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Study on location enhancements for mission critical services

(Release 17)

** 

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# Foreword

This Technical Specification 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:

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# Introduction

This technical report seeks to identify key issues and associated solutions for enhancements to the existing location architecture. Key issues introduced in this study should seek to uncover gaps between MC service level requirements (found in 3GPP TS 22.179 [2], 3GPP TS 22.280 [3], 3GPP TS 22.281 [4], and 3GPP TS 22.282 [5]) and stage 2 MC application architecture (found in 3GPP TS 23.379 [6], 3GPP TS 23.280 [7], 3GPP TS 23.281 [8], and 3GPP TS 23.282 [9]) related to MC location.

# 1 Scope

The present document identifies the impact of location requirements from stage 1 that have yet to be realized within the stage 2 MC services architecture, and to propose solutions and enhancements where needed to fulfil these requirements.

Based on any gaps found between stage 1 service level requirements and existing MC location architecture, the present document consists of a technical report that includes: identification of key issues and gaps with the existing location architecture as specified in 3GPP TS 23.379 [6], 3GPP TS 23.280 [7], 3GPP TS 23.281 [8], and 3GPP TS 23.282 [9]; associated solutions for enhancements to existing MC location architecture; and corresponding evaluations and conclusions.

The location enhancements considered in the present document are limited to MC services over EPS.

# 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 TS 22.179: "Mission Critical Push to Talk (MCPTT); Stage 1".

[3] 3GPP TS 22.280: "Mission Critical Services Common Requirements (MCCoRe); Stage 1".

[4] 3GPP TS 22.281: "Mission Critical Video services".

[5] 3GPP TS 22.282: "Mission Critical Data services".

[6] 3GPP TS 23.379: "Functional architecture and information flows to support Mission Critical Push To Talk (MCPTT); Stage 2".

[7] 3GPP TS 23.280: "Common functional architecture to support mission critical services; Stage 2".

[8] 3GPP TS 23.281: "Functional architecture and information flows to support Mission Critical Video (MCVideo); Stage 2".

[9] 3GPP TS 23.282: "Functional architecture and information flows to support Mission Critical Data (MCData); Stage 2".

[10] 3GPP TS 24.379: "Mission Critical Push To Talk (MCPTT) call control; Protocol specification".

[11] 3GPP TS 33.180: "Security of the mission critical service".

[12] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] apply.

3.2 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].

GNSS Global Navigation Satellite System

# 4 Use cases

## 4.1 Use case #1: Location information - Timestamp

In order to find a missing child in a kidnapping case, a detective is charged with the observation of the suspect. A small UE with a GNSS receiver is attached to the suspect's car. It periodically sends location reports, which then are used to create a movement profile. The timestamp in the location report allows associating the coordinates with the right time the position was determined. The analysis of the profile finally leads to the hideout, which the child is locked in.

## 4.2 Use case #2: Location information - Speed and bearing

The control room of a greater city responsible for the coordination of all the city's ambulances uses frequent location reports from the UEs of the ambulance fleet based on both the travelled distance and the elapsed time, to be able to assign the nearest located car as fast as possible in case an emergency occurs. As the city has many tunnels and the cars often lose their GNSS signals when heading through, additional information like speed and direction of travel is used to estimate the current location and continue displaying on the dispatcher's map.

## 4.3 Use case #3: Location information - Accuracy

After chasing a pickpocket through the inner city without success, a police officer is missing his UE. Back at the patrol car he briefs his colleague and they inform the control room about the situation. The UE will be temporarily disabled to be on the safe side and the dispatcher sends them the current location of the lost UE acquired by an on-demand location report. The coordinates delivered by the UE are not very accurate, because it fell out of the officer's pocket under a steel stair in a dark corner without free sight. Using the accuracy information displayed as ellipse around the coordinates the officers know which area they have to look for and are able to find the UE after a while.

## 4.4 Use case #4: Location information - Altitude

Two mountaineers initiate emergency, because they have lost orientation due to nightfall and have run into difficult terrain. They cannot answer the question where they actually are. The only information they can provide is the name of the route on which they wanted to ascend. Both a helicopter is sent and a ground team is composed to do the ascension. The helicopter is able to find the two mountaineers after a while, but the terrain is unsuitable for a rescue operation from the helicopter. Therefore, the pilot sends his location information to the rescue team on the ground. Beyond longitude and latitude, the altitude information helps the team to assess the position of the mountaineers and how long they will take to get to them.

## 4.5 Use case #5: Location History Reporting

A child is missing and an extensive search with several hundred police officers is ongoing. Due to an unknown technical failure location information from 12 police officers is not available at the overlooking dispatcher. The dispatcher is observing the search on a large scale map with live location information from involved police officers. It is obvious, that a region is currently not searched by any police officer, because no location information is available for this region. After the technical problem is solved all not yet transmitted location information is transmitted as bulk to the dispatcher and remaining gaps are filled. The dispatcher is able to concentrate the search at other regions and is therefore avoiding the waste of valuable time.

## 4.6 Use case #6: Location triggering criteria for emergency state

In preparation of an operation to liberate some people who have been taken as hostages by terrorists and are now held captive in a building complex, it is arranged that if anything goes wrong, the members of the special unit shall initiate emergency and try to head to a specific safe area. The entering of this area is defined as triggering criteria in emergency cases for sending a location report and the UEs are configured with it. When receiving the location report the overlooking dispatcher knows which unit in emergency has reached the safe area. He can cancel the emergency alert of this safe unit and concentrate the rescue efforts to the other units still in emergency. This approach is chosen in preference over the simple deactivation of the emergency state by the units themselves, because it is feared that the units could maybe be captured and manipulated by the terrorists.

## 4.7 Use case #7: Location information – individual receiving UE

First responder Jorge is on his day shift and has therefore his personal cell phone with a special mission critical app in use. In parallel the official mission critical smart phone along with the health tablet and the ambulance car onboard system. All four devices can be used with one single mission critical ID, which offer voice, short messages and location information. In his current state all four devices report with defined triggers location information to the critical mission control room, but the control room is not able to distinguish between these location information. Jorge requested additional support. In order to send support to Jorge the estimated center of these four location information is used together with the associated inaccuracy. The support arrives at the wrong location and can't find Jorge. By selecting just the mission critical smart phone from which Jorge is currently talking the dispatcher can coordinate the support to the building across the street and around the corner.

## 4.8 Use case #8: Location information – individual addressable UE

Fire fighter Isabella is using on duty her official mission critical UE along with a pager, but now she is on standby and both devices are active. The dispatcher is receiving location information from both devices, but is not able to make the connection between location information received and devices. In standby all fire fighters have to carry their pager all the time. Therefore the dispatcher is able to request the location information of her pager by selecting this device and sending the proper request, which is acknowledged with the location of Isabella. The dispatcher is able to make the right judgment to leave her in standby or based on her location to include her to the nearby car accident with engine oil on the street.

## 4.9 Use case #9: Sharing of location information

A first responder car is blocking the street as well as parked cars due to an elderly person requiring oxygen after a small kitchen fire. While Inés is providing support, Miguel is at the first responder's car for additional medication. In this moment the owner of a blocked car is demanding the removal of the first responder's car, because of his very important meeting. Miguel is not paying attention to the arguing person. The working procedure in such circumstances requires emergency support and Miguel is pressing the red button on his voice communication device. The location information of this emergency call is reaching the emergency dispatcher and is shared with the city owned video processing system which is not under the same organisation as Miguel. Based on this location information video footage is selected and automatically provided. Therefore, the dispatcher of his organisation receives live footage of two stationary cameras of a different organisation observing the area. The dispatcher sees Miguel, the first responder's car as well the person arguing with Miguel. The dispatcher is warning Miguel, who is currently inside the first responder's car, about a shiny object the person is pulling from his pocket. The in parallel immediately requested police support is able to avoid a dangerous situation for Miguel and the elderly person.

## 4.10 Use case #10: Location information of unauthenticated user

Police officer George just started his shift at an outpost. His colleague Margaret is very nervous and instantly sends him to an emergency, which she just got from the dispatcher for this region. George hurries up, powers on his UE and leaves to his car. He doesn't manage to log on to the MC service providing his MC ID, but the UE is already registered to the SIP core. George drives with high speed to get to the emergency scene as soon as possible. Suddenly, a cat appears on the road in front of him and he leaves the road accidentally. His car has gone head over heels and now lays in a hardly visible ditch, whereas George has lost his consciousness. The dispatcher gets nervous as he is not able to reach George and decides to send help to him. He alerts George's colleague in the outpost. While Margaret drives along the road, the dispatcher directly requests location information from George's UE and transfers it to Margaret. Margaret arrives at George's accident location and gives first aid. George can be rescued, but not a moment too soon.

## 4.11 Use case #11: Location information in off-network operation

An upcoming match between two rival soccer clubs requires a large-scale operation, because the fans of these two clubs have come to the notice several times in terms of violence in the past. In order to ensure the security of the event, patrols in the whole city are expanded and the fans of the soccer clubs are observed and controlled by unit A as early as they arrive at the station and head for the stadium. For tactical and capacitive reasons the police officers of unit B securing the stadium communicate with their officer in charge in off-network operation and the officer in charge communicates with the other units and gets information from them.

The unit responsible for the security in and around the stadium communicates within a dedicated off-network group and the group members are configured to report their location information periodically to the authorized officer in charge, who has an overview of the crowded stadium and needs this information to coordinate the operation and to be able to react as fast and efficient as possible to disturbances or violence in the stadium.

## 4.12 Use case #12: Sharing of past location information

A dispatcher at City Centre is responsible for 1200 police officers and is receiving periodic location information, due to location information subscriptions to all police officers under the supervision of this dispatcher location. Due to a failure the dispatcher at City East, which is part of the same MC system, has to take over. This dispatcher is able to subscribe for periodic location information as well as to request location information of 48 police officers of the special task force for the past 24 hours.

## 4.13 Use case #13: Location sharing and temporary location configuration between interconnected MC systems

Daan a police officer of The Police of the Netherlands is coordinating a joint mission on opioid and drug smuggling with forces in Germany and Belgium. Each country is providing 5 members of a special task force. In order to coordinate the mission, Daan has subscribed to the location information of each member of the joint team, with the possibility to temporarily adjust the configuration for the periodic location information as well as in case of an emergency. Daan is able to see location updates based on the temporary configuration.

After the operation has been concluded, Daan removes the temporary changes, which reverts each team member to their original location reporting configuration.

Editor's Note: The complexity introduced by configurations changes of any type from a remote system are significant and therefore require further study.

# 5 Key Issues

5.1 Key Issue 1: Information in the location report

### 5.1.1 Description

Clause 10.9.3.1 of 3GPP TS 23.280 [7] describes "ECGI, MBMS SAIs, geographic coordinates and other location information" as possible information included in the location report. This description justifies the interpretation just to use longitude and latitude as required for geographical coordinates. Clause F.3.3 of 3GPP TS 24.379 [10] shows longitude and latitude as the selected location information out of 3GPP TS 23.280 [7], but further elements like timestamp, speed, bearing, altitude, accuracy are required, which common GNSS receivers get or calculate from the satellite signals. It is the intention to provide more guidance to specify also the other required location information.

### 5.1.2 Architectural Requirements

No new architectural requirements are needed.

## 5.2 Key Issue 2: Location History Reporting

### 5.2.1 Description

After being off-network a UE may want to send location information of multiple positions, collected during the time it was off-network based on the triggering criteria it is configured with. Therefore, this key issue will study the reporting of location history when the UE has come back on-network, after being off-network.

### 5.2.2 Architectural Requirements

No new architectural requirements are needed.

## 5.3 Key Issue 3: Handling of triggering criteria in emergency cases

### 5.3.1 Description

At the current state of the MC architecture it is only possible to adjust the triggering criteria in non-emergency cases over the air, but not the triggering criteria in emergency cases since no information element is designated for this in the location reporting configuration (see Table 10.9.2.1-1 of 3GPP TS 23.280 [7] and location reporting trigger (see Table 10.9.2.4-1 of 3GPP TS 23.280 [7] messages. Therefore, this key issue studies the handling of triggering criteria in emergency cases.

## 5.4 Key Issue 4: Location mechanism compatibility for MCPTT

### 5.4.1 Description

In R13, the user location is reported to and handled at MCPTT server. In R14, the location mangement server and location management client are introduced to management the user location for all the service including MCPTT, MCVideo and MCData, and the MCPTT server acquires the user location from the location management server.

For MCVideo and MCData service, there is no compatibility issue as R14 location mechanism is the only one option.

For MCPTT, there are two location mechanisms since R14. How to handle the two location mechanism at MCPTT server and MCPTT UE with the backward compatibility is not clear.

For different cases, the backward compatibility issues are identified in table 5.4.1-1.

Table 5.4.1-1: Cases for compatibility consideration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Case | LMS && LMC | MCPTT client | MCPTT server | Remarks |
| A | N | R13 | R13 | Only R13 location mechanism is available and shall be utilized. |
| B | N | R13 | R14 | Only R13 location mechanism is available and shall be utilized. |
| C | N | R14 | R13 | Only R13 location mechanism is available and shall be utilized. |
| D | N | R14 | R14 | Only R13 location mechanism is available and shall be utilized. |
| E | Y | R13 | R13 | Only R13 location mechanism is available and shall be utilized . |
| F | Y | R13 | R14 | Both R13 and R14 location mechanism are available |
| G | Y | R14 | R13 | Only R13 location mechanism is available and shall be utilized. |
| H | Y | R14 | R14 | Both R13 and R14 location mechanism are available |

1. For the cases A, C, E and G with R13 MCPTT server, there is no compatibility issues as there is no interface between R13 MCPTT server and LMS, and only R13 location mechanism is available.

2. For the cases B and D with R14 MCPTT server, there is no compatibility issues as there is no deployment of LMS and LMC, and only R13 location mechanism available.

3. For the cases F and H with R14 MCPTT server and deployment of LMS and LMC, both R13 and R14 location mechanisms are available, i.e., MCPTT server acquires location information from either MCPTT client or LMS.

The location mechanism to be utilized in MCPTT server for the cases F and H needs to be resolved.

Editor's Note: The description for the version of MCPTT server and MCPTT client is FFS.

### 5.4.2 Architectural Requirements

No new architectural requirements are needed.

## 5.5 Key Issue 5: Sharing of location information

### 5.5.1 Description

The following aspects have been identified in order to share available location information and refer to use case #9: Sharing of location information and use case #13: Location sharing and temporary location configuration between interconnected MC systems:

a. Use of the location information of a MC user from one MC service at one MC service UE by another MC service of the same user at a different MC service UE;

b. Location information of one MC user at home MC system is shared with other MC users at home system;

c. Location information of one MC user at home MC system is shared with other MC users at partner MC system;

d. Location information of one MC user at home MC system is shared with other MC users at connected LMR system;

e. Location information of one MC user at home MC system is shared with an outside 3GPP recipient.

f. An authorized MC user at partner/home MC system is able to temporarily change location configuration parameters of users at home/partner MC system.

Editor's Note: Current MC architecture intentionally does not allow configuration changes of any type from a remote system because of increased complexity. Only an authorized user which is homed to the system where the configuration change is resident may make such a change.

NOTE: Sharing of location information includes requesting and automatically provide them.

### 5.5.2 Architectural Requirements

Adjustments of the existing information flows and procedures as well as additional information flows and procedures are required.

## 5.6 Key Issue 6: Individual UE addressing

### 5.6.1 Description

The current Stage-2 approach allows addressing on the MC service ID basis, which does take into account a user could have several MC clients running the same MC service. The addressing of a specific UE, out of multiple simultaneously running UEs offering the same MC service, is currently not possible by using the MC service ID.

This key issue is addressing use case #7: Location information – individual receiving UE and use case #8: Location information – individual addressable UE.

The following gaps have been identified:

a. Support for communication (e.g. location) with a specific MCX UE when a MC user is using several MCX UEs at the same time;

b. Support for communication (e.g. location) with a specific MCX UE when no MCX service clients are active in the MCX UE;

c. Support for communication (e.g. emergency group call including location) with a specific MCX UE when the MCX service client on that MCX UE is operating in a limited service state (i.e. unauthenticated).

### 5.6.2 Architectural Requirements

Adjustments of the existing information flows and procedures as well as additional information flows and procedures are required.

## 5.7 Key Issue 7: Location information of unauthenticated user

### 5.7.1 Description

This key issue arises from use case #10: Location information of unauthenticated user.

In some cases it is necessary to request location information, before the user is authenticated and authorized by the MC service, but has already registered to the SIP core. This situation may occur in a deployment scenario, where the MC service provider is different from the PLMN operator (further described in 3GPP TS 23.280 [7] clause 9.2.2) and MC user authentication and SIP registration are separate procedures.

According to 3GPP TS 23.280 [7] clause 10.1.1.1 providing MC services to an MC service UE with an unauthenticated MC service user is FFS and according to 3GPP TS 33.180 clause 5.1.1 a UE may enter a "limited service" state in this case.

This key issue tries to find solutions for the following aspects:

a. Requesting location information from a UE which is in a "limited service" state.

### 5.7.2 Architectural Requirements

The MC System has to be able to individually address a specific UE of a MC user as the MC ID is not available to the Identity Management Server before authentication took place, e.g. by use of an existing or new UE specific identity.

## 5.8 Key Issue 8: Location information in off-network operation

### 5.8.1 Description

This key issue arises from use case #11: Location information in off-network operation.

Location management for on-network operation is described in 3GPP TS 23.280 clause 10.9, but today there are no procedures and information flows for off-network location management.

Issues:

- Can the architecture for on-network location management or a subset be reused for off-network location management?

- Whether or which new entities are required?

- Which functionalities (e.g. immediate request, event-triggered, client-triggered) are required?

- Whether or which authorizations are required?

- How are privacy restrictions applied?

NOTE: This key issue only targets off-network UE to UE communication.

## 5.9 Key Issue 9: Sharing of past location information

### 5.9.1 Description

3GPP TS 23.280 [7] clause 10.9.2.3 describes the request of location information and the procedure in clause 10.9.3.2 is asking for the latest location information. Information flow elements are missing to request also past location information either from the location management server, if such capability is provided to store for a defined period of time, or from the location management client of the target MC service ID, if such capability is provided to store for a defined period of time.

The following aspects have been identified in order to share available past location information and refer to use case #12: Sharing of past location information:

a. How past location information can be requested;

b. Who is providing past location information;

c. Who is storing location information;

d. Appropriate time period to retain location information;

e. How past location information can be identified and separated from the latest location information; and

f. How the location information can be provided to the requester.

### 5.9.2 Architectural Requirements

No new architectural requirements are needed.

# 6 Solutions

6.1 Solution 1: Additional details within the location information report

### 6.1.1 Description

This solution addresses key issue #1 - Information in the location report.

The solution is to add a description to the corresponding parts of the location management in clause 10.9 of 3GPP TS 23.280 [7] which describes timestamp, speed, bearing, altitude and accuracy as examples for location information.

### 6.1.2 Impacts on existing nodes and functionality

The following solution does not have an impact on the specified architecture.

#### 6.1.2.1 Location information report

Table 6.1.2.1-1 describes the information flow from the location management client to the location management server for the location information reporting.

Table 6.1.2.1-1: Location information report

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| Set of MC service IDs | M | Set of identities of the reporting MC service user on the MC service UE (e.g. MCPTT ID, MCVideo ID, MCData ID) |
| Triggering event | M | Identity of the event that triggered the sending of the report |
| Location Information | M | Location information (see NOTE) |
| NOTE: This may include timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information. | | |

Timestamp: Time expressed with a certain precision to reflect the moment of the location measurement. The timestamp shall allow the comparison of associated location information in respect to timestamp and is therefore based on a common clock.

Accuracy: Reflects the deviation of the location in the moment of location measurement with a defined unit and scale.

Speed: Movement in the moment of location measurement with a defined unit and scale. Speed is the magnitude or absolute value of velocity.

Bearing: Direction in the moment of location measurement with a defined unit and scale. The direction shall also have a reference, like "true north" or "magnetic north".

Altitude: Third dimension for the geographical coordinates in the moment of location measurement with a defined ground level, unit and scale. The altitude shall also have a reference, like "sea level (MSL)" or "local ground level (above ground level, or AGL)".

Measurement code: This part of the location information element shall give an indication for what reason the location could not be determined from the positioning system on the UE and gives an indication of how to correctly interpret the provided values, e.g. Measurement code = "no satellite using default value set 1" and in this case the Latitude / Longitude may be set to "Null" or to "last known position".

### 6.1.3 Solution Evaluation

This solution provides additional details about location information elements contained in the location information report in 3GPP TS 23.280 clause 10.9.2.2. Currently identified elements are: timestamp, accuracy, speed, bearing, altitude, measurement code. Other elements that are already described in 3GPP TS 23.280 clause 10.9.3.1 may be considered as well. Definitions of all these elements may have to be provided in 3GPP TS 23.280 clause 3.1.

## 6.2 Solution 2: Additional details within the location information notification

### 6.2.1 Description

The following solution does not have an impact on the specified architecture.

This solution addresses key issue #1 - Information in the location report.

The solution is to add a description to the corresponding parts of the location management in clause 10.9 of 3GPP TS 23.280 [7] which describes timestamp, speed, bearing, altitude and accuracy as examples for location information.

### 6.2.2 Impacts on existing nodes and functionality

#### 6.2.2.1 Location information notification

Table 6.2.2.1-1 describes the information flow from the location management server to the MC service server.

Table 6.2.2.1-1: Location information notification

|  |  |  |
| --- | --- | --- |
| **Information element** | **Status** | **Description** |
| MC service ID list | M | List of the MC service users whose location information needs to be notified |
| MC service ID | M | Identity of the MC service user subscribed to location of another MC service user (see NOTE 1) |
| Triggering event | M | Identity of the event that triggered the sending of the notification |
| Location Information | M | Location information (see NOTE 2) |
| NOTE 1: This is only used for location management server sends location information notification to the MC service user who has subscribed the location.  NOTE 2: This may include timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information. | | |

Timestamp: Time expressed with a certain precision to reflect the moment of the location measurement. The timestamp shall allow the comparison of associated location information in respect to timestamp and is therefore based on a common clock.

Accuracy: Reflects the deviation of the location in the moment of location measurement with a defined unit and scale.

Speed: Movement in the moment of location measurement with a defined unit and scale. Speed is the magnitude or absolute value of velocity.

Bearing: Direction in the moment of location measurement with a defined unit and scale. The direction shall also have a reference, like "true north" or "magnetic north".

Altitude: Third dimension for the geographical coordinates in the moment of location measurement with a defined ground level, unit and scale. The altitude shall also have a reference, like "sea level (MSL)" or "local ground level (above ground level, or AGL)".

Measurement code: This part of the location information element shall give an indication for what reason the location could not be determined from the positioning system on the UE and gives an indication of how to correctly interpret the provided values, e.g. Measurement code = "no satellite using default value set 1" and in this case the Latitude / Longitude may be set to "Null" or to "last known position".

### 6.2.3 Solution Evaluation

This solution provides additional details about location information elements contained in the location information notification in 3GPP TS 23.280 clause 10.9.2.7. Currently identified elements are: timestamp, accuracy, speed, bearing, altitude, measurement code. Other elements that are already described in 3GPP TS 23.280 clause 10.9.3.1 may be considered as well. Definitions of all these elements may have to be provided in 3GPP TS 23.280 clause 3.1.

## 6.3 Solution 3: Adjusting the location reporting procedure

### 6.3.1 Description

This solution addresses key issue #1 - Information in the location report.

The solution extends the location information element as provided in clause 10.9 of 3GPP TS 23.280 [7] as part of the event-triggered location reporting procedure.

### 6.3.2 Impacts on existing nodes and functionality

#### 6.3.2.1 Event-triggered location reporting procedure

The location management server provides location reporting configuration to the location management clients, indicating what information the location management server expects and what events will trigger the sending of this information to the location management server. The decision to report location information can be triggered at the location management client by different conditions, e.g., the reception of the location reporting configuration, initial registration, distance travelled, elapsed time, cell change, MBMS SAI change, MBMS session change, leaving a specific MBMS bearer service area, tracking area change, PLMN change, call initiation, or other types of events such as emergency alert, emergency call or imminent peril calls. The location report can include information described as timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information.

### 6.3.3 Solution Evaluation

The current set of elements which describe triggers for the location information reporting in 3GPP TS 23.280 clause 10.9.3.1 are extended to add the conditions provided in solution #1 and solution #2.

## 6.4 Solution 4: Handling of triggering criteria in emergency cases

### 6.4.1 Description

This solution addresses key issue #3 - Handling of triggering criteria in emergency cases.

The solution is to provide an information element "triggering criteria in emergency cases" in the location reporting configuration (see Table 6.4.2.1-1) and location reporting trigger (see Table 6.4.2.2-1) messages. The existing procedures for event-triggered location reporting and client-triggered location reporting in clause 10.9.3 of 3GPP TS 23.280 [7] will be used and are not be affected by this solution, but are listed below for illustration.

Figure 6.4.1-1 illustrates the message flow for event triggered location reporting:



Figure 6.4.1-1: Event-triggered location reporting procedure

Figure 6.4.1-2 illustrates the message flow for client-triggered location reporting:



Figure 6.4.1-2: Client-triggered location reporting procedure

### 6.4.2 Impacts on existing nodes and functionality

#### 6.4.2.1 Location reporting configuration

Table 6.4.2.1-1 describes the information elements of the location reporting configuration message from the location management server to the location management client.

Table 6.4.2.1-1: Location reporting configuration

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | Identity of the MC service user to which the location reporting configuration is targeted. |
| Requested non-emergency location information | O (see NOTE) | Identifies what location information is requested, except for emergency or imminent peril calls or emergency alerts |
| Requested emergency location information | O (see NOTE) | Identifies what location information is requested, for emergency or imminent peril calls or emergency alerts |
| Triggering criteria in non- emergency cases | O (see NOTE) | Identifies when the location management client will send the location report in non-emergency cases |
| Triggering criteria in emergency cases | O (see NOTE) | Identifies when the location management client will send the location report in emergency cases |
| Minimum time between consecutive reports | O (see NOTE) | Defaults to 0 if absent and 0 for emergency calls, imminent peril calls and emergency alerts |
| NOTE: If none of the information element is present, this represents a cancellation for location reporting. | | |

#### 6.4.2.2 Location reporting trigger

Table 6.4.2.2-1 describes the information elements of the location reporting trigger message from the location management client to the location management server.

Table 6.4.2.2-1: Location reporting trigger

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M(see NOTE 1) | Identity of the requesting authorized MC service user (e.g. MCPTT ID, MCVideo ID, MCData ID) |
| MC service ID | M (see NOTE 1) | Identity of the requested MC service user (e.g. MCPTT ID, MCVideo ID, MCData ID) |
| Immediate Report Indicator | O (see NOTE 2) | Indicates whether an immediate location report is required |
| Requested non-emergency location information | O (see NOTE 2) | Identifies what location information is requested, except for emergency or imminent peril calls or emergency alerts |
| Requested emergency location information | O (see NOTE 2) | Identifies what location information is requested, for emergency or imminent peril calls or emergency alerts |
| Triggering criteria in non- emergency cases | O (see NOTE 2) | Identifies when the client will send the location report in non-emergency cases |
| Triggering criteria in emergency cases | O (see NOTE 2) | Identifies when the client will send the location report in emergency cases |
| Minimum time between consecutive reports | O (see NOTE 2) | Defaults to 0 if absent and 0 for emergency calls, imminent peril calls and emergency alerts |
| NOTE 1: The identity of the requesting MC service user and the requested MC service user should belong to the same MC service. E.g. if requesting MC service user is using a MCPTT ID, then the requested MC service user identity should be an MCPTT ID.  NOTE 2: At least one of these rows shall be present. | | |

### 6.4.3 Solution Evaluation

This solution provides an additional information element to ensure that triggering criteria can be adjusted separately for the emergency and non-emergency case.

As location information of a specific client may be needed, using an individual identity to address a specific client, should be taken into considerations.

## 6.5 Solution 5: Location management mechanism backward compatibility for MCPTT

### 6.5.1 Description

For case F and G identified with backward compatibility problem in the key issue 4, both R13 and R14 location mechanism are available at the MCPTT server (i.e., MCPTT server acquires location information from either MCPTT client or LMS). It is the MCPTT server that makes the decision to use R13 or R14 location mechanism based on policy.

In addition, the server URI of location management server should be included in the initial UE configuration table in annex A.6 in 3GPP TS 23.280[7].

### 6.5.2 Impacts on existing nodes and functionality

MCPTT server is enhanced to determine the location management mechanism to be used based on policy.

### 6.5.3 Solution Evaluation

This solution solves the location management mechanism backward compatibility for MCPTT by enhancing the MCPTT server to determine the location management mechanism based on its capability (i.e., release version) and policy.

Editor's Note: The description for the version of MCPTT server and MCPTT client is FFS.

## 6.6 Solution 6: Off-network storing of event-triggered location information

### 6.6.1 Description

This solution addresses key issue #2: Location History Reporting.

The location management client gets the location reporting configuration from the location management server and reports location information to the location management server based on conditions. When the location management client is not able to send location information reports to the location management server, the location management client locally stores the event-triggered location information reports.

### 6.6.2 Impacts on existing nodes and functionality

#### 6.6.2.1 Off-network storing of event-triggered location information procedure

The location management client may get into an off-network situation at any time after the initial location reporting configuration was provided by the location management server. If any location information trigger applies, the location management client locally saves the corresponding location information report. The conditions in off-network situation may vary from the conditions in an on-network situation and may e.g. include distance travelled, elapsed time, call initiation, off-network emergency alert, off-network emergency group call, off-network imminent peril group call and off-network emergency private call.

NOTE 1: The procedure may also apply in some scenarios of isolated operation for public safety. Which conditions are applicable in this case, may depend on the particular isolated operation scenario. They may include all or a subset of the on-network conditions and e.g. in case only one single base station is available, the conditions entering cell and leaving cell may be relevant instead of cell change.



Figure 6.6.2.1-1: Off-network storing of event-triggered location information procedure

1. The location management server sends location reporting configuration message to the location management client(s) containing the initial configuration (or a subsequent update) for reporting the location of the MC service UE.

NOTE 2: The location reporting configuration information can be made part of the user profile, in which case the sending of the message is not necessary.

NOTE 3: Different location management clients may be given different location reporting criteria.

2. The location management client loses connection to the location management server or changes to off-network operation.

3. A location reporting event occurs.

4. The location management client locally stores the location information report, containing location information identified by the location reporting configuration and available to the location management client.

NOTE 4: It is proposed, that the location management client stores location information based on a configurable period of time or number of reports.

NOTE 5: The location information report may include timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information.

### 6.6.3 Solution Evaluation

The solution adds a mechanism for configuring events, which will cause the location management client to store location reports while operating off-network. This does not affect any of the existing location management procedures. A separate set of off-network trigger criteria besides the on-network trigger criteria may be required.

The following configuration aspects may have to be defined for each location management client separately:

a) Activation and de-activation to locally store location reports;

b) Activation of automatic transmission of triggered events after the location management client returns from off-network operation; and

c) Amount of location reports locally stored before the first location report while operating off-network will be overwritten.

## 6.7 Solution 7: On-demand location history reporting

### 6.7.1 Description

This solution addresses key issue #2: Location History Reporting.

The location management client may have stored one or multiple event-triggered location information reports while operating off-network. This solution provides information flows and procedures for on-demand request of one ore multiple stored location information reports based on different criteria (e.g. specific number of last stored reports, all reports of a specific period of time, all reports triggered by a specific triggering criteria), after the location management client returns to on-network operation.

### 6.7.2 Impacts on existing nodes and functionality

#### 6.7.2.1 Location information history request

Table 6.7.2.1-1 describes the information flow from the location management server to the location management client for requesting one or several location information reports.

Table 6.7.2.1-1: Location information history request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID list | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of one MC user at home MC system whose location information is requested |
| Reporting number of last stored reports | O (see NOTE) | Indicates the number of last stored reports to be sent |
| Reporting start time | O (see NOTE) | Indicates to send all reports having this time stamp and newer |
| Reporting end time | O (see NOTE) | Indicates to send all reports having this time stamp and older |
| Reporting triggering criteria | O (see NOTE) | Indicates to send all reports triggered by this condition |
| Minimum time between consecutive reports | O | Defaults to 0 if absent |
| NOTE: If none of these information elements are present, all stored location information reports shall be reported. Reporting number of last stored reports shall not be present, if either reporting start time or reporting end time is present. | | |

#### 6.7.2.2 On-demand location history reporting procedure

The location management server can request UE location information history at any time by sending a location information history request to the location management client, which triggers location management client to send the requested location information report(s) immediately or based on interval determined by the location management server.



Figure 6.7.2.2-1: On-demand location information history reporting procedure

1. The location management client indicates the location management server the on-network status (e.g. through a triggered location information report).

2. Based on configurations such as periodical location information history timer, or location information history request from other entities (e.g. another location management client, MC service server), the location management server initiates the request of location information history from the location management client.

3. The location management server sends a location information history request to the location management client.

4. The location management client decides to send one or several location information reports as determined by location management server (e.g. period of time, last N reports, all stored reports).

5. The location management client responds to the location management server with one or several off-network location information reports.

NOTE 1: The transmission of requested off-network location information reports does not interrupt the on-network location information reports.

NOTE 2: The last stored location information report is transmitted first.

6. The location management client responds to the location management server with one or several off-network location information reports.

A method is necessary to allow the location management server to indicate one or many location management clients to stop the transmission of off-network location information reports (e.g. in case of channel congestion).

#### 6.7.2.3 Location information report

Table 6.7.2.3-1 describes the information flow from the location management client to the location management server for the location information reporting.

Table 6.7.2.3-1: Location information report

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID list | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of the reporting MC user at home MC system |
| Triggering event | M | Identity of the event that triggered the sending of the report |
| Location Information | M | Location information (see NOTE) |
| Off-network | O | Off-network location information indicator |
| NOTE: This may include timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information. | | |

### 6.7.3 Solution Evaluation

The solution provides information flows and procedures for on-demand location information history reporting, after the location management client returns from off-network operation. The described solution does not affect any of the existing information flows and procedures for on-network operation.

## 6.8 Solution 8: Triggered location history reporting

### 6.8.1 Description

This solution addresses key issue #2: Location History Reporting.

The location management client may have stored one or multiple event-triggered location information reports while operating off-network. This solution provides a procedure for the automatic transmission of off-network stored location reports after the location management client returns to on-network operation. This solution may affect the existing information flow for reporting location information.

### 6.8.2 Impacts on existing nodes and functionality

#### 6.8.2.1 Triggered location history reporting procedure

The location management client may be triggered to send any stored location information report(s) to the location management server by entering on-network operation.



Figure 6.8.2.1-1: Triggered location history reporting procedure

1. The location management client enters on-network operation, establishes connection to the location management server and enters the state to transmit location information reports.

2. The location management client sends one or multiple location information reports to the location management server.

NOTE 1: The transmission of requested off-network location information reports does not interrupt the on-network location information reports.

NOTE 2: The last stored location information report is transmitted first.

3. Upon receiving the report(s), the location management server stores location information reports of the reporting location management client.

A method is necessary to allow the location management server to indicate one or many location management clients to stop the transmission of off-network location information reports (e.g. in case of channel congestion).

#### 6.8.2.2 Location information report

Table 6.8.2.2-1 describes the information flow from the location management client to the location management server for the location information reporting.

Table 6.8.2.2-1: Location information report

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID list | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of the reporting MC user at home MC system |
| Triggering event | M | Identity of the event that triggered the sending of the report |
| Location Information | M | Location information (see NOTE) |
| Off-network | O | Off-network location information indicator |
| NOTE: This may include timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information. | | |

### 6.8.3 Solution Evaluation

The solution provides a procedure for triggered location history reporting on returning to on-network operation after the location management client has stored location reports while operating off-network, which does not affect any of the existing procedures.

## 6.9 Solution 9: Adding a UE label to Initial MC service UE configuration

### 6.9.1 Description

This solution addresses key issue #6: Individual UE addressing.

An MC UE label is added to table A.6.1 in 3GPP TS 23.280 [7], the Initial MC service UE configuration data. After user authentication and service authorization the MC service client will inform the MC service server of the MC UE label being used. The MC service will be able to map the MC UE label to the MC service ID for that specific instance of user login.

When a MC service user is logged on to multiple MC service UEs using the same MC service ID, the MC service server will be able to map location reports from these different MC service UEs by using the MC service ID together with the MC UE label to distinguish between specific MC service UEs.

Editor's note: It is FFS how to transfer the MC UE label from MC service client to MC service server.

Editor's note: It is FFS how to indicate a specific MC service ID and MC UE label in the delivery of location reports to the MC service clients consuming these location reports.

### 6.9.2 Impacts on existing nodes and functionality

Addition of extra parameter to 3GPP TS 23.280 [7] Initial MC service UE configuration data

Table 6.9.2-1: Initial MC service UE configuration data (on-network)

|  |  |
| --- | --- |
| Reference | Parameter description |
| Subclause 10.1.1 | Operational information |
|  | > MC service UE information |
|  | >> MC UE label |

### 6.9.3 Solution Evaluation

This solution adds a new entry to the existing Initial MC service UE configuration data (on-network) table, in order to identify a specific UE.

A solution is needed for how to transfer the MC UE label from the MC service client to the MC service server, and how the MC UE label is sent in conjunction with the MC service ID in delivery reports to MC service clients consuming these location reports.

## 6.10 Solution 10: Associate a user profile per MC service UE

### 6.10.1 Description

This solution addresses key issue #6: Individual UE addressing.

When a MC service user logs on to a specific MC service UE, each time a specific MC service user profile may be used (either automatically or manually) to identify which MC service UE the MC service user has just logged on to.

With the possibility to select an individual MC service user profile for each MC service UE, the MC service ID together with the current MC service user profile can be used to identify a specific MC service UE (e.g. for location information report).

In the case of manual selection of the MC service user profile, each MC service user profile should uniquely identify an MC service UE.

In the case of automatic selection no additional setup step for the MC service user is required. The MC service user profile is automatically assigned by the MC system for a specific MC service UE using a specific MC UE identifier.

Editor's note: It is FFS how the individual MC service user IDs will be mapped to the associated MC service user.

### 6.10.2 Impacts on existing nodes and functionality

No significant impacts on the existing architecture are identified using this solution because it uses the already defined MC service ID and MC service user profile to identify individual UEs.

### 6.10.3 Solution Evaluation

The solution has to be evaluated from the operative-tactical point of view.

The manual mapping allows meaningful MC service UE identifications, but requires an additional setup step for the MC service user.

The automatic mapping does not require an additional setup step for the MC service user, but requires additional impact to the existing architecture.

## 6.11 Solution 11: MC UE identity (new ID)

### 6.11.1 Description

This solution addresses key issue #6: Individual UE addressing.

A new MC UE identity (MC UE ID) is introduced, which is included in every location report that is sent by the MC service client. With this each location report will contain a MC service ID and a MC UE ID which allows the MC service clients consuming to interpret the location reports correctly.

The new MC UE ID may include manufacturer related information (e.g. name of manufacturer, brand, model, serial number).

### 6.11.2 Impacts on existing nodes and functionality

Editor's note: Capture impacts on existing 3GPP nodes and functional elements.

#### 6.11.2.1 MC UE ID part of location information report

An additional information element is added to 3GPP TS 23.280 [7] clause 10.9.2.2. Location information report.

Table 6.11.2.1-1 describes the information flow from the location management client to the location management server for the location information reporting.

Table 6.11.2.1-1: Location information report

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| List of MC service IDs | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of the reporting MC user at home MC system |
| MC UE ID | O | MC UE ID of the reporting MC service UE at home MC system |
| Triggering event | M | Identity of the event that triggered the sending of the report |
| Location Information | M | Location information |

#### 6.11.2.2 MC UE ID part of location information request

An additional information element is added to 3GPP TS 23.280 [7] clause 10.9.2.3. Location information request.

Table 6.11.2.2-1 describes the information flow from the MC service server to the location management server and from the location management server to the location management client for requesting an immediate location information report.

Table 6.11.2.2-1: Location information request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| List of MC service IDs | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of the requested MC user at home MC system |
| MC UE ID | O | MC UE ID of the requested MC service UE at home MC system |

#### 6.11.2.3 Definition

An additional definition is added to 3GPP TS 23.280 [7] clause 3.1 Definitions.

**MC UE ID:** Mission critical unique identification of a specific MC service UE.

##### 6.11.2.4 MC service UE configuration data

An extra parameter is added to 3GPP TS 23.280 [7] Table A.6-1: Initial MC service UE configuration data.

Table 6.11.2.4-1: Initial MC service UE configuration data (on-network)

|  |  |
| --- | --- |
| Reference | Parameter description |
| Subclause 10.1.1 | Operational information |
|  | > MC service UE information |
|  | >> MC UE ID |

### 6.11.3 Solution Evaluation

Depending on the size of the MC UE identity, including the MC UE identity in the location report may have a large impact on message size. As location reports may be sent frequently this will decrease efficiency.

A mechanism may be needed to allow an MC service server to query the association of MC UE ID to a MC service user.

6.12 Solution 12: Obtaining location of UE in "limited MC service" state

### 6.12.1 Description

This solution addresses key issue #7: Location information of unauthenticated use..

The solution is to provide a mechanism to obtain the location of the UE in "limited MC service" state by reusing the procedure in subclause 9.1.15 - EPC Mobile Terminating Location Request (EPC-MT-LR) in 3GPP TS 23.271 [12].

The utilization of this network procedure is outside the scope of the present specification.

### 6.12.2 Impacts on existing nodes and functionality

## 6.13 Solution 13: Sharing location information across MC service UEs

### 6.13.1 Description

This solution addresses key issue #5 - Sharing of location information.

This solution adds new procedures and information flows for the sharing of location information across MC service UE's either operated by the same or a different MC service user.

### 6.13.2 Impacts on existing nodes and functionality

Addition of new information flows and procedures to 3GPP TS 23.280 [7] at clause 10.9 Location management (on-network). Changes to existing procedures in 3GPP TS 23.280 [7] at clause 10.9 Location management (on-network).

#### 6.13.2.1 Location information client subscription request

Table 6.13.2.1-1 describes the information flow from the location management client to the location management server for a location information subscription request.

Table 6.13.2.1-1: Location information client subscription request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | Identity of the requesting MC service user at home MC system |
| MC service ID list | M | List of identities of the reporting MC service users at home MC system |
| MC UE ID list (see NOTE) | O | List of identifications of the reporting MC service UEs of the MC service users at home MC system |
| Time between consecutive reports | M | It indicates the interval time between consecutive reports |
| NOTE: The order of this list has to be the same as the list of the MC service IDs of the reporting MC service UEs. | | |

#### 6.13.2.2 Location information client subscription response

Table 6.13.2.2-1 describes the information flow from the location management server to the location management client for location information client subscription response.

Table 6.13.2.2-1: Location information client subscription response

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | Identity of the responding MC service user at home MC system |
| Subscription status | M | List of indications of the individual subscription results |

#### 6.13.2.3 Location information client notification

Table 6.13.2.3-1 describes the information flow from the location management server to the location management client.

Table 6.13.2.3-1: Location information client notification

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | Identity of the MC service user subscribed to location information of another MC service user at home MC system |
| MC service ID | M | Identity of the MC service user who location information have to be updated at home MC system |
| MC UE ID | O | Identification of the MC service UE of the MC service user who location information have to be updated at home MC system |
| Triggering event | M | Identity of the event that triggered the sending of the notification |
| Location Information | M | Location information (see NOTE) |
| NOTE: This may include timestamp, ECGI, MBMS SAIs, longitude, latitude, accuracy, speed, bearing, altitude, measurement code and additional other location information. | | |

#### 6.13.2.4 Location information client subscription procedure

Figure 6.13.2.4-1 illustrates the high level procedure of location information client subscription request.



Figure 6.13.2.4-1: Location information client subscription request procedure

1. Location management client sends a location information subscription request to the location management server to subscribe location information of one or more MC service UE's.

2. The location management server shall check if the location management client is authorized to initiate the location information subscription request.

3. The location management server replies with a location information subscription response indicating the subscription status for each individual subscription request.

#### 6.13.2.5 Event-triggered location information notification procedure

Figure 6.13.2.5-1 illustrates the high level procedure of sharing event-triggered location information within the home MC system.

NOTE: The location management client and sever have already successfully subscribed to location information of one or more MC service UE.



Figure 6.13.2.5-1: Event-triggered location notification information procedure

1. The location management server checks the configurations, e.g., subscription, periodical location information timer.

2. Based on the configuration and subscription the location management server sends the location information report including the last available location information of one MC service user and the respective MC service UE to one location management client and to the MC service server. The last available location information is derived from the location report procedure as described in clause 10.9.3.1, or may come from a PLMN operator.

3. MC service server may further share this location information to a group or to another MC service user.

NOTE: Step 3 can be skipped if not required.

#### 6.13.2.6 On-demand request of location information procedure

The MC service server can request MC service UE's location information at any time by sending a location information request to the location management server. The location information request as described in clause 10.9.2.3 of 3GPP TS 23.280 [7] is carried out as an immediate procedure to receive on-demand the last available location information of the requested MC service UE.

Figure 6.13.2.6-1 illustrates the high level procedure of requesting on-demand location information.

NOTE: The location management client has already successfully subscribed to location information of one or more MC service UE.



Figure 6.13.2.6-1: On-demand request of location information procedure

1. MC service server sends a location information request to the location management server.

2. The location management server acquires the last available location information of a MC service UE, by triggering an on-demand location report procedure as described in clause 10.9.3.2, or from a PLMN operator.

3. The location management server checks the configurations and subscriptions to receive notification of location information.

4. Based on the configuration and subscription the location management server immediately sends the location information report including the last available location information acquired of one MC service UE to one or more location management clients and the MC service server.

5. MC service server may further share this location information to a MC service group or to another MC service user.

NOTE: Step 3 can be skipped if not required.

### 6.13.3 Solution Evaluation

This solution depends on the MC UE ID proposed in solution 11 of this study. The procedures and information flows have to be adapted after the overall evaluation of identifying location information of a specific MC UE ID have been completed.

6.14 Solution 14: Functional model for sharing location information across MC systems

### 6.14.1 Description

This solution addresses key issue #5 (5.5.1.c) - "Location information of one MC user at home MC system is shared with other MC users at partner MC system".

This solution adds an enhanced functional model, enabling the sharing of location information across MC systems.

### 6.14.2 Impacts on existing nodes and functionality

#### 6.14.2.1 On-network functional model

This solution is based on an enhanced functional model for application plane for an MC system, as described in 3GPP TS 23.280 [7], clause 7.3.1.

Figure 6.14.2.1-1 describes the enhanced functional model.



Figure 6.14.2.1-1 Enhanced functional model to support the sharing of location information between MC systems

#### 6.14.2.2 Reference point CSC-23 (between location management servers in different MC systems)

The CSC-23 reference point, which exists between location management servers in different MC systems, is used by location management servers to handle location management related signalling in different security domains, as described in 3GPP TS 23.280  [7] clause 10.9.

The CSC-23 reference point uses the HTTP-1, HTTP-2 and HTTP-3 reference points for transport and routing of non-subscription/notification related signalling.

#### 6.14.2.3 Reference point CSC-22 (between location management server and MC gateway server)

The CSC-22 reference point, which exists between location management server and MC gateway server, is used to handle location management related signalling between different security domains.

The CSC-22 reference point uses SIP-2 and SIP-3 reference points for transport and routing of subscription/notification related signalling.

#### 6.14.2.4 Reference point CSC-21 (between MC gateway servers in different MC systems)

The CSC-21 reference point, which exists between MC gateway servers in different MC systems in different security domains, is used to share subscription and notification related signalling for group configuration, user configuration and location management to permit interconnection and migration between MC systems.

The CSC-21 reference point uses the SIP-3 reference point for transport and routing of subscription/notification related signalling.

#### 6.14.2.5 Information flows

NOTE: This includes the information flows for location reporting configuration, location information report, location information request, location reporting trigger, location information subscription requests, location information subscription response, location information notification, location information cancel subscription request, location information cancel subscription response and location report response.

### 6.14.3 Solution Evaluation

The functional model needs to be enhanced, as a new reference point between the location management servers in the primary and partner MC systems is needed.

A mechanism may be required in order to terminate a subscription for location information across MC systems.

6.15 Solution 15: Sharing location information for interconnected MC system

### 6.15.1 Description

This solution addresses key issue #5 – Sharing of location information.

This solution adds new procedures and information flows for the sharing of location information with other MC service users at partner MC system(s) either operated under the same or different organisation / administration / authorized user.

### 6.15.2 Impacts on existing nodes and functionality

#### 6.15.2.1 General

Addition of new information flows and procedures to 3GPP TS 23.280 [7] clause 10.9 Location management (on-network). Changes to existing procedures in 3GPP TS 23.280 [7] clause 10.9 Location management (on-network).

6.15.2.2 Location information subscription request

Table 6.15.2.2-1 describes the information flow from the MC service server or location management client in the primary MC system to the other location management server in the partner MC system for the location information subscription request.

Table 6.15.2.2-1: Location information subscription request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE 1) | M | The MC service ID of the requesting MC service user located in the primary MC system |
| MC service ID list | M | List of the MC service IDs of MC service user(s) located in the partner MC system whose location information are requested |
| Time between consecutive location notifications (see NOTE 2) | M | Indicates the interval time between consecutive location notifications |
| NOTE 1: This element is only present when the subscription request is originated by an MC service client.  NOTE 2: If the interval time has a value of zero then the location management server will send the location information notification immediately after the location information update is received from the MC service user in the MC service ID list. | | |

#### 6.15.2.3 Location information subscription response

Table 6.15.2.3-1 describes the information flow from the location management server in the partner MC system to the location management server, MC service server or location management client in the primary MC system for location information subscription response.

Table 6.15.2.3-1: Location information subscription response

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE 1) | M | MC service ID of the requesting MC service user |
| Subscription status (see NOTE 2) | M | Indicates the subscription result |
| NOTE 1: This element is only present when the subscription request was originated by an MC service client.  NOTE 2: The subscription status provides the status for each MC service ID listed in the subscription request. | | |

#### 6.15.2.4 Location information notification

Table 6.X.2.4-1 describes the information flow from the location management server in the partner MC system to the MC service server and location management server in the primary MC system for location information notification.

Table 6.15.2.4-1: Location information notification

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE) | M | MC service ID of MC service user in the primary MC system who subscribed to location information update |
| MC service ID | M | MC service ID of MC service user in the partner MC system who provided an location information update |
| Triggering event | M | Describes the event which triggered the location information update |
| Location Information | M | Location information |
| NOTE: This element is only present when the location information notication is the result of a subscription by an MC service client. | | |

#### 6.15.2.5 Location information subscription procedure

Figure 6.15.2.5-1 illustrates the high level procedure of location information subscription requests of an interconnected MC system.

Pre-conditions:

- The MC service server or an authorized MC service user in the primary MC system is in possession of the MC service ID of the target MC service user in the partner MC system.

- The MC service user in the primary MC system is authorized to subscribe to location information of the target MC service user in the partner MC system.



Figure 6.15.2.5-1: Location information subscription request procedure

1. The MC service server or a location management client in the primary MC system requests to subscribe to location information of MC service user located in the partner MC system.

2. The location management server in the primary MC system checks if the MC service user in the primary MC system is authorized to subscribe to location information of the target MC servicer user in the partner MC system.

3. The location management server in the primary MC system sends the location information subscription request to the location management server in the partner MC system.

4. The location management server in the partner MC system checks if the MC service user in the primary MC system is authorized to receive location information of the target MC service user in the partner MC system.

NOTE: Whether the authorization check is a specific check of the requesting MC service user or is a general policy check is outside the scope of this solution.

5. The location management server in the partner MC system replies with a location information subscription response indicating the subscription status.

6. The location management server in the primary MC system sends the location information subscription response indicating the subscription status to the requesting MC service server or the location management client.

#### 6.15.2.6 Event-triggered location information notification procedure

Figure 6.15.2.6-1 illustrates the high level procedure of event-triggered sharing of location information.

Pre-conditions:

- The MC service server or an authorized MC service user in the primary MC system has successfully subscribed to receive the location information of an MC service user in the partner MC system.



Figure 6.15.2.6-1: Event-triggered sharing of location information procedure

1. The location management client at partner MC system is triggered to send a location information update. For triggers see 3GPP TS 23.280 clause 10.9.3.1.

2. The location management server in the partner MC system sends the location information notification, based on the subscription.

3. The location management server in the primary MC system sends the location information notification to the MC service server or the location management client in the primary MC system.

#### 6.15.2.7 Location information request

Table 6.15.2.7-1 describes the information flow from the MC service server or location management client in the primary MC system to the other location management server in the partner MC system for the location information request.

Table 6.15.2.7-1: Location information request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE) | M | The MC service ID of the requesting MC service user located in the primary MC system |
| MC service ID list | M | List of the MC service IDs of MC service user(s) located in the partner MC system whose location information are requested |
| NOTE: This element is only present when the request is originated by an MC service client. | | |

#### 6.15.2.8 Location information report

Table 6.15.2.8-1 describes the information flow from the location management server in the partner MC system to the MC service server and location management server in the primary MC system for location information report.

Table 6.15.2.8-1: Location information report

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE) | M | MC service ID of MC service user in the primary MC system who requested a location information update |
| MC service ID | M | MC service ID of MC service user in the partner MC system who provided an location information update |
| Triggering event | M | Describes the event which triggered the location information update |
| Location Information | M | Location information |
| NOTE: This is only used when the location management server sends location information notification to the MC service user who has requested an location information report. | | |

#### 6.15.2.9 On-demand request of location information procedure

The MC service server or location management client in the primary MC system can request MC service user's location information, which is in the partner MC system, at any time by sending a location information request to the location management server at primary MC system.

Figure 6.15.2.9-1 illustrates the high level procedure of on-demand request of location information.

Pre-conditions:

- The MC service server or the location management client at primary MC system is in possession of the MC service ID of a MC service user at partner MC system.



Figure 6.15.2.9-1: On-demand request of location information procedure

1. The MC service server or a location management client in the primary MC system requests on-demand location information of MC service user located in the partner MC system.

2. The location management server in the primary MC system checks if the MC service user in the primary MC system is authorized to request on-demand location information of the target MC service user in the partner MC system.

3. The location management server in the primary MC system sends the on-demand location information request to the location management server in the partner MC system.

4. The location management server in the partner MC system checks if the MC service user in the primary MC system is authorized to receive location information of the target MC service user in the partner MC system.

NOTE: Whether the authorization check is a specific check of the requesting MC service user or is a general policy check is outside the scope of this solution.

5. The location management server at partner MC system updates the location information. For the procedure to get the latest location information see 3GPP TS 23.280 clause 10.9.3.2.

6. The location management server in the partner MC system replies with a location information report.

7. The location management server in the primary MC system sends the location information report to the requesting MC service server or the location management client.

#### 6.15.2.10 Authorization to share location information

Editor's note: How the authorization of a MC service server to request location information is FFS.

Table 6.15.2.10-1 contains the authorization part of the MCPTT user profile as described in 3GPP TS 23.379 Annex A.3.

Table 6.15.2.10-1: MCPTT user profile data (on and off network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCPTT UE | MCPTT Server | Configuration management server | MCPTT user database |
| [R-5.11-004],  [R-6.17.2-001] of 3GPP TS 22.280 [3] | List of MCPTT IDs, for which subscription information sharing is permitted. |  |  |  |  |
|  | > MCPTT ID | N | Y | Y | Y |

Table 6.15.2.10-2 contains the authorization part of the MCData user profile as described in 3GPP TS 23.282 Annex A.3.

Table 6.15.2.10-2: MCData user profile data (on and off network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCData UE | MCData Server | Configuration management server | MCData user database |
| [R-5.11-004],  [R-6.17.2-001] of 3GPP TS 22.280 [3] | List of MCData IDs, for which subscription information sharing is permitted. |  |  |  |  |
|  | > MCData ID | N | Y | Y | Y |

Table 6.15.2.10-3 contains the authorization part of the MCVideo user profile as described in 3GPP TS 23.281 Annex A.3.

Table 6.15.2.10-3: MCVideo user profile data (on and off network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCVideo UE | MCVideo Server | Configuration management server | MCVideo user database |
| [R-5.11-004],  [R-6.17.2-001] of 3GPP TS 22.280 [3] | List of MCVideo IDs, for which subscription information sharing is permitted. |  |  |  |  |
|  | > MCVideo ID | N | Y | Y | Y |

#### 6.15.2.11 Location information cancel subscription request

Table 6.X.2.11-1 describes the information flow from the MC service server or location management client in the primary MC system to the location management server in the partner MC system for the location information cancel subscription request.

Table 6.15.2.11-1: Location information cancel subscription request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE) | M | The MC service ID of the requesting MC service user located in the primary MC system |
| MC service ID list | M | List of the MC service IDs of MC service user(s) located in the partner MC system for who the subscription is cancelled |
| NOTE: This element is only present when the cancel subscription request is originated by an MC service client. | | |

#### 6.15.2.12 Location information cancel subscription response

Table 6.15.2.12-1 describes the information flow from the location management server in the partner MC system to the location management client or the MC service server in the primary MC system for location information cancel subscription response.

Table 6.15.2.12-1: Location information cancel subscription response

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID (see NOTE 1) | M | MC service ID of the requesting MC service user |
| Subscription status (see NOTE 2) | M | Indicates the cancel subscription result |
| NOTE 1: This element is only present when the cancel subscription request was originated by an MC service client.  NOTE 2: The subscription status provides the status for each MC service ID listed in the cancel subscription request. | | |

#### 6.15.2.13 Location information cancel subscription procedure

Figure 6.15.2.13-1 illustrates the high level procedure of location information cancel subscription request.

Pre-conditions:

- The MC service server or an authorized MC service user in the primary MC system is in possession of the MC service ID of the target MC service user in the partner MC system.

- The MC service user in the primary MC system has successful subscribed to location information of the target MC service user in the partner MC system.



Figure 6.15.2.13-1: Location information cancel subscription procedure

1. The MC service server or location management client in the primary MC system requests to cancel subscription to location information of MC service users located in the partner MC system.

2. The location management server in the primary MC system sends a location information cancel subscription request to the location management server in the partner MC system.

3. The location management server in the partner MC system replies with a location information cancel subscription response indicating the subscription status.

4. The location management server in the primary MC system sends the location information cancel subscription response indicating the cancel subscription status.

#### 6.15.2.14 Location reporting temporary configuration request

Table 6.15.2.14-1 describes the information flow from the location management client and location management server in the primary MC system to the location management server and location management client in the partner MC system for the location reporting temporary configuration request. This information flow may be sent individually addressed or group addressed on unicast or multicast (see 3GPP TS 23.280 clause 10.7.3.4.1).

Table 6.15.2.14-1: Location reporting temporary configuration request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | The MC service ID of the configuring MC service user located in the primary MC system |
| MC service ID or MC service group ID | M | The MC service ID or MC service group ID of MC service user(s) located in the partner MC system whose location reporting has to be configured |
| Temporary location reporting configuration | M | Provides set of location reporting parameters to be used temporarily. |
| Configuration expiration criteria | O | Criteria for restoration of original location reporting parameters (e.g. timer). |

#### 6.15.2.15 Location reporting temporary configuration response

Table 6.15.2.15-1 describes the information flow from the location management client and location management server in the partner MC system to the location management server and location management client in the primary MC system for the location reporting temporary configuration response.

Table 6.15.2.15-1: Location reporting temporary configuration response

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | The MC service ID of the configuring MC service user located in the primary MC system |
| MC service ID | M | The MC service ID located in the partner MC system whose location reporting has been configured |
| Result | M | Indicates the status of each configuration parameter |

#### 6.15.2.16 Location reporting temporary configuration procedure

Figure 6.15.2.16-1 illustrates the high level procedure of location reporting temporary configuration procedure.

Editor's Note: Current MC architecture intentionally does not allow configuration changes of any type from a remote system because of increased complexity. Only an authorized user which is homed to the system where the configuration change is resident may make such a change.

Pre-conditions:

- An authorized MC service user in the primary MC system is in possession of the MC service ID or the MC service group ID of the target MC service user(s) in the partner MC system.

- The MC service user in the primary MC system is authorized to configure the location reporting of the target MC service user(s) in the partner MC system.



Figure 6.15.2.16-1: Location reporting temporary configuration procedure

1. The location management client in the primary MC system requests to configure the location reporting of MC service user(s) located in the partner MC system.

2. The location management server in the primary MC system checks if the MC service user in the primary MC system is authorized to configure the location reporting of the target MC servicer user(s) in the partner MC system.

3. The location management server in the primary MC system sends the location reporting temporary configuration message to the location management server in the partner MC system.

4. The location management server in the partner MC system checks if the MC service user in the primary MC system is authorized to receive location information of the target MC service user(s) in the partner MC system

NOTE: Whether the authorization check is a specific check of the requesting MC service user or is a general policy check is outside the scope of this solution.

5. The location management server in the partner MC system sends the location reporting temporary configuration message to the location management client at the partner MC system.

6. The location management client in the partner MC system applies the request configuration.

7. The location management client in the partner MC system is providing the full status report on all configuration parameters, even if only one parameter has received a request of adaptation.

8. The location management server in the partner MC system sends the status response to the location management server in the primary MC system.

9. The location management server in the primary MC system sends the status response to the location management client in the primary MC system.

### 6.15.3 Solution Evaluation

This solution depends on changes to the functional model as proposed in solution 14.

This solution provides a set of information flows and procedures to allow location reporting from an interconnected partner MC system.

The interconnection architecture in 3GPP TS 23.280 does not permit configuration of a server or client in a partner system due to security concerns. Additional authorization checks would be required in case of performing location reporting configuration in interconnected MC systems under the administration of different organizations.

## 6.16 Solution 16: Sharing of past location information

### 6.16.1 Description

This solution addresses key issue #5 – Sharing of past location information.

The solution is to add a description to the corresponding parts of the location management in clause 10.9 of 3GPP TS 23.280 [7], which describes location information handling within one MC system.

### 6.16.2 Impacts on existing nodes and functionality

The following solution does not have an impact on the specified architecture.

#### 6.16.2.1 Location information request

Table 6.16.2.1-1 describes the information flow from the MC service server to the location management server and from the location management client to the location management server for requesting an immediate location information report together with optional past location information either defined by a number, a period of time or based on a specific trigger.

Table 6.16.2.1-1: Location information request

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | The MC service ID of the requesting MC service user |
| MC service ID list | M | List of MC service IDs of MC service user(s) whose location information is requested |
| Reporting start time | M | Indicates the requested time stamp as start time |
| Reporting end time | M | Indicates the requested time stamp as end time |
| Reporting triggering criteria | O | Indicates to send all reports triggered by this condition |

#### 6.16.2.2 Providing past location information from the location management server

The location management client can request past location information at any time by sending a location information request to the location management server. Past location information are provided by the location management server, if the location management server stores location information.



Figure 6.16.2.2-1: On-demand past location information procedure

1. The location management client requests location information by sending a location information request to the location management server.

2. The location management server checks if the location management client is authorized to receive past location information.

3. The location management server responds with one or several location information reports.

NOTE 1: The transmission of requested past location information reports does not interrupt the on-network location information reports.

NOTE 2: The latest location information report is transmitted first.

A method is necessary to allow the location management client to indicate the location management server to stop the transmission of past location information reports (e.g. in case of channel congestion).

#### 6.16.2.3 Identifying past location information

By using the associated timestamp within each location information, the location information is identified as past location information within each location information report.

#### 6.16.2.4 Time period to retain past location information

A minimum time period, e.g. 24 hours, for all MC service users to store location information received by the location management server from the location management client should be considered. Additional requirements, e.g. 180 days for all MC service users or a subset of MC service users, should be based on MC system operation guidelines or/and national regulations, which are outside of the scope of this solution.

An agreement defining the storing of location information of MC service users homed in the primary MC system but in collaboration with the partner MC system in case of interconnected MC systems either under the same or different organisation is outside of the scope of this solution.

#### 6.16.2.5 Authorization to request past location information

Table 6.16.2.5-1 contains the authorization part of the MCPTT user profile as described in 3GPP TS 23.379 Annex A.3.

Table 6.16.2.5-1: MCPTT user profile data (on and off network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCPTT UE | MCPTT Server | Configuration management server | MCPTT user database |
| [R-5.11-004],  [R-6.17.2-001] of 3GPP TS 22.280 [3] | List of MCPTT IDs, by whom past location information can be queried |  |  |  |  |
|  | > MCPTT ID | N | Y | Y | Y |

Table 6.16.2.5-2 contains the authorization part of the MCData user profile as described in 3GPP TS 23.282 Annex A.3.

Table 6.16.2.5-2: MCData user profile data (on and off network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCData UE | MCData Server | Configuration management server | MCData user database |
| [R-5.11-004],  [R-6.17.2-001] of 3GPP TS 22.280 [3] | List of MCData IDs, by whom past location information can be queried |  |  |  |  |
|  | > MCData ID | N | Y | Y | Y |

Table 6.16.2.5-3 contains the authorization part of the MCVideo user profile as described in 3GPP TS 23.281 Annex A.3.

Table 6.16.2.5-3: MCVideo user profile data (on and off network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCVideo UE | MCVideo Server | Configuration management server | MCVideo user database |
| [R-5.11-004],  [R-6.17.2-001] of 3GPP TS 22.280 [3] | List of MCVideo IDs, by whom past location information can be queried |  |  |  |  |
|  | > MCVideo ID | N | Y | Y | Y |

### 6.16.3 Solution Evaluation

The solution provides means to share past location information within one MC system stored on the location management server.

A new functionality to the location management server is introduced, which requires the location management server to store past location reports for the necessary period of time, for all users for who past reports might be requested.

## 6.17 Solution 17: Location information in off-network mode operation

### 6.17.1 Description

This solution addresses use case #11: Location information in off-network operation key issue at clause 4.11 as well as key issue #8: Location information in off-network operation at clause 5.8.

The MC service UE / MC user does not have to be, prior to the off-network mode of operation, authenticated and authorized in order to use the MC UE label as described in this document in clause 6.9.

The introduced MC UE label to the initial MC service UE configuration data (on-network) of this document in clause 6.9 is also used for off-network mode of operation. Together with solution #11 from of this document in clause 6.10, which describes the usage of the MC UE ID with each location information report and request, information flows are required for the location management during off-network mode of operation.

### 6.17.2 Impacts on existing nodes and functionality

#### 6.17.2.1 Location information report (off-network mode)

Table 6.17.2.1-1 describes the information flow from the location management client to one or more location management clients for the location information reporting during off-network mode of operation.

Table 6.17.2.1-1: Location information report (off-network mode)

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| List of MC service IDs (see NOTE 1 and NOTE 2) | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of the reporting MC user |
| MC UE ID (see NOTE 2) | O | MC UE ID of the reporting MC service UE |
| Triggering event | M | Identity of the event that triggered the sending of the report |
| Location Information | M | Location information |
| NOTE 1: Only present, if the MC user has been authenticated and authorized during on-network operation.  NOTE 2: At least one shall be present. | | |

#### 6.17.2.2 Location information report procedure (off-network mode)

Figure 6.17.2.2-1 illustrates the procedure of location information report for MC service UEs being in off-network mode of operation.

Pre-condition:

- All required MC service UEs are able to use off-network mode communication.



Figure 6.17.2.2-1: Location information report procedure (off-network mode)

1. A location information triggers occurs, which is maybe part of the periodic location information update process.

2. Location information client 1 is providing a location information report to all location management clients in the range of the location management client 1. The receiving location management clients could filter the location information on the basis of the selected MC service group to which the location management client 1 belongs.

#### 6.17.2.3 Location information request (off-network mode)

Table 6.17.2.3-1 describes the information flow from one location management client to another location management client for the location information requesting during off-network mode of operation.

Table 6.17.2.3-1: Location information request (off-network mode)

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| List of MC service IDs (see NOTE 1 and NOTE 2) | M | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) of the requesting MC user |
| MC UE ID (see NOTE 2) | O | MC UE ID of the requesting MC service UE |
| List of MC service IDs (see NOTE 1 and NOTE 3) | O | List of MC service IDs (e.g. MCPTT ID, MCData ID, MCVideo ID) from who the location information is requested |
| MC UE ID (see NOTE 3) | O | MC UE ID from who the location information is requested |
| NOTE 1: Only present, if the MC user has been authenticated and authorized during on-network operation.  NOTE 2: At least one shall be present.  NOTE 3: At least one shall be present. | | |

#### 6.17.2.4 Location information request procedure (off-network mode)

Figure 6.17.2.4-1 illustrates the procedure of location information request for MC service UEs being in off-network mode of operation communication.

Pre-condition:

- All required MC service UEs are able to use off-network mode of operation communication.

- Location management client 1 may does not know, that the location information client 2 is reachable.



Figure 6.17.2.4-1: Location information request (off-network mode)

1. Location information client 1 is requesting from location information client 2 the latest location information, by sending the location information request to all location information clients in the range of the location information client 1.

2. Location information client 2 is responding to the request with the latest location information, by sending the location information request to all location information clients in the range of the location information client 2.

### 6.17.3 Solution Evaluation

This solution adds the capability to handle location information while being in off-network state, by using the MC service ID, which has to be stored on the MC service UE.

Additional authorization checks may be required to provide and request location information while in off-network operation.

This solution also solves the issue of providing the required information for the authorization check.

# 7 Overall Evaluation

## 7.1 General

The following clauses contain an overall evaluation of the solutions presented in this technical report, and their applicability to the key issues raised. Clause 7.2 provides the mapping of key issues and described solutions as well as the solution evaluation. Clause 7.3 lists the key issues with security implications that will need consideration in 3GPP SA WG3.

## 7.2 Solution evaluation

Table 7.2-1 below shows the mapping of key issues to solutions.

Table 7.2-1: Mapping of key issues to solutions

|  |  |
| --- | --- |
| Key issue | Solution |
| 5.1 Key Issue 1: Information in the location report | 6.1 Solution 1: Additional details within the location information report  6.2 Solution 2: Additional details within the location information notification  6.3 Solution 3: Adjusting the location reporting procedure |
| 5.2 Key Issue 2: Location History Reporting | 6.6 Solution 6: Off-network storing of event-triggered location information  6.7 Solution 7: On-demand location history reporting  6.8 Solution 8: Triggered location history reporting |
| 5.3 Key Issue 3: Handling of triggering criteria in emergency cases | 6.4 Solution 4: Handling of triggering criteria in emergency cases |
| 5.4 Key Issue 4: Location mechanism compatibility for MCPTT | 6.5 Solution 5: Location management mechanism backward compatibility for MCPTT |
| 5.5 Key Issue 5: Sharing of location information | 6.13 Solution 13: Sharing location information across MC service UEs  6.14 Solution 14: Functional model for sharing location information across MC systems  6.15 Solution 15: Sharing location information for interconnected MC system |
| 5.6 Key Issue 6: Individual UE addressing | 6.9 Solution 9: Adding a UE label to Initial MC service UE configuration  6.10 Solution 10: Associate a user profile per MC service UE  6.11 Solution 11: MC UE identity (new ID) |
| 5.7 Key Issue 7: Location information of unauthenticated user | 6.12 Solution 12: Obtaining location of UE in "limited MC service" state |
| 5.8 Key Issue 8: Location information in off-network operation | 6.17 Solution 17: Location information in off-network mode operation |
| 5.9 Key Issue 9: Sharing of past location information | 6.16 Solution 16: Sharing of past location information |

Table 7.2-2 below shows the correlation of each solution and associated key issue(s).

Table 7.2-2: Solution evaluations

| Solution | Applicable key issues | Solution evaluation | Impact on other entities and working groups |
| --- | --- | --- | --- |
| Solution 1: Additional details within the location information report | Key Issue 1: Information in the location report | This solution provides additional details about location information elements contained in the location information report in 3GPP TS 23.280 clause 10.9.2.2. Currently identified elements are: timestamp, accuracy, speed, bearing, altitude, measurement code. Other elements that are already described in 3GPP TS 23.280 clause 10.9.3.1 may be considered as well. Definitions of all these elements may have to be provided in 3GPP TS 23.280 clause 3.1. | Impact on downstream groups to add attributes to location information. |
| Solution 2: Additional details within the location information notification | Key Issue 1: Information in the location report | This solution provides additional details about location information elements contained in the location information notification in 3GPP TS 23.280 clause 10.9.2.7. Currently identified elements are: timestamp, accuracy, speed, bearing, altitude, measurement code. Other elements that are already described in 3GPP TS 23.280 clause 10.9.3.1 may be considered as well. Definitions of all these elements may have to be provided in 3GPP TS 23.280 clause 3.1. | Impact on downstream groups to add attributes to location information. |
| Solution 3: Adjusting the location reporting procedure | Key Issue 1: Information in the location report | The current set of elements which describe triggers for the location information reporting in 3GPP TS 23.280 clause 10.9.3.1 are extended to add the conditions provided in solution 1 and solution 2. | Impact on downstream groups to add attributes to location information. |
| Solution 4: Handling of triggering criteria in emergency cases | Key Issue 3: Handling of triggering criteria in emergency cases | This solution provides an additional information element to ensure that triggering criteria can be adjusted separately for the emergency and non-emergency case.  As location information of a specific client may be needed, using an individual identity to address a specific client, should be taken into considerations. | No impact on downstream groups (see CR0469 to 3GPP TS 24.379 and CR0070 to 3GPP TS 24.281). |
| Solution 5: Location management mechanism backward compatibility for MCPTT | Key Issue 4: Location management mechanism backward compatibility for MCPTT | This solution solves the location management mechanism backward compatibility for MCPTT by enhancing the MCPTT server to determine the location management mechanism based on its capability (i.e., release version) and policy. | No impact on downstream groups. |
| Solution 6: Off-network storing of event-triggered location information | Key Issue 2: Location History Reporting | The solution adds a mechanism for configuring events, which will cause the location management client to store location reports while operating off-network. This does not affect any of the existing location management procedures. A separate set of off-network trigger criteria besides the on-network trigger criteria may be required.  The following configuration aspects may have to be defined for each location management client separately:  - Activation and de-activation to locally store location reports;  - Activation of automatic transmission of triggered events after the location management client returns from off-network operation; and  - Amount of location reports locally stored before the first location report while operating off-network will be overwritten. | Impact on downstream groups to a new trigger event as well as the capability to store location information. |
| Solution 7: On-demand location history reporting | Key Issue 2: Location History Reporting | The solution provides information flows and procedures for on-demand location information history reporting, after the location management client returns from off-network operation. The described solution does not affect any of the existing information flows and procedures for on-network operation. | Impact on downstream groups to request and receive stored location information from a UE. |
| Solution 8: Triggered location history reporting | Key Issue 2: Location History Reporting | The solution provides a procedure for triggered location history reporting on returning to on-network operation after the location management client has stored location reports while operating off-network, which does not affect any of the existing procedures. | Impact on downstream groups to receive stored location information from a UE. |
| Solution 9: Adding a UE label to Initial MC service UE configuration | Key Issue 6: Individual UE addressing | This solution adds a new entry to the existing Initial MC service UE configuration data (on-network) table, in order to identify a specific UE.  A solution is needed for how to transfer the MC UE label from the MC service client to the MC service server, and how the MC UE label is sent in conjunction with the MC service ID in delivery reports to MC service clients consuming these location reports. | Unknown impact on downstream groups. |
| Solution 10: Associate a user profile per MC service UE | Key Issue 6: Individual UE addressing | The solution has to be evaluated from the operative-tactical point of view.  The manual mapping allows meaningful MC service UE identifications, but requires an additional setup step for the MC service user.  The automatic mapping does not require an additional setup step for the MC service user, but requires additional impact to the existing architecture. | Unknown impact on downstream groups. |
| Solution 11: MC UE identity (new ID) | Key Issue 6: Individual UE addressing | Depending on the size of the MC UE identity, including the MC UE identity in the location report may have a large impact on message size. As location reports may be sent frequently this will decrease efficiency.  A mechanism may be needed to allow an MC service server to query the association of MC UE ID to a MC service user. | Impact on downstream groups to extend the existing information flows. |
| Solution 12: Obtaining location of UE in "limited MC service" state | Key Issue 7: Location information of unauthenticated user | FFS | FFS |
| Solution 13: Sharing location information across MC service UEs | Key Issue 5: Sharing of location information | This solution depends on the MC UE ID proposed in solution 11. The procedures and information flows have to be adapted after the overall evaluation of identifying location information of a specific MC UE ID have been completed. | Minor impact on downstream groups to add functionality to existing functional entities and reference points. |
| Solution 14: Functional model for sharing location information across MC systems | Key Issue 5: Sharing of location information | The functional model needs to be enhanced, as a new reference point between the location management servers in the primary and partner MC systems is needed.  A mechanism may be required in order to terminate a subscription for location information across MC systems. | Impact on downstream groups to add new information flows and procedures. |
| Solution 15 Sharing location information for interconnected MC system | Key Issue 5: Sharing of location information | This solution depends on changes to the functional model as proposed in solution 14.  This solution provides a set of information flows and procedures to allow location reporting from an interconnected partner MC system.  The interconnection architecture in 3GPP TS 23.280 does not permit configuration of a server or client in a partner system due to security concerns. Additional authorization checks would be required in case of performing location reporting configuration in interconnected MC systems under the administration of different organizations. | Impact on downstream groups to add new information flows and procedures. |
| Solution 16: Sharing of past location information | Key Issue 9: Sharing of past location information | The solution provides means to share past location information within one MC system stored on the location management server.  A new functionality to the location management server is introduced, which requires the location management server to store past location reports for the necessary period of time, for all users for who past reports might be requested. | Impact on downstream groups to add one new information flow and procedure. |
| Solution 17: Location information in off-network mode operation | Key Issue 8: Location information in off-network operation | This solution adds the capability to handle location information while being in off-network state, by using the MC service ID, which has to be stored on the MC service UE.  Additional authorization check may be required to provide and request location information while in off-network operation.  This solution also solves the issue of providing the required information for the authorization check. | Impact on downstream groups to add new information flows and procedures. |

## 7.3 Key issues with security implications

The following key issues have security considerations that will need review and possible solutions by SA3:

- Key Issue 5: Sharing of location information, subpart "e. Location information of one MC user at home MC system is shared with an outside 3GPP recipient."; and

- Key Issue 7: Location information of unauthenticated user.

# 8 Conclusions

This technical report presents use cases, key issues and solutions for enhancements to the location management of the mission critical architecture.

All key issues that are addressed by one or more solutions in this Technical Report are presented in clause 7.2, and key issues with security aspects are addressed in clause 7.3.

Solutions described in this Technical Report have impact on the functional model for MC services. These solutions provide updates to the functional models for MC services and enables the following enhancements:

- Support for additional details as part of the location information;

- Methods to handle location information during off-network;

- Association of location information to a specific MC service UE;

- Sharing of location information with other MC services as well as across MC systems; and

- Handling of past location.

A selection process should be undertaken to decide which additional identity from solutions 9 and 11 can be progressed.

Further study is needed on mechanisms that can provide a limited service state for the inclusion of an unauthenticated MC service user.

Handling of location information while being in IOPS mode of operation shall be added at a later stage, after 3GPP TS 23.180 is finalized.

Annex <A> (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2018-10 | SA6 #26 | S6-181526 |  |  |  | Initial skeleton | 0.0.0 |
| 2018-11 | SA6 #26 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-181527, S6-181578, S6-181579, S6-181580 | 0.1.0 |
| 2019-01 | SA6 #27 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-181804, S6-181805, S6-181807, S6-181844, and S6-181863 | 0.2.0 |
| 2019-02 | SA6 #28 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-190230, S6-190281, S6-190282, S6-190233, S6-190290, and S6-190093. | 0.3.0 |
| 2019-03 | SA6 #29 |  |  |  |  | Implementation of the following p-CR approved by SA6:  S6-190519. | 0.4.0 |
| 2019-04 | SA6 #30 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-190546, S6-190737, S6-190834, S6-190835. | 0.5.0 |
| 2019-05 | SA6 #31 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-191093. | 0.6.0 |
| 2019-05 | SA#84 | SP-190469 |  |  |  | Presentation for Information at SA#84 | 1.0.0 |
| 2019-07 | SA6 #32 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-191546. | 1.1.0 |
| 2019-10 | SA6 #33 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-191823, S6-191824, S6-191825, S6-191827, S6-191976,  S6-191977 | 1.2.0 |
| 2019-12 | SA6 #34 |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-192244, S6-192353, S6-192354, S6-192355, S6-192356,  S6-192366 | 1.3.0 |
| 2020-05 | SA6#36-e |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-200422 | 1.4.0 |
| 2020-06 | SA6#37-e |  |  |  |  | Implementation of the following p-CRs approved by SA6:  S6-200661, S6-200664, S6-200665, S6-200666, S6-200667,  S6-200668, S6-200669, S6-200906, S6-200910, S6-200911,  S6-200912, S6-200914, S6-200915, S6-200916 | 1.5.0 |