches to a default FFP configuration.

R1-2107473 ETRI [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107473%20ETRI%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: The symbol offset for UE FFP configuration can be determined based on the smallest SCS among the configured SCSs in a cell.

**Proposal 2**: Support the channel access fields in Rel-16 DCI 0\_1 and 1\_1 to be included in Rel-17 DCI 0\_2 and 1\_2, respectively.

**Proposal 3**: COT initiator indication for scheduled UL is based on existing channel access fields in scheduling DCI, which can be configured to be absent (i.e., 0 bit) in Rel-17 DCI 0\_2/1\_2 for FBE.

**Observation 1**: For scheduled UL based on cross-FFP scheduling or for configured UL, UE should receive a DL signal other than a UL grant to be granted for PUSCH transmission within the same FFP.

**Observation 2**: The UL reliability performance of unlicensed URLLC can be severely degraded if UE’s processing time for DL detection to share a COT is unknown to gNB.

**Proposal 4**: For gNB-to-UE COT sharing, define a UE processing time for detection of the DL signal granting UL authorization (and UL preparation).

**Proposal 5**: For UE-to-gNB COT sharing, consider defining processing time for gNB’s UL burst detection for UE power saving purpose.

**Proposal 6**: For FBE, a symbol overlapping with idle period of a FFP associated to PUSCH transmission is regarded as invalid symbol for PUSCH mapping type B.

**Observation 3**: It seems that no special handling of orphan symbol(s) for PUSCH repetition type B in FBE is needed.

R1-2107294 FGI, Asia Pacific Telecom [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107294%20FGI%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1** RAN1 to discuss whether different starting positions caused by different TA or CP extension for different UE-FFPs violates the regulation that the fixed frame period shall not be changed more than once every 200 ms.

**Proposal 2** When gNB schedules UL transmission in a later gNB-FFP that is different from the gNB-FFP that carries the scheduling DCI, if the start of the UL transmission is aligned with a UE-FFP and the end of the UL transmission is before the idle period of the UE-FFP, the UL transmission can be performed based on the UE-FFP if DL transmission is not detected in the later gNB-FFP.

**Proposal 3** When gNB schedules UL transmission in a later gNB-FFP that is different from the gNB-FFP that carries the scheduling DCI, if the start of the UL transmission is following a CG PUSCH that has been used to initiate a UE-FFP and the end of the UL transmission is before the idle period of the UE-FFP, the UL transmission can be performed based on the UE-FFP if DL transmission is not detected in the later gNB-FFP.

**Proposal 4** PUSCH repetition type B can be segmented around the idle period of a UE-FFP, and UE can initiate the next UE-FFP with an actual repetition.

R1-2106964 CATT [Discussion on remaining issues on enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2106964%20CATT%20Discussion%20on%20remaining%20issues%20on%20enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: In semi-static channel access mode when a UE can operate as initiating device, reserved state of ChannelAccess-CPext in DCI format 0\_0/0\_1 and ChannelAccess-CPext-CAPC in DCI formats 0\_1/1\_1 can be used to indicate a scheduled UL transmission is based on UE-initiated COT.

**Proposal 2**: In semi-static channel access mode when a UE can operate as initiating device, all the PUSCH transmissions scheduled by a single DCI is based on UE-initiated COT or sharing a gNB-initiated COT based on the content in the scheduling DCI.

**Proposal 3**: For Type-B PUSCH repetition in unlicensed band, if one nominal repetition is divided into one or more actual repetitions due to invalid symbol(s), additional LBT window before actual repetition transmission should be supported.

R1-2107274 OPPO [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107274%20OPPO%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: Harmonization for NR-U PUSCH repetition and Type-B repetition, e.g. NR-U PUSCH repetition crossing slot boundary, or PUSCH repetition Type B should be considered in unlicensed band to ensure continuous transmission.

**Proposal 2**: Information transmitted in adjacent repetition can fill in orphan symbols to avoid interrupt.

**Proposal 3**: cg-RetransmissionTimer can be configured for each configured grant independently.

**Proposal 4**: For configured UL, support Alt-a.

**Proposal 5**: For scheduled UL, support Alt-a.

R1-2107013 NEC [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107013%20NEC%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: Support the absence of the corresponding channel access field in DCI. Predefined rules for configured UL transmissions should be applied in this case.

**Proposal 2**: The channel access field in DCI is applicable to the gNB’s next FFP when the gNB schedules an UL transmission in the gNB’s next FFP period.

**Proposal 3**: gNB may cancel a low priority UE’s transmission and release the corresponding UE initiated COT in order to support high priority URLLC transmission of another UE.

**Proposal 4**: Once a UE initiated COT is released by gNB, the UE may not initiate another COT for the same transmission/service until gNB reschedules its UL transmission.

R1-2107792 Sharp [Enhancements for unlicensed band URLLC IIoT](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C8.3%5CR1-2107792%20Sharp%20Enhancements%20for%20unlicensed%20band%20URLLC%20IIoT.docx)

**Proposal 1**: Whether a UE-initiated COT is initiated to transmit a dynamic scheduled PUSCH is indicated by the DCI format scheduling the PUSCH, reusing ChannelAccess-CPext/ChannelAccess-CPext-CAPC field in the DCI format.

**Proposal 2**: In Rel-17 DCI 0\_2 and 1\_2, include ChannelAccess-CPext/ChannelAccess-CPext-CAPC field.

**Proposal 3**: Even when a DCI format scheduling a PUSCH in an FFP indicates that the UE transmission should be associated to COT-u, the UE drops the PUSCH in the FFP if the UE determines that the COT-u is not initiated in the FFP.

**Proposal 4**: When a PUSCH in a later gNB FFP is scheduled by a DCI format in a previous gNB FFP, if the COT association for the PUSCH is indicated as COT-g and if UE determines that COT-g is not initiated in the later gNB FFP, UE drops the PUSCH.