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| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Services and System Aspects;  Study on ad hoc group communication support for mission critical services;  (Release 18) | |
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# Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

# Introduction

The ad hoc group call allows authorised users to combine a set of MCX users based on implementation-specific criteria into a group call. The main characteristics of this ad hoc group call are:

a) The ad hoc group does not exist until it is spontaneously created during the call.

b) The ad hoc group ceases to exist when the call terminates.

c) The ad hoc group does not support 'persistent state' communication, e.g. emergency state.

MCX users that are combined in an ad hoc group call can be served by the same or different MCX systems. The ad hoc group call uses a common security level, priority level, floor control method, and set of operational characteristics for the participants during the call. As with any group call, the priority level can change dynamically.

The ad hoc group is used for a single call and it does not persist when the call is terminated. Authorized users can recreate the ad hoc group for subsequent calls, or request creation of a permanent MCX group from the participants in the ad hoc group call.

This technical report identifies the key issues and corresponding solutions with recommendations for the normative work.

# 1 Scope

The present document studies solutions to satisfy the requirements identified to support Ad hoc group communication for MCX services. It identifies enhancements to be included in the technical specifications for MCPTT, MCVideo, MCData and in the common functional architecture to support Ad hoc group communications. Requirements for this study are taken from 3GPP TS 22.280 [3].

# 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)".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

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

**Ad hoc Group Communication**: The combining of a multiplicity of MCX Users into a group for the duration of a communication and when the communication is terminated the group no longer exists.

For the purposes of the present document, the following terms given in 3GPP TS 22.280 [3] apply

**MCX UE**

**MCX User**

**Mission Critical**

**Mission Critical Service**

**Functional alias**

## 3.2 Symbols

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

<symbol> <Explanation>

## 3.3 Abbreviations

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

<ABBREVIATION> <Expansion>

# 4 Key issues

## 4.1 Key issue 1 – Ad hoc group communication

The requirements for MCX service Ad hoc group communication are captured in 3GPP TS 22.280 [3] clause 6.15.5.

Ad hoc group communication enables authorized MCX users to combine a random set of MCX Users into a group communication. The ad hoc group does not exist until it is spontaneously created during the communication and it ceases to exist once the communication is terminated. The participants of the ad hoc group communication may be served by the same or different MC systems.

Hence it is required to study the following:

- Procedures for establishing and release of the ad hoc group communication.

- Procedures for establishing the ad hoc group communication with end-to-end encryption support.

- Identify whether new information flows are required or existing information flows can be enhanced to support the ad hoc group communication set up.

- How to support different mechanisms for determining the participants list for the ad hoc group communication. It could be supplied by the initiator of the ad hoc group call or determined by the MCX system based on some pre-defined criteria.

- How to support a mechanism for the initiator of an MCX Service ad hoc group communication to request that the list of participants be determined and updated by the MCX Service system using a specific pre-defined criteria.

- Identify whether any changes are required to the existing MCX functional architecture for supporting the ad hoc group communication.

## 4.2 Key issue 2 – Network topology hiding from MC service client while establishing Ad hoc group communication

Ad hoc group communication enables authorized MCX users to combine a random set of MCX Users into a group communication. To best utilize the network resources, achieve best network performance and provide service resilience, a network operator normally deploys more than one MC service servers to serve its customers. This is applicable for all types of group communication and especially true in ad hoc group communications when it enables authorized users to combine a random set of MCX users into a group communication. This kind of deployment topology cannot be exposed and learned by the third party and only be controlled by the network operator. Ad hoc group is created spontaneously by the initiating client during the communication set up and therefore it leaves no choice for the network operators to decide on where to host the communication beforehand.

Hence it is required to study the following:

- How the group ID used for the ad hoc group communication can be created by MC service client and managed when establishing the ad hoc group communication.

- Whether and how to support the ad hoc group communication without exposing the network topology.

- Whether and how to support the ad hoc group communication with dynamically allocated network resources (such as the MC service server that will host the communication).

NOTE: This key issue also applies to existing specification of temporary groups creation by MC service client (e.g user regroup)

## 4.3 Key issue 3 – Configuration parameters for Ad hoc group communication

3GPP TS 22.280[3] has defined several requirements related to configuration of parameters required for ad hoc group communication by the administrator and initiator of the ad hoc group communication. Hence it is required to study the following :

- Identify the required system or service level configuration parameters and document them.

- Identify the user level configuration parameters and document them.

- Identify the default parameters to be configured which will be applied when these parameters are not supplied as part of the ad hoc group communication request by the initiator.

- How the MCX server shall be able to determine whether the user is authorized to initiate ad hoc group communication.

## 4.4 Key issue 4 – Modifying participants list of on-going ad hoc group communication

During the course of an on-going ad hoc group communication, the initiator of the ad hoc group communication can be able to add or remove particpants from the communication or the MCX system can add or remove participants based on some pre-defined criteria. This key issue is to identify the information flows and procedures required between the MCX client and MCX server to add/remove particpants to/from an on-going ad hoc group communication.

## 4.5 Key issue 5 – Ad hoc group emergency alert

Ad hoc group emergency alert enables MC service users to send an MC service emergency alert also to an ad hoc group. The participants of the ad hoc emergency alert group may be served by multiple MC systems.

It is required to study the following:

- How the solution for the ad hoc group communication can be reused for the ad hoc group emergency alert.

- Procedures for initiating and cancelling an ad hoc group emergency alert.

- Support of a functional alias as target for sending an alert notification.

- Whether any new information flows are required or whether existing ad hoc group information flows can be enhanced to support ad hoc group emergency alerts.

- Whether the participants list for the ad hoc group emergency alert needs any modification compared to an ad hoc group communication.

- Whether any changes are required to the existing MC functional model to support the ad hoc group emergency alert.

- Clarify whether and which additional information along with the alert indication is useful.

# 5 Architectural requirements

NOTE: No architectural requirements were identified.

# 6 Architectural enhancements

NOTE: No architectural enhancements were identified.

# 7 Solutions

## 7.1 Solution 1: Ad hoc group communication set up for MCX service

### 7.1.1 General

This solution addresses the key issue 1 described in the clause 4.1 to support ad hoc group communication set up for MCX service. Information flows and procedures that are required to address the key issue 1 are addressed in this section.

### 7.1.2 Information flows

#### 7.1.2.1 Ad hoc group communication request (MC service client – MC service server)

Table 7.1.2.1-1 describes the information flow ad hoc group communication request from the MC service client to the MC service server.

Table 7.1.2.1-1 Ad hoc Group communication request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service ad hoc group ID (see NOTE 1) | O | The MC service group ID which is generated by the MC service user to be associated with the ad hoc group communication |
| Encryption supported (see NOTE 2) | O | Indicates whether this ad hoc group communication supports end-to-end encryption |
| MC service ID list (see NOTE 3, NOTE 6) | O | MC service IDs of the participants being invited for the ad hoc group communication |
| SDP offer | M | Media parameters of MC service clients |
| Implicit floor request (see NOTE 4) | O | When originating client requests the floor, this element shall be included |
| Broadcast indicator | O | Indicates that the group communication request is for a broadcast group communication |
| Imminent peril indicator (see NOTE 5) | O | Indicates that the ad hoc group communication request is an MC service imminent peril communication |
| Emergency Indicator (see NOTE 5) | O | Indicates that the ad hoc group communication request is an MC service emergency communication |
| MC service ID list (see NOTE 3) | O | List of participants required to acknowledge the ad hoc group communication before start of the audio transmission |
| Block sharing participants list indicator (see NOTE 8) | O | Indicates that the participants shall be able to determine list of other participants or not |
| Location information | O | Location of the calling party. |
| Criteria for determining the participants (see NOTE 6) | O | Carries the details of criteria or meaningful label identifying the criteria or the combination of both which will be used by the MC service server for determining the participants e.g., it can be a location based criteria to invite particpants in a particular area |
| Preconfigured ad hoc group identity (see NOTE 7) | O | Group identity whose configuration is to be applied for this ad hoc group call. |
| Requested priority | O | Application priority level requested for this group communication |
| NOTE 1: If this information element is not included the MC service server shall assign one to be used for the ad hoc group communication and shall return it to the calling party to use in the ad hoc group communication.  NOTE 2: This information element shall be present and set to true only if this ad hoc group communication is encrypted. When the ad hoc group communication is initiated with participants provided by the initiator this acts as an indicator that subsequent requests shall follow targeting the individual participants and carrying the relevant key material. If this information element is set to false or not present, then this ad hoc group communication is unencrypted.  NOTE 3: This element shall be included only when the originating client sends the list of participants.  NOTE 4: This element shall be included only when the originating client requests the floor.  NOTE 5: If used, only one of these information elements shall be present.  NOTE 6: Only one of these information elements shall be present.  NOTE 7: This information element shall be included if the criteria for inviting the participants information element is present and end-to-end encryption is supported.  NOTE 8: This information element shall not be included if the criteria for inviting the participants information element is present. | | |

#### 7.1.2.2 Ad hoc group communication request return (MC service server – MC service client)

Table 7.1.2.2-1 describes the information flow ad hoc group communication request return from the MC service server to the MC service client.

Table 7.1.2.2-1 Ad hoc group communication request return information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| MC service ad hoc group ID | M | The MC service group ID to be associated with the ad hoc group communication which could be same as generated by the MC service client or assigned by the MC service server |
| Authorization result | M | Indicate if authorization is success or failure |

#### 7.1.2.3 AHGC share security material command (MC service client – MC service server)

Table 7.1.2.3-1 describes the information flow AHGC share security material command from the MC service client to MC service server.

Table 7.1.2.3-1 AHGC share security material command information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service ad hoc group ID | M | The MC service group ID which is generated by the MC service user to be associated with the ad hoc group communication |
| MC service ID | M | The MC service ID of the user being invited for the ad hoc group communication |
| Security key material | M | Key material to be shared with the target participant for use with the ad hoc group communication if end-to-end encryption supported |

#### 7.1.2.4 Ad hoc group communication request (MC service server – MC service client)

Table 7.1.2.4-1 describes the information flow ad hoc group communication request from the MC service server to the MC service client.

Table 7.1.2.4-1 Ad hoc group communication request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service ad hoc group ID | M | The MC service group ID to be associated with the ad hoc group communication |
| SDP offer | M | Media parameters of MC service server |
| Security key material (see NOTE 1) | O | Key material for use with the ad hoc group communication if end-to-end encryption supported |
| Broadcast indicator | O | Indicates that the ad hoc group communication request is for a broadcast ad hoc group communication |
| Imminent peril indicator (see NOTE 2) | O | Indicates that the ad hoc group communication request is an MC service imminent peril communication |
| Emergency Indicator (see NOTE 2) | O | Indicates that the ad hoc group communication request is an MC service emergency communication |
| Preconfigured ad hoc group identity | O | Group identity whose configuration is to be applied for this ad hoc group call. |
| NOTE 1: This information element shall be present if the participants list is provided by the initiator and if end-to-end encryption is supported.  NOTE 2: If used, only one of these information elements shall be present. | | |

#### 7.1.2.5 Ad hoc group communication response (MC service server – MC service client)

Table 7.1.2.5-1 describes the information flow ad hoc group communication response from the MC service server to the MC service client.

Table 7.1.2.5-1 Ad hoc group communication response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service group ID | M | The MC service group ID to be associated with the ad hoc group communication |
| SDP answer | M | Media parameters selected |
| Result | M | Result of the group communication request (success or failure) |

#### 7.1.2.6 Ad hoc group communication response (MC service client – MC service server)

Table 7.1.2.6-1 describes the information flow ad hoc group communication response from the MC service client to the MC service server.

Table 7.1.2.6-1 Ad hoc group communication response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the target MC service user |
| Functional alias | O | The functional alias of the target MC service user |
| MC service ad hoc group ID | M | The MC service group ID to be associated with the ad hoc group communication |
| SDP answer | M | Media parameters selected |
| Result | M | Result of the ad hoc group communication request (success or failure) |

#### 7.1.2.7 Ad hoc group communication release request (MC service server – MC service client)

Table 7.1.2.7-1 describes the information flow ad hoc group communication release request from the MC service server to the MC service client.

Table 7.1.2.7-1 Ad hoc group communication release request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the ad hoc group communication participant |
| Functional alias | O | The functional alias of the ad hoc group communication participant |
| MC service ad hoc group ID | M | The MC service group ID of the ad hoc group communication on which communication is released |

#### 7.1.2.8 Ad hoc group communication release response (MC service client – MC service server)

Table 7.1.2.8-1 describes the information flow ad hoc group communication release response from the MC service server to the MC service client.

Table 7.1.2.8-1 Ad hoc group communication release response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the ad hoc group communication participant |
| Functional alias | O | The functional alias of the ad hoc group communication participant |
| MC service group ID | M | The MC service group ID of the ad hoc group communication on which communication is released |

#### 7.1.2.9 Ad hoc group communication get userlist (MC service server – MC service server)

Table 7.1.2.9-1 describes the information flow ad hoc group communication get userlist from one MC service server to another MC service server.

Table 7.1.2.9-1: Ad hoc group communication get userlist

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| Criteria for determining the participants | M | Carries the details of criteria or meaningful label identifying the criteria or the combination of both which will be used by the MC service server for determining the participants e.g., it can be a location based criteria to invite particpants in a particular area |

#### 7.1.2.10 Ad hoc group communication get userlist response (MC service server – MC service server)

Table 7.1.2.10-1 describes the information flow ad hoc group communication get userlist response from one MC service server to another MC service server.

Table 7.1.2.10-1: Ad hoc group communication get userlist response

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID list | M | List of MC service IDs meeting the criteria specified in the ad hoc group communication get userlist |

#### 7.1.2.11 Group Call Notify (MC service server – MC service client)

Table 7.1.2.11-1 describes the information flow group call notify from MC service server to MC service client.

Table 7.1.2.11-1: Group Call Notify

|  |  |  |
| --- | --- | --- |
| Information element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service ad hoc group ID | M | The MC service group ID associated with the ad hoc group communication |
| MC service ID list (see NOTE) | O | The list of the invited MC service users who did not acknowledge the ad hoc group call request |
| NOTE: Only applicable to acknowledged group calls. | | |

### 7.1.3 Procedure

#### 7.1.3.1 Ad hoc group communication within one MC system

##### 7.1.3.1.1 Ad hoc group communication setup

Figure 7.1.3.1.1-1 below illustrates the ad hoc group communication setup procedure initiated by an authorized user.

Pre-conditions:

1. The authorized user at MC service client 1 wants to invite MC service users at MC service client 2, MC service client 3 and MC service client 4 for the ad hoc group communication.

2. Number of participants being invited for the communication is within the limit for non pre-configured approach.

3. End-to-End encryption is supported for this ad hoc group communication.

4. MC service client 1 is aware of the MC service IDs of the participants and has all the security related information required to communicate with the participants of the ad hoc group communication.

NOTE: Selection of MC service IDs of the participants can be manual or from the user profile configuration data or by any other means. This is left for the implementation.



Figure 7.1.3.1.1-1: Ad hoc group communication setup

1. User at MC service client 1 would like to initiate an ad hoc group communication. MC service client 1 initiates the ad hoc group communication by sending the ad hoc group communication request containing the list of participants to the MC service server. Encryption supported information element shall be set to true since end-to -end encryption is supported. The ad hoc group communication request may also contain block sharing participants list indicator information element set to true if the originating user want to suppress sharing of the participants list to other users. The ad hoc group communication request may include the MC service group ID that is created by the MC service client 1 or not include the MC service group ID that allow the MC service server to assign one for use. An SDP offer containing the MC service client media parameters is included. If there is a floor request to transmit, then the ad hoc group communication request contains an indication of an implicit floor request. If the MC service user of MC service client 1 has selected a functional alias, then the ad hoc group communication request contains that functional alias. If the ad hoc group communication request contains an implicit floor request it may also include location information.

If the MC service user at MC service client 1 initiates an MC service emergency ad hoc group communication or the MC service emergency state is already set for the MC service client 1 (due to a previously triggered MC service emergency alert):

i. the MC service ad hoc group communication request shall contain an emergency indicator;

ii. if the MC service emergency state is not set already, MC service client 1 sets its MC service emergency state. The MC service emergency state of MC service client 1 is retained until explicitly cancelled by the user of MC service client 1.

2. The MC service server accepts the ad hoc group communication request if the ad hoc group communication is supported and authorized. Otherwise reject the ad hoc group communication request and do not continue with the rest of the steps. If authorised, it validates whether the number of invited participants is within the configured limit before proceeding with the communication setup.

If functional alias is present, the MC service server checks whether the provided functional alias is allowed to be used and has been activated for the user.

If location information was included in the ad hoc group communication request, the MC service server checks the privacy policy of the MC service user to decide if the location information of MC service client 1 can be provided to other users on the communication (refer to Annex A.3 "Authorisation to provide location information to other MC service users on a communication when talking").

If an emergency indicator is present in the received MC service ad hoc group communication request, the MC service ad hoc group is considered to be in the in-progress emergency state until this ad hoc group communication is terminated; and

If an imminent peril indicator is present in the received MC service ad hoc group communication request, the MC service ad hoc group is considered to be in the in-progress imminent peril state until this ad hoc group communication is terminated.

The MC service server considers the ad hoc group communication participants as implicitly affiliated to the ad hoc group.

3. The MC service server shall send the ad hoc group communication request return message to MC service client 1 containing the below:

i. The MC service ad hoc group ID (e.g. either provided by MC service client 1 which is acceptable to the MC service server or generated by the MC service server in the case where the MC service ad hoc group ID created by the MC service client 1 is not acceptable or the case where the MC service ad hoc group ID was not provided by MC service client 1); and

ii. Result of whether the ad hoc group communication is authorized or not

If the ad hoc group communication request is not authorized, MC service client 1 shall not proceed with the rest of the steps.

4a-4c. MC service client 1 sends AHGC share security material command targeting each of the participants containing the security material to be shared with the participants for use in this ad hoc group communication.

NOTE 1: If end-to-end encryption is not supported, then the ad hoc group communication security material requests are not sent.

5a-5c. The MC service server sends the ad hoc group communication requests towards the MC service clients of the invited users based on step 1. While sending the ad hoc group communication requests, the MC service server shall remove the information elements that are not required to be conveyed to the target MC service clients (e.g. Block sharing participants list indicator, MC service ID list of the users who are required to acknowledge)

6a-6c. The receiving MC service clients are notified about the incoming ad hoc group communication.

7a-7c. The receiving MC service clients accept the ad hoc group communication requests and send ad hoc group communication responses to the MC service server. The response may also contain a functional alias of the responding MC service user, which is verified (valid and activated for the user) by the MC service server.

8. The MC service server sends the ad hoc group communication response to MC service client 1 through the signalling path to inform about successful communication establishment.

NOTE 2: Steps 5 to step 7 can start to occur before all of step 4 is completed since the MC service server do not require to wait for the previous ad hoc group communication request to complete before sending the ad hoc group request to another participant.

9. If the initiating MC service user requires the acknowledgement from the invited MC service users, and the required MC service users do not acknowledge the communication setup within a configured time (the "acknowledged communication setup timeout"), then the MC service server may proceed with or abandon the communication and then notify the initiating MC service user that the acknowledgements did not include all required members according to ad hoc group communication policy from the user profile configuration. The MC service server may notify the initiating MC service user of all MC service users who did not acknowledge the ad hoc group communication request within the configured time. This notification may be sent to the initiating MC service user by the MC service server more than once during the communication when MC service users join or leave the MC service ad hoc group communication.

10. MC service client 1, MC service client 2, MC service client 3 and MC service client 4 establish media plane and floor control resources.

NOTE 3: Step 10 can occur any time following step 8 if the conditions to proceed with the communication are met.

##### 7.1.3.1.2 Release ad hoc group communication

The procedure focuses on the case where the MC service server releases an ongoing MC service ad hoc group communication for all the participants of that ad hoc group communication, since at least one of the release conditions are met e.g., due to hang time expiry, last participant leaving, second last participant leaving, initiator leaving.

Figure 7.1.3.1.2-1 below illustrates the signalling control plane procedure for the MC service server initiating termination an ongoing ad hoc group communication.



Figure 7.1.3.1.2-1: Release ad hoc group communication

1. It is assumed that MC service users on MC service client 1, client 2 and client 3 are already part of the ongoing ad hoc group communication.

2. MC service server would like to release the MC service ad hoc group communication which is ongoing e.g., due to hang time expiry, last participant leaving, second last participant leaving, initiator leaving.

3. MC service server identifies the participants of the ongoing ad hoc group communication and generates ad hoc group communication release request to release ongoing session. The MC service server cancels the in-progress emergency state or in-progress imminent peril state of the ad hoc group if the ad hoc group communication is an emergency or imminent peril communication respectively.

4. MC service server sends ad hoc group communication release request via SIP core towards each participant of the ongoing ad hoc group communication.

5. MC service users are notified about the release of the ad hoc group communication.

6. MC service client(s) receiving ad hoc group communication release request, acknowledge towards the MC service server by sending an ad hoc group communication release response.

NOTE: If the participants list is not suppressed by the initiator of the ad hoc group communication, the MC service client(s) may choose to store the list of participants for easy re-initiation of another ad hoc group communication with the same participants.

7. MC service client 1, client 2 and client 3 have successfully released the floor control and media plane resources associated with the ad hoc group communication that is terminated and the ad hoc group ceases to exist (i.e., further communication is not possible over the same ad hoc group.

##### 7.1.3.1.3 MC service server determining the participants list for the Ad hoc group communication setup

Figure 7.1.3.1.3-1 below illustrates the ad hoc group communication setup procedure initiated by the MC service user and MC service client 1 wherein the list of participants is determined by the MC service server based on the citeria received from the MC service client.

Pre-conditions:

1. The MC service user at MC service client 1 is authorized to initate ad hoc group communication.

2. The MC service user at MC service client 1 wants to invite MC service users who are satisying certain criteria for the ad hoc group communication.



Figure 7.1.3.1.3-1: Ad hoc group communication participants determined by MC service server

1. User at MC service client 1 would like to initiate an ad hoc group communication in-order to invite the participants satisfying specific criteria. MC service client 1 initiates the ad hoc group communication by sending the ad hoc group communication request containing the details of the criteria to be applied by the MC service server for determining the participants list. If end-to-end encryption is supported Encryption supported information element shall be set to true and pre-configured ad hoc group identity whose configuration is to be applied is included. The ad hoc group communication request may include the MC service group ID that is created by the MC service client 1 or not include the MC service group ID that allow the MC service server to assign one for use. An SDP offer containing the MC service client media parameters is included. If there is a floor request to transmit, then the ad hoc group communication request contains an indication of an implicit floor request. If the MC service user of MC service client 1 has selected a functional alias, then the ad hoc group communication request contains that functional alias. If the ad hoc group communication request contains an implicit floor request it may also include location information.

If the MC service user at MC service client 1 initiates an MC service emergency ad hoc group communication or the MC service emergency state is already set for the MC service client 1 (due to a previously triggered MC service emergency alert):

i. the MC service ad hoc group communication request shall contain an emergency indicator;

ii. if the MC service emergency state is not set already, MC service client 1 sets its MC service emergency state. The MC service emergency state of MC service client 1 is retained until explicitly cancelled by the user of MC service client 1.

2. The MC service server accepts the ad hoc group communication request if the ad hoc group communication is supported and authorized. Otherwise reject the ad hoc group communication request and do not continue with the rest of the steps.

If functional alias is present, the MC service server checks whether the provided functional alias is allowed to be used and has been activated for the user.

If location information was included in the ad hoc group communication request, the MC service server checks the privacy policy of the MC service user to decide if the location information of MC service client 1 can be provided to other users on the communication (refer to Annex A.3 "Authorisation to provide location information to other MC service users on a communication when talking").

If an emergency indicator is present in the received MC service ad hoc group communication request, the MC service ad hoc group is considered to be in the in-progress emergency state until this ad hoc group communication is terminated; and

If an imminent peril indicator is present in the received MC service ad hoc group communication request, the MC service ad hoc group is considered to be in the in-progress imminent peril state until this ad hoc group communication is terminated.

3. The MC service server shall send the ad hoc group communication request return message to MC service client 1 containing the below:

i. The MC service ad hoc group ID (e.g. either provided by MC service client 1 which is acceptable to the MC service server or generated by the MC service server in the case where the MC service ad hoc group ID created by the MC service client 1 is not acceptable or the case where the MC service ad hoc group ID was not provided by MC service client 1); and

ii. Result of whether the ad hoc group communication is authorized or not

If the ad hoc group communication request is not authorized, MC service server and client 1 shall not proceed with the rest of the steps.

4. The MC service server determines the list of participants to be invited for the ad hoc group communication based on the information present in the information element Criteria for determining the participants. This information element could carry either criteria or indicator identifying the criteria or combination of both.

5. The MC service server sends the ad hoc group communication requests towards the MC service clients 2 and 3. While sending the ad hoc group communication requests, the MC service server shall remove the information elements that are not required to be conveyed to the target MC service clients. This request carries the pre-configured group ID whose configuration is to be applied for this ad hoc group communication if end-to-end encryption is requested. The MC service server considers the ad hoc group communication participants as implicitly affiliated to the ad hoc group.

6. The receiving MC service clients are notified about the incoming ad hoc group communication.

7. The receiving MC service clients accept the ad hoc group communication requests and send ad hoc group communication responses to the MC service server. The response may also contain a functional alias of the responding MC service user, which is verified (valid and activated for the user) by the MC service server.

8. The MC service server sends the ad hoc group communication response to MC service client 1 through the signalling path to inform about successful communication establishment.

9. The MC service server may notify the initiating MC service user of all MC service users who acknowledged the ad hoc group communication request and joined the ad hoc group communication. This notification may be sent to the initiating MC service user by the MC service server more than once during the communication when MC service users join or leave the MC service ad hoc group communication.

10. MC service client 1, MC service client 2 and MC service client 3 establish media plane and floor control resources.

#### 7.1.3.2 Ad hoc group communication involving multiple MC system

##### 7.1.3.2.1 Ad hoc group communication setup – Participants list provided by the initiator

Figure 7.1.3.2.1-1 below illustrates the ad hoc group communication setup procedure initiated by an authorized user involving the MC service users from multiple MC system.

Pre-conditions:

1. The authorized user at MC service client 1 wants to invite MC service users at MC service client 2, MC service client 3 and MC service client 4 for the ad hoc group communication.

2. MC service client 1 and MC service client 2 are registered to the MC service provider 1. MC service client 3 and MC service client 4 are registered to MC service provider 2.

3. Number of participants being invited for the communication is within the limit.

4. End-to-End encryption is supported for this ad hoc group communication.

5. MC service client 1 has all the security related information required to communicate with the participants of the ad hoc group communication.



Figure 7.1.3.2.1-1: Ad hoc group communication setup involving multiple MC systems

1-5a. Same as described in sub-clause 7.1.3.1.1.

5b-5c. The MC service server sends the ad hoc group communication requests for MC service client 3 and MC service client 4 to the MC service server 2. While sending the ad hoc group communication requests, the MC service server shall remove the information elements that are not required to be conveyed to the target MC service clients (e.g. Block sharing participants list indicator, MC service ID list of the users who are required to acknowledge) and shall include the security key material as received in steps 4b and 4c.

6a-6b. The MC service server 2 forwards the ad hoc group communication requests to the MC service client 3 and MC service client 4.

7a-7c. The receiving MC service clients are notified about the incoming ad hoc group communication.

8. The MC service client 2 accept the ad hoc group communication request and send ad hoc group communication response to the MC service server 1.

9a-9b. The MC service client 3 and MC service client 4 accepts the ad hoc group communication request and sends ad hoc group communication responses to the MC service server 2.

10a-10b. The MC service server 2 forwards the responses to the MC service server 1.

11. The MC service server sends the ad hoc group communication response to MC service client 1 through the signalling path to inform about successful communication establishment.

12. The MC service server may notify the initiating MC service user of all MC service users who acknowledged the ad hoc group communication request and joined the ad hoc group communication. This notification may be sent to the initiating MC service user by the MC service server more than once during the communication when MC service users join or leave the MC service ad hoc group communication.

13. MC service client 1, MC service client 2, MC service client 3 and MC service client 4 establish media plane and floor control resources.

NOTE: How to handle the end-to-end encryption when the MC service client 1 does not have the required security related information to communicate with the participants of the ad hoc group communication is in the scope of SA3.

##### 7.1.3.2.2 Ad hoc group communication setup – Participants list determined by the MC service server

Figure 7.1.3.2.2-1 below illustrates the ad hoc group communication setup procedure initiated by an authorized user wherein the list of participants is determined by the MC service server based on the citeria received from the MC service client and determined MC service users are from multiple MC systems.

Pre-conditions:

1. The MC service user at MC service client 1 is authorized to initate ad hoc group communication.

2. End-to-End encryption is supported for this ad hoc group communication.



Figure 7.1.3.2.2-1: Ad hoc group communication setup involving multiple MC systems

1-4. Same as described in sub-clause 7.1.3.1.3.

5. MC service server 1 if it needs to involve the partner system based on the agreement and based on the criteria for determining the participants list, sends the ad hoc group communication get userlist request to the MC service server 2. This request carries the criteria specified in the step 1 .

6. MC service server 2 evaluates the criteria and determines the particpants satisfying the criteria and sends the response containing the list of MC service users satisfying the criteria

7. The MC service server 1 sends the ad hoc group communication request towards the MC service server 2. This request carries the list of MC service users who needs to be invited for this ad hoc group communication and are registered with MC service server 2. It also carries the pre-configured group ID whose configuration is to be applied for this ad hoc group communication if end-to-end encryption is requested.

8a-8b. The MC service server 2 sends the ad hoc group communication request towards the MC service client 3 and MC service client 4.

9. The MC service server 1 sends the ad hoc group communication requests towards the MC service client 2. While sending the ad hoc group communication request, the MC service server shall remove the information elements that are not required to be conveyed to the target MC service clients. This request carries the pre-configured group ID whose configuration is to be applied for this ad hoc group communication if end-to-end encryption is requested. The MC service server considers the ad hoc group communication participants as implicitly affiliated to the ad hoc group.

10a-10c. The receiving MC service clients are notified about the incoming ad hoc group communication.

11. The MC service client 2 accept the ad hoc group communication request and send ad hoc group communication response to the MC service server 1.

12a-12b. The MC service client 3 and MC service client 4 accepts the ad hoc group communication request and sends ad hoc group communication responses to the MC service server 2.

13a-13b. The MC service server 2 forwards the responses to the MC service server 1.

14. The MC service server 1 sends the ad hoc group communication response to MC service client 1 through the signalling path to inform about successful communication establishment.

15. The MC service server 1 may notify the initiating MC service user of all MC service users who acknowledged the ad hoc group communication request and joined the ad hoc group communication. This notification may be sent to the initiating MC service user by the MC service server 1 more than once during the communication when MC service users join or leave the MC service ad hoc group communication.

16. MC service client 1, MC service client 2, MC service client 3 and MC service client 4 establish media plane and floor control resources.

### 7.1.4 Solution Evaluation

The procedures proposed as part of this solution handles the ad hoc group communication setup and release as per the key issue 1. It also achieves the end-to-end security as per the stage-1 requirements. This solution introduces a new set of information flows required for ad hoc group communication. It also proposes a mechanism for the ad hoc group communication setup wherein the particpants of the communication is determined by the MC service server based on the criteria which is either pre-defined or supplied by the initiator of the communication.

Further the proposed solutions provide flexibility for the deployments to use the ad hoc group ID provided by the MC service client or the MC service server can generate and share the same to the initiator of the ad hoc group communication. This solution may require additional deployment considerations e.g. to configure the maximum number of participants allowed to participate in an ad hoc group communication, to meet the Stage 1 group call KPIs.

The procedures proposed as part of this solution implicitly handles the Key issue #2 related to network topology hiding from MC service client while establishing Ad hoc group communication by having the ad hoc group ID generated by the MC service server.

## 7.2 Solution 2: Ad hoc group call involving multiple MC systems

### 7.2.1 General

This solution pertains to key issue#1. The key characteristics of ad hoc group call are the following:

- The ad hoc group does not exist until it is spontaneously created during the ad hoc group call setup.

- The ad hoc group ceases to exist when the communication terminates with the ad hoc group call release.

### 7.2.2 Solution description

#### 7.2.2.1 Procedures

##### 7.2.2.1.1 Procedure for ad hoc group call setup

Figure 7.2.2.1.1-1 illustrates the procedure for ad hoc group call setup procedure.

Pre-conditions:

1. The security aspects of sharing the user information between primary and partner MC systems shall be governed as per the service provider agreement between them. In this case, we consider the partner MC system does not share their users' information to the primary MC system.

2. The authorized MC service user/dispatcher belongs to the primary MC system.

3. The MC service server of the primary MC system is where the authorized MC service user/dispatcher creates the ad hoc group.

4. Some users of the ad hoc group may belong to partner MC systems.

5. The ad hoc group identity and ad hoc group configuration for an ad hoc group have been preconfigured in MC service client and other participants of ad hoc group have also received the relevant security related information to allow them to communicate in an ad hoc group communication.

6. The call initiating MC service client is aware of a suitable preconfigured ad hoc group whose configuration has been preconfigured in the MC service UEs who are the participants of the ad hoc group.



Figure 7.2.2.1.1-1: Ad hoc group call setup

1. The MC service client of authorized user initiates a group call with multiple users from primary and partner MC systems. A group call request message with the information of the MC service IDs and the pre-configured ad hoc group is routed to the MC service server of the primary MC system.

2. The MC service server of the primary MC system forms the ad hoc group by using MC service users' information and the configuration of the preconfigured ad hoc group received in step 1 and assigns a MC service group ID for the newly formed ad hoc group. It identifies the appropriate MC service server responsible for the MC service users of the ad hoc group. The MC service users are automatically affiliated to the ad hoc group.

NOTE 1: The newly formed ad hoc group information including the MC service group ID and the list of users is held in dynamic data in the MC service server.

3. The MC service server of the primary MC system sends the group call request to the affiliated group members of the ad hoc group belonging to the primary MC system.

4. The MC service clients receive in the group call request the information of the MC service group ID for the ad hoc group and further notify their corresponding MC service user. The affiliated group members of the ad hoc group of the primary MC system may accept or reject the call and respond with the group call response.

5. The primary MC service server further initiates a group call request message to the MC service server of the partner MC system for the ad hoc group's MC service users' belonging to partner MC system.

6. Upon receiving the group call request message from the MC service server of the primary MC system, the MC service server of the partner MC system initiates a call invitation to its MC service users and sends the group call request to the MC service users of the partner MC system.

7. The MC service clients receive in the group call request the information of the MC service group ID for the ad hoc group and further notify their corresponding MC service user. The MC service users upon receipt of the invitation may accept or reject the call, and respond with the group call response.

8. The MC service server of the partner MC system provides a group call response message to the MC service server of the primary MC system with success or failure result and/or detailed reason information in case of failure.

9. The MC service server of the primary MC system provides a group call response message to the MC service client of the authorized MC service user upon receiving response to the corresponding group call request with the MC service server of the partner MC system. The group call response will consist of the success or failure result and/or detailed reason information in case of failure. The MC service client 1 receives the MC service group ID assigned for the ad hoc group via this step.

NOTE 2: The group call response message is triggered depending on the conditions to proceed with the call.

10. Upon successful group call setup, a group call is established amongst the multiple group members from primary and partner MC systems. The media plane and floor control resources are established.

##### 7.2.2.1.2 Procedure for ad hoc group call release

This procedure focuses on the case where an MC service server initiates the termination of an ongoing MC service ad hoc group call for all the participants of that group call, since at least one of the termination conditions are met e.g., due to hang time expiry, last participant leaving, second last participant leaving, initiator leaving, or minimum number of affiliated MC service group members are not present.

Procedures in figure 7.2.2.2-1 are the signalling control plane procedures for the MC service server initiating termination of an ongoing MC service ad hoc group call.



Figure 7.2.2.2-1: Ad hoc group call release

1. It is assumed that MC service users on MC service client 1, client 2 belonging to primary MC system and client 3 belonging to partner MC system are already part of the ongoing ad hoc group call (e.g. as a result of ad hoc group call setup as specified in clause 7.2.2.1.1).

2. The MC service server would like to release the MC service group call which is ongoing e.g., due to hang time expiry, last participant leaving, second last participant leaving, initiator leaving, or minimum number of affiliated MC service group members are not present.

3. The MC service server identifies the participants of the ongoing ad hoc group call and generates group call release request to release ongoing session.

4. The MC service server sends a group call release request via SIP core towards each participant of the ongoing group call. If the participants belong to partner MC system, then group call release request is sent to the partner MC service server, which further sends the group call release request to the MC service clients.

5. The MC service users are notified about the release of the ad hoc group call.

6. The MC service client(s) receiving group call release request, send acknowledgement towards the MC service server by sending a group call release response.

7. The MC service client 1, client 2 and client 3 have successfully released the floor control and media plane resources associated with the group call that is terminated. The MC service servers remove the ad hoc group information from the dynamic data held in the MC service servers and thus the ad hoc group ceases to exist.

#### 7.3.2.1 Information Flows

##### 7.3.2.1.1 Group call request (MC service client – MC service server)

Table 7.3.2.1.1-1 describes the information flow group call request from the MC service client to the MC service server. The group call request information flow specified in MC service specifications is to be updated accordingly as shown in **bold**.

Table 7.3.2.1.1-1 Group call request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service group ID **(see NOTE 1)** | **O** | The MC service group ID of the group on which the call is requested |
| **MC service ID list (see NOTE 2)** | **O** | **The list of MC service IDs on which the group call is requested.** |
| **Preconfigured ad hoc group identity (see NOTE 2)** | **O** | **Ad hoc group identity whose configuration is to be applied on the group call.** |
| SDP offer | M | Media parameters of MC PTT clients |
| Implicit floor request | O | When originating client requests the floor, this element shall be included |
| Broadcast indicator | O | Indicates that the group call request is for a broadcast group call |
| Location information | O | Location of the calling party. |
| Requested priority | O | Application priority level requested for this call |
| **NOTE 1: This IE may be included when the group call is an ad hoc group call. This IE is always included for other group calls**  **NOTE 2: These IEs are included when the group call is an ad hoc group call.** | | |

##### 7.3.2.1.2 Group call request (MC service server – MC service server)

Table 7.3.2.1.2-1 describes the information flow group call request between the MC service servers. The group call request information flow specified in MC service specifications is to be updated accordingly as shown in **bold**.

Table 7.3.2.1.2-1 Group call request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service group ID **(see NOTE 3)** | M | The MC service group ID of the group on which the call is initiated |
| **MC service ID list (see NOTE 2)** | **O** | **The list of MC service IDs of ad hoc group's MC service users' belonging to partner MC system on which the group call is requested.** |
| **Preconfigured ad hoc group identity (see NOTE 2)** | **O** | **Ad hoc group identity whose configuration is to be applied on the group call.** |
| SDP offer | M | Media parameters of MC service server |
| Broadcast indicator | O | Indicates that the group call request is for a broadcast group call |
| Implicit floor request (see NOTE 1) | O | Indicates that the originating client requests the floor. |
| Requested priority | O | Priority level requested for the call. |
| Location information | O | Location of the calling party |
| NOTE 1: This element shall be included only when the originating client requests the floor.  **NOTE 2: These IEs are included when the group call request is for ad hoc group call.**  **NOTE 3: If Preconfigured ad hoc group identity IE or MC service ID list is included then MC service group ID IE indicates the MC service group ID of the ad hoc group.** | | |

##### 7.3.2.1.3 Group call request (MC service server – MC service client)

Table 7.3.2.1.3-1 describes the information flow group call request from the MC service server to the MC service client. The group call request information flow specified in MC service specifications is to be updated accordingly as shown in **bold**.

Table 7.3.2.1.3-1 Group call request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service group ID | M | The MC service group ID of the group on which the call is initiated. |
| **Preconfigured ad hoc group identity (see NOTE 1)** | **O** | **Ad hoc group identity whose configuration is to be applied on the group call.** |
| SDP offer | M | Media parameters of MC service server |
| Broadcast indicator | O | Indicates that the group call request is for a broadcast group call |
| **NOTE 1: This IE is included when the group call request is for ad hoc group call.** | | |

##### 7.3.2.1.4 Group call response (MC service server – MC service client)

Table 7.3.2.1.4-1 describes the information flow group call response from the MC service server to the MC service client. No change is expected to the group call response information flow specified in MC service specifications.

Table 7.3.2.1.4-1 Group call response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service group ID | M | The MC service group ID of the group on which the call is requested |
| SDP answer | M | Media parameters selected |
| Result | M | Result of the group call request (success or failure) |

##### 7.3.2.1.5 Group call response (MC service server – MC service server)

Table 7.3.2.1.5-1 describes the information flow group call response between the MC service servers. No change is expected to the group call response information flow specified in MC service specifications.

Table 7.3.2.1.5-1 Group call response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the target MC service group member |
| Functional alias | O | The functional alias of the target MC service group member |
| MC service group ID | M | The MC service group ID of the group on which the call is requested |
| SDP answer | M | Media parameters selected |
| Result | M | Result of the group call request (success or failure) |

##### 7.3.2.1.6 Group call response (MC service client – MC service server)

Table 7.3.2.1.6-1 describes the information flow group call response from the MC service client to the MC service server. No change is expected to the group call response information flow specified in MC service specifications.

Table 7.3.2.1.6-1 Group call response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the target MC service group member |
| Functional alias | O | The functional alias of the target MC service group member |
| MC service group ID | M | The MC service group ID of the group on which the call is initiated |
| SDP answer | M | Media parameters selected |
| Result | M | Result of the group call request (success or failure) |

### 7.3.3 Solution Evaluation

This is a viable solution to setup and release an ad hoc group call where the ad hoc group is created during the group call setup and the ad hoc group is removed when the group call is released thus the ad hoc group ceases to exist. This procedure achieves the required performance and security as per the stage 1 requirements for a group call. The group call security is achieved via the use of a preconfigured ad hoc group information and its group security information is applied on the ad hoc group call.

## 7.3 Solution 3: Configuration parameters required for Ad hoc group communication

### 7.3.1 General

This solution addresses the key issue 3 described in clause 4.3 on configuration parameters required for supporting ad hoc group communication. This clause identifies the list of configuration parameters and which category of the configuration data they belong to.

### 7.3.2 MC service configuration data

Table 7.3.2-1 describes MCPTT service configuration data required for the ad hoc group communication.

Table 7.3.2-1: MCPTT service configuration data (on‑network)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference | Parameter description | MCPTT UE | MCPTT server | Configuration management server |
| [R-6.15.5.3-005] of 3GPP TS 22.280 [17] | Support of ad hoc group call | Y | Y | Y |
| [R-6.15.5.3-002] of 3GPP TS 22.280 [17] | Maximum number of particpants allowed to participate in an ad hoc group communication | Y | Y | Y |
| [R-6.15.5.3-004] of 3GPP TS 22.280 [17] | Hang timer for ad hoc group communication | N | Y | Y |
|  | Maximum duration for ad hoc group communication | Y | Y | Y |
|  | List of preferred voice codecs for ad hoc group call | Y | Y | Y |

### 7.3.3 MC service user profile configuration data

Table 7.3.3-1 describes MCPTT user profile configuration data required for the ad hoc group communication.

Table 7.3.3-1: MCPTT user profile configuration data (on‑network)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference | Parameter description | MCPTT UE | MCPTT server | Configuration management server | MCPTT user database |
|  | Permissions related to ad hoc group communication |  |  |  |  |
| [R-6.15.5.3-001] of 3GPP TS 22.280 [17] | > Authorised to initiate ad hoc group call | Y | Y | Y | Y |
| R-6.15.5.3-003] of 3GPP TS 22.280 [17] | > Authorised to participate in ad hoc group call | Y | Y | Y | Y |
|  | > Authorised to initiate emergency ad hoc group call | Y | Y | Y | Y |
|  | > Authorised to initiate imminent peril ad hoc group call | Y | Y | Y | Y |

### 7.3.4 Solution Evaluation

This solution provides additional configuration parameters that are required to support MCX ad hoc group communication procedures. Parameters proposed as part of this solution are based on the requirements specified in 3GPP TS 22.280 [3].

## 7.4 Solution 4: Modifying participants list of on-going ad hoc group communication

### 7.4.1 General

This solution addresses the key issue 4 described in clause 4.4 on Modifying participants list of on-going ad hoc group communication. Information flows and procedures that are required to address the key issue 4 are addressed in this section.

### 7.4.2 Information flows

#### 7.4.2.1 Modify ad hoc Group call participants request (MC service client – MC service server)

Table 7.4.2.1-1 describes the information flow Modify ad hoc Group call participants request from the MC service client to the MC service server.

Table 7.4.2.1-1 Modify ad hoc group call participants request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service ad hoc group ID | M | The MC service group ID of ad hoc group call whose participants list needs to be modified |
| MC service ID list (see NOTE 1) | O | List of additional MC service users to be added to the on-going ad hoc group call |
| MC service ID list (see NOTE 1) | O | List of MC service users to be removed from the on-going ad hoc group call |
| NOTE 1 : Either one or both of these elements shall be present | | |

#### 7.4.2.2 Modify ad hoc group call participants response (MC service server – MC service client)

Table 7.4.2.2-1 describes the information flow Modify ad hoc group call participants response from the MC service server to the MC service client.

Table 7.4.2.2-1 Modify Ad hoc group call participants response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the calling party |
| Functional alias | O | The functional alias of the calling party |
| MC service ad hoc group ID | M | The MC service group ID of ad hoc group call whose participants list needs to be modified |
| Result | M | Result of the modify ad hoc group call participants request (success of failure) |
| MC service ID list | O | List of MC service users who are not allowed to be added to the on-going ad hoc group call |

#### 7.4.2.3 Ad hoc group call leave request (MC service server – MC service client)

Table 7.4.2.3-1 describes the information flow ad hoc group call leave request from the MC service server to the MC service client.

Table 7.4.2.3-1 Ad hoc group call leave request information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the ad hoc group call participant leaving the call |
| MC service ad hoc group ID | M | The MC service group ID of ad hoc group call on which call is on-going |
| Reason to leave | O | Carries the reason of why the MC service client is being asked to leave the ongoing ad hoc group call |

#### 7.4.2.4 Ad hoc group call leave response (MC service client – MC service server)

Table 7.4.2.4-1 describes the information flow Ad hoc group call leave response from the MC service client to the MC service server.

Table 7.4.2.4-1 Ad hoc group call leave response information elements

|  |  |  |
| --- | --- | --- |
| Information Element | Status | Description |
| MC service ID | M | The MC service ID of the ad hoc group call participant leaving the call |
| MC service ad hoc group ID | M | The MC service group ID of ad hoc group call on which call is on-going |

### 7.4.3 Procedure

#### 7.4.3.1 Modification of ad hoc group communication participants by the initiator

Figure 7.4.3.1-1 below illustrates the modification of ad hoc group communication participants procedure by the initiator of the ad hoc group communication.

Pre-conditions:

1. The MC service client 1 is the initiator of the ad hoc group communication.

2. The MC service users on MC service client 1, MC service client 3 to MC service client n are on an ongoing ad hoc group communication.

3. The MC service user 1 requests to remove the user of MC service client 3 from the ad hoc group communication and add user of MC service client 2 into the on-going ad hoc group communication.



Figure 7.4.3.1-1: Modification of ad hoc group communication participants by the initiator

1. The MC service client 1 sends the modify ad hoc group call participants request to the MC service server inorder to remove MC service client 3 from the ongoing ad hoc group communication and add MC service client 2 into it.

2. The MC service server verifies whether the MC service client 1 is authorized to add or remove(modify) the participants of the on-going ad hoc group communication.

3. The MC service server sends the modify ad hoc group communication participants response to the MC service client 1.

4. The MC service server sends the ad hoc group call leave request to the MC service client 3 in order to remove it from the on-going ad hoc group communication.

5. The MC service client 3 notifies the user of the ad hoc group call leave request.

6. The MC service client 3 sends the ad hoc group call leave response to the MC service server.

7. The MC service server removes the MC service client 3 from the ongoing ad hoc group communication.

8. MC service client 1 sends AHGC share security material command to the MC service targeting MC service client 2 containing the security material to be shared with the MC service client 2 for use in this ad hoc group communication.

NOTE: Steps 8 to 11 can occur at any time following step 3.

9. The MC service server sends the ad hoc group communication request towards MC service client 2.

10. The receiving MC service client 2 notifies the user about the incoming ad hoc group communication.

11. The MC service client 2 accepts the ad hoc group communication request and send ad hoc group communication responses to the MC service server. The response may also contain a functional alias of the responding MC service user, which is verified (valid and activated for the user) by the MC service server.

12. The MC service server may notify the initiating MC service user of all the users who are added to the on-going ad hoc group communication. This notification may be sent to the initiating MC service user by the MC service server more than once during the call when MC service users join or leave the ad hoc group communication.

13. The MC service server may notify the participants about the change in the participants list of on-going ad hoc group communication.

#### 7.4.3.2 Modification of ad hoc group communication participants by the MC service server

Figure 7.4.3.2-1 below illustrates the modification of ad hoc group communication participants procedure by the MC service server.

Pre-conditions:

1. The MC service client 1 is the initiator of the ad hoc group communication.

2. MC service server determined the participants for the ad hoc group communication based on the criteria specified by the MC service client 1 while initiating the ad hoc group communication.

3. MC service server continuously evaluates the criteria to monitor the list of users who meets or not meets the criteria for participating in the on-going ad hoc group communication.

4. The MC service server detects that the MC service client 5 satisfies the criteria and MC service client 4 stops to meet the criteria specified by the MC service client 1.



Figure 7.4.3.2-1: Modification of ad hoc group communication participants by the MC service server

1. The ad hoc group communication is established and on-going with the participants MC service client 1, MC service client 2, MC service client 3 and MC service client 4. The participants list is determined by the MC service server based on the criteria specified by the MC service client 1 while initiating the communication

2. The MC service server detects that the MC service client 5 satisfies the criteria specified by the MC service client.

3. The MC service server sends the ad hoc group communication request to the MC service client 5.

4. The MC service client 5 notifies the user about the incoming ad hoc group communication.

5. The MC service client 5 accepts the ad hoc group communication request and sends the ad hoc group communication response to the MC service server.

6. The on-going ad hoc group communication is updated by adding MC service client 5 which satisfies the criteria specified by the MC service client 1.

7. The MC service server detects that the MC service client 4 is no more satisfying the criteria to be the participant of the ad hoc group communication.

8. The MC service server sends the ad hoc group communication leave request to the MC service client 4 and removes it from the on-going ad hoc group communication.

9. The MC service client 4 notifies the user of the ad hoc group call leave request.

10. The MC service client 4 sends the ad hoc group communication leave response to the MC service server.

11. The on-going ad hoc group communication is updated by removing MC service client 4 which no more satisfies the criteria specified by the MC service client 1.

### 7.4.4 Solution evaluation

The procedures proposed as part of this solution handle the modification of participants list of the on-going ad hoc group communication. Participants can either be added to or removed from the on-going ad hoc group communication. This solution provides a mechanism for the initiator of the ad hoc group communication to modify the participants list if the list of participants is provided by the initiator and for the MC service server if the list of participants for the on-going ad hoc group communication is determined by the MC service server.

# 8 Overall evaluation

## 8.1 Key issue and solution evaluation

### 8.1.1 Introduction

All the key issues and solutions specified in this technical report are listed in table 8.1.2-1. It includes the mapping of the key issues (clause 4) to the solutions (clause 7) and corresponding solution evaluations.

In addition, table 8.1.2-1 lists the impacts to other working groups that will need consideration during the normative phase.

### 8.1.2 Results

Table 8.1.2-1: Key issues, solutions and solution evaluations

|  |  |  |  |
| --- | --- | --- | --- |
| Key issues | Solution | Evaluation (clause reference) | Dependency on other working groups |
| Key issue #1 – Ad hoc group communication | Solution #1: Ad hoc group communication set up for MCX service | Clause 7.1.4 | SA3 |
| Solution #2: Ad hoc group call involving multiple MC systems | Clause 7.2.3 | SA3 |
| Key issue #2 – Network topology hiding from MC service client while establishing Ad hoc group communication | Solution #1: Ad hoc group communication set up for MCX service | Clause 7.1.4 | None |
| Key issue #3 – Configuration parameters for Ad hoc group communication | Solution #3: Configuration parameters required for Ad hoc group communication | Clause 7.3.4 | None |
| Key issue #4 – Modifying participants list of on-going ad hoc group communication | Solution #4: Modifying participants list of on-going ad hoc group communication | Clause 7.4.4 | None |

### 8.1.3 Overall evaluation of key issue #1

Key issue #1 is about the Ad hoc group communication, which enables authorized MCX users to combine a random set of MCX Users into a group communication. Following open issues are considered during the study :

1. Procedures for establishing and release of the ad hoc group communication.

2. Procedures for establishing the ad hoc group communication with end-to-end encryption support.

3. Identify whether new information flows are required or existing information flows can be enhanced to support the ad hoc group communication set up.

4. How to support different mechanisms for determining the participants list for the ad hoc group communication. It could be supplied by the initiator of the ad hoc group call or determined by the MCX system based on some pre-defined criteria.

5. How to support a mechanism for the initiator of an MCX Service ad hoc group communication to request that the list of participants are updated by the MCX Service system using a specific pre-defined criteria.

6. Identify whether any changes are required to the existing MCX functional architecture for supporting the ad hoc group communication.

Both solution#1 and solution#2 addresses the open issues described above. Based on solution#1 and solution#2, a harmonized procedure is required to address the key issue#1. End-to-end encryption support is mandatory for the AHGC and usage of pre-configured group to achieve end-to-end encryption as specified in solution #2 will be adapted. New information flows except the AHGC share security material command described as part of solution #1 will be used. No architectural updates as specified in open issue 7 are required to support AHGC.

### 8.1.4 Overall evaluation of key issue #2

Key issue #2 is about the network topology hiding while establishing the ad hoc group communication. Following open issues are considered :

- How the group ID used for the ad hoc group communication can be created by MC service client and managed when establishing the ad hoc group communication.

- Whether and how to support the ad hoc group communication without exposing the network topology.

- Whether and how to support the ad hoc group communication with dynamically allocated network resources (such as the MC service server that will host the communication).

Solution #1 with the option that the network creates the ad hoc group ID for the AHGC addresses the open issues listed above. This solution provides a procedure for the MC service server to create the ad hoc group ID and share it to the MC service clients that needs to be used for the ad hoc group communication. MC service client is not allowed to create AHGC group ID in solution #1.This way the MC service client is totally transparent of the network topology of the MC system domain and no need to create the ad hoc group ID by itself. As the network is the one selecting which MC service server to host the AHGC, network resources (the MC service server that hosts this group communication) can be dynamically allocated based on real-time information of network resources such as availability and traffic load balance that can be further specified in the normative work. The mechanism provided in Solution #1 can serve as basis for the normative work when topology hiding is required.

### 8.1.5 Overall evaluation of key issue #3

Key issue #3 is about the configuration parameters that are required to be applied while establishing the ad hoc group communication. Following open issues are considered :

- Identify the required system or service level configuration parameters and document them.

- Identify the user level configuration parameters and document them.

- Identify the default parameters to be configured which will be applied when these parameters are not supplied as part of the ad hoc group communication request by the initiator.

- How the MCX server shall be able to determine whether the user is authorized to initiate ad hoc group communication.

Solution #3 identifies the configuration parameters that are required to address the open issues listed above and it can serve as basis for the normative work. There were no default parameters identified which needs to be configured. These configuration parameters are applied by MC service server handling AHGC as described in the below table:

|  |  |
| --- | --- |
| Parameter description | Details |
| Support of ad hoc group call | Value of this parameter determines whether ad hoc group communication is supported or not. MC service server rejects the ad hoc group communication if the value of this parameter is set to false. |
| Maximum number of participants allowed to participate in an ad hoc group communication | MC service server rejects the ad hoc group communication request if the number of participants invited for the call is exceeding the value of this parameter. |
| Hang timer for ad hoc group communication | MC service server terminates the ad hoc group call if there is no traffic for the time duration specified by this parameter. |
| Maximum duration for ad hoc group communication | This parameter value determines maximum allowed time duration for the ad hoc group communication to remain active after which the MC service server will terminate it. |
| List of preferred voice codecs for ad hoc group call | List of codecs, which can be used by the MC service client in the SDP offer. |
| Authorised to initiate ad hoc group call | MC service server uses this parameter to check whether the MC service user is authorized to initiate the ad hoc group call |
| Authorised to participate in ad hoc group call | MC service server uses this parameter to check whether the MC service user is authorized to participate the ad hoc group call |
| Authorised to initiate emergency ad hoc group call | MC service server uses this parameter to check whether the MC service user is authorized to initiate the emergency ad hoc group call |
| Authorised to initiate imminent peril ad hoc group call | MC service server uses this parameter to check whether the MC service user is authorized to initiate the imminent peril ad hoc group call |

Editor's note: Any additional parameters related to MCVideo and MCData services applicable for AHGC is FFS.

### 8.1.6 Overall evaluation of key issue #4

Key issue #4 is related to modification of participants list of on going ad hoc group communication. Following open issues are considered :

- Modifying the participants list by the initiator of the ad hoc group communication when the participants list is provided by the initiator while establishing the ad hoc group communication.

- Modifying the participants list by the MC service server when the participants list is determined by the MC service server.

Solution #4 identifies the information flows and procedures required to address the open issues listed above and it can service as basis for the normative work.

# 9 Conclusions

This technical report fulfils the objectives of the study on supporting ad hoc group communication for MC services. The report includes the following:

1. Definition of terms and abbreviations used in the study (clause 3);

2. Key issues identified by the study (clause 4);

3. Individual solutions addressing the key issues (clause 7); and

4. Overall evaluations of all the solutions (clause 11).

No architectural requirements and enhancements were identified as part of the study. Also no dependencies on other working groups within 3GPP were identified.

The study concludes with following considerations for the normative work:

1. Definition of terms and abbreviations captured in clause 3 will be reused;

2. Following individual solutions, corresponding to the key issues, will be considered as candidate solutions:

a. for Key issue #1 (Ad hoc group communication):

i. Information flows specified in Solution #1 (Ad hoc group communication set up for MCX service)

ii. Information flow AHGC share security material command is not required

iii. Pre-configured group as specified in Solution #2 to be used for achieving the end-to-end security for both the cases where the participants list is supplied by the initiator of the AHGC and participants list is determined by the MC Service server.

iv. Pre-configured group to be used for the AHGC is determined by the MC Service server and not by the initiating client.

b. for Key issue #2 (Network topology hiding):

i. Mechanism provided in Solution #1 (Ad hoc group communication set up for MCX service) where the MC service group ID is created by the MC Service server and shared to the participating clients to be adapted.

c. for Key issue #3 (Configuration parameters):

i. Solution #3 (Configuration parameters)

d. for Key issue #4 (Modifying participants list):

i. Solution #4 (Modifying participants list)

Annex A (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2022-02 | SA6#47-e |  |  |  |  | TR skeleton | 0.0.0 |
| 2022-02 | SA6#47-e |  |  |  |  | S6-220050, S6-220051, S6-220052, S6-220443, S6-220405, S6-220054, S6-220055, S6-220444, S6-220406 | 0.1.0 |
| 2022-04 | SA6#48-e |  |  |  |  | S6-220777, S6-220802, S6-220807 | 0.2.0 |
| 2022-05 | SA6#49-e |  |  |  |  | S6-221441, S6-221362, S6-221090, S6-221092 | 0.3.0 |
| 2022-06 | SA#96 |  |  |  |  | Presentation for information at SA#96 | 1.0.0 |
| 2022-07 | SA6#49-bis-e |  |  |  |  | S6-221565, S6-221566 | 1.1.0 |
| 2022-09 | SA6#50-e |  |  |  |  | S6-221523(SA6#49-bis-e), S6-222444, S6-222571, S6-222572, S6-222596, S6-222573, S6-222224 | 1.2.0 |
| 2022-10 | SA6#51-e |  |  |  |  | S6-222751, S6-222917, S6-222763 | 1.3.0 |
| 2022-12 | SA#98-e | SP-221223 |  |  |  | Submitted for Approval at SA#98-e | 2.0.0 |
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