3GPP TSG-RAN WG2 Meeting #117 Electronic R2-2203951

Online, Feb 21st – Mar 3rd, 2022

Agenda Item: 8.5.1

Source: Ericsson

Title: Summary of [AT117-e][513][IIoT] CR 38.331(Ericsson)

Document for: Discussion, Decision

# 1 Introduction

This contribution collects companies’ views on some aspects of the RRC CR, per the below email discussion instruction:

* [AT117-e][513][IIoT] CR 38.331 (Ericsson)

Review and agree to final CR 38.331

Deadline:

Contact person(s) for each participating company:

|  |  |  |
| --- | --- | --- |
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# 2 Discussion

## 2.1 Periodicity of UE Rx-Tx time difference

RAN2 agrees the below

1 RAN2 confirms that gNB-side RTT Propagation Delay Compensation is supported.

2 UE Rx-Tx time difference measurement report is triggered by an explicit one-shot RRC request.

3 Periodic measurement reporting is supported

4 The periodicity of UE Rx-Tx time difference measurement is part of the RRC configuration.

5 The periodicity value is selected by the gNB as part of periodic reporting configuration. Range for required periodicities can be decided by RAN2 and further confirmed with RAN1/RAN4 later, if needed.

In the paper R2-2202728 [1], it is proposed that two options can be used to determine the periodicity.

1. The same order of SIB9, which is used to periodically deliver RTI. But, after receiving the UE Rx-Tx time difference, gNB can only transmit the pre-compensated RTI in a unicast message, per the latest agreement. It does not seem to be necessary to align with SIB9.

The supported periodicity is shown below. One “rf” (radio frame) equals to 10 milliseconds.

SchedulingInfo ::= SEQUENCE {

 si-BroadcastStatus ENUMERATED {broadcasting, notBroadcasting},

 si-Periodicity ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},

 sib-MappingInfo SIB-Mapping

}

1. The regular RRM measurement periodicity. NR supports periodical reporting, and the period is configured as *reportInterval*. However, it is unclear if this can meet the requirement of 100 nanoseconds accuracy of reference time delivery on the Uu interface and so the same PDC accuracy requirement. The channel could change quite a lot in the lowest periodicity, 120 milliseconds, that impact the propagation delay, while it would be okay for mobility and RRM.

– ReportInterval

The IE *ReportInterval* indicates the interval between periodical reports. The *ReportInterval* is applicable if the UE performs periodical reporting (i.e. when *reportAmount* exceeds 1), for *triggerTypeevent* as well as for *triggerTypeperiodical*. Value *ms120* corresponds to 120 ms, value *ms240* corresponds to 240 ms and so on, while value *min1* corresponds to 1 min, *min6* corresponds to 6 min and so on.

***ReportInterval* information element**

-- ASN1START

-- TAG-REPORTINTERVAL-START

ReportInterval ::= ENUMERATED {ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, ms20480, ms40960,min1,min6, min12, min30}

-- TAG-REPORTINTERVAL-STOP

-- ASN1STOP

Since this is the last meeting, rapporteur proposes to first adopt a set of values that seem to be okay for most companies and discuss case-by-case the minimum periodicity and the maximum periodicity. The baseline value is the values supported by both *reportInterval* and *si-Periodicity* and up-to 5120 ms.

**Q1. Do companies agree to use the below value as the baseline for the supported periodicity? Please also provide any inputs on if some periodicity values are not needed.**

**{80ms, 120ms, 160ms, 240ms, 320ms, 480ms, 640ms, 1024ms, 1280ms, 2048ms, 2560ms, 5120ms}**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes, No?** | **Comments** |
| Samsung | Yes |  |
| Nokia | Yes, but … | As far as we know, RAN3 is also discussing periodicity of measurement reporting from DU to CU for gNB-side PDC. It makes sense if RAN2 and RAN3 can align on such periodicity, so some changes in either RAN2 or RAN3 in the future may be foreseeable. |
| Huawei, HiSilicon | Yes, less intermittent values | The intermittent values may be based on UE inner clock accuracy. Considering UE clock shall have uniform accuracy, maybe 120, 240, 480, 1024, 2048 not needed. |
| Intel  | Yes, but no need for smaller values | Our understanding of the periodicity of Rx-Tx measurement reporting is mainly related to the clock drift, instead of UE speed (propagation delay change). The reason is that once UE has applied reference time (adjusted by PDC) once, the UE only needs to be provided with reference time when the clock drift between UE clock and 5GS time exceeds the synchronization budget. RAN4 has requirement on frequency error in TS 38.101-1, “*the UE modulated carrier frequency shall be accurate to within ±0.1 PPM observed over a period of 1 ms compared to the carrier frequency received from the NR Node B.*” This implies that the UE can afford a maximum clock drift of ±0.1 PPM which is equivalent to ±0.1us per second. To be on the safe side, 320 ms might be sufficient as the minimum value of periodicity, as the maximum clock drift is ±32 ns per 320 ms. |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Ericsson | Yes | Agree with Nokia that an alignment of the periodicity between RAN2/3 is needed.@Intel.Periodic measurement reporting is to align with periodic reference time refresh (with pre-compensation) from the network. The fact that the SIB9 can be broadcasted every 80 milliseconds means that there is an anticipation from the implementation that a refresh periodicity for accurate reference time delivery can be this small. It seems strange not to support this for the measurement reporting. |
| CATT | Minimum values are overkill. Starting with 480ms is sufficient. | From our perspective, RTI and Rx-Tx measurement refresh are addressing two different error sources:- RTI refresh addresses variations in either the TSN clock (to be synced to) or the UE internal clock. - Rx-Tx measurement refresh addresses path delay variations, due to variation of the UE distance to gNB.Hence they are fundamentally uncorrelated in nature and there is no reason to couple the refresh period of one with another. For example a static UE with static surrounding reflectors will have a constant path delay to be compensated and should never need to update its PDC.We already discussed at length that the RTI refresh is left to gNB implementation, nothing more needs to be specified for this. We should not re-discuss this.So Rx-Tx measurement refresh should be driven by the UE motion to/from the gNB. A simple calculation yields:The lower bound for the reference time accuracy in R17 IIOT was set to +/- 145ns (control-to-control scenario) in RAN2#112-e, which results from UE moving by +/- 3E8\*145E-9 = 43.5 meters. Considering the UE speed of an IIOT device is upper bounded by 75km/h in TS22.104, this corresponds to a refresh period of 43.5\*3.6/75 = 2 s. Taking some pad to be on the safe side, something in the 0.5s refresh period seems sufficient. |
| Sequans | Yes (as a baseline) | No strong view on the values.We think they are only linked to path delay change (UE movement) so we agree with CATT analysis (but don't mind with shorter values).In our understanding:- Regarding the clocks, RAN2 agreed the following assumptions at RAN2#113e:\* There is **no UE clock drift** issue to be addressed \* The source and target gNB are **tightly synchronized to the same master clock** within the budget and there is no need to optimize anything for HO. Hence, only cases where **RTI refresh** are needed are:1) gNB SFN timing drift (compared to the master clock from RAN2 assumption)For us it was ruled out by Rel-16 agreement"UE can calculate/predict the reference timing **based on DL timing information** after receiving the referenceTimeInfo from gNB **once**. (No spec impact)"But maybe some NW cannot ensure this requirement (?). We are not sure it was even discussed (what would be the maximum possible gNB DL timing drift?). 2) gNB side precompensation being used, and change in path delay that requires to send new RTI to UE.The **Rx-Tx measurement refresh** is needed in case of path delay change (UE movement). It may then require an RTI refresh if gNB side precompensation is used. |

For larger periodicity value, it can be implemented by the network with a periodic one-shot request and thus the benefit beyond signalling overhead reduction needs to be discussed.

**Q2. Do companies see any benefits to have periodicity larger than, e.g., 5120 ms? If yes, what is the maximum value?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes, No?** | **Comments** |
| Samsung | No | For larger periodicity, one-shot request can be used. |
| Nokia | No, but | Following our comment in Q1, some alignment with RAN3 may be needed in the future. |
| Huawei, HiSilicon | No |  |
| Intel | No | One-shot request can be used instead. |
| Qualcomm | No |  |
| OPPO | No | We can use one-short request for such larger periodicity. |
| Ericsson | No | Can leave it out for the moment.  |
| CATT | No | Considering the analysis in Q1, one-shot request is always sufficient. |
| Sequans | No |  |

On the other hand, the smallest periodicity of the PRS is 4 slots at 15 kHz SCS, 8 slots at 30 kHz SCS, 16 slots at 60 kHz SCS, 32 slots at 120 kHz. The smallest periodicity of the CSI-RS resources is 4 slots and not clear if it would be different for different SCS. Both PRS and CSI-RS can be configured for measurements. The smallest periodicity of the SRS is 1 slot and not clear if it would be different for different SCS. See annex 5 for details. On one extreme, the UE reports for every measurement and so the smallest reporting periodicity can be four slots, i.e., 4 milliseconds.

The next question is to ask if companies see any benefits to have periodicity smaller than 80 milliseconds. RAN2 can also leave this question to RAN1/4. In any case, there will be reserved code points in ASN.1 to incorporate any smaller periodicity if found useful in deployment.

**Q3. On the smallest periodicity, what are the companies’ preference?**

 **Alt1: Periodicity can be smaller than 80 milliseconds, e.g., 10 ms, 20ms, 40ms**

 **Alt2: The smallest periodicity is 80 milliseconds**

 **Alt3: RAN2 ask RAN1/4 for further inputs.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt1, Alt2, Alt3?** | **Comments** |
| Samsung | Alt 2 |  |
| Nokia | Alt2 |  |
| Huawei, HiSilicon | Alt3 | RTT PDC is based on RS measurement so at least RAN1 can provide inputs this minimum periodicity.  |
| Intel | Other | As replied in Q1, we think 320 ms might be sufficient as the smallest periodicity. |
| Qualcomm | Alt2 |  |
| OPPO | Alt2 | Anyway, we can revisit it if RAN1/4 provides further inputs. |
| Ericsson | Alt1, Alt3 | Of course, a shorter periodicity is good to allow efficient filtering at the network and allow future support.The DL reference signals for PDC can be configured much more frequently than 80 milliseconds. It is unclear what the impacts are for RAN1/4, if RAN2 cannot agree any values below 80 milliseconds. In any case, it is better to consult RAN1/4 regardless of the outcome in RAN2. |
| CATT | None, min 480ms is sufficient | See analysis in Q1. |
| Sequans | Other/Alt3 | We agree with CATT analysis so don't really see a reason to add even smaller values.RAN1/4 can be consulted too. |

## 2.2 One-shot explicit request

There were comment online that the one-shot explicit request and periodic request can re-use the same RRC signalling structure. It seems that the one-shot explicit request can be implemented with *reportAmount=1*. See below RRC spec excerpt

|  |
| --- |
| 5.5.5 Measurement reporting1> increment the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* by 1;1> stop the periodical reporting timer, if running;1> if the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* is less than the *reportAmount* as defined within the corresponding *reportConfig* for this *measId*:2> start the periodical reporting timer with the value of *reportInterval* as defined within the corresponding *reportConfig* for this *measId*; |

**Q4. Do companies agree that the explicit one-shot request can be implemented with *reportAmount* configured with value one?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes, No?** | **Comments** |
| Samsung | Yes |  |
| Nokia | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Ericsson | Yes |  |
| CATT | Yes but | Note though that this should trigger the report, not the measurement, which is started as soon as the PRS configuration is received per RAN2 agreement:*For the separate signalling procedures for UE-side RTT PDC, provision of measurement configuration indicates that UE measures the Rx-Tx time difference, and provision of gNB Rx-Tx time difference to UE implicitly activates RTT-based PDC calculation at the UE side.*So maybe it should be clarified in the field description of the associated measurement object in your CR, *dl-Ref-r17*, that UE starts measuring the Rx-Tx time difference upon receiving the *measObjectRxTxDiff* configuration? |
| Sequans | Yes |  |

## 2.3 Explicit indication to fallback to SIB9

RAN2 has agreed to the below

6 The network tells the UE whether to fallback to SIB9 via explicit signalling, at least in the RRC reconfiguration with synch and reconfiguration after re-establishment.

There are a couple of options for which the explicit signalling can be added. The explicit signalling can be, for example, an RRC field with value “fallback” in the below.

**Option 1:** the RRC message *DLInformationTransfer*. This is aligned with the existing RTI delivery procedure. The network can indicate this, if needed, after handover (RRC reconfiguration with synch), RLF recovery (reconfiguration after re-establishment) and etc.

**Option 2:** The RRC message *RRCReconfiguration*.

Since the explicit signalling is agreed, from rapporteur’s point of view, option 1 is preferred. It is easier to capture and has less impacts from/to other features/functionalities in the RRC message *RRCReconfiguration*.

**Q5. Do companies agree to add the explicit indication to fallback to SIB9 in the RRC message *DLInformaionTrasnfer*?If not, please indicate an alternative.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes, No?** | **Comments** |
| Samsung | Yes | Prefer a simple indication. |
| Nokia | Yes | This is a simple approach. |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Ericsson | Yes |  |
| CATT | Yes |  |
| Sequans | Yes but | The discussion above makes us wonder if RTI from SIB9 needs to be periodically refreshed by UE.In our understanding it was not the case (read RTI from SIB9 once and then use DL SFN timing to update is ok).Is there a requirement to refresh RTI e.g. at each SIB9 transmission? If yes we think it should be clarified.(that would be only because of gNB DL SFN timing drift compared to 5GS clock) |

# 3 Conclusion

TBD

# 4 References

1. R2-2202728, Remaining Issues on PDC Enhancement, CMCC

# 5 Annex

NR-DL-PRS-Periodicity-and-ResourceSetSlotOffset-r17 ::= CHOICE {

 scs15-r17 CHOICE {

 n4-r17 INTEGER (0..3),

 n5-r17 INTEGER (0..4),

 n8-r17 INTEGER (0..7),

 n10-r17 INTEGER (0..9),

 n16-r17 INTEGER (0..15),

 n20-r17 INTEGER (0..19),

 n32-r17 INTEGER (0..31),

 n40-r17 INTEGER (0..39),

 n64-r17 INTEGER (0..63),

 n80-r17 INTEGER (0..79),

 n160-r17 INTEGER (0..159),

 n320-r17 INTEGER (0..319),

 n640-r17 INTEGER (0..639),

 n1280-r17 INTEGER (0..1279),

 n2560-r17 INTEGER (0..2559),

 n5120-r17 INTEGER (0..5119),

 n10240-r17 INTEGER (0..10239),

 ...

 },

 scs30-r17 CHOICE {

 n8-r17 INTEGER (0..7),

 n10-r17 INTEGER (0..9),

 n16-r17 INTEGER (0..15),

 n20-r17 INTEGER (0..19),

 n32-r17 INTEGER (0..31),

 n40-r17 INTEGER (0..39),

 n64-r17 INTEGER (0..63),

 n80-r17 INTEGER (0..79),

 n128-r17 INTEGER (0..127),

 n160-r17 INTEGER (0..159),

 n320-r17 INTEGER (0..319),

 n640-r17 INTEGER (0..639),

 n1280-r17 INTEGER (0..1279),

 n2560-r17 INTEGER (0..2559),

 n5120-r17 INTEGER (0..5119),

 n10240-r17 INTEGER (0..10239),

 n20480-r17 INTEGER (0..20479),

 ...

 },

 scs60-r17 CHOICE {

 n16-r17 INTEGER (0..15),

 n20-r17 INTEGER (0..19),

 n32-r17 INTEGER (0..31),

 n40-r17 INTEGER (0..39),

 n64-r17 INTEGER (0..63),

 n80-r17 INTEGER (0..79),

 n128-r17 INTEGER (0..127),

 n160-r17 INTEGER (0..159),

 n256-r17 INTEGER (0..255),

 n320-r17 INTEGER (0..319),

 n640-r17 INTEGER (0..639),

 n1280-r17 INTEGER (0..1279),

 n2560-r17 INTEGER (0..2559),

 n5120-r17 INTEGER (0..5119),

 n10240-r17 INTEGER (0..10239),

 n20480-r17 INTEGER (0..20479),

 n40960-r17 INTEGER (0..40959),

 ...

 },

 scs120-r17 CHOICE {

 n32-r17 INTEGER (0..31),

 n40-r17 INTEGER (0..39),

 n64-r17 INTEGER (0..63),

 n80-r17 INTEGER (0..79),

 n128-r17 INTEGER (0..127),

 n160-r17 INTEGER (0..159),

 n256-r17 INTEGER (0..255),

 n320-r17 INTEGER (0..319),

 n512-r17 INTEGER (0..511),

 n640-r17 INTEGER (0..639),

 n1280-r17 INTEGER (0..1279),

 n2560-r17 INTEGER (0..2559),

 n5120-r17 INTEGER (0..5119),

 n10240-r17 INTEGER (0..10239),

 n20480-r17 INTEGER (0..20479),

 n40960-r17 INTEGER (0..40959),

 n81920-r17 INTEGER (0..81919),

 ...

 },

 ...

}

***periodicityAndOffset***

This field specifies the periodicity of DL-PRS allocation in slots and the slot offset with respect to SFN #0 slot #0 in the PCell where the DL-PRS-PDC Resource Set is configured (i.e., slot where the first DL-PRS Resource of DL-PRS-PDC Resource Set occurs).

– *CSI-ResourcePeriodicityAndOffset*

The IE *CSI-ResourcePeriodicityAndOffset* is used to configure a periodicity and a corresponding offset for periodic and semi-persistent CSI resources, and for periodic and semi-persistent reporting on PUCCH. both, the periodicity and the offset are given in number of slots. The periodicity value *slots4* corresponds to 4 slots, value *slots5* corresponds to 5 slots, and so on.

***CSI-ResourcePeriodicityAndOffset* information element**

-- ASN1START

-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-START

CSI-ResourcePeriodicityAndOffset ::= CHOICE {

 slots4 INTEGER (0..3),

 slots5 INTEGER (0..4),

 slots8 INTEGER (0..7),

 slots10 INTEGER (0..9),

 slots16 INTEGER (0..15),

 slots20 INTEGER (0..19),

 slots32 INTEGER (0..31),

 slots40 INTEGER (0..39),

 slots64 INTEGER (0..63),

 slots80 INTEGER (0..79),

 slots160 INTEGER (0..159),

 slots320 INTEGER (0..319),

 slots640 INTEGER (0..639)

}

-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-STOP

-- ASN1STOP

SRS-PeriodicityAndOffset-r16 ::= CHOICE {

 sl1 NULL,

 sl2 INTEGER(0..1),

 sl4 INTEGER(0..3),

 sl5 INTEGER(0..4),

 sl8 INTEGER(0..7),

 sl10 INTEGER(0..9),

 sl16 INTEGER(0..15),

 sl20 INTEGER(0..19),

 sl32 INTEGER(0..31),

 sl40 INTEGER(0..39),

 sl64 INTEGER(0..63),

 sl80 INTEGER(0..79),

 sl160 INTEGER(0..159),

 sl320 INTEGER(0..319),

 sl640 INTEGER(0..639),

 sl1280 INTEGER(0..1279),

 sl2560 INTEGER(0..2559),

 sl5120 INTEGER(0..5119),

 sl10240 INTEGER(0..10239),

 sl40960 INTEGER(0..40959),

 sl81920 INTEGER(0..81919),

 ...

}