**3GPP TSG-RAN WG2 Meeting #122 (To be) R2-23xxxxx**

**Incheon, Korea, 22th - 26th May, 2023**

**Agenda item: x.x.x**

**Source: Xiaomi**

**Title: [Post121][655][IDC] Discussion on Leftover issues for IDC (xiaomi)**

**Document for:**  **Discussion**

# 1. Introduction

This paper is to trigger the following email discussion of IDC TDM solutions:

* [Post121][655][IDC]  Discussion on Leftover issues for IDC (xiaomi)

      Scope: Continue the discussion on leftover issues and issues raised during short post meeting discussion.

      Intended outcome: Report to May meeting (proposals with agreeable TPs)

      Deadline:  Very long

## 1.1 Contacts

Contact person for each participating company:

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# 2. Discussion

## 2.1 Autonomous denial

The following FFS(s) are quoted from the endorsed CRs given in the reference section.

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| R2-2304331 38.331 running CR for introduction of IDC Xiaomi draftCR Rel-18 38.331 17.4.0 NR\_IDC\_enh-Core1> if the *CellGroupConfig* contains the *autonomousDenialParameters*:2> consider itself to be allowed to deny any transmission in a particular UL slot if during the number of slots indicated by *autonomousDenialValidity*, preceding and including this particular slot, it autonomously denied fewer UL slots than indicated by *autonomousDenialSlots* within the same cell group;Editor’s Note: FFS whether the UE sums up the denied UL slots together across all CC(s) in the CG and how the UE calculates the number of denied slots when different CCs have different slot length.Editor’s Note: FFS whether the NR autonomous denial configuration and the LTE autonomous denial configuration can be configured simultaneous for EN-DC.Editor’s note: FFS on the UE behaviour when receiving *autonomousDenialValidity*. |

According to the endorsed CR, when the UE receives the *autonomousDenialValidity* configuration from the network, no extra UE behaviour is specified (as LTE). It is unclear whether any clarification is required in the specification.

#### Question 1: Do you think that extra UE behaviours need to be clarified in the specification when receiving *autonomousDenialValidity*?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes | **We propose to start counting the autonomousDenialValidity period starting the first scheduled UL slot after configuration**. The reason being is that the UE may not be scheduled for some slots after receiving the RRC signalling indicating autonomous denials so those slots would be counted towards autonomousDenialValidity but there is no possibility for autonomous denials to happen there. Thus, to make use of the configuration without sacrificing the common understanding between UE and gNB on when the validity period starting, the UE and gNB may assume that UE would start counting at first UL scheduled slot. |
| Nokia | No | Regarding third FFS: Not sure what it this FFS trying to say. Isn’t the denial requirements to be defined in RAN4 and we don’t need to capture more in RAN2? |
| Ericsson | No | As for LTE, no extra UE behaviour is specified |
| ZTE | No | As for LTE, no extra UE behaviour is specified. For the start point, in LTE it was agreed that ”A moving window is used to specify the start and end of the time validity period over which the autonomous denial subframes shall be counted.” so in LTE spec, it doesn’t define the start and end point for the autonomousDenialValidity. |
| Apple | See comments | For QC’s comment, our understanding is autonomousDenialValidity period should be a moving window. Thus, it is not critical to mention whether it has to start from the first UL.Regarding rapporteur’s question, we think some clarifications are required, as in Q2/Q3. |
| Xiaomi | No | It seems that the autonomous denial function does not require the gNB to know the exact timing when/how the UE drops an UL transmission. The autonomous denial function is only to control the (allowed) percentage of the overall dropped UL transmissions over the last *autonomousDenialValidity* number of UL slots. Maybe we should clarify a bit that *autonomousDenialValidity* counts for all UL slots across CCs within the same CG. |
| Intel | No | Although we tend to agree with Qualcomm that the counting starts after receiving the RRC message, we think this is the general principle about applying the RRC (re)configuration and there is no need to capture it explicitly.  |
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According to the LTE specification, the autonoums denial configuration is per UE. However as RAN2 agreed to introduce per-CG autonomous denial configuration, it seems that allowing the simultaneous configuration of the autonoums denial configuration via the LTE MCG and the autonoums denial configuration via the NR SCG will cause confusions at the UE.

#### Question 2: Do you think that the NR autonomous denial configuration and the LTE autonomous denial configuration can be configured simultaneously for EN-DC?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes | It does not seem like an issue to have the SN configure autonomous denials and operating it separately from LTE. In our view no spec impact needed for LTE and no issues foreseen to keep autonomous denial configuration per CG in NR.It may be worth clarifying in the agreements that LTE autonomous denial configuration does not apply to NR SN as thos configurations should be separate. |
| Nokia | Yes | We would more ask why not – If one allows denying in one system it seems quite natural that it is possible that denial is needed in other system as well. If configured for both systems it would be up to UE to ensure it does not deny more slots in any RAT than allowed by the configuration on that RAT. This does not seem to require any changes in specification – Possibly the clarification in LTE that what “per UE” means can be considered that it is per RAT. |
| Ericsson | No | Share the concern as raised by Rapp. |
| ZTE | Yes | We think the mechanism for the autonomous denial shall be simplified as much as possible for that it’s for the rare case. So we tend to agree with Nokia that it will not require any changes in the specification, otherwise, some MN-SN coordination (e.g. avoid simultaneously configuration) may be needed, which will also increase specification burden (On this issue, we can also accept the majorities’ view.) |
| Apple | Yes | In general, we prefer allowing simultaneous configuration from both LTE and NR legs.When autonomous denial was introduced in LTE, there was no dual connectivity yet. When it comes to EN-DC, we are fine with either way below. RAN2 should make a decision on which one to go.1) LTE autonomous denial configuration is per UE and NR autonomous denial configuration is per SN, or2) LTE autonomous denial configuration is per MN and NR autonomous denial configuration is per SN |
| Xiaomi | No strong view | Since LTE did not discuss how the autonomous denial function can work in the DC scenario. If companies want to make the LTE autonomous denial function work for EN-DC, maybe RAN2 can confirm the common understanding that the LTE autonomouos denial configuration is only for LTE frequencies in EN-DC. Maybe this is too obvious as the LTE specification is supposed to work only for LTE frequencies. |
| Intel | Yes | Agree with QC and Nokia that simultaneous configuration is fine and does not erquire any change in specification. |
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As RAN2 agreed that the autonomous denial configuration is per CG, some companies consider that it is not very clear how the UE counts the UL slots across all CCs in the same CG, while considering the case that different CCs could have different slot length. It seems that if we do not consider the numerology impacts on counting the dropped UL slots, the UE would have to count all UL slot in all CCs. It is also not very clear whether we need to clarify the UE behaivour when the UE sums up the denied UL slots together across all CC(s) in the CG. The rapporter considers that if companies agree with the common UE behaviour as “the UE sums up the denied UL slots together across all CC(s) in the CG”, we could add a NOTE in the specification to avoid some ambiguities.

#### Question 3: Do you think that the UE sums up the denied UL slots together across all CC(s) in the CG?

(Rapporteur’s comments: Companies providing the answer “No”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | see comment | The issue with configuring autonomous denials across CCs is that autonomous denials is an RRC configuration at the Pcell that is not aware of the Scell activation state let alone dropping. Thus if a UE drops and counts an Scell slot, the Pcell would not know. We propose another way to count is by:1. Count dropping in the Pcell only
2. During a slot dropped in the Pcell, the UE may also drop slots across Scells

Since Pcell is the longest slot, it may span multiple Scell, the UE can drop those and count them as a single Pcell slot. [Apple] With this proposal, we are wondering if PCell is not subject to IDC and SCell is, could UE apply the autonomous denial configuration to SCell?  |
| Nokia | No | When NW indicates allowance for autonomous denial it provides maximum amount of UL slots that can be denied – This is common for all CCs in our understanding. If other CC have different slot length it is up to UE to not deny any slots that would cause more denied slots on any CC. Isn’t this clear in the text already? If not then is it unclear in LTE as well? |
| Ericsson | No | We agree with both Qualcomm and Nokia, either of their proposed options would work. We shall aim for no/minimal further spec changes. |
| ZTE | Yes(but) | The similar issue was discussed in the LTE, and a confirmation was added to the chairman note that (base on paper R2-130589 RAN2 #81)=> RAN2 confirms that there is just one counter. If the UE denies on one (or more) serving cells in a certain subframe, it counts it as one denial.So it can be clarified in the chairman note without Specification, we can also accept Rapporteur’s suggestion that to add it as a Note |
| Apple | See comments | From our understanding, the most reasonable solution is to provide a **per CC** configuration for autonomous denial as link adaptation should be performed on CC level. If sticking to per CG config (as current agreement), when UE denies UL slots at CC #1 and CC#2, we think there are different UE interpretations. We are fine with either way, however it is good to clarify which one is the common understanding and make a note in the spec. 1) Interpretation 1: UE considers that each CC can deny up to the configured amount of slots, no matter if there is or isn’t overlapping on denied slots across multiple CC(s). This is somehow a per-CC config to us. 2) Interpretation 2: UE sums up the number of denied UL slots across CC(s) first (no matter if there is or isn’t overlapping) and the summed value is subject to the configured amount. Regarding the Editor’s note if this is relevant to SCS of each CC (slot length), our understanding is no if the UE anyway counts the slots across CC(s) independently. 3) Interpretation 3: For overlapping slot, UE only count it once (but we need to clarify the case where different numerolgies are applied on those CC(s)). And for non-overlapping slots across CC(s), UE counts every denial. LTE agreement is aligned with this interpretation.Another question is on mini-slots, our view is UE counts the denied slot as 1 no matter one or multiple mini-slots are denied in the slot. It would be also good to clarify this among companies. |
| Xiaomi | Probably Yes | Firstly we agree with ZTE on the legacy UE behaviours in LTE. However as NR slots could have different duration for different numerologies in different serving cells, the duration of one slot in PCell could include more than one slots in a SCell at the same time. If we only counts PCell dropping(s), the SCell interference may not be resolved.If the UE sums up the denied UL slots together across all CC(s), we do not need to deal with the issue cause by different numerologies.  |
| Intel | Commens | It is desirable to have a common understanding to avoid inter-operabiliyt issue. Our understanding is that the configured denied UL slot is across all CCs in the cell group, i.e. the overlapping denialed UL slots across CCs are counted as a single denialed UL slot, without summing up the denialed UL slots across all CCs. But we’re OK to follow majority view. |
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## 2.2 Inter-node coordination

The following FFS(s) are quoted from the endorsed CRs given in the reference section.

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| R2-2303884 37.340 Running CR for Introduction of IDC ZTE Corporation, Sanechips draftCR Rel-18 37.340 17.4.0 B NR\_IDC\_enh-Core* Editor’s Note: FFS whether any additional coordination is needed for network to resolve the problem when network receives an IDC report from UE.
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| RAN2#121 meeting agreement:* FFS whether any additional coordination is needed for network to resolve the problem when network receives the reporting from UE.
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#### Question 4: Do you think that additional coordination between MN and SN is needed when network receives an IDC report from UE?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes (e.g. whether the coordination is required for either FDM or TDM or both) in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | No | Seems coordination may be needed as an optimization only. Given that this is the last meeting it may not be essential to introduce coordination to share UE IDC report |
| Nokia | No | But we are open to listen to arguments to do otherwise. We should aim for good solution. |
| Ericsson | No | For EN-DC, it is already condluded no further coordination apart from the existing ones. For NR-DC, our view is that Given the below reasons1. The current agreed framework is sufficient for UE to report IDC issues for NR-DC. Any coordination mechanism can be categorized as optimization. It can be up to NW implementation or OAM to address the need of any coordination.
2. Due to limited work time in Rel-18, there is limited time to work on any further enhancement, which would require additional design efforts.

Therefore, **Coordination between MN and SN for either IDC configuration or IDC assistance information report is not supported for NR-DC**.The same comment is for both FDM and TDM |
| ZTE | Yes | For the NR-DC, it’s still not clear how the UE report the NR-DC IMD interference to the network, and how to avoid such kind of the interference at the network side.At least the for the NR-DC IMD interference(the interference caused by the simultaneous transmission of the MN and SN), the coordination would be needed.About the specification burden, we think the similar mechanism as EN-DC can be reused with bandwidth enhancement. |
| Apple | See comments | For reporting, we think legacy exchange on ConfigRestrictInfoSCG over Xn interface is sufficient.But we are open if companies want to improve the resource coordination for IMD issue. |
| Xiaomi | No strong view | We understand that if the MN and the SN can share the IDC assistance information reported by the UE, the reporting of the same information in both nodes may not be required. Then we could have more optimized signaling. |
| Intel | No | Although the coordination of IDC solution between MN and SN is helpful for resource utilization, it requires additional standardization efforts. Considering that enhanced FDM solution already improves resource utilization with finer granularity indication, We prefer to not consider inter-node coordination for IDC solution. |
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As requested by companies offline, it seems that some companies consider that reusing some signaling similar as the legacy IDC configuration coordination between MN and SN should not be considered as “additiaonl” coordination. Rapporteur considers that companies may need to clarify what the expected “coordination” (or signaling) is required for the IDC configuration coordination between MN and SN

#### Question 5: Do you think that additional coordination between MN and SN is needed when network configures IDC assistance information reporting or autonomous denial for the UE?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes (e.g. whether the coordination is required for either FDM or TDM or both) in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes | For autonomous denials, since MN can configure SN it needs to tell SN about the active autonomous denial configuration so that the SN will not misinterpret denied UL slots.  |
| Nokia | No | But we are open to listen to arguments to do otherwise. We should aim for good solution. |
| Ericsson | No | For EN-DC, it is already condluded no further coordination apart from the existing ones. For NR-DC, our view is that Given the below reasons1. The current agreed framework is sufficient for UE to report IDC issues for NR-DC. Any coordination mechanism can be categorized as optimization. It can be up to NW implementation or OAM to address the need of any coordination.
2. Due to limited work time in Rel-18, there is limited time to work on any further enhancement, which would require additional design efforts.

Therefore, **Coordination between MN and SN for either IDC configuration or IDC assistance information report is not supported for NR-DC**.The same comment is for both FDM and TDM |
| ZTE | Yes | For the autonomous denial, we don’t think any coordination is needed.But for the NR-DC IMD interference, we think the MN exchange both the current serving Frequency Ranges and the potential serving Frequency Ranges that are included in NR-DC IMD interference frequency combination. |
| Apple | Yes | How to support MN controlled IDC is still not complete. For example, following information are needed from SN to MN:1) SN configured autonomous denial configuration2) Interested frequency range for candidate frequencies |
| Xiaomi | No strong view | It is unclear whether the coordination between MN and SN is required for autonomous denial configuration, as the gNB anyway does not know which UL slot will be dropped by the UE.For TDM assistance reporting configuration, as the TDM assistance information is per CG, there is no strong motivation observed for inter-node coordination.For FDM assistance reporting configuration, we think that some reporting signaling can be optimized. For example, MN configures f1+f2 as IDC candidate frequencies, and then SN does not need to configure the same frequencies as IDC candidate frequencies.  |
| Intel | No | We think existing inter-node message is sufficient. |
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## 2.3 Others

The following FFS(s) are quoted from the endorsed CRs given in the reference section.

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| R2-2304331 38.331 running CR for introduction of IDC Xiaomi draftCR Rel-18 38.331 17.4.0 NR\_IDC\_enh-Core* Editor’s Note: FFS on the dependency between FDM and TDM configuration.
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According to the LTE specification for reporting the TDM assistance information, there is not separate configuration for allowing the UE to report the TDM assistance information. Only one bit configuration is provided for both FDM and TDM assistance information in Rel-11, as quoted below:

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| 36.331:IDC-Config-r11 ::= SEQUENCE { idc-Indication-r11 ENUMERATED {setup} OPTIONAL, -- Need OR autonomousDenialParameters-r11 SEQUENCE { autonomousDenialSubframes-r11 ENUMERATED {n2, n5, n10, n15, n20, n30, spare2, spare1}, autonomousDenialValidity-r11 ENUMERATED { sf200, sf500, sf1000, sf2000, spare4, spare3, spare2, spare1} } OPTIONAL, -- Need OR ..., [[ idc-Indication-UL-CA-r11 ENUMERATED {setup} OPTIONAL -- Cond idc-Ind ]], [[ idc-HardwareSharingIndication-r13 ENUMERATED {setup} OPTIONAL -- Need OR ]], [[ idc-Indication-MRDC-r15 CHOICE{ release NULL, setup CandidateServingFreqListNR-r15 } OPTIONAL -- Cond idc-Ind ]]} |

The consequence is that the UE would have to report FDM assistance information when reporting TDM assistance information, as quoted below:

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| 1> if there is at least one E-UTRA carrier frequency, for which a measurement object is configured, that is affected by IDC problems:2> include the field *affectedCarrierFreqList* with an entry for each affected E-UTRA carrier frequency for which a measurement object is configured;2> for each E-UTRA carrier frequency included in the field *affectedCarrierFreqList*, include *interferenceDirection* and set it accordingly;2> include Time Domain Multiplexing (TDM) based assistance information, unless *idc-HardwareSharingIndication* is configured and the UE has no Time Doman Multiplexing based assistance information that could be used to resolve the IDC problems:3> if the UE has DRX related assistance information that could be used to resolve the IDC problems:4> include *drx-CycleLength*, *drx-Offset* and *drx-ActiveTime*;3> else (the UE has desired subframe reservation patterns related assistance information that could be used to resolve the IDC problems):4> include *idc-SubframePatternList*;3> use the MCG as timing reference if TDM based assistance information regarding the SCG is included; |

#### Question 6: Do you think that FDM configuration and TDM configuration can be configured independently?

(Rapporteur’s comments: Companies providing the answer “No”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes | We have already provided a TDM configuration in the CR and agreed that TDM capability is separate from FDM capability. The procedural text in the current CR as well does not require FDM to be supported for TDM reporting so it does not seem a spec change is needed from the current CR. Note that our motivation to deploy TDM with no FDM is that some deployments like n255 for NTN cannot benefit from FDM solution so in this case this would be a standalone TDM solution. |
| Nokia | Yes | IDC solution is much more rugged in case FDM and TDM is combined. Separate TDM solution for discrete and separate frequencies/bands (bands defined as: Centre frequency and BW) can be implemented, however not sure (FFS) if the signaling means we have defined until now covers this completely.  |
| Ericsson | No | We don’t see the use case that UE only report TDM assistance info.The TDM assistance info needs to be always to be together with FDM information in order to make the TDM assistance info to be useful. We can just follow the LTE rule. This is also beneficial to reduce the configurational complexity for the network. |
| ZTE | No strong view | We tend to follow the majorities’ view on this issue. We don’t see strong concern (and also strong motivation) to have separate configuration |
| Apple | Yes | We share QC’s comments that TDM alone is needed when FDM solution is not there. |
| Xiaomi | Yes | We agree with the use case (i.e. n255 for NTN) as provided by QC. It seems that a standlone TDM solution can be useful for those specific use cases.  |
| Intel | Yes | We’re OK to have independent configuration of FDM and TDM, which is in current RRC running CR. |
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According to the LTE specification as quoted below, as the TDM assistance information is only allowed for MCG, the timing referenc for IDC TDM assistanc information uses MCG.

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| 36.331:2> include Time Domain Multiplexing (TDM) based assistance information, unless *idc-HardwareSharingIndication* is configured and the UE has no Time Doman Multiplexing based assistance information that could be used to resolve the IDC problems:3> if the UE has DRX related assistance information that could be used to resolve the IDC problems:4> include *drx-CycleLength*, *drx-Offset* and *drx-ActiveTime*;3> else (the UE has desired subframe reservation patterns related assistance information that could be used to resolve the IDC problems):4> include *idc-SubframePatternList*;3> use the MCG as timing reference if TDM based assistance information regarding the SCG is included; |

Since the NR TDM assistance information is per CG, the rapporteur considers that we can reuse the LTE solution to use the CG for reporting TDM as the timing reference. The following FFS(s) are quoted from the endorsed CRs given in the reference section.

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| R2-2304331 38.331 running CR for introduction of IDC Xiaomi draftCR Rel-18 38.331 17.4.0 NR\_IDC\_enh-Core3> include Time Domain Multiplexing (TDM) based assistance information as indicated by *idc-TDM-Assistance* that could be used to resolve the IDC problems;3> if *idc-TDM-AssistanceConfig* is provided from MCG:4> use the MCG as timing reference;3> else:4> use the SCG as timing reference;Editor’s Note: FFS whether the time reference for *idc-TDM-AssistanceConfig* is needed. |

#### Question 7: Do you think that the time reference for *idc-TDM-AssistanceConfig* is needed, as LTE?

(Rapporteur’s comments: Companies providing the answer “No”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes | Current text is fine |
| Nokia | No | We would be fine to similarly as in LTE (MCG as time reference always). Regarding text how it is now written – how does UE understand whether configuration is coming from MCG or SCG – or is the intention to say that if configuration is part of cell group configuration then UE uses that CG as timing reference for that configuration. Isn’t that obvious? So no need to capture it like shown here as it just confuses the reader.Xiaomi: Yes, the intention to say that if configuration is part of cell group configuration then UE uses that CG as timing reference for that configuration. |
| Ericsson | Yes |  |
| ZTE | Yes | We think the current context is OK. |
| Apple | Yes but see comments | In principle it is fine. But we would like to suggest another way of capturing it. If look into the procedure in 38.331, it could be seen that for the per-CG features in UAI including power saving (see below), “of a cell group” is specifically used. 1> if transmission of the *UEAssistanceInformation* message is initiated to provide *drx-Preference* of a cell group for power saving according to 5.7.4.2 or 5.3.5.3:1> if transmission of the *UEAssistanceInformation* message is initiated to provide *maxBW-Preference* of a cell group for power saving according to 5.7.4.2 or 5.3.5.3:1> if transmission of the *UEAssistanceInformation* message is initiated to provide *maxBW-PreferenceFR2-2* of a cell group for power saving according to 5.7.4.2 or 5.3.5.3:<other power saving features are omitted>While for features (overheating and legacy IDC) which only have MCG control and no per-CG config, no such wording “of a cell group” is used. We think this was intentionally designed to explicitly explain which feature is per-CG and which is not.1> if transmission of the *UEAssistanceInformation* message is initiated to provide IDC assistance information according to 5.7.4.2 or 5.3.5.3:1> if transmission of the *UEAssistanceInformation* message is initiated to provide overheating assistance information according to 5.7.4.2 or 5.3.5.3;Thus, our suggestion is to follow this format and change the following text as below. With this, there is no need to explicitly mention the timing source.1> if transmission of the *UEAssistanceInformation* message is initiated to provide IDC assistance information of a cell group according to 5.7.4.2 or 5.3.5.3:Xiaomi: If companies consider “provide IDC assistance information of a cell group” is clear for the timing reference, maybe we can remove the timing reference texts captured in the CR. |
| Xiaomi | Yes | The timing reference is required so that the gNB and the UE can have the common understanding on the timing for TDM. |
| Intel | Yes |  |
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The following FFS(s) are quoted from the endorsed CRs given in the reference section.

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| R2-2304331 38.331 running CR for introduction of IDC Xiaomi draftCR Rel-18 38.331 17.4.0 NR\_IDC\_enh-CoreIDC-TDM-Assistance-r18 ::= SEQUENCE {cycleLength-r18 ENUMERATED {ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32, ms35, ms40, ms60, ms64, ms70, ms80, ms128, ms160, ms256, ms320, ms512, ms640, ms1024, ms1280, ms2048, ms2560, ms5120, ms10240},startOffset-r18 INTEGER (0..10239),slotOffset-r18 INTEGER (0..31), activeDuration-r18 CHOICE { subMilliSeconds INTEGER (1..31), milliSeconds ENUMERATED { ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60, ms80, ms100, ms200, ms300, ms400, ms500, ms600, ms800, ms1000, ms1200, ms1600, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 } }}AffectedCarrierFreqRangeList-r18 ::= SEQUENCE (SIZE (1..FFS)) OF AffectedCarrierFreqRange-r18Editor’s Note: FFS whether to use maxFreqIDC-r16.AffectedCarrierFreqRange-r18 ::= SEQUENCE { centerFreq-r18 ARFCN-ValueNR, affectedBandwidth-r18 ENUMERATED {mhz5, mhz10, mhz20, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400, whole}, interferenceDirection-r18 ENUMERATED {nr, other, both, spare}}Editor’s Note: FFS on the values of bandwidth, and the meaning of the “whole” bandwidth of the frequency or whether to make *affectedBandwidth* optional.Editor’s Note: FFS whether the codepoint of “both” and “spare” for interferenceDirection-r18 is needed.AffectedCarrierFreqRangeCombList-r18 ::= SEQUENCE (SIZE (1..maxCombIDC-r16)) OF AffectedCarrierFreqRangeComb-r18 AffectedCarrierFreqRangeComb-r18 ::= SEQUENCE { affectedCarrierFreqRangeComb-r18 SEQUENCE (SIZE (2..FFS)) OF AffectedCarrierFreqRangeComb-r18 OPTIONAL, victimSystemType-r18 VictimSystemType-r16}Editor’s Note: FFS whether to reuse the Rel-16 IDC ASN.1 framework of adding *interferenceDirection* and *victimSystemType*.Editor’s Note: FFS on the number of entries (e.g. maxNrofServingCells) of affectedCarrierFreqRangeComb-r18.AffectedCarrierFreqRangeComb-r18 ::= SEQUENCE { centerFreq-r18 ARFCN-ValueNR, affectedBandwidth-r18 ENUMERATED {mhz5, mhz10, mhz20, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400, whole},}Editor’s Note: FFS on the values of bandwidth and the meaning of the “whole” bandwidth of the frequency or whether to make *affectedBandwidth* optional. |

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| AffectedCarrierFreqRangeList-r18 ::= SEQUENCE (SIZE (1..FFS)) OF AffectedCarrierFreqRange-r18Editor’s Note: FFS whether to use maxFreqIDC-r16. |

#### Question 8: Do you think that *maxFreqIDC-r16* is reused for *AffectedCarrierFreqRangeList-r18*?

(Rapporteur’s comments: Companies providing the answer “No”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes | We have not identified issues where we need a number higher than current maxFreqIDC-r16 (128). We are open to alternatives if use cases are identified  |
| Nokia | Yes | Open to discuss other values |
| Ericsson | Yes | Reuse of the legacy values are sufficient. |
| ZTE | Yes | Open to discuss other values |
| Apple | Yes |  |
| Xiaomi | Yes |  |
| Intel | Yes | We think value 128 is sufficient for Rel-18. |
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As quoted below, *interferenceDirection-r18* reuses the same values of *interferenceDirection-r16*.

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| AffectedCarrierFreq-r16 ::= SEQUENCE { carrierFreq-r16 ARFCN-ValueNR, interferenceDirection-r16 ENUMERATED {nr, other, both, spare}} |
| interferenceDirection-r18 ENUMERATED {nr, other, both, spare} |

#### Question 9: Do you think that *interferenceDirection-r18* reuses the values of *interferenceDirection-r16*?

(Rapporteur’s comments: Companies providing the answer “No”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | Yes |  |
| Nokia | No | i.e. we agree with QC comment in Q10 – Thus we are confused with QC answer here but anyway I think we agree generally with QC on Q10. |
| Ericsson | Yes | For this note, it makes more sense to keep the value “both” which is also existing in the legacy specs. There is no clear motivation to remove this value. How to handle this reported value is anyway up to the network implementation. In addition, by keeping this value, it may be beneficial in order to reduce signalling overhead in the frequency UE IDC report |
| ZTE | Yes |  |
| Apple | Yes |  |
| Xiaomi | Yes |  |
| Intel | Yes |  |
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According to the endorsed CR, the Rel-16 IDC ASN.1 framework of adding *interferenceDirection* and *victimSystemType* is reused for the Rel-18 IDC FDM assistance information.

#### Question 10: Do you think that the Rel-16 IDC ASN.1 framework of adding *interferenceDirection* and *victimSystemType* is reused for the Rel-18 IDC FDM assistance information?

(Rapporteur’s comments: Companies providing the answer “No”, please also provide the reasons and the required specification changes in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | See comment | In the current running CR (and LTE spec), the UE can only report victimSystemType when it’s reporting a frequency combination.2> if there is at least one supported UL CA or MR-DC combinations comprising of frequency ranges included in *candidateServingFreqRangeListNR*, and each affected frequency range in the UL CA or MR-DC combination overlaps with one frequency range included in *candidateServingFreqRangeListNR*, and the center frequency of the affected frequency range is within the frequency range included in *candidateServingFreqRangeListNR*, the UE is experiencing IDC problems that it cannot solve by itself:3> include *victimSystemType* for each UL CA or MR-DC combination included in *affectedCarrierFreqRangeCombList*It is unclear why restritcting victimSystemType to reporting IMD issues only is needed and why victimSystemType is not allowed to report for single frequency range reporting, e.g. for adjacent IDC issue. Thus we would like to generalize interferenceDirection and victimSystemType to allow always including them in IDC report for both FDM and TDM |
| Nokia |  | QC comment makes sense to us. Making this more generic seems useful. |
| Ericsson |  | We share the view as QC, however, not for the TDM reporting.We are fine to make this more general to FDM report, including both adjacenet carrier IDC and frequency combination. However, no need to introduce interfereceDirection and victimSystemType for TDM reporting. In our view, UE needs to always report TDM assistance information and FDM assistance information together. It is sufficient for UE to include interfereceDirection and victimSystemTyp in FDM assistance information. |
| ZTE | Yes | In the LTE, there is a similar discussion about the victimSystemType. Our understanding is that for the single frequency, the network can determine the victimSystemType from the frequency itself(During the LTE discussion, there are two options affected Frequency or victim type, at last the affected frequency was selected)

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| RAN2#71bis2) Candidate information (still FFS): a) Frequency of aggresor/victim non-LTE tech (LTE network judgement), or b) LTE frequencies that are probably still usable/not useable (UE judgement) |

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| Apple | See comments | QC’s suggestion seems good. |
| Xiaomi | No strong view | Firstly we agree with ZTE on the LTE understandings on the victimSystemType.We also agree with other companies that removing the LTE “Optional” function for victimSystemType would also work.  |
| Intel | Yes | Our understanding is that in current RRC running CR, *interferenceDirection* can be included in IDC report for single frequency range, while *victimSystemType* cannot be included. We don’t have strong view on whether to allow *victimSystemType* to be reported for single frequency range or not. |
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| AffectedCarrierFreqRangeComb-r18 ::= SEQUENCE { centerFreq-r18 ARFCN-ValueNR, affectedBandwidth-r18 ENUMERATED {mhz5, mhz10, mhz20, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400, whole},}Editor’s Note: FFS on the values of bandwidth and the meaning of the “whole” bandwidth of the frequency or whether to make *affectedBandwidth* optional. |
| AffectedCarrierFreqRange-r18 ::= SEQUENCE { centerFreq-r18 ARFCN-ValueNR, affectedBandwidth-r18 ENUMERATED {mhz5, mhz10, mhz20, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400, whole}, interferenceDirection-r18 ENUMERATED {nr, other, both, spare}}Editor’s Note: FFS on the values of bandwidth, and the meaning of the “whole” bandwidth of the frequency or whether to make *affectedBandwidth* optional. |
| CandidateServingFreqRangeNR-r18 ::= SEQUENCE { candidateCenterFreq-r18 ARFCN-ValueNR, candidateBandwidth-r18 ENUMERATED {mhz5, mhz10, mhz20, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400, whole}}Editor’s Note: FFS on the values of bandwidth and the meaning of the “whole” bandwidth of the frequency or whether to make *affectedBandwidth* optional. |

As per RAN2 agreement, the endorsed CR adds the value “whole” for *affectedBandwidth-r18* and *candidateBandwidth-r18*. As RAN2 did not discuss the meaning of the value “whole”, it is better to clarify how this value “whole” for *affectedBandwidth-r18* and *candidateBandwidth-r18* is used in the specification.

#### Question 11: Do you think that the value “whole” for *affectedBandwidth-r18* and *candidateBandwidth-r18* is needed?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes (e.g. the meaning of the value “whole”) in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | No  | gNB can configure any arbitrary range(s) for reporting including serving and non-serving cells. Unclear what including a “whole” value means for the UE. Same intention can be achieved by configuring [fc,BW] pairs covering “whole” BW the gNB has in min. Note that, RRC configuration is per cell, there is no whole band configuration for the RRC so we are not in favor of breaking this rule with a vague field value. |
| Nokia | Yes  | Also making the field optional is fine as well. We need to have method where UE can indicate whole band is affected – It would also prevent the need to be always updating this whenever new BWs are introduced. |
| Ericsson | Yes | Regarding whether to define a code point of “whole” indicating the full bandwidth of the frequency or to make *candidateBandwidth-r18* to be optional, we think it is better to use a code point of “whole” indicating the full bandwidth of the frequency. This reduces the configuration complexity for both the network and the UE. Meanwhile, no need to define Need Code and the corresponding UE behaviour. The same conclusion is also applicable for *affectedBdnwidth-r18*. |
| ZTE | Yes(Whole” can be replaced by the UE supported maximum bandwidth ) | The “Whole” can be replaced by the UE supported maximum bandwidth (according to the UE capability reporting), and for this no spec change needed, it belongs to the NW implementation.If the UE only support 80M bandwidth, there is no meaning to configure 100M from the UE side, the network would know the supported maximum bandwidth for each frequency from the UE capability. The network can indicate this maximum supported bandwidth immediately in the IDC config,  |
| Apple | No | With the value “whole”, is UE supposing to check the maximum channel bandwidth of the band corresponding to the ARFCN? But one ARFCN may map to multiple bands then if those bands have different maximum channel bandwidth, how could UE determine the interested frequency range?In addition, we guess network can even configure a larger value than the maximum channel bandwidth? Thus, we don’t see the need to use “whole” instead of a exact value. |
| Xiaomi | No | Agree with Qualcomm and Apple that value “whole” can be replaced by any other values. |
| Intel | No | We think explicit values for bandwidth are sufficient. |
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#### Question 12: Do you think that *candidateBandwidth-r18* can be optional for the FDM configuration from the network, e.g. if the value “whole” for *candidateBandwidth-r18* is not applicable?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes (e.g. what would be expected UE behavior when this field is not present) in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | No | Same as last comment. The term is unclear and not used elsewhere in the spec spec, so including [fc,BW] is probably the safest route to avoid later misunderstandings |
| Nokia | Yes | Making it optional would in our understanding mean same as “whole”. So either “whole” or optional is sufficient. |
| Ericsson | No |  |
| ZTE | No | See above, and if set it as optional, it still need to specify the meaning of absence,(e.g. does it mean the UE report only frequency, or does it mean that the “maximum supported bandwidth”.) |
| Apple | No | If it is optional, we need to further specify (hardcode) what is the interested frequency range. |
| Xiaomi | No |  |
| Intel | No | See answer to Q11. |
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#### Question 13: Do you think that *affectedBandwidth-r18* can be optional for the FDM assistance information reported from the UE, e.g. if the value “whole” for *affectedBandwidth-r18* is not applicable?

(Rapporteur’s comments: Companies providing the answer “Yes”, please also provide the reasons and the required specification changes (e.g. what would be expected UE behavior when this field is not present) in the Comments column. A converged solution (if required) would be highly appreciated.)

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| **Company** | **Answers** **(Yes/No)** | **Comments** |
| Qualcomm | No | Same comment as above. Also, it seems also that this would just be a fallback to Rel-16 behavior where the UE reports a freq and gNB initiates HO so if this is the intention, Rel-16 framework can be used. As the WID is about more granularity we think reporting [fc,BW] is more in scope with WID. The other use case is appropriate for Re-16  |
| Nokia | Yes | Making it optional would in our understanding mean same as “whole”. So either “whole” or optional is sufficient. If this is optional then wouldn’t the report be pretty much same as in R17 for that frequency i.e. UE only indicate affected carrier and whole carrier is impacted? |
| Ericsson | No |  |
| ZTE | No strong view | Our understanding is that absence of the bandwidth maybe mean that it’s the same as the network configured bandwidth, it can be seen as an signaling optimization. Anyway, no strong view and can accept the majorities’ view. |
| Apple | See comments | Same reason as above. If UE does not report affectedBandwidth, does network have a clear understanding on the actual problematic frequency range? |
| Xiaomi | No |  |
| Intel | No | See answer for Q11. In addition, in previous RAN2 meeting, only the *configuration* part related to “whole” bandwidth was discussed, and we don’t think such signalling optimization is needed for the UE reporting. |
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# 3. Conclusion

After collecting companies’ feedbacks, the discussion on the remaining issues of IDC is summarized as follows:

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# 4. Reference

[1] R2-2302979 38.306 running CR for Rel-18 IDC UE capabilities Intel Corporation draftCR Rel-18 38.306 17.4.0 B NR\_IDC\_enh-Core

[2] R2-2302980 38.331 running CR for Rel-18 IDC UE capabilities Intel Corporation draftCR Rel-18 38.331 17.4.0 B NR\_IDC\_enh-Core

[3] R2-2304331 38.331 running CR for introduction of IDC Xiaomi draftCR Rel-18 38.331 17.4.0 NR\_IDC\_enh-Core

[4] R2-2303884 37.340 Running CR for Introduction of IDC ZTE Corporation, Sanechips draftCR Rel-18 37.340 17.4.0 B NR\_IDC\_enh-Core

[5] R2-2304107 38.300 running CR for IDC Enhancements Huawei, HiSilicon draftCR Rel-18 38.300 17.4.0 B NR\_IDC\_enh-Core

[6] RAN2#121 meeting agreements

# Annex - RAN2 agreements

Green highlight – agreement captured in the specification

Blue highlight – agreement captured as editor’s notes

No highlight – agreement with no direct impact on specifications

## RAN2#119-e

**FDM**

* The Adjacent channel interference between NR Stand Alone (SA) or MN of NR-DC and non-3GPP should be considered for the FDM enhancement in Rel.18.
* The Adjacent channel interference between SN (NR) of MR-DC and non-3GPP should be considered for the FDM enhancement in Rel.18.
* NE-DC is not considered; We will work on NR freq as SA NR case.
* We will not consider the enhancements on E-UTRA freq for EN-DC scenario.
* FFS, on signalling details;
* The IMD interference from simultaneous Tx in EN-DC to non-3GPP should be considered for the FDM enhancement in Rel.18.
* The IMD interference from simultaneous Tx in NR-DC to non-3GPP should be considered for the FDM enhancement in Rel.18.
* Note: the solution (on freq granularity) for adjacent can be reused for IMD, we will not invent new solution on freq granularity for IMD. FFS on signalling details.
* Granular indications of the affected NR frequency reported for IDC issue needs to consider both serving and non-serving frequency as in the legacy FDM solution.

**TDM**

* The use cases (e.g. BT voice, BT eSCO and WLAN beacon) as described in 3GPP TR 36.816 for LTE TDM solutions are considered for developing the Rel-18 IDC TDM solution in RAN2.
* Rel-18 IDC TDM solution(s) targets at resolving the adjacent channel interference issue and the intermodulation distortion interference issue, as LTE.
* As the baseline, the UE reports the TDM assistance information for IDC affected frequency list , as LTE.
* Note, this does not exclude MUSIM gap like solution.

**General**

* RAN2 consider “hardware sharing indication” is out of scope. Company should bring this to RANP if want to support it.

## RAN2#120

**FDM**

* Reconfirm, The Rel-18 IDC solution should allow for more granular IDC indications both on serving and on non-serving frequencies.
* Only one single new finer granularity report is introduced, that applies for both serving and non-serving frequencies.
* For LTE, problematic frequencies of E-UTRA are indicated by indicating measurement object IDs (same as existing LTE, no specification impact is foreseen.)
* RAN2 down select one of solution 1, 2 or 2a based on ASN.1 details. FFS on the signalling details, how to configure, how to report.
* MN can configure IDC, FFS whether SN can configure IDC for SN

**TDM**

* Periodic pattern is supported; FFS on the values.
* Option 3 (i.e. UL and/or DL transmission occasion(s) solution) is not supported in Rel-18.
* The periodic pattern reported by the UE includes cycle, start offset and active duration. FFS, whether multiple patterns are supported. FFS on per CG pattern.
* RAN2 confirms the understanding that in Rel-17 NR RRC, the values from periodic pattern in MUSIM-gap is a subset of the DRX parameters.
* NR DRX values can be treated as a starting point for assistance information reported by UE. FFS, on exact values.
* RAN2 reconfirms the previous RAN2 agreement that the aperiodic traffics as described in 3GPP TR 36.816 are considered for developing the Rel-18 IDC TDM solution in RAN2.
* Autonomous denial solution is supported in Rel-18 IDC, RAN2 will not introduce other solution on aperiodic use case (i.e. no report from UE on this aperiodic issue).

## RAN2#121

**FDM**

* Adopt Option 1 based frequency range reporting to the network i.e Center frequency + bandwidth in KHz/MHz for the actual affected frequencies is reported by the UE to the network for addressing IDC problem in R18.
* Take the ASN.1 framework for option 1 as a starting point in the Text proposal section and work on the following enhancements
	+ 1. Add granular values for band width (including BW in KHz/Mhz) to cover all the scenarios involving Wi-Fi, GNSS, BT
	+ 2. Add the other IEs such as direction of interference.
	+ 3. Add combination of frequencies’ range for addressing IMD scenarios.
	+ 4. Check whether to reuse maxFreqIDC-r16, or define maxFreqIDC-r18
* In MR-DC scenarios, SN can also configure the UE for IDC reporting in SN, including both FDM and TDM solution.
* no additional co-ordination is needed for IDC configuration, apart from the existing mechanism between MN and SN (i.e. candidateServingFreqListNR in CG-Config for EN-DC).
* The gNB configures the candidate frequency ranges using (centre frequency + bandwidth) for which the UE should report IDC issues. Network may indicate the whole bandwidth of the freq.
* The frequency range (centre frequency + bandwidth) reported by the UE shall at least overlap with the frequency range (centre frequency + bandwidth) configured by the network.
* The centre frequency reported by the UE is within the frequency range (centre frequency + bandwidth indicated by network in the configuration) configured by the network.
* If the UE detects interference in both directions for one candidate frequency range indicated by the gNB, the UE can report two affected frequency ranges with the respective interference direction, as legacy. No extra specification change is required.
* LTE MN does not configure the UE with R18 NR IDC configuration.

**TDM**

* The NR values of long/short DRX cycle and start offset are used for periodic pattern. RAN2 will not introduce new DRX value for network configuration for IDC purpose.
* The slot offset with 1/32ms granularity is included in UEAssistanceInformation-v18xy-IEs for start offset.
* Multiple periodic patterns for IDC are not supported in R18.
* Per CG pattern is supported for MR-DC. SN can configure the UE to report the TDM assistance information directly to SN, either through SRB 1 (if SRB3 is not configured) or SRB 3.
* FFS whether any additional coordination is needed for network to resolve the problem when network receives the reporting from UE.
* Slot as time unit for autonomous denial
* Agree to send LS to RAN4, indicate the progress in RAN2
* For NR-DC, per CG idc-AssistanceConfigTDM-r18 is introduced to indicate whether TDM assistant information needs to be reported.
* For NR-DC, per CG idc-AssistanceConfigFDM-r18 is introduced to indicate whether FDM assistant information needs to be reported. FFS on dependency between FDM and TDM configuration.
* The values of drx-onDurationTimer in NR is used as the baseline for active Duration in UE assistant information. FFS on other values.
* The same values of validity period and number of denial slots as in LTE is reused. FFS on other values.
* The autonomous denial configuration is per CG.

**UE capabilities**

* Rel-18 IDC UE capability(ies) defined in NR side is/are per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.
* In NR side, 3 capability bit is introduced for FDM, periodic pattern and autonomous denial separately.
* The pre-requisite of autonomous denial is FDM solution (R16 or R18) or periodic pattern.