**3GPP T****SG-RAN WG3 Meeting #110-e R3-210965**

**Online, 25th January – 5th February 2020**

Agenda Item: 8.3.1

Source: Ericsson

Title: Summary of Discussion for LTE-NR Relative Timing

Document for: Discussion, Decision

# Introduction

A Summary of Offline Discussions has been assigned to the topic of LTE-NR Relative Timing.

The discussion has been summarised as follows in the meeting minutes:

**CB: # 12\_****LTE-NR RelTiming**

**CT,QC,ZTE,CATT**

**LTE->NR direction needs to be supported in Rel-16.**

**Both SFTD format and SFN0 offset with respect to common reference time should be supported in standard.**

**E///**

**Knowledge of the SFN0 start time with respect to an absolute time reference is needed for NR cells and for LTE cells. A single solution should be selected for both LTE and NR cases.**

**define the SFN0 start time with respect to the common initialization time as 1980-01-06T00:00:19 International Atomic Time (TAI). This maintains alignment with the specifications in TS38.401.**

**signal as part of the served cell information, over the X2 and Xn interfaces, the SFN0 time offset with nanoseconds granularity and with respect to the initiation time 1980-01-06T00:00:19 International Atomic Time (TAI)**

**SFTD measurement results are not signaled over the X2/Xn interface**

**HW**

**exchange SF0 starting time info, or SF0 offset (between starting time and absolute timing reference point) over Xn**

**- consensus for exchanging SF0 start time; suggest trying to converge around this**

**- common solution for LTE and NR?**

**- F1AP impact?**

**- check details; merge/revise as needed**

**(E/// - moderator)**

**Summary of offline disc** [**R3-210965**](file:///C%3A%5CUsers%5Cllopes%5COneDrive%20-%20Qualcomm%5CDocuments%5CAppData%5CLocal%5CTemp%5CTemp1_RAN3_111-e_agenda_with_Tdocs20210126_1005.zip%5CInbox%5CR3-210965.zip)

# For the Chairman’s Notes

* **It is proposed to agree to use the SFN0 timing offset relative to an absolute initialization time as measure of the relative time difference between LTE and NR**
* **It is proposed to adopt the encoding formatting proposed in [4] to [8] for the SFN0 Time Offset, namely:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** | **Criticality** | **Assigned Criticality** |
| SFN Time Offset | M |  | BIT STRING (SIZE(40)) | Time offset in ns between the absolute time reference « 1980-01-06T00:00:19 International Atomic Time (TAI)” and the SFN0 start. The maximum usable value is (1024\*10^7-1). Values higher than the maximum are discarded. |  |  |

* **It is proposed to discuss whether signalling of SFN0 Time Offset from LTE to NR can be part of Rel16 corrections.**
* **There is no consensus on introduction of SFN0 Time Offset for neighbour cells.**
* **0372 rev in [R3-211091](file:///C%3A%5C%5CUsers%5C%5Ceangcen%5C%5CDocuments%5C%5C3GPP_ETSI%5C%5CRAN3%5C%5CRAN3-111%5C%5CMyEmailDiscussions%5C%5CInbox%5C%5CR3-211091.zip)**
* **0373 rev in [R3-211092](file:///C%3A%5C%5CUsers%5C%5Ceangcen%5C%5CDocuments%5C%5C3GPP_ETSI%5C%5CRAN3%5C%5CRAN3-111%5C%5CMyEmailDiscussions%5C%5CInbox%5C%5CR3-211092.zip)**
* **0374 rev in** [**R3-211093**](file:///C%3A%5CUsers%5Ceangcen%5CDocuments%5C3GPP_ETSI%5CRAN3%5CRAN3-111%5CMyEmailDiscussions%5CInbox%5CR3-211093.zip)

# Discussion

It was discussed at the last RAN3 meeting that there is value in reporting the time difference between SFN0 start time of NR and LTE neighbouring cells. Such reporting would need to be signalled over the F1, Xn and X2 interfaces to cover the cases of EN-DC and NG-RAN scenarios.

During RAN3-110e it was agreed that

Define signaling for LTE-NR timing information exchange between eNB and gNB

NR->LTE direction is agreeable as Rel-16 correction; LTE->NR direction may be discussed as TEI17

*Format of timing info (SFTD format, SFN0 format, or both): To be continued on this basis...*

In this SoD we tackle the formating of timing info and whether to signal only NR->LTE or also LTE->NR information exchange at the same time.

## Format of LTE-NR Timing Information

In [1] it is proposed that the format of the relative timing information exchanged between LTE and NR is a “choice” between UE measurement based SFTD information and an “SFN Timing Offset” calculated as the time offset between SFN0 start and the absolute initialization time “GPS EPOCH 1980-01-06 T00:00:19 International Atomic Time (TAI)” (i.e. the same absolute initialization time specified in TS38.401). This is done to provide redundancy between the two types of information.

In [2] and [3] it is proposed that only the time offset between SFN0 start and the absolute initialization time “GPS EPOCH 1980-01-06 T00:00:19 International Atomic Time (TAI)” is signalled between LTE and NR nodes. The reason for this is that SFTD measurements availability depends on the presence of UEs with SFTD capabilities and that SFTD measurements are of variable accuracy depending on UE position, making the information on LTR-NR relative timing un-reliable.

**Companies are invited to provide their view on whether the essential information needed to make the solution work, i.e. SFN0 timing offset or both SFN0 timing offset and SFTD measurements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | SFN0 timing Offset. As discussed in [2] and [3], the relative timing information between LTE and NR is a crucial piece of information that needs to be as accurate as possible. Leaving this information to SFTD measurements reporting will decrease the reliability of the solution and it will expose it also to possible errors due to different UE implementations.  |
| Qualcomm | In principle both could be used. However we are fine to use SFN0 timing offset for simplicity. We think that some value of SFTD might available in some scenarios where SFN0 is not available, and given the size of measurement gaps, the uncertainty due to UE location (related to the SFTD measurement) does not appear critical.But as stated above we can progress for now with SFN0. |
| Nokia | Fine to progress with SFN0 timing offset |
| Huawei | SFN0 timing Offset.Note that in [9] [10], we call it as SF0 reference timing point, since anyway the meaning is the same, to indicate the absolute starting time point for SFN0. |
| China Telecom | As all companies support SFN0 with offset, we can compromise to only specify SFN0 timing offset in Rel-17.However, SFN0 timing offset cannot available in some scenarios mentioned in [1]. So we think both solutions shall be supported in principle.  |

**Conclusion: It is proposed to agree to use the SFN0 timing offset relative to an absolute initialization time as measure of the relative time difference between LTE and NR**

## Format of the SFN0 time offset

In [4], [5], [6], [7], [8] the same format for the SFN0 time offset is proposed, namely:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** | **Criticality** | **Assigned Criticality** |
| SFN Time Offset | M |  | BIT STRING (SIZE(40)) | Time offset in ns between the GPS EPOCH absolute time reference and the SFN0 start. The maximum usable value is (1024\*10^7-1). Values higher than the maximum are discarded. |  |  |

In [9], [10] a slightly different formatting is proposed, namely:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SF0 Reference Timing | M |  | INTEGER (0.. 549755813887, …) | The field counts the number of UTC seconds in 10 ms units since 00:00:00 on Gregorian calendar date 6 January, 1980 (start of GPS time)  | YES | reject |

**In order to follow the majority view, it is proposed that the formatting for the SFN Time Offset proposed in [4], [5], [6], [7], [8] is agreed. Companies are invited to provide their view if they do not agree with this proposal**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | The principle of the first proposal (with ns resolution) has our preference, however the signaled value should be an integer for unambiguous decoding. |
| Huawei | We prefer the formatting proposed in [9] and [10], since this aligns with RAN2 definition… |
| China Telecom | We prefer the first proposal to use Bit string (40). |

**Conclusion: Given the majority view and the comments received, it is proposed to adopt the encoding formatting proposed in [4] to [8] for the SFN0 Time Offset. As an alternative, the adoption of an Integer type for the *SFN0 Time Offset* IE may be followed**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** | **Criticality** | **Assigned Criticality** |
| SFN Time Offset | M |  | INTEGER (0..9,999,999,999 | Time offset in ns between the GPS EPOCH absolute time reference and the SFN0 start.  |  |  |

## Signalling direction of LTE-NR relative timing information

RAN3 has agreed to the following:

Define signaling for LTE-NR timing information exchange between eNB and gNB

NR->LTE direction is agreeable as Rel-16 correction; LTE->NR direction may be discussed as TEI17

In [2] it is explained that

* Knowing the SFN0 timing of neighbour LTE cells is needed for an NR node because short measurement gaps (3ms) can be configured for a UE served in NR. Hence, measurement gaps may not be configured correctly in NR, unless the exact SFN0 start time of neighbour LTE cells is known by a gNB

Given that a solution for LTE-NR relative timing signalling is under discussion and agreement now, it would be efficient to tackle both the LTE->NR and NR->LTE signalling exchange with the same solution, if RAN3 agrees that both scenarios are useful and feasible.

**Companies are invited to provide their view on whether both the LTE->NR and NR->LTE signalling can be covered with the same solution for LTE-NR relative timing exchange**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We see the benefits of providing the LTE-NR relative timing information also in the LTE to NR direction. If this is not done, it is not possible to correctly use short measurement gaps in NR (to measure LTE cells). This will imply a drop in efficiency due to forced usage of 5ms gaps or longer.We believe that we can cover both directions now. This is more efficient as we will not need to reopen the topic in TEI17 and it will ensure that the solution is the same for both signalling directions. |
| Qualcomm | We fully agree that the LTE to NR direction is useful, and it is anyway better to use a general approach. In addition to the fact that NR side can then use shorter measurement gaps for LTE inter-RAT measurements (mentioned by Ericsson), the other use case is when the MN configures per-UE measurement gaps in EN-DC. In our understanding the en-gNB cannot tell the exact timing of the gaps as they are referred to the eNB’s frame timing – but the UE is not required to listen to the NR cell during the gaps. This causes performance loss on the NR side. |
| Nokia | For the moment prefer to stick to current agreement for Rel-16 correction (NR to LTE direction). Will still double-check. |
| Huawei | We would like to stick to the existing agreement on the table, anyway technically the LTE->NR is more important. |
| China Telecom | Both directions1. smaller measurement gaps can improve the measurement efficiency, hence the information is needed in both directions

single UL Operation and spectral sharing in MR-DC require accurate LTE-NR timing offset information |

**Conclusion: 3 companies think it is opportune to introduce LTE to NR time offset information as a Rel16 correction. 2 companies think LTE to NR time offset information signalling should be left to TEI17. It is proposed to continue discussion on the introduction of LTE-> NR measurement offset as a Rel16 correction in the second round of discussions.**

### Second Round - Signalling direction of LTE-NR relative timing information

Companies are invited to present reasons in favour or against the introduction of SFN0 Time Offset information from LTE to NR.

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | As mentioned above, if relative timing information is not provided from LTE to NR it is not possible to correctly use short measurement gaps in NR (to measure LTE cells). This will imply a drop in efficiency due to forced usage of 5ms gaps or longer.We believe that we can cover both directions now. This is more efficient as we will not need to reopen the topic in TEI17 and it will ensure that the solution is the same for both signalling directions. |
| China Telecom | Agree with Ericsson. Ericsson, Qualcomm and China Telecom had analysis the need to support both directions in first round discussion. In order to support smaller measurement gap, the direction LTE to NR could be also supported in Rel-16 for future-proof. We don’t want to reopen this issue in TEI-17. |
| Qualcomm | As already mentioned above, LTE to NR is already needed at least for EN-DC due to potential impact of per-UE measurement gaps, set be the eNB, on NR performance (and could even be argued as needed for rel-15). This is not to set measurement gaps in NR – it is about understanding of the gap timing (set by LTE) on the NR side.But in addition, on a more general point, we fully agree it allows for shorter measurement gaps in NR to measure LTE cells.  |
|  |  |

## LTE-NR relative timing information for served and neighbour cells

In [6], [7], [8], it is proposed that the SFN0 Time Offset is signalled not only for cells served by an NG-RAN node but also for neighbour cells.

**Companies are invited to provide their view on whether signalling the SFN0 Time Offset of neighbour cells is useful and needed**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We are in favour of signlling the SFN0 Time Offset for neighbor cells. This helps the ANR process in case a neighbnour is not Xn/X2 connected to the source node and measurements need to be configured at the source node to discover the neighbour and eventually setup an Xn/X2 interface with it. Without neighbour’s SFN0 Time Offset information measurement gaps to measure the neighbour’s cell cannot be correctly assigned |
| Qualcomm | We acknowledge that this can be useful in relation to ANR, and seems to require relatively little extra effort.  |
| Nokia | Due to the often high number of signaled neighbor cells the additional signal burden should be taken into account. So at least for EUTRA neighbours the benefit of such signaling may not be sufficient. |
| Huawei | Not sure if needed, since the neighbor cells of a serving cell might be under another base station, right? For ANR, the most important thing is the TNL address for source how to find target, anyway, you could not assign one gap for one cell…Also, actually there is a practical  |
| China Telecom | Agree with Qualcomm[views in second round]: our CRs [4] and [5] also propose to add SFN0 offset in both served cell info and neighbor cell Info. In principle the timing offset between LTE and NR is per cell basis. If the offset of neighbor cells are put into the serving cell info, the additional cell id ,i.e., ECGI, is needed for each neighbor cells. Thus the timing offset value contained in both serving cell and neighbor cells info IE is a simple solution. One compromised solution is to add SFN0 offset of serving cell and that of neighbor cells in served cell information IE.  |

**Conclusion: 2 companies are in favour of SFN0 Time Offset signalling for neighbour cells. 2 cmopanies do not see the need for it. There is no consensus on introduction of SFN0 Time Offset for neighbour cells.**

# Conclusion, Recommendations

# References

[1] R3-210232, Discussion on the LTE-NR Relative Timing indication (China Telecom, Qualcomm Incorporated, ZTE, CATT)

[2] R3-210418, Discussion on SFN0 offset signalling between LTE and NR (Ericsson)

[3] R3-210811, Further discussion on LTE-NR timing information exchange over eNB and gNB (Huawei)

[4] R3-210233, CR to TS36.423 on the LTE-NR Relative Timing indication (China Telecom, Qualcomm Incorporated, ZTE,CATT)

[5] R3-210235, CR to TS38.423 on the LTE-NR Relative Timing indication (China Telecom, Qualcomm Incorporated, ZTE,CATT)

[6] R3-210372, Introduction of SFN Offset per NR cell (Ericsson)

[7] R3-210373, Introduction of SFN Offset per NR cell (Ericsson)

[8] R3-210374, Introduction of SFN Offset per NR cell (Ericsson)

[9] R3-210812, CR to 36.423 on LTE-NR timing information exchange over eNB and gNB (Huawei)

[10] R3-210813, CR to 38.423 on LTE-NR timing information exchange over eNB and gNB (Huawei)