3GPP TSG-RAN WG2 Meeting #120 Draft R2-2213008

**Toulouse, France, November, 2022**

Agenda: 9.8

Source: Session Chair (Intel)

Title: Report from IDC breakout session

Document for: Approval

 **Organizational:**

* [AT120][650][IDC] Organizational Yi – IDC (Intel)

 Scope:

* Share plans for the e-meetings and list/status of ongoing email discussions for the sessions.
* Share meeting notes and agreements for review and endorsement.

## 8.10 IDC enhancements for NR and MR-DC

(NR\_IDC\_enh-Core; leading WG: RAN2; REL-18; WID: RP-221281)

Time budget: 1 TU

Tdoc Limitation: 2 tdocs

This WI expects to address interference between 3GPP (including various MR-DC architectures, i.e. NR-DC and EN-DC) and non-3GPP RAT (e.g. WiFi). Note: Enhancements to FDM solution is prioritized. LTE IDC solution should be considered as the baseline for the solutions developed in this WI.

### 8.10.1 Organizational

LS in. Rapporteur Input

### 8.10.2 FDM solution enhancements

Enhancements to FDM solution, to allow more granular indication of affected frequencies (e.g. granularity of BWP or PRB level).

Including the outcome of email discussion [Post119-e][650][IDC] Comparison of FDM solutions (Ericsson). Further discussion on, e.g. stage 3 details of the selected solutions if time is allowed.

[R2-2212420](file:///C%3A%5Cwork%5CRAN2%5CExtracts%5CR2-2212420%20-%20Report%20from%20%5BPost119-e%5D%5B650%5D%5BIDC%5D%20Comparison%20of%20FDM%20solutions%20%28Ericsson%29.docx) Report from [Post119-e][650][IDC] Comparison of FDM solutions (Ericsson) Ericsson discussion Rel-18 NR\_IDC\_enh-Core

Discussion:

Proposal 1 The Rel-18 IDC solution should allow for more granular IDC indications both on serving and on non-serving frequencies.

* OPPO, do not support the finer granularity for non-serving freq, and we should focus on serving freq. QC agree with OPPO. Serving freq is more important, and would like to focus on serving freq first. ZTE share the same as OPPO and QC, and has concern on signalling overhead.
* Huawei this has been discussed and agreed in last meeting. Do not need to rediscuss this. Nokia agree. Network should get proper information before the HO. Samsung/Intel also support the proposal. Xiaomi, we do not need to reconfirm what we agreed before. Samsung, the guanularity for non serving freq is also more important.
* ZTE if we go for solution 1-2a, we should study how to reduce signalling overhead. QC also has concern on signalling overhead.
* Ericsson, it is dedicate RRC signalling, overhead should not be the serious concern.
* Reconfirm, The Rel-18 IDC solution should allow for more granular IDC indications both on serving and on non-serving frequencies.

Proposal 2 Only one single new finer granularity report is introduced, that applies for both serving and non-serving frequencies.

* QC, BWP ID is more efficient way for serving cell. Do not want to consider this for non-serving cell. Vivo, ZTE, OPPO, support QC. OPPO, once the IDC information is changed, the UE has to retrigger it, and report will be more freq if finer granularity is introduced.
* Samsung, support the proposal. Intel support. Huawei, Lenovo support, similar as LTE, same solution for both serving and non-serving freq.
* Huawei, BWP is not finer granularity, esp, for larger BW scenario.
* Nokia, would like to have easy implemented solution. BWP solution is not attractive than others.
* Ericsson, think BWP solution can still work for non-serving cell if network can configure it for non-serving cell. QC/Apple/OPPO do not support BWP ID for nonserving freq, that is complicated.
* But Ericsson can accept solution 1, 2 or 2a. Xiaomi, share the view.
* Apple, P2 impact the solution selection. BWP was initial one during RANP discussion. They do not support P2.
* Xiaomi, do not see the problem for signalling overhead since it is dedicated signalling. Lenovo agree with Ericsson, signalling overhead is not the big issue.
* QC, would like to understand how 2, 2a work. They do not the reason why we exclude the solution just based on the unique solution for serving and non-serving.
* Vivo, BWP is the good fact to be used for NR, they also agree Ericsson on non-serving freq. They would like to support BWP.
* ZTE, the network can solve the problem by BWP switching. That’s the benefit they see to support BWP solution.
* Ericsson, do not want to have different solution for serving and nonserving, esp if TDM is linked to instance.
* Xiaomi, the compromise could be make it configurable, and the network can configure what they want, and UE vendor to follow the network configuration.
* VDF, would like to have similar solution for serving and non-serving freq, and would like to have simple solution. Huawei also want to have only one solution for serving and non-serving.
* Ericsson cannot accept different granularity for non-serving, serving.
* Apple/QC can compromise on this proposal. But they can accept this only if we only focus on proposal 1/2 and 2a.
* Only one single new finer granularity report is introduced, that applies for both serving and non-serving frequencies.

Proposal 3 For LTE, problematic frequencies are indicated by indicating measurement object IDs

* Samsung, for NR, the promatic freq is indicated based on ARFCN instead of measObject.
* Nokia, what’s the impact to spec? Chair think, we will not change E-UTRA Freq based on this proposal.
* Ericsson, this is for LTE, not for NR, and confirmed for LTE, we do not change anything.
* For LTE, problematic frequencies of E-UTRA are indicated by indicating measurement object IDs (same as existing LTE, no specification impact is foreseen.)

Proposal 4 RAN2 down select one of solution 1, 2 or 2a.

* Ericsson suggest to do ASN.1 first, and then do the down slecton.
* Xiaomi, the granularity of option 1/2a could be Mhz, and does not need to be BWP, PRB. Option 2 may cause more signalling overhead. And they prefer option 1.
* Huawei, bandwidth is configurable, and cover BWP, PRB, etc, then it can cover all issues.
* Chair, what’s the granularity of bandwidth, BWP, PRB, RBG, BW, or configurable?
* Intel, the solution is quite similar. We also need to discuss for non-serving freq, whether additional configuration from network is needed, esp, considering the large BW.
* ZTE is ok with the proposal, and agree the downslection can be done based on ASN.1 details.
* Huawei support the proposal, and option 1. They think the granularity can be configured network, e.g. 5Mhz, etc.
* Ericsson, we did not agree what network can configure, e.g. range? We can discuss this later.
* 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..

Option 1: Central frequency + Bandwidth of the actual affected frequency range (3/14 for both serving and non serving frequency, 2/14 non serving frequency) [5], [6], [9], [11].

Option 2: Starting frequency + Ending frequency of the actual affected frequency range (2/14 for both serving frequency and non-serving frequency) [5], [6].

Option 2a: starting frequency + Bandwidth of the actual affected frequency range (1/14 for both serving frequency and non-serving frequency) [6].

Pros:

- Clear how to use for both serving and non-serving, and for EN-DC/NR-DC

- Fine granularity - Possible for the gNB address the IDC issues by avoiding only the impacted PRBs.

Cons:

- More overhead compared to e.g. BWP-based approach

Option 3: BWP-based reporting using BWP ID (5/14 serving frequency only , 2/14 for both serving and non serving frequency) [1], [6], [7], [10], [12], [13].

Pro:

- Small signalling overhead.

- Suitable if IDC issues to be addressed by BWP-switching.

- Simple configuration.

Con:

- Limited granularity – Not possible for the gNB to avoid only impacted PRBs.

- Unclear how to make applicable for non-serving.

Option 4: BWP-based reporting using BWP ID + PRB index (2/14 for serving frequency) [6]. [7], [9].

Pros:

- Fine granularity - Possible for the gNB address the IDC issues by avoiding only the impacted PRBs.

- Less overhead compared to Option 1/2/2a.

Cons:

- Unclear how to make applicable for non-serving.

Option 5: Measurement object ID [5] (1/14 – For LTE frequency only)

* Existing solution for LTE freq;

Option 6: Resource Block Group (RBG) based reporting (1/14 for both serving frequency and non-serving frequency) [8].

Pros:

- Fine granularity - Possible for the gNB address the IDC issues by avoiding only the impacted PRBs.

Cons:

- Unclear how to make applicable for non-serving

Handling of MR-DC, how to configure IDC for MCG and SCG, report of assistance data for MCG and SCG, etc; Is this also applied for TDM?

[R2-2211740](file:///C%3A%5Cwork%5CRAN2%5CExtracts%5CR2-2211740_IDC%20FDM.doc) Discussion on FDM solutions in IDC Apple discussion Rel-18 NR\_IDC\_enh-Core

Discussion:

Proposal 6: Both MN and SN can configure IDC reporting to UE via SRB1 or SRB3 for the IDC reporting which only involve the carriers from one CG. UE reports IDC to the corresponding network entity via SRB1 or SRB3.

Proposal 7: If the affected carriers are across two CG(s), UE should only report the IDC status to MN and MN is responsible for IDC handling.

* Apple, if SRB3 is not configured, the IDC configuration of SCG should go through MN and configure to UE. But both MN and SN can configure IDC configuration. Chair, can MN configure IDC for SCG without SCG involvement? Apple, no.
* VDF, would like to have unify solution. They would like only MN can configure IDC for both MN and SCG, but MN may get the information from SN for SCG IDC configuration.
* Huawei, P6 is for adjacent, and P7 is for IMD. They would like have flexible configuration, i.e. SN can configure IDC SCG configuration. IDC SCG configuration is transparent to MN if it is transferred via SRB11. Apple, P6 is not only for adjacent. We should discuss whether we allow SN to make decision.
* Question: Can SN decide to configure IDC?
* Samsung support proposal 7. For P6, it can be optimization if the interference only happens on one of CG.
* QC, P7 usually MN/SN configure separately and then do the coordination. Apple, we have different design for power saving which allow separate configuration from MN and SN. But for overheating, the configuration has to be from MN.
* ZTE, how to avoid the candidate freq overlapping among MCG configured IDC and SCG configured IDC? Apple, for measurement, we let MN and SN to coordinate each other in oder to avoid this happen.
* OPPO is ok with P6/7. If SRB3 is there, and SN does not configure SCG IDC. Can UE report IDC?
* CATT, The coordination between MN and SN is needed. MN can make the final decision.
* VDF, what’s benefit to do this? ZTE share the same view. We should go for basic solution first. Huawei, we have scenario that only carrier in SCG is impacted. In this case, no need to let the MN to configure IDC configuration.
* Xiaomi, the same logic (coordination on SCG configuration) can be applied here for IDC.
* Lenovo, MN configured IDC is needed.
* OPPO, can MN be aware of SN frequency details, and not sure whether RAN3 need to be involved. Ericsson has same concern.
* QC, the node configures the configuration should get the report. Vivo, it depends on which node should solve the problem.
* Huawei, for the IMD issue, MN can configure IDC for both MCG and SCG freq. If the issue only caused by SN, then SN can configure it directly.
* Ericsson, the question here is whether SN can configure IDC or not. Nokia support Ericsson’s view.
* MN can configure IDC, FFS whether SN can configure IDC for SN

The following documents will not be individually treated

R2-2211581 FDM Solutions in IDC Qualcomm Incorporated discussion Rel-18

R2-2211608 Discussion on FDM enhancement Huawei, HiSilicon discussion Rel-18 NR\_IDC\_enh-Core

R2-2211618 Enhanced FDM solution for IDC Intel Corporation discussion Rel-18 NR\_IDC\_enh-Core

R2-2211740 Discussion on FDM solutions in IDC Apple discussion Rel-18 NR\_IDC\_enh-Core

R2-2211756 Discussion on FDM solution enhancements for IDC OPPO discussion Rel-18 NR\_IDC\_enh-Core

R2-2211969 FDM solutions Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_IDC\_enh-Core

R2-2211979 Discussion on the FDM Option 1 and 2 Xiaomi discussion Rel-18 NR\_IDC\_enh-Core

R2-2212412 More granular FDM indications Ericsson discussion Rel-18

R2-2212652 Discussion on FDM solution for R18 IDC vivo discussion Rel-18 NR\_IDC\_enh-Core

R2-2212668 Discussion on FDM solution enhancements Sharp discussion

R2-2212743 Further Consideration on the IDC FDM Solutions ZTE Corporation, Sanechips discussion Rel-18 NR\_IDC\_enh-Core

R2-2212816 Discussion on FDM solution for IDC Samsung discussion Rel-18 NR\_IDC\_enh-Core

R2-2212921 IDC FDM solution LG Electronics discussion Rel-18 NR\_IDC\_enh-Core

R2-2212931 FDM solution for IDC Lenovo discussion Rel-18 NR\_IDC\_enh-Core

### 8.10.3 TDM solution

Introduction of TDM solution (e.g. indication of UE preferred TDM pattern for UL/DL).
Note: The TDM solution is considered complementary to the FDM solution.

Including the outcome of email discussion [Post119-e][651][IDC] Comparison of TDM solutions (Xiaomi). Further discussion on, e.g. stage 3 details of the selected solutions if time is allowed.

[R2-2211978](file:///C%3A%5Cwork%5CRAN2%5CExtracts%5CR2-2211978_Summary%20of%20the%20comparison%20of%20TDM%20solutions%20%28Xiaomi%29.docx) Summary of [Post119-e][651][IDC] Comparison of TDM solutions (Xiaomi) Xiaomi discussion Rel-18 NR\_IDC\_enh-Core Late

Discussion:

Proposal 1 (11/14): Option 1 (i.e. DRX solution) is supported in Rel-18.

* QC, DRX only cannot work for Bluetooth. MUSIM gap solution can work for all scenario. Vivo agree with QC.
* Huawei, in LTE, it shown it can work for all scenarios. For MUSIM gap, we have to introduce additional things. The Ue in the market may not support it. Ericsson agree, we could take DRX as baseline.
* OPPO agree the proposal 1.
* Vivo, there are two steps, first is the UE to report the pattern, and then network provides the configuration. It should be network implementation on what solution should be used, DRX or MUSIM when the network gets the assistance data from the UE.
* LG, DRX and MUSIM gap are similar, we should only pick up one. They agree with QC on MUSIM gap.
* Intel, P1 is focusing on the assistance information from UE. But Intel preference is DRX. Samsung DRX and MUSIM assistance infor are quite similar. We can have unified pattern to cover both DRX and MUSIM. agree.
* Samsung, for MUSIM gap, it is unclear how can the UE determine when aperiodic gap is needed.
* QC, DRX cannot offer aperiodic gap. They are still unclear how DRX solve Bluetooth issue.
* ZTE, we can decouple the discussion for the UE reporting and Network Configuration, from the UE reporting aspect, the DRX is similar to the MUSIM periodic Gap. We may first agree, the periodic pattern is needed from UE.
* Periodic pattern is supported; FFS on the values;

FFS on whether aperiodic pattern is needed?

* Xiaomi, for aperiodic issue, in LTE, we use autonomous denial solution. Samsung/Huawei/CATT agree.
* Ericsson, DRX is more important. VDF, for periodic, we can follow DRX. For other cases, we can consider later. Huawei agree.
* Intel, not so sure whether this work for time sensitive case, agree with xiaomi, autonomous denial can be used. LG agree.

Proposal 2 (13/14): Option 3 (i.e. UL and/or DL transmission occasion(s) solution) is not supported in Rel-18.

* Option 3 (i.e. UL and/or DL transmission occasion(s) solution) is not supported in Rel-18.

Proposal 3: RAN2 is kindly requested to discuss which of the following solutions should also be considered in Rel-18:

 Option 2：MUSIM gap-like solution (6/14)

 Option 4: Autonomous denial solution (7/14)

support Autonomous denial solution?

* vivo, cannot agree autonomous denial since it has RAN4 impact. Xiaomi, we already reserved TU in RAN4 for this autonomous denial solution. Apple, fine with Autonomous denial. I recall in LTE IDC, RAN4 did almost nothing for autonomous denial.
* Ericsson, TDM is low priority. We need to focus on periodic pattern first. We should not agree this for now. They need more time.
* Xiaomi, we do not have time, only 2 meeting left. Based on email discussion, autonomous denial got quite many support.
* Nokia, do not see the strong motivation, and need more time.

Proposal 4: Depending on the down-selection result of the TDM solutions, the solutions (with the list of FFS issues) provided from the Phase-1 discussion can be considered as the baseline for further study.

* [AT120][651][IDC] Leftover issue on TDM (Xiaomi)

 Scope: To discuss leftover issue on TDM:

* FFS on whether aperiodic pattern is needed?
* Whether Autonomously denial solution is supported?

 Intended outcome: Report to Friday CB session in R2-2213091

 Deadline: Thursday 2022-11-17 18:00

**Observation 1: The benefits and drawbacks of the DRX solution are listed as follows:**

|  |  |  |
| --- | --- | --- |
|  | **Benefits** | **Drawbacks** |
| **DRX solution** | * Applicalbe for all traffic type, and more suitable for periodic traffic
* Finer granularity than MUSIM gap-lik solution
* The stable LTE baseline can be easily implemented in NR
 | * Not suitable for aperiodic service (e.g. some events during BT/WiFi connection-setup or other important signalling)
* Not suitable for some periodic service with smaller cycle (e.g. BT eSCO with 3.75ms cycle).
* Complex on multiple DRX timers
* Stopping all UL transmission is a bit overkill for IMD issue.
* Stopping both UL and DL transmission is a bit overkill when the intereferenc is UL-only or DL-only.
 |

**Observation 2: The benefits and drawbacks of the MUSIM gap-like solution are listed as follows:**

|  |  |  |
| --- | --- | --- |
|  | **Benefits** | **Drawbacks** |
| **MUSIM gap-like solution** | * Applicable for all traffic type
* Can reuse Rel-17 MUSIM framework
* Can react quickly to request for aperiodic gaps
 | * Not suitable for some periodic service with smaller cycle (e.g. BT eSCO with 3.75ms cycle).
* Coarser granurity than DRX solution
* Stopping all UL transmission is a bit overkill for IMD issue.
* Stopping both UL and DL transmission is a bit overkill when the intereferenc is UL-only or DL-only.
* More standard efforts than DRX due to unclear changes (e.g. more granularities) in the specification by using the Rel-17 MUSIM gap-like solution for IDC
* Whether/which the MUSIM gap-like solution (e.g. periodic gap or aperiodic gap) applicable for resolving the IDC issue may need RAN4 evaluation.
* It is unclear whether we need multiple patterns, hysteresis etc.
* It is unclear how the Rel-18 MUSIM work impacts the Rel-18 IDC solution.
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**Observation 3: The benefits and drawbacks of the UL and/or DL transmission occasion(s) solution are listed as follows:**

|  |  |  |
| --- | --- | --- |
|  | **Benefits** | **Drawbacks** |
| **UL and/or DL transmission occasion(s) solution** | * Applicalbe for all traffic type including periodic traffic and aperiodic traffic
* Can support the BT voice (eSCO) use case
* The DL and UL differentiation can provide more fine time domain separation between 3GPP and non-3GPP module
 | * More standard efforts on finding a proper UL/DL pattern in NR, as which UL/DL pattern is applicable for NR and IDC is still unclear.
* It is unclear how the pattern is adaptive to the NR asynchronous HARQ and the flexible TDD pattern.
* Complex for the implementation of both the UE and the gNB, since it is difficult to change the TDD configuration provided by the gNB.
 |

**Observation 4: The benefits and drawbacks of the autonomous denial solution are listed as follows:**

|  |  |  |
| --- | --- | --- |
|  | **Benefits** | **Drawbacks** |
| **Autonomous denial solution** | * Applicalbe for all traffic type including periodic traffic and aperiodic traffic, e.g., WiFi beacons and other connection setup events.
* More applicable for IMD issue, compared with other solutions.
* Very fast reaction time since it does not rely on signalling to obtain the gap in time.
* Does not need very stringent coordination between RATs.
* The LTE baseline can be reused in NR.
* Can work as a complementory solution with other TDM solution
 | * Not applicable for resolving DL interference to NR.
* Reduced cell throughput due to missed PUSCH.
* May trigger link adaptation and increased PDCCH load.
* It is difficult to work as a standalone solution. May lead to the increased market fragmentation
* Need new RAN4 performance requirements.
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Handling of MR-DC for TDM, how to configure IDC for MCG and SCG, report of assistance data for MCG and SCG, etc; May not be treated if the agreements made for FDM is applied for TDM;

[R2-2211609](file:///C%3A%5Cwork%5CRAN2%5CExtracts%5CR2-2211609%20Discussion%20on%20TDM%20solution%20for%20NR%20IDC.docx) Discussion on TDM solution for NR IDC Huawei, HiSilicon discussion Rel-18 NR\_IDC\_enh-Core

Discussion:

Proposal 5: To support the TDM solution as in Proposal 4 for scenario 1-2,

 If SRB3 is not configured: SN configures the reporting of the UE suggested TDM pattern information via SRB1 by using the RRCReconfiguration container to the UE, and UE reports the IDC assistance information with UE suggested TDM pattern information to SN via SRB1 by reporting UAI in the *ULInformationTransferMRDC* message

 if SRB3 is configured: SN configures the reporting of the UE suggested TDM pattern information to the UE via SRB3, and UE reports the IDC assistance information with UE suggested TDM pattern information to SN via SRB3

The following documents will not be individually treated

R2-2211583 TDM Solutions in IDC Qualcomm Incorporated discussion Rel-18

R2-2211619 TDM solution for IDC Intel Corporation discussion Rel-18 NR\_IDC\_enh-Core

R2-2211741 Discussion on TDM solutions in IDC Apple discussion Rel-18 NR\_IDC\_enh-Core

R2-2211757 Discussion on TDM solutions for IDC OPPO discussion Rel-18 NR\_IDC\_enh-Core

R2-2211970 TDM solutions Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_IDC\_enh-Core

R2-2211980 Discussion on the TDM Option 1 and 4 Xiaomi discussion Rel-18 NR\_IDC\_enh-Core

R2-2212004 NR IDC TDM solutions and indications Ericsson discussion Rel-18 NR\_IDC\_enh-Core

R2-2212653 MUSIM gap like solution for IDC vivo discussion Rel-18 NR\_IDC\_enh-Core

R2-2212742 Further Consideration on the IDC TDM Solutions ZTE Corporation, Sanechips discussion Rel-18 NR\_IDC\_enh-Core

R2-2212817 Discussion on TDM solution for IDC Samsung discussion Rel-18 NR\_IDC\_enh-Core