**3GPP TSG-SA1 Meeting #94e *S1-211014***

**Electronic Meeting, 10 May - 20 May 2021** *(revision of S1-20xxxx)*

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **22.261** | **CR** | **0506** | **rev** | **-** | **Current version:** | **18.2.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network | **X** |

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| ***Title:*** | Adding High-level and Performance Requirements for Ranging | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Xiaomi | | | | | | | | | |
| ***Source to TSG:*** | SA1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | Ranging | | | | |  | ***Date:*** | | | 2021-05-10 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | Ranging based service WID has been agreed, the new requirements for Ranging based service need to be captured in TS22.261. | | | | | | | | |
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| ***Summary of change:*** | | Ranging definition is added in chapter 3. A new section including the general description and functional requirement for Ranging based services are added in chapter 6. A new section including KPIs for Ranging based services is added in chapter 7. | | | | | | | | |
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| ***Consequences if not approved:*** | | If not approved, the Ranging requirements are not captured in TS. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 6.36, 7.8 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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### 3.1 Definitions

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**private network:** an isolated network deployment that does not interact with a public network.

**private slice:** a dedicated network slice deployment for the sole use by a specific third-party.

**Ranging:** refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct device connection.

**relative positioning:** relative positioning is to estimate position relatively to other network elements or relatively to other UEs.

**reliability**: in the context of network layer packet transmissions, percentage value of the amount of sent network layer packets successfully delivered to a given system entity within the time constraint required by the targeted service, divided by the total number of sent network layer packets.

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### 6.36 Ranging based services

### 6.36.1 Description

Ranging-based services refer to applications utilizing the distance between two UEs and/or the direction of one UE from the other one. In 3D case, direction includes horizontal direction and elevation direction. Ranging-based services can apply to a variety of verticals, such as consumer, smart home, smart city, smart transportation, smart retail, and industry 4.0. Some Ranging-based services may only require the distance measurement, some may only require direction measurement, others may require both distance and direction measurement.

Ranging can be supported with or without 5G (NG-RAN) coverage, Fig. 6.36.1-1 is an illustration of Ranging between UEs that are in coverage, out of coverage, or with partial coverage. Both licensed and unlicensed spectrum can be used for Ranging. If licensed spectrum is used, it shall be fully under operator control.



Figure 6.36.1-1 illustration of Ranging between UEs with or without 5G coverage

### 6.36.2 Requirements

The 5G system shall be able to support for a UE to discover other UEs supporting Ranging.

The 5G system shall be able to authorize Ranging for a UE or a group of UE when using licensed spectrum.

The 5G system shall be able to protect privacy of a UE and its user, ensuring that no identifiable information can be tracked by undesired entities during Ranging.

The 5G system shall be able to enable or disable Ranging.

The 5G system shall support mutual Ranging, i.e. two UEs shall be able to initiate Ranging to each other.

The 5G system shall be able to ensure that Ranging, if using licensed spectrum and in network coverage, is only permitted under the full control of the operator who provides the coverage.

NOTE: The above requirement does not apply for public safety networks with dedicated spectrum.

The 5G system shall support energy efficient UE Ranging operation.

The 5G system shall be able to start Ranging and stop Ranging according to the application layer’s demand.

The 5G system shall be able to provide mechanisms for a MNO, or authorized 3rd party, to provision and manage Ranging operation and configurations.

The 5G system shall be able to support mechanisms for a UE to assist another UE to perform Ranging of a third UE (if the requesting UE is LOS with the assisting UE and the assisting UE is LOS with the third UE).

NOTE: It cannot be assumed that all Ranging UEs support the same application for exchange of information.

The 5G system shall be able to support Ranging enabled UEs to determine the Ranging capabilities (e.g. capabilities to perform distance and/or angle measurement) of other Ranging enabled UEs.

The 5G system shall be able to allow a Ranging enable UE to determine if another Ranging enabled UE is stationary or mobile, before and/or during Ranging.

NOTE: This may require assistance from other Ranging enabled UEs.

The 5G system shall allow Ranging between 2 UEs triggered by and exposed to a third UE.

The 5G system shall allow Ranging service between 2 UEs triggered by and exposed to the application server.

The 5G system shall be able to support one UE initiating Ranging to the other UE.

The 5G system shall be able to support Ranging between UEs which subscribe to different operators.

The 5G system shall be able to allow roaming UEs to perform Ranging.

The 5G system shall be able to ensure the integrity and confidentiality of Ranging information used by Ranging-enabled UEs.

The 5G system shall be able to ensure that user privacy is not violated during Ranging, e.g., subject to regional or national regulatory requirements.

The 5G system shall be able to ensure security protection (e.g., interworking security) when the Ranging concerns UEs subscribed with different operators.

The level of security provided by the existing 5G system shall not be adversely affected when Ranging is enabled.

The 5G system shall support means to securely identify other ranging capable UEs, with a certain UE can perform ranging with.

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### 7.8 KPIs for Ranging based services

In several scenarios, it can be beneficial to determine the distance between two UEs and/or the direction of one UE from the other one via direct communication connection. The functional requirements related to Ranging based services can be found in clause 6.36.2. Performance requirements for Ranging based services in different scenarios can be found in table 7.8-1.

Key performance indicators and key attributes for Ranging are defined as follows:

- **Ranging accuracy**: describes the absolute value of the deviation of the measured distance and/or direction between two UEs to the true distance and/or direction value.

- **Confidence level**: describes the percentage of all the possible measured distance and/or direction that can be expected to include the true distance and/or direction considering the Ranging accuracy.

**- Effective Ranging distance**: the largest distance between the UE who initiates the Ranging and target UEs in the Ranging operation.

**- Environment of use**: the physical environment between the UE who initiate the Ranging and target UEs, such as LOS environment and NLOS environment. Also the physical environments of the UEs who are involved in Ranging, such as in coverage and out of coverage.

NOTE: as described in sec. 6.36, if using licensed spectrum and in network coverage, ranging is only permitted under the full control of the operator who provides the coverage.

**- Relative UE velocity**: the target UE can be either static or mobile relative to the UE who initiates the Ranging. In the latter, the attribute shall also provide some elements about its motion, e.g. maximum speed, trajectory.

- **Availability**: percentage value of the amount of time when a ranging system is able to provide the required Ranging-related data within the performance targets or requirements divided by the amount of time the system is expected to provide the Ranging service in a targeted service area.

- **Latency**: time elapsed between the event that triggers the determination of the Ranging-related data and the availability of the Ranging-related data at the Ranging system interface.

**- Ranging interval:** time difference between two consecutive Ranging operations.

Table 7.8-1: Performance requirements for Ranging based services

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ranging service level** | **Ranging scenario** | **Ranging Accuracy**  **(95 % confidence level)** | | **Availability** | **Latency**  10ms  50ms  50ms | **Effective Ranging distance** | **Coverage** | **NLOS/LOS** | **Relative UE velocity** | **Ranging interval** | **Number of concurrent Ranging operation for a UE** | **Number of concurrent Ranging operation in an area** |
| **Distance Accuracy** | **Direction Accuracy** |
| 1 | Smart TV Remoter | 10cm up to 3 meter separation | ±2° horizontal direction accuracy at 0.1 to 3 meter separation and AoA coverage of (-60°) to (+60°);  ±2° Elevation direction accuracy at 0.1 to 3 meter separation and AoA coverage of (-45°) to (+45°) | 99 % | 50ms | 10m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | - | - |
| 1 | Picture and video sharing based on Ranging results | 10cm | 2° | 99 % | 50ms | 10m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | - | - |
| 2 | Distance based smart device control | 10cm | - | 99 % | 100ms | 20m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | 20 | - |
| 2 | Smart Vehicle Key | 10 cm | - | 99 % | 50ms | 30m | IC/PC/OOC | LOS | Static/ Moving  (<2m/s) | 25ms | - | 50UEs/  (104m2) |
| 2 | Touchless Self-checkout Machine Control | 10cm | - | 99% | 150ms | 1m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 100ms | - | = |
| 2 | Hands Free Access | 10cm | - | 99 % | 500ms | 10 m | IC/PC/OOC | LOS | Static/ Moving  (1 m/s) | 50ms | - | 20 UEs/3.14\*100m2 |
| 2 | Smart Transportation Metro/Bus Validation | 10cm | - | 99 % | - | 2m | IC/PC/OOC | LOS | Static/ Moving  (3km/h) | 50ms | 20 | 100 in the area of 8 m2 |
| 3 | Ranging of UE’s in front of vending machine | 20cm | 10° | - | 1s | 5m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | - | 10 |
| 3 | Finding Items in a supermarket | 50 cm | 5 degree | 95 % | - | 100m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 250ms | - | 100 UEs/  (3.14\*104m2) |
| 4 | distance based intelligent perception for public safety | 50cm | - | 99 % | - | 20m | IC/PC/OOC | LOS | Static/ Moving  (<20km/h) | - | 100 | - |
| 5 | Long Distance Search | 20m | 5° | 99 % | - | 100m-1km | IC/PC/OOC | LOS | Static/ Moving  (up to 10m/s) | 5s | - | - |
| 5 | Long range approximate location | [10m] | ±[12.5°] | 99 % | - | 500m | IC/PC/OOC | LOS | Static/ Moving  (<10m/s) | - | 1 | [50]UEs/  (104m2) |
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\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End third modification \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*