3GPP TSG RAN WG2 Meeting #116-e R2-210xxxx

**Electronic meeting, Online, November 2021**

**Agenda item:** 8.x

**Source:** Intel Corporation

**Title:** Summary of [Post115-e][605][POS] Pre-configured assistance data

**Document for:**  Discussion, Agreement

# Introduction

This document aims at collecting company views on pre-configured assistance data as per the following email discussion:

* **[Post115-e][605][POS] Pre-configured assistance data (Intel)**

Scope: Discuss signalling and validity criteria for pre-configured assistance data:

* Options for validity conditions:
  + - Option A: Based on a validity area (e.g. a list of cells)
    - Option B: Based on a (configured) validity timer or a numerical limit on number of times it is utilized
    - Option C: Based on explicit modification or release from the LMF/NG-RAN
    - Option D: Based on the UE’s current location and/or the time
* Validity in relation to the duration of the positioning session
* Need for enhancements for signalling and use of pre-configured assistance data:
  + Add/mod/release mechanism for PRS configurations
  + Dynamic triggering of a preconfigured PRS at UE by LMF or gNB for making measurements on DL-PRS
  + Dynamic triggering of a preconfigured SRS at UE by gNB for transmitting SRS based on measurement report provided by UE
  + Priority indications for multiple (pre-)configured assistance data sets corresponding to multiple position fixes
* Stage 2 impact of pre-configured assistance data

Intended outcome: Report to next meeting

Deadline: Long

# Contact Information

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Huawei, HiSilicon | YinghaoGuo | yinghaoguo@huawei.com |
| ZTE | Yu Pan | pan.yu24@zte.com.cn |
| Ericsson | Ritesh Shreevastav | Ritesh.shreevastav@ericsson.com |
| Qualcomm | Sven Fischer | sfischer@qti.qualcomm.com |
| Lenovo, Motorola Mobility | Robin Thomas | [rthomas7@lenovo.com](mailto:rthomas7@lenovo.com) |
| Fraunhofer | Birendra Ghimire | [birendra.ghimire@iis.fraunhofer.de](mailto:birendra.ghimire@iis.fraunhofer.de) |
| Apple | Sasha Sirotkin | ssirotkin@apple.com |
| InterDigital | Jaya Rao, Fumihiro Hasegawa | jaya.rao@interdigital.com, fumihiro.hasegawa@interdigital.com |
| vivo | Xiang Pan | panxiang@vivo.com |
| Xiaomi | Xiaolong Li | lixiaolong1@xiaomi.com |
| OPPO | Liu yang | liuyangbj@oppo.com |
| CATT | Jianxiang Li | lijianxiang@datangmobile.cn |
| Nokia | Mani Thyagarajan | mani.thyagarajan@nokia.com |

# Phase 1 discussion

## Validity in relation to the duration of the positioning session

Based on the FFS from RAN2#114 meeting, there were proposals from several companies discussing the need for defining some validity criteria associated with the pre-configured assistance data in order to enable usage of the positioning assistance data for more than one consecutive positioning sessions. [6] proposes to optionally configure validity conditions for enabling usage of the positioning assistance data for more than one consecutive positioning sessions and lists several possible options. [8] and [13] proposes that the pre-configuration of assistance data is valid within a specific area and period. It is proposed in [10] that the pre-configured positioning assistance data is considered valid unless explicitly modified or released by the LMF/NG-RAN. [27] also proposes that the pre-configured assistance data can be activated based on the condition which can be specified by the UE’s current location and/or the time.

Based on the above, it would be good to get a baseline understanding of company views on when it would be useful to consider and associate validity condition for usage of pre-configured assistance data to the UE for a single positioning session. In other words, if pre-configured assistance data is configured during a positioning session and is only considered valid during that positioning session, whether we still need to consider additional validity conditions. So, companies are invited to comment on whether the validity condition(s) should be considered for usage of pre-configured assistance data across a single positioning session.

**Question1-1: Do companies think validity condition(s) need to be defined for pre-configured assistance data configured during a single positioning session?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Yes/No** | **Comments** | |
| Huawei, HiSilicon | No | If assistance data is considered as valid only during a single positioning session, there is no gain for the assistance data pre-onfiguration for latency reduction compared with the current solution. | |
| ZTE | No | | Firstly to our understanding, the single positioning session in the question means a single LPP session.  A single LPP session corresponds to a single location request (e.g., for a single MT-LR, MO-LR or NI-LR). Commonly there is only one of a LPP transaction for assistance data transfer in a single LPP session, so bring forward this assistance data transfer procedure will not reduce the latency. since pre-configured assistance data is not needed in a single LPP session, the validity conditions are not needed, too. |
| Ericsson | No | As such there are already mechanism where by NW can inform to UE the AD validity area, expiration time; for example, AD through posSIBs or validity area of AD for barometer pressure sensor and these can anyway be reused. We do not think there is need to have separate indication just for pre-configured AD. We should be able to reuse the AD that we have today and its characteristics also for pre-configured configuration. We need to ensure minimum stage 3 changes for this. | |
| Qualcomm | No | Similar to other comments above, it is not quite clear what pre-configured assistance data during a single positioning session really means. When the UE receives a LPP Provide Assistance Data (e.g., for GNSS, DL-TDOA, etc.) the UE assumes the assistance data are "valid". Some Assistance Data (e.g., GNSS ephemeris, etc.) may expire after some time and/or location (i.e., became "invalid"). But this is handled in each specific assistance data element anyhow and is independent on any "pre-configuration". | |
| Lenovo, Motorola Mobility | No | Share similar views with the above companies in that (pre-)configured assistance data is already deemed valid once received by the UE. Validity conditions do not need to be defined for a single positioning session. | |
| Fraunhofer | Yes | We find it particularly useful for MT-LR in case of RRC\_INACTIVE. A UE could be provided with more than one set of assistance data, and the applicable A/D set for the given location shall be selected based on some measurements or based on certain list (e.g. list of cells). Especially for deferred MT-LR, the UE may move along and one of the pre-configured A/D from the set of pre-configured AD may become applicable. The selection of the A/D could be based, for example, on the camped cell identifier or based on the measurement of certain DL-PRS (thereby implicitly indicating proximity to certain TRPs). Between the multiple A/D, details such as the TRPs involved or their priority could be different. | |
| Apple | No | As others mentioned, this makes little sense. | |
| InterDigial | No | We share same understanding with other companies that we do not see much benefit in defining validity conditions where the pre-configured AD will be valid only during a single positioning session. | |
| vivo | Yes | The pre-configuration is beneficial for deferred MT-LR even during a single positioning session. For periodical deferred MT-LR, it may be a long time and the UE may move a long distance after the UE receives the pre-configuration. The UE shall check whether the pre-configuration is still valid when it detects the event.  If the pre-configuration is valid, the UE shall reuse it to perform location measurement. Otherwise, the UE shall request assistance data updates. | |
| Xiaomi | No | We also don’t see much benefit for the validity conditions for pre-configured assistance data during a single positioning session, | |
| OPPO | No | Agree with Qualcomm. This question is awkward. In current implementation, the assistance data is provided and valid during one single positioning session. | |
| CATT | No | There is no need to define the validity condition(s) for a single positioning session:  - When the pre-configured assistance data is the DL-PRS, the data still is valid which is independent of any positioning session. If an indication of area where DL-PRS belongs to is set together with the DL-PRS, then the UE may search the proper DL-PRS according to where the UE locates. It seems no need to define the validity condition(s) for a single positioning session in this case.  - When the pre-configured assistance data is for A-GNSS, the data still is valid when the positioning session is ended. There is an existing mechanism on validity of A-GNSS. So it seems no need to define the validity condition(s) for a single positioning session in this case. | |
| Nokia | See comments | First, the moderator must clarify that this whole discussion on pre-configured assistance data and validity of pre-configured assistance data is in the context of latency enhancements. This is not clear from the discussions in this document except for the fact that the referenced documents are all from the latency enhancements agenda item from last meeting. If this discussion applies to on-demand PRS use of pre-configured assistance data or how pre-configured assistance data and related validity criteria handling applies to inactive positioning, then it should be clarified.  Pre-configured assistance data is stored information that is used by UE. So, when we talk about validity of such stored information, we need not look at it from a single positioning session vs different positioning session (across multiple sessions). The validity conditions should just tell what the validity of the stored assistance data information is. So, validity of pre-configured assistance data should equally apply irrespective of whether it is single session or across different sessions. | |

**Summary:**

**Question 1-2: If the answer to the above question is Yes, what should be UE behavior when the validity condition(s) for usage of pre-configured assistance data are no longer met?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Fraunhofer | The UE shall select one of the A/D from the set of A/D provided to the UE. If the UE is at a location where none are applicable, then it initiates mechanisms to request A/D or retrieve A/D. |
| vivo | There may be multiple sets of pre-configured assistance data. Each set may associate with a validity condition. The UE still stores it when the validity condition for a set of pre-configured assistance data is no longer met and uses it again when the validity condition is met in the future. If all the assistance data is not valid, the UE shall send the LPP *RequestAssistanceData* to update the configuration. |
| Nokia | UE can request assistance data from LMF or LMF can update the assistance data if it knows that the assistance data is no longer valid (or soon to be become invalid). The UE request for assistance data from LMF should not be limited to UEs in connected state; UEs in inactive state should also be able to request assistance data updates. To minimize signaling traffic the validity conditions should be a simple area based validity (as in SI area and use of stored system information) as otherwise any timer/absolute time or counter based validity or location based validity would result in too frequent signaling of assistance data updates. |

**Summary:**

Before discussing the applicability of the pre-configured assistance data to multiple positioning sessions, it should be discussed what the relationship between pre-configured assistance data and a given positioning session is, i.e. whether the former can be configured independently of a positioning session. Companies are invited to provide input to the following questions:

**Question 2-1: Do companies think pre-configured assistance data can be configured independent of any positioning session, i.e. not necessarily configured for a specific positioning session?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | If pre-configuration is found useful, it should be kept even after the positioning sessions end such that it can be reused in the next positioning session. |
| ZTE | Yes | The question is opposite to Q1-1. Please refer to our comments on Q1-1 and Q2-2 |
| Ericsson | Yes |  |
| Qualcomm |  | We think this is the case with any assistance data anyhow. E.g., a UE may want to keep its stored assistance data up-to-date and send a MO-LR for assistance data when stored assistance data expires, or may read the posSI when updated assistance data are available, etc. |
| Lenovo, Motorola Mobility | Yes | We are of the view that this is already the common understanding regarding the configuration of AD, where the AD (pre-)configuration/validity is not dependent on a particular positioning session. |
| Fraunhofer | Yes | The pre-configured data could be considered for a certain area and certain time interval. Then the A/D provided could be useful for multiple sessions. The A/D could then also be provided outside the session and shared among multiple sessions. |
| Apple | Yes | Agree with QC, this can be supported today. |
| InterDigital | Yes | We share similar view with QC that the AD can be preconfigured and retrieved without any dependencies with an LPP positioning session. |
| vivo | Yes | Reusing the valid configuration within multiple location sessions may reduce the overall latency. |
| Xiaomi | Yes | It can reduce positioning latency and it is a reasonable assumption that the pre-configured assistance data can be configured independent of any positioning session. |
| OPPO | Yes | Overall latency could be reduced. |
| CATT | Yes | When the pre-configured assistance data is the DL-PRS, the data which is independent of any positioning session still is valid. If an indication of area where DL-PRS/TRP belongs to is set to the DL-PRS, then the UE may search the proper DL-PRS quickly according to where the UE locates, for example the SI area ID or RNA area ID. UE may set the lower priorities of some DL-PRS which are out of the UE’s RNA or SI area. |
| Nokia | Yes | Pre-configured assistance data is stored information that is used by UE. So, when we talk about validity of such stored information, we need not look at it from a single positioning session vs different positioning session (across multiple sessions). The validity conditions should just tell what the validity of the stored assistance data information is. So, validity of pre-configured assistance data should equally apply irrespective of whether it is single session or across different sessions. |

**Summary:**

Depending on whether pre-configured assistance data is configured independent of any positioning session, the next question is whether pre-configured assistance data should be considered valid for more than one positioning session. In other words, whether the pre-configured assistance data can be utilized for positioning procedures across multiple positioning sessions should be discussed.

**Question 2-2: Do companies think whether pre-configured assistance data should be considered valid for usage across multiple (consecutive) positioning sessions?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No, but see comments | For assistance data delivered by dedicated signaling, they should not be considered as valid across sessions as legacy.  For assistance data delivered by broadcast, they should be considered as valid across positioning sessions, since they are not associated with positioning sessions. |
| ZTE | Yes | If the assistance data is pre-configured, that means multiple positioning sessions can use the pre-configured assistance data, and it saves the time of assistance data exchange/transfer procedure in these multiple positioning sessions. That is what pre-configured assistance data is aimed for. |
| Ericsson | Yes | The objective is that when UE connects to the NW for positioning in an IIOT scenario then NW should provide all the configurations that is valid for the UE in the factory premises. After that the NW may track the UE and provide delta configuration saying if any cells/TRPs that need to be prioritized or prohibited.  When the UE is within the factory premises, it should always be able to (re)use the provided AD from previous sessions. |
| Qualcomm |  | Similar to our comment for Question 2-1, we think there is no difference compared to today. |
| Lenovo, Motorola Mobility | Yes | Share similar view as ZTE and Ericsson and note that there are latency reduction benefits in delivering pre-configured assistance data via broadcast (legacy posSIBs) and UE-specific signalling (via LPP). Such pre-configured assistance data configurations should be valid across multiple LPP sessions. |
| Fraunhofer | Yes | If the A/D is associated with a certain area, such as serving cell / camped cell belonging to a group of cells, then the A/D could be considered valid across multiple sessions. |
| Apple | Yes | Agree with QC |
| InterDigital | Yes | For realizing latency reduction, the preconfigured AD should be valid and usable across multiple positioning sessions. We also do not see the need to limit the validity of the preconfigured AD only for ‘consecutive’ positioning sessions. |
| vivo | Yes | Reusing the valid configuration within multiple location sessions may reduce the overall latency. |
| Xiaomi | Yes | It can reduce positioning latency. |
| OPPO | Yes | The core benefit of pre-configured assistance data is to enable UE to directly apply the already stored assistance data for immediate positioning services without asking or waiting for the LMF to send a new set of assistance data for the current positioning session. |
| CATT | Yes | If an indication of area where DL-PRS belongs to is set together with the pre-configured DL-PRS, then the UE may search the proper DL-PRS according to where the UE locates. The area indication will help UE search DL-PRS more efficiently to reduce the positioning latency. |
| Nokia | Yes | See our comments to Question 1-1 and Question 2-1. Also, we are not sure why multiple consecutive session was mentioned by the moderator. Validity of pre-configured assistance data should be independent of number of positioning sessions and whether the sessions are consecutive or not. |

**Summary:**

If the answer to the above question is no, then we may not need to consider definition of validity conditions for pre-configured assistance data across multiple sessions since it can be implicitly assumed that previously pre-configured assistance data is no longer valid for a new positioning session. However, if the answer to the above question is yes, the same principle as in Question 1-1 needs to be established for multiple positioning sessions as well, so company views are invited for that case.

**Question 2-3: If the answer to question 2-2 is yes, do companies agree that validity condition(s) need to be defined for usage of pre-configured assistance data across multiple (consecutive) positioning sessions?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes | If pre-configured assistance data can be used across multiple LPP sessions, the validity conditions of pre-configured assistance data should also be the same, i.e., available across multiple LPP sessions. |
| Ericsson |  | For factory premises where NW may be tracking UE; it should be able to provide some delta signaling to prioritize certain TRPs or to prohibit measurements from certain cells/TRPs. |
| Qualcomm |  | If individual assistance data have a limited validity, this is handled either explicitly or implicitly in each individual assistance data element (GNSS ephemeris is a typical example which expires after some time; DL-TDOA TRP list can only be used/valid when the UE is in the “coverage area” of the TRP list, etc.). |
| Lenovo, Motorola Mobility | Yes | Validity conditions should be able to assist in distinguishing valid (or updated) and invalid (pre-) configured assistance data. |
| Fraunhofer | Yes | Similar to the view as Ericsson. One way to do this could be to configure multiple A/D. The different sets could have different TRPs within the AD or different priorities for the same TRPs in different sets. |
| Apple | Not sure | As QC mentioned, some validity conditions are supported already. If the question is about new validity conditions to be introduced, then we should discuss them on a case by case basis (as indeed we do below). |
| InterDigital | Yes | We think validity conditions which are associated with preconfigured ADs will be helpful for the UE to identify which of the ADs are usable, need updating, or unusable for the multiple positioning sessions. We don’t see a need to limit the case to consecutive sessions. |
| vivo | Yes | The pre-configuration of assistance data may contain the PRS configuration of some TRPs, which is valid within a specific area. When the UE gets out of the area due to mobility, the pre-configuration will turn invalid and the UE shall request for a new configuration. |
| Xiaomi | Not sure | As QC commented, if the existing validity conditions can be reused, the new validity conditions for pre-configured assistance data are not needed. |
| OPPO | Yes |  |
| CATT | Yes | If an indication of area where DL-PRS belongs to is set together with the pre-configured DL-PRS, then the UE may search the proper DL-PRS according to where the UE locates. The area indication will help UE search DL-PRS more efficiently to reduce the positioning latency. |
| Nokia | Yes | As we explained under Question 1-1, and copied here again:  Pre-configured assistance data is stored information that is used by UE. So, when we talk about validity of such stored information, we need not look at it from a single positioning session vs different positioning session (across multiple sessions). The validity conditions should just tell what the validity of the stored assistance data information is. So, validity of pre-configured assistance data should equally apply irrespective of whether it is single session or across different sessions.  Our comments on “consecutive positioning session” for Question 2-2 applies here as well. |

**Summary:**

**Question 2-4: If the answer to the above question is Yes, what should be UE behavior when the validity condition(s) for usage of pre-configured assistance data are no longer met?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | We don’t think there should be an issue on the dissatisfaction about validity conditions needed to be solved. Explicitly activate or release the pre-configured assistance data from the LMF/NG-RAN is enough. |
| Qualcomm | We can’t see any difference compared to what is available/done today. When assistance data expires, they will not be used by the UE anymore. E.g., a UE is not using an ephemeris from an old week, or use a TRP neighbour list received in one part of a network when the UE is at a completely different location or different network from where the assistance data have originally been received, etc. |
| Lenovo, Motorola Mobility | UE should deem the pre-configured AD invalid. |
| Fraunhofer | The UE could store these data, and if the UE returns to the old location, the old A/D if it is still within the validity time, could be “refreshed” and used. |
| InterDigital | The UE does not use the preconfigured AD when determining it has expired with respect to the validity conditions. |
| vivo | There may be multiple sets of pre-configured assistance data. Each set may associate with a validity condition. The UE still stores it when the validity condition for a set of pre-configured assistance data is no longer met and uses it again when the validity condition is met in the future. If all the assistance data is not valid, the UE shall send the LPP *RequestAssistanceData* to update the configuration.  The explicit area and duration criteria are essential for UE in RRC\_INACTIVE, in this case, the LMF/RAN node does not know the camping cell of the UE. |
| OPPO | UE should send a assistance data request or notification information towards the network. |
| CATT | The UE may search these valid DL-PRS as the first priority to reduce the latency of searching DL-PRS. |
| Nokia | UE should request assistance data from LMF or LMF must update the assistance data if it knows that the assistance data is no longer valid (or soon to be become invalid). The UE request for assistance data from LMF should not be limited to UEs in connected state; UEs in inactive state should also be able to request assistance data updates. To minimize signaling traffic the validity conditions should be a simple area based validity (as in SI area and use of stored system information) as otherwise any timer/absolute time or counter based validity or location based validity would result to frequent signaling of assistance data updates. |

**Summary:**

## Validity conditions for pre-configured assistance data

Regarding the specific validity conditions to be defined, it was captured in the last meeting minutes to consider at least the following options:

 Option A: Based on a validity area (e.g. a list of cells)

 Option B: Based on a (configured) validity timer or a numerical limit on number of times it is utilized

 Option C: Based on explicit modification or release from the LMF/NG-RAN

 Option D: Based on the UE’s current location and/or the time

Companies are invited to comment on whether they support one or more of the validity conditions individually captured above.

**Question 3-1: Regarding the validity conditions/criteria associated with pre-configured assistance data, do companies think validity condition based on a specified area (e.g. a list of cells where the pre-configured assistance data is considered valid) should be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No | We think it is important that we first establish common understanding that the network and the UE should be synchronized on their understanding of the UE’s usage of assistance data. However, the current spec seems to lack such clarifications, e.g., the UE can keep the configuration that is receives long time ago, and what’s the relationship between the assistance data delivered by dedicated signaling and those delivered by broadcast. |
| ZTE | No | 1. The validity condition is quite difficult for a LMF to configure accurately. For example, what criteria should a LMF to take for determining a list of cells or a validity timer? How can LMF ensure the configured list of cells or a timer is actually valid for using assistance data? 2. The validity condition lacks the scheduling flexibility. 3. If a list of cells or validity timer is configured, an issue about dissatisfaction of validity conditions should also be solved, which leads to large spec impact. |
| Ericsson | Yes, to some extent | There may be some ambiguity with regards to where broadcast-based configuration may be valid. As broadcast based signaling is common for all UEs; it may not be applicable for example in certain (border) area of factory (Ues moving from outside to inside of factory premises may still perform positioning using cells/TRPs of outside factory coverage; for example, macro cells). This may not be desirable, and it is preferred if UE uses the DL-PRS configuration from factory premises. Hence, as what part of broadcast AD is applicable for the UE or not applicable in certain geographical area needs to be communicated to UE. |
| Qualcomm |  | In our understanding, this is the case anyhow and depends on the type of assistance data. E.g., GNSS Acquisition Assistance is valid at the current location and time, since visible SVs are different at a different location and time. The same is the case for e.g., DL-TDOA assistance data, which depends on the cells/TRPs around the current UE location (and will depend on time with on-demand PRS). We can’t see anything specific/new here for “pre-configured assistance data”. |
| Lenovo, Motorola Mobility | Yes | Option A seems to follow on from a previous Rel-16 discussion on creating positioning-specific SI areas (consisting of valid cells) rather than overlapping the validity of posSIBs with the common SI area for all normal SIBs. This could be a reasonable option for the pre-configured AD broadcast solution since the UE’s location requirements and location will vary when compared to the common SI area already defined for normal SI messages. |
| Fraunhofer | Yes | We agree with Huawei that we need to first establish common understanding that the network and the UE should be synchronized on their understanding of the UE’s usage of assistance data.  However, we have similar views as Ericsson that the optimal set of TRPs for indoor and outdoor may be different. Hence, in our opinion, it should be made possible for a UE to be configured with multiple of A/D (e.g. a set consisting of outdoor TRPs and a second set consisting of indoor TRPs), particularly in RRC\_INACTIVE mode.  When the UE moves from outdoor to indoor, as in Ericsson’s example, it should be possible to identify this via measurements or via the serving cell. Then the A/D containing the set of indoor TRPs could be activated when indoors, and the A/D containing the set of outdoor TRPs could be deactivated. The reverse needs to be done when the UE transits from indoor to outdoor.  Regarding the comments from ZTE, if the assistance data delivered by broadcast or unicast are identified with a common identifier, (e.g. area ID, version ID or validity time), then it should be possible to associate the validity condition to specified area and time without having conflicts. And if a UE moves outside the validity area, it should be able to request new A/D or acquire from broadcast. |
| Apple | Maybe | Needs to be discussed on a case by case basis for a specific assistance data information. |
| InterDigital | Yes | As indicated by others, area-based validity conditions for AD are already supported implicitly to certain extent (e.g. via SIB). We think extending the concept is useful for numerous scenarios (e.g. transitioning from inside to outside of factory as indicated by Ericsson), by providing the area-based validity conditions to the UE and associating them with the preconfigured AD. |
| vivo | Yes | UE in different locations may need to use different assistance data. There may be multiple sets of pre-configured assistance data and each set may associate with a validity area. |
| Xiaomi | Yes | The existing validity conditions can be considered as starting point. |
| OPPO | Yes | It should be supported since PRS from certain TRPs may be not hearable after the UE leaves the area. PRS and/or TRP should be re-assigned for positioning. |
| CATT | Yes | Agree with Lenovo that validity area of DL-PRS can be taken into consideration. Either the broadcast AD or pre-configured AD (only for DL-PRS) in some LPP session can support the validity area for DL-PRS. So UE may search proper TRPs which are considered as valid according to its serving cell. |
| Nokia | Yes | To minimize signaling traffic the validity conditions should be a simple area based validity (as in SI area and use of stored system information) as otherwise any timer/absolute time or counter based validity or location based validity would result to frequent signaling of assistance data updates. |

**Summary:**

**Question 3-2: Regarding the validity conditions/criteria associated with pre-configured assistance data, do companies think validity condition based on a configured validity timer should be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No |  |
| ZTE | No | Similar comments as Q3-1 |
| Ericsson | No |  |
| Qualcomm | No | Validity time is implicit for many of the assistance data elements today anyhow (where needed). GNSS ephemeris is an example. |
| Lenovo, Motorola Mobility | See comments | The need on an explicit or implicit validity timer for pre-configured AD needs further discussion and can depend on different factors (e.g., coverage area, etc.). |
| Fraunhofer | Yes | Validity timer could indicate when the UE (e.g. in RRC\_INACTIVE) needs to request new A/D. It could also be implicit as Qualcomm indicated. |
| Apple | No |  |
| InterDigital | Maybe | Share similar view with Lenono in that whether/how the different types of timer-based validity conditions (i.e. implicit or explicit) can be used is to be discussed further. |
| vivo | Yes | Pre-configured assistance data may change over time, e.g., the TRP broadcasting the DL-PRS may be turned off periodically for energy saving. In this case, a validity timer is needed for pre-configuration. |
| Xiaomi | No |  |
| OPPO | Yes |  |
| CATT | No | If the pre-configured assistance data is DL-PRS, there is no proof that DL-PRS will be valid based on timer. |
| Nokia | No | We think a baseline functionality would be a validity condition based on area, but other conditions are optimizations which we should avoid minimizing complexity. |

**Summary:**

**Question 3-3: Regarding the validity conditions/criteria associated with pre-configured assistance data, do companies think validity condition based on an upper limit on the number of times the UE utilizes the assistance data for positioning should be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No |  |
| ZTE | No | Similar comments as Q3-1 |
| Ericsson | No |  |
| Qualcomm | No |  |
| Lenovo, Motorola Mobility | No | The benefits are not clear in terms of utilization of the pre-configured assistance data with this aspect of Option B. This seems to place a hard limit on UE’s usage behavior of pre-configured assistance data, which lacks flexibility in our view. |
| Fraunhofer | No |  |
| Apple | No |  |
| InterDigital | No |  |
| vivo | No |  |
| Xiaomi | No |  |
| CATT | No |  |
| Nokia | No | We think a baseline functionality would be a validity condition based on area, but other conditions are optimizations which we should avoid minimizing complexity. |

**Summary:**

**Question 3-4: Regarding the validity conditions/criteria associated with pre-configured assistance data, do companies think whether the UE continuing to use assistance data for positioning until explicit modification/release by LMF/NG-RAN should be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | We think this can be enabled by release/add/modification mechanism |
| ZTE | Yes | This method brings the largest flexibility to the network |
| Ericsson | Yes | We think below option is the best:  *Based on explicit modification or release from the LMF/NG-RAN* |
| Qualcomm | No | The need/benefit/use case for this is not quite clear. E.g., will a LMF have to keep track of assistance data stored in the UE, the UE location, time, etc. and notify the UE when the assistance data should be “released”? Would this information be exchanged between LMFs in a network? |
| Lenovo, Motorola Mobility | No | The benefits are not clear in terms of utilization of the pre-configured assistance data. The reduction in latency benefits of pre-configured assistance data might be nullified based on such extra modification/release signalling. We prefer a more implicit mechanism since this might involve more background signalling especially in cases, where the UE might be roaming. |
| Fraunhofer | Yes | Furthermore, considering that the A/D outside the validity area may be useful later when the UE returns back, in addition to release/add/modification, mechanisms to store and retrieve expired data may be useful. |
| Apple | Not sure | Needs to be discussed based on at least one example of which assistance data it would be used with. |
| InterDigital | No | We do not see how explicit indication for modification/releasing the preconfigured AD can be more beneficial than implicit approaches based on validity conditions for identifying when to use/update/not-use the AD. |
| vivo | Yes with modification | We also think the modification/release mechanism is essential for AD configuration. However, we think it is not in conflict with others.  That is, the UE shall continue to use assistance data when the validity criteria met until explicit modification/release by LMF/NG-RAN |
| Xiaomi | No | If option A is introduced, we don’t see the additional benefit to introduce option C. |
| OPPO | Yes |  |
| CATT | Not sure | For DL-PRS and A-GNSS AD, it doesn’t make sense for LMF to release the AD because the TRP and the satellite always send the positioning signals.  For UL-SRS AD, we need more discussion on pre-configured AD at first. |
| Nokia | No | First, it should be clarified what assistance data we are talking about when we say NG-RAN should be able to modify/release it.  Explicit modification/release by LMF is basically an update of the provisioned assistance data, although the release function would be something new. We don’t see the need for release of assistance data without updated assistance data information. Explicit update of assistance data is already possible in LPP signaling, so we think nothing new is needed for Question 3-4. |

**Summary:**

**Question 3-5: Regarding the validity conditions/criteria associated with pre-configured assistance data, do companies think validity condition based on UE’s current position/location should be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No |  |
| ZTE |  | Firstly, this option is not a parallel option compared to option A, B and C. It should be assumed as an additional conditions of option A and B.  Although we are not supportive of option A and B, it still make sense that the option A and B should be based on the UE’s current location. |
| Ericsson | No |  |
| Qualcomm |  | Most assistance data are location and time dependent implicitly. |
| Lenovo, Motorola Mobility | See comments | Generally, support in principle, but further study is needed on whether this aspect is already supported e.g. in the case RAT-dependent and/or RAT-independent assistance data configurations. |
| Fraunhofer | Yes | This supports the UE mobility better, if the A/D could be tied to a location in the network. For example, the A/D received in cell x could be used with a certain area scope (which includes its current location). In a different area (e.g. cell y), the A/D associated with a different A/D scope may be used. |
| Apple | No |  |
| InterDigital | Maybe | Similar to QC, we think validity conditions are already implicitly associated with the UE’s current location. It is not immediately clear whether there are any benefits for defining additional conditions for associating the validity conditions with different UE locations (e.g. when/where the validity conditions may apply). |
| vivo | Yes | This option is similar to Option A.  UE in different locations may need to use different assistance data. There may be multiple sets of pre-configured assistance data and each set may associate with a validity area. |
| Xiaomi | Not sure | We are not sure how to use UE location or position, if the UE location is GNSS location, this option is not feasible, if the UE location can be represented by TRP ID or Cell ID, just like option A, we think this option can be further studied. |
| OPPO | No | Such validity condition concept is overlapped with the validity condition of specific area |
| CATT | Yes with comments | Option A (based on a validity area) needs where UE locates (e.g. serving cell) but not very accurate location. |
| Nokia | See comments | From the point-of-view of reducing latency, we do not think a location-based condition is needed. A simple area-based condition is sufficient. Location-based assistance data updates may be detrimental to the goal of reducing latency as this would result in frequent signaling of assistance data updates. |

**Summary:**

In addition to the above options captured in the meeting minutes, companies are invited to propose if they have some other validity condition in mind to consider. Companies are suggested to add helpful details for the proposed options to make sure the proposed solution is clearly understood.

**Question 3-6: Do companies think some other validity condition(s) than those discussed in Questions 3-1 to 3-5 should be supported? If so, please provide details of how it would work.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | No. To minimize signaling traffic the validity conditions should be a simple area-based validity (as in SI area and use of stored system information). Adding more conditions/criteria only increases the specification and implementation complexity. |
|  |  |
|  |  |

**Summary:**

## Need for enhancements for signalling and use of pre-configured assistance data

Several enhancements related to signaling and use of pre-configured assistance data were proposed by companies during the last meeting. As per the meeting minutes, the following enhancements were identified for further discussion:

|  |
| --- |
| * Add/mod/release mechanism for PRS configurations and complete definition of priority of PRS configuration for measurement, including the PRS configuration received by dedicated LPP signalling and posSIB [7] * Dynamic triggering of a preconfigured PRS at UE by LMF or gNB for making measurements on DL-PRS [13] * Dynamic triggering of a preconfigured SRS at UE by gNB for transmitting SRS based on measurement report provided by UE [13] * Priority indications for multiple (pre-)configured assistance data sets corresponding to multiple position fixes [15] |

Given the fact that the above options are based on individual company proposals and there has not been an opportunity to collect views form other companies on the need and feasibility of supporting these enhancements, rapporteur thinks it would be good to collect company views and comments in Phase 1 discussion. Based on the outcome, we can then discuss further details as needed in Phase 2.

**Question 4-1: Which of the following proposed enhancements need to be pursued in Rel-17 NR positioning discussion? (Select all that apply)**

1. **The introduction of an Add/mod/release mechanism for PRS configurations**  **and a complete definition of priority of PRS configuration for measurement**
2. **Dynamic triggering of a preconfigured PRS at UE by LMF or gNB for making measurements on DL-PRS**
3. **Dynamic triggering of a preconfigured SRS at UE by gNB for transmitting SRS based on measurement report provided by UE**
4. **Priority indications for multiple (pre-)configured assistance data sets corresponding to multiple position fixes**

|  |  |  |
| --- | --- | --- |
| **Company** | **Options** | **Comments/Reason** |
| Huawei, HiSilicon | 1 | We think that 1 can be the baseline solution for R17 latency reduction. With this mechanism, the network can synchronize its record of the UE’s AD with the UE.  The current issue with priority of PRS configuration is that (a) priority is not defined between different frequency layers (b) priorities handling between AD received by dedicated signaling and broadcast are not defined. After these problems are resolved, we may think about other optimizations, such as solution 4 for dynamically varying the priorities between different configurations. |
| ZTE | Option 2 | Option 2 is almost the same as option C in section 3-2, which brings the largest flexibility to the network |
| Ericsson | 1 | We should try to have the solution simple. From NW perspective, if NW provides a new AD; UE should release previous AD and use new one. Further provision of delta signaling/configuration should be provided. For example; NW provides all the configuration to the UE and UE stores that then on later stage NW based upon UE tracking should be able to prioritize certain TRPs (for example while computing z-component).  Agree with Huawei on prioritization between broadcast and dedicated signaling discussion is needed. Our understanding is that as broadcast based signaling is common for all UEs; and dedicated signaling should be able to always override the broadcast AD. Further broadcast AD may not be applicable to for example in certain border area of factory (Ues moving from outside to inside of factory premises may still perform positioning using coverage of outside factory coverage; for example, macro cells). Hence, as what part of broadcast AD is applicable for the UE or not applicable in certain geographical area needs to be communicated to UE. |
| Qualcomm | None. | The use case/benefit of all this is not quite clear. |
| Lenovo, Motorola Mobility | At least 4 | It is well understood that positioning may not rely on single fix depending on the positioning method and the more fixes required will inevitably increase latency. Currently, the UE has no explicit priority mechanism in which to handle any pre-configured AD. Given that multiple sets of pre-configured AD may be provided to the UE for one or more fixes, a NW configured explicit priority handling of the sets of pre-configured AD is preferred. Priority can be optionally modified based on Option 1 or 2. |
| Fraunhofer | 2, 3 | The triggering could simply be a signaling of the A/D from multiple preconfigured A/Ds received by the UE. |
| Apple | Nor sure | We can discuss this further on a case by case basis |
| InterDigital | 2, 3 | For latency reduction and flexible use of pre-configured AD, we think sending an indication to UE for triggering the usage of an AD can be considered. |
| vivo | 1, 2 with modification | For Option 1, the add/mod/release mechanism for PRS configurations shall be specified.  For Option2, in our view, the LMF initiated on-demand PRS is a dynamic triggering of a preconfigured PRS at UE by LMF. |
| Xiaomi | None | We think the current positioning measurement trigger can be reused, such as LPP request location information. |
| OPPO | 1 |  |
| CATT | 4 with comments | The priorities of positioning methods of AD (not the priority of DL-PRS) will help UE reduce the positioning latency when there are hybrid positioning methods assigned to UE. |
| Nokia | See comments | Option 1 is complex but not essential. Options 2 through 4 seems related to activation of a pre-configured PRS/SRS configuration set and can be discussed under on-demand PRS discussions. It looks like the decision whether to use an index for signaling the request for on-demand PRS is related to this. |

**Summary:**

## Other issues

Companies are invited to comment whether there are any other open issues with respect to pre-configuration of assistance data that need to be discussed.

**Question 5-1: Do companies think there are any other critical issues to be addressed regarding pre-configured assistance data?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Keep the solution simple as possible and reuse existing framework. |
| Qualcomm | A precise definition of what "pre-configured assistance data" means and how it is different compared to today would be helpful. For example, are posSIBs or MO-LR considered as "pre-configured assistance data", etc.? |
| Fraunhofer | We see benefits of having preconfigured A/D especially in RRC\_INACTIVE positioning. |
| vivo | Agree with QC that the definition of "pre-configured assistance data" shall be clarified.  We think the configuration that can be used for potential location in the future is pre-configured assistance data. |
| CATT | Consensus on the clear definition of pre-configured assistance data should be reached at first. Then discuss how to get the pre-configured assistance data, and then what the validity of pre-configured assistance data is. |
| Nokia | We think mapping of different pre-configured PRS configurations to positioning QoS and/or radio conditions needs to be addressed. Different pre-configured PRS configurations with an associated identification and mapping to specific positioning QoS and/or radio condition is beneficial to reduce latency. |

**Summary:**

# Phase 2 discussion

# References

1. R2-2107090 Discussion on positioning latency reduction ZTE discussion
2. R2-2107091 Discussion on scheduled location time ZTE discussion
3. R2-2107132 Discussion on Response LS on Scheduling Location in Advance to reduce Latency from SA2 CATT discussion Rel-17 NR\_pos\_enh-Core
4. R2-2107134 Discussion on Enhancements for Latency Reduction CATT discussion Rel-17 NR\_pos\_enh-Core
5. R2-2107135 Discussion on storage of UE Positioning Capabilities LS from SA2 and the granularity of response time LS from RAN1 CATT discussion Rel-17 NR\_pos\_enh-Core
6. R2-2107399 Further consideration of positioning latency enhancements OPPO discussion Rel-17 NR\_pos\_enh-Core
7. R2-2107500 Discussion on positioning latency Huawei, HiSilicon discussion Rel-17 NR\_pos\_enh-Core
8. R2-2107641 Discussion on latency enhancement vivo discussion Rel-17 NR\_pos\_enh-Core
9. R2-2107642 Discussion on Scheduling Location in Advance to reduce Latency vivo discussion Rel-17 NR\_pos\_enh-Core
10. R2-2107670 Scheduled location time based latency reduction Intel Corporation discussion Rel-17 NR\_pos\_enh
11. R2-2107673 Storing UE positioning capability in AMF Intel Corporation discussion Rel-17 NR\_pos\_enh
12. R2-2107680 Summary of agenda 8.11.2 Latency enhancements Intel Corporation discussion Rel-17 NR\_pos\_enh Late
13. R2-2107681 Discussion on Enhancements for Latency Reduction InterDigital, Inc. discussion Rel-17 NR\_pos\_enh
14. R2-2107962 Discussion on the response time Samsung discussion Rel-17
15. R2-2108127 Positioning Latency Reduction Enhancements Lenovo, Motorola Mobility discussion Rel-17
16. R2-2108175 Positioning enhancements on latency reduction Xiaomi discussion
17. R2-2108367 Scheduling Location in Advance to Reduce Latency Qualcomm Incorporated discussion
18. R2-2108376 [draft] Response LS on Scheduling Location in Advance to reduce Latency Qualcomm Incorporated LS out Rel-17 FS\_NR\_pos\_enh To:SA2 Cc:RAN1, RAN3
19. R2-2108377 LPP impacts for UE positioning capability storage Qualcomm Incorporated discussion
20. R2-2108378 [draft] Response LS on storage of UE Positioning Capabilities Qualcomm Incorporated LS out Rel-17 To:SA2 Cc:RAN3
21. R2-2108393 Utilizing Time T and other associated parameters Ericsson discussion
22. R2-2108397 On UE Positioning Capabilities Ericsson discussion
23. R2-2108536 Discussion on latency reduction for positioning CMCC discussion Rel-17 NR\_pos\_enh-Core
24. R2-2108704 Enhancement to reduce latency for high volume positioning Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_pos\_enh-Core
25. R2-2108769 Handling of multiple QoS for latency reduction Samsung Electronics discussion NR\_pos\_enh-Core
26. R2-2108771 Latency reduction via configured grant for positioning Samsung Electronics discussion NR\_pos\_enh-Core
27. R2-2108773 Discussion on the scheduled location time Samsung Electronics discussion NR\_pos\_enh-Core
28. R2-2106918 Reply LS to SA2 on Scheduling Location in Advance (R1-2106312; contact: Qualcomm) RAN1 LS in Rel-17 NR\_pos\_enh To:SA2 Cc:RAN2, RAN3
29. R2-2107133 Draft Response LS to SA2 on the scheduled location time CATT LS out Rel-17 NR\_pos\_enh-Core To:SA2 Cc:RAN1, RAN3
30. R2-2106919 LS on granularity of response time (R1-2106316; contact: Huawei) RAN1 LS in Rel-17 NR\_pos\_enh To:RAN2
31. R2-2106971 LS on storage of UE Positioning Capabilities (S2-2105153; contact: Qualcomm) SA2 LS in Rel-17 5G\_eLCS\_ph2 To:RAN2 Cc:RAN3
32. R2-2107680 Summary of agenda 8.11.2 Latency enhancements Intel Corporation discussion Rel-17 NR\_pos\_enh