**3GPP TSG-RAN WG2 Meeting #121 *R2-230xxxx***

**Athens, Greece, 27 February – 3 March 2023**

**Agenda item: 8.10.4**

**Source: Intel Corporation**

**Title: [AT121][653][IDC] Discussion on IDC capabilities (Intel)**

**Document for: Discussion and Decision**

# Introduction

This is the report of following at meeting offline discussion:

* [AT121][653][IDC] Discussion on IDC capabilities (Intel)

 Scope: P1 on NR capability. LTE capability should wait for offline discussion [652]

 Intended outcome: Report to Friday CB session in R2-2302073

 Deadline: Thursday 2023-03-02 19:00 EET

# Contact information

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |
| --- | --- |
| Company | Contact: Name (E-mail) |
| Intel | Yujian Zhang (yujian.zhang@intel.com) |
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# Discussion

The offline discussion is about the IDC UE capability to be reported at NR side. Chair notes for relevant online discussion is as follows:

Proposal 1: [2 vs 4] RAN2 to discuss whether in NR side, common or separate UE Rel-18 IDC capabilities for FDM and TDM are introduced.

* QC, Huawei, Ericsson, vivo, Samsung, Apple see the benefit to have separate bits.
* ZTE would like to follow LTE approach. Nokia also prefer LTE approach. Xiaomi, we have separate capabilities in LTE for R15/16 new IDC solutions. Xiaomi would suggest to add some restrictions on how to report TDM capability, e.g. UE must support R15/R18 FDM.
* QC, there are different use cases, e.g. NTN only has 1 band, only TDM solution can work.
* ZTE, network can only configure freq list and autonomous denial, and therefore does not need to know whether UE support periodic pattern or not. Apple, to address ZTE’s concern, we can introduce separate bit for autonomous denial.
* QC do not support the precondition for autonomous dedial.
* Offline discussion [653]

During online discussion, it seems that following option gained most support: introduce one capability bit for FDM and periodic pattern, and another capability bit for autonomous denial. The reasoning is that gNB only configures candidate frequencies to report IDC issue and autonomous denial. TDM assistance information can be reported together with FDM assistance information.

**Question 1:** Do you agree with the following? If not, please provide reasoning and / or preferred alternative.

In NR side, one capability bit is introduced for enhanced FDM and periodic pattern, and another capability bit is introduced for autonomous denial.

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree / Disagree** | **Comments** |
| Intel | Agree |  |
| Xiaomi | Agree | We think the periodic pattern can be bonded together with FDM. Reporting only TDM assistance information does not work for most cases, as the gNB does not know which frequency range should use the TDM pattern.  |
| Ericsson | disagree | We think FDM and TDM capabilities shall be introduced separately. We shall not unnecessarily combine features together in the same capability bit.We are fine to have 3 capability bits wherein one is for FDM, one is for periodic pattern, and another one is for autonomous denial. Any FDM, TDM solution is no problem to run independently. How to use any FDM or TDM information provided by any one or multiple UEs are fully left up to gNB implementation.In addition, TDM assistance information (e.g., preferred periodic TDM pattern) is not needed to be coupled to a frequency region, since the TDM pattern is per CG (MAC entity), which is common to all frequencies in the CG (MAC entity). |
| Qualcomm | Disagree | Agree with Ericsson on this: “We are fine to have 3 capability bits wherein one is for FDM, one is for periodic pattern, and another one is for autonomous denial.” |
| ZTE | Agree | Share the same view as Xiaomi.As in the legacy, the network only configure the candidate frequency, and it’s up to UE whether to report the TDM assistance information for the affected frequency. |
| Nokia | Disagree | In LTE we have just one capability bit. It seems sufficient here i.e. UE supporting IDC will support FDM,TDM and autonomous denial |

**Summary**

All 5 companies agree to introduce a capability bit for autonomous denial on NR side. Regarding the capability bit(s) for enhanced FDM and periodic pattern, 3 companies support to have a single capability bit, while 2 companies support to have separate capability bits.

**Proposal 1**: In NR side, one capability bit is introduced for autonomous denial.

**Proposal 2**: [3 vs 2] RAN2 to discuss whether in NR side, common or separate UE Rel-18 IDC capabilities for FDM and periodic pattern are introduced.

In the online discussion, the pre-requisite for autonomous denial was discussed. There were arguments that pre-requisite of autonomous denial should be FDM and periodic pattern, while there were also arguments that in certain use cases (e.g. NTN with only 1 band), FDM solution might not be applicable.

In LTE IDC, the applicability of autonomous denial was extensively studied. In TR 36.816 clause 5.2.2.1.1, following is captured for autonomous denial:

UE can autonomously deny LTE resources due to some critical short-term events of ISM side, e.g. some events during BT/WiFi connection-setup or other important signalling. Otherwise, large delay or failure of connection-setup could happen if these events are not prioritized over LTE. This solution is assumed to be used for the event that rarely takes place.

The applicability of IDC TDM solutions was also captured in TR 36.816, as below:

Table 5.3‑1: Applicability of different TDM solutions

|  |  |
| --- | --- |
| **TDM solution** | **Usage scenario** |
| **LTE+BT earphone (VoIP service)** | **LTE+BT earphone (Multimedia service)** | **LTE+WiFi portable router** | **LTE+WiFi offload** | **LTE+GNSS Receiver** |
| HARQ process reservation based solution | Applicable | Applicable for BT Master, but not applicable for BT Slave | FFS | FFS | Applicable |
| DRX based solution | Applicable | Applicable | Applicable | Applicable | Applicable |
| Uplink scheduling restriction based solution | Not applicable | Not applicable | Not applicable | Not applicable | Applicable |
| Autonomous denial solution | Complementary solution for receiving important signalling |

According to LTE study, autonomous denial is a *complementary* solution to other TDM solutions for rare events, and cannot be used as the only solution to solve IDC problem. Given the nature of IDC issues, it is expected that above principle is also applicable to NR. In NR, the only other TDM solution is periodic pattern. Therefore autonomous denial should be used together with periodic pattern. Note that to make the discussion independent of outcome of question 1, enhanced FDM solution is not mentioned in the following question although it is possible to group enhanced FDM solution and periodic pattern with a single capability bit.

 **Question 2:** Do you agree with the following? If not, please indicate preferred pre-requisite of autonomous denial.

The pre-requisite of autonomous denial solution (if a capability bit is defined) is the support of periodic pattern.

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree / Disagree** | **Comments** |
| Intel | Agree |  |
| Xiaomi | Agree | If most companies agree that the periodic pattern is bonded together with FDM, then it is fine to have the periodic pattern as the pre-requisite for autonomous denial. Otherwise, we would think that the FDM should be the pre-requisite for autonomous denial. We consider that supporting only autonomous denial without providing any assistance information to the network seems not realistic, as different UE implementation may have different situation for the internal interferences. |
| Ericsson | maybe | This is depending on discussion outcome of UE capability bits. |
| Qualcomm | Disagree | This is unneeded and we don’t agree with the reasoning. Due to coordination difficulty, some IDC events e.g., BT better be solved using autonomous denial. Also, those things not necessarily configured together or for same use cases/NWs/UEs.  |
| ZTE | Agree (same view as Xiaomi) | We share the same view as Xiaomi |
| nokia | Yes | But we only need a R18 capability for IDC so no need to make such a decision. |

**Summary**

Four companies think that pre-requisite of autonomous denial is either enhanced FDM solution or periodic pattern, depending on the outcome of the UE capability bit discussion in Question 1. One company doesn’t agree that pre-requisite of autonomous denial is periodic pattern, arguing that autonomous denial can be used alone to solve IDC issue. However it should be noted that this view is not aligned with conclusion from LTE IDC, which states that autonomous denial is a *complementary* solution to other TDM solutions for rare events.

**Proposal 3**: The pre-requisite of autonomous denial is FDM solution or periodic pattern, and exact detail will be concluded depending on outcome of UE capability bit discussion.

# Conclusion

Based on the input from companies, we have the following proposals:

**Proposal 1**: In NR side, one capability bit is introduced for autonomous denial.

**Proposal 2**: [3 vs 2] RAN2 to discuss whether in NR side, common or separate UE Rel-18 IDC capabilities for FDM and periodic pattern are introduced.

**Proposal 3:** The pre-requisite of autonomous denial is FDM solution or periodic pattern, and exact detail will be concluded depending on outcome of UE capability bit discussion.