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| 3GPP TR 38.845 V1.0.0 (2021-06) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases  (Release 17) | |
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# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, certain modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

NOTE 1: The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

NOTE 2: The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

NOTE 3: The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

NOTE 4: The constructions "can" and "cannot" shall not to be used as substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

NOTE 5: The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document captures the findings of the study item, "Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage positioning use cases" [2]. The purpose of this TR is to facilitate future 3GPP work by identifying the requirements and deployment/operation scenarios for V2X and public safety use cases. In particular, this study considers positioning for the UEs in in-coverage, partial coverage, and out-of-coverage as per the network coverage definition in the current specifications.

This document is a 'living' document, i.e. it is permanently updated and presented to TSG-RAN meetings until it is approved.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP RP-201518: "Revised SID on Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage positioning use cases".

[3] 3GPP TS 22.261: "Service requirements for the 5G system".

[4] 3GPP TS 22.186 v16.2.0: "Enhancement of 3GPP support for V2X scenarios".

[5] 3GPP RP-210040: "Reply LS to RP-201390 on requirements of in-coverage, partial coverage, and out-of-coverage positioning use cases," (source: 5GAA).

[6] 3GPP RP-210036: "Reply LS to 3GPP TSG RAN on requirements of in-coverage, partial coverage and out-of-coverage positioning use cases," (source: SAE Advanced Applications Technical Committee).

[7] 3GPP TS 22.280: "Mission Critical Services Common Requirements (MCCoRe)".

[8] 3GPP TS 38.304: "User Equipment (UE) procedures in Idle mode and RRC Inactive state".

[9] 3GPP TR 22.872: "Study on positioning use case".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**absolute position:** absolute position is an estimate of the UE position in 2D/3D geographic coordinates (e.g., latitude, longitude, elevation) within a coordinate system

**relative position:** relative position is an estimate of the UE position relative to other network elements or relative to other UEs

**positioning service availability:** percentage value of the amount of time the positioning service is delivering the required position-related data within the performance requirements, divided by the amount of time the system is expected to deliver the positioning service according to the specification in the targeted service area.

**positioning service latency:** time elapsed between the event that triggers the determination of the position-related data and the availability of the position-related data at the system interface.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5GAA 5G Automotive Association

SAE AA TC SAE Advanced Applications Technical Committee

TTFF Time To First Fix

HD High Definition

RV Remote vehicle

TOD Tele-Operated Driving

MCX Mission Critical X, with X = PTT or X= Video or X= Data

# 4 Positioning use cases and requirements

4.1 Introduction

This clause summarizes the positioning use cases and requirements defined for V2X and public safety in 3GPP specifications and input from other organizations. Sources used in this summary are provided in Annex A for information.

## 4.2 V2X

In 3GPP specifications, V2X positioning requirements can be found in TS 22.261 [3] and TS 22.186 [4]. TS 22.261 [3] specifies the high accuracy positioning requirements for the 5G system and these requirements are summarized in its Clause 7.3.2.2 with a note that these requirements include V2X. Seven different positioning service levels are defined in Table 7.3.2.2-1 [3] in terms of the horizontal and vertical accuracy, positioning service availability, and positioning service latency. TS 22.186 [4] specifies the relative lateral positioning requirement for general V2X use cases and the relative longitudinal positioning requirement for the platooning use case in its Clause 5.1 and 5.2.

5GAA provides positioning requirements for 58 V2X services that were summarized into three groups [5]; the first group with tens of meters accuracy, the second with lane level accuracy, and the third with sub-meter level accuracy. The positioning requirements can be on the 3D/2D coordinates (absolute position) or on the distance and/or angle (relative position) to a reference point, e.g. another UE.

SAE AA TC informs that it is necessary to have a 3GPP positioning technology which supports advanced V2X applications working even in various out-of-coverage scenarios [6].

It is observed that the positioning requirements in V2X depend on the service the UE operates. Also, the requirements are applicable to relative and absolute positioning depending on the use case or the positioning service level. In terms of the horizontal or lateral/longitudinal accuracy, the requirements for the absolute position or relative position can be categorised into three sets as follows by incorporating the requirements from the sources mentioned above:

- Set 1: 10 – 50 m with 68 – 95 % confidence level. This includes Group 1 in [5] and Service level 1 in [3].

- Set 2: 1 – 3 m with 95 – 99 % confidence level. This includes Group 2 in [5], Service level 2, 3, 4 in [3].

- Set 3: 0.1 – 0.5 m with 95 – 99 % confidence level. This includes Group 3 in [5], Service level 5, 6, 7 in [3], the requirements in [4].

It is noted that all the three sets are applicable for absolute positioning and relative positioning.

Requirements for other performance metrics are also defined in a range depending on the positioning service level in TS 22.261 [3]; 2 – 3 m (absolute) or 0.2 m (relative) vertical accuracy, 95 – 99.9% positioning service availability, 10 ms – 1 s positioning service latency.

Positioning service should be provided in indoor, outdoor, tunnel areas. The UE velocity up to 250 km/h needs to be supported for outdoor and tunnel areas. As long as the UE operates a V2X use case having the corresponding positioning requirements, the requirements should be fulfilled when the UE is inside the network coverage as well as when it is outside the network coverage. The requirements should be also fulfilled when the GNSS-based positioning is not available or not accurate enough.

## 4.3 Public safety

Public safety positioning requirements are defined in TS 22.261 [3] and TS 22.280 [7]. TS 22.261 [3] provides numerical positioning requirements for the "1st responders" use case in Table B.1-1 in TS 22.261 [3]; 1 m horizontal accuracy, 2 m (absolute) or 0.3 m (relative) vertical accuracy, 95 – 98 % positioning service availability. TS 22.280 [7] specifies some qualitative positioning requirements in its Clause 5.11, 6.12, and 7.8. These requirements are applicable to both relative and absolute positioning.

Positioning service should be provided both in indoor and outdoor areas. As long as the UE operates a public safety use case having the corresponding positioning requirements, the requirements should be fulfilled when the UE is inside the network coverage as well as when it is outside the network coverage. The requirements should be also fulfilled when the GNSS-based positioning is not available or not accurate enough.

# 5 Potential deployment and operation scenarios

5.1 Network coverage

Three network coverage scenarios can be considered when at least two UEs are involved in positioning for V2X and public safety use cases. Taking the case of two UEs as an example, in-coverage scenario refers to the case where both UEs are inside the network according to TS 38.304 [8]. Partial coverage means that one UE remains inside the network coverage but the other UE is outside the network coverage. Out-of-coverage scenario refers to the case where both UEs are outside the network coverage network according to TS 38.304 [8].

Editor’s note: FFS additional contents including a figure illustrating the three scenarios, the need for transitions between coverage states, the network coverage requirement of operation scenarios, etc.

5.2 Radio link

Uu interface (uplink and downlink), PC5 interface (sidelink), and their combinations can be considered as the radio link for positioning.

Uu interface is available in in-coverage scenario, and also for UE in network coverage in partial coverage scenario, while PC5 interface is available in in-coverage, partial coverage, out-of-coverage scenarios.

A positioning operation can be called a Uu-based solution if it uses only measurements on Uu interface. An operation can be called a PC5-based solution if it uses only measurements on PC5 interface. An operation can be called a hybrid solution if it uses measurements on both Uu and PC5 interfaces.

Editor’s note: FFS RAT independent positioning, Uu based solution with assistance of PC5 interface, PC5 based solution with assistance of Uu interface, etc.

5.3 Position calculation entity

Positioning solutions can be categorized by the entity performing the positioning estimation. Network based positioning refers to the solutions where UE position is calculated by a network node. For this network based positioning, the UE may report necessary information to the network for the calculation. UE based positioning refers to the solution where UE position is calculated by a UE.

5.4 UE types

For V2X use cases, a UE involved in positioning can be installed in a vehicle, a road side unit, or a device of a vulnerable road user.

A UE in a vehicle or a road side unit can be equipped with a distributed antenna system where multiple antenna panels of a UE are installed in different locations.

Editor’s note: FFS additional contents including the battery capability and processing capability of different types, the power class in public safety, the vehicle types and antenna placement options defined in TR 37.885, etc.

5.5 Spectrum

For V2X use case, the ITS-dedicated spectrum, the spectrum licensed to mobile network operators (including FR2), and the unlicensed spectrum can be considered, with a note that there is no mechanism corresponding to regulatory requirements to use unlicensed spectrum in Rel-17 NR sidelink.

Editor’s note: FFS additional contents including the pros and cons, spectrum for public safety, etc.

# 6 Conclusions

Annex A:  
Sources of positioning requirements for V2X and public safety

**Sources in TS 22.261 [3]**

copied from TS 22.261 [3] Clause 7.3.2.2:

*The 5G system shall be able to provide positioning services with the performance requirements reported in Table 7.3.2.2-1.*

*NOTE: The requirements do not preclude any type of UE, including specific UE such as for example V2X, MTC.*

***Table 7.3.2.2-1 Performance requirements for Horizontal and Vertical positioning service levels***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Positioning service level*** | ***Absolute(A) or Relative(R) positioning*** | ***Accuracy***  ***(95 % confidence level)*** | | ***Positioning service availability*** | ***Positioning service latency*** | ***Coverage, environment of use and UE velocity*** | | |
| ***Horizontal Accuracy*** | ***Vertical Accuracy***  ***(note 1)*** | ***5G positioning service area*** | ***5G enhanced positioning service area***  ***(note 2)*** | |
| ***Outdoor and tunnels*** | ***Indoor*** |
| *1* | *A* | *10 m* | *3 m* | *95 %* | *1 s* | *Indoor - up to 30 km/h*  *Outdoor*  *(rural and urban) up to 250 km/h* | *NA* | *Indoor - up to 30 km/h* |
| *2* | *A* | *3 m* | *3 m* | *99 %* | *1 s* | *Outdoor*  *(rural and urban) up to 500 km/h for trains and up to 250 km/h for other vehicles* | *Outdoor*  *(dense urban) up to 60 km/h*  *Along roads up to 250 km/h and along railways up to 500 km/h* | *Indoor - up to 30 km/h* |
| *3* | *A* | *1 m* | *2 m* | *99 %* | *1 s* | *Outdoor*  *(rural and urban) up to 500 km/h for trains and up to 250 km/h for other vehicles* | *Outdoor*  *(dense urban) up to 60 km/h*  *Along roads up to 250 km/h and along railways up to 500 km/h* | *Indoor - up to 30 km/h* |
| *4* | *A* | *1 m* | *2 m* | *99,9 %* | *15 ms* | *NA* | *NA* | *Indoor - up to 30 km/h* |
| *5* | *A* | *0,3 m* | *2 m* | *99 %* | *1 s* | *Outdoor*  *(rural) up to 250 km/h* | *Outdoor*  *(dense urban) up to 60 km/h*  *Along roads and along railways up to 250 km/h* | *Indoor - up to 30 km/h* |
| *6* | *A* | *0,3 m* | *2 m* | *99,9 %* | *10 ms* | *NA* | *Outdoor*  *(dense urban) up to 60 km/h* | *Indoor - up to 30 km/h* |
| *7* | *R* | *0,2 m* | *0,2 m* | *99 %* | *1 s* | *Indoor and outdoor (rural, urban, dense urban) up to 30 km/h*  *Relative positioning is between two UEs within 10 m of each other or between one UE and 5G positioning nodes within 10 m of each other (note 3)* | | |
| *NOTE 1: The objective for the vertical positioning requirement is to determine the floor for indoor use cases and to distinguish between superposed tracks for road and rail use cases (e.g. bridges).*  *NOTE 2: Indoor includes location inside buildings such as offices, hospital, industrial buildings.*  *NOTE 3: 5G positioning nodes are infrastructure equipment deployed in the service area to enhance positioning capabilities (e.g. beacons deployed on the perimeter of a rendezvous area or on the side of a warehouse).* | | | | | | | | |

*The 5G system shall be able to provide the 5G positioning services with a TTFF less than 30 s and, for some 5G positioning services, shall support mechanisms to provide a TTFF less than 10 s.NOTE 1: In some services, a TTFF of less than 10s may only be achievable at the expense of a relaxation of some other performances (e.g. horizontal accuracy may be 1 m or 3 m after 10 s TTFF, and reach a steady state accuracy of 0,3 m after 30 s).*

*The 5G system shall support a mechanism to determine the UE's velocity with a positioning service availability of 99%, an accuracy better than 0,5 m/s for the speed and an accuracy better than 5 degree for the 3-Dimension direction of travel.*

*The 5G system shall support a mechanism to determine the UE's heading with an accuracy better than 30 degrees (0,54 rad) and a positioning service availability of 99,9 % for static users and with an accuracy better than 10 degrees (0,17 rad) and a positioning service availability of 99 % for users up to 10 km/h.*

*The 5G system shall support positioning technologies that allow the UE to operate at Service Level 1 for at least 12 years using less than 1800 mWh of battery capacity, assuming multiple position updates per hour.*

*NOTE 2: This requirement aims energy-efficient positioning technologies draining a minimal energy on the UE battery. It derives from use cases, such as asset tracking, with a small form-factor battery representative of an IoT device. This requirement may translate into an energy consumption for the UE’s positioning functions in the order of 20 mJ per fix.*

*NOTE 3: This requirement does not preclude the use of higher energy consumption to fulfil higher position update rates than the one above, or other KPIs than those of Service Level 1 (e.g. more accurate service levels).*

copied from TS 22.261 [3] Annex B (only a part of the table is copied):

***Table B.1-1 Typical needs to support example use cases from vertical industries.***

|  |  |  |
| --- | --- | --- |
| ***Use cases*** | ***Description*** | ***Main KPIs range and drivers*** |
| *1st responders* | *Tracking and guidance of 1st responders, with requirements for high-accuracy in the horizontal domain and vertical domain, as well as accurate awareness of height variation to detect falls, combined to a high level of availability and reliability* | *Service area is both indoor and outdoor*  *Accuracy: < 1m horizontal, < 2m vertical (indoor for floor detection) and < 0,3 m vertical (relative) to detect changes in height of the UE holder.*  *Availability > 95 % (98% outdoor)*  *Other KPI drivers include: MCX, confidence, event-triggered report* |
| *Road* | *Use cases involving road vehicles such as traffic monitoring, road-user charging (e.g. Road-Tolling, insurance mechanisms, etc.) which require positioning or tracking of vehicles at lane level, but also some awareness of position in the vertical domain (e.g. bridges) Service area is outdoor, but may include tunnels.* | *Accuracy: 1-3m horizontal (with <1m across-track for lane detection), <2,5 m vertical,*  *Velocity < 2m/s, Availability: 95-99%*  *Other KPI drivers include: tampering detection and prevention (typically for Road User Charging)* |

**Sources in TS 22.186 [4]**

copied from TS 22.186 [4] Clause 5.1:

*[R.5.1-007] The 3GPP system shall support relative lateral position accuracy of 0.1 m between UEs supporting V2X application.*

copied from TS 22.186 [4] Clause 5.2:

*[R.5.2-003] The 3GPP system shall support relative longitudinal position accuracy of less than 0.5 m for UEs supporting V2X application for platooning in proximity.*

**Sources in the input from 5GAA [5]**

The positioning requirements according to the 5GAA TRs on Use Cases Vol. I and II can be summarized into three main groups, all at the highest speed a participating vehicle might be driving at, depending on the type of road environment and/or safety rules (e.g. 250km/h on German Autobahn):

1) Relatively lax, 10s of meters with 1 sigma (information provisioning)

- Traffic Jam Warning - Urban Scenario on Road Warning

- Traffic Jam Warning - Rural Scenario on Road Warning

- Traffic Jam Warning - Highway Scenario on Road Warning

- Rural Scenario on Route Information

- Highway Scenario on Route Information

- Software Update - Conventional-Routine/Urgent, Autonomous-Routine

- Software Update - Autonomous-Urgent

- Software Update - Without Infrastructure, Vehicle to Workshop

- Remote Automated Driving Cancellation

- HD Content Delivery - High-End Service for cars

- HD Content Delivery - Low-End Service for cars

- HD Content Delivery – Bus Passenger Service

- Software Update of Reconfigurable Radio System

- Patient Transport Monitoring

- Automated Valet Parking (Wake Up)

2) Lane level accuracy, 1.5 m with 3 sigma (e.g. day1 safety use cases)

- Cross-Traffic Left-Turn Assist

- Intersection Movement Assist

- Emergency Break Warning

- Lane Change Warning - lagging vehicle, leading vehicle, Highway

- Lane Change Warning - lagging vehicle, leading vehicle, urban

- Lane Change Warning - not permitted case, rural

- Vehicle Health Monitoring

- Speed Harmonization

- See-Through for Pass Maneuver

- Obstructed View Assist via CCTV

- Obstructed View Assist via Remote Vehicles

- Continuous Traffic Flow via Green Lights Coordination

- Vehicle collects hazard and road event for AV

- Vehicles Platooning in Steady State

- Cooperative Lane Merge

- Autonomous Vehicle Disengagement Report

- Accident Report

- Awareness Confirmation

- Coordinated, Cooperative Driving Manoeuvre - Cooperative Lane Change

- Coordinated, Cooperative Driving Manoeuvre - Road Blockage

- Bus Lane Sharing Request

- Bus Lane Sharing Revocation

- Vehicle Decision Assist - RV Waiting for a Short Period of Time, Broken Down, Bus Having to Wait

- Vehicle Decision Assist - Slow Vehicle en Route

3) Below meter level accuracy, e.g. 0.1 m with 3 sigma (e.g. automated driving or teleoperated driving)

- High Definition Sensor Sharing

- Vulnerable Road User - Awareness near potentially dangerous situations Urban

- Vulnerable Road User - Collision risk warning

- Real-Time Situational Awareness & High-Definition Maps

- Group Start

- Tele-Operated Driving (TOD)

- TOD support

- TOD for Automated Parking

- Cooperative Manoeuvres of Autonomous Vehicles for Emergency Situations

- High definition map collecting & sharing

- Automated Intersection crossing

- Infrastructure Assisted Environment Perception - Data Distribution about Objects on the Road

- Infrastructure Assisted Environment Perception - Individual Data Transmission in Form of Trajectories or Actuation Commands)

- Infrastructure based Tele-Operated Driving

- Automated Valet Parking – Joint Authentication and Proof of Localisation

- Coordinated, Cooperative Driving Manoeuvre - Pedestrian Crossing

- Cooperative Traffic gap

- Cooperative Lateral Parking

- Cooperative Curbside Management

**Sources in 3GPP TS 22.280 [7]**

copied from TS 22.280 [7] Clause 5.11:

*[R-5.11-001] The MCX Service shall support obtaining and conveying Location information describing the position of the MCX UE.*

*[R-5.11-002] The MCX Service should support obtaining and conveying high accuracy Location information describing the position of the MCX UE.*

*[R-5.11-002a] The MCX Service shall be able to provide a mechanism for obtaining high accuracy Location information by integrating position information from multiple external sources (e.g. magnetometers, orientation sensors, GNSS)*

*[R-5.11-003] The MCX Service shall provide for the flexibility to convey future formats of Location information.*

*[R-5.11-004] The MCX Service shall provide a means for MCX Service Administrators to manage the privacy of Location information for MCX Users within their authority.*

*[R-5.11-005] An authorized MCX User shall be able to control the supplying of Location information by the MCX UE for MCX Service communications.*

*[R-5.11-006] The conveyed Location information shall be the most recently obtained information about the position of the MCX UE at the time of the Location information conveyance.*

*[R-5.11-007] The MCX Service shall be capable of configuring and re-configuring one or more Location information update triggers (i.e., identified conditions that, when satisfied, cause the MCX UE to report its current Location information).*

*[R-5.11-008] The MCX Service shall be able to modify Location information update triggers of an MCX User while the MCX User is on the network.*

*[R-5.11-009] The MCX Service shall provide a means for an MCX UE to send a Location information update whenever a trigger condition is satisfied (e.g., initial registration, distance travelled, elapsed time, cell change, tracking area change, PLMN change, MCX Service communication initiation).*

*[R-5.11-010] The MCX Service shall provide a means for an MCX UE to send a Location information update whenever the MCX User initiates an MCX Service Emergency Alert.*

*[R-5.11-011] The MCX Service shall provide a means for an MCX UE to send a Location information update whenever the MCX User initiates an MCX Service Emergency Group Communication.*

*[R-5.11-012] The MCX Service shall provide a means for an MCX UE to send a Location information update if the MCX User is in an MCX Service Emergency State and a configured amount of time has passed since the previous location information update.*

*[R-5.11-013] The MCX Service shall provide a means for an MCX UE to send a Location information update whenever a trigger condition is satisfied while the MCX User is in MCX Service Emergency State (e.g., initial registration, distance travelled, elapsed time, cell change, tracking area change, PLMN change, MCX Service communication initiation).*

*NOTE 1: The Location information update triggers for an MCX User in an MCX Service Emergency State might be different than the Location information update triggers used when the MCX User is not in an MCX Service Emergency State.*

*[R-5.11-014] The MCX Service shall provide a means for an MCX Service Administrator to define geographical areas to be used for Location information update triggers for MCX Users within their authority.*

*[R-5.11-015] The MCX Service shall provide a means for an MCX UE in a predefined area to send a Location information update whenever a trigger condition configured in an MCX User's active MCX Service User Profile is satisfied (e.g., initial registration, distance travelled, elapsed time, cell change, tracking area change, PLMN change, MCX Service communication initiation).*

*NOTE 2: The Location information update triggers for an MCX User in a predefined area might be different than the Location information update triggers used when the MCX User is not in a predefined area.*

copied from TS 22.280 [7] Clause 6.12:

*[R-6.12-001] The MCX Service shall provide Location information of the transmitting MCX UE to receiving MCX UEs subject to privacy restrictions.*

*[R-6.12-002] The MCX Service shall support conveyance of Location information provided by 3GPP location services.*

*[R-6.12-003] The MCX Service shall provide a means for an authorized MCX User to restrict the dissemination of his Location information.*

*[R-6.12-004] The MCX Service shall provide end-to-end confidentiality of Location information.*

*[R-6.12-005] The MCX Service shall provide authentication of messages carrying Location information.*

*[R-6.12-006] The MCX Service shall provide a means for an authorized MCX User to activate a one-time Location information report of an MCX User and periodic Location information update reports of an MCX User or a specific Functional Alias.*

*[R-6.12-007] The MCX Service shall provide a means for an authorized MCX User to deactivate periodic Location information update report of an MCX User.*

copied from TS 22.280 [7] Clause 7.8:

*[R-7.8-001] An MCX UE shall be capable of transmitting its Location, if known, to other MCX UEs when operating off the network, subject to privacy restrictions.*

*[R-7.8-002] An MCX UE shall be capable of providing a mechanism for obtaining the distance between the MCX UE and other MCX UEs within communication range.*

*[R-7.8-003] The Off-Network MCX Service shall provide a means for an authorized MCX User to activate a one-time Location information report of a particular target MCX User within communication range.*

**Sources in 3GPP TR 22.872 [9]**

summaized requirements from TR 22.872 [9]:

**Table A.1 Summary of positionnig requirements related to public safety in [8]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Use case set** | **Absolute**  **Positioning**  **Accuracy** | **Relative**  **accuracy** | **Availability** | **Heading** | **Latency for position estimation of UE** | **UE speed**  **accuracy** |
| **Set1**  **(Accurate Positioning for 1st responder)** | **Outdoor**  **H:[1]m**  **V:[0.3]m** | **Outdoor**  **H:[1]m**  **V:[0.3]m** | **Outdoor**  **[98%]** | **/** | **Outdoor**  **[5]s**  **TTFF**  **[10]s** | **/** |
| **Indoor**  **H:[1]m**  **V:[2]m** | **Indoor**  **H:[1]m**  **V:[2]m** | **Indoor**  **[95%]** | **/** | **Indoor**  **[1]s**  **TTFF**  **[10]s** | **/** |
| **Set2**  **(Alerting nearby emergency responder)** | **H:[50]m**  **V:[3]m** | **H:[50]m**  **V:[3]m** | **/** | **/** | **/** | **/** |

Annex B (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-03 | RP-91e | RP-210282 |  |  |  | TR skeleton | 0.0.0 |
| 2021-03 | RP-91e | RP-210285 |  |  |  | Positioning requirements for V2X and public safety acc. to pCR RP-210839 | 0.1.0 |
| 2021-06 | RP-92e | RP-210981 |  |  |  | Editorial cleanup to align TR with the drafting rules | 0.1.1 |
| 2021-06 | RP-92e | RP-211276 |  |  |  | Updated positioning requirements and addition of potential deployment and operation scenarios acc. To pCR RP-211275 | 1.0.0 |