8 MBMS Procedures

8.1 MBMS Notification

8.1.1 Iu mode notification (UTRAN and GERAN)

When an MBMS Session starts, UEs interested in the MBMS bearer service (PMM-CONNECTED UEs and PMM-IDLE UEs) shall be notified.

MBMS Session attributes such as Session Identifier and MBMS Service Area(s) are made available in all interested RNCs during the Session Start procedure.

For radio efficiency reasons, the UTRAN may select on a per cell basis whether to establish point-to-point or point-to-multipoint links for the distribution of MBMS data to the UEs.

In order to perform this selection, the UTRAN requests a proportion of UEs to move to PMM-CONNECTED mode by means of MBMS notification sent in the MBMS service Area.

The exact number of UEs moved to PMM-CONNECTED mode is a decision of the RAN node. It is not necessary for all UEs to move to PMM-CONNECTED mode in order for the RAN to decide to use point-to-multipoint, other UEs may remain in PMM-IDLE state. This is a UTRAN choice (based on Radio Resource Management criteria).

Following the decision to set up point-to-point or point-to-multipoint links, the number of UEs that need to be maintained in PMM-CONNECTED mode or moved to PMM-IDLE mode for MBMS data reception is also a decision of the RAN node.

8.1.2 A/Gb mode notification (GERAN)

When an MBMS Session starts, UEs interested in the MBMS bearer service and that are in READY or STANDBY states shall be notified. The MBMS notification triggers detection or counting of UEs per cell for selection of the most appropriate MBMS radio bearer.

MBMS Session attributes such as Session Identifier, MBMS Service Area, QoS are made available in all interested BSCs that are connected to a registered SGSN by the Session Start procedure.

8.2 MBMS Multicast Service Activation

The MBMS multicast service activation procedure registers the user in the network to enable the reception of data from a specific multicast MBMS bearer service. The activation is a signalling procedure between the UE and the network. The procedure establishes MBMS UE contexts in UE, SGSN and GGSN and Iu mode BSC/RNC for each activated multicast MBMS bearer service comparable to regular PDP contexts.

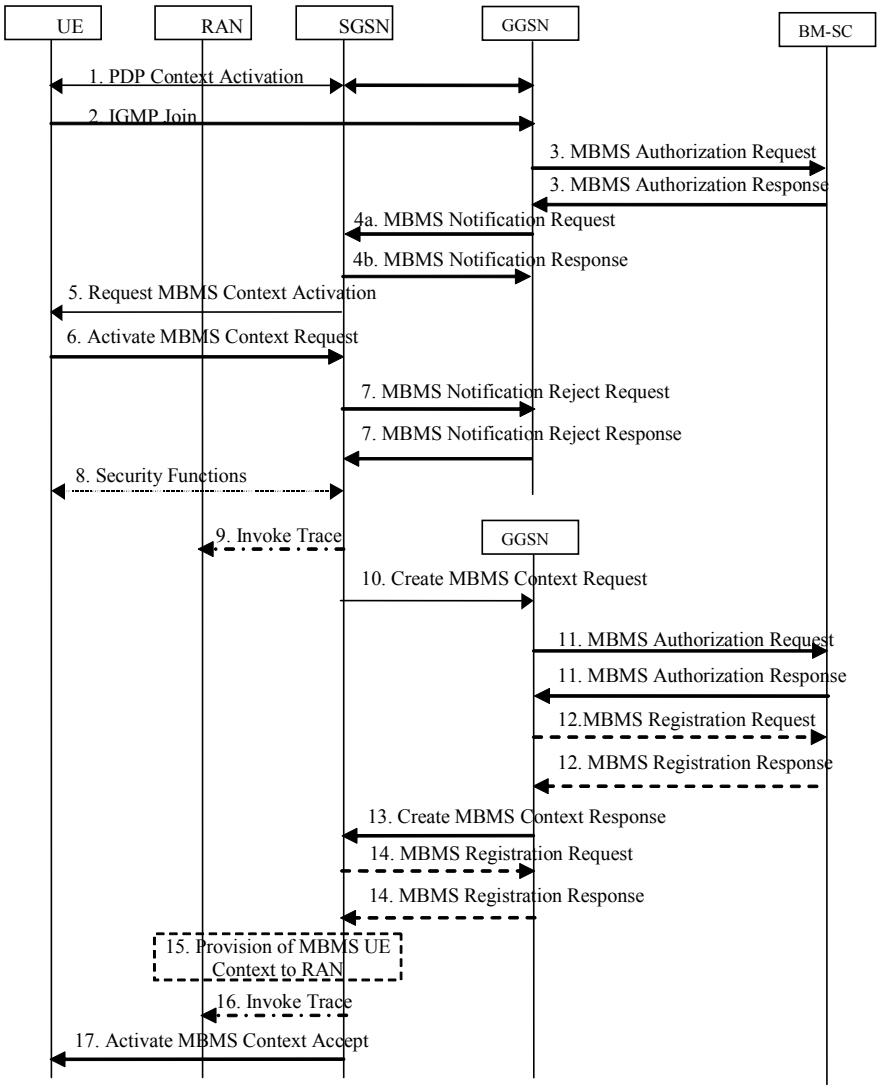

Figure 7: The activation of an MBMS multicast service

1. The UE activates a general purpose PDP context if one is not already established.

Steps 2) to 5) are not used for UEs that do not use IGMP (IPv4) or MLD (IPv6) for control of MBMS services.

2. The UE sends an IGMP (IPv4) or MLD (IPv6) Join message over the default PDP context to signal its interest in receiving a particular multicast MBMS bearer service identified by an IP multicast address.

3. The GGSN sends an MBMS Authorization Request seeking authorization for the activating UE to receive data. The MBMS Authorization Request may include trace information (Additional MBMS Trace Info), if activated. The authorization decision, which may be based on subscription data in the BM-SC, Membership function is provided in the MBMS Authorization Response together with the APN to be used for creation of the MBMS UE context. If the MBMS Authorization Response indicates that the UE is not authorized to receive the MBMS data the process terminates with no additional message exchange.

4a. The GGSN sends an MBMS Notification Request (IP multicast address, APN, Linked NSAPI) to the SGSN. Linked NSAPI is set equal to the NSAPI of the PDP context over which the Join request was received. The IP multicast address is the one requested by the UE in the Join request. The APN may be different from the APN to which the default PDP context has been activated. In any case, the APN may resolve to a GGSN that is different from the GGSN receiving the IGMP/MLD Join request. The GGSN starts a MBMS Activation Timer as GGSN may receive no response, e.g. in case SGSN or UE does not support MBMS.

4b. The SGSN sends a MBMS Notification Response (Cause) to the GGSN that sent the MBMS Notification Request, where Cause shall indicate whether or not the MBMS context activation will proceed. Upon reception of the response message with Cause indicating unsuccessful operation the GGSN should not send any further MBMS Notification Request messages. The procedure is then terminated.

5. The SGSN sends a Request MBMS Context Activation (IP multicast address, APN, Linked NSAPI, TI) to the UE to request it to activate an MBMS UE Context. Linked NSAPI allows the UE to associate the MBMS UE Context with the PDP context over which it sent the IGMP/MLD Join message in step 2. TI was chosen by the SGSN and contains a value not used by any other activated PDP context and MBMS UE context for this UE.

6. The UE creates an MBMS UE context and sends an Activate MBMS Context Request (IP multicast address, APN, MBMS_NSAPI, MBMS bearer capabilities) to the SGSN. The IP multicast address identifies the MBMS multicast service, which the UE wants to join/activate. An APN may indicate a specific GGSN. If the UE does not use IGMP (IPv4) or MLD (IPv6) for MBMS service control, it should indicate the APN it uses for general purpose PDP contexts. The SGSN may modify the APN. The MBMS bearer capabilities indicate the maximum QoS the UE can handle. The MBMS_NSAPI was chosen by the UE and contains a value not used by any other activated PDP context and MBMS UE context for this UE. If the SGSN has the MBMS Bearer Context information for this MBMS bearer service, the SGSN should verify the UE's MBMS bearer capabilities. If the SGSN determines that the UE's MBMS bearer capabilities are less than the Required MBMS Bearer Capabilities, it shall reject the request for activation of an MBMS context with an appropriate cause. If the PLMN does not support MBMS service control without IGMP (IPv4) or MLD (IPv6), the SGSN shall reject the request for activation of an MBMS context. In this case the UE may start the activation procedure with step 2, i.e. by using IGMP (IPv4) or MLD (IPv6).

7. If the MBMS UE Context was not established, the SGSN sends a MBMS Notification Reject Request (Cause) to the GGSN that sent the MBMS Notification Request, where Cause shall indicate the reason why the MBMS UE Context could not be established. The GGSN then sends a MBMS Notification Reject Response back to the SGSN. This should prevent further sending of MBMS Notification Request messages. The procedure is then terminated. This step is only for UEs that use IGMP (IPv4) or MLD (IPv6) for MBMS service control.

8. Security Functions may be performed, e.g. to authenticate the UE.

9. In A/Gb mode and if BSS trace is activated, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, and OMC Identity) message to the BSS. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.

10. The SGSN creates an MBMS UE context and sends a Create MBMS Context Requests (IP multicast address, APN, MBMS_NSAPI, IMSI, MSISDN, RAI, IMEI-SV, RAT Type, MS Time Zone, CGI/SAI, Trace Reference, Trace Type, Trigger Id, OMC Identity , Additional MBMS Trace Info) to the GGSN. The SGSN shall include Trace Reference, Trace Type, Trigger Id, and OMC Identity if GGSN trace is activated. The SGSN shall include Additional MBMS Trace Info if BM-SC trace is activated. The SGSN shall copy Trace Reference, Trace Type, and OMC Identity from the trace information received from the HLR or OMC. The inclusion of CGI/SAI shall be according rules detailed in sub-clause 15.1.1a in TS 23.060 [15].

11. The GGSN sends an MBMS Authorization Request (IMSI, MSISDN, RAI, IMEI-SV, RAT Type, MS Time Zone, CGI/SAI, Additional MBMS Trace Info) seeking authorization for the activating UE. The GGSN shall include Additional MBMS Trace Info if BM-SC trace is activated. The CGI/SAI is included, if available. The authorization decision is provided in the MBMS Authorization Response. The BM-SC creates an MBMS UE Context.

12. If the GGSN does not have the MBMS Bearer Context information for this MBMS bearer service, the GGSN sends a MBMS Registration Request to the BM-SC. See subclause "MBMS Registration Procedure".

    If no TMGI has been allocated for this MBMS bearer service, the BM-SC will allocate a new TMGI. This TMGI will be passed to GGSN and SGSN via the MBMS Registration Response message and further to UE via Activate MBMS Context Accept message.

    The BM-SC responds with a MBMS Registration Response containing the MBMS Bearer Context information for this MBMS bearer service and adds the identifier of the GGSN to the "list of downstream nodes" parameter in its MBMS Bearer Context. See subclause "MBMS Registration Procedure".

13. The GGSN creates an MBMS UE context and sends a Create MBMS Context Response to the SGSN.

14. If the SGSN does not have the MBMS Bearer Context information for this MBMS bearer service, the SGSN sends a MBMS Registration Request to the GGSN. See subclause "MBMS Registration Procedure".

    The GGSN responds with a MBMS Registration Response containing the MBMS Bearer Context information for this MBMS bearer service and adds the identifier of the SGSN to the "list of downstream nodes" parameter in its MBMS Bearer Context. See subclause "MBMS Registration Procedure".

15. The SGSN provides Iu mode RAN with the MBMS UE Context(s) if at least one PS RAB is established for the UE.

16. In Iu mode and if trace is activated, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, and OMC Identity) message to the RAN. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.

NOTE: Step 16 is applied when the trace activation is triggered by means of signalling. Another alternative is the triggering of trace activation by the OMC. The details of both Trace Activation procedures are described in TS 32.422 [14].

17. The SGSN sends an Activate MBMS Context Accept (TMGI) to the UE. If it was not possible to verify the UE's MBMS bearer capabilities in Step 6, the UE's MBMS bearer capabilities shall be verified now b y the SGSN. If the SGSN determines that the UE's MBMS bearer capabilities are lower than the Required MBMS Bearer Capabilities the SGSN rejects the request for activation of an MBMS context indicating an appropriate cause and starts the deactivation of the already established MBMS UE contexts.

8.3 MBMS Session Start Procedure

The BM-SC initiates the MBMS Session Start procedure when it is ready to send data. This is a request to activate all necessary bearer resources in the network for the transfer of MBMS data and to notify interested UEs of the imminent start of the transmission.

Through this procedure, MBMS session attributes such as QoS, MBMS service Area, estimated session duration, time to MBMS data transfer, are provided to the GGSN(s) and SGSN(s) that have previously registered for the corresponding MBMS bearer service and to all BSCs/RNCs that are connected to a registered SGSN. In addition the procedure allocates the bearer plane to all registered GGSNs and all registered SGSNs and to BSCs/RNCs that respond to the session start request message.

After sending the Session Start Request message the BM-SC waits for a configurable delay (time to MBMS data transfer) before sending MBMS data. This delay should be long enough to avoid buffering of MBMS data in entities other than the BM-SC, i.e. the delay should allow the network to perform all procedures required to enable MBMS data transfer before the BM-SC sends MBMS data. For example notification of UEs and radio bearer establishment should be performed before MBMS data arrive in the RAN. The delay may be in the region of multiple seconds or tens of seconds. It may be useful for the BM-SC to be able to configure different delays for MBMS bearer services on 2G and 3G, respectively.

For multicast MBMS bearer services the registration of SGSNs and GGSNs is initiated by MBMS multicast Service Activation procedures, Inter SGSN Routeing Area Update procedures, Inter SGSN Serving RNS Relocation procedure and performed by MBMS Registration procedures.

For broadcast MBMS bearer services the list of downstream nodes of BM-SC and GGSN are achieved in the following ways:

- The list of downstream nodes for GGSN will be sent from the BM-SC to the GGSN in the Session Start Request.

Normally, the GGSN contained in the "list of downstream nodes" for BM-SC is the default GGSN (or two for resilience).

The overall Session Start procedure is presented in the following figure:

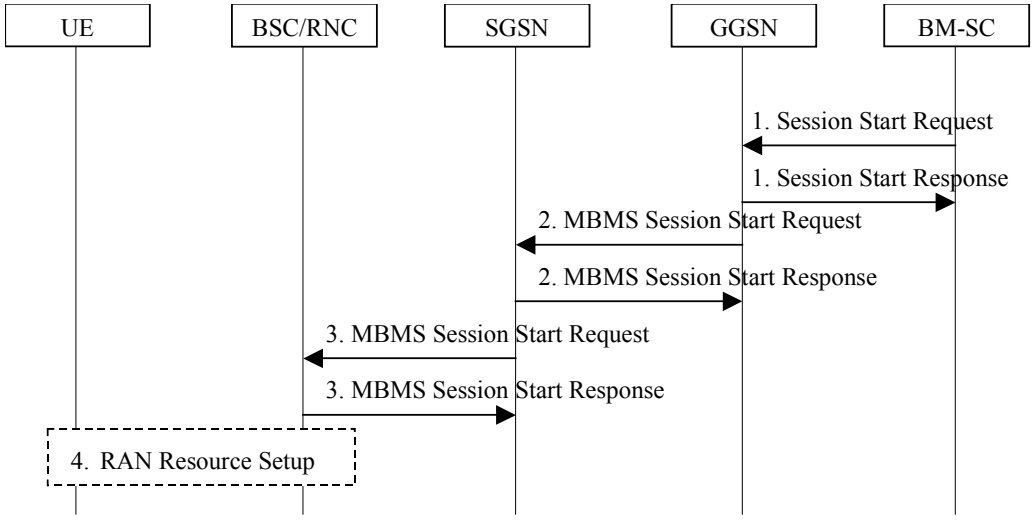

Figure 8 Session Start procedure

1. The BM-SC Session and Transmission function sends a Session Start Request message to indicate the impending start of the transmission and to provide the session attributes (TMGI, QoS, MBMS service Area, Session identifier, estimated session duration, broadcast/multicast, list of downstream nodes for GGSN (Broadcast only), time to MBMS data transfer, ...) and the 2G/3G indicator. The message is sent to the BM-SC Proxy and Transport function, which then forwards it to the GGSNs listed in the "list of downstream nodes" parameter of the corresponding MBMS Bearer Context. The BM-SC Proxy and Transport function sets the state attribute of its MBMS Bearer Context to 'Active'. For a broadcast MBMS bearer service the GGSN creates an MBMS bearer context. The GGSN stores the session attributes and the list of downstream nodes in the MBMS Bearer Context, sets the state attribute of its MBMS Bearer Context to 'Active' and sends a Session Start Response message to the BM-SC. Proxy and Transport function which forwards it to the BM-SC Session and Transmission function. The BM-SC Proxy and Transport function copies Session Start Requests to the BM-SC Membership function for charging purposes.

2. The GGSN sends an MBMS Session Start Request message containing the session attributes (TMGI, QoS, MBMS service Area, Session identifier, estimated session duration, broadcast/multicast, time to MBMS data transfer, …) and the 2G/3G indicator to the SGSNs listed in the "list of downstream nodes" parameter of the corresponding MBMS Bearer Context. For a broadcast MBMS bearer service the SGSN creates an MBMS bearer context. The SGSN stores the session attributes and the 2G/3G indicator in the MBMS Bearer Context, sets the state attribute of its MBMS Bearer Context to 'Active' and responds with an MBMS Session Start Response message providing the TEID for bearer plane that the GGSN shall use for forwarding the MBMS data. For MBMS bearer service a SGSN receiving multiple MBMS Session Start Request messages establishes only one bearer plane with one GGSN.

3. The SGSN sends an MBMS Session Start Request message including the session attributes (TMGI, QoS, MBMS service Area, Session identifier, estimated session duration, broadcast/multicast, time to MBMS data transfer, list of RAs …) to each BSC and/or each RNC that is connected to this SGSN. The 2G/3G indicator shall be used by the SGSN to determine whether the MBMS Session Start Request message is sent only to BSCs, or only to RNCs, or to both RNCs and BSCs. For a broadcast MBMS bearer service the BSC/RNC creates an MBMS Service Context. The BSC in Iu mode/RNC stores the session attributes in the MBMS Service Context, sets the state attribute of its MBMS Service Context to 'Active' and responds with an MBMS Session Start Response message and the RNC/Iu mode BSC includes the TEID in the MBMS Session Start Response message for the Iu bearer plane that the SGSN shall use for forwarding the MBMS data. A BSC in Gb mode which does not serve the MBMS Service Area need not store the session attributes. A BSC/RNC receiving multiple MBMS Session Start Request messages establishes only one bearer plane with one SGSN.

4. The BSC/RNC establishes the necessary radio resources for the transfer of MBMS data to the interested UEs. RAN resource set up can be scheduled according to the time to MBMS data transfer parameter.

NOTE: The upstream node normally provides the MBMS Session Start Request message once per MBMS session to a downstream node. Due to "Intra Domain Connection of RAN Nodes to Multiple Core Network Nodes" however, a BSC/RNC may receive the MBMS Session Start Request message from several SGSNs.

8.4 MBMS Registration Procedure

The MBMS Registration is the procedure by which a downstream node informs an upstream node that it would like to receive session attributes and data for a particular MBMS bearer service in order to distribute it further downstream. This procedure builds up a distribution tree for the delivery of MBMS session attributes and data from the BM-SC to the UEs interested in the service. This procedure results in the set-up of a corresponding MBMS Bearer Context in the nodes along the distribution tree, but it does not result in the establishment of bearer plane which will be established by the Session Start procedure.

The MBMS Registration procedure is initiated:

- When the first MBMS UE Context for a particular MBMS bearer service is created in the SGSN or GGSN (see subclause "MBMS UE Context") and the corresponding MBMS Bearer Context is not already established in the node;
- When an MBMS Registration Request for a particular MBMS bearer service is received from a downstream node but the corresponding MBMS Bearer Context is not established in the node; or
- When a DRNC detects that it hosts UEs interested in the MBMS bearer service.

NOTE: The terms 'downstream' and 'upstream' refer to the topological position of one node with respect to another and relative to the direction of the MBMS data flow, i.e. from BM-SC to UE.

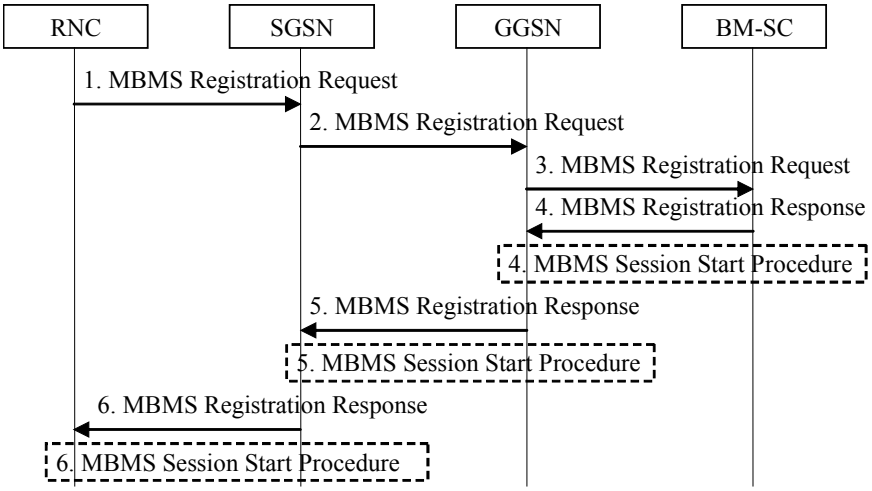

Figure 9: MBMS Registration procedure

1. When the DRNC detects that it hosts UEs interested in the MBMS bearer service, the DRNC sends a MBMS Registration Request message to its parent SGSN if not already done. How the RNC determines its parent SGSN is a matter of implementation.
2. If the SGSN has no MBMS Bearer Context for an MBMS bearer service and the SGSN receives an MBMS Registration Request from an RNC for this MBMS bearer service, or if the first MBMS UE Context is created in the SGSN for an MBMS bearer service for which the SGSN has no corresponding MBMS Bearer Context, the SGSN creates an MBMS Bearer Context (in "Standby" state) and sends an MBMS Registration request (IP multicast address, APN) message to the GGSN. How the SGSN selects a GGSN is a matter of implementation; it may for instance be based on prior signalling related to a particular UE or via APN resolution.
3. If the GGSN has no MBMS Bearer Context for an MBMS bearer service and the GGSN receives an MBMS Registration from an SGSN for this MBMS bearer service, or when the first MBMS UE Context is created in the GGSN for an MBMS bearer service for which the GGSN has no MBMS Bearer Context, the GGSN creates an MBMS Bearer Context (in "Standby" state) and sends a Registration Request (IP multicast address, APN) message to the BM-SC. Proxy and Transport function The exact nature of the signalling between GGSN and BM-SC via Gmb interface is specified in TS 29.061 [4].
4. Upon reception of an MBMS Registration Request from a GGSN, the BM-SC Proxy and Transport function adds the identifier of the GGSN to the "list of downstream nodes" parameter in its MBMS Bearer Context and

responds with a MBMS Registration Response (TMGI, Required Bearer Capabilities) message. The exact nature of the signalling between GGSN and BM-SC via Gmb interface is specified in TS 29.061 [4]. If the MBMS Bearer Context is in the 'Active' state, the BM-SC initiates the Session Start procedure with the GGSN, as described in clause "MBMS Session Start Procedure".

5. If the GGSN receives a Registration Request from the SGSN in step 2, the GGSN:

   - adds the identifier of the SGSN to the "list of downstream nodes" parameter in its MBMS Bearer Context,
   - responds with an MBMS Registration Response (TMGI, Required Bearer Capabilities) message, and
   - if the MBMS Bearer Context is in the 'Active' state, initiates the Session Start procedure with the SGSN, as described in clause "MBMS Session Start Procedure".

6. If the SGSN received MBMS Registration Request from the DRNC in step 1, the SGSN:

   - adds the identifier of the RNC to the "list of downstream nodes" parameter in its MBMS Bearer Context,
   - responds with an MBMS Registration Response message, and
   - if the MBMS Bearer Context is in the 'Active' state, initiates the Session Start procedure with the DRNC, as described clause "MBMS Session Start Procedure".

8.5 MBMS Session Stop Procedure

The BM-SC Session and Transmission function initiates the MBMS Session Stop procedure when it considers the MBMS session to be terminated. The session is typically terminated when there is no more MBMS data expected to be transmitted for a sufficiently long period of time to justify a release of bearer plane resources in the network. The procedure is propagated to all SGSNs and GGSNs that are registered for the corresponding MBMS bearer service and to BSCs/RNCs that have an established Iu bearer plane with an SGSN.

The overall MBMS Session Stop procedure is presented in the following figure:

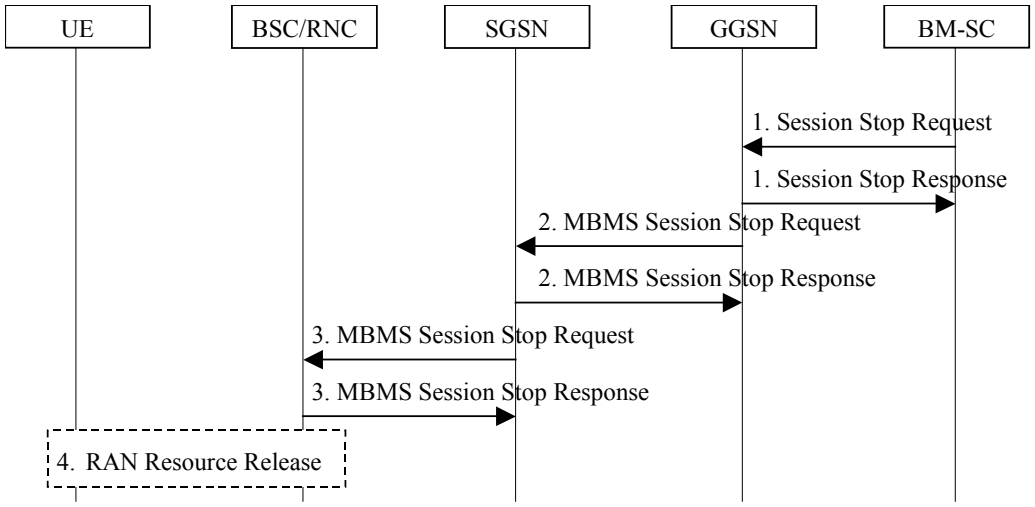

Figure 10: MBMS Session Stop procedure

1. The BM-SC Session and Transmission function sends a Session Stop Request message to the BM-SC Proxy and Transport function, which forwards it to all GGSNs listed in the "list of downstream nodes" parameter of the affected MBMS Bearer Context to indicate that the MBMS session is terminated and the bearer plane resources can be released. The BM-SC Proxy and Transport function sets the state attribute of its MBMS Bearer Context to 'Standby'. The GGSN sends a Session Stop Response message to the BM-SC Proxy and Transport function, which forwards it to the BM-SC Session and Transmission function. The BM-SC Proxy and Transport function copies Session Stop Requests to the BM-SC Membership function for charging purposes.

2. The GGSN sends an MBMS Session Stop Request message to all SGSNs that have a bearer plane established with the GGSN, releases the corresponding bearer plane resources towards these SGSNs and sets the state

attribute of its MBMS Bearer Context to 'Standby'. The GGSN releases the MBMS Bearer Context in case of a broadcast MBMS bearer service.

3. The SGSN releases the TEID and bearer plane resources on which it was receiving MBMS data from the GGSN for the affected MBMS bearer service and sends an MBMS Session Stop Request message to all BSCs/RNCs that have a bearer plane established with the SGSN. The SGSN releases the MBMS Bearer Context in case of a broadcast MBMS bearer service.

4. The RNC releases the affected radio and Iu resources; the BSC releases the affected radio resources. The BSC/RNC releases the MBMS Service Context in case of a broadcast MBMS bearer service. A BSC in Gb mode shall send an acknowledgement to the SGSN even if there is no active MBMS context in the BSC.

8.6 MBMS De-Registration Procedure

8.6.0 Common MBMS De-Registration procedure

The MBMS De-Registration is the procedure by which a downstream node informs an upstream node that it does not need to receive signalling, session attributes and data for a particular MBMS bearer service anymore and therefore would like to be removed from the corresponding distribution tree.

The MBMS De-registration procedure is initiated:

- By the SGSN or GGSN when the last MBMS UE Context for a particular MBMS bearer service is deleted from the node and the "list of downstream nodes" parameter in the corresponding MBMS Bearer Context is empty;

- By the SGSN or GGSN when the last node registered in the "list of downstream nodes" de-registers from an MBMS bearer service for which there is no corresponding MBMS UE Context; or

- By the DRNC that registered at an SGSN when it deletes the associated MBMS Service Context.

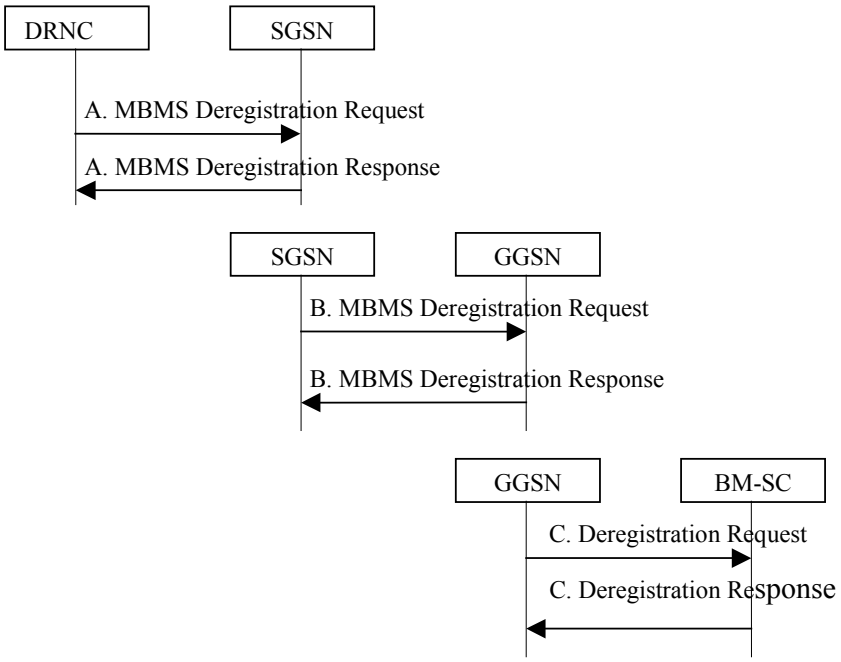

Figure 11: MBMS De-Registration Procedure

A. When the DRNC that is registered at an SGSN no longer hosts any UE interested in that MBMS bearer service, the DRNC requests the de-registration from the MBMS bearer service to its parent SGSN. As an implementation option, the DRNC may decide not to de-register from the MBMS bearer service immediately when these conditions are met, e.g. in order to avoid unnecessary signalling in the case where the RNC would again need the same MBMS bearer service shortly after.

The SGSN removes the identifier of the RNC from the "list of downstream nodes" parameter of the affected MBMS Bearer Context and confirms the operation by sending an MBMS De-Registration Response message to the RNC. If an Iu bearer plane had been established between the DRNC and the SGSN for this MBMS bearer service, the Iu bearer plane is released.

B. When the "list of downstream nodes" of a particular MBMS Bearer Context in the SGSN becomes empty and the SGSN has no MBMS UE Contexts linked to that MBMS Bearer Context, the SGSN sends an MBMS De-Registration Request (IP multicast address, APN) message to its upstream GGSN associated with the MBMS Bearer Context.

   The GGSN removes the identifier of the SGSN from the "list of downstream nodes" parameter of the affected MBMS Bearer Context and confirms the operation by sending an MBMS De-Registration Response message to the SGSN. If a bearer plane had been established between the SGSN and the GGSN for this MBMS bearer service, the bearer plane is released.

C. When the "list of downstream nodes" of a particular MBMS Bearer Context in the GGSN becomes empty and the GGSN has no MBMS UE Contexts linked to that MBMS Bearer Context, the GGSN sends a De-Registration Request (IP multicast address, APN) message to the BM-SC. Proxy and Transport function If a bearer plane had been established over Gi for this MBMS bearer service, the bearer plane is released.

   The BM-SC removes the identifier of the GGSN from the "list of downstream nodes" parameter of the affected MBMS Bearer Context and confirms the operation by sending a De-Registration Response message to the GGSN.

8.6.1 BM-SC initiated MBMS De-Registration Procedure

This MBMS De-Registration Procedure is initiated by BM-SC when the specific MBMS bearer service is terminated. This procedure tears down the distribution tree for the delivery of session attributes and MBMS data. This procedure results in releasing of all MBMS Bearer Contexts and associated MBMS UE Contexts in the nodes along the distribution tree.

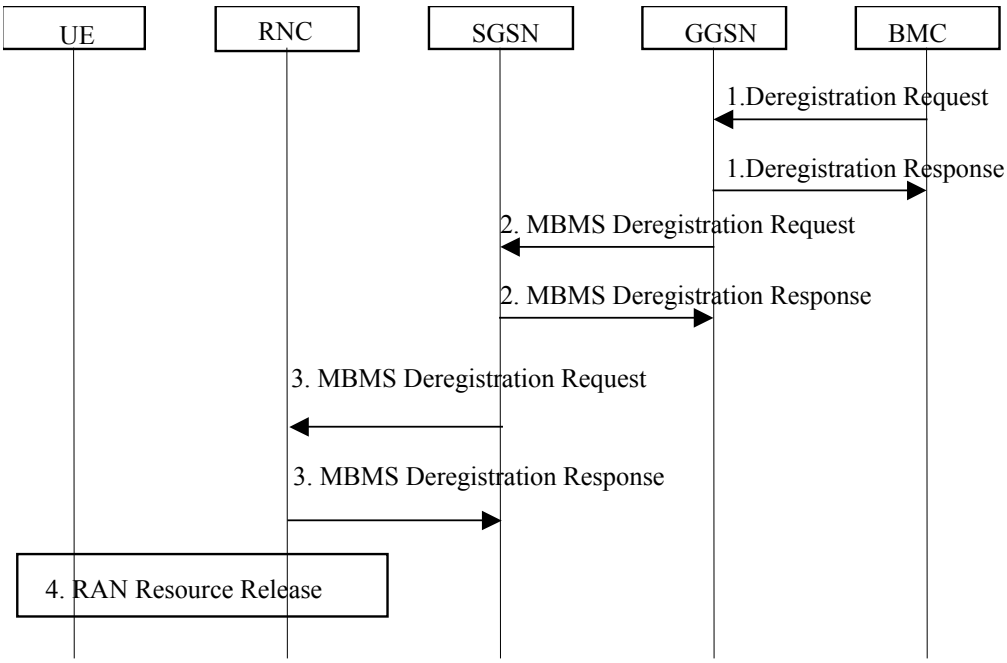

Figure 12: BM-SC initiated MBMS De-Registration Procedure

1. The BM-SC sends a De-Registration Request message to all GGSNs contained in the "list of downstream nodes" parameter of the corresponding MBMS Bearer Context to indicate the session is terminated and any related MBMS bearer resources shall be released.

   The GGSN returns a De-Registration Response message to the BM-SC. The BM-SC releases all MBMS UE Contexts and the corresponding MBMS Bearer context.

2. The GGSN sends an MBMS De-Registration Request message to all SGSNs contained in the "list of downstream nodes" parameter. of the corresponding MBMS Bearer Context. The SGSN returns an MBMS De-registration Response message to the GGSN. The GGSN releases all MBMS UE Contexts and the affected MBMS Bearer Context. If a bearer plane had been established over Gi for this MBMS bearer service, the bearer plane is released.

3. The SGSN sends an MBMS De-Registration Request message to all RNCs connected with this SGSN. The RNC returns an MBMS De-Registration Response message to the SGSN, and releases all bearer resources if the state attribute of the MBMS Service Context is 'Active'. The SGSN releases all MBMS UE Contexts and the affected MBMS Bearer Context. If a bearer plane had been established between the SGSN and the GGSN for this MBMS bearer service, the bearer plane is released.

4. The RNC releases the affected radio resources, all MBMS UE Contexts and the MBMS Service Context. The detailed procedures are specified in TS 25.346 [10] and TS 43.246 [11]. RAN may notify the UEs that the MBMS Bearer service has being terminated, so that the UE can locally deactivate its MBMS UE context, detailed procedures are specified in TS 25.346 [10] and TS 43.246 [11].

8.7 MBMS Multicast Service Deactivation

The multicast service deactivation is a signalling procedure between the UE and the network. The procedure removes the MBMS UE Context from the UE, RAN, SGSN and GGSN for a particular MBMS multicast service. The multicast service deactivation can be initiated by:

- The UE;
- The GGSN;
- The BM-SC; or
- The SGSN

All these cases are contained in the procedure illustrated in figure 13. The UE initiated Multicast Service Deactivation starts with step 1) or 6a), the BM-SC initiated Multicast Service Deactivation starts with step 3), the GGSN initiated Multicast Service Deactivation starts with step 4), the SGSN initiated Multicast Service Deactivation starts with step 5) or 9), and the MBMS UE de-linking is performed at step 7).

At GPRS detach, all MBMS UE contexts of the UE are implicitly deactivated in the UE, SGSN and GGSN, i.e. the SGSN performs the deactivation procedure starting with step 7).

If the PDP context linked to the MBMS UE context by the linked NSAPI is deactivated by the UE or SGSN or GGSN, then the SGSN shall perform the MBMS deactivation procedure starting with step 7). The UE will remove all MBMS UE Contexts locally after the Linked PDP Context was deactivated.

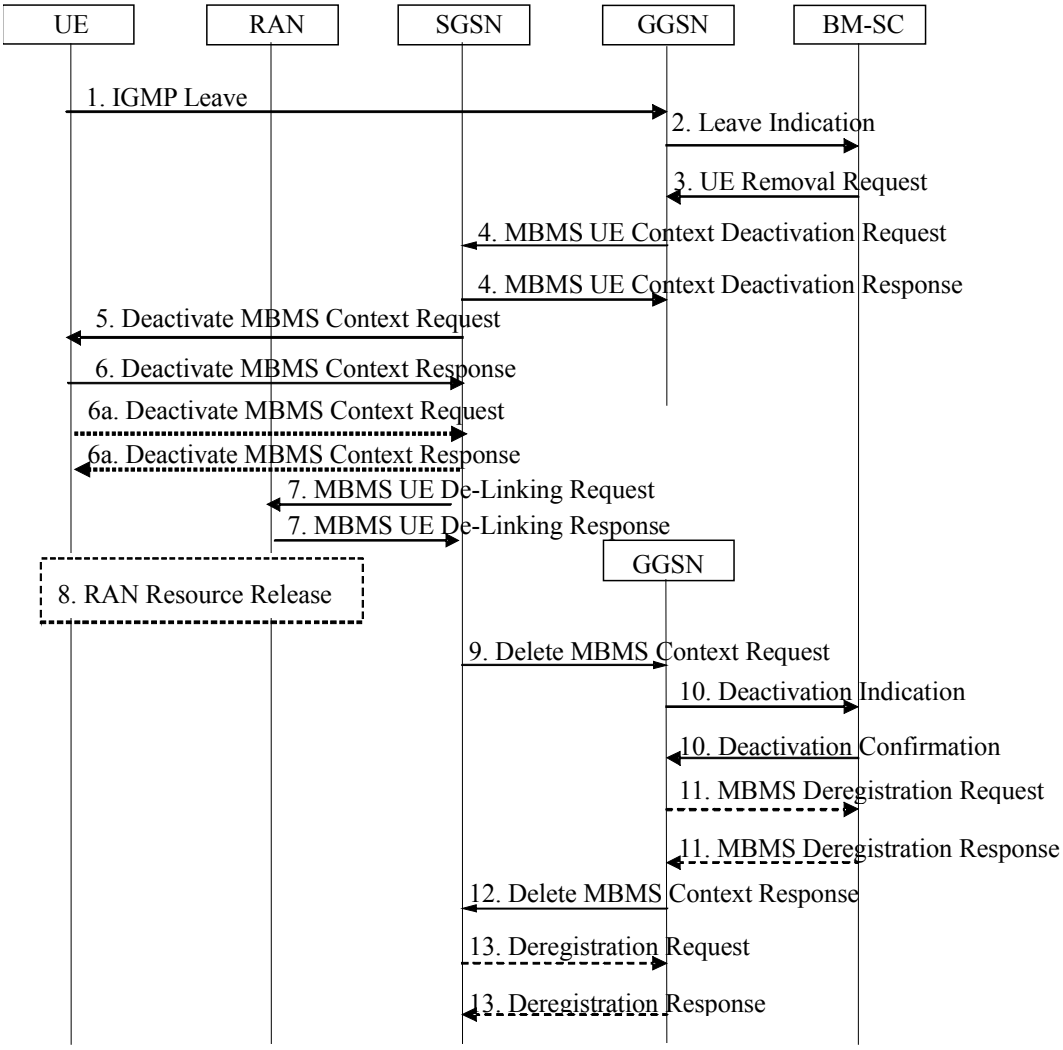

Figure 13: MBMS Multicast Service Deactivation

Steps 1) to 6) are not used for UEs that do not use IGMP (IPv4) or MLD (IPv6) for control of MBMS services.

1. The UE sends an IGMP (IPv4) or MLD (IPv6) Leave message (here, the Leave message means Leave Group message in RFC 2236 for IGMP (IPv4) and Multicast Listener Done in RFC2710 for MLD (IPv6)) over the default PDP context to leave a particular multicast service identified by an IP multicast address.

2. The GGSN sends a Leave Indication (IP multicast address, APN,IMSI) to the BM-SC Proxy and Transport function, which forwards it to the BM-SC Membership function, indicating that the UE is requesting to leave the multicast service identified by the IP multicast address. The exact nature of the signalling between GGSN and BM-SC is specified in TS 29.061 [4].

3. Upon reception of the Leave Indication, the BM-SC Membership function verifies that the IP multicast address corresponds to a valid MBMS bearer service and sends a UE Removal Request (IP multicast address, APN, IMSI) to the GGSN that originated the Leave Indication. The APN shall be the same that was provided during service activation (see "MBMS Multicast Service Activation"). The exact nature of the signalling between GGSN and BM-SC is specified in TS 29.061 [4]. The BM-SC Membership function may also initiate the deactivation of an MBMS UE Context for service-specific reasons (e.g. the service is terminated but the UE has not yet left the multicast group) by directly sending a UE Removal Request message to the GGSN.

4. Upon reception of the UE Removal Request or for other reasons (e.g. Error cases), the GGSN sends an MBMS UE Context Deactivation Request (IP multicast address, APN, IMSI) to the SGSN. The IP multicast address, APN and IMSI together identify the MBMS UE Context to be deleted by the SGSN. The APN is the one

received in step 3. The SGSN acknowledges reception of the MBMS UE Context Deactivation Request by sending an MBMS UE Context Deactivation Response to the GGSN.

5. Upon reception of the MBMS UE Context Deactivation Request or for other reasons (e.g. due to a change in the roaming restrictions for the user) the SGSN sends a Deactivate MBMS Context Request (TI) to the UE. The TI identifies the MBMS UE Context to be deleted by the UE.

6. The UE deletes the MBMS UE Context and sends a Deactivate MBMS Context Accept (TI) to the SGSN.

6a. The UE deletes the MBMS UE Context and sends a Deactivate MBMS Context Request (TI) to the SGSN. The SGSN confirms the deactivation.

7. If the UE is PMM-CONNECTED and has been already linked towards the RAN, t he SGSN sends a MBMS UE De-Linking Request to the RNC (IP multicast address, APN, TMGI). RAN deletes the MBMS UE Context and sends a MBMS UE De-Linking Response (TMGI) to the SGSN.

8. If dedicated radio resources are currently assigned to the UE for the reception of the MBMS data, the RAN releases these radio resources. If shared radio resources are currently assigned for the distribution of the MBMS data, the RAN may decide to move the remaining UEs to dedicated resources. The detailed procedures and conditions are specified in TS 25.346 [10] and TS 43.246 [11].

9. Upon reception of the Deactivate MBMS Context Accept or for other reasons (e.g. due to expiry of the long timer that is started upon a periodic routeing area update not being received) the SGSN sends a Delete MBMS Context Request (MBMS_NSAPI) to the GGSN that holds the MBMS UE Context. This GGSN may be different from the GGSN that receives IGMP Leave request in step 1.

10. The GGSN deletes the MBMS UE Context and sends a Deactivation Indication to the BM-SC to confirm the successful deactivation of the MBMS UE Context. The BM-SC, after receiving the Deactivation Indication, deletes the MBMS UE Context and sends a confirmation to the GGSN. The exact nature of the signalling between GGSN and BM-SC is specified in TS 29.061 [4].

11. If the GGSN does not have any more users interested in this MBMS bearer service and the "list of downstream nodes" in the corresponding MBMS Bearer Context is empty, the GGSN sends a MBMS De-Registration Request to the BM-SC Proxy and Transport function. The BM-SC Proxy and Transport function responds with a MBMS De-Registration Response and removes the identifier of the GGSN from the "list of downstream nodes" parameter in its MBMS Bearer Context. See subclause "MBMS De-Registration Procedure".

12. The GGSN confirms the deactivation of the MBMS UE Context to the SGSN by sending a Delete MBMS Context Response to the SGSN, which then deletes the MBMS UE Context.

13. If the SGSN does not have any more users interested in this MBMS bearer service and the "list of downstream nodes" in the corresponding MBMS Bearer Context is empty, the SGSN sends an MBMS De-Registration Request to the GGSN. The GGSN responds with an MBMS De-Registration Response and removes the identifier of the SGSN from the "list of downstream nodes" parameter in its MBMS Bearer Context. See subclause "MBMS De-Registration Procedure".

8.8 MBMS Session Update procedure

8.8.1 General

The MBMS Session Update procedure may be invoked by BM-SC or by SGSN. The BM-SC uses the procedure to update the service area for an ongoing MBMS Broadcast service session. The SGSN can also use the procedure to update the list of RAs where MBMS multicast users are located for an ongoing MBMS Multicast service session.

8.8.2 SGSN initiated Session Update for MBMS Multicast service

If the SGSN has provided a list of RAs in the MBMS Session Start Request message (even if the list was empty) and RAs are added or removed from the list, the SGSN shall use the MBMS Session Update procedure to inform the RNCs that the list has changed. The SGSN sends the Session Update message only to the RNCs that are affected by the list change. The procedure is used only during the MBMS Multicast service session and when SGSN has already sent a MBMS Session Start Request message to the RNC.

If the SGSN has provided a list of RAs in the MBMS Session Start Request message (even if the list was empty) the SGSN shall send the Session Update to a RNC when:

- the first UE which have activated the service enters in a RA that is not in the list;
- the last UE which have activated the service leaves from a RA that was in the list.

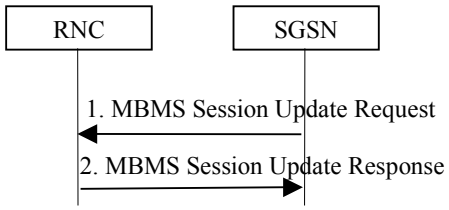

Figure 13a. Session Update procedure

1) The SGSN sends MBMS Session Update Request message to a RNC.
2) The RNC acknowledges the MBMS Session Update Request with the MBMS Session Update Response message.

8.8.3 BM-SC initiated Session Update for MBMS Broadcast service

The BM-SC initiates the MBMS Session Update procedure when the service area for an ongoing MBMS Broadcast service session shall be modified.

The attributes that can be modified by the Session Update Request are the MBMS Service Area, and the list of downstream nodes for GGSN (Broadcast only). A node receiving the Session Update Request determines how the attributes have changed by comparing the attributes in the message with corresponding attributes in its stored MBMS Bearer Context.

A Session Update received in one node, results in a Session Update being sent to downstream nodes, to inform of the changed MBMS Service Area. If a Session Update with the List of SGSN parameter included is received in the GGSN, it does also result in a Session Start being sent to new downstream nodes, and in a Session Stop being sent to downstream nodes that have been removed from the list.

The overall Session Update procedure is presented in figure 13b.

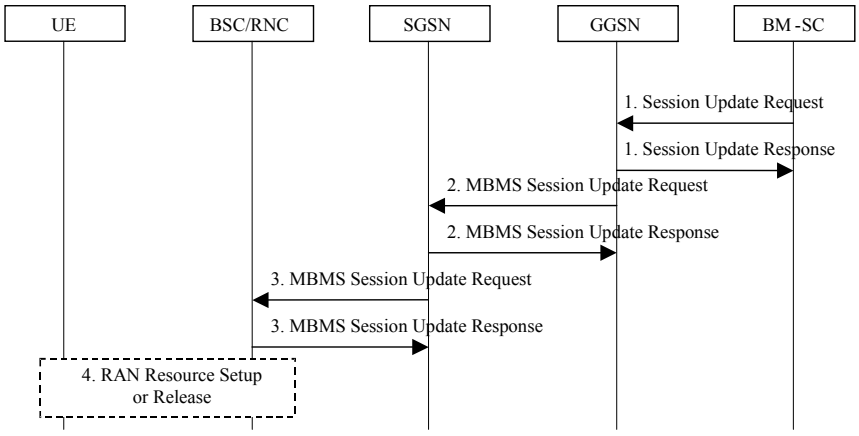

Figure 13b: Session Update procedure

1. The BM-SC Session and Transmission function sends a Session Update Request (TMGI, QoS, MBMS Service Area, Session identifier, estimated session duration, broadcast/multicast, list of downstream nodes for GGSN, time to MBMS data transfer) to the BM-SC Proxy and Transport function, which then forwards it to the GGSNs listed in the "list of downstream nodes" parameter of the corresponding MBMS Bearer Context. The TMGI and Session identifier identifies the ongoing session. The QoS, broadcast/multicast attributes and the 2G/3G indicator shall be identical as in the preceding Session Start message. The MBMS Service Area and the List of

downstream nodes for GGSN define the new service area. The time to MBMS data transfer shall be set to 0 and the estimated session duration shall be set to a value corresponding to the remaining part of the session.

The GGSN stores the new session attributes and the list of downstream nodes in the MBMS Bearer Context and sends a Session Update Response message to the BM-SC Proxy and Transport function which forwards it to the BM-SC Session and Transmission function. The BM-SC Proxy and Transport function copies the Session Update Request to the BM-SC Membership function for charging purposes.

2. The GGSN compares the new list of downstream nodes with the list of downstream nodes it has stored in the MBMS Bearer Context. It sends an MBMS Session Start Request message to any added SGSN, an MBMS Session Stop Request to any removed SGSN, and an MBMS Session Update Request to the remaining SGSNs in the new list.

3. The SGSN receiving an MBMS Session Update Request message, sends an MBMS Session Update Request message including the session attributes (TMGI, QoS, MBMS service Area, Session identifier, estimated session duration, broadcast/multicast, time to MBMS data transfer, list of RAs, etc.) to each BSC and/or each RNC that is connected to this SGSN.

4. The BSCs/RNCs establish or release the necessary radio resources for the transfer of MBMS data to the interested UEs.

8.9 MBMS UE Context Synchronisation Procedure

The Routing Area Update procedure transfers the MBMS UE Context status between UE and SGSN. This MBMS UE Context status identifies MBMS UE contexts, which are lost or deactivated only on one side. All MBMS UE Contexts, which are active on one side only shall be deactivated locally. If the UE wishes to re-activate the related MBMS bearer service, it shall join the MBMS bearer service again. See subclause 8.2 "MBMS Multicast Service Activation".

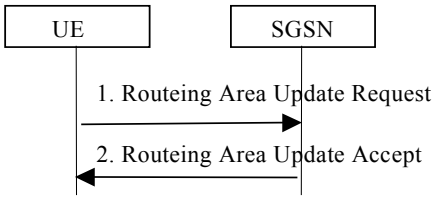

Figure 13b. MBMS UE Context Synchronisation procedure

1) The UE sends Routeing Area Update Request to the SGSN. It includes the MBMS UE Context status, which indicates the UE's active MBMS UE Contexts.

2) The SGSN sends Routeing Area Update Accept to the UE. It includes the MBMS UE Context status, which indicates the UE's MBMS UE Contexts that are stored in the SGSN.

8.9a MBMS feature support indication

An SGSN that supports MBMS shall indicate MBMS feature support to the UE during Routing Area Update procedure in the Routing Area Update Accept message and during GPRS attach procedure in the Attach Accept message. The UE then knows it can use already activated MBMS bearers, or activate new MBMS bearers according to subclause 8.2 "MBMS Multicast Service Activation".

An SGSN that does not support MBMS will not indicate MBMS feature support to the UE. This indicates to the UE that MBMS bearers are no longer supported, which may allow the UE to use point-to-point bearers for MBMS data transfer. In this case, the UE shall deactivate all active MBMS UE Contexts locally.

8.10 Inter SGSN Routeing Area Update

This procedure describes the handling of MBMS bearer services when an MBMS UE performs a Routeing Area Update and the serving SGSN changes. It is based on the Inter SGSN Routeing Area Update procedure specified in TS 23.060 [15]. The procedure is performed regardless whether MBMS sessions are ongoing or not. The handling of any PDP contexts established by the UE is not changed compared to the procedure without MBMS. The procedure described below does not show all details of the Routeing Area update procedure. Only for the MBMS specific additions the steps are described.

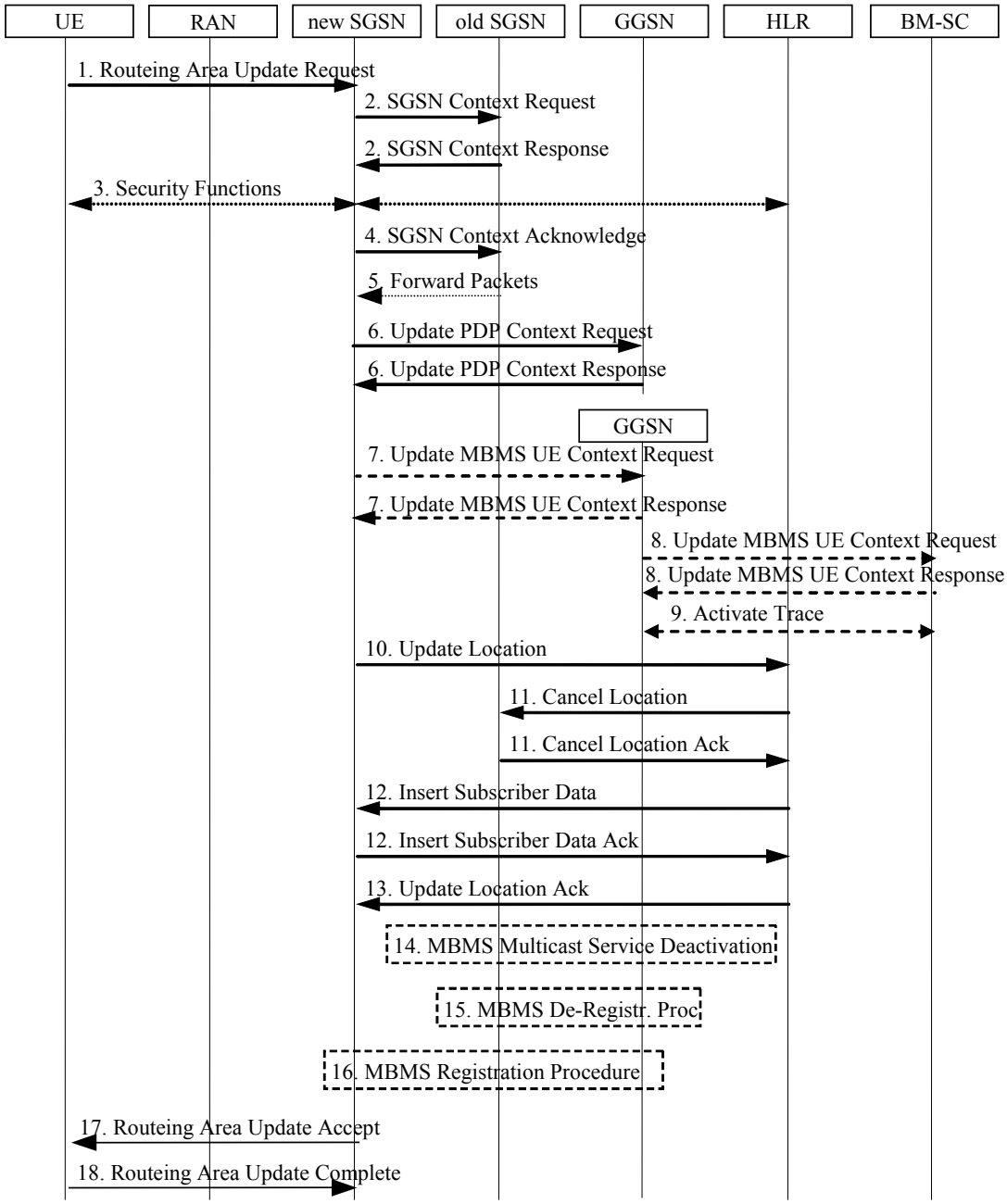

Figure 14: Inter SGSN Routeing Area Update

2) An SGSN supporting MBMS indicates its MBMS support in the SGSN Context Request message. If the SGSN indicates that it supports MBMS, the old SGSN includes the transfer of the MBMS UE Context(s) in the SGSN Context Response message.

7) For the MBMS UE context(s) received in step 2) the new SGSN sends Update MBMS UE Context Request (Serving network identity, MS Time Zone, CGI/SAI, RAT Type, Additional MBMS Trace Info) to the GGSNs concerned. The GGSNs update their MBMS UE Context fields and return Update MBMS UE Context Response.

8) The GGSN sends Update MBMS UE Context Request (RAI) to the BM-SC. The inclusion of CGI/SAI shall be according rules detailed in subclause 15.1.1a in TS 23.060 [15]. The BM-SC updates its MBMS UE Context fields and return Update MBMS UE Context Response.

9) If the GGSN receives new or updated Additional MBMS Trace Info from the new SGSN, the GGSN sends an Activate Trace (Additional MBMS Trace Info) message to the BM-SC.

14) In case the new SGSN indicated no MBMS support in step 2) the old SGSN deactivates all MBMS UE context(s) of the UE in SGSN, GGSN and BM-SC by initiating deactivation procedure(s) as described in subclause "8.7 MBMS Multicast Service Deactivation".

15) If the old SGSN does not have any more MBMS UE Contexts for the MBMS bearer service(s) and the "list of downstream nodes" in the corresponding MBMS Bearer Context is empty, the SGSN initiates the MBMS De-Registration Procedure. See subclause "8.6 MBMS De-Registration Procedure".

16) In case the new SGSN indicated MBMS support in step 2), the new SGSN verifies for each MBMS UE Context received whether it has a corresponding MBMS Bearer Context. For each MBMS Bearer Context that the SGSN does not already have, the SGSN creates an MBMS Bearer Context (in "Standby" state) and initiates the MBMS Registration Procedure towards the GGSN. See subclause "8.4 MBMS Registration Procedure".

17) An SGSN without MBMS support does not indicate MBMS feature support in the Routing Area Update Accept message. On the other hand if the SGSN supports MBMS, the Routing Area Update Accept indicates to the UE that the network supports MBMS.

8.10a Inter-system Intra-SGSN change

For an MBMS UE transitioning between UTRAN and A/Gb mode GERAN, the procedures are the same as the Iu mode to A/Gb mode Intra SGSN Change and A/Gb mode to Iu mode Intra SGSN Change procedures specified in TS 23.060 [15].

Furthermore, the same considerations on Radio Access Technology changes apply as specified in the impacts of applying flow based charging specified in TS 23.060 [15], i.e. the SGSN shall send an Update MBMS UE Context Request to the GGSN. Subsequently the GGSN shall send an Update MBMS UE Context Request to the BM-SC as described in the Inter SGSN Routeing Area Update procedure in subclause 8.10.

8.11 Inter SGSN Serving RNS Relocation Procedure

This procedure is performed when the SGSN changes due to SRNS relocation. It bases on the SRNS Relocation procedure specified in TS 23.060 [15]. The procedure is performed regardless whether MBMS sessions are ongoing or not. The handling of any PDP contexts established by the UE is not changed compared to the procedure without MBMS. The procedure described below does not show all details of the SRNS relocation procedure. Only for the MBMS specific additions the steps are described.

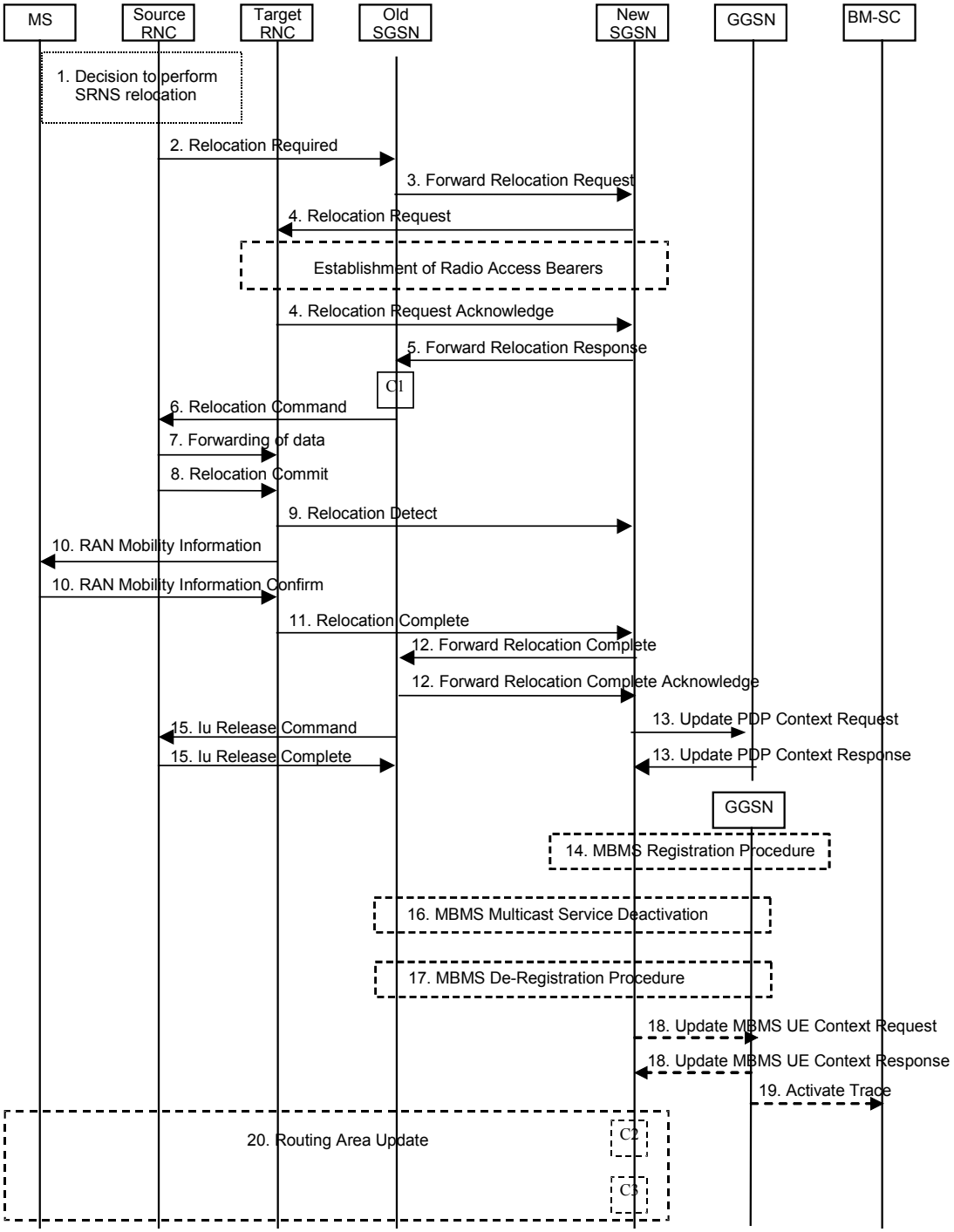

Figure 15: SRNS Relocation Procedure

3) The old SGSN transfers the MBMS UE Context(s). in the Forward Relocation Request message to the new SGSN

5) An MBMS supporting SGSN indicates its MBMS support in the Forward Relocation Response message.

14) In case the new SGSN supports MBMS it verifies for each MBMS UE Context received whether it has a corresponding MBMS Bearer Context. For each MBMS Bearer Context not yet existing in the SGSN the SGSN creates an MBMS Bearer Context (in "Standby" state) and initiates the MBMS Registration Procedure. See subclause "MBMS Registration Procedure".

16) In case the new SGSN indicated no MBMS support in step 3) the old SGSN deactivates all MBMS UE contexts of the UE in SGSN, GGSN and BMSC by initiating deactivation procedure(s) as described in clause "8.7 MBMS Multicast Service Deactivation".

17) If the old SGSN does not have any more MBMS UE Contexts for this MBMS bearer service and the "list of downstream nodes" in the corresponding MBMS Bearer Context is empty, the SGSN initiates the MBMS De-Registration Procedure. See subclause "MBMS De-Registration Procedure".

18) If the new SGSN supports the MBMS and for the MBMS UE context(s) received in step 5) the new SGSN sends Update MBMS UE Context Request (Serving network identity, MS Time Zone, CGI/SAI, RAT Type, Additional MBMS Trace Info) to the GGSNs concerned. The GGSNs update their MBMS UE Context fields and return Update MBMS UE Context Response. The GGSN sends updated Serving network identity to the BM-SC. The inclusion of CGI/SAI shall be according rules detailed in sub-clause 15.1.1a in TS 23.060 [15].

19) If the GGSN receives new or updated Additional MBMS Trace Info from the new SGSN, the GGSN sends an Activate Trace (Additional MBMS Trace Info) message to the BM-SC.

20) An SGSN without MBMS support does not indicate MBMS feature support in the Routing Area Update Accept message. On the other hand if the SGSN supports MBMS, the Routing Area Update Accept indicates to the UE that the network supports MBMS.

8.12 MBMS Broadcast Service Activation

MBMS Broadcast service activation is the procedure by which a UE locally activates a broadcast MBMS bearer service:

- The MBMS broadcast service activation procedure does not register the user in the network. There is no MBMS bearer service specific signalling exchanged between the UE and the Network.
- The broadcast service activation procedure does not establish MBMS UE contexts in UE, SGSN and GGSN.

8.13 MBMS Broadcast service de-activation

The MBMS Broadcast service de-activation by the UE is local to the UE, i.e. without interaction with the Network.

8.14 Void

8.15 MBMS UE Linking/De-linking mechanism

MBMS UE Linking is the process by which UE MBMS context(s) is (are) provided to an Iu-mode RAN.

MBMS UE linking procedure is performed when the UE is PMM-CONNECTED at least in the following cases.

- When a UE which has a MBMS UE context is moved to the PMM CONNECTED state and a PS RAB is established. This may happen at any point in time e.g. before, during and between Sessions.
- When a UE joins the MBMS bearer service and is in the PMM CONNECTED state due to an existing PS RAB. This may happen at any point in time e.g. before, during and between Sessions.
- When a UE is moved to the PMM CONNECTED state via the MBMS Service Request procedure. This may happen at any point in time during a MBMS session.

The UE linking is performed to link a specific UE to an MBMS service. It provides the SRNC/Iu-mode BSC with a list of MBMS service identifiers (including TMGI) for MBMS bearer services activated by the UE. If no MBMS service context exists for this particular MBMS bearer service then the SRNC/Iu-mode BSC creates an MBMS service context after this procedure.

NOTE: the MBMS Bearer Context is referred to as the MBMS Service Context in 3GPP RAN specifications

MBMS UE De-Linking denotes the process where a MBMS UE context is removed from the RAN.

MBMS UE De-Linking procedure is performed if the UE is PMM-CONNECTED and has been already linked towards the RAN at least when it initiates MBMS Multicast Service Deactivation procedure. This may happen at any point in time during the whole MBMS service availability i.e. before, during and between MBMS sessions.

The UE De-Linking is performed to unlink a specific UE from a MBMS service. The entry for this UE is removed from the concerned MBMS service context(s) in the SRNC.

8.16 MBMS Service Request Procedure

For MBMS, when UTRAN wants to count the number of users that are interested in a specific MBMS service which are present in a cell, it will request a percentage of the interested UEs to transit to PMM-CONNECTED state. The MBMS Service Request procedure is used by a UE in the PMM-IDLE state to move to the PMM-CONNECTED state.

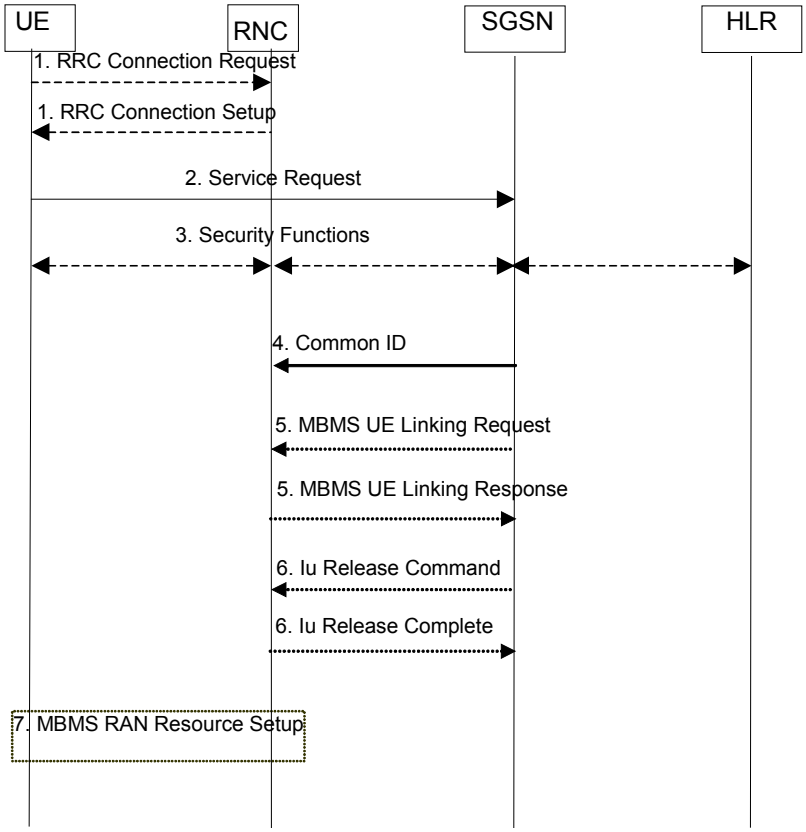

Figure 17: MBMS Service Request procedure

2) The UE sends a Service Request message to the SGSN if required to do so by the RAN after an MBMS Session starts. The Service Type shall indicate MBMS multicast service reception or MBMS broadcast service reception.

3) The SGSN may perform the security functions.

4) The SGSN provides the RAN with the IMSI of the UE.

5) The SGSN provides the RAN with the MBMS UE context(s) (IP multicast address/APN, TMGI, MBMS_NSAPI) via MBMS UE Linking procedure, if the SGSN has active MBMS UE context(s) for the UE.

6) The SGSN may release the Iu connection.

NOTE: Step 7 is independent of steps 4 to 6 and can occur before or simultaneously with any of these steps.

7) The RNC establishes the necessary radio resources for the transfer of MBMS data to the interested UEs.

8.17 Notification in case of parallel services

8.17.1 Notification of incoming CS domain call during an ongoing MBMS session

For the RRC connected mobiles in UTRAN, the RNS will have received the IMSI from the core network and hence is able to perform paging coordination. The UEs in RRC idle state in UTRAN need to perform paging coordination while receiving the MBMS session's user data.

In GERAN, this is achieved by the UE monitoring its paging channels while receiving the MBMS session's user data. If the mobile responses to the CS paging in GERAN, then the ongoing MBMS service is likely to be interrupted in the UE.

8.17.2 Notification of additional MBMS session during an ongoing MBMS session

For the RRC connected mobiles in UTRAN, the SGSN has sent the list of MBMS bearer services that the user has activated to the UTRAN. The RNS needs to notify an RRC connected UE.

For the UEs in RRC idle state, the UTRAN performs MBMS notification for the UE.

In GERAN, this is achieved by the UE monitoring its paging channel(s) where notification is sent while receiving the MBMS session's user data.

If the mobile accepts the new MBMS session in GERAN, then the ongoing MBMS service is likely to be interrupted in the UE.

8.17.3 Notification of Mobile Terminating PS data during an ongoing MBMS session

For the RRC connected mobiles in UTRAN, the SGSN request the establishment of a RAB which will be used to deliver the MT user data.

For the UEs in RRC idle state, the UTRAN performs paging notification for the UE.

In GERAN, this is achieved by the UE monitoring its paging channels while receiving the MBMS session's user data.

If the mobile responses to the PS paging in GERAN, then the ongoing MBMS service is likely to be interrupted in the UE.

8.17.4 Notification of MBMS session during an ongoing CS or PS domain "connection"

When the UE establishes the UTRAN RRC connection for a CS service, the UE shall send a flag indicating that it has activated at least one MBMS bearer service. The RNC requests the SGSN to send the list of MBMS bearer services that the user has activated to enable the RNC to notify the UE when MBMS session starts.

When a UE moves to PMM-connected state, the SGSN sends the list of MBMS bearer services that the user has activated to the RNC. The RNC notifies the UE when an MBMS session of the user's activated MBMS bearer services starts.

These procedures are not supported by GERAN in this version of the specification.

9 Security

Security of MBMS is found in TS 33.246 [5].