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Technical Specification

Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2 (3GPP TS 23.272 version 8.0.0 Release 8)

GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

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Contents

Foreword

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1 Scope

This document defines the Stage 2 architecture and specification for the CS Fallback for EPS. The scope of this document includes the architecture enhancements for functionality to enable fallback from E-UTRAN access to UTRAN/GERAN CS domain access and to CDMA 1x RTT CS domain access, and functionality to reuse of voice and other CS-domain services (e.g. CS UDI video / SMS/ LCS / USSD) by reuse of CS infrastructure.

The architecture enhancements to support CS fallback for CDMA 1x RTT CS domain access are specified in Annex B.

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 23.401: "GPRS Enhancements for E-UTRAN Access".

[3] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[4] 3GPP TS 44.018: "Mobile radio interface layer 3 specification Radio Resource Control (RRC) protocol".

[5] 3GPP TS 23.018: "Basic call handling; Technical realization".

[6] 3GPP TS 48.008: "MSC-BSS interface layer 3 specification; Protocol specification".

[7] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol specification".

[8] 3GPP TS23.271: "Functional stage 2 description of Location Services (LCS)".

[9] Open Mobile Alliance, OMA AD SUPL: "Secure User Plane Location Architecture", http://www.openmobilealliance.org

[10] 3GPP TS23.090: "Unstructured Supplementary Service Data (USSD); Stage 2".

[11] 3GPP TS 23.012: "Location management procedures".

[12] 3GPP TS 44.060: "MS-BSS interface; RLC/MAC protocol ".

[13] 3GPP TS24.010: "Supplementary services specification; General aspects".

[14] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".

[15] 3GPP TS 23.204: 'Short Message Service (SMS) over generic 3GPP Internet Protocol (IP) access'.

[16] 3GPP2 A.S0008-C: "Interoperability Specification (IOS) for High Rate Packet Data (HRPD) Radio Access Network Interfaces with Session Control in the Access Network"

[17] 3GPP2 A.S0009-C: "Interoperability Specification (IOS) for High Rate Packet Data (HRPD) Radio Access Network Interfaces with Session Control in the Packet Control Function"

[18]   3GPP2 A.S0013-C: "Interoperability Specification (IOS) for cdma2000 Access Network Interfaces – part 3 Features'

[19]   3GPP TS 36.938: "Improved Network Controlled Mobility between E-UTRAN and 3GPP2/Mobile WiMAX Radio Technologies"

[20]   3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC); 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. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

3.3 Abbreviations

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

4 Overall Description

4.1 General Considerations

The CS fallback in EPS enables the provisioning of voice and other CS-domain services (e.g. CS UDI video/ SMS/ LCS/ USSD) by reuse of CS infrastructure when the UE is served by E-UTRAN. A CS fallback enabled terminal, connected to E-UTRAN may use GERAN or UTRAN to establish one or more CS-domain services. This function is only available in case E-UTRAN coverage is overlapped by either GERAN coverage or UTRAN coverage.

The solution should have no or minimum impacts on CS domain entities and UE as well as the user experience on CS Domain services.

It should be possible to handoff the ongoing data session to 2G/3G PS if the target cell supports simultaneous PS/CS sessions when the terminal use GERAN or UTRAN to establish one or more CS-domain services.

It should be possible for the operator to provide SMS service to the user without the necessity to fallback to GERAN or UTRAN.

It should be possible for the operator to provide LCS service to the user without the necessity to fallback to GERAN or UTRAN using other available technologies such as SUPL.

The solution should be able to cope with imperfect planning between TA and 2G/3G LA.

CS Fallback and IMS-based services shall be able to co-exist in the same operator"s network.

4.2 Reference Architecture

The CS fallback in EPS function is realized by reusing the Gs interface mechanism between the MSC Server and the MME.
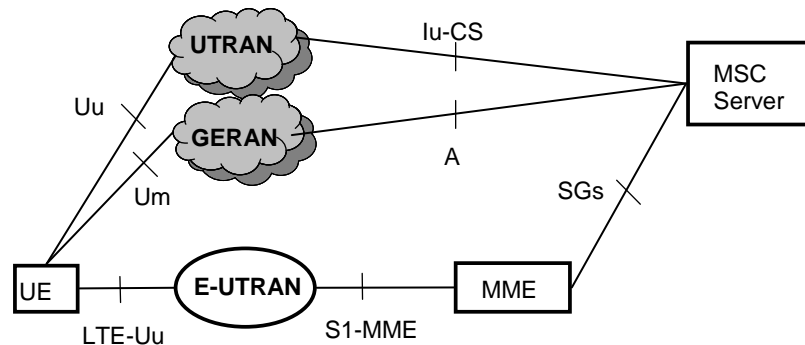
Figure 4.2-1: CS fallback in EPS architecture

NOTE: The MGW is not shown in the figure 4.2-1 since the CS fallback in EPS does not have any impacts to the U-plane handling.

4.2.1 Reference points

SGs: It is the reference point between the MME and MSC server. The SGs reference point is used for the mobility management and paging procedures between EPS and CS domain, and is based on the Gs interface procedures. The SGs reference point is also used for the delivery of both mobile originating and mobile terminating SMS.

4.3 Functional entities

4.3.1 UE

The CS fallback capable UE supports access to E-UTRAN/EPC as well as access to the CS domain over GERAN and/or UTRAN. It supports the following additional functions:

- Combined procedures specified in this document for EPS/IMSI attach, update and detach.

- CS fallback and SMS procedures specified in this document for using CS domain services.

4.3.2 MME

The CS fallback enabled MME supports the following additional functions:

- Deriving a VLR number and LAI out of the TAI.

- Maintaining of SGs association towards MSC/VLR for EPS/IMSI attached UE.

- Initiating IMSI detach at EPS detach.

- Initiating paging procedure specified in this document towards eNodeB when MSC pages the UE for CS services.

- Supporting SMS procedures defined in this document.

4.3.3 MSC

The CS fallback enabled MSC supports the following additional functions:

- Maintaining SGs association towards MME for EPS/IMSI attached UE.

- Paging on SGs and Iu/A in parallel.

- Supporting SMS procedures defined in this document.

4.3.4 E-UTRAN

The CS fallback enabled E-UTRAN supports the following additional functions:

- Forwarding paging request and SMS to the UE.

- Directing the UE to the target CS capable cell (FSS if this is done by MME or E-UTRAN).

4.4 Control plane

4.4.1 MME - MSC Server

SGsAP		SGsAP
SCTP		SCTP
IP		IP
L2		L2
L1		L1

MME   SGs   MSC Server
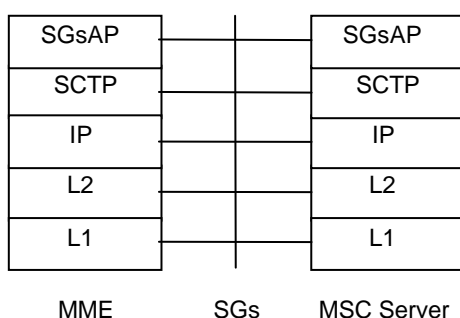
Legend:
SGsAP: This protocol is used to connect an MME to an MSC Server based on the BSSAP+.
Stream Control Transmission Protocol (SCTP): This protocol transfers signalling messages.

Figure 4.4.1-1: SGs Interface

4.5 Co-existence with IMS services

If a UE is configured to use IMS voice services it shall, if registered to IMS, initiate voice calls over IMS, even if it is EPS/IMSI attached.

NOTE: The home operator has to be able to activate/deactivate the UE configuration to use IMS voice services by means of device management in order to allow alignment with HPLMN support of IMS voice services.

If a UE is configured to use SMS over IP services it shall, if registered to IMS, send SMS over IMS, even if it is EPS/CS attached.

NOTE: The operator has to be able to activate/deactivate the UE configuration to use SMS over IP by means of device management in order to allow alignment with HPLMN support of SMS over IP.

In special cases when the IMS registered and EPS/IMSI attached UE can not initiate an IMS voice session or SMS (because e.g. IMS voice services are not supported by the serving IP-CAN or UE) CS fallback should be applied for voice calls and/or SMS.

5 Mobility Management

5.1 General

The CS fallback in EPS is realized by reusing the Gs interface mechanism between the MSC Server and the MME.

5.2 Attach procedure

The attach procedure for the CS fallback in EPS is realized based on the combined GPRS/IMSI Attach procedure specified in TS 23.060 [3].

Figure 5.2-1: Attach Procedure

1) The MS initiates the attach procedure by the transmission of an Attach Request (parameters as specified in TS 23.401 [2], CS fallback indicator) message to the MME. The CS fallback indicator indicates that the UE is capable and configured to use CS fallback.

2) The EPS Attach procedure is performed as specified in TS 23.401 [2].

3) The VLR shall be updated according to the combined GPRS/IMSI Attach procedure in TS 23.060 [3] if Attach Request message includes the Combined Update indicator. The VLR number is derived from the TAI. The MME starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HSS in step 2). This operation marks the MS as EPS-attached in the VLR.

4) The MME sends a Location Update Request (new LAI, IMSI, MME address, Location Update Type) message to the VLR. New LAI is determined in MME based on mapping from the TA. A mapped LAI could be either GERAN or UTRAN based on an operator configuration. MME address is an IP address.

5) The VLR creates an association with the MME by storing MME address.

6) The VLR performs Location Updating procedure in CS domain.

7) The VLR responds with Location Update Accept (VLR TMSI) to the MME.

8) The MME sends an Attach Accept (parameters as specified in TS 23.401 [2], LA, VLR TMSI) message to the UE. The existence of LA and VLR TMSI indicates successful attach to CS domain.

NOTE: The case of unsuccessful attach to CS domain is documented in stage 3 specifications, taking into account reachability for CS services of UEs that have the user preference to prioritize voice over data services and are not configured/supporting to use IMS voice services.

5.3 Detach procedure

5.3.1 UE-initiated Detach procedure

The UE-initiated Detach procedure for the CS fallback in EPS is realized based on the MS-Initiated Detach Procedure specified in TS 23.060 [3].
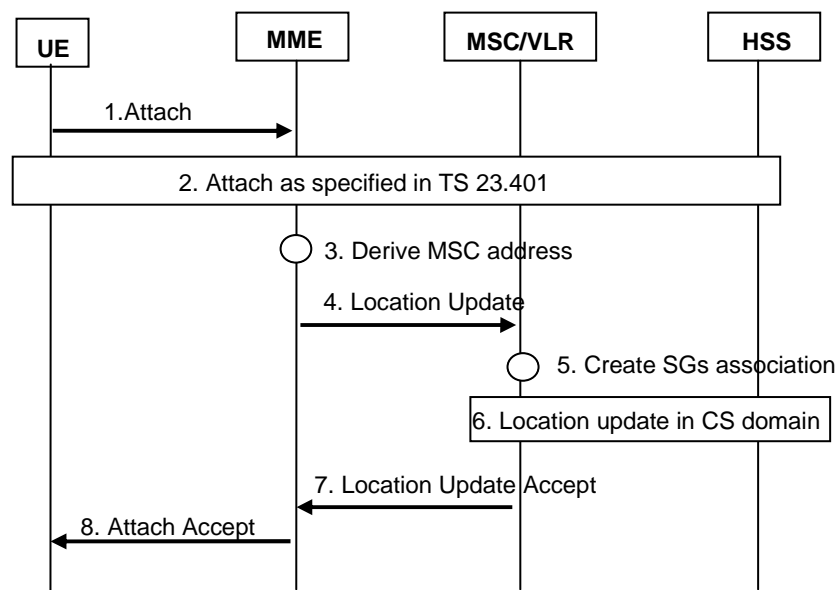

Figure 5.3.1-1: UE-initiated Detach Procedure

1) The UE initiates the detach procedure by the transmission of a Detach Request (parameters as specified in TS 23.401 [2], Detach Type) message to the MME. Detach Type indicates which type of detach is to be performed, i.e., IMSI Detach only or combined EPS and IMSI Detach.

2) If EPS detach is indicated in step 1, the EPS Detach procedure is performed as specified in TS 23.401 [2].

3) The MME sends an IMSI Detach Indication (IMSI) message to the VLR.

4) The VLR removes the association with the MME.

5) The MME sends a Detach accept message as specified in TS 23.401 [2].

5.3.2 MME-initiated Detach procedure

The MME-initiated detach procedure for the CS fallback in EPS is realized based on the SGSN-Initiated Detach Procedure specified in TS 23.060 [3].

Figure 5.3.2-1: MME-initiated Detach Procedure

1) The MME-initiated Detach procedure is performed as specified in TS 23.401 [2].

2) The MME sends an IMSI Detach Indication (IMSI) message to the VLR.

3) The VLR removes the association with the MME.

5.3.3   HSS-initiated Detach procedure

The HSS-initiated detach procedure for the CS fallback in EPS is realized based on the HLR-Initiated Detach Procedure specified in TS 23.060 [3].

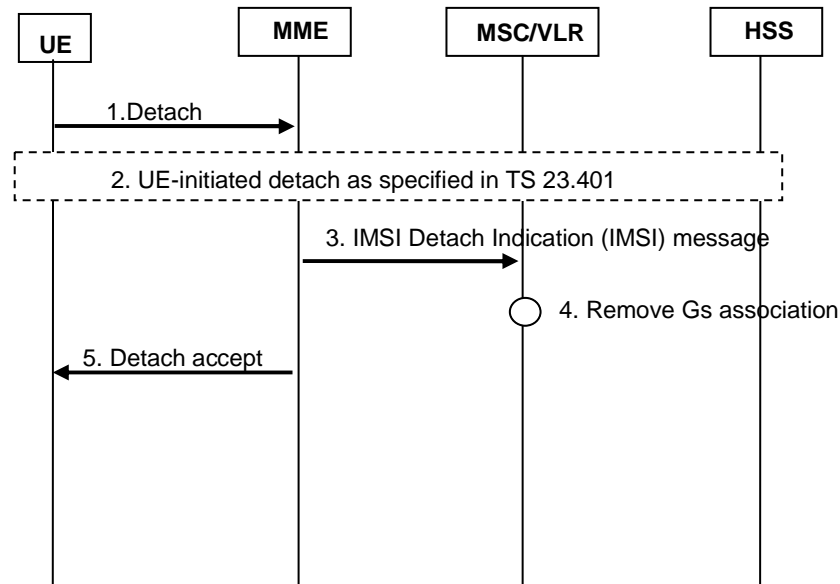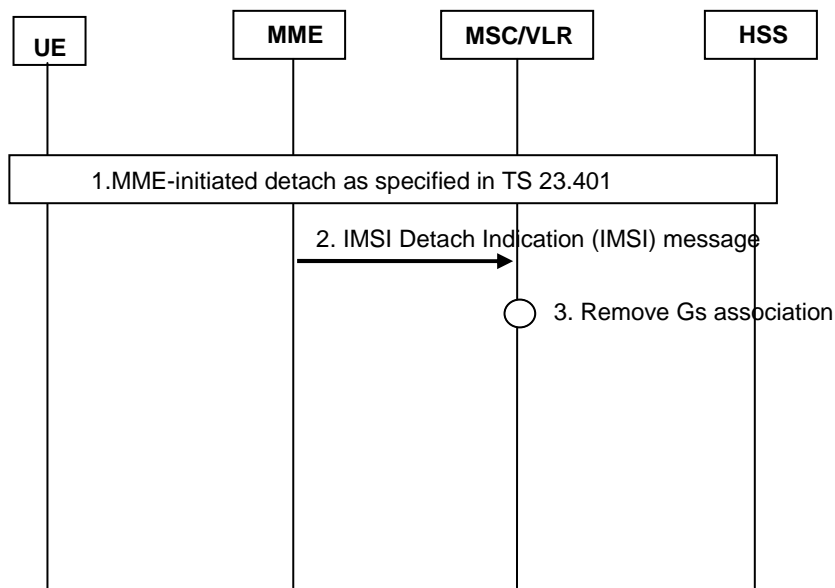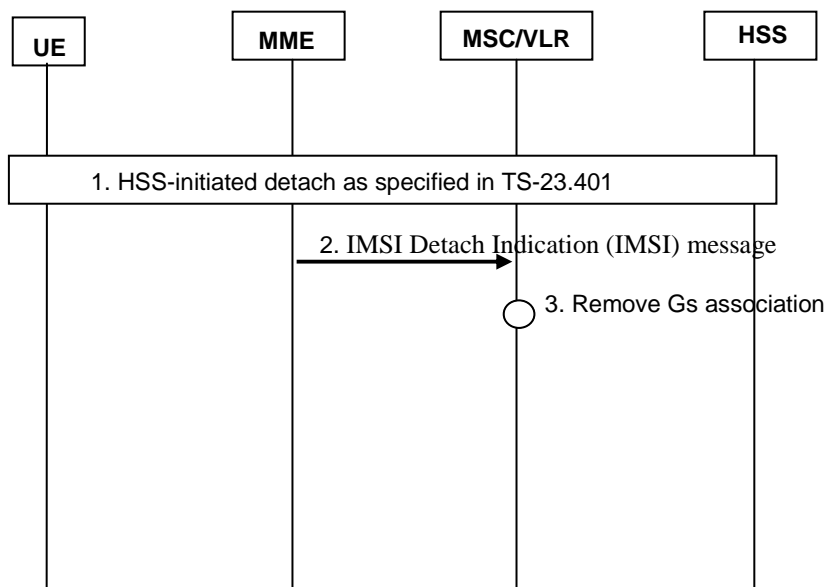**Figure 5.3.3-1: HSS-initiated Detach Procedure**

1) The HSS-initiated Detach procedure is performed as specified in TS 23.401 [2].

2) The MME sends an IMSI Detach Indication (IMSI) message to the VLR.

3) The VLR removes the association with the MME.

5.4 TA/LA Update procedure

5.4.1 Combined TA/LA Update Procedure

NOTE: The combined TA/LA Update procedure for the CS fallback in EPS is realized based on the combined RA/LA Update procedure specified in TS 23.060 [3].
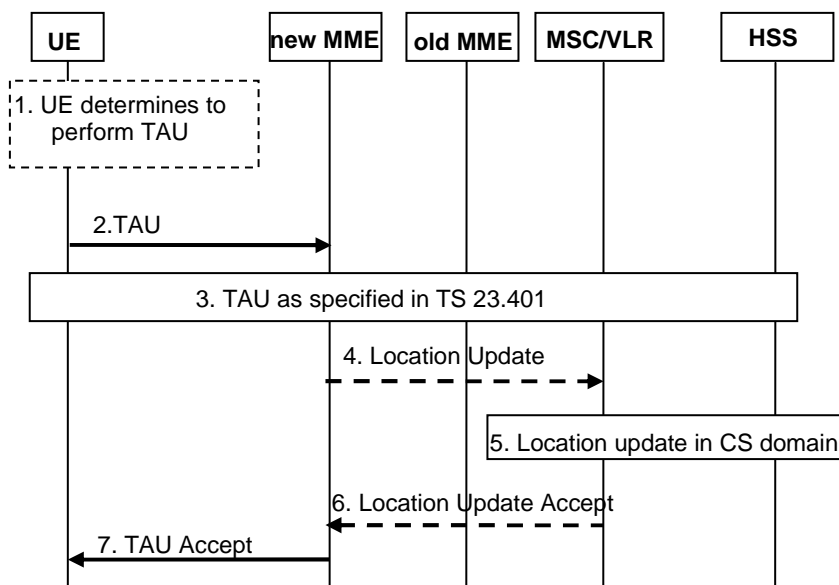
Figure 5.4.1-1: Combined TA / LA Update Procedure

1) The UE detects a change to a new TA by discovering that its current TAI is not in the list of TAIs that the UE registered with the network. The combined TA/LA Update Procedure is also performed in order to re-establish the SGs association. Therefore, when the UE performed a LAU (which releases the SGs association) and enters ECM_IDLE state in an area that requires combined TA/LA Updates, then the UE performs a combined TA/LA Update.

2) The UE initiates the TAU procedure by sending a TAU Request (parameters as specified in TS 23.401 [2], CS fallback indicator) message to the MME. The CS fallback indicator indicates that this is a combined Tracking Area/Location Area Update Request message.

3) The EPS TAU procedure is performed as specified in TS 23.401 [2].

4) If there is an associated VLR in the MM context, the VLR also needs to be updated. If the association has to be established or if the LA changed, the new MME sends a Location Update Request (new LAI, IMSI, MME address, Location Update Type) message to the VLR. New LAI is determined in the MME based on mapping from the TA. Location Update Type shall indicate normal location update. The VLR number is derived from the TAI. MME address is an IP address.

5) The VLR performs Location Update procedure in CS domain.

6) The VLR responds with Location Update Accept (VLR TMSI) to the MME.

7) The MME sends a TAU Accept (parameters as specified in TS 23.401 [2], LAI, VLR TMSI) message to the UE. The VLR TMSI is optional if the VLR has not changed. When the MME allocates the TA list to the UE, the TA list shall be configured ensuring that all TAs in the TA list belong to the same LA.

5.4.2 Periodic TA and LA Update Procedure

When the UE is camped in the E-UTRAN, periodic LA updates shall not be performed. In this case the MSC/VLR shall disable implicit detach for EPS-attached UEs and instead rely on the MME to receive periodic TA updates. If periodic TA updates are not received in the MME and the MME detaches the UE, the MME shall notify the MSC/VLR by sending an IMSI Detach Indication message.

If the UE is both EPS/IMSI and GPRS/IMSI attached, the UE shall initiate combined periodic TA/LA or RA/LA update procedure.

6 Mobile Originating Call

6.1 General

This clause describes the mobile originating call procedures for the CS Fallback in EPS.

6.2 Mobile Originating call in Active Mode - PS HO supported

Figure 6.2-1: CS Call Request in E-UTRAN, Call in GERAN/UTRAN

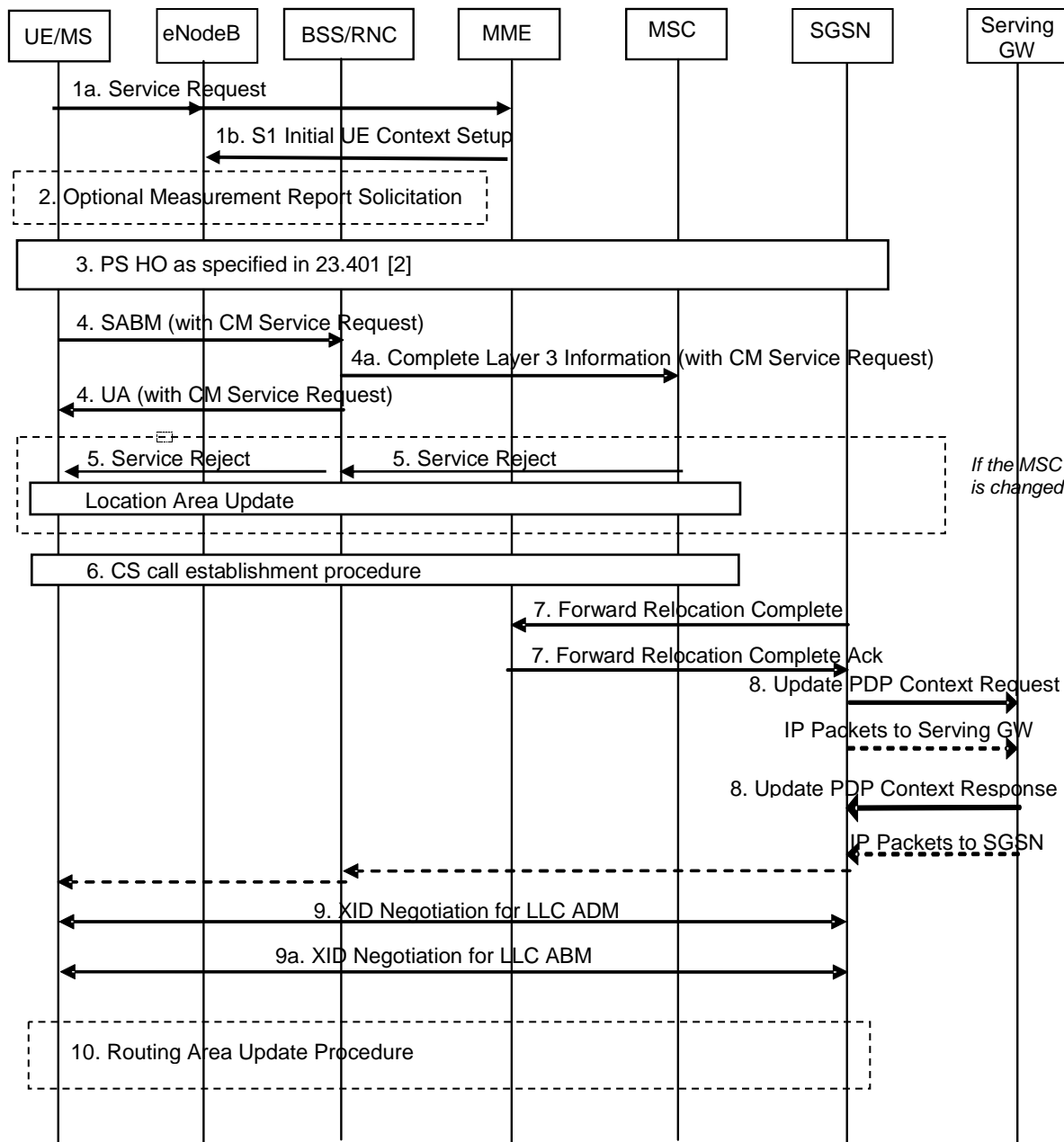NOTE 1: For simplicity, figure 6.2-1 includes some messages which are only applicable to GERAN access (e.g. SABM, UA and XID negotiation). In case of UTRAN access, the applicable messages can be found in the E-UTRAN to UTRAN inter-RAT HO procedures specified in TS 23.401 [2].

NOTE 2: Steps 1a and 1b need to be further investigated in CT1 considering aspects such as speed and complexity.

1a. UE sends Service Request (CS Fallback Indicator) to MME. Service Request message is encapsulated in RRC and S1-AP messages. CS Fallback Indicator indicates MME to perform CS Fallback. The UE only transmits this request if it is attached to CS domain (with a combined EPS/IMSI Attach) and can not initiate an IMS voice session (because e.g. the UE is not IMS registered or IMS voice services are not supported by the serving IP-CAN, home PLMN or UE).

1b. MME sends S1-AP: Initial UE Context Setup (UE capabilities, CS Fallback Indicator) to indicate the eNB to move the UE to UTRAN/GERAN.

2. The eNode may optionally solicit a measurement report from the UE to determine the target GERAN/UTRAN cell to which PS handover will be performed.

3. The eNodeB triggers PS handover to a GERAN/UTRAN neighbour cell by sending a Relocation Required message. In the following a PS HO as specified in TS 23.401 [2] takes place.

4. Target RAT is UTRAN: As soon as the UE completes the PS HO procedure the UE establishes an RRC connection and responds to the paging in an RRC Initial Direct Transfer message as specified in TS 25.331 [7]. CN Domain Indicator is set to "CS" in the Initial Direct Transfer message.

   Target RAT is GERAN: As soon as the UE completes the PS HO procedure the UE establishes an RR connection using legacy procedures (i.e. UE requests and is assigned a dedicated channel where it sends a SABM containing a layer 3 Service Request message = PAGING RESPONSE to the BSS) and the BSS responds by sending a UA. Upon receiving the SABM (containing a PAGING RESPONSE message) the BSS sends a COMPLETE LAYER 3 INFORMATION message (containing a PAGING RESPONSE message) to the MSC which indicates CS resources have been allocated in the GERAN cell. After the establishment of the main signalling link as described in TS 44.018 [6] the UE enters either Dual Transfer Mode or Dedicated Mode and the CS call establishment procedure completes.

NOTE 3: Whether or not the page response requires a CSFB indicator needs to be considered by stage 3.

5. In case the MSC serving the 2G/3G cell is different from the MSC that served the UE while camped on LTE, the MSC shall reject the service request, if implicit location update is not performed. The service reject shall trigger the UE to perform a Location Area Update as follows:

   - If the target system operates in Network Mode of Operation (NMO) I the UE shall perform a combined RA/LA update, as defined in TS 23.060 [3]

   - If the target system operates in NMO II or III the UE performs a Location Area Update towards the MSC.

6. The UE initiates the CS call establishment procedure.

7. Upon receiving the PS Handover Complete message (part of step 3), the SGSN sends a Forward Relocation Complete message to the MME to indicate completion of the PS handover procedures. The MME responds with a Forward Relocation Complete Acknowledge message.

8. The SGSN sends an Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated) message to the Serving GW concerned. The Serving GW updates the PDP context fields and returns an Update PDP Context Response (TEID) message. From now on the Serving GW sends new incoming downlink IP packets to the SGSN instead of to the Source eNodeB.

NOTE 4: The additional steps of the Update Bearer Request - Update Bearer Response exchange between the Serving GW and PDN GW are not shown but will be performed as per the equivalent steps in TS 23.401 [2].

9. If the SGSN indicated Reset (i.e. reset to default parameters) in the NAS container for PS HO included in the Handover from eUTRAN Command message then on receipt of the PS Handover Complete the SGSN initiates an LLC/SNDCP XID negotiation for each LLC SAPI used in LLC ADM. In this case if the SGSN wants to use the default parameters, it shall send an empty XID Command. If the SGSN indicated 'Reset to the old XID

parameters' in the NAS container for PS HO, no further XID negotiation is required for LLC SAPIs used in LLC ADM only.

The SGSN (re-)establishes LLC ABM for the PDP contexts which use acknowledged information transfer. During the exchange of SABM and UA the SGSN shall perform LLC/SNDCP XID negotiation.

10. The UE may trigger the Routing Area Update procedure when the sending of uplink packet data is possible. The detailed steps performed are as per TS 23.401 [2].

6.3 Mobile Originating call in Active Mode – No PS HO support in GERAN
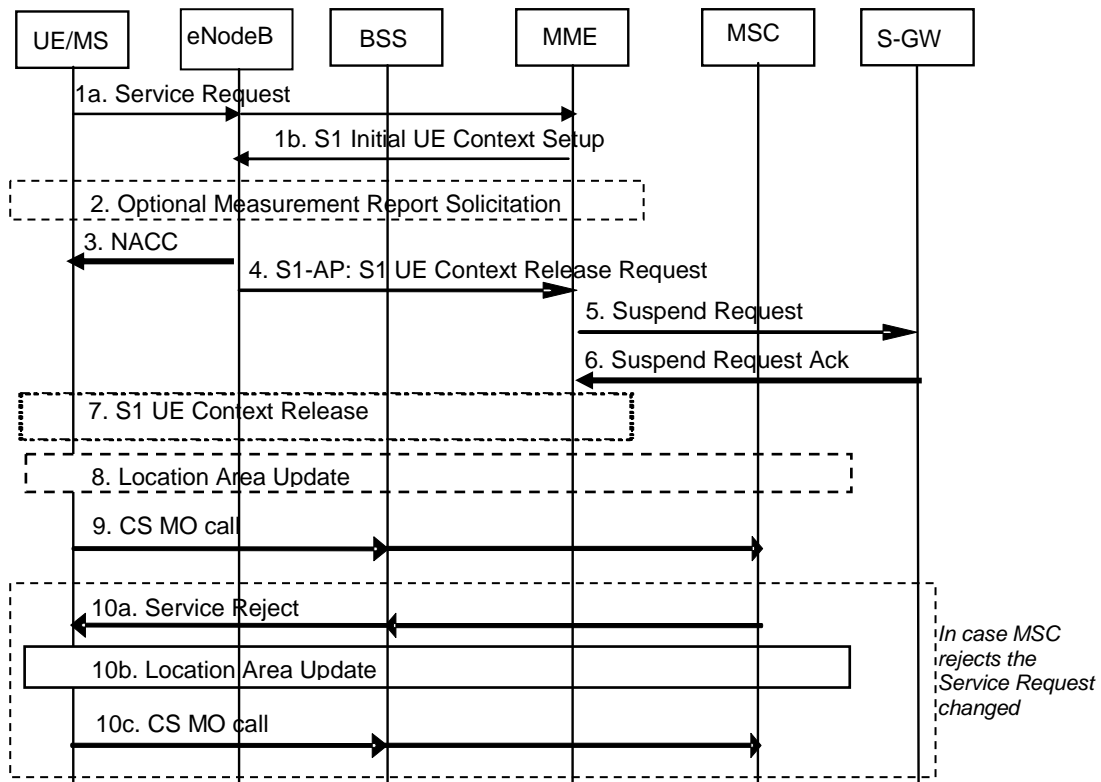
Figure 6.3-1: CS Call Request in E-UTRAN, Call in GERAN

NOTE: Steps 1a and 1b need to be further investigated in CT1 considering aspects such as speed and complexity.

1a. The UE sends a Serivce Request (CS Fallback Indicator) to the MME. Service Request message is encapsulated in RRC and S1-AP messages. CS Fallback Indicator indicates MME to perform CS Fallback. The UE only transmits this request if it is attached to CS domain (with a combined EPS/IMSI Attach) and can not initiate an IMS voice session (because e.g. the UE is not IMS registered or IMS voice services are not supported by the serving IP-CAN, home PLMN or UE).

1b. MME sends S1-AP: Initial UE Context Setup (UE capabilities, CS Fallback Indicator) to indicate the eNB to move the UE to UTRAN/GERAN.

2. The eNode may optionally solicit a measurement report from the UE to determine the target GERAN cell to which PS handover will be performed.

3. The eNodeB triggers an inter-RAT cell change order (optionally with NACC) to a GERAN neighbour cell by sending an RRC message to the UE.

4. The eNodeB sends an S1 UE Context Release Request (Cause) message to the MME. Cause indicates that the UE is not available for the PS service.

5. The MME sets the UE context to suspended status and sends to the S-GW a Suspend Request (IMSI) message that requests the suspension of EPS bearers for the UE.

6. The S-GW acknowledges the Suspend Request message and marks the UE as suspended. When a downlink data packet for the UE arrives at the S-GW, the S-GW should not send a downlink data notification message to the MME if the UE is marked as suspended.

7. S1 UE Context in the eNodeB is released as specified in TS 23.401 [2].

8. The UE moves to the new RAT and establishes an RR connection using legacy procedures. If the UE obtains LA information of the new cell (e.g. based on the system information) and the LA of the new cell is different from the one stored in the UE, it performs a Location Area Update.

9. The UE continues with the MO call setup procedure.

10a. In case the MSC serving the 2G/3G cell is different from the MSC that served the UE while camped on LTE, the MSC shall reject the call setup service request, if implicit location update is not performed.

10b. A UE detecting that the MSC rejected the service request shall perform the Location Area Update according to existing GERAN or UTRAN procedures.

10c. After completion of the Location Area Update the UE continues with a MO call setup procedure.

6.4 Mobile Originating call in Idle Mode

Mobile Originating call in Idle Mode procedure is specified by reusing the Mobile Originating Call in Active mode procedure with the following modifications:

- Target RAT has no PS HO capability: The UE sends Service Request (CS Fallback Indicator)to MME. Service Request message is encapsulated in RRC and S1-AP messages. CS Fallback Indicator indicates MME to perform CS Fallback.

NOTE: The above procedure needs to be further investigated in CT1 considering aspects such as speed and complexity.

- The UE then awaits further instructions from the serving eNodeB, e.g. the S1 connection is established to get the UE capabilities downloaded from the MME to the eNB and the RRC connection is released with a redirection info to change to CS capable RATs (RAT, frequency, cell info), optionally based on measurements. As an option the inter-RAT system information might be provided by the eNB using the NACC procedure for GERAN.

- Target RAT has PS HO capability: The eNodeB may choose to invoke the optional Measurement Report Solicitation during the preparation phase so that the UE is at minimum informed that its CS Call Request has been accepted and a PS Handover is pending (i.e. so it can implicitly perform a state transition to Active mode).

The execution phase is the same as for the Mobile Originating Call in Active mode except that there are no incoming IP packets to be delivered to the UE.

6.5 Returning back to E-UTRAN

Once CS service ends in CS domain, existing mechanisms can be used to move the UE to E-UTRAN, no specific CS Fallback mechanisms are needed.

When the UE moves to E-UTRAN, if the EPS service was suspended during the CS service, it is resumed according to the procedure shown in the figure 6.5-1 below.
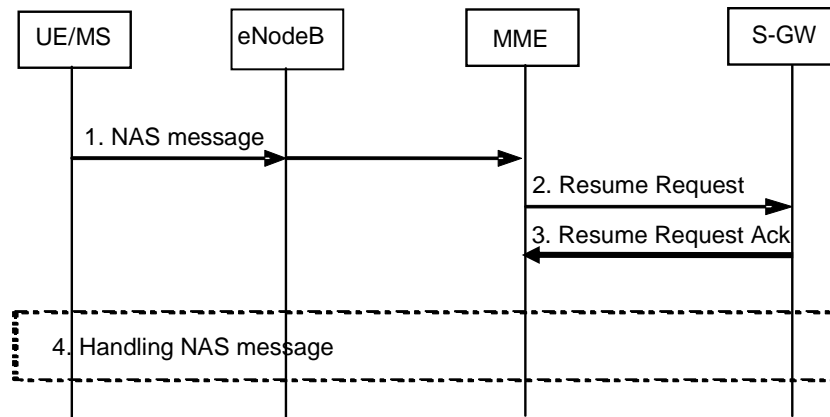
Figure 6.5-1: Resume Procedure returning from CS fallback no PS HO

1. The UE sends a NAS message, e.g. Service Request or TAU, to the MME.

2. If the UE context in the MME indicates that UE is in suspended status, the MME sends a Resume Request (IMSI) message to the S-GW that requests the resumption of EPS bearers for the UE.

3. The S-GW acknowledges the Resume Request and clears the UE's suspending status.

4. The NAS message is processed accordingly.

7 Mobile Terminating Call

7.1 General

This clause describes the mobile terminating call procedures for the CS Fallback in EPS.

7.2 Mobile Terminating call in idle mode

The procedure for Mobile Terminating Call in idle mode is illustrated in figure 7.2-1.
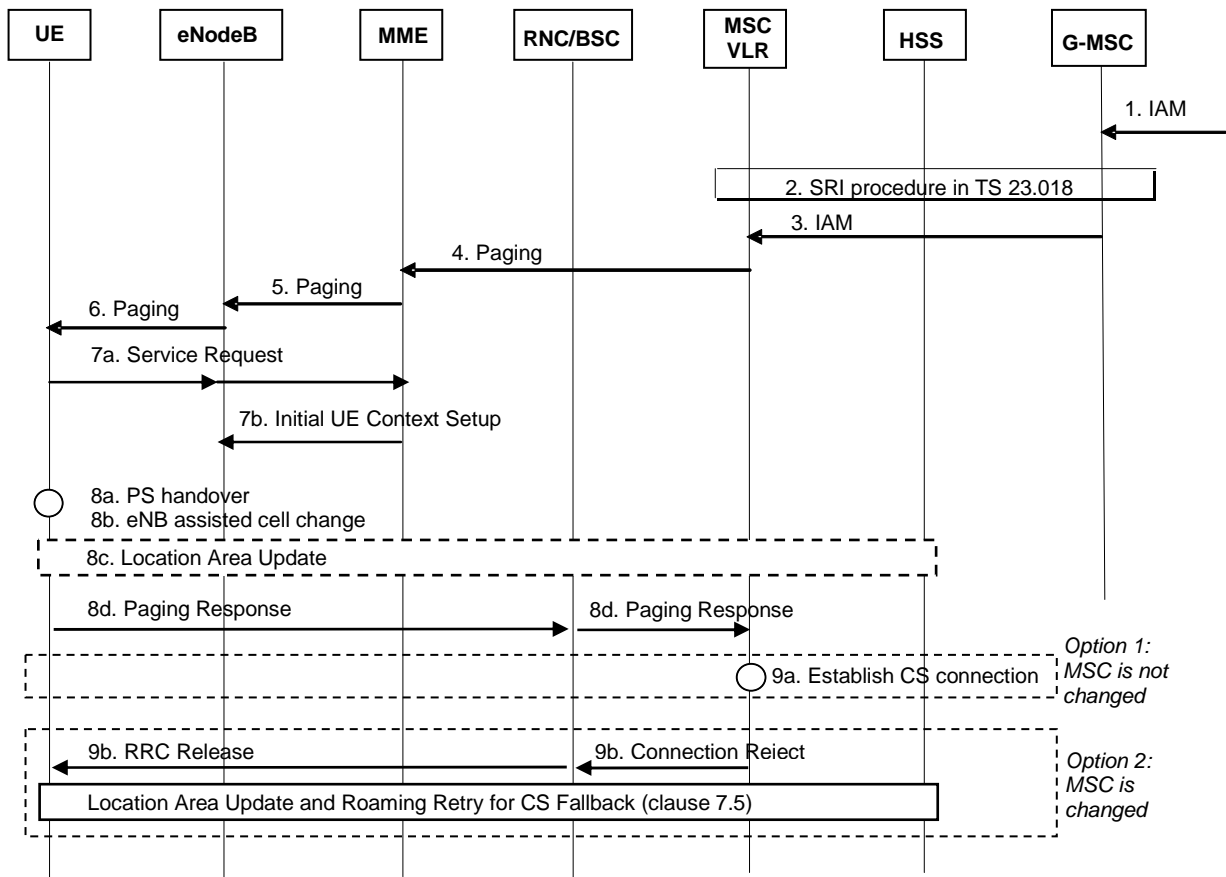
Figure 7.2-1: Mobile Terminating Call in idle mode

NOTE 1: Steps 7a and 7b need to be further investigated in CT1 considering aspects such as speed and complexity.

1. G-MSC receives IAM.

2. G-MSC retrieves routing information of the terminating UE by Send Routing Info procedures as specified in TS 23.018 [5].

3. G-MSC sends IAM to the MSC on the terminating side as specified in TS 23.018 [5].

4. The MME receives a Page (IMSI, VLR TMSI, Location Information) message from the MSC over a SGs interface. If VLR TMSI is omitted, the IMSI is used instead of the TMSI as a paging address at the radio interface. If location information is reliably known by MME (i.e. MME stores the list of TAs), the MME shall page the UE in all the TAs. If the MME does not have a stored TA list for the UE, the MME should use the location information received from the MSC to page the UE.

5. The MME sends a Paging (as specified in TS 23.401 [2], and CN Domain Indicator) message to each eNodeB. CN Domain Indicator indicates which domain (CS or PS) initiated the paging message, and in this case it must be set to "CS" by the MME.

6. The radio resource part of the paging procedure takes place. The message contains CN Domain indicator.

7a. UE sends Service Request (CS Fallback Indicator) to MME. Service Request message is encapsulated in RRC and S1-AP messages. CS Fallback Indicator indicates MME to perform CS Fallback.

7b. MME sends S1-AP: Initial UE Context Setup (UE capabilities, CS Fallback Indicator) to indicate the eNB to move the UE to UTRAN/GERAN.

8a. Target RAT has PS HO capability: Upon receipt of a Paging Request message for a circuit-switched service the eNB sets up an RRC Connection with the UE and may optionally solicit a measurement report from the UE to determine the target cell to which PS handover will be performed. PS handover is then performed as specified in TS 23.401 [2].

8b. Target RAT has no PS HO capability Upon receipt of a Paging Request message for a circuit-switched service the UE sets up an RRC Connection with E-UTRAN, the S1 connection is established to get the UE capabilities downloaded from the MME to the eNB and the RRC connection is released with a redirection info to change to CS capable RATs (RAT, frequency, cell info), optionally based on measurements. As an option the inter-RAT system information might be provided by the eNB using the NACC procedure for GERAN.

8c. If the UE obtains LA information of the new cell (e.g. based on the system information or redirection info) and the LA of the new cell is different from the one stored in the UE, it performs a Location Area Update.

8d. The UE responds with a page response message to the MSC:

- If Target RAT is UTRAN: the UE establishes an RRC connection and responds to the paging in an RRC Initial Direct Transfer message as specified in TS 25.331 [7]. CN Domain Indicator is set to "CS" in the Initial Direct Transfer message. When received at the RNC, the Paging Response message is sent in an RANAP Initial UE message to the MSC.

- If Target RAT is GERAN: the UE establishes an RR connection using legacy procedures (i.e. UE requests and is assigned a dedicated channel where it sends a SABM containing a layer 3 Service Request message = PAGING RESPONSE to the BSS and the BSS responds by sending a UA). After the establishment of the main signalling link as described in TS 44.018 [4] the UE enters either Dual Transfer Mode or Dedicated Mode and the CS call establishment procedure completes. When received at the BSC, the Paging Response message is sent in a BSSAP COMPLETE LAYER 3 INFORMATION message to the MSC as specified in TS 48.008 [6].

NOTE 2: Whether or not the page response requires a CSFB indicator needs to be considered by stage 3.

9a. In case the MSC serving the 2G/3G cell is the same as the MSC that served the UE while camped on LTE, it shall stop the paging response timer and establish the CS connection.

9b. Otherwise (if the MSC that receives the paging response is different from the MSC that sent the paging request), the MSC shall reject the page response message by releasing the Iu connection for UTRAN or the A/Gb connection for GERAN. The BSC/RNC in turn releases the RRC connection for UTRAN or the RR connection for GERAN. The RRC/RR release shall trigger the UE to perform a Location Area Update as follows:

- If the target system operates in Network Mode of Operation (NMO) I the UE shall perform a combined RA/LA update, as defined in TS 23.060 [3].

- If the target system operates in NMO II or III the UE performs a Location Area Update towards the MSC.

The Location Area Update triggers the Roaming Retry for CS Fallback procedure as defined in clause 7.5.

7.3 Mobile Terminating call in Active Mode - PS HO supported
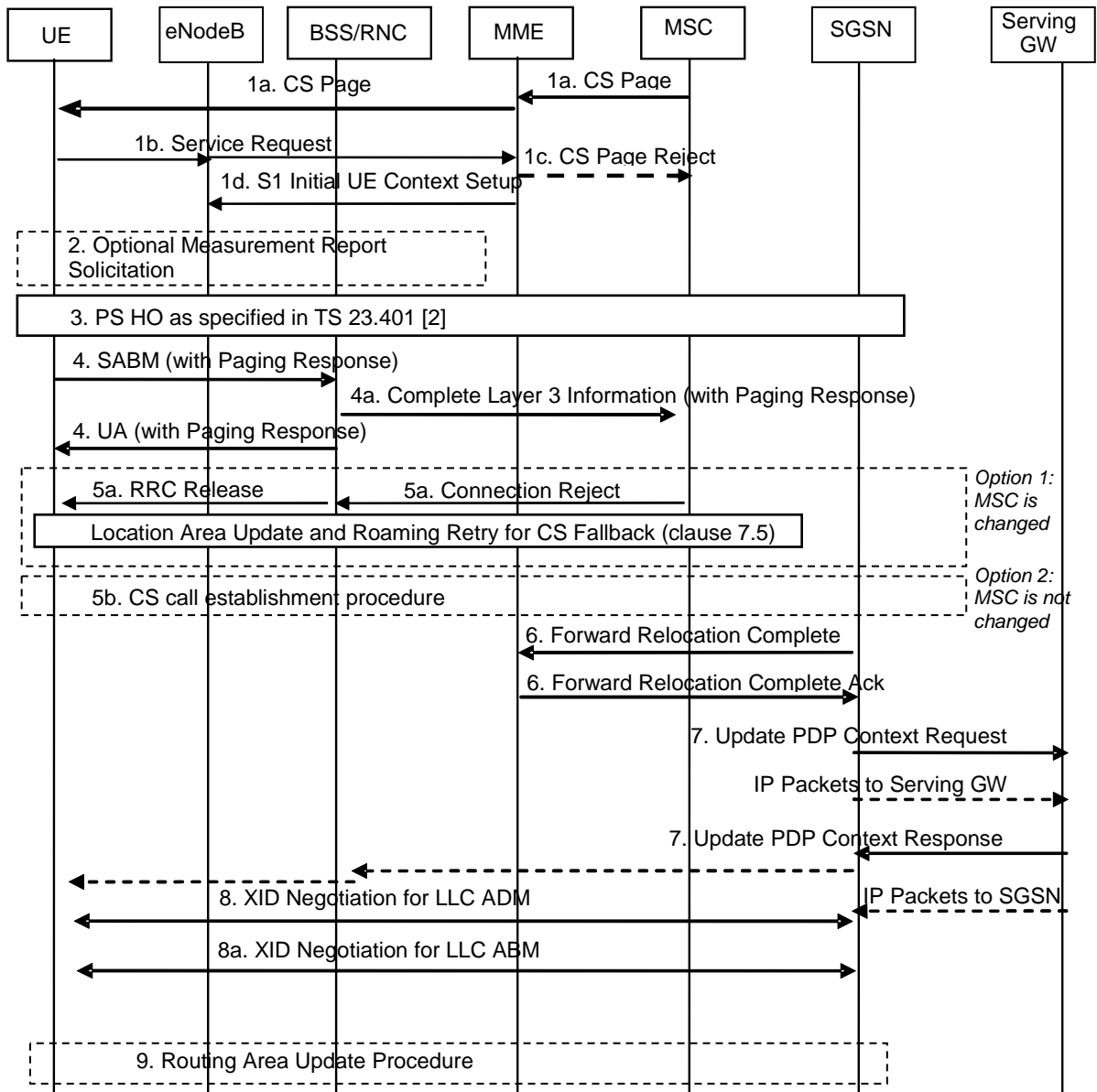
Figure 7.3-1: CS Page in E-UTRAN, Call in GERAN/UTRAN – Preparation Phase

NOTE 1: For simplicity, figure 7.3-1 includes some messages which are only applicable to GERAN access (e.g. SABM, UA and XID negotiation). In case of UTRAN access, the applicable messages can be found in the E-UTRAN to UTRAN inter-RAT HO procedures specified in TS 23.401 [2].

NOTE 2: Steps 1b and 1c need to be further investigated in CT1 considering aspects such as speed and complexity.

NOTE 3: The addition of Caller Line Identification functionality needs to be evaluated further and may need to be revised and/or removed from this specification.

1a. The MSC receives an incoming voice call and responds by sending a CS Page (IMSI or TMSI, optional Caller Line Identification and Connection Management information) to the MME over a SGs interface. In active mode the MME has an established S1 connection and the MME reuses the existing connection to relay the CS Page to the UE. The MSC only sends a CS Page for an UE that provides location update information using the SGs interface.

The eNB forwards the paging message to the UE. The message contains CN Domain indicator and Caller Line Identification if available and needed. Note that the pre-configured policy may be used by UE to avoid being disturbed without Caller Line Identification display and the detailed handling is to be decided by CT1 and CT6.

1b. UE sends Service Request to MME. Service Request message is encapsulated in RRC and S1-AP messages. CS Fallback Indicator indicates MME to perform CS Fallback. The UE may decide to reject CSFB based on Caller Line Identification. The UE sends Service Request (CS Fallback Indicator, Reject or Accept) message towards the MME.

1c. Upon receiving the Service request (CSFB, Reject), the MME sends CS Paging Reject towards MSC to stop CS Paging procedure and this CSFB procedure stops.

1d. MME sends S1-AP: Initial UE Context Setup (UE capabilities, CS Fallback Indicator) to indicate the eNB to move the UE to UTRAN/GERAN.

2. The eNodeB may optionally solicit a measurement report from the UE to determine the target GERAN/UTRAN cell to which PS handover will be performed.

3. The eNodeB triggers PS handover to a GERAN/UTRAN neighbour cell by sending a Relocation Required message. In the following a PS HO as specified in TS 23.401 [2] takes place.

4. Target RAT is UTRAN: As soon as the UE completes the PS HO procedure the UE establishes an RRC connection and responds to the paging in an RRC Initial Direct Transfer message as specified in TS 25.331 [7]. CN Domain Indicator is set to "CS" in the Initial Direct Transfer message.

   Target RAT is GERAN: As soon as the UE completes the PS HO procedure the UE establishes an RR connection using legacy procedures (i.e. UE requests and is assigned a dedicated channel where it sends a SABM containing a layer 3 Service Request message = PAGING RESPONSE to the BSS) and the BSS responds by sending a UA. Upon receiving the SABM (containing a PAGING RESPONSE message) the BSS sends a COMPLETE LAYER 3 INFORMATION message (containing a PAGING RESPONSE message) to the MSC which indicates CS resources have been allocated in the GERAN cell. After the establishment of the main signalling link as described in TS 44.018 [6] the UE enters either Dual Transfer Mode or Dedicated Mode and the CS call establishment procedure completes.

NOTE 4: Whether or not the page response requires a CSFB indicator needs to be considered by stage 3.

5a. In case the MSC serving the 2G/3G cell is different from the MSC that served the UE while camped on LTE, the MSC shall reject the page response message by releasing the Iu connection for UTRAN or the A/Gb connection for GERAN. The BSC/RNC in turn releases the RRC connection for UTRAN or the RR connection for GERAN. The RRC/RR release shall trigger the UE to perform a Location Area Update as follows:

   - If the target system operates in Network Mode of Operation (NMO) I the UE shall perform a combined RA/LA update, as defined in TS 23.060 [3]

   - If the target system operates in NMO II or III the UE performs a Location Area Update towards the MSC.

   The Location Area Update triggers the Roaming Retry for CS Fallback procedure as defined in clause 7.5.

5b. Otherwise (if the MSC receiving the paging response is the same as the MSC that sent the paging message), the UE initiates the CS call establishment procedure.

6. Upon receiving the PS Handover Complete message (part of step 3), the SGSN send a Forward Relocation Complete message to the MME to indicate completion of the PS handover procedures. The MME responds with a Forward Relocation Complete Acknowledge message.

7. The SGSN sends an Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated) message to the Serving GW concerned. The Serving GW updates the PDP context fields and returns an Update PDP Context Response (TEID) message. From now on the Serving GW sends new incoming downlink IP packets to the SGSN instead of to the source eNodeB.

NOTE 5: The additional steps of the Update Bearer Request - Update Bearer Response exchange between the Serving GW and PDN GW are not shown but will be performed as per the equivalent steps in TS 23.401 [2].

8. If the SGSN indicated Reset (i.e. reset to default parameters) in the NAS container for PS HO included in the Handover from eUTRAN Command message then on receipt of the PS Handover Complete the SGSN initiates an LLC/SNDCP XID negotiation for each LLC SAPI used in LLC ADM. In this case if the SGSN wants to use the default parameters, it shall send an empty XID Command. If the SGSN indicated 'Reset to the old XID

parameters' in the NAS container for PS HO, no further XID negotiation is required for LLC SAPIs used in LLC ADM only.

The SGSN (re-)establishes LLC ABM for the PDP contexts which use acknowledged information transfer. During the exchange of SABM and UA the SGSN shall perform LLC/SNDCP XID negotiation.

9. The UE may trigger the Routing Area Update procedure when the sending of uplink packet data is possible. The detailed steps performed are as per TS 23.401 [2].

7.4 Mobile Terminating call in Active Mode - No PS HO support in GERAN
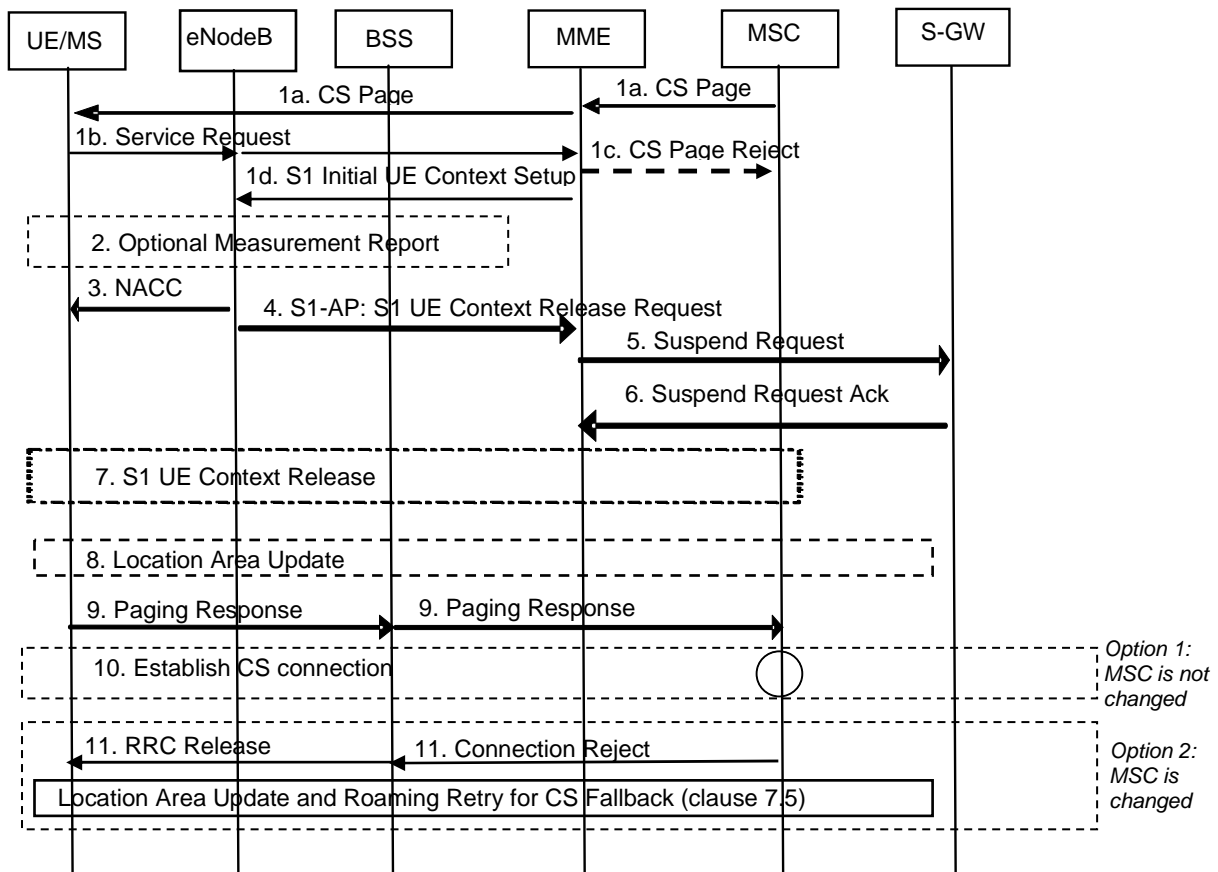
Figure 7.4-1: CS Page in E-UTRAN, Call in GERAN without PS HO

NOTE 1: Steps 1b and 1c need to be further investigated in CT1 considering aspects such as speed and complexity.

NOTE 2: The addition of Caller Line Identification functionality needs to be evaluated further and may need to be revised and/or removed from this specification.

1a. The MSC receives an incoming voice call and responds by sending a CS Page (IMSI or TMSI, optional Caller Line Identification and Connection Management information) to the MME over a SGs interface. In active mode the MME has an established S1 connection and the MME reuses the existing connection to relay the CS Page to the UE. The MSC only sends a CS Page for an UE that provides location update information using the SGs interface.

The eNB forwards the paging message to the UE. The message contains CN Domain indicator and Caller Line Identification if available and needed. Note that the pre-configured policy may be used by UE to avoid being disturbed without Caller Line Identification display and the detailed handling is to be decided by CT1 and CT6.

1b. UE sends Service Request (CS Fallback Indicator) to the MME. Service Request message is encapsulated in RRC and S1-AP messages. CS Fallback Indicator indicates MME to perform CS Fallback. The UE may decide

to reject CSFB based on Caller Line Identification. The UE sends Service Request (CS Fallback Indicator, Reject or Accept) message towards the MME.

1c. Upon receiving the Service Request (CSFB, Reject), the MME sends CS Paging Reject towards MSC to stop CS Paging procedure and this CSFB procedure stops.

1d. Service Accept message is encapsulated in S1-AP: Initial UE Context Setup (NAS message, UE capabilities, CS Fallback Indicator) to indicate the eNB to move the UE to UTRAN/GERAN.

2. The eNodeB may optionally solicit a measurement report from the UE to determine the target GERAN cell to which the redirection procedure will be performed.

3. The eNodeB triggers an inter-RAT cell change order (optionally with NACC) to a GERAN neighbour cell by sending an RRC message to the UE.

4. The eNodeB sends an S1 UE Context Release Request (Cause) message to the MME. Cause indicates that the UE is not available for PS service.

5. The MME sets the UE context to suspended status and sends to the S-GW a Suspend Request (IMSI) message that requests the suspension of EPS bearers for the UE.

6. The S-GW acknowledges the Suspend Request message and marks the UE as suspended. When a downlink data packet for the UE arrives at the S-GW, the S-GW should not send a downlink data notification message to the MME if the UE is marked as suspended.

7. S1 UE Context in the eNodeB is released as specified in TS 23.401 [2].

8. The UE moves to the new RA, establishes an RR connection using legacy procedures as described in TS 44.060 [12]. If the UE obtains LA information of the new cell (e.g. based on the system information) and the LA of the new cell is different from the one stored in the UE, it performs a Location Area Update.

9. The UE responds to the paging by sending a Paging Response message as specified in TS 44.018 [4]. When received at the BSS, the Paging Response is sent in a BSSAP COMPLETE LAYER 3 INFORMATION message to the MSC.

NOTE 3: Whether or not the page response requires a CSFB indicator needs to be considered by stage 3.

10. In case the MSC serving the 2G/3G cell is the same as the MSC that served the UE while camped on LTE, it shall then stop the paging response timer and establish the CS connection.

11. Otherwise (if the MSC that receives the paging response is different from the MSC that sent the paging request), the MSC shall reject the page response message by releasing the A/Gb connection. The BSS in turn releases the RR connection. The RR release shall trigger the UE to perform a Location Area Update.

The Location Area Update triggers the Roaming Retry for CS Fallback procedure as defined in clause 7.5.

7.5   Roaming Retry for CS fallback

The procedure in this section is applied for mobile terminated calls where the MSC, to which the UE sends the LAU, is different from the MSC that sent the paging message to the UE. The procedure is based on the 'Mobile Terminating Roaming Retry Call' procedure defined in TS 23.018 [5] and there is an only minor adaptation of the procedure to support CS fallback.

NOTE: At CS fallback the UE will always perform a location update procedure in the 2G or 3G RAT before sending a Page response. Hence, the MSC will always receive the Location Update before a page response.
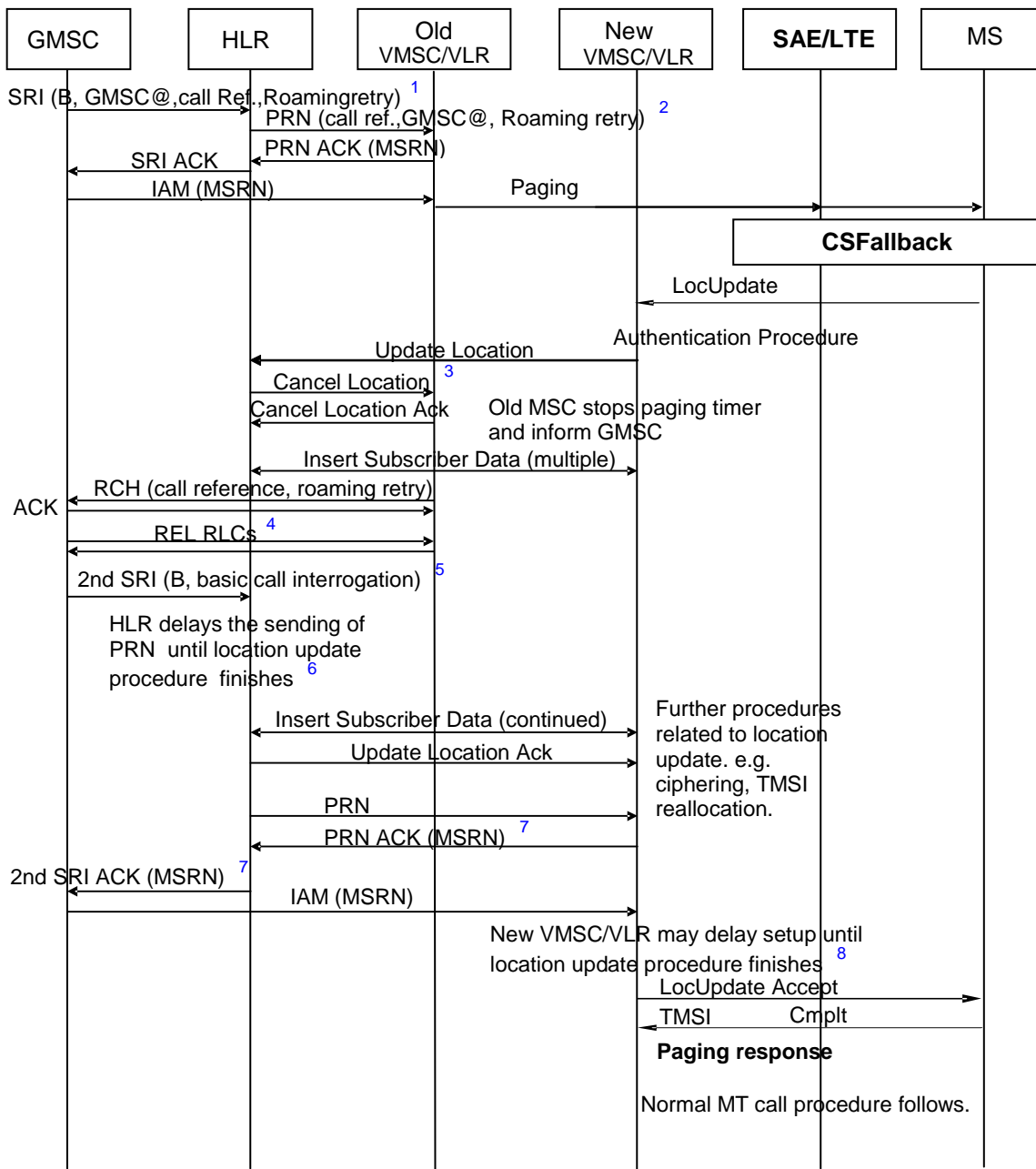
Figure 7.5-1: Roaming Retry for CS fallback

There are only 2 differences in this procedure compared to the 'Mobile Terminating Roaming Retry Call' procedure defined in TS 23.018 [5]. The first difference is that the paging message triggers the CS fallback including a location update in the new RAT. This functionality is already supported in the CS fallback flows for terminating calls and no additional functionality is needed. The second difference is that the UE may send a page response message after receiving Location Update Accept message. The new MSC will ignore or reject the page response message.

7.6 Returning back to E-UTRAN

Once CS service ends in CS domain, existing mechanisms can be used to move the UE to E-UTRAN, no specific CS Fallback mechanisms are needed.

When the UE moves to E-UTRAN, if the EPS service was suspended during the CS service, it is resumed as specified in clause 6.5.

7.7 Interaction with ISR

7.7.1 General

When ISR is active, a mechanism is needed to ensure that CS Fallback paging is always reaching the UE. The MSC/VLR shall keep either Gs association with SGSN or SGs association with MME, depending from which entity the last location update message is received. When the MT call comes, the MSC/VLR sends CS paging message to the entity (SGSN or MME) which has Gs or SGs association with the MSC/VLR.

- SGSN or MME starts a CS paging process in its domain and forwards the CS paging message to the ISR associated entity which is MME or SGSN when ISR is active and the UE is in idle state (for SGSN, the UE is in PMM-IDLE (IU mode) or STANDBY (A/Gb mode) state, for MME, the UE is in ECM-IDLE).

- SGSN or MME starts a CS paging process only in its own domain when ISR is active and the UE is in active state (for SGSN, the UE is in PMM-connected (IU mode) or READY (A/Gb mode), for MME, the UE is in ECM-CONNECTED).

7.7.2 Mobile Terminating Call when ISR is active and SGs is active between MSC/VLR and MME
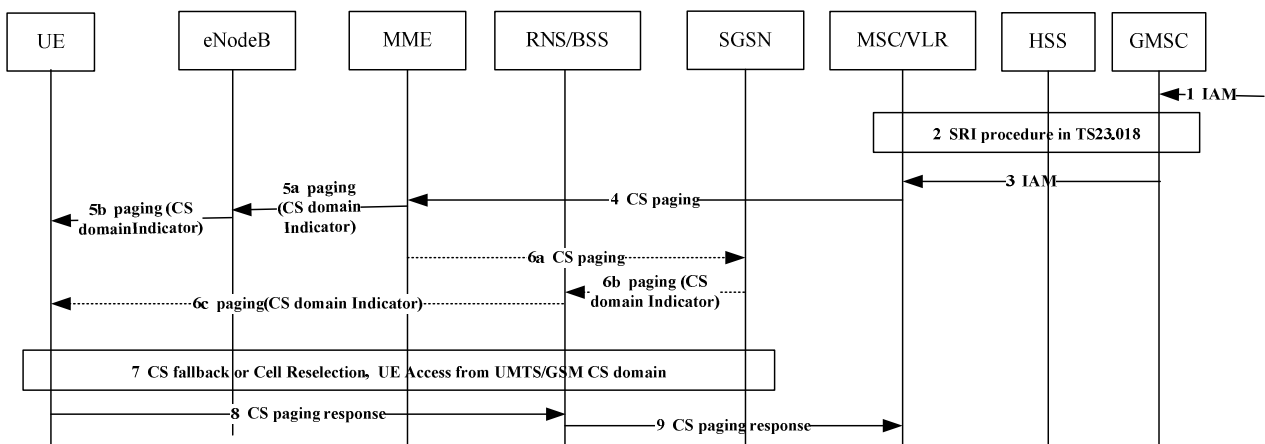

Figure 7.7.2-1: Mobile Terminating Call when ISR is active and SGs is active between MSC/VLR and MME

1) G-MSC receives IAM.

2) G-MSC retrieves routing information of the terminating UE by Send Routing Info procedures as specified in TS 23.018 [5].

3) G-MSC sends IAM to the MSC/VLR on the terminating side as specified in TS 23.018 [5].

4) The MSC/VLR sends a Page message to the MME via SGs (details on the Page message can be found in clauses 7.2 or 7.3).

5a) The MME receives the Page message from the MSC/VLR. If the UE is in ECM-IDLE state, the MME sends a Paging (as specified in TS 23.401 [2], and CN Domain Indicator) message to each eNodeB serving the TA list the UE is registered to as specified in clause 7.2. If the UE is in ECM-CONNECTED, the MME relays the CS Page message to the serving eNodeB over the S1 interface as specified in sub clause 7.3.

5b) If the UE is in ECM-IDLE state, the eNodeBs receive CS paging messages from the MME, and the procedures take place as specified in sub clause 7.2. If the UE is in ECM-CONNECTED state, the eNodeB receives CS paging message from the MME, and the procedure take place as specified in sub clause 7.3.

6a If ISR is active and the UE is in ECM-IDLE state, the MME forwards the CS paging message received from the MSC/VLR to the associated SGSN. The MME gets the SGSN information in the ISR activation process.

6b) The SGSN receives the CS paging message from the MME. If the SGSN has no Gs interface with the MSC/VLR, the SGSN discards the CS paging message received from the MME. If the SGSN has a Gs interface with the MSC/VLR, the SGSN sends paging messages to RNS/BSSs, which is described in detail in TS 23.060 [3].

6c) When RNS/BSS nodes receive paging message from the SGSN, paging is initiated as described in detail in TS 23.060 [3].

NOTE: If ISR is not active or the UE is in ECM-CONNECTED state, the MME does not send the CS paging message to the SGSN. That means, the steps of 6a, 6b, 6c are not needed in the MT call procedure.

7)   Upon receipt of a Paging Request message for a circuit-switched service, the CS Fallback (as defined in this specification) or Cell Reselection (as defined in TS 23.060[3]) take place, and the UE accesses CS domain from UMTS/GSM.

8)   When the CS Fallback or Cell Reselection completes, the UE responds to the CS paging request and returns the CS paging response as described in detail in this specification and TS 23.060 [3] to the RNS/BSS.

9)   When received at the RNS/BSS, the CS Paging Response message is sent to the MSC/VLR as described in detail in TS 23.060 [3]. The MSC/VLR receives CS paging response contained in corresponding message which shall then stop the paging response timer and establish the CS connection, then the MT call process as described in detail in TS 23.018 [5].

7.7.3   Mobile Terminating Call when ISR is active and Gs is active between MSC/VLR and SGSN
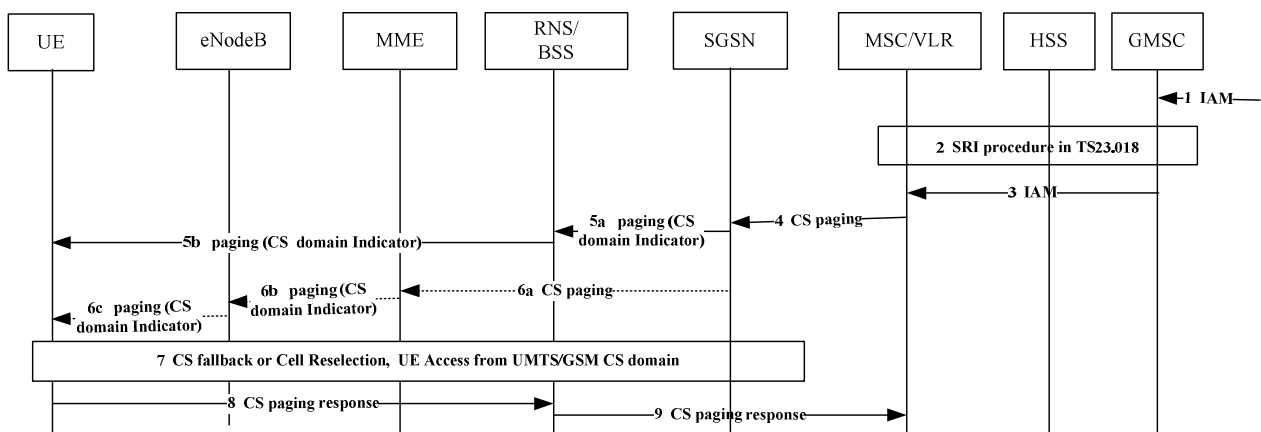

Figure 7.7.3-1: Mobile Terminating Call when ISR is active and Gs is active between MSC/VLR and SGSN

1)   G-MSC receives IAM.

2)   G-MSC retrieves routing information of the terminating UE by Send Routing Info procedures as specified in TS 23.018 [5].

3)   G-MSC sends IAM to the MSC/VLR on the terminating side as specified in TS 23.018 [5].

4)   The MSC/VLR sends a Page (IMSI, VLR TMSI, Location Information) message to the SGSN in IU mode or a Page (IMSI, VLR TMSI, Channel Needed, Priority, Location Information) message in A/Gb mode to the SGSN as described in detail in TS 23.060 [3].

5a) The SGSN receives the CS Paging message from the MSC/VLR, sends paging message to RNS/BSS, which is described in detail in TS 23.060 [3].

5b) After the RNS/BSS nodes receive paging messages from the SGSN, the UE is paged by the RNS/BSS nodes, which is described in detail in TS 23.060 [3].

6a) If ISR is active and the UE is in PMM-IDLE (IU mode) or STANDBY (A/Gb mode), the SGSN forwards the CS paging message received from the MSC/VLR to the MME. The SGSN gets the MME information in the ISR activation process.

6b) The MME receives the CS Page message from the SGSN. If the UE is in ECM-IDLE state, the MME sends a Paging (as specified in TS 23.401 [2], and CN Domain Indicator) message to each eNodeB serving the TA list the UE is registered to as specified in clause 7.2. If the UE is in ECM-CONNECTED state, the MME relays the CS Page message to the current accessed eNodeB over the S1 interface as specified in sub clause 7.3.

6c) If the UE is in ECM-IDLE state, the eNodeBs receive CS paging message from the MME, the following procedures takes place as specified in sub clause 7.2. If the UE is in ECM-CONNECTED state, the eNodeB receives CS paging messages from the MME, the following procedures take place as specified in sub clause 7.3.

NOTE: If ISR is not active or the UE is in PMM-connected(IU mode) or READY(A/Gb mode), the SGSN does not forward the CS paging message to the MME, That means, the steps of 6a, 6b, 6c are not needed in the MT call procedure.

7) Upon receipt of a Paging Request message for a circuit-switched service, the CS Fallback or Cell Reselection take place , the UE access from UMTS/GSM CS domain.

8) When the CS Fallback or Cell Reselection completes, the UE responds to the CS paging request and returns the CS paging response as described in detail in TS 23.060 [3] to the RNS/BSS.

9) When received at the RNS/BSS, the CS Paging Response message is sent to the MSC/VLR as described in detail in TS 23.060 [3]. The MSC/VLR receives the CS paging response contained in corresponding message which shall then stop the paging response timer and establish the CS connection, then the MT call process as described in detail in TS 23.018 [5].

8 Other CS Services

8.1 General

8.2 Short Message Service (SMS)

8.2.1 General

The procedures for SMS in this specification apply only if the UE is EPS/CS attached and the CS access domain is chosen by the UE and/or the home PLMN for delivering short messages.

This clause describes both the mobile originating and mobile terminating SMS procedures for CS Fallback in EPS. SMS support is based on the connectionless SGs reference point between the MME and the MSC Server and use of NAS signalling between the UE and the MME.

The SMS protocol entities are reused from the existing MS/UE and MSC implementations. This means that the SMS procedures for CS Fallback reuse the different protocol layers as defined in TS 23.040 [14].

8.2.2 Mobile originating SMS in Idle Mode

The following sequence flow shows the delivery of mobile originating SMS in idle mode.
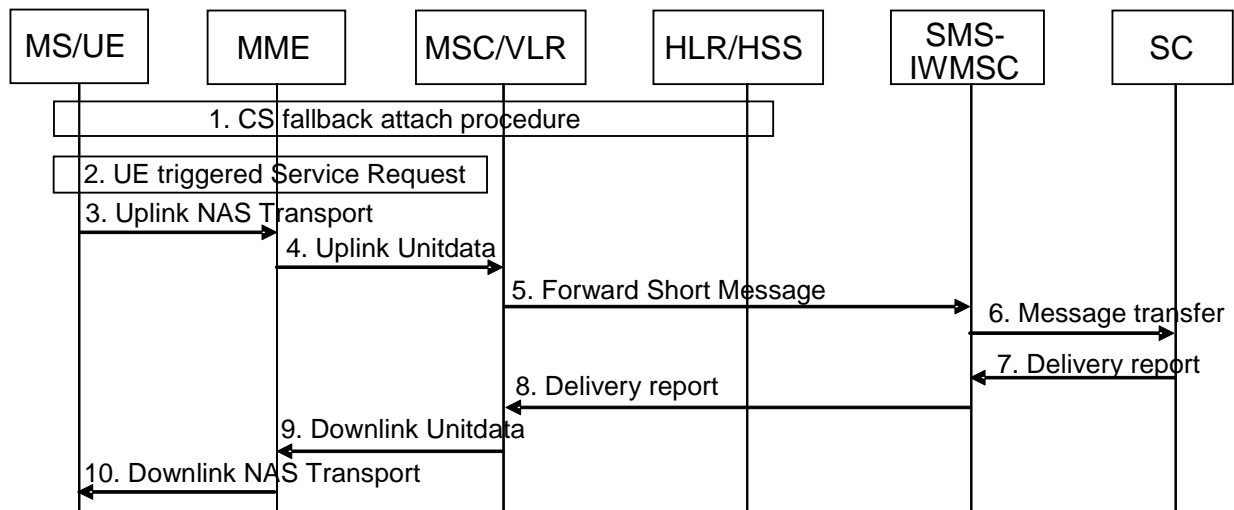
Figure 8.2.2-1: Mobile originating SMS in idle mode

1. The CS Fallback attach procedure as described in clause 5.2 has been performed earlier.

2. A mobile originating SMS is triggered and the MS/UE is in idle mode. The MS/UE initiates the UE triggered Service Request procedure, which is defined in TS 23.401 [2].

3. The MS/UE builds the SMS message to be sent as defined in TS 23.040 [14] (i.e. the SMS message consists of CP-DATA/RP-DATA/TPDU/SMS-SUBMIT parts). The SMS message is encapsulated in an NAS message and sent to the MME.

4. The MME forwards the SMS message to the MSC/VLR in an Uplink Unitdata message.

5.-8.   These steps are performed as defined in TS 23.040 [14]. The SMS message is forwarded to the SC that returns a delivery report message.

9. The MSC/VLR forwards the received delivery report to the MME associated with the MS/UE in an Downlink Unitdata message.

10. The MME encapsulates the received delivery report in an NAS message and sends the message to the MS/UE. After this point, the MME may release the resources associated for the SMS transfer.

8.2.3   Mobile originating SMS in Active Mode

Mobile Originating SMS in active Mode procedure is specified by reusing the Mobile Originating SMS in Idle Mode with the following modification:

-     The established signalling connection between the MS/UE and the MME is reused for the transport of the SMS message and the delivery report (i.e. the UE triggered Service Request procedure defined in step 2 is skipped).

8.2.4   Mobile terminating SMS in idle mode

The following sequence flow shows the delivery of mobile terminating SMS in idle mode.
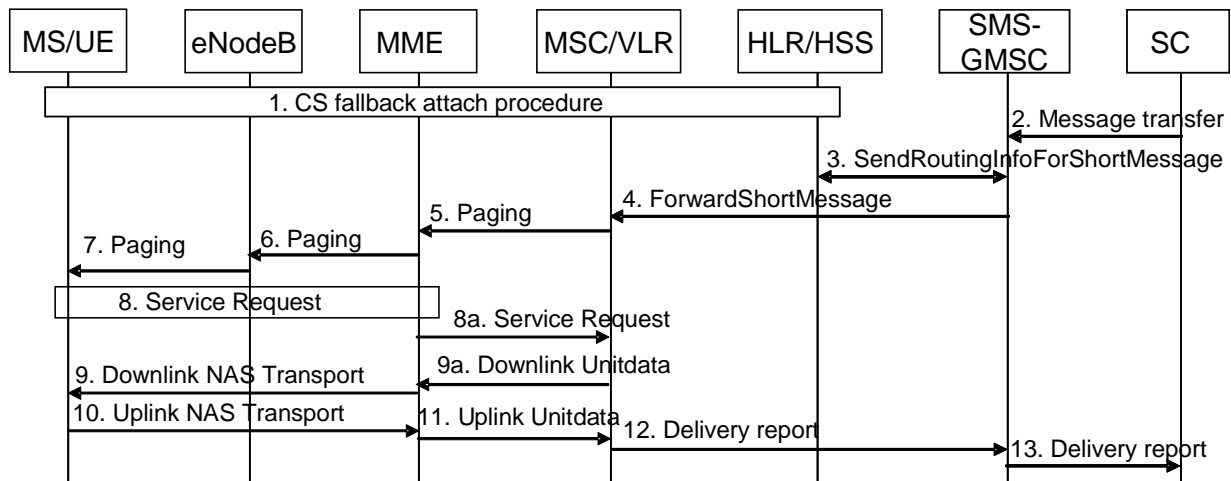
Figure 8.2.4-1: Mobile terminating SMS in idle mode

1. The CS Fallback attach procedure as described in clause 5.2 has been performed.

2-4.   The SC initiates transfer of mobile terminating SMS. The HLR is requested for routing number for SMS services and the SMS message is forwarded to the MSC/VLR where the MS/UE is CS attached.

5. The MSC/VLR sends a Paging (IMSI, VLR TMSI, Location Information, SMS indicator) message to the MME.

6. The MME initiates the paging procedure by sending the Paging (as specified in TS 23.401 [2], and SMS indicator) message to each eNodeB with cells belonging to the tracking area(s) in which the UE is registered.

7. The MS/UE is paged by the eNodeBs.

8. The UE sends a Service Request (SMS Indicator) message to the MME.

8a. The MME sends an Service Request (SMS Indicator) message to the MSC.

9a. The MSC/VLR builds the SMS message to be sent as defined in TS 23.040 [14] (i.e. the SMS message consists of CP-DATA/RP-DATA/TPDU/SMS-DELIVER parts). The MSC/VLR forwards the SMS message to the MME in an Downlink Unitdata message.

9. The MME encapsulates the SMS message in a NAS message and sends the message to the MS/UE.

10. The MS/UE returns a delivery report as defined in TS 23.040 [14]. The delivery report is encapsulated in an NAS message and sent to the MME.

11. The MME forwards the delivery report to the MSC/VLR in an Uplink Unitdata message.

12-13. These steps are performed as defined in TS 23.040 [14]. The delivery report is forwarded to the SC.

8.2.5   Mobile terminating SMS in Active Mode

Mobile terminating SMS in Active Mode procedure is specified by reusing the Mobile Terminating SMS in Idle Mode with the following modification:

-   There is no need for the MME to perform Paging of the MS/UE after step 5. The MME immediately sends a Service Request message to the MSC (i.e. steps 6 to 8 are skipped).

8.2.6   Co-Existence with SMS over generic 3GPP IP access

If the home operator has deployed SMS over generic 3GPP IP access and/or SMS-Instant Messaging Interworking as defined in TS 23.204 [15], and has configured the network and the UE for using SMS over IP or SMS-Instant Messaging Interworking, then an SMS or IM will be delivered over EPS in any visited network whether or not the visited network supports SMS over generic 3GPP IP access.

If the home operator has not deployed SMS over generic 3GPP IP access and the UE fails to successfully complete the combined EPS/CS attach procedure in the visited network (i.e. the visited network supports SMS over generic 3GPP IP access and does not support CS fallback for SMS capability), then the UE cannot execute MT or MO SMS procedures in the visited network.

8.3 Location Services (LCS)

8.3.1 MO-LR procedure

MO-LR procedure in the CS fallback in EPS is performed as specified in TS 23.271 [8].

When UE is in active mode, UE and the network follows the procedure in clause 6.2 "Mobile Originating Call in Active-Mode". After UE changes its RAT from E-UTRAN to UTRAN/GERAN, it performs CS-MO-LR procedures as specified in TS 23.271 [8].

When UE is in active mode but there's no need for PS-Handover, then UE and the network follows the procedure in clause 6.3 "Mobile Originating Call in Active Mode - No PS HO Support in GERAN". After UE changes its RAT from E-UTRAN to UTRAN/GERAN, it performs CS-MO-LR procedure as specified in TS 23.271 [8].

When UE is in idle mode, UE follows the procedure in clause 6.4 "Mobile Originating Call in Idle Mode". After UE changes its RAT from E-UTRAN to UTRAN/GERAN, it performs CS-MO-LR procedure as specified in TS 23.271 [8].

8.3.2 MT-LR procedure

Figure 8.3.2-1: MT-LR procedure
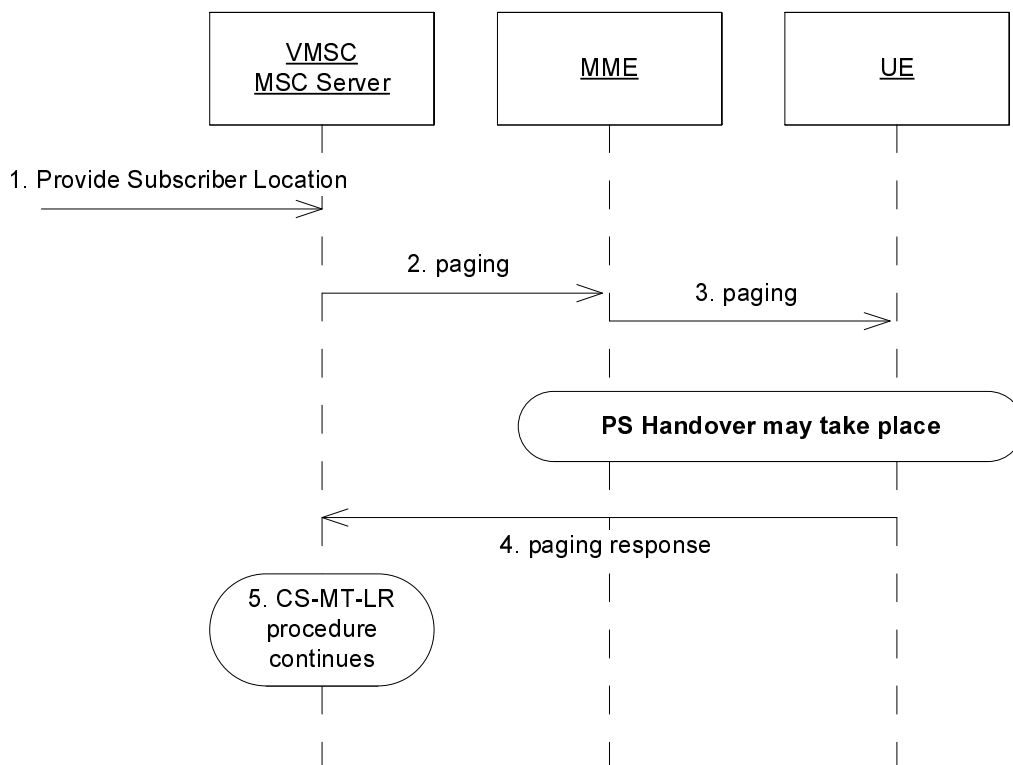
1. MSC receives a PROVIDE_SUBSCRIBER_LOCATION message due to CS-MT-LR (TS 23.271 [8], clause 9.1.2).

2. MSC sends Paging message to MME.

3. MME sends Paging (parameters as specified in TS 23.401 [2], CN Domain Indicator) message to UE.

4. UE responds with Paging_Resp message in UMTS/GERAN. Service based redirection/reselection or PS Handover may take place as specified in clause 7.

5. MSC continues with the CS-MT-LR procedure as defined in TS 23.271 [8], clause 9.1.2.

8.3.3 NI-LR procedure

NI-LR procedure takes place during emergency calls, and is thus performed in GERAN/UTRAN during the Mobile Originating call procedure.

8.3.4 Returning back to E-UTRAN

Once CS service ends in CS domain, existing mechanisms as specified in TS 23.401 [2] can be used to move the UE to E-UTRAN, no specific CS Fallback mechanisms are needed.

8.3.5 Co-Existence with Other Location Services

8.3.5.1 Co-Existence with SUPL

There is no race condition between OMA AD SUPL [9] and CS Fallback for LCS. When network initiated SUPL procedure takes place, the paging message does not contain CN Domain Indicator by default. This prevents CS Fallback for LCS to take place. For SET initiated SUPL procedure, changing of RAT does not take place.

8.4 Call Independent Supplementary Services

8.4.1 Mobile-Initiated Call Independent SS procedure

When UE is in active mode, UE and the network follow the procedure in clause 6.2 "Mobile Originating Call in Active-Mode". After UE changes its RAT from E-UTRAN to UTRAN/GERAN, it performs Mobile-Initiated Call Independent Supplementary Service procedure as specified in TS 24.010 [13].

When UE is in active mode and network initiates NACC procedure, then UE and the network follow the procedure in clause 6.3 "Mobile Originating Call in Active Mode - No PS HO Support in GERAN". After UE changes its RAT from E-UTRAN to UTRAN/GERAN, it performs Supplementary Service procedure as specified in TS 24.010 [13].

When UE is in idle mode, UE and the network follows the procedure in clause "Mobile Originating Call in Idle Mode". After UE changes its RAT from E-UTRAN to UTRAN/GERAN, it performs Supplementary Services procedure as specified in specifications such as TS 24.080 [10].

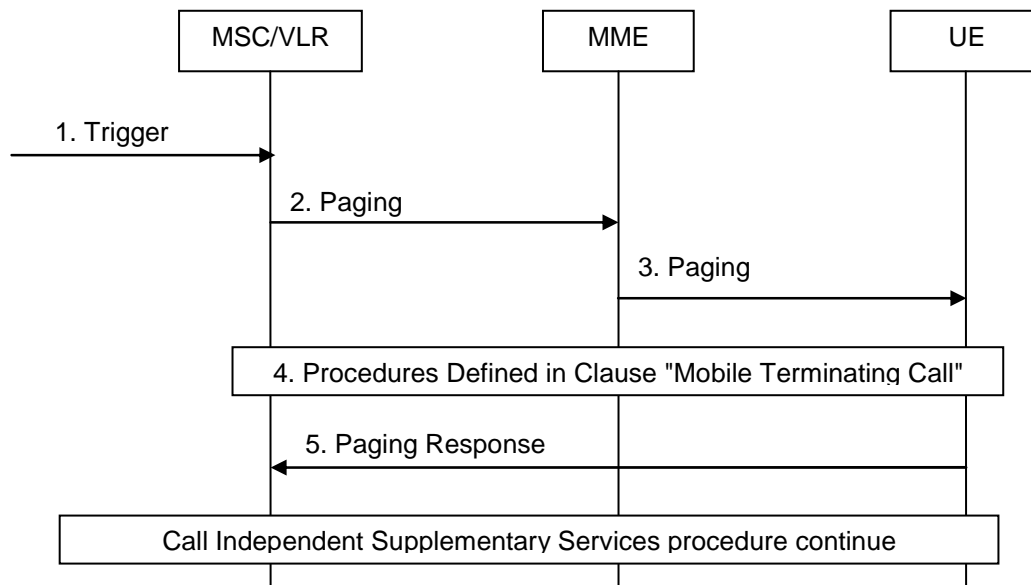## 8.4.2 NW-Initiated Call Independent SS procedure

Figure 8.4.2-1: NW-Initiated Call Independent Supplementary Service procedure

1. MSC/VLR receives a trigger for NW-Initiated Call Independent SS procedure.

2. MSC/VLR sends Paging message to MME.

3. MME sends Paging (parameters as specified in TS 23.401 [2], CN Domain Indicator) message to UE.

4. The mobile terminating call procedure then takes place as specified in clause 7 "Mobile Terminating Call Procedure".

5. Once the paging is successfully returned to MSC, Supplementary Service procedures continues as specified in specifications such as TS 23.090 [10].

8.4.3 Returning back to E-UTRAN

Once CS service ends in CS domain, existing mechanisms as specified in TS 23.401 [2] can be used to move the UE to E-UTRAN, no specific CS Fallback mechanisms are needed.

Annex A (informative):
Solutions addressing misaligned LAs/TAs at Pool Area Boundaries

This annex describes alternative solutions addressing the problem of idle-mode mobility across pool area boundaries in case of misaligned LAs/TAs.

A.1 Solution 1: Overlapping Pool Areas with 2G/3G coverage > E-UTRAN coverage at Pool Area Boundaries

This section defines a simple solution for misaligned LAs/TAs at pool area boundaries and is based on the concept of overlapping and aligned MSC/MME pool areas and adequate configuration of the TAs (with respect to the LAs) at pool area boundaries. More precisely, the TAs at pool area boundaries must be configured such that they do not extend beyond the coverage of the corresponding LAs.

Figure A.1-1 illustrates how this solution works based on a simple example scenario. It is assumed here that the UE is initially served by MME1 and MSC1 (i.e. Pool Area 1). When the UE reaches the TAI=3, which belongs to a different Pool Area than the service MME (MME1), the TAU to the target MME (MME2) will trigger a relocation of the MME (MME1 → MME2), which in turn triggers a change of the serving MSC (MSC1 → MSC2).
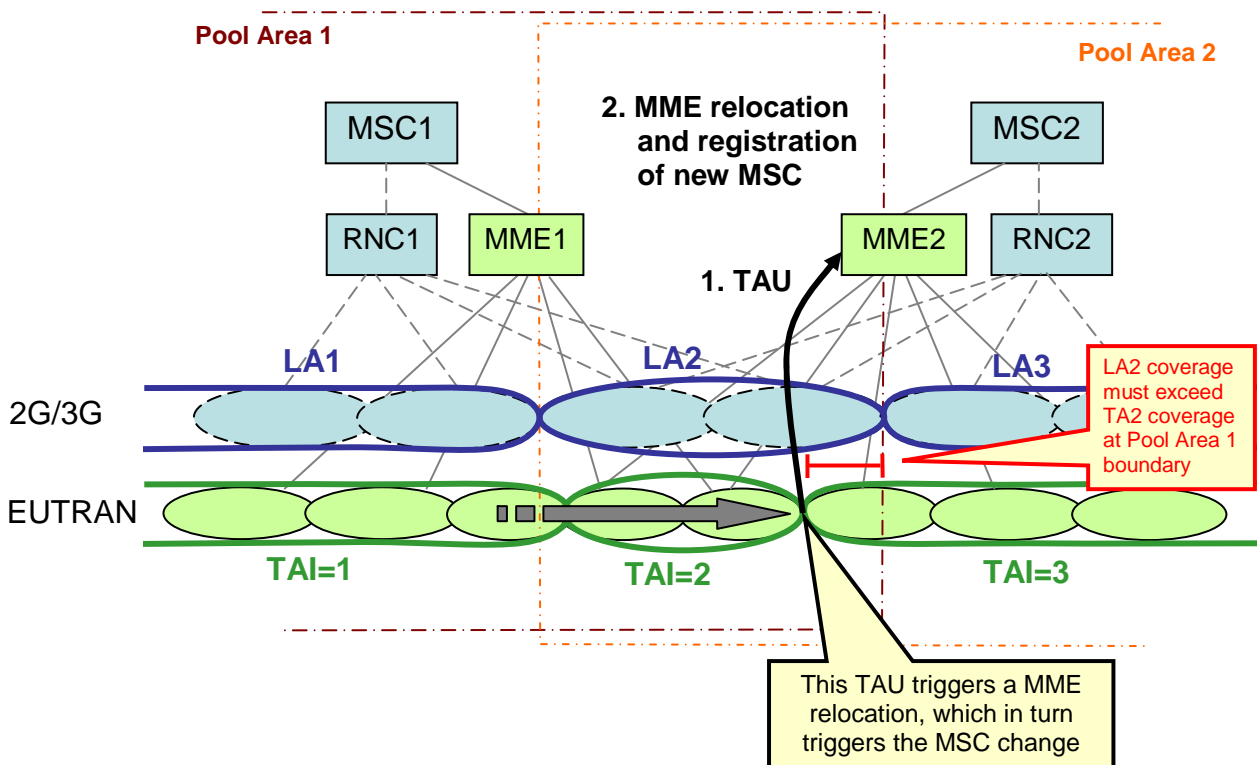

Figure A.1-1: Solution 1: Overlapping Pool Areas with 2G/3G coverage > EUTRAN coverage at Pool Boundaries

In the event of a TAU (Step 1) for a TA served by a different pool area, the target MME will trigger a MME relocation (Step 2). As a consequence of the MME change, the target MME will trigger the MSC change. The VLR/HLR will be updated accordingly.

A.2 Solution 2: Overlapping Pool Areas with SGs-flex support

This section defines a simple solution for misaligned LAs/TAs at pool area boundaries based on the concepts of overlapping pool area and 'SGs-flex' support. This solution does not rely on adequate configuration of the TAs and alignment of MME and MSC pool areas, but demands the MMEs to supply a configurable TAI→MSC Mapping Table.

Figure A.2-1 illustrates how this solution works based on a simple example scenario. It is assumed here that the UE is initially served by MME1 and MSC1 (i.e. Pool Area 1). When the UE reaches the TAI=2, which is served by a different Pool Area, the TAU (to MME1) will trigger the establishment of the SGs to the target MSC (MSC2). For this, the MME1 maintains a mapping table that indicates which TA should be served by which MSC.
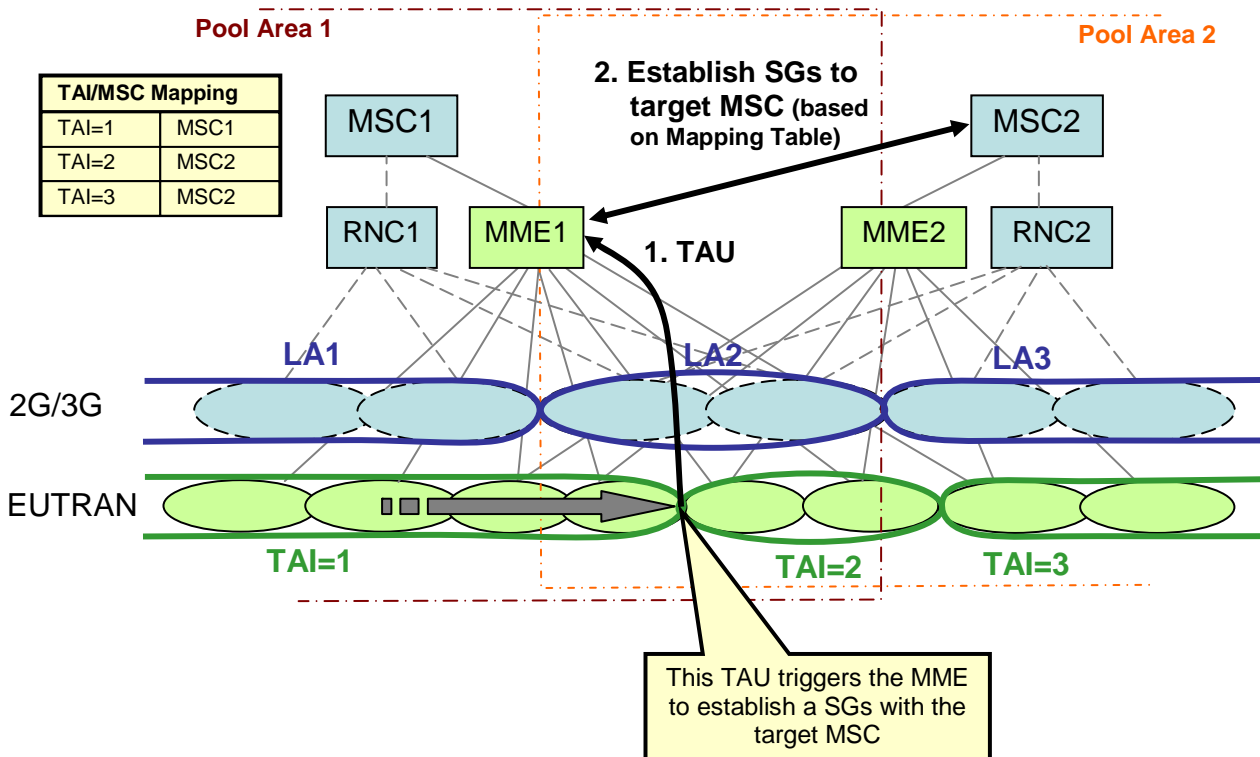

Figure A.2-1: Solution 2: Overlapping Pool Areas with SGs-flex support

In the event of a TAU (Step 1) for a TA belonging to a different pool area, the serving MME will trigger the establishment of the SGs connection to the target MSC (Step 2). The VLR/HLR will be updated accordingly.

Annex B (normative): CS Fallback to 1xRTT

This annex describes a CS Fallback to 1xRTT solution for dual mode 1xRTT/E-UTRAN terminals.

B.1 Overall Description

B.1.1 General Considerations

The CS fallback for 1xRTT in EPS enables the delivery of CS-domain services by reuse of the 1xCS infrastructure when the UE is served by E-UTRAN. A CS fallback enabled terminal, while connected to E-UTRAN may pre-register in the 1x RTT CS domain in order to be able to use 1xRTT access to establish voice call in the CS domain. This function is only available where E-UTRAN coverage overlaps with 1xRTT coverage.

CS Fallback to 1xRTT and IMS-based services shall be able to co-exist in the same operator's network.

B.1.2 Reference Architecture

The CS fallback in EPS function is realised by reusing the S102 reference point between the MME and the 1xCS IWS. The reference architecture described in figure B.1.2-1 is similar to the SRVCC architecture for E-UTRAN to 3GPP2 1xCS described in TS 23.216 [20], with the additional aspect that the S102 session is long-lived (similar to pre-registration for S101).
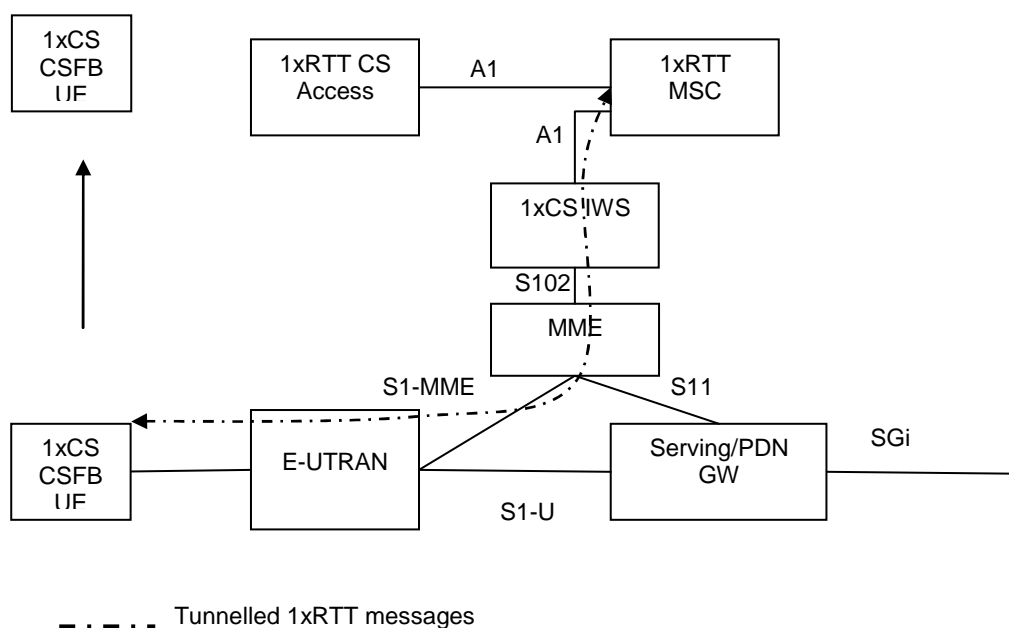

Figure B.1.2-1: Reference architecture for CS fallback to 1xRTT CS

B.1.2.1 Reference points

S102: It is the reference point between the MME and the 1xCS IWS. The S102 reference point provides a tunnel between MME and 3GPP2 1xCS IWS to relay 3GPP2 1xCS signalling messages. 1x CS signalling messages are those messages that are defined for A21 interface as described in 3GPP2 A.S0008-C [16] and 3GPP2 A.S0009 [17].

NOTE. It is up to stage 3 to determine whether the tunnelling protocol for S102 can be defined as exactly as in A21. If so, S102 is then equivalent to A21.

B.1.3 Functional entities

B.1.3.1 UE

The UE capable of CS fallback to 1xRTT supports access to E-UTRAN/EPC as well as access to the 1xCS domain over 1xRTT. It supports the following additional functions:

- 1xRTT CS pre-registration over the EPS after the UE has completed the E-UTRAN attachment;

- 1xRTT CS re-registration due to mobility;

- CS fallback procedures specified for 1xRTT CS domain voice service.

B.1.3.2 MME

The MME enabled for CS fallback to 1xRTT supports the following additional functions:

- It serves as a signalling tunnelling end point towards the 3GPP2 1xCS IWS via S102 interface for sending/receiving encapsulated 3GPP2 1xCS signalling messages to/from the UE, which are encapsulated in S1-MME S1 Information Transfer messages, as defined in TS 36.938 [19];

- 1xCS-IWS (terminating S102 reference point) selection for CSFB procedures;

- Handling of S102 tunnel redirection in case of MME relocation;

- Buffering of messages received via S102 for UEs in idle state.

B.1.3.3 E-UTRAN

The E-UTRAN enabled for CS fallback to 1xRTT supports the following additional functions:

- Provision of control information that causes the UE to trigger 1xCS registration;

- Forwarding 1x RTT CS paging request to the UE;

- Forwarding 1x RTT CS related messages between MME and UE;

- Release of E-UTRAN resources after UE leaves E-UTRAN coverage subsequent to a page for CS fallback to 1xRTT CS.

B.1.4 Co-existence with IMS services

Clause 4.4 of this specification also applies here.

B.2 Procedures

B.2.1 Mobility Management

B.2.1.1 1x RTT CS Pre-Registration over EPS Procedure

This clause describes how the UE in an E-UTRAN system establishes and maintains pre-registration in the 1xCS system.
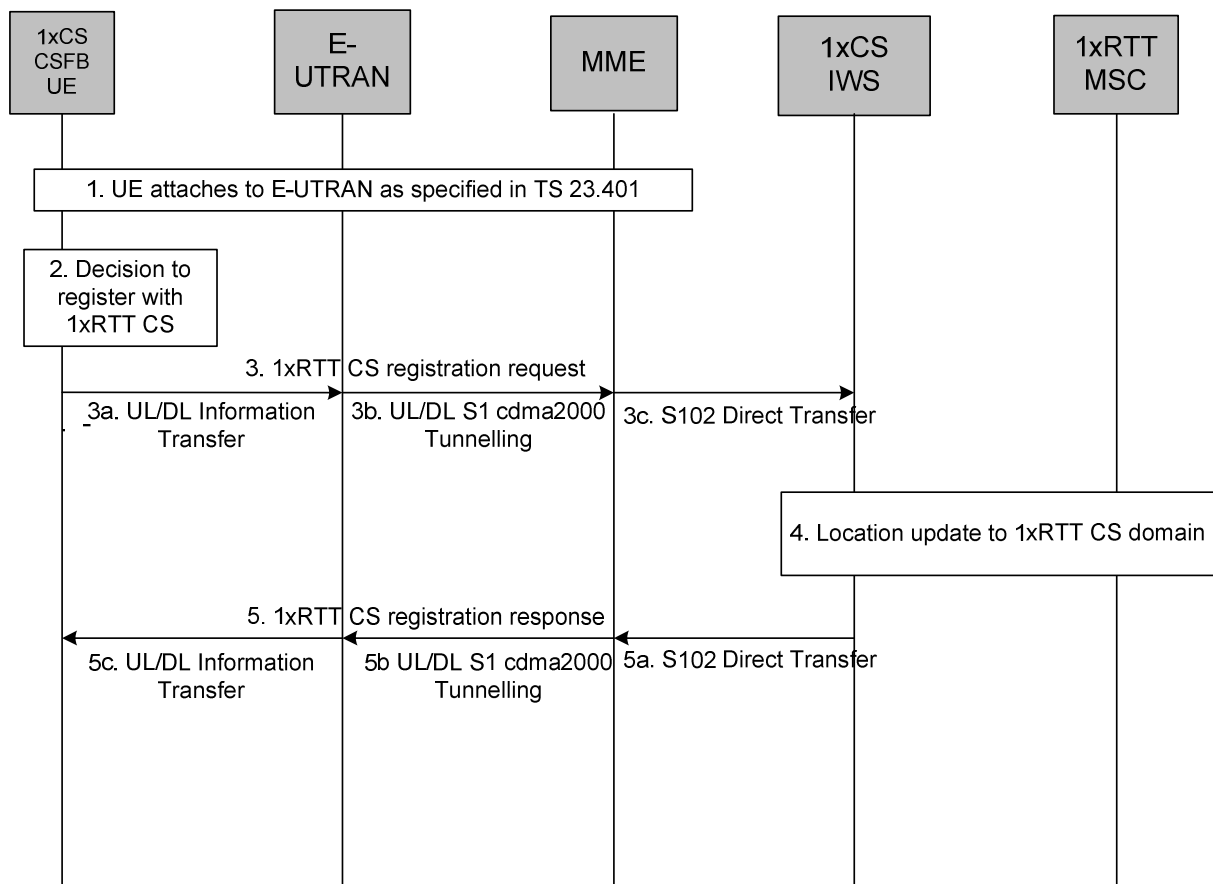
Figure B.2.1.1-1: 1xRTT CS registration procedure

1. UE attaches to E-UTRAN as specified in TS 23.401 [2];

2. Based on a radio layer trigger (e.g. an indication from the E-UTRAN when the UE is in connected state or an indication over the broadcast channel), the UE decides to register with the 1xRTT CS domain;

3. UE generates a 1xRTT CS registration request.

3a. The 1xRTT CS message is transferred from the UE to E-UTRAN.

3b. E-UTRAN forwards the 1xRTT CS message to the MME including the Reference CellID.

3c. MME selects a 1xCS IWS node based on Reference CellID. The IMSI is used to distinguish S102 signalling transactions belonging to different UEs. The MME sends a S102 Direct Transfer message (IMSI, 1xCS message) to the 1xCS IWS node.

4. 1xRTT CS registration is then performed by the 1xCS IWS node based on 3GPP2 A.S0008 [20].

5a. 1xRTT CS registration response is tunnelled back to the MME in a S102 Direct Transfer message (IMSI, 1xCS message).

5b. MME forwards the 1xRTT CS message to the E-UTRAN.

5c. E-UTRAN forwards the 1xRTT CS message to the UE.

If the triggers for 1xCS registration change over time, the UE (both in idle or active state), uses this information to update the 1xCS registration via the tunnel.

B.2.1.2   S102 Tunnel Redirection

S102 Tunnel Redirection Procedure is used when the UE perform Tracking Area Update with MME change (as specified in TS 23.402 [2] in case of S101 tunnel redirection) while the UE is registered with the 1xRTT CS domain as described in clause B.2.1.1 and the S102 session exists between the MME and the 1xCS IWS.

B.2.2   Mobile Originating Call

This clause describes the mobile originating call procedures for the CS Fallback to 1xRTT.
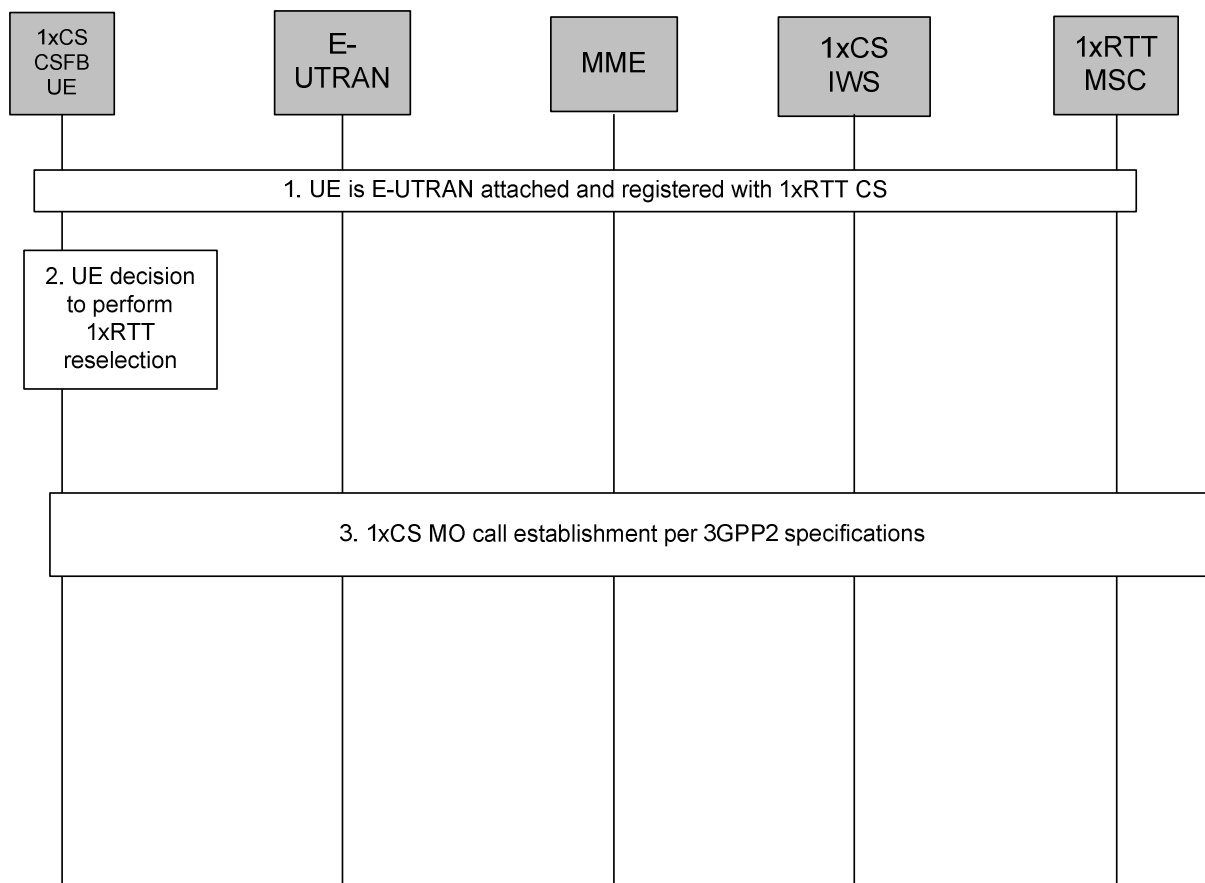

Figure B.2.2-1: CS MO call using fallback to CDMA 1x RTT network

1. UE is E-UTRAN attached and registered with 1xRTT CS as defined in clause B.2.1.1.

2. UE makes a decision to perform a mobile originated CS call.

3. UE performs cell reselection to 1xRTT autonomously and performs the procedure for mobile originating call as specified in 3GPP2 A.S0013 [18].

No special handling is required for the ongoing PS sessions in EPS.

Once CS service ends in the 1xCS domain, the UE returns to E-UTRAN by performing reselection.

B.2.3   Mobile Terminating Call

This clause describes the mobile terminating call procedures for the CS Fallback to 1xRTT.

When the 1x MSC receives a registration from a UE, it makes note of the RAN equipment from which it received the registration. Subsequent paging activities may thus be directed toward that RAN equipment. However, paging activities by the 1xMSC are not limited to the single RAN equipment from which the registration was received. The MSC may choose to page a wider area, including inter-system paging. If the 1xMSC has direct interfaces to 1xCS IWS, as well as

to 1xRTT access, the MSC may choose to do direct paging activities to both E-UTRAN and 1x RAN equipments in its attempts to contact the UE.

The 1x paging request sent by the 1xMSC to the 1xCS IWS is delivered to the UE via the tunnel. The UE tunes to 1xRTT access, acknowledges the 1x page and performs the 1xCS procedures for mobile terminated call. The detailed procedure is described in figure B.2.3-1.
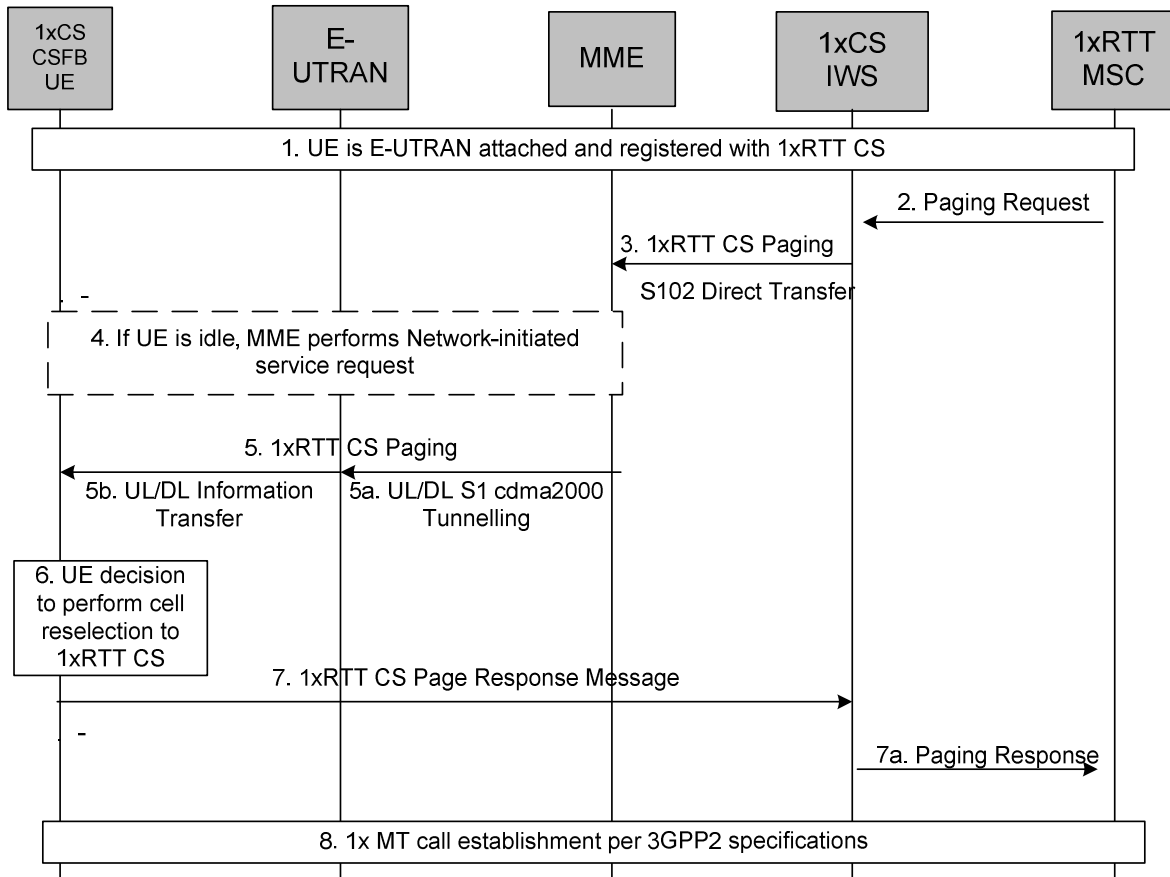

Figure B.2.3-1: CS MT call using fallback to CDMA 1x RTT network

1. UE is E-UTRAN attached and pre-registered with 1xRTT CS as defined in clause B.2.1.1.

2. 1xMSC sends a paging request to the 1xCS IWS node.

3. 1xCS IWS node forwards the 1x RTT CS paging request via the S102 tunnel to the MME.

4. If the UE is in idle state, the MME performs the network initiated Service Request procedure in order to bring the UE to active state prior to tunnelling of the 1x RTT CS paging request toward the UE.

5. MME forwards the 1xRTT CS paging request to the UE.

6. UE performs cell reselection to 1xRTT autonomously.

7. UE tunes to 1xRTT and acknowledges the page by transmitting a 1xRTT Paging Response message over the 1x Access Channel.

8. Subsequently UE performs the procedure for mobile terminated call establishment as specified in 3GPP2 A.S0013 [18].

No special handling is required for the ongoing PS sessions in EPS.

Once CS service ends in the 1xCS domain the UE returns to E-UTRAN by performing reselection.

Annex C (informative):
Change history

<table>
<tr><th colspan="8">Change history</th></tr>
<tr><th>Date</th><th>TSG #</th><th>TSG Doc.</th><th>CR</th><th>Rev</th><th>Subject/Comment</th><th>Old</th><th>New</th></tr>
<tr><td>2008-06</td><td>SP-40</td><td>SP-080357</td><td>-</td><td>-</td><td>MCC Editorial update for presentation to TSG SA for Approval</td><td>1.2.0</td><td>2.0.0</td></tr>
<tr><td>2008-06</td><td>-</td><td>-</td><td>-</td><td>-</td><td>MCC Editorial update after TSG Approval to version 8.0.0 (Rel-8)</td><td>2.0.0</td><td>8.0.0</td></tr>
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History

Document history		
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