**3GPP TSG-RAN WG2 Meeting #117-e *R2-220xxxx***

**Electronic meeting, 21 February – 3 March 2022**

**Agenda item: 8.5.1**

**Source: Intel Corporation**

**Title: Report of email discussion [AT117-e][508][IIoT] UE Capabilities (Intel)**

**Document for: Discussion and Decision**

# Introduction

The contribution is the report of following email discussion:

* [AT117-e][508][IIoT] UE Capabilities (Intel)

UE capabilities CR (38.306/308.331)

Deadline: final approval by March 2nd

# Contact Information

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# Discussion

## UE capability for RTT based PDC

In email discussion “[POST116bis-e][513][IIoT] CP open issues (Ericsson)” R2-2203302 [1], UE capability regarding UE-side and gNB-side PDC was discussed. Following is the summary and proposal by the rapporteur. In RAN2#117-e online session, the issue was not handled due to lack of time and will be discussed in current email discussion.

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| --- |
| **Summary:**  A UE supporting FG 25-19/25-19a shall also support:   * 3 companies support UE-side PDC * 8 companies support both UE-side and gNB-side PDC (if agreed) * 4 companies support at least UE-side or gNB-side PDC (if agreed)   There seems to have some misunderstandings. Rapporteur intends to sort-out the capability dependency, in light of the RAN1 introduced FG 25-19/25-19a. Some more clarification below (assuming the gNB-side PDC is agreed):   * If UE supporting of FG 25-19/25-19a also supports UE-side PDC, then there is a need for a separate optional UE capability for gNB-side PDC; * If UE supporting of FG 25-19/25-19a supports both UE-side and gNB-side PDC, then there is no need for any more optional UE capabilities in RAN2; * If UE supporting of FG 25-19/25-19a also at least supports UE-side PDC or gNB-side PDC, then there is a need for two separate optional UE capabilities, one for gNB-side PDC and another for UE-side PDC.   The proposal below is a majority view  Proposal 8 UE supporting of FG 25-19/25-19a also supports both UE-side and gNB-side PDC (if agreed). (8/15) |

In current email discussion, we will focus on UE capability aspect. RAN1 has defined two separate RTT based PDC capabilities in feature list R1-2200780 [2]:

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| --- | --- | --- | --- |
| 25-19 | RTT-based Propagation delay compensation based on CSI-RS for tracking and SRS | Support RTT-based Propagation delay compensation for time synchronization of the Uu interface based on CSI-RS for tracking and SRS | 2-51, 2-53 |
| 25-19a | RTT-based Propagation delay compensation based on DL PRS and SRS | Support RTT-based Propagation delay compensation for time synchronization of the Uu interface based on DL PRS and SRS | 25-19, 13-1, 2-53 |

As highlighted by rapporteur of “[POST116bis-e][513][IIoT] CP open issues (Ericsson)”, if RAN2 agreed that UE supporting of FG 25-19/25-19a shall support both UE-side and gNB-side PDC, then there is no need for any additional UE capabilities in RAN2. Otherwise, additional UE capabilities should be defined.

**Question 1:** Please provide your preferred option on UE capability regarding UE-side and gNB-side RTT based PDC.

* Option a: A UE supporting FG 25-19/25-19a shall support both UE-side and gNB-side PDC (if agreed). In this option, there is no need for any additional optional UE capabilities in RAN2.
* Option b: A UE supporting FG 25-19/25-19a shall support UE-side PDC. The UE supports gNB-side PDC (if agreed) optionally. In this option, separate UE capability for gNB side PDC should be introduced.
* Option c: A UE supporting FG 25-19/25-19a shall support either UE-side or gNB-side PDC (if agreed). In this option, two separate UE capabilities for UE-side and gNB side PDC should be introduced.

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| **Company** | **Preferred option (a/b/c)** | **Comments** |
| Intel | a | Our understanding is that if UE supports one of the UE-side or gNB-side RTT PDC method, the additional efforts to support the other is marginal. Therefore it is reasonable to go with option a to avoid market segmentation as well as to minimize the introduction of additional UE capabilities due to option b/c. |
| Ericsson | a | Agree with Intel |
| MediaTek | C | We don’t see an issue with introducing two separate UE capabilities. We should let the market decide which option to go with, rather than forcing all UE vendors to implement all possible solutions.  This approach is very similar to the approach we’ve taken for other features in IIoT, e.g.   * Survival time feature implies support of either DC or CA duplication; * Survival time implies support of either CG type 1 or CG type 2. |
| Apple | c | We can accept two separate optional UE capabilities for UE-side PDC and gNB-side PDC. We think this is a cleaner way to define/split the capabilities. |
| OPPO | a | Agree with Intel |
| Qualcomm | b | We think UE side is the most straight-forward solution and also follows the Rel-16 approach of having the UE perform compensation, thus it’s fine to take as a baseline as a UE that supports only UE-side PDC is fully capable of functioning in any accurate synchronization use-case. |
| Samsung | b | Agree with Qualcomm that UE side is the most straight-forward solution and also follows the Rel-16 approach of having the UE perform compensation |
| CATT | a | Agree with Intel |
| Huawei, HiSilicon | a | From UE capability perspective, we don’t think there is much difference between supporting gNB RTT PDC and UE side RTT PDC as Intel stated. From flexibility of using PDC schemes perspective, we think it is beneficial if UE can support both RTT PDC schemes. |
| Nokia | a |  |

**Summary**

(RAN2 agrees “RAN2 confirms that gNB-side RTT Propagation Delay Compensation is supported”, therefore “if agreed” regarding gNB-side PDC not kept in summary.)

The views are as follows:

* 6 companies prefer option a (a UE supporting FG 25-19/25-19a shall support both UE-side and gNB-side PDC)
* 2 companies prefer option b (a UE supporting FG 25-19/25-19a shall support UE-side PDC).
* 2 companies prefer option c (a UE supporting FG 25-19/25-19a shall support either UE-side or gNB-side PDC).

Option a is majority view, while option b and c are supported by several UE vendors. The situation is similar to email discussion “[POST116bis-e][513][IIoT] CP open issues (Ericsson)”, where 8 out of 15 companies prefer option a. For current email discussion, there are 8 out of 10 companies (counting supporters for both option a and b) prefer that a UE supporting FG25-19/25-19a supports at least UE-side PDC. The additional complexity of supporting gNB-side PDC from UE’s perspective is discussed as below.

For both UE-side PDC and gNB-side PDC, UE needs to perform Rx-Tx time difference measurement (FG 25-19/25-19a) based on PRS/TRS, and gNB needs to perform Rx-Tx time difference measurement based on SRS. The differences between UE-side and gNB-side PDC are:

* UE-side PDC: UE is provided with gNB side Rx-Tx time difference, UE performs the PDC calculation and applies to the received reference time.
* gNB-side PDC: UE is configured to provide Rx-Tx time difference report to gNB in existing measurement report framework. gNB performs PDC calculation based on UE’s report, and sends the compensated reference time to UE.

The additional complexity of gNB-side PDC from UE’s point of view is the related measurement report, which is within the current measurement framework. Therefore it is expected there is not much UE side complexity increase to support gNB-side PDC.

Given above discussion, it is proposed to go with option a to follow majority view.

**Proposal 1** (6/10): A UE supporting FG 25-19/25-19a shall support both UE-side and gNB-side PDC.

If RAN2 agrees on option b in Q1, separate UE capability for gNB side PDC should be introduced, and the dependency, capability type, and FRx/xDD differentiation of the capability need to be discussed. Since RAN1 has separate UE capabilities FG 25-19/25-19a, there could be various options regarding the dependency between UE capability for gNB side PDC and FG 25-19/25-19a. Currently the dependency between FG 25-19 and 25-19a is still not finalized (highlighted in yellow above) in R1-2200780 [2]. For simplicity, it is proposed that if option b in Q1 is supported, a UE supporting gNB side RTT based PDC shall support either 25-19 or 25-19a. If RAN1 confirms that 25-19 is one of the prerequisite FGs of 25-19a, then RAN2 dependency can be updated so that a UE supporting gNB side RTT based PDC shall support 25-19. In addition, given that gNB side RTT based PDC is mainly a RAN2 feature related to RAN1 features, it is proposed that the capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.

**Question 2:** If Option b in Q1 is agreed, do you agree with the following:

An optional UE capability signalling is introduced for gNB side RTT based PDC (if agreed). A UE supporting this feature shall also support FG 25-19 or 25-19a (the dependency can be further updated based on RAN1 progress). The capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.

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| **Company** | **Agree / Disagree** | **Comments** |
| Intel | Agree |  |
| Ericsson | Agree | If, in any chance, FG25-19/FG25-19a is FDD-TDD DIFF or FR1-FR2 DIFF, this is still per UE but interpreted as that it is restricted by the underlying support of FG25-19/FG25-19a on TDD or FDD, on which frequency range, and etc. |
| MediaTek | Agree | While it makes sense that capability is per UE, it should be the same as FG 25-19/25-19a |
| Apple | Disagree | We do not support option b and the capability should not be per UE also.  [Rapporteur] Regarding per UE capability, the intention is the same as Ericsson’s comments. gNB side RTT based PDC capability (if introduced) anyway depends on FG25-19 / FG25-19a. Suppose FG25-19 is per FS capability, then gNB side RTT based PDC is applicable for the FS(s) where FG25-19 is reported. Per UE capability is sufficient, and there is no need to duplicate the report for gNB side RTT based PDC capability for every FS that FG25-19 is reported.  Same clarification applies for Question 3 below.  [Apple] Thanks for the clarification. Our intention is to allow a more fine-granular association. If the capability description is clearly conditioned on the scope of FG 25-19 / 25-19a then an association with per UE may be acceptable (subject to the text for capability definition and if option b is introduced, which is not our preference). |
| OPPO | Agree |  |
| Qualcomm | Agree | Agree with Ericsson |
| Samsung | Agree |  |
| CATT | Agree |  |
| Huawei, HiSilicon | Agree | Fine to have the capability as per UE, as from the beginning of this WI, xDD, FRx differentiation have not been discussed or regarded as issues. |
| Nokia | Agree |  |

**Summary**

9 companies agree with rapporteur proposal. One company initially had concerns on per UE capability, but considered per UE capability acceptable if the capability is conditioned on FG 25-19 / 25-19a. It is therefore proposed to agree on the following proposal.

**Proposal 2:** If RAN2 agrees that a UE supporting FG 25-19/25-19a shall support UE-side PDC, an optional UE capability signalling is introduced for gNB side RTT based PDC. A UE supporting this feature shall also support FG 25-19 or 25-19a (the dependency can be further updated based on RAN1 progress). The capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.

Similar reasoning regarding option b can be applicable to option c.

**Question 3:** If Option c in Q1 is agreed, do you agree with the following:

An optional UE capability signalling is introduced for gNB side RTT based PDC (if agreed). A UE supporting this feature shall also support FG 25-19 or 25-19a (the dependency can be further updated based on RAN1 progress). The capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.

An optional UE capability signalling is introduced for UE side RTT based PDC. A UE supporting this feature shall also support FG 25-19 or 25-19a (the dependency can be further updated based on RAN1 progress). The capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.

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| **Company** | **Agree / Disagree** | **Comments** |
| Intel | Agree |  |
| Ericsson | Agree |  |
| MediaTek | Agree | While it makes sense that capability is per UE, it should be the same as FG 25-19/25-19a |
| Apple | Disagree | The capability should be aligned with RAN1’s type definition for FG 25-19 / 25-19a, and it should not be defined per UE – we would prefer finer granularity. |
| OPPO | Agree |  |
| Qualcomm | Agree |  |
| Samsung | Agree |  |
| CATT | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Nokia | Agree |  |

**Summary**

The discussion is same as Q2. It is therefore proposed to agree on the following proposal.

**Proposal 3:** If RAN2 agrees that a UE supporting FG 25-19/25-19a shall support either UE-side PDC or gNB-side PDC, following capabilities are introduced:

* An optional UE capability signalling is introduced for gNB side RTT based PDC. A UE supporting this feature shall also support FG 25-19 or 25-19a (the dependency can be further updated based on RAN1 progress). The capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.
* An optional UE capability signalling is introduced for UE side RTT based PDC. A UE supporting this feature shall also support FG 25-19 or 25-19a (the dependency can be further updated based on RAN1 progress). The capability is per UE, not FDD-TDD DIFF, not FR1-FR2 DIFF.

## Other disucssion for UE capability CRs

Draft UE capabilities CRs based on [3][4] are provided for review. In addition to use comments for the draft CRs, additional comments can be provided below.

**Question 4:** Additional comments for draft UE capabilities CRs can be provided below.

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| **Company** | **Comments** |
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# Conclusion

To be updated.

# References

[1] R2-2203302, Ericsson, "Summary of [POST116bis-e][513][IIoT] CP open issues (Ericsson)"

[2] R1-2200780, Moderators (AT&T, NTT DOCOMO, INC.), "Updated RAN1 UE features list for Rel-17 NR after RAN1 #107bis-e"

[3] R2-2202464, Intel, "Draft 38.306 CR for Rel-17 NR IIoT URLLC UE capabilities"

[4] R2-2202465, Intel, "Draft 38.331 CR for Rel-17 NR IIoT URLLC UE capabilities "