3GPP TR 23.847 V8.0.0 (2007-12)

Technical Report

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Enhancements to IMS service functionalities facilitating multicast bearer services (Release 8)

Keywords
UMTS, IMS

3GPP

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Contents

Foreword

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

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where:

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Introduction

During the definition of MBMS enhancement requirements, IMS support of media delivery over multicast bearers has been identified in TS 22.228 [2] as follows:

> *Multicast services allow IMS users and service providers to send multimedia to a group of IMS users simultaneously in an unidirectional way of communication. The underlying network may be able to support mechanisms that optimize the delivery of multimedia to the individual members of that group (e.g. MBMS [7])*

Initial understanding of the architectural implications would base on the regional services to grouped IMS users provided at hot spots such as a football stadium. From such a requirement point towards the feasibility analysis and more IMS services should be investigated for the better understanding of the use and applicability of multicast bearers (e.g. MBMS) in the context of IMS.

1 Scope

This study analyzes the feasibility and applicability of using multicast bearers (e.g. MBMS) in the context of IMS-based applications.

This study item captures the results of the technical considerations and solutions for transporting IMS services over multicast bearers with a focus on the possible enhancements to IMS functionalities and relevant charging, security and service provision procedures.

A brief summary of considerations include:

- Signalling procedures of multicast enabled IMS services should be analyzed based on the grouped communication scenarios and possible optimisations to the delivery mechanisms should be investigated.
- Charging and policy control procedures according to the PCC architecture.
- Service provision procedures both in network elements and UEs.
- Possible security requirements to multicast enabled IMS functionalities and bearer service entities.
- Real-time QoS requirements e.g. delay , interruption.
- UE capability requirements.

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 23.228: "IP Multimedia Subsystem (IMS); Stage 2".

[3] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description".

[4] 3GPP TS 33.246: "3G Security; Security of Multimedia Broadcast/Multicast Service (MBMS)".

[5] 3GPP TS 23.203: "Policy and charging control architecture ".

[6] 3GPP TS 23.002: "Network Architecture".

[7] 3GPP TS 33.203: "Access Security for IP-based Services".

[8] 3GPP TS 33.210: "Network Domain Security; IP Network Layer Security".

[9] 3GPP TS 33.220: "Generic Authentication Architecture (GAA); Generic bootstrapping architecture".

[10] 3GPP TS 25.401: "UTRAN overall description".

[11] 3GPP TS 43.051: "GSM/EDGE Radio Access Network; Overall description - Stage 2".

3 Definitions and abbreviations

3.1 Definitions

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

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] apply.

4 General

When looking at the current requirements of IMS services, the multicast bearer based applications on the market is obvious and will developing from a minor role to a larger extent. This is especially valid in the lights of the deployment of the grouped real-time multimedia services. The profit of IMS service media delivery optimization based on multicast bearer services is not restricted to traditional IMS services as PoC and conference only, but the emergence of new value-added services.

In general, it can be expected if there is a technical guidance to enable IMS service functionalities to utilize the efficient multicast bearer service that IMS offer hundreds of combined real-time multimedia applications one never would have thought of before.

The general issues as the additional enhancements and the alignments with relative architectural requirements as charging and policy control, security should be investigated and identified.

4.1 Context of this study

This study describes architectural concepts and procedures for IMS service functionalities utilizing multicast bearer based on MBMS bearer services defined in TS 23.246 [3].

4.2 Goals of this study

The study identifies the improvements to IMS service functionalities needed to utilize the multicast bearer services in the core network and related enhancements needed to PCC, service provisioning and security requirements, and identifies the affected standards and the appropriate change requests.

5 Study Areas

5.1 Architecture requirements

5.1.1 Architecture principles

The following general requirements shall be applicable when utilizing MBMS:

- It shall be possible to combine existing MBMS capabilities with existing IMS.
- It shall be possible to ensure control and provision the related MBMS bearer services when the service is initiated over IMS.

5.1.2 Baseline Architecture

The figure below shows the current architecture of IMS and MBMS.

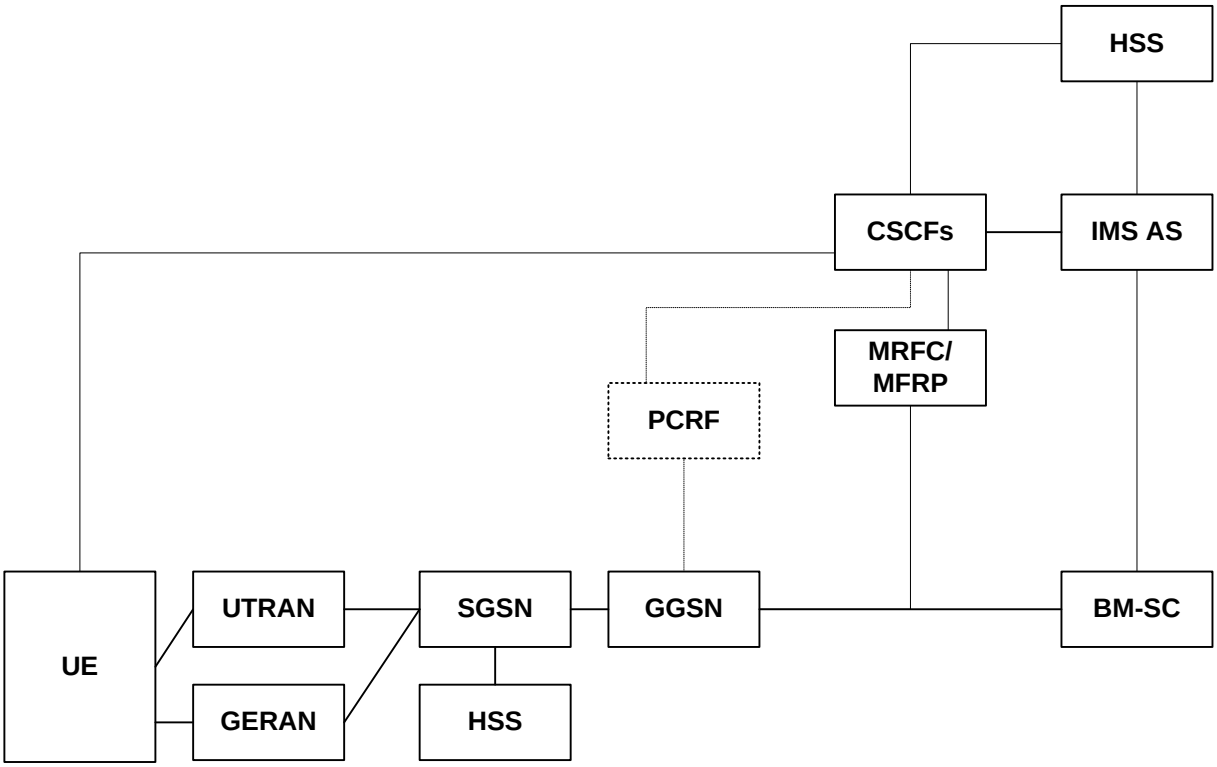

Figure 1: Architecture of IMS applications using MBMS as a bearer

IMS AS: The means of using an IMS AS is identical to its usage in IMS.

CSCFs: The CSCFs functionality is the same as defined in TS 23.002 [6].

MRFC/MRFP: The MRFC/MRFP functionality is the same as defined in TS 23.002 [6].

HSS: The HSS functionality is the same as defined in TS 23.002 [6].

UTRAN/GERAN: The UTRAN and the GERAN are the same as defined in TS 25.401 [10] and TS 43.051 [11].

BM-SC: The BM-SC functionality is the same as defined in TS 23.246 [3].

GGSN: The GGSN functionality is same as defined in TS 23.246 [3].

SGSN: The SGSN functionality is the same as defined in TS 23.246 [3].

HLR: The HLR functionality is the same as defined in TS 23.002 [6].

UE: The UE needs to support MBMS functionality, IMS functionality and IMS applications (e.g. PoC). Additionally, the UE should support UE capability exchange mechanisms.

PCRF: The usage of the PCRF for IMS applications using MBMS as a bearer is FFS.

Editor's note: In order to support IMS applications using MBMS as a bearer, additional functionalities may be needed in the entities above. What new functionalities are needed is FFS.

Editor's note: The interface between IMS AS and BM-SC is FFS.

5.2 Procedures to combine IMS session signalling with MBMS bearer services

This clause describes the procedures for IMS applications using MBMS as a bearer. The IMS AS should be able to find out UE capabilities and whether MBMS is supported at the location where UE resides. Based on this information, the IMS AS decides which bearer will be used for the IMS application, which will be MBMS in this case. The IMS AS may communicate with the BM-SC for provisioning of the MBMS bearer service. After this the MBMS procedures will take place. Figure 2 shows an information flow for the procedures for IMS applications using MBMS as a bearer.

For some services in which MBMS is used as default bearer, e.g. IPTV, UE capabilities exchange and related procedures are not required.

Editors Note: It is for further study how the IMS AS identifies that the MBMS bearer is supported at the location serving the UE.

5.2.1 IMS multicast signalling via BM-SC

5.2.1.1 Alternative 1

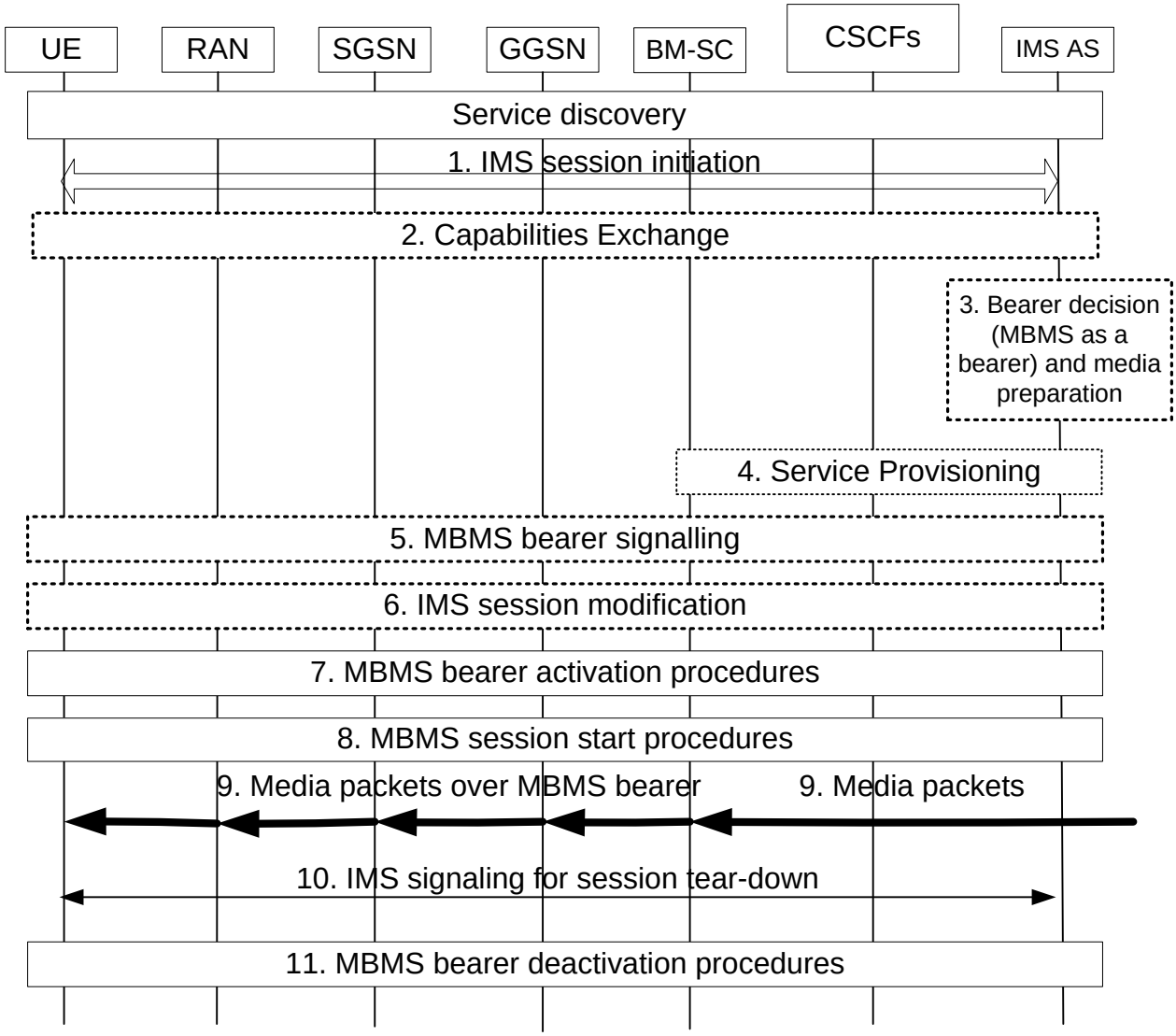

Figure 2: Information flow for IMS applications using MBMS as a bearer

The information which is exchanged during the service discovery may include the related MBMS information, such as IP addresses, if the multicast service is available or preconfigured in the network before IMS session establishment, e.g. IPTV.

1. Initiation of the IMS session.

2. Exchange of MBMS capabilities. This information should include the UE capabilities, MBMS support indicator and the QoS parameters. The MBMS support indicator indicates whether MBMS is supported at the location where UE resides.

NOTE 1: This may be done after or during the IMS session initiation.

3. The IMS AS decides what bearer should be used for the IMS application. The IMS application bases this decision on the information received during the MBMS capability exchange. In this case, the IMS AS chooses MBMS as bearer for the IMS application.

NOTE 2: Step 2 through step 3 may be skipped if the multicast service is already available or preconfigured in the network before IMS session initiation.

4. The IMS-AS communicates with the BM-SC for assignment of a unique multicast IP address/ port and TMGI, and for provisioning of other information related to the MBMS bearer service, e.g., SDP parameters, QoS parameters etc. This interaction can be done before the IMS session initiation (step 1) depending on the service.

5. At the MBMS bearer signalling, the information regarding the bearer decision of the IMS AS is exchanged. In addition also the QoS parameters should be exchanged.

6. Modification of the IMS session.

NOTE 3: Step 5 through step 6 may be skipped if the multicast service is already available or preconfigured in the network before IMS session initiation.

7. MBMS bearer activation procedures as defined in TS 23.246 [3].

8. MBMS session start procedures as defined in TS 23.246 [3].

9. The MBMS data transmission takes place certain time after the MBMS session start procedures. If the session requires it, the traffic originated by UE is carried over point-to-point link over the air. At this point, media packets are carried over MBMS bearer from the GGSN to the UE.

10. IMS signalling for session tear-down.

11. MBMS bearer deactivation procedures as defined in TS 23.246 [3].

5.2.1.2 Alternative 2

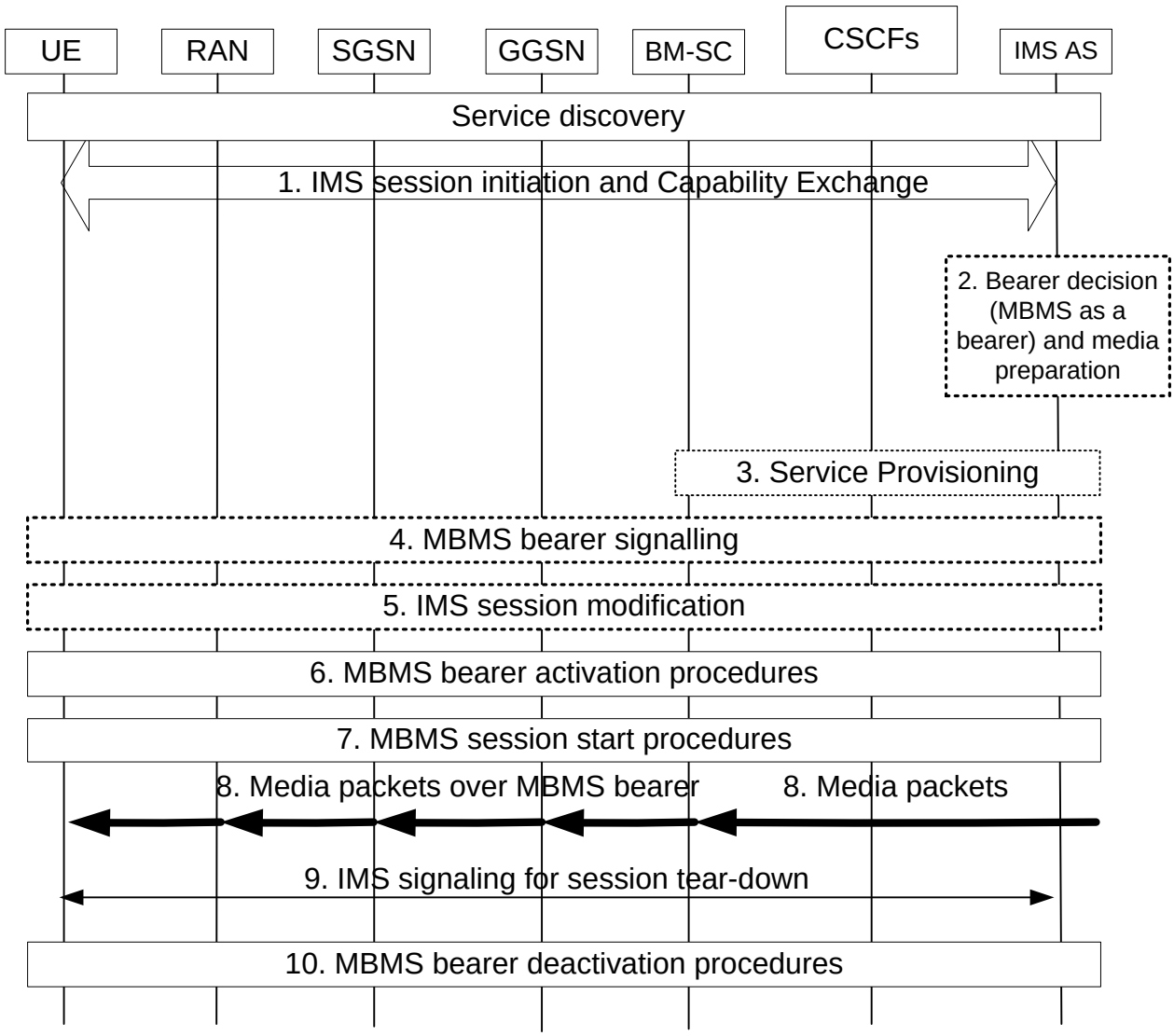

Figure 3: Information flow for IMS applications using MBMS as a bearer

The information which is exchanged during the service discovery may include the related MBMS information, such as IP addresses, if the multicast service is available or preconfigured in the network before IMS session establishment, e.g. IPTV.

1. Initiation of the IMS session and exchange of MBMS capabilities. This information should include the UE capabilities, MBMS support indicator and the QoS parameters. The MBMS support indicator indicates whether MBMS is supported at the location where UE resides.

Editor's Note: The need to exchange the MBMS capabilities in this option is FFS.

Option 1:

- The IMS AS includes alternate offers in the SDP – one containing a unicast IP address/port, and the other containing a multicast IP address/port.

- The UE, depending upon its MBMS capability and the capability of the serving network, selects one of these two offers (i.e., either unicast or multicast) and responds with its selection in the SDP answer.

- Upon receiving the SDP answers, the IMS AS can decide whether to set up a multicast session (e.g., depending on number of UE's accepting the multicast offer).

- If the IMS AS decides to setup a unicast bearer, the IMS AS will issue a re-INVITE to the UE's that accepted multicast offer.

Option 2:

- The IMS AS includes the unicast address in SDP offer.
- The UE includes its MBMS capability in the 200 OK response (depending upon its MBMS capability and the capability of the serving network).
- Upon receiving the SDP answers, the IMS AS can decide whether to set up a multicast session (e.g., depending on number of UEs supporting MBMS).
- If the IMS AS decides to setup a multicast bearer, the IMS AS will issue a re-INVITE to all the UEs with the multicast offer.

NOTE 1: This may be done after or during the IMS session initiation.

2. The IMS AS decides what bearer should be used for the IMS application. The IMS application bases this decision on the information received during the MBMS capability exchange. In this case, the IMS AS chooses MBMS as bearer for the IMS application.

NOTE 2: Step 2 through step 3 may be skipped if the multicast service is already available or preconfigured in the network before IMS session initiation.

3. The IMS-AS communicates with the BM-SC for assignment of a unique multicast IP address/ port and TMGI, and for provisioning of other information related to the MBMS bearer service, e.g., SDP parameters, QoS parameters etc. This interaction can be done before the IMS session initiation (step 1) depending on the service.

4. At the MBMS bearer signalling, the information regarding the bearer decision of the IMS AS is exchanged. In addition also the QoS parameters should be exchanged.

5. Modification of the IMS session.

NOTE 3: Step 5 through step 6 may be skipped if the multicast service is already available or preconfigured in the network before IMS session initiation.

6. MBMS bearer activation procedures as defined in TS 23.246 [3].

7. MBMS session start procedures as defined in TS 23.246 [3].

8. The MBMS data transmission takes place certain time after the MBMS session start procedures. If the session requires it, the traffic originated by UE is carried over point-to-point link over the air. At this point, media packets are carried over MBMS bearer from the GGSN to the UE.

9. IMS signalling for session tear-down.

10. MBMS bearer deactivation procedures as defined in TS 23.246 [3].

5.2.2 IMS multicast service delivery signalling with direct control

To avoid the dependence of the deployment of the BM-SC in the network, the IMS multicast service delivery could be achieved in an alternative solution as the direct service delivery and control.

In the direct service delivery scheme, all sub-functions of BM-SC except Security function are considered to be realized with some enhancements to the existing IMS entities as IMS AS or MRF.

The interaction between GGSN and IMS service host AS shall be fulfilled according to Gmb functions.

The IMS service control in IMS AS shall act as the Membership function for user service subscription management and user authorization.

Proxy and Transport Function and Session and Transmission Function might be realized by the media functions in IMS AS or IMS MRF according to the service realization requirements.

IMS AS could utilize any user layer protocols to announce the multicast service information as SDP/SIP, SMS, PUSH, etc.

The security procedures shall refer to TS 33.246 [4].

Editors Note: The impact to the PCRF function is FFS.

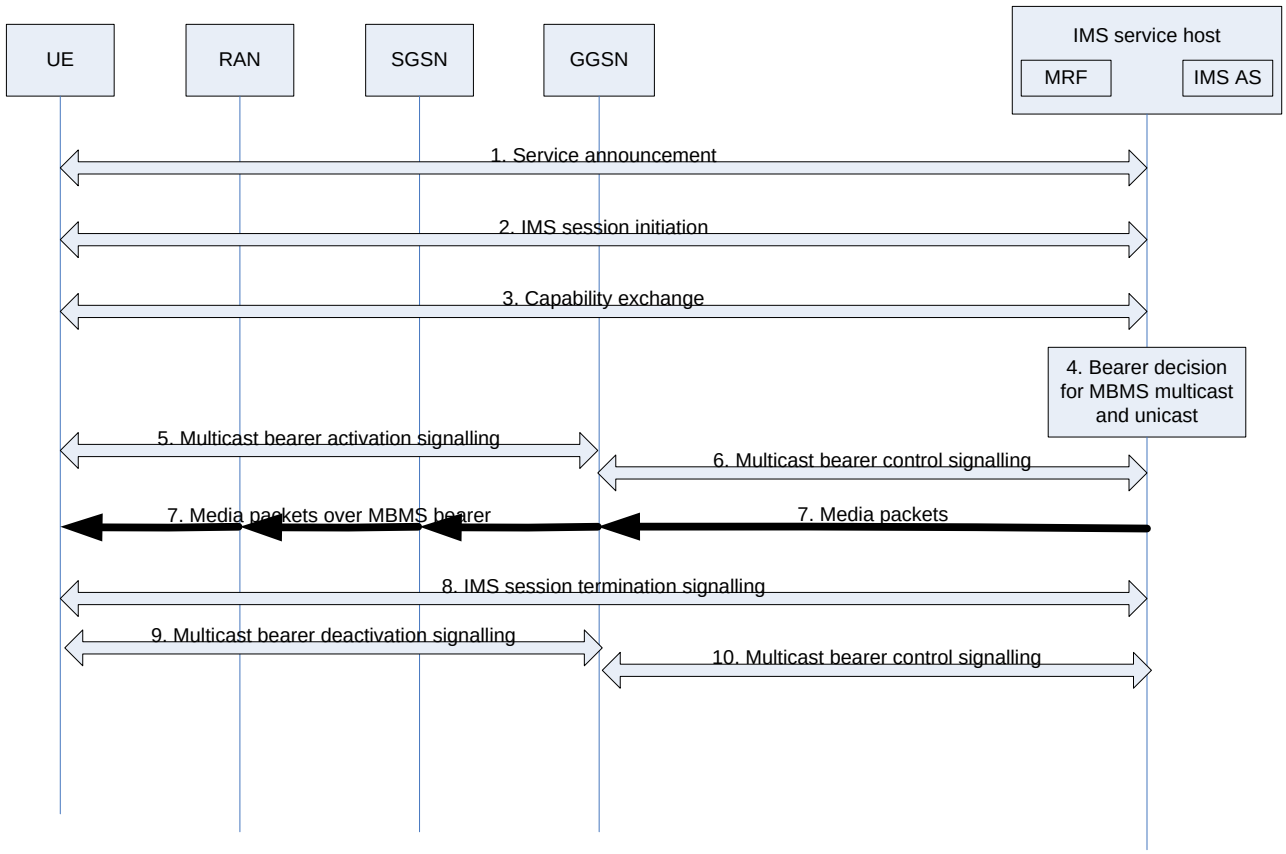

Figure 4: Signalling flows for the direct delivery of the IMS multicast service

The basic signalling flow of the direct service delivery of IMS multicast service can be depicted in following important steps:

1. The multicast service announcement to the UE should be initiated by IMS service host entities in SDP/SIP, SMS, WAP, etc. This announcement may include the related MBMS information, such as IP addresses, if the multicast service is available or preconfigured in the network before IMS session establishment, e.g. IPTV.
2. The IMS service session shall initiated between UE and IMS service host entity in IMS signalling.
3. UE and the IMS service host entity should exchange the multicast capabilities for the service delivery decision. This information should include the UE capabilities, multicast support indicator and the QoS parameters. The multicast support indicator indicates whether multicast is supported at the location where UE resides.
4. The IMS service host decides what bearer should be used for the IMS application. The IMS service host bases his decision on the information received during the multicast capability exchange. In this case the IMS service host chooses multicast as bearer for the IMS application.

NOTE: Step 3 through step 4 may be skipped if the multicast service is already available or preconfigured in the network before IMS session initiation.

5. The multicast bearer activation signalling could be started from UE to SGSN and GGSN.
6. GGSN acts the multicast bearer control by interacting with IMS multicast service host entity.
7. At this point, media packets are carried over the MBMS bearer from the GGSN to the UE.

8. The IMS multicast session could be terminated within IMS signalling.
9. UE perform the multicast bearer deactivation procedures with SGSN and GGSN.
10. GGSN update the multicast user and bearer information to IMS service host entity accordingly.

5.2.3 Information flow of bearer switching between Unicast and Multicast for the ongoing IMS service

5.2.3.1 Bearer switching from Unicast to Multicast

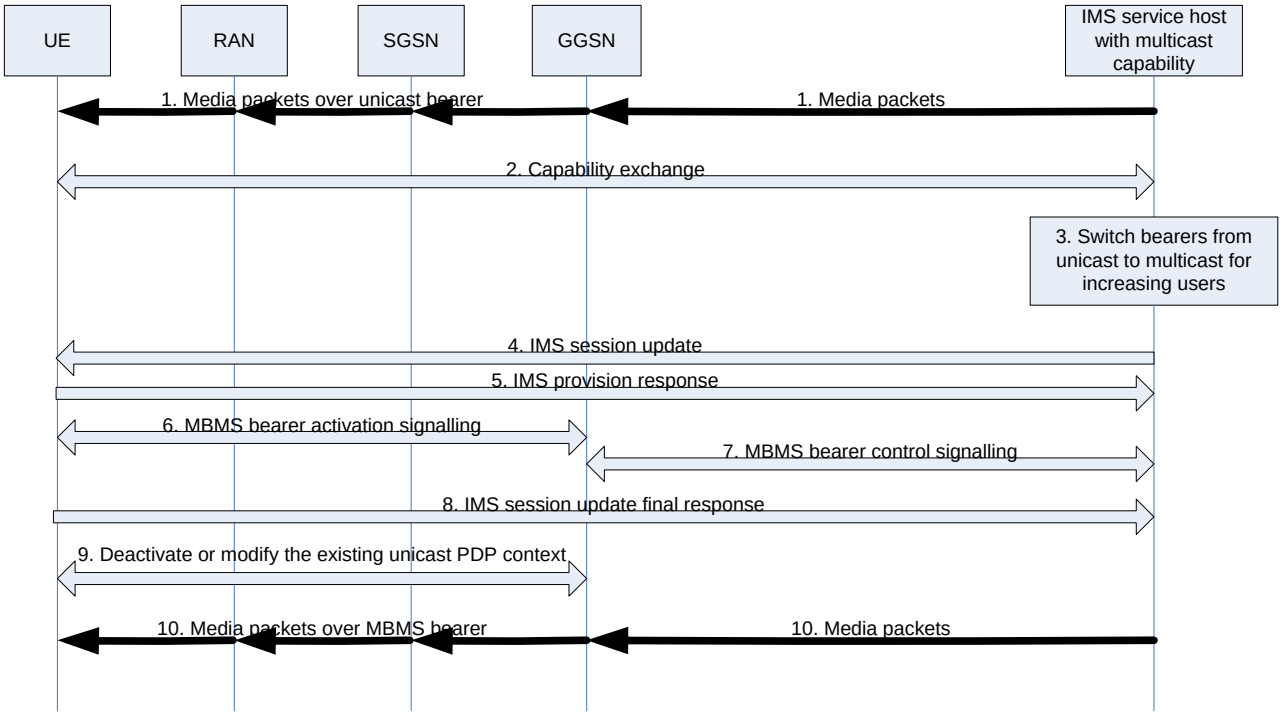

Figure 5: Signalling flows for bearer switching from Unicast to Multicast

NOTE: IMS service host with multicast capability may be interpreted as separated nodes when it is depicted in two options of 5.2.1 and 5.2.2. In the IMS signalling via BM-SC, IMS service host with multicast capability will be separated nodes of BM-SC and IMS AS, and in the IMS direct control signalling flow, it represent the IMS application server.

The IMS service host decides to poll for the bearer switching by recounting UE capabilities , which could be triggered by certain service level information, eg. the greatly increased users in the IMS session.

1. The IMS session is ongoing with media packets carried by a unicast bearer from the GGSN to the UE.
2. The IMS service host collects the UE MBMS capability including the UE capabilities, MBMS support indicator and the QoS parameters in Capability Exchange.
3. The IMS service host decides to replace the current unicast services to all UEs of the same IMS session with the multicast service.
4. The IMS service host updates the IMS session to the UE in the IMS signalling.
5. The UE shall answer the IMS service host with IMS provision response as 183 (session progress) for the resource reservation of the MBMS bearers.
6. The UE shall interact with GGSN for the MBMS PDP context activation.
7. The IMS service host assist with GGSN for the authentication and authorization of the MBMS bearer activation.

8. After the successful activation of the MBMS bearers, UE shall answer the with IMS final response as 200 OK.
9. UE deactivates or modifies the existing unicast PDP context accordingly.
10. The unicast bearer from the GGSN to the UE is replaced by a MBMS bearer.

5.2.3.2 Bearer switching from Multicast to Unicast

5.2.3.2.1 Bearer switching originated by UE

The UE may give IMS network a hint to switch bearer when user instructs it or UE receives an indication from PS network which shows the UE MBMS context will be deactivated. Under this condition bearer switching from Multicast to Unicast maybe need.

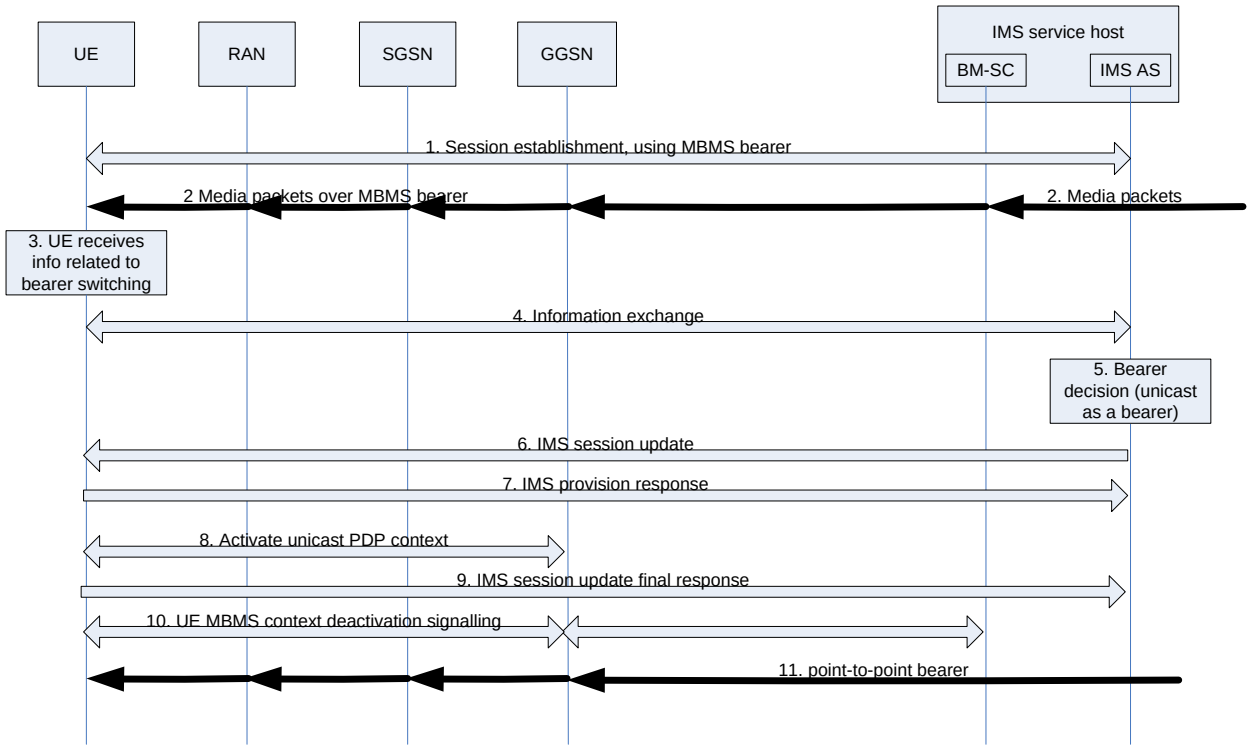

Figure 6: Signalling flows for bearer switching from Multicast to Unicast originated from UE

NOTE 1: IMS service host with multicast capability may be interpreted as separated nodes when it is depicted in two options of 5.2.1 and 5.2.2. In the IMS signalling via BM-SC, IMS service host with multicast capability will be separated nodes of BM-SC and IMS AS, and in the IMS direct control signalling flow, it represent the IMS application server.

1. The UE has successfully established a service using MBMS bearer.
2. The media packets are carried by MBMS bearer from the GGSN to the UE. The BM-SC gets the bearer from an external entity (not shown).
3. The UE receives info related to bearer switching. The info can be the user's instruction to switch bearer or the indication from PS network which shows the UE MBMS context will be deactivated.
4. The UE sends this information to IMS AS.
5. The IMS AS make bearer switching decision based on operator's policy. Here it decides to choose using unicast bearer.
6. The IMS AS updates the IMS session to the UE in the IMS signalling.

7. The UE shall answer the IMS service AS with IMS provision response as 183 (session progress) for the resource reservation of the Unicast bearer.

8. The UE shall interact with SGSN and GGSN for the Unicast PDP context activation.

9. After the successful activation of the Unicast bearer, UE shall answer the IMS AS with IMS final response as 200 OK

10. The UE may interact with GGSN for the UE MBMS context deactivation.

11. From the GGSN to the UE, the MBMS bearer is now replaced by the point-to-point bearer.

NOTE 2: Step 10 could be skipped if the UE MBMS context has already been deactivated in step 3.

5.2.3.2.2 Bearer switching originated by BM-SC

When BM-SC has received an indication from PS network that UE MBMS context will be deactivated, it may notify IMS AS, then IMS AS can switch bearer.

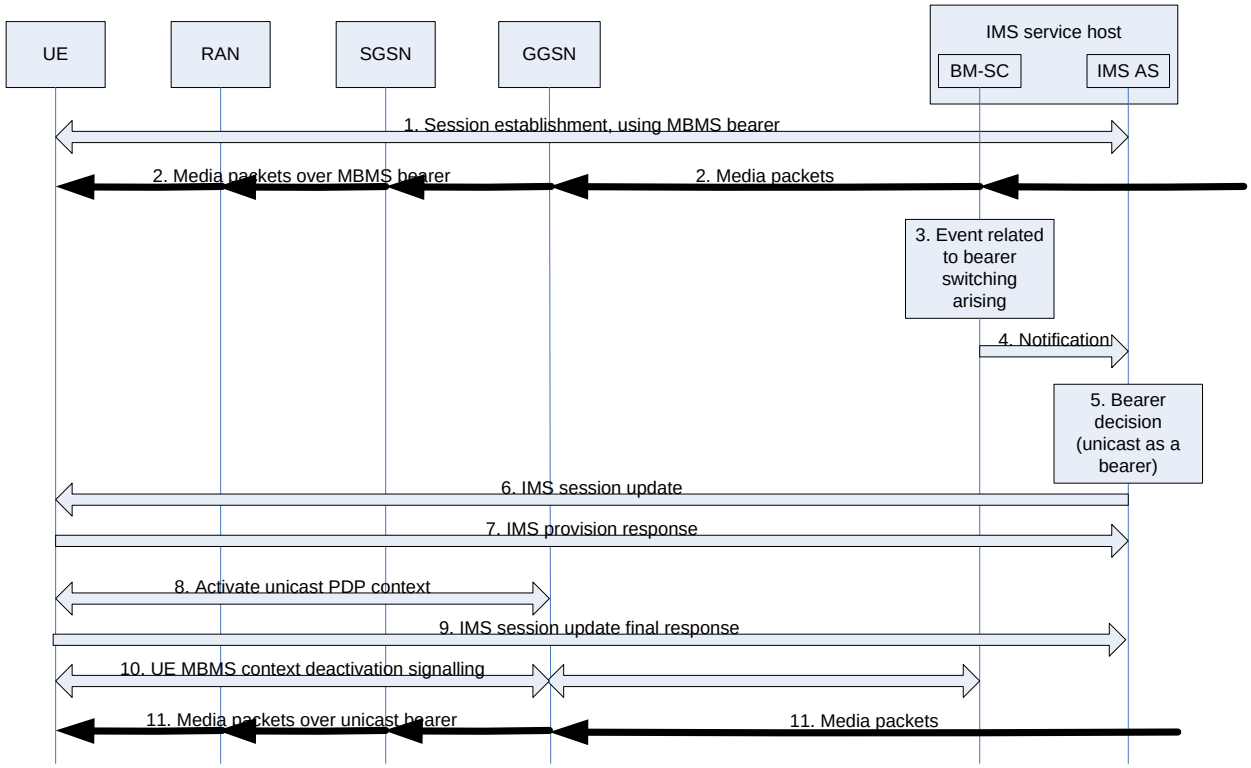

Figure 7: Signalling flows for bearer switching from Multicast to Unicast originated from BM-SC

NOTE 1: IMS service host with multicast capability may be interpreted as separated nodes when it is depicted in two options of 5.2.1 and 5.2.2. In the IMS signalling via BM-SC, IMS service host with multicast capability will be separated nodes of BM-SC and IMS AS, and in the IMS direct control signalling flow, it represent the IMS application server.

1. The UE has successfully established a service with MBMS bearer.

2. The media packets are carried by MBMS bearer from the GGSN to the UE. The BM-SC receives the media packets from an external entity (not shown).

3. The BM-SC received a notification from PS network that MBMS bearer to UE(s) is no longer available.

4. The BM-SC sends a notification to IMS AS.

5. The IMS AS make bearer switching decision based on operator's policy. Here it decides to choose using unicast bearer.
6. The IMS AS updates the IMS session to the UE in the IMS signalling.
7. The UE shall answer the IMS service AS with IMS provision response as 183 (session progress) for the resource reservation of the unicast bearer.
8. The UE shall interact with SGSN and GGSN for the unicast PDP context activation.
9. After the successful activation of the unicast bearer, UE shall answer the with IMS final response as 200 OK
10. The UE may interact with GGSN for the UE MBMS context deactivation.
11. From the GGSN to the UE, the MBMS bearer is now replaced by the point-to-point bearer.

NOTE 2: Step 10 could be skipped if the UE MBMS context has already been deactivated in step 3.

5.3 Charging and Policy control enforcement

In the cases when the multicast bearer decision was made at the initiation of the service, there is no requirements to current PCC specification TS 23.203 [5] to create the charging and policy control rule for the multicast bearer for the resource management would be performed at Gmb interface from GGSN to the multicast service control host as the equivalent function entity of BM-SC in R6 MBMS architecture.

However, this is somehow different with normal PCRF behaviour upon receiving SDP information from P-CSCF because the producing of the policy and charging rule to the IMS multicast media bearer shall be prohibited by additional self-awareness of multicast addresses in PCRF. In this case, the judgement of multicast addresses would be required based on the pre-configured IP multicast address allocation information in PCRF.

NOTE 1: How to manage IP multicast address allocation information in PCRF is FFS.

In some other cases as the bearer switching of ongoing sessions, the example signalling flow is shown as the following figure

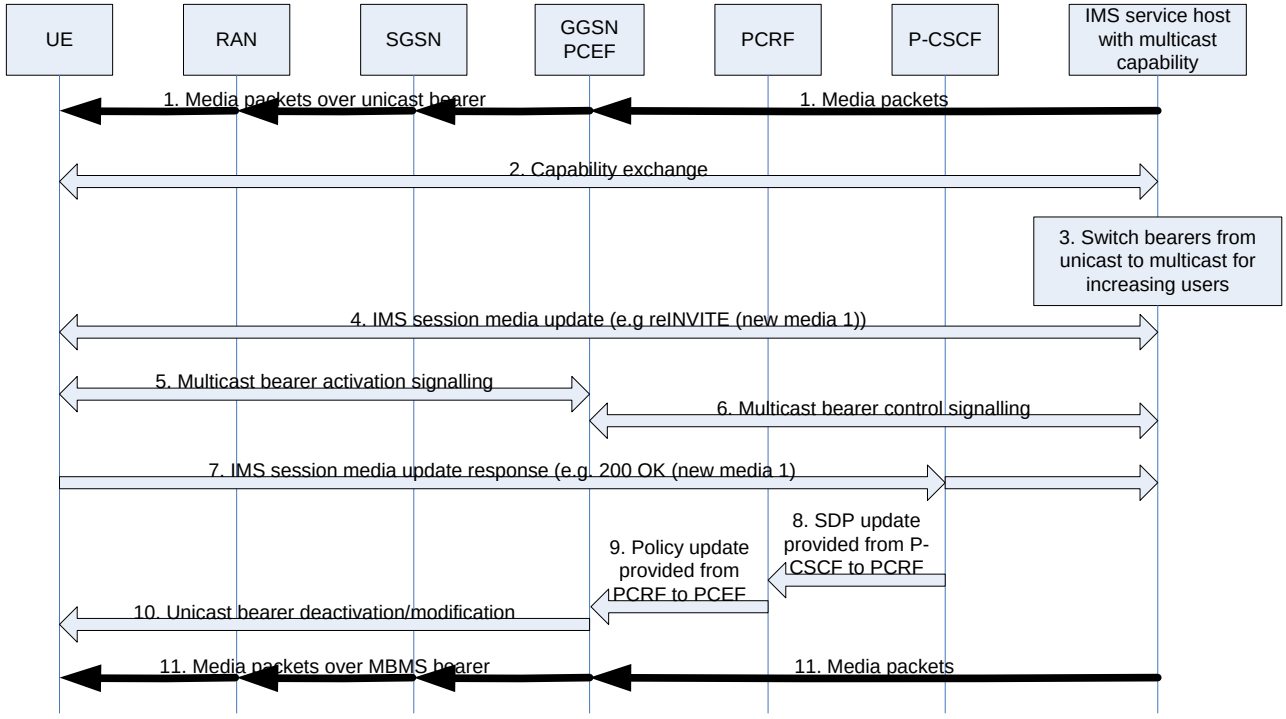

Figure 8: Signalling flow of bearer switching from unicast to multicast with PCC

1. IMS session is established with downlink media being carried over unicast bearer from the GGSN to the UE.
2. The IMS service host collects UE MBMS capability in Capability Exchange
3. IMS service host decides to replace the current unicast services to all UEs in the same IMS session with the multicast bearer service
4. The IMS service host updates UE with the multicast address information of the media in the IMS signalling
5. UE shall interact with GGSN for Multicast PDP context activation
6. IMS service host interact with GGSN for the authentication and authorization of the multicast bearer
7. After the successful activation of Multicast PDP context, UE shall answer the IMS service host with the final response as 200 OK
8. The IMS P-CSCF updates PCRF with the confirmed information of modified media in IMS signalling after the successful activation of multicast bearers
9. Updated policies should be provided to PCEF accordingly
10. UE shall deactivate or modify the unicast PDP context accordingly
11. The downlink data is now carried from GGSN to the UE by MBMS bearer.

In step 7, the PCRF would update the PCC rule of the existing PDP context for the QoS downgrading for the set-up of the separate multicast bearer for the current media plane.

In all possible and practical service scenarios, another case shall be taken into account.

When the new multicast bearer intends to replace the existing bearer in the network, PCRF shall update the rule in PCEF to filter out the old one accordingly.

So in the first case that the new multicast media bearer is based on an existing one and only intends to replace part of it, so downgrading of the bearer QoS would be measured and performed by PCRF from the network resource management view. And in this case, the downgrading criterion should be further clarified.

In the other case of bearer replacement, the set-up of a new multicast bearer in the network requires PCRF to prohibit the correspondent unicast bearer in PCEF.

NOTE 2: PCRF criteria on QoS downgrading or termination of the existing PDP context is FFS.

NOTE 3: The impacts on PCRF would be further investigated and evaluated.

5.4 Considerations on Security

Security is in accordance with TS 33.203 [7], TS 33.210 [8], TS 33.220 [9], and TS 33.246 [4].

No additional security issues have been identified by SA2 when the IMS media packets are to be transported over MBMS.

6 Conclusion

This feasibility study contains the results and investigations to enhance IMS service functionalities to facilitate Multicast Bearer services. The study concludes with the following:

- The feasibility study was completed with technical alternatives documented on the reference architecture with preferred developing principles, the signalling flows, the policy and charging control impacts.
- Alternative signalling flows were documented for both IMS grouped applications, IPTV and more value-added service cases. It shows examples of the combined signalling flow of IMS and MBMS in the actual use cases.

- The main stage 2 requirements and modification to policy control and charging should be created when needed, however this requires further study.
- Concerns on security and media plane QoS were removed from this version and could be added when provided by the appropriate expertise

It is recommended to conclude this TR as an intermediate work in this area.

Annex A:
Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2007-12	SP#39	SP-070829	-	-	MCC Editorial update for presentation to TSG SA for approval	1.3.1	2.0.0
2007-12	SP#38	-	-	-	Release 8 Version created after approval at TSG SA #38	2.0.0	7.0.0