3GPP TSG-RAN WG2 Meeting #109bis-e***R2-20xxxxx***

Online, April 20 – 30, 2020

**Agenda item:** 6.8.2.4

**Source:** Ericsson

**Title:** Email discussion report: [AT109bis-e][610][POS] LPP proposals (Ericsson)

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following email discussion:

* [AT109bis-e][610][POS] LPP proposals (Ericsson)

Scope: Discuss proposals 2, 4, 5, 6, 7, 8 from R2-2003783

Intended outcome: Summary of agreements in R2-2003997

Deadline: Wednesday 2020-04-29 1000 UTC

2 Discussion

The following rappoorted proposals from [1] are discussed in the below subsections:

**Rapporteur’s Proposal 2:** RAN2 should discuss the interpretation of additional paths measurements (*nr‑AdditionalPathList*) in case of additional timing measurements are reported.

**Rapporteur’s Proposal 4:** RAN2 should discuss the use cases for a new *LocationInformationType* ‘locationEstimateAndMeasurementsRequired’ in IE *CommonIEsProvideLocationInformation* first, before introducing the feature in LPP.

**Rapporteur’s Proposal 5:** RAN2 should discuss whether PSCell/Scell information should be provided by a target device in *CommonIEsRequestAssistanceData*.

**Rapporteur’s Proposal 6:** RAN2 should inform RAN1 of the RAN2 discussion and concerns related to the SMTC information in the SSB assistance data, and ask RAN1 for any status update of the working assumption in RAN1.

**Rapporteur’s Proposal 7:** RAN2 should inform RAN1 of the RAN2 discussion and ask whether PRS-PRS QCL Type D indication is still needed (this may be a combined LS to RAN1 incl. Rapporteur’s Proposal 6).

**Rapporteur’s Proposal 8:** RAN2 should discuss whether

(a) to change the name of the IE *TRP-ID* (e.g., to distinguish from the RAN3 TRP-ID), or

(b) to remove IE *TRP-ID* from LPP and add the relevant *TRP-ID* fields to the individual parent IEs.

2.1 Interpretation of additional paths measurements

The current definition in LPP for the additional path reporting is ambiguous/unclear; in particular together with the additional measurement reporting capability. The figure below is provided in [2] which illustrates the different path timing possibilities (for different resources of two exemplary TRPs):

The black line illustrates the "main RSTD", *nr-RSTD* measurement.

Reference Path

Reference TRP

Path#1

Neighbouring TRP

Path#2

Path#2

Path#1

Path#1

Path#2

Path#2

Path#1

Path#1

Path#2

Path#2

Resource#0

Resource#1

Resource#2

Resource#0

Resource#1

Resource#2

RSTD

The blue line illustrates the *nr-RSTD-ResultDiff* (provided in IE *NR-DL-TDOA-AdditionalMeasurementElement*).

The red line illustrates the *nr-AdditionalPathList* for the "main RSTD" (outside the *NR-DL-TDOA-AdditionalMeasurementElement*).

The green and orange dashed curves are the candidates for the *nr-AdditionalPathList*for *NR-DL-TDOA-AdditionalMeasurementElement* according to [2].

The proposal in [2] is to clarify the definition of the time reference of the additional paths, with the following two options:

**Option 1.1.** The additional path time reference is the first path of the resource (the reference path) illustrated in “orange” in the figure

**Option 1.2.** The additional path time reference is the first path of the resource used to determine RSTD illustrated in “green” in the figure.

Companies are asked to provide comments and a preference of option in the table below

|  |  |
| --- | --- |
| 1 Additional path time reference of the additional measurements (RSTD and UE RxTx) | |
| Company | Comments |
| Huawei, HiSIicon | Option 1.2  We prefer not to break the differential RSTD into two parts. |
| Qualcomm | The additional path feature in case of additional time-difference (RSTD) measurements is rather confusing. Currently, it is defined as “the additional path in association to the TOA measurements”, and the additional measurements are RSTD relative/delta to the “main” RSTD.  In LTE, the additional path is indeed per TOA, but the reference measurement can be provided separately. Now, the additional path seems per RSTD, which as such is not clear. Some clarification of the additional path for an RSTD would be required first, before defining additional path for additional RSTD measurements. From the Figure, and using Option 1.2, I have difficulties to see the difference between additional paths and additional RSTDs. |
| CATT | We need to clarify what the addtional path at first:   1. Addtiontional path of WHAT? RSTD or TOA?  * If RSTD, the reference TRP should not have addtional path. The only reference timing is the reference TRP, Resource#0, path1. * If TOA, Does the referencec TRP have addtional path of TOA?  1. the Picture above is not what we understand on RAN1 agreement   Only RSTD of different TRs can be the cadidate of addtional.  Here is RAN1 agreement for your reference:  “a single report should have a single reference timing. *AdditionalPathList uses the same reference timing per my understanding.*The additional RSTDs are not from the different paths of the same DL PRS resources or DL PRS resource sets.”  In summary, there is only one time reference for RSTD which is from the reference TPP based on the RAN1 agreement. Neither option1.1 nor 1.2 is supported. |
| OPPO | As commented above, it would be good to further clarify the per-RSTD structure further, and we tend to lean towards a design where a single reference timing is used, which would be a cleaner method. |
| Intel | * UE can be configured to measure and report up to [M] DL PRS RSTD measurements with each measurement between a different pair of DL PRS resources or DL PRS resource sets, and the M measurements being performed on the same pair of TRPs subject to UE capability   + All the RSTD measurements in a single report should have a single reference timing   + Note: Each RSTD measurement is between DL PRS Resources corresponding to different TRP IDs.   + M=[3]   Based on RAN1 agreements, the additional measurement is based on different pair of DL PRS reources or DL PRS resource sets for the same pair of TRPs, and with the same reference timing.  So tend to agree with CATT. |
| Ericsson | We think Huawei has made a very good illustration of how the additional paths and the additional measurements come about. The additional path list contains paths in relation to a time reference. In LTE, the time reference was the detected path used to determine the RSTD value. This means that all LTE paths originaled from the same DL-PRS transmission. In NR, there are instead DL-PRS transmitted in different resources. For each resource, there is a path used to determine the *nr-RSTD-ResultDiff-r16* value. This is the natural time reference to use for the additional paths of the resource. The additional paths of a particular resource is therefore reported if the particular resource was selected for reporting as an additional measurement, which means that the orange line in the figure is the most appropriate definition. Also the green line in the figure would work. |
| Nokia | RAN2 scope is to provide signaling support and to ensure the definitions of signaled elements are clear. It looks like we are treading in to RAN1 area in designing additional path measurements here. If such open issues exist to make additional path reporting work, then our preference is to send LS to RAN1 (cc: RAN4) and ask them to take care of how additional path measurements are defined. |
| vivo | Agree with Qualcomm, a discussion on what is additional path for additonal RSTD is needed first. |
| Ericsson | The matter brought up by Huawei in [2] is what time reference that shall be used for the additional paths of the additional measurements. Two time references are identified – either (green) the detected path used to determine the RSTD value of the TRP or (orange) the detected path of he additional measurement that was used to determine the relative RSTD.  Hence, the discussion is not about any definition, but rather a selection of time reference for the reporting which in the hands of RAN2. Both time references will convey the same information about the additional paths, and what is important is to make sure the field description is clear.  It can also be more clear to change the name of the field for the additional paths of the additional measurements, maybe nr-AddMeasAdditionalPathList-r16. Now, this field has the same name in both. With different name, it is possible to stress the specific *reference path timing* for each of these. Thereby, it is straightforward to define a generic NR-AdditionalPathList IE relating to the reference path timing, specific for each instance  For example, for DL-TDOA, there is some suggested modifications in Annex 6.1 of the NR-DL-TDOA-SignalMeasurementInformation to introduce the notion of reference path timing. Both Option 1.1 (orange) and 1.2 (green) are described. By updating the NR-AdditionalPath field description with reference to the reference path timing, this becomes generic. |
| Apple | Agree with CATT and Intel |

2.2 Use cases for reporting both measurements and location

[3] argues that due to the introduction of UE-based DL-TDOA and DL-AoD positioning modes in Rel-16, "the concept of information type needs to be updated" [3] such that the UE reports both, a location estimate and location measurements.

With UE-assisted positioning, the operator obtains information via the reported measurements and quality from the devices as well as the UE-assisted positioning and estimated uncertainty that can be used to optimize configurations, procedures, deployments costs etc with respect to the performance of UE-asisted positioning.

With UE-based positioning the UE can benefit from regular measurements over time and can obtain a better position estimate compared to UE-assisted position estimated in the network based on reported UE measurements. The operator can currently request measurements as part of UE-assisted positioning or estimated UE-based positions but not both. Therefore, the operator cannot correlate the signal configurations and measurements on the one hand and the UE-based position estimates on the other hand, in order to to optimize configurations, procedures, deployments costs etc with respect to the performance of UE-based positioning.

The discussion can be summarized in two options:

**Option 2.1**. Introduce the location information type locationEstimateAndMeasurementsRequired, enabling the operator to request for both a UE-based location estimate and measurements to allow positioning configuration optimization.

**Option 2.2**. Do not introduce the location information type locationEstimateAndMeasurementsRequired, meaning that the operator has to rely on a network-based UE-assisted location estimate to represent the UE-based location estimate in the positioning configuration optimization.

Companies are asked to provide comments and a preference of option in the table below

|  |  |
| --- | --- |
| 2 Introduction of a new location information type for compbined location estimate and measurements | |
| Company | Comments |
| Huawei, HiSilicon | We don’t have a strong opinion on this. |
| Qualcomm | We disagree with the statements in Option 2.1 and 2.2 above about operator’s ability to enable “positioning configuration optimization”; this may be Ericsson’s judgement.  A new location information type is not needed, since a location server should always be able to calcluate a location from the UE measurements. I.e., the location server has always UE measurements and UE location in case of UE-assisted mode. The proposal has also quite some impacts, since it affects all positioning methods. |
| CATT | If there is such requirement from SA2, RAN2 can discuss how to support it. But the proposals are out of the WI scope of R16, we’d better discuss the requirement at first. |
| OPPO | Option 2.2.  We see this as an optimization, rather than a critial issue, at this late stage. |
| Intel | DO not see the need. |
| Ericsson | The main driver behind UE-based positioning is to benefit from regular monitoring of all DKL-PRS resources and therefore enable statistical filtering of the time series of DL-PRS transmissions. This is not possible with UE-assisted positioning where snapshot samples of data has been collected and reported to the location server and based on which the location server can estimate a position. Therefore, the operator cannot correlate and analyze the relation between the UE-based position with the measurements, and see how there matches the positioning requirements and grade of service. The measurements essentially provides the operator with an understanding of what DL-PRSs and configurations that have been used, and the UE-based positioning and uncertainty the resulting positioning. This is the only way the operator can efficiently analyze and optimize the positioning configuration.  Therefore, Option 2.1 is important from a positioning configuration management perspective. |
| Nokia | We prefer not to confuse the current definitions of UE-based and UE-assisted and the signaling options currently available for location information type. We also do not understand the use case at all and don’t think it was well justified to make such changes. Out of curiosity, if UE is supposed to provide both measurements and position estimates it should mutually impact the performance of both. Does UE perform the measurement per defined performance requirement and report it in time to LMF and still be able to do position estimate meeting the QoS requirement for the positioning? What does it mean by “operator cannot correlate the signal configurations and measurements on the one hand and the UE-based position estimates on the other hand”? Is this a way for network to cross check the position estimate done by UE by obtaining the same measurement used by the UE to do the estimates? |
| vivo | Gennerally agree with CATT, and if the requirement needs to be satisfied , could we reuse the IE '*locationEstimatePreferred*' in LTE and change the description as below?.   |  | | --- | | ***locationInformationType***  This IE indicates whether the server requires a location estimate or measurements. For '*locationEstimateRequired*', the target device shall return a location estimate if possible, or indicate a location error if not possible. For '*locationMeasurementsRequired*', the target device shall return measurements if possible, or indicate a location error if not possible. For '*locationEstimatePreferred*', the target device shall return a location estimate if possible, but may also or instead return measurements for any requested position methods ~~for which a location estimate is not possible~~. For '*locationMeasurementsPreferred*', the target device shall return location measurements if possible, but may also or instead return a location estimate for any requested position methods for which return of location measurements is not possible. |   Then leave it to positioning device implementation to supply both or only one of them. |
| Ericsson | Just to clarify w.r.t Nokias questions. UE-based positioning is in many ways opening up new possibilities for the operator. Already from the start of LTE, operators have expressed strong interest in monitoring functionalities. Many features have been introduced under the SON/MDT umbrella, but over time, the observability has been discussed as part of feature introductions as well.  If providing a high quality positioning service for device navigation, is is natural to aim at providing some service level agreement which relates to the experienced UE-based positioning.  If the SLA is not met, the operator needs observability to understand that the accuracy is inadequate, and also means to disclose why.  Therefore, the operator needs to get samples of UEB-positioning estimates and UE measurements in order to identify issues with the positioning. In a certain region A, the observed UEB-position accuracy is worse than promised, and the operator may see that the distribution of the number of TRPs indicates that the UE a) detects too few TRPs, or b) always uses TRP A in this region. Therefore, the operator can understand that there is a need to adjust something, maybe add infrastructure, maybe retilt some antenna, maybe stop providing TRP A in this region since it seems to always be in NLOS etc.  As always, observability has a tendency to be discussed in the end of work items, but it important to analyze the operator network management situation. |
| Apple | We share the same view with Qualcomm. This is out of the WI scope. |

2.3 PSCell/Scell location information provisioning

In a request for assistance data, according to [2], the UE should not only provide the UE current Pcell identity, but also PSCell/Scell information. It was commented in [2] that PSCell/Scell information could be helpful for the LMF e.g., in case a target device does not support inter-frequency DL RSTD.

According to Summary Rapporteur’s understanding, this issue was proposed in previous Releases. One of the arguments against this feature was that the activation/deactivation of Scell’s can be a rather dynamic process, and the information provided by a UE may be outdated/less useful by a location server.

**Option 3.1.** The UE only provides the Pcell identity in the request for assistance data

**Option 3.2.** The UE provides the identity of the PCell as well as of any PSCells/SCells in the request for assistance data.

Companies are asked to provide comments and a preference of option in the table below

|  |  |
| --- | --- |
| 3 PSCell/Scell location information provisioning | |
| Company | Comments |
| Huawei, HiSilicon | Option 3.2.  If more serving cells are repored, LMF can more easily estimate the locaiton of the UE. If serving cells of the UE are non-co-located.  Inter-frequency measuremnet is one UE capability and some of the UEs do not support. If all the serving cells are reported, the LMF can know for a certain PRS, whether it is inter-/intra-frequency measurement for the UE.  In the (NG-)EN-DC scenario, UE can report LTE and NR at the same time. It would be better to report all the cells than to only report LTE PCell, if the UE is using NR positioning, while the UE only report LTE Pcell.  In the legacy release, the reason why reporting of Scell is not supported was Scell may experienece frequent activation/deactivation. If this is the reason, we are ok not to support for Scell. But for the PSCell in the MR-DC scenario, this still can be supported. |
| Qualcomm | We don’t have a strong opinion on this, but generally prefer no additional features at this stage of the WI.  It seems an LMF would get these additional cell IDs only in case the UE requests additional assistance data, and therefore, it seems of limited use. |
| CATT | Perhaps there is such use in CA or DCCA senario. But per my understanding, the use case is out of scope of Rel-16 WI and suggest to postpone it in Rel-17.  We can study what kind of situation should be considered and enhanced in Rel-17 SI. |
| OPPO | Option 3.1  Share the view from email rapporteur, this is an optimization rather than a critial issue. |
| Intel | Do not see the need to have such additional feature in late stage of WI. |
| Ericsson | No strong view, but realizes that there are detailed aspects to consider, such as whether tjhese cells are configured or activated etc. |
| Nokia | Option 3.1. This is an addition of new functionality. We do not support doing this in Rel-16 at this stage as the WID is closed now. |
| vivo | Option 3.1 |
| Apple | Optoon 3.1 |

2.4 SMTC window information as part of the SSB assistance data

It was argued in [2] that the use case for the SMTC included in the SSB assistance data is not quite clear. It was pointed out in that the SMTC information in the SSB assistance data is indeed still a working assumption in RAN1. It is proposed to remove the SMTC information in the SSB assistance data in [2].

Since the SMTC information is part of the RAN1 parameter list, it should not be removed without RAN1 consultation. The situation can be summarized in the following two options

**Option 4.1.** Leave the SSB configuration as is, including the SMTC window parametsr

**Option 4.2.** Send an LS to RAN1 informing that from a RAN2 perspective, SMTC parameters do not seem the be necessary in the SSB assistance data over LPP, and ask about RAN1s view concerning these parameters

Companies are asked to provide comments and a preference of option in the table below

|  |  |
| --- | --- |
| 4 SMTC window information as part of the SSB assistance data | |
| Company | Comments |
| Huawei, HiSilicon | Option4.2  Actually, this was not an agreement, but included as a **working assumption** in the LS from RAN1 to RAN2, waiting RAN2 to confirm. RAN1’s working assumption is that the SMTC is per SSB frequency rather than per cell. Whil, for the current spec, the SMTC window is configured under NR-SSB-Config, which is not per frequency layer.  The question is who determins the SMTC. We think that LMF cannot determine the SMTC. If this can be enabled, it requires complex signaling between gNB and LMF in NRPPa.  RAN4 is also discussing this issue and is likely to conclude that the UE is not required to additionaly measure SSB for purpose of receiving PRS. In this way, SMTC is useless.  Also, when UE receives this SMTC configuration, the UE does not know what is the reference timing and the reference timing is based on which cell. |
| Qualcomm | Option 4.1 (for now)  We would prefer if companies could sort this issue out in RAN1 directly. The SMTC parameter is included in the RAN1 parameter list. |
| CATT | Option 4.1  Follow the RAN1 LS. |
| OPPO | Option 4.2  We tend to agree with the point that if SSB periodicity and offset are already provided, SMTC does not seem to bring benefit here. So good to consult RAN1 on this. |
| Intel | Agree with Qualcomm. |
| Ericsson | Option 4.2. It is clear that the UE alredy should have this and trhere is not need to repeat it here. |
| Nokia | Option 4.1. We discussed this issue in the last meeting based on LS R1-1913522 and RAN2 attempted to send a reply LS to RAN1. In the end, RAN2 decision was to not send a reply LS. From RAN2 discussions, it was quite clear that RAN2 singalling has the necessary support for the RAN1 requested parameters. |
| vivo | Option4.1,follow RAN1 |
| Apple | Option 4.2, we are fine to double check this with RAN1 |

2.5 QCL information in the DL-PRS assistance data

Accoring to [2], QCL Type D information between two DL-PRS Resources was only introduced to support DL-AoD positioning ; i.e., to force a target device to use the same RX beam for receiving multiple DL-PRS Resources from the same TRP. Since the assistance data and/or location request can be customized for DL-AoD, there appears to be no need for QCL Type D information between two DL-PRS Resources according to [2].

**Option 5.1.** Leave the QCL Type D information as is in the assistance data

**Option 5.2.** Send an LS to RAN1 to inform about the RAN2 discussion and ask whether PRS-PRS QCL Type D indication is still needed

Companies are asked to provide comments and a preference of option in the table below

|  |  |
| --- | --- |
| 5 QCL information in the DL-PRS assistance data | |
| Company | Comments |
| Huawei, HiSilicon | Option 5.2  We know that it may be hard to accept 5.2 for most of the comapnies. It is OK for us to compromise to 5.1 but optimization in signalling is needed. Now there is a large overhead.  A rough estimation for the overhead:  To configured PRS source, we need (2bit resorurce set id + 6bit resource id )\*64 resource. Hence, if we want to configure the source RS for a PRS resouce in a TRP, it will requires around ~500 bits for one TRP. |
| Qualcomm | Option 5.1  Similar to 2.4 above. If there is any issue, it should be sorted out in RAN1 directly.  The assistance data are provided by the NW to the UE, and it’s a NW decision which QCL info to provide (if any). |
| CATT | Option 5.1  Follow the RAN1 LS. |
| OPPO | Option 5.2  Considering the SSB and PRS QCL info is in a choice structure, it is hard to share the same IE, so it would be good to consult RAN1 on this. |
| Intel | Agree with Qualcomm. |
| Ericsson | The purpose of the PRS to PRS QCL-D information is to help the device to find DL-PRS. A typical example can be one resource set with a few wide beams, and another resource set with narrow beams, where there is an overlap between one wide beam and several narrow beams, and this information is shared to the device to facilitate detecting the narrow beams once the wide beam had been detected etc.  Therefore, we are fine with Option 5.1 |
| Nokia | Option 5.1. The current signaling is based on the list of L1 parameters received from RAN1. Any issues with it should be discussed directly in RAN1. |
| vivo | Option 5.1. Fowllow RAN1 |
| Apple | Optioon 5.2, we are fine to send an LS to. check with RAN1 about this |

2.6 TRP ID

It is argued in [2] and [4] that the IE *TRP-ID* in RAN2 need to be better defined to avoid confusion with RAN3, its use needs to be clarified and in what IEs it is needed and how the identifiers associated to a TRP shall be represented.

According to [2], it is enough with the PRS ID to uniquely identify a TRP within an LPP session between LMF and a UE. Furthermore, [4] provides a summary of TRP-ID issues. Ultimately, the following Table of required TRP-ID elements for various IEs is derived in [4]:

|  |  |
| --- | --- |
| IE name | Required fields |
| *NR-Multi-RTT-MeasElement* | dl-PRS-ID |
| *NR-DL-AoD-MeasElement* | dl-PRS-ID |
| *NR-DL-TDOA-MeasElement* | dl-PRS-ID |
| *NR-MeasuredResultsElement* | pci, CGI and ARFCN |
| *NR-TimeStamp* | None |
| *DL-PRS-IdInfo* | dl-PRS-ID |
| *NR-DL-PRS-AssistanceDataPerTRP* | dl-PRS-ID and ARFCN |
| *NR-SSB-Config* | PCI and ARFCN |
| *ReferenceTRP-RTD-Info* | dl-PRS-ID |
| *RTD-InfoElement* | dl-PRS-ID |
| *NR-DL-PRS-BeamInfo* | dl-PRS-ID |
| *TRP-LocationInfoElement* | dl-PRS-ID |

The above Table summarizes the IEs which currently make use of the IE *TRP-ID,* and which fields of the IE *TRP-ID* is/are required for the functionality in the corresponding parent IE.

In addition, the summary Rapporteur’s comment [1] is that a Cell-ID may be required in *NR-TimeStamp* to indicate the cell/TRP from which the SFN has been derived.

Companies are asked to provide comments about what IEs and procedures that make use of the different TRP identifiers in the table below

|  |  |
| --- | --- |
| 6.1 IEs and procedures that make use of different TRP identifiers within an LPP session | |
| Company | Comments |
| Huawei, HiSilicon | We can see from the above table that most of the cases only use PRS id. It is fine with us that we only use individual fields of the current *TRP-ID*, which means that to remove this IE and ues the fields within individually.  Also, we would like to point out that the following fields does not need ARFCN   |  |  | | --- | --- | | *NR-DL-PRS-AssistanceDataPerTRP* | dl-PRS-ID ~~and ARFCN~~ | |
| Qualcomm | I don’t think a (local) DL-PRS ID is suffient in all cases. A UE may not always get the assistance data in the same LPP message or session. A global ID is needed if e.g. some assistance data are provided via broadcast and some via unicast/NAS MO-LR.  Our preference would be to keep the TRP-ID container, but change the name to e.g., TRP-IDs or TRP-ID-Set.  However, if the majority view is to distribute the fields into individual IEs, we are also O.K., but the PCI, CGI, etc. would have to be included. In that case, the DL-PRS ID could be moved into the PRS configuration, and the cell-ids into the various elements per TRP. This would be analogous to LTE, where the PRS-ID is also provided in the PRS-Config, and the cell-id, tp-id, etc. in each element. |
| CATT | Remove IE TRP-ID from LPP and add the relevant TRP-ID fields to the individual parent IEs.  I suggest this TRP-ID issue as the 1st priority topic to disuss in the summary. |
| OPPO | We generally share the same view as the table included in [4] and copied above. One exceptional case is for NR-TimeStamp, seems PCI/ARFCN and/or CGI is needed, to indicate the reference TRP for the reported SFN.  Our view of the signaling design is provided in 6.2. |
| Intel | Agree the comments from Huawei and OPPO on DL-PRS-AssistanceDataPerTRP and NR-TimeStamp. |
| Ericsson | From the analysis of where the IDs are used, it seems natural to avoid the complex structure and instead used individual fields to be included where appropriate.  In LTE, PCI was needed since it was initially used for PRS sequency generation, and CGI was added to handle PCI confusion. Since then, in LTE Rel 14, the PRS ID was introduced which allowed the sequence to be generated based on an ID from a much wider value range effectually avoiding confusion.  Therefore, is there really a need for PCI and CGI, as well as ARFCN for the DL-PRS? The subsets of AD distributed via unicast and broadcast has been mentioned in other discussions as well, but that does not imply the need for globally unique TRP IDs, locally unique TRP IDs are sufficient to allow matching between broadcast and unicast.  To have PCI and ARFCN as part of the SSB config is natural, and if there is a need to analyze puncturing between SSB and DL-PRS. So, in cases where the TRP to PCI relation needs to be made, adding a relation to SSB would be enough. |
| vivo | In principle，we agree with Huawei and OPPO.  But we are also concerned that in broadcast scenarios, only including dl-PRS-ID may cause ambiguity when broadcating assitant data or reporting measurement. |
| Apple | In principle, we prefer the clarity of the IE name, which shall have a unique meaning, instead of subject to different interpretaitn in different context. We are fine to either 1) dissolve the TRP ID container and use individual fields directly; or 2) Clean up the inappropriate usage of the TRP-ID, by renaming them or 3) do a combination of both 1) and 2). |

Another set of issues raised are

* appropriate name for the TRP identifier that identifies one of the up to 256 TRPs that a UE can handle (currently the name PRS ID is used)
* if the identifiers associated to TRPs shall be gathered in an IE, or if they should be present as individual fields
* the appropriate name of an IE gathering the TRP identifiers if agreed (currently, the name TRP-ID is used)

Companies are asked to provide comments about how different TRP identifiers are represented and named within an LPP session, in the table below

|  |  |
| --- | --- |
| 6.2 TRP identifier representation and naming within an LPP session | |
| Company | Comments |
| Huawei, HiSilicon | If the individual fields are used in the current IE TRP-ID and the TRP-ID is removed, there is no need for the above discussion on the naming and this is our prefered option.  If the fields are still grouped under one IE, we think the proper name for the IE can be ”positioning node id” |
| Qualcomm | The only confusion exists in the IE name “*TRP-ID*” and not in the individual fields included in the IE *TRP-ID*. If the name of the IE *TRP-ID* is changed to e.g. *TRP-ID-Set*, there is no issue. |
| CATT | The confusion comes from TRP-ID which should be solved. |
| OPPO | We tend to leave the current container / grouping based method as it is, so no need for ASN.1 structure re-design to use individual fields.  The only thing to do is to rename the container to avoid misunderstanding, e.g., TRP-ID-Information-r16 |
| Intel | Agree with Huawei. |
| Ericsson | If we are anyway removing the complex IE known as TRP-ID, then it would be better to let the TRP ID represent what the name suggests – the identify of the TRP.  DL-PRS-ID is less appropriate name, since if is similar to PRS-ID which was introduced in LTE Rel 14 as a PRS sequence ID. In NR we use a slightly different name – dl-PRS-SequenceId for the same thing. To let DL-PRS ID also represent a TRP ID is confusing and should be avoided. |
| Nokia | RAN1 has defined a so-called “ID” which is defined as follows:  *This ID can be used along with a DL PRS Resource Set ID and a DL PRS Resources ID to uniquely identify a DL PRS Resource.*  *This ID can be associated with multiple DL PRS Resource Sets associated with a single TRP.*  *Each TRP should only be associated with one such ID. Name can be defined by RAN2 WG.*  And RAN2 decided to name it dl-PRS-ID. The definition of dl-PRS-ID in 37.355 matches the above RAN1 definition.  Whether dl-PRS-ID is the right name or not it is a parameter used to uniquely identify a PRS resource in one TRP in one of the 8 resource sets in that TRP. So, it looks like the dl-PRS-ID links (or points to) a TRP ID and a resource set under that TRP. Hence, if we use dl-PRS-ID and a resource ID then it should uniquely point to a resource under a resource set under a specifc TRP (pointed to by dl-PRS-ID). If this interpretation is right, we just need to define dl-PRS-ID as an IE containing 1) a globally unique TRP ID, 2) a list of 8 resource sets. TRP-ID can just identify a TRP but to globally uniquely identify a TRP the TRP-ID should be defined as a structure containing TRP-ID, cell identity (PCI and/or NCGI). May be worth calling it as a NTGI (NR TRP Global ID). Now, whereever we need to specify a PRS resource, we can just include the dl-PRS-ID and a resource ID (range 0-63). If this interpretation is correct, we can finalize the ASN.1 definitions for dl-PRS-ID and NTGI. The naming of dl-PRS-ID can also be adjusted to something else if needed. Techincally it is the ID defined by RAN1 which should be called something like GPRI (Global PRS Resource ID). |
| vivo | We think the conclusion depends on the result of 6.1. |
| Apple | Agree with Huawei and Intel to have a more proper name for the container. |

# 4. Summary

# 5. References

1. R2-2003783, “Summary of LPP agenda item 6.8.2.3”, Qualcomm Incorporated (Summary Rapporteur)
2. R2-2003061, "Remaining issues with LPP", Huawei, HiSilicon.
3. R2-2003130, "Measurement Reporting for UE based positioning", Ericsson
4. R2-2003318, "Handling on TRP-ID", Intel Corporation

# 6. Annex 6.1, Additional path representation

– *NR-DL-TDOA-SignalMeasurementInformation*

The IE *NR-DL-TDOA-SignalMeasurementInformation* is used by the target device to provide NR-DL TDOA measurements to the location server. The measurements are provided as a list of TRPs, where the first TRP in the list is used as reference TRP in case RSTD measurements are reported. The first TRP in the list may or may not be the reference TRP indicated in the *NR-DL-PRS-AssistanceData*. Furthermore, the target device selects a reference resource per TRP, and compiles the measurements per TRP based on the selected reference resource.

-- ASN1START

NR-DL-TDOA-SignalMeasurementInformation-r16 ::= SEQUENCE {

dl-PRS-ReferenceInfo-r16  DL-PRS-IdInfo-r16,

nr-DL-TDOA-MeasList-r16 NR-DL-TDOA-MeasList-r16,

nr-AdditionalPathListRef-r16 NR-AdditionalPathList-r16 OPTIONAL,

nr-DL-TDOA-AdditionalMeasurementsRef-r16 NR-DL-TDOA-AdditionalMeasurements-r16,

...

}

NR-DL-TDOA-MeasList-r16 ::= SEQUENCE (SIZE(1.. nrMaxTRPs)) OF NR-DL-TDOA-MeasElement-r16

NR-DL-TDOA-MeasElement-r16 ::= SEQUENCE {

trp-ID-r16 TRP-ID-r16 OPTIONAL,

nr-DL-PRS-ResourceId-r16 NR-DL-PRS-ResourceId-r16 OPTIONAL,

nr-DL-PRS-ResourceSetId-r16 NR-DL-PRS-ResourceSetId-r16 OPTIONAL,

nr-TimeStamp-r16 NR-TimeStamp-r16,

nr-RSTD-r16 INTEGER (0..ffs), -- FFS on the value range

nr-AdditionalPathListNeighbor-r16 NR-AdditionalPathList-r16 OPTIONAL,

nr-TimingMeasQuality-r16 NR-TimingMeasQuality-r16,

nr-PRS-RSRP-Result-r16 INTEGER (FFS) OPTIONAL, -- FFS, value range to be decided in RAN4.

nr-DL-TDOA-AdditionalMeasurementsNeighbor-r16 NR-DL-TDOA-AdditionalMeasurements-r16,

...

}

NR-DL-TDOA-AdditionalMeasurements-r16 ::= SEQUENCE (SIZE (1..3)) OF NR-DL-TDOA-AdditionalMeasurementElement-r16

NR-AdditionalPathList-r16 ::= SEQUENCE (SIZE(1..2)) OF NR-AdditionalPath-r16

NR-DL-TDOA-AdditionalMeasurementElement-r16 ::= SEQUENCE {

nr-DL-PRS-ResourceId-r16 NR-DL-PRS-ResourceId-r16 OPTIONAL,

nr-DL-PRS-ResourceSetId-r16 NR-DL-PRS-ResourceSetId-r16 OPTIONAL,

nr-TimeStamp-r16 NR-TimeStamp-r16,

nr-RSTD-ResultDiff-r16 INTEGER (0..ffs), -- FFS on the value range to be decided in RAN4

dl-PRS-RSRP-ResultDiff-r16 INTEGER (FFS) OPTIONAL, -- FFS on the value range to be decided in RAN4

nr-AddMeasAdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL,

...

}

nrMaxTRPs INTEGER ::= 256 -- Max TRPs per UE

-- ASN1STOP

| ***NR-DL-TDOA-SignalMeasurementInformation* field descriptions** |
| --- |
| ***nr-PRS-RSRP-Result***  This field specifies the reference signal received power (RSRP) measurement, as defined in TS 38.331 [35]. |
| ***nr-AdditionalPathListRef***  This field specifies one or more additional detected path timing values for the reference TRP, relative to the path timing used for determining the *nr-RSTD* value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nr-AdditionalPathListNeighbor***  This field specifies one or more additional detected path timing values for the neighbour TRP, relative to the path timing used for determining the *nr-RSTD* value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nr-RSTD***  This field specifies the relative timing difference between this neighbour TRP and the PRS reference TRP, as defined in FFS. Mapping of the measured quantity is defined as in FSS. |
| ***nr-TimingMeasQuality***  This field specifies the target device′s best estimate of the quality of the measurement. |
| ***nr-RSTD-ResultDiff***  This field specifies the relative time difference between the detected path timing of this DL-PRS resource relative to the path timing used for determining the *nr-RSTD* value, compensated for the difference in DL-PRS transmission timing. |
| ***nr-AddMeasAdditionalPathList***  This field specifies one or more additional detected path timing values of this DL-PRS resource, relative to the detected path timing of this DL-PRS resource / the detected path timing used for determining the *nr-RSTD* value (the reference path timing). If this field was requested but is not included, it means the UE did not detect any additional path timing values. |

*[…]*

*– NR-AdditionalPath*

The IE *NR-AdditionalPath* is used by the target device to provide information about additional paths in association to the path timing measurements associated to NR positioning in the form of a relative time difference and a quality value. The additional path *nr-relativeTimeDifference* is the detected path timing relative to the reference path timing used for determining the positioning measurements, and each additional path can be associated with a quality value *nr-path-Quality.*

-- ASN1START

NR-AdditionalPath-r16 ::= SEQUENCE {

nr-relativeTimeDifference-r16 INTEGER (FFS),--FFS to be decided in RAN4

nr-path-Quality-r16 NR-TOAMeasQuality-r16 OPTIONAL,

...

}

-- ASN1STOP

| ***NR-AdditionalPath* field descriptions** |
| --- |
| ***nr-relativeTimeDifference***  This field specifies the additional detected path timing relative to the reference path timing. If the additional detected path timings and the reference path timing are associated to different DL-PRS transmission timings, the device subtracts the transnmission timing difference from the value. A positive value indicates that the particular path is later in time than the reference path timing; a negative value indicates that the particular path is earlier in time than the reference path timing. |
| ***nr-path-Quality***  This field specifies the target device′s best estimate of the quality of the detected timing of the additional path. |